Trade Integration in the Economic Community Of West African States: Assessing Constraints And Opportunities Using An Augmented Gravity Model

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Abstract

This study assesses and compares the determinants of intra-trade in the Economic Community of West African States (ECOWAS) and the Association of Southeast Asian Nations (ASEAN). Regarding the adopted methodology, we estimate two versions of the gravity model over intra-trade. For the two communities, the first model captures standard effects of the exporting and the importing economic size, the distance, contiguity, while the second model incorporates, as additional explanatory variables, the quality of infrastructure and the bilateral complementarity. The Pseudo Poisson Maximum Likelihood (PPML) technique is used to offset the systematic heteroscedasticity bias. The results show that the effort of export in ECOWAS captured through the elasticity to export is surprisingly higher than the ASEAN, once we control for the infrastructure and complementarity. Transaction costs, captured, inter alia, through the landlockness variable, are very informative in this case, as they has lost significance in the augmented gravity model mainly for the ECOWAS, meaning that what matters the most in this case is infrastructure base and complementarity index that allows the country to overcome geographic constraints. Then, we simulate the potential or the theoretical trade within the ECOWAS and compare it to observed data, using the coefficients estimated over the ASEAN. Results suggest that trade potential within the ECOWAS, remains below the potential given by the gravity model, especially for small economies in the community. This calls for pro-active strategic policies that aim to reap the benefits of trade liberalization and fulfill the potential. This comes through closing Africa's infrastructure gap to reduce trade costs and the promotion of economic diversification. In fact, estimation results display higher sensitiveness to infrastructure and complementarity indexes in the ECOWAS than the ASEAN. Nonetheless, trade dynamics are more complicated and depend on several factors of which the centrality of local product competitiveness. The latter can indeed determine how far ECOWAS's products can replace foreign products at least in the domestic market. A brief analysis of revealed comparative advantage (RCA) shows that aside from primary commodities, the majority of products imported by the ECOWAS are supplied by other countries who have a stronger RCA.

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Introduction

The proliferation of Regional Economic Communities (REC) in Africa underlines the importance of regional integration, which has become an essential priority for the continent. Regional integration is seen as an important tool for Africa's development, since one third of its economies are landlocked and depend on their coastal neighbors for trade. Besides, the domestic African markets are small, fragmented and below the critical size needed for companies to grow and achieve significant economies of scale. Accounting for nearly 17% and 30% of Africa's surface area and population respectively, the ECOWAS is one of the most densely populated areas on the continent. Despite its great potential in terms of human and natural resources, the ECOWAS still faces obstacles to achieve an effective regional integration. Indeed, the performance of its intra-regional trade remains very modest compared to other economic blocs of the world. Intra-regional trade is limited to around 10% while it exceeds 20% in the East African Community (EAC) for instance and 25% in the Association of Southeast Asian Nations (ASEAN) in 2016. Therefore, it becomes crucial to investigate the existence of a potential for intra-regional trade in the ECOWAS as well as the constraints for its realization.

It is widely recognized that the potential of regional integration in Africa has been largely untapped (UNCTAD (2013) and ADB (2017)). Studies by authors such as Geda & Seid (2015) and Ebaidalla & Yahia (2015) have shown the significance of the potential between African countries. Using a standard gravity model, they projected the intra-flow of trade and revealed the huge potential for trade expansion. The majority of African countries seem to operate well below the potential and are not reaping the benefits of the trade liberalization. These studies agreed over the necessity to upgrade the quality of infrastructure and diversify the productive fabric to further economic integration. However, the poor structural performance of trade integration casts doubts over the adaptation of standard empirical models and the deployed approach to estimate the trade potential. This calls for an innovative approach and methodology to tackle this issue. Thus, it is imperative to revive this old issue capitalizing on a new approach to assess whether Africa, in the case of ECOWAS, is likely to witness an improvement in its integration dynamics in the medium term.

This paper contributes to the literature in three main ways. **First**, it estimates a gravity model to explain trade flows inside the ECOWAS and in a well-integrated region, such as the ASEAN to address the heterogeneity of trade policies adopted towards economic partners outside the REC. **Second**, it compares coefficients of each variable between the two communities, deploying an augmented version of the gravity model that controls for the quality of infrastructure and the bilateral complementarity. **Third,** it simulates trade potential inside the ECOWAS region, using coefficients estimated over the ASEAN. Following this spirit, the paper is organized as follows: a first section is dedicated to a brief overview of the trade structure of the ECOWAS countries and analyses some relevant trade indicators. A second section provides an overview of the literature on this issue. Subsequently, the third section describes the model and the data while the fourth section discusses the results estimation and the simulations output for the ECOWAS. Finally, the fifth section discusses the supply sides constraints in the region in order to enrich the analysis. By offering policy recommendations, section six concludes.

II. Economic Overview of the ECOWAS and Trade Indicators Analysis

a) Divergence in growth patterns

The ECOWAS is a regional grouping of 15 West African states sharing a coast on the Atlantic Ocean, except for Burkina Faso, Mali, and Niger, which are landlocked countries. It is a free trade area founded in 1975, whose main objective is to foster regional cooperation and integration in all economic fields, with the intent of creating an economic union. Within the ECOWAS, eight member countries[1] form the West African Economic and Monetary Union (WAEMU), which became operational in 2000. The WAEMU is a custom union who uses the CFA franc as a common currency.

The ECOWAS has witnessed a sustained economic growth- despite a drop in 2010 amid the economic and financial crisis- with rates ranging from 5 percent to 10 percent. In 2014, however, a sharp slowdown has been observed due to the decline in commodity prices in general and oil prices specifically, when GDP growth decreased from 6 percent in 2014 to 0.4 percent in 2016. This slowdown is partially explained by the negative performance of the biggest economy of the region Nigeria. In fact, Nigeria remains the largest contributor of wealth creation in the ECOWAS and the largest in terms of population. According to the latest estimations[2], GDP growth is likely to pick up in 2017 and 2018.

Figure 1: GDP growth (percentage) of ECOWAS and Sub-Saharan Africa during the period 2005-2018

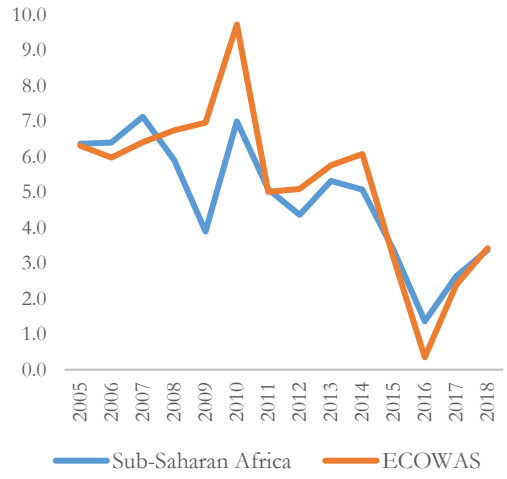
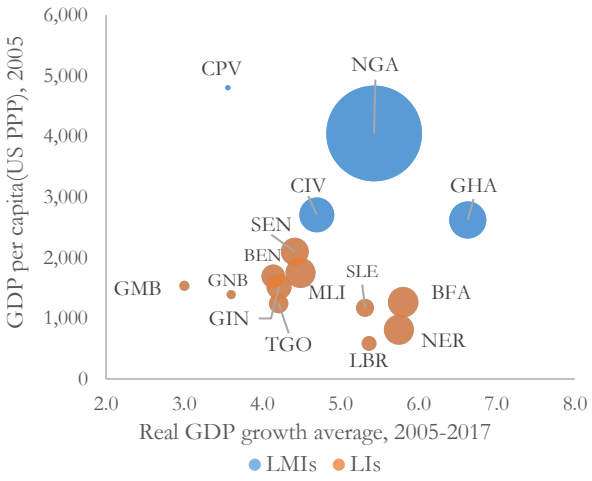


Figure 2 : GDP growth average (2005-2017) and GDP per capita (2005) of ECOWAS countries[3][4]*



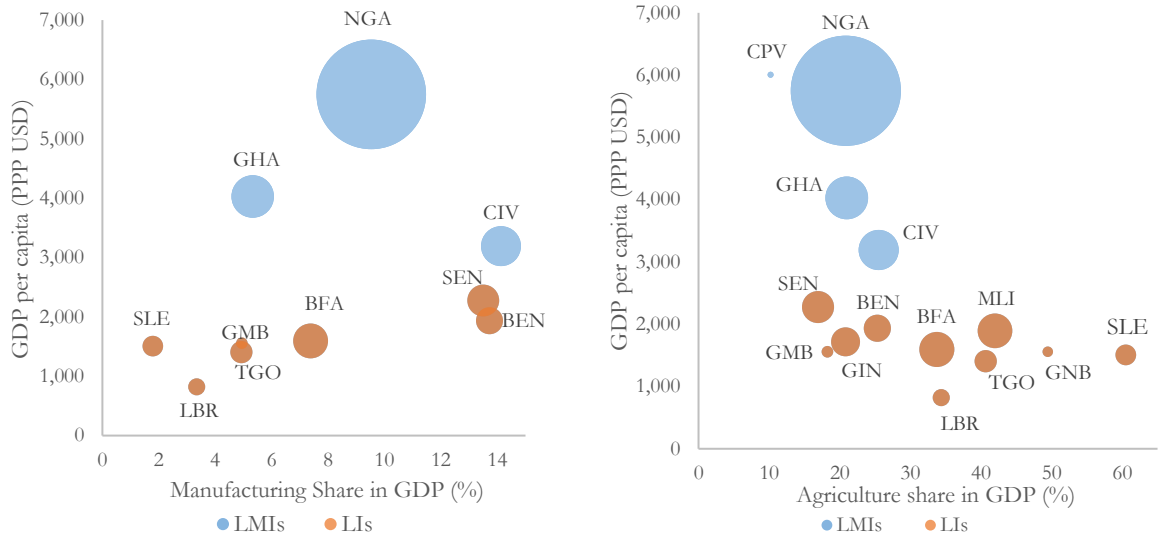
**Bubble size represents population*
Source: International Monetary Fund.

With the exceptions of Cape Verde, Nigeria, Ghana, and Côte d'Ivoire, all ECOWAS members are classified as Least Developed Countries[5]. Hence, their growth performances vary quite sharply,

[1] Benin, Burkina Faso, Cote d'Ivoire, Guinea Bissau, Mali, Niger, Senegal and Togo.
[2] IMF. 2017. Fiscal Adjustment and Economic Diversification. Sub-Saharan Africa Regional Economic Outlook.
[3] "*Low-income economies (LIs) are defined as those with a GNI per capita, calculated using the World Bank Atlas method, of $1,005 or less in 2016; lower middle-income economies (LICs) are those with a GNI per capita between $1,006 and $3,955*". World Bank.
[4] Benin (BEN), Burkina Faso (BFA), Cape Verde (CPV), Côte d'Ivoire(CIV), Gambia (GMB), Ghana (GHA), Guinea (GIN), Guinea-Bissau (GNB), Liberia (LBR), Mali (MLI), Niger (NER), Nigeria (NGA), Senegal (SEN), Sierra Leone (SLE), and Togo (TGO).
[5] According to the World Bank.

reflecting their diversity. Between 2005 and 2017, average growth rates of real GDP ranged from 3 percent in Gambia to 6.6 percent in Ghana. When taking into consideration population growth, real GDP per capita goes from -0.3 percent in Gambia to 4 percent in Ghana. Despite a slowdown in real GDP growth the latest years, Nigeria still accounts for 70 percent of this bloc's GDP with 395 billion dollars for 2017, nearly ten times the GDP of the region's second largest economy, Ghana, which accounted for only 8 percent with 45 billion dollars for the same year. Nigeria has also the second highest GDP per capita estimated at 5,402 dollars behind that of Cape Verde estimated at 6327 dollars in 2017. In terms of economic structure, only a few member countries have developed relatively bigger manufacturing industries such as Benin, Côte d'Ivoire and Senegal whose share of manufacturing in their GDP vary between 13 percent and 14 percent in 2015, while most others, notably Sierra Leone, Gambia and Mali depend primarily on agriculture as shown in figure 3.

Figure 3: Size and Economic structure of ECOWAS Members6 in 2015*.



**Bubble size represents population*

Source: World Development Indicators, World Economic Outlook.

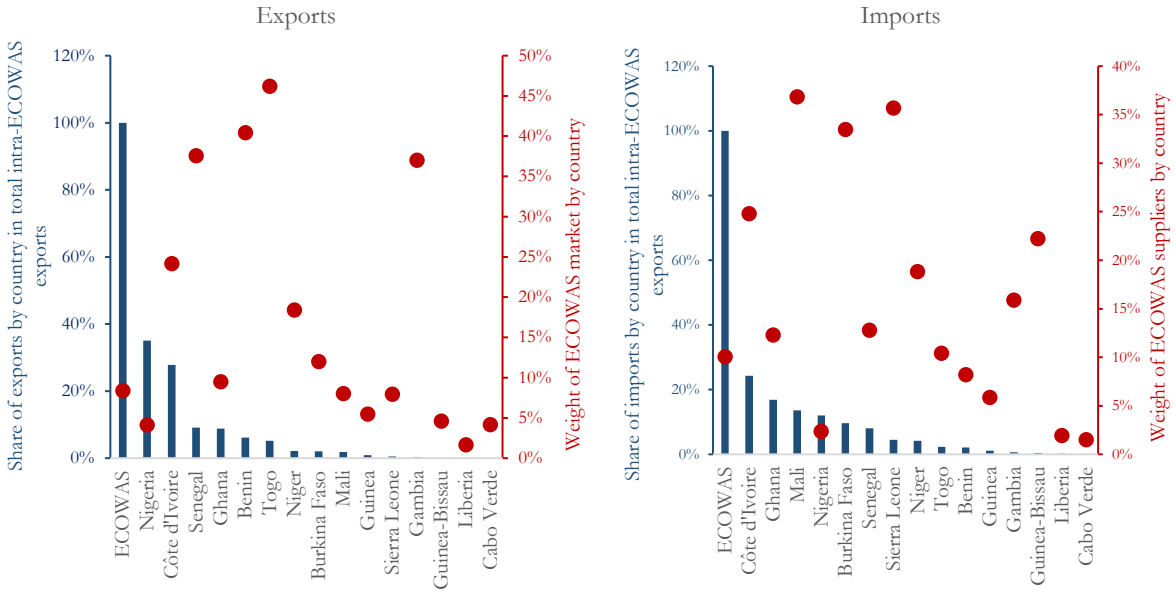
b) Intra-regional trade remains low and concentrated in fuel products

Efforts to reduce trade barriers within the ECOWAS have not yielded effective results since intra-trade remains low. The share of exports from ECOWAS countries sold within the bloc has stayed relatively steady around 10% from 1995 to 2016. As it can be seen in Figure 4, Nigeria and Côte d'Ivoire, given their size, dominate trade within the ECOWAS by supplying the highest volume of merchandises. Their share in total intra-regional exports to the ECOWAS is estimated at 35.6 percent and 28.9 on average between 2005 and 2016 respectively. Yet, Nigeria's exports to ECOWAS represent only a small percentage – around 4 percent – of its total exports to the world, while this share reaches 24 percent for Côte d'Ivoire. This means that Nigeria relies less on ECOWAS partners in terms of its trade relations. During the same period, Senegal, (which is the next most important exporter to the region) Togo and Gambia account for 9.3 percent, 5.4 percent and 0.1 percent of the total exports to ECOWAS partners respectively, yet they rely heavily on

[6] Data regarding the share of manufacturing in GDP is not available for Cabo Verde, Guinea, Guinea Bissau, Mali and Niger.

ECOWAS. Indeed, their exports account for 37 percent, 47 percent and 26 percent of their total exports to the world respectively.

Figure 4: Intra ECOWAS export and imports, average 2005-2016, by country.



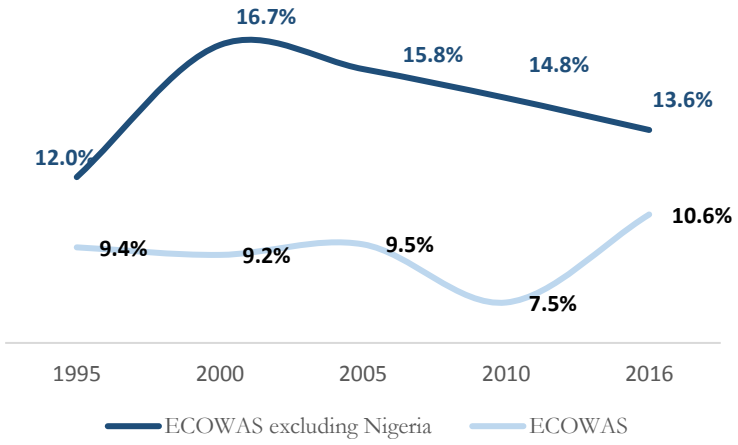
Source: UNCTAD

The same observation can be drawn for imports. Between 2005 and 2016, Côte d'Ivoire, Ghana and to a lesser extent Mali and Nigeria imported high volumes of merchandise from The ECOWAS, ranging from 984 million dollars to 2.0 billion dollars. Nevertheless, imports' share of Ghana and Nigeria from ECOWAS make up a relatively low percentage. This point stands out the most for Nigeria in particular whose imports from ECOWAS partners represents only 2 percent of its total imports from the world. Unlike Nigeria, other countries, namely Burkina Faso, Sierra Leone, Niger, Gambia and Guinea Bissau, are heavily supplied by the ECOWAS. Therefore, even though intra-regional trade in ECOWAS remains low, particularly for large economies, compared to other developing economic blocs of the world, few countries rely on it for a large portion of their trade.

The striking fact regarding the ECOWAS is the non-relevance of the Nigerian economy for the ECOWAS market, neither in terms of exports nor for imports. If the extreme dependence over oil industry might explain why the Nigerian economy dedicates only 4.2% of its total exports to the REC, the low share of imports provided by the ECOWAS is actually not being understood. Nigeria in fact ranks at the fourth position in the most important market for ECOWAS products. Yet, it imports actually half of what Côte d'Ivoire purchases from the ECOWAS market for example, even though the size of the Nigerian economy is 7.7 times bigger. The ECOWAS economies supply only around 2.5% of total Nigerian needs, which makes it one of the less integrated economy, just as Cabo Verde. Having said that, we have recalculated the trade integration rate for the REC, excluding Nigeria both as an exporter and importer (figure 5) When comparing the two indicators of integration, we conclude how Nigeria is not participating in the intra-trade in the ECOWAS and to what extent it doesn't play the role of engine of growth in the region. Therefore, we can conclude that the rest of economies in the REC seems to be relatively more integrated among themselves and have developed tight trade relations. Their integration rate have reached 16.7% in the year

2000, when excluding Nigeria. In 2016, Nigeria pulls back the integration rate by three percentage points.

Figure 5 : Intra-exports as a share of total exports in the ECOWAS



Source: UNCTAD

The range of products traded within the ECOWAS has not been submitted to significant changes. As shown in Table 1, during the period 2005-2016, trade concerned mainly fuel products (oil), which accounted for 54 percent of intra-regional trade in the ECOWAS, followed by chemicals and food products. It is important to note however, that official intra-regional trade volumes data are underestimated since they do not include informal trade, which account for a large share of trade between ECOWAS countries[7]. In addition, there is also the occurrence of misreporting and inconsistencies in data results, notably in the difference between volumes in monetary units of intra-regional export and intra-regional imports. Regarding trade with the world, exports of the ECOWAS are concentrated in fuels, followed by food products, stone, and glass, whereas imports of the ECOWAS concern machinery and electrics, followed by fuel and transportation.

Table 1: Top 10 products traded by the ECOWAS (in value, average 2005-2016)

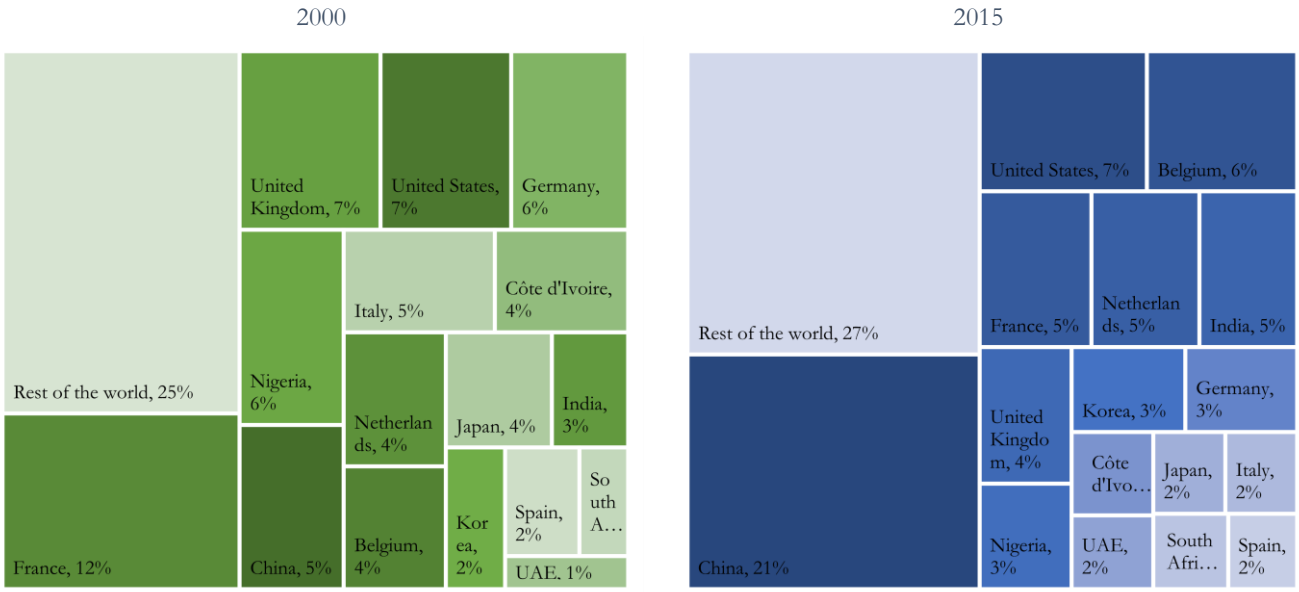
Top 10 intra-regional Trade in the ECOWAS		Top 10 ECOWAS EXPORTS to the World		Top 10 ECOWAS IMPORTS from the World	
Fuels	54%	Fuels	72%	Machinery and Electrics	20%
Chemicals	7%	Food Products	7%	Fuels	15%
Food Products	7%	Stone And Glass	6%	Transportation	13%
Vegetable	5%	Plastic OR Rubber	3%	Vegetable	9%
Transportation	4%	Vegetable	3%	Chemicals	8%
Minerals	4%	Transportation	2%	Metals	8%
Plastic OR Rubber	4%	Minerals	1%	Food Products	6%
Animal	3%	Textiles and Clothing	1%	Plastic OR Rubber	6%
Metals	3%	Chemicals	1%	Animal	4%
Wood	3%	Wood	1%	Textiles and Clothing	2%

Source: World Integrated Trade Solution (WITS).

[7] European Centre for Development Policy Management (ecdpm), "Overview of trade barriers to trade in West Africa: Insights in political economy dynamics, with particular focus on agricultural and food trade". Discussion Paper, No. 195, July 2016.

When it comes to imports' structure by economic partners, figure 6 indicates how the Chinese economy is positioning itself as a major supplier of ECOWAS's market, as it captures around 21% of total imports. It is also worth mentioning that in 2000, Chinese products were representing only 5% of total imported goods, behind the United Kingdom and France with 7% and 12% respectively. The Indian economy is also being considered as a major economic partner of the ECOWAS, with a positive dynamic since 2000, supplying around 5% of total imported goods in 2015 after 3% in 2000. The favorable dynamics of Asian economies, especially China and India, were achieved to the detriment of European economies that have witnessed a shrink in their market share in the last two decades. France, the United Kingdom, and Germany have been the top economic partners of the ECOWAS since 2000, but as of 2015, they have been surpassed by China and the United States. To elaborate, the prominence of France, given its historical and cultural links especially francophone countries in the ECOWAS market, made it one of the most important partners in the beginning of the 21th century. However, this relation has lost momentum during this century, with France being at the fourth position. In the European Union, Belgium could be considered as an exception, with a stronger market presence. Its share has, thus, increased from 4% to 6%. For the United States, it has been able to maintain its share in the ECOWAS market, at around 7%. Except the United States, the ECOWAS countries do not trade much with the opposite side of the Atlantic.

Figure 6 : Evolution of ECOWAS imports structure by economic partner



Source: UNCTAD.

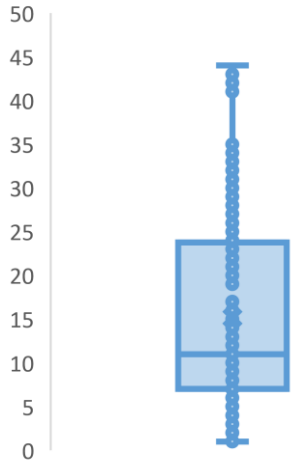
c) Lack of complementarity within the ECOWAS members

Another way to evaluate intra-regional trade within the ECOWAS is to look at the trade complementarity index, which measures the potential trade between two partners. It illustrates to what extent the export profile of ECOWAS members corresponds the import profile of other ECOWAS members. It is constructed as follow:

$$TC_{j,k} = 100 * (1 - \frac{\sum|X_{i,j} - M_{i,k}|}{2})$$

Where $X_{i,j}$ is the share of good i in global exports of country j and $M_{i,k}$ is the share of good i in all imports of country k. Values close to 100 indicate a great match between country j's export structure and country k's import structure and values close to 0 indicate a low correspondence in their export and import pattern. Countries with a high index suggest a gain from trade expansion.

Figure 7 : Complementary Index Distribution, among ECOWAS members



Source: UNCTAD

Trade complementarity index varies considerably across ECOWAS members and does not exceed 50%. In fact, 75% of observed complementarity data are below 24% in the region. Senegal, as an exporter, displays relatively high levels of bilateral complementarity with almost all ECOWAS members except with Côte d'Ivoire and Liberia. Interestingly enough, Côte d'Ivoire as an exporter has a relatively high bilateral complementarity index with Senegal. This indicates that the exports structure of Côte d'Ivoire match with the imports structure of Senegal, whereas the exports structure of Senegal does not match with the imports structure of Côte d'Ivoire. Benin has also a high complementarity index with a number of ECOWAS countries, namely Burkina Faso, Cabo Verde, Guinea-Bissau and Senegal, and Togo with Burkina Faso, Ghana and Guinee-Bissau. The lowest level of bilateral complementarity is recorded between Guinee-Bissau and several ECOWAS countries, namely Burkina Faso, Gambia, Ghana, Guinea, Liberia, Mali, Niger and Togo.

Table 2: Trade complementarities index in ECOWAS, 2013[8]

	BEN	BFA	CPV	CIV	GMB	GHA	GIN	GNB	LBR	MLI	NER	NGA	SEN	SLE	TGO
BEN	_	31	30	17	21	23	30	31	11	27	21	23	35	29	25
BFA	16	_	16	10	14	15	17	16	9	17	13	17	19	16	16
CPV	10	9	_	12	8	12	10	9	4	9	9	11	9	7	10
CIV	29	30	29	_	22	25	29	32	13	30	20	26	41	27	29
GMB	15	11	14	11	_	13	12	12	5	11	12	12	13	12	11
GHA	10	11	12	30	11	_	10	11	8	11	12	11	22	10	9
GIN	4	5	6	26	3	5	_	4	2	4	4	6	15	4	3
GNB	2	1	2	4	1	1	1	_	1	1	1	2	4	2	1

[8] Latest year available.

LBR	5	7	7	10	5	6	6	5	_	6	6	8	8	6	5
MLI	10	12	10	10	9	11	10	9	7	_	10	11	11	9	9
NER	20	30	32	8	14	14	28	23	8	22	_	17	23	42	41
NGA	9	9	10	25	8	9	8	10	7	8	6	_	21	9	8
SEN	34	43	43	28	33	33	43	44	13	43	33	35	_	35	34
SLE	5	4	5	5	4	5	4	3	4	4	4	6	4	_	4
TGO	26	30	27	22	29	32	26	32	14	31	27	28	28	24	_

Source: UNCTAD

III. Empirical Literature

Intra-regional trade in Africa has been the focus of many empirical and theoretical studies since the creation of regional economic communities in the continent and the proliferation of free trade zones and custom unions. Scholars have indeed argued that intra-regional trade holds a great potential for raising the level of welfare of Africans by promoting regional economic development and improving the living standards of their population (Longo and Sekkat, 2001; Geda and Kibret, 2008).

However, the unsatisfactory performance of Africa in boosting intra-regional trade has led to a growing interest for studies that assess not only the trade patterns, but most importantly the potential of intra-regional trade in several African RECs using gravity models. The latter are commonly used as an ex post analytical framework in empirical studies of bilateral trade flows. They can also be used to address the issue of regionalism by simulating trade potentials between any groupings of countries.

Tinbergen (1962) applied a gravity model on 42 countries in his analysis of the determinants of bilateral trade patterns and the effect of regional trading arrangements (RTAs). His findings demonstrate the positive impact of the Gross Domestic Product (GDP) of both the exporting and importing country on trade flows on the one hand and the negative impact of distance on trade on the other hand. Following on Tinbergen (1962), Eichengreen and Irwin (1995) introduced historical variables to a dynamic gravity model to analyze whether countries with a history of trading continue to trade with each other. They found that the exclusion of historical factors exaggerates the impact of trading blocs. Further studies have expanded the gravity model and used variables like contiguity, common colonizer, common language, tariffs, exchange rates etc. (Hacker and Einarsson, 2003; Cardamone, 2006; Adekunle and Gitau, 2011).

With particular emphasis to the Sub-Saharan Africa (SSA), Foroutan and Pritchett (1993) applied the traditional gravity model for 19 SSA countries based on proximity, economy size and other characteristics. They used the Tobit maximum likelihood estimation method to correct censoring bias produced by the Ordinary Least Square (OLS) method. They compared actual trade data with the prediction of the model. Despite the low intra-African trade, Foroutan and Pritchett (1993) found that the reported intra-trade is higher than the potential predicted by the model. The actual share of SSA's trade was an average of 8.1 percent whereas the gravity model estimated a slightly lower mean of 7.5 percent.

Cassim (2001) conducted an empirical study on the determinants of intra-regional trade in Southern African countries employing the gravity model with a Tobit maximum likelihood estimation method. He found that intra-regional trade in the South African Development Community (SADC)[9] is actually in line with international standards, meaning that this region's trade is beyond its potential. He confirmed that fundamental economic factors like economic and geographic size of the trading partners measured by GDP and land areas have significant impact on trade flows, while transport costs adversely affect the bilateral trade. However, this result is biased by the high volumes of exports from South Africa to the rest of the members. In fact, the model used by Cassim (2001) shows that intra-SADC trade excluding South Africa is low, indicating the existence of a potential for increased exports.

Alemayehu and Haile (2008) replicated the gravity model using a Tobit formulation to test the determinants of bilateral trade flows and assess the outlooks and challenges of regional integration in the Common Market for Eastern and Southern Africa (COMESA)[10]. The findings demonstrate that the standard gravity model variables such as the GDP of both the exporting and partner countries, bilateral distance and contiguity have the expected signs except for the common language variable. This strengthens the hypothesis that trade between similar countries tends to be higher. However, the coefficient of the regional integration dummy was negative and non-significant, meaning that regional trading blocs in Africa fail to promote intra-regional trade.

Alemayehu and Edris (2015) reexamined the potential for intra-Africa trade with the objective of advancing regional economic integration by trade. They used a variety of gravity models to two groups of countries with one group characterized by an advanced level of integration (West and Central Africa) and the second group compromising the rest of the continent (North, East and Southern Africa). They estimated the model using the Pseudo Poisson Maximum Likelihood (PPML) technique. A simulation exercise was conducted afterwards to analyze the potential of intra-Africa trade for each group of countries, given the parameters of the model. This was then compared with actual trade of each country. The results showed the existence of significant potential for intra-Africa trade, which is however dampened by lack of complementarities of exports and imports, weak infrastructure as well as the relative competitive position of African potential export suppliers.

Regarding the ECOWAS specifically, Luqman et al. (2015) analyze bilateral trade patterns and the openness level of ECOWAS through a gravity model using three techniques: the PPML, the fully modified ordinary least squares (FMOLS) and canonical cointegrating regression (CCR), for the period from 1981 to 2003. Trade openness was negatively significant under PPML, whereas financial openness was negatively significant under FMOLS and CCR. Contiguity (common border) and distance had a strong effect on ECOWAS trade, while there was a negative effect of trade flow among ECOWAS members.

Recent studies introduce infrastructure variables to the gravity models in order to capture their impact on bilateral trade in Africa, especially given the fact that the continent faces an important

[9] SADC includes Angola, Botswana, Dem. Rep. Of the Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, United Republic of Tanzania, Zambia, Zimbabwe.
[10] The COMESA includes Burundi, Comoros, Dem. Rep. Of the Congo, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Sudan, Swaziland, Uganda, Zambia, Zimbabwe.

deficit in terms of infrastructure provision, which in turn acts as a barrier to the entire process of regional integration. Deen-Swarray and al. (2011) investigate the effect of infrastructure development on intra-regional flows of member countries of the ECOWAS employing a modified gravity model and using both a time series and a cross-sectional analysis for the period from 1990 to 2008. They developed an index for different kinds of infrastructure (road, rail, airport etc.) to analyze how they individually influence trade. Deen Swarray and al. (2011) used three estimation methods, namely a pooled model, a fixed effect model and random effects model. They found that GDP, language, common currency and distance variables have a significant and the expected effect on total trade in ECOWAS, whereas infrastructure index variable have a puzzling negative impact on total trade.

Akpan (2014) examines the effect of improving the quality of a regional road infrastructure within ECOWAS if it was at the level of roads in South Africa. He uses a traditional gravity model that includes variables for contiguity, common language and road quality as well as the positive difference in per capita GDP between exporting and partner countries. Akpan (2014) used a Tobit estimation and found that improvement in road infrastructure lead to an increase in intra-regional trade relative to the 2012 level of 5.3 percent.

With regards to another economic grouping, Zarzoro and Lehmann (2003) used the gravity model with fixed effects to evaluate the trade potential between Southern Common Market (MERCOSUR) members and the European Union (EU) following the agreements established between the two blocs. The model includes 20 countries (4 members of MERCOSUR in addition to Chile and 15 members of the EU). The authors found that variables such as infrastructure, income differences and exchange rates have important determinants of bilateral trade flows.

Regarding the role of complementarity index in the specification model, Armstrong, Drysdale and Kalirajan (2008), assess the trade potential within East Asian on one hand and South Asian countries on the other. Referring to gravity specification, the authors consider the role of complementarity in defining the intensity of trade between two economic partners. Results suggest that East Asian countries outperforms the world average, while South Asian lags behind. For our variables, the authors explained how important is it to include the complementarity index for assessing trade potential.

Similarly, Kakinaka (2007) assesses to what extent the entry of Cambodia into the ASEAN Free Trade Area (AFTA) benefited to trade expansion. A measure of trade complementarity has been included into the gravity model. The empirical results show that a higher degree of trade complementarity is associated with a higher level of trade flows. The author claimed that this fact is consistent with a Heckscher-Ohlin model in which factor endowment difference between economies, captured by the measure of trade structure, is a dominant driving force for trade flows.

IV. The specification, the estimation technique and the methodology

The gravity model has been derived initially from Newton's Law of Universal Gravitation. Tinbergen (1962) introduced this physical law in the area of international trade. According to the model, the intensity of bilateral trade between two economies, like the gravitational force between two objects, depends positively on their respective 'masses' (in economics, nominal GDP is often

used as a proxy) and inversely on the distance separating them. The distance per se is not the key element, but in fact it captures the cost of transportation or cost of trade in general. Therefore, the distribution of goods or factors across space is determined by gravity forces conditional on the size of economic activities at each location. The equation translates a supply (GDP of the exporting country) and demand (GDP of the importing country) mechanism. The gravity equation can be expressed in its non-linear form as:

$$Trade_{ijt=}\alpha.\frac{GDP_{it}.GDP_{jt}}{Distance_{ij}}$$

The equation has been often transformed into the following linear form:

$$\log Trade_{ijt} = \alpha + \rho \log GDP_{it} + \beta \log GDP_{jt} + \mu \log Distance_{ij} + \mu_{ijt}$$

Since then, international trade economists have been referring to this equation whenever they study the determinants of international bilateral trade flows (WTO (2016)). Besides, economists have enriched the equation with other characteristics that might hamper/foster trade, such as a free trade agreement, or other types of bilateral costs, usually referred to as bilateral trade resistance. The success of this equation in literature owes it to the ease of estimation and handling. In addition, gravity models enjoy fit of between 60 and 90 percent with aggregate data as well as with sectoral data (WTO (2016)). However, despite being extensively used in empirical literature, the gravity model was lacking solid theoretical microeconomic foundations. Anderson (1979) and Anderson and van Wincoop (2003) derive the gravity equation starting from the assumptions that goods are differentiated by place of origin (Armington, (1969) and CES utility function in which preferences are homothetic and identical across countries.

Regarding the estimation technique, Silva and Tenreyro (2006, in their pioneering paper "The Log of Gravity," demonstrated how biased the coefficients are when the gravity model is estimated in its log-log form by Ordinary Least Square (OLS). The heteroscedasticity, which often plagues trade, hampers the consistency of the OLS estimates. In addition, the censored nature of such trade data implies that the log-linearized form disregard zero trade flows. They suggested a Pseudo Poisson Maximum Likelihood (PPML) estimator for gravity models that address all caveats associated with OLS, estimating the function over the exports in monetary units instead of the logarithm of exports.

Several studies have confirmed the advantages of using such technique. WTO (2016) recommended the use of this estimator when dealing with gravity models. Besides, the estimation technique produces robust coefficients that address heteroscedasticity issues. Silva and Tenreyro (2006) pointed out the need to perform a test to assess the specification of the model. Ramsey Reset test is the most recommended one, Silva and Tenreyro (2006) and WTO (2016). The null hypothesis (H0) states that the model is correctly specified, while the hypothesis (H1) states that the model suffers misspecification or omitted variables.

In this paper and in line with these novelties, the following two gravity equations are estimated over bilateral trade flows between the ten members of the ASEAN and 15 members of the ECOWAS, covering the period 2007-2014:

Standard basic gravity model:

$$Trade_{ijt} = \alpha + \rho \log GDP_{it-1} + \beta \log GDP_{jt-1} + \mu \log Distance_{ij} + \gamma\ Contiguity_{ij} + \lambda\ landlocked_i + \mu_{ijt}$$

Augmented version of the gravity model:

$$Trade_{ijt} = \alpha + \rho \log GDP_{it-1} + \beta \log GDP_{jt-1} + \mu \log Distance_{ij} + \gamma\ Contiguity_{ij} + \lambda\ landlocked_i + \varphi \log(infrastructure_{it-1}) + \tau \log(infrastructure_{jt-1}) + \varphi\ Complementarity\_index_{ijt-1} + \mu_{ijt}$$

Where : $Trade_{ijt}$ is bilateral trade between pair of countries, contiguity is a dummy variable that is equal to 1 if a pair country shares borders and 0 if not. Landlocked is also a dummy variable that captures if a country is having a direct access to the ocean or not. Infrastructure is an index that captures the quality and the availability of infrastructure. Regarding the complementarity index, "*it measures to what extent the export profile of country i to the world matches the import profile of country j from the world. The index values range from 0 to 1 with 0 indicating that there is no correspondence between country i's export structure and country j's import structure and 1 indicating a perfect match in their export/import pattern*" (UNCTAD). A higher indicator, ceteris paribus, implies a chance to increase trade, as the demand fits the supply.

The two models are estimated using the PPML approach, suggested by Silva and Tenreyro (2006). Following, Donaubauer, Glas & Nunnenkamp (2015) we attempt to evaluate the impact of infrastructure on the performance of bilateral trade. We tried to address endogeneity by integrating the lagged observation of infrastructure index and complementarity index. The latter is included in the equation to address the productive structure and matching issue between the supply side and the demand side. For example, this indicator is expected to bring down the potential between two economies such as Angola and Algeria. Being two of the biggest economies of the continent, the standard gravity equation must expect huge potential of bilateral trade. However, the structure of the two economies is heavily concentrated on energy products and their exports are likely similar. For each economic community, the two equations are estimated. The objective is to compare to what extent the complementarity and the infrastructure indexes enrich the specification. Then, a comparison of trade dynamics is performed to analyze and understand the convergence and divergence between the two regions, in terms of the coefficient estimated. The third step is to generate the trade potential (Estimated $trade_{ijt}$) and compare it to the observed trade for the ECOWAS region, based on the coefficient estimated over the ASEAN. In a case where the ratio is close to 100%, we would therefore conclude that trade potential between two pair economies has reached a threshold, fully exploited and is hardly expected to grow in the medium term and vice-versa.

V. Estimation and Simulations results

According to the model presented in Table 3, the estimation has been performed using the PPML technique. The two above equations have been estimated for the ASEAN and the ECOWAS

countries. For the ASEAN estimation[11], results shows that all variables[12] have the expected economic sign and are statistically significant except for the contiguity, which is not statistically significant.

Regarding the standard version of the model, the propensity to export relative to GDP for ASEAN members equals 0.8, meaning that 1% increase in nominal GDP push upward exports by 8%, while the propensity to import is slightly lower around 7%. According to the literature[13], landlocked countries tend to trade less because they require higher logistic costs to be able to access the sea. Hence, the coefficient of this variable is expected to be negative, which is the case for the exporting country. It is worth mentioning that the ASEAN community is a grouping of archipelago nations. The only landlocked country is Lao People's Democratic Republic. Therefore, the coefficient is likely to capture in general country special effect, beyond landlockedness. In an alternative version of the specification (not reported in the paper), the landlockedness of the importing country has been added to the model specification. However, it was not significant and its sign was not following the economic intuition. The same conclusion comes out of the impact analysis of cultural variables, such as common spoken language or colonial links. They do not enrich significantly the model. One explanation for this is that REC generally gather countries that have already shared history and cultural links.

Regarding the augmented version of the model, it appears that complementarity index and infrastructure quality matters for trade development across ASEAN members. For infrastructure, the improvement in quality by 1% fosters trade proportionally, but only when it comes to the infrastructure of the exporting country. However, for the importing country, its infrastructure assets seem not to matter for the exporting country, as it statistically is equal to zero, even though the sign of the coefficient is positive. This result is in line with the finding of Donaubauer, Glas & Nunnenkamp (2015). Regarding the complementarity index, it plays an important role in determining the intensity of bilateral trade with a statistically significant coefficient at 1% level. Economies, in which demand and supply seem to match, are expected to have higher bilateral trade, while those who do not enjoy this quality, could not leverage uniquely on their size or the infrastructure to foster their trade cooperation.

After the addition of the infrastructure and complementary indexes, all the coefficients of the size variables (GDP) are still positive but they seem to have slightly decreased, meaning that once we consider these variables, the propensity to export and import is revised downward. This implies that the impact of the economic size of both partners diminishes when taking into consideration the infrastructure and complementary variables that are relatively higher. The same observation can be drawn for the bilateral distance. Indeed, better infrastructure and a more complementary trade structure appear to mitigate the negative impact of distance between distant partners. Nevertheless, to check for the validity of the coefficients drop between the two specifications, we run the equality test and confirm that statistically speaking, the coefficients did change, except for the contiguity, which is not significant in both versions.

[11] The both version of the model, we have decided to keep only significant variables, except when it is the case for central explanatory variables.
[12] For data description, refer to Annex 1.
[13] Alemayehu and Edris 2015; Suarez-Burguet et al. 2005.

Table 3: Intra-trade between ASEAN members (2007-2015): PPML estimation[14]

Variables	ASEAN			ECOWAS		
	Standard version	Augmented version	Test of coefficient equality	Standard version	Augmented version	Test of coefficient equality
lagged Ln (GDP-exporting)	0.79***	0.57***	3.41*	0.63***	0.91***	13.21***
lagged Ln (GDP-importing)	0.77***	0.56***	33.48***	0.50***	0.51***	0.06
Ln (bilateral Distance)	-1.84***	-1.09***	11.03***	-0.24	-0.13	0.26
Contiguity	-0.15	-0.29	0.52	0.71**	0.74**	0.01
Landlocked-exporting	-1.25***	-0.47	3.24*	-1.23***	-0.17	13.40***
Lagged Complementarity Index	-	3.16***		-	6.15***	
Lagged Ln(Infrastructure index-exporting)	-	1.26***		-	0.95*	
Lagged Ln (Infrastructure index-importing)	-	0.44**		-	1.18**	
Constant	2.58	-1.39	3.32*	-12.19***	-19.32***	8.40**
R^2	0.7	0.9		0.3	0.7	
RESET P-value	1.7	2.6		4.3**	0.3	

Standard errors in all estimations are clustered by trading pair in order to account for any intra-cluster correlations. ***,**,* significance at 1%, 5% and 10%. Equality test allow assessing whether a coefficient has statistically changed or not.

For the ECOWAS region, the same approach has been adopted. In the standard version of the model, the propensity to export and to import in the ECOWAS are closer to ASEAN dynamics, with coefficients around 0.6, 0.5 respectively, and statistically significant. The divergence concerns the transportation cost indicators, notably bilateral distance and contiguity. Surprisingly, the distance does not disrupt bilateral trade as in the ASEAN community, with the elasticity equal to -0.2. It is however not statistically significant meaning that it lost completely its effect over trade. In other words, ECOWAS members are more prone to develop trade even with a geographically distant country. What matters in this case is whether the exporter is sharing borders, which gives similar information as the bilateral distance. Indeed, if two countries share a border, they are more likely to trade given that the distance between them is reduced. Otherwise, the trade dynamics are the same. In fact, trade increases by 7% when economic partners share borders. Besides, like for the ASEAN community, landlocked countries in the ECOWAS are faced with higher logistic costs when trading, since they are required to be able to access the sea. Hence, the coefficient of this

[14] In a version not reported in this paper, we added the remoteness variables for both ASEAN and ECOWAS models in order to capture the multilateral resistance terms that are not observable in the classic gravity model. The coefficient of the remoteness variables for exporting and importing countries were aligned with the literature (positive and significant) they lose their significance once adding the infrastructure and complementarity variables. Hence, we did not report tem in this paper.

variable is negative, and statistically significant. Exports by a landlocked country tend to diminish by around 12%.

Considering the augmented model, some changes are worth mentioning. The size variables' effects have dramatically changed with the addition of infrastructure and complementarity indexes especially for the exporting country. A 1% increase in GDP of the exporting country leads to a rise in export by 9% instead of 6% as reported in the standard version. The GDP of the importing country is still positive and statistically significant but the coefficient has not differed drastically. These results are supported by the equality test. Moreover, the landlocked variable of the exporting country has lost its significance once we control for infrastructure and complementarity indexes, meaning that it does not affect trade anymore. Therefore, the effort of export (propensity to export) is relatively higher once we control for the infrastructure base and the complementarity index. The same conclusion can be said about the constraints to bilateral trade, such as landlockedness, that do not actually impede bilateral trade after the integration of these variables. This result should be, however, interpreted with caution. The period of the study ranging from 2007-2014 is characterized by a jump in commodity prices and the start of price adjustments in mid-2014. Being large commodity exporters, this erratic movement is hard to be addressed, as we analyze nominal variables in our model. The RESET test that assesses to what extent the model is well specified confirm that our main variable has really enriched the model.

Given the role of our main variables. Complementarity is crucial in explaining bilateral trade within the ECOWAS, even more important than the ASEAN, with a coefficient being 2 times higher. For the infrastructure, the elasticity is above the unity for the importing country, suggesting that trade responds more proportionally to infrastructure improvement, as the coefficient is equal to 1.3. The coefficient for the exporting country is lower but is still close to the unity and is statistically significant. Namely, the infrastructure base for both the exporting and importing country mitigate the role of transportation costs and in fine broaden the international market for domestic suppliers. These results confirm the finding of Bougheas et al (1999) who showed that transportation cost depends not only on the distance but also on the stock of infrastructure. Our results might thus have some important implications for policy makers, at least for the ECOWAS. In fact, the availability and the quality of infrastructure could be considered as an *international or regional public good* that enable foreign companies to penetrate domestic markets. Share cost behavior within the ECOWAS is one option to consider in dealing with the infrastructure lag issue. Moreover, infrastructure and complementarity indexes significantly affect trade within the ECOWAS more than they do in the case for the ASEAN.

Overall, the comparison of trade dynamics between ASEAN and ECOWAS shows that the effort of export in ECOWAS, captured through the elasticity to export, is relatively higher than the ASEAN, which might seem surprising. In fact, in the standard version the elasticity either for the exporting or the importing country, the ASEAN outperforms the ECOWAS. However, once we control for the infrastructure and complementarity, that are lower than the ASEAN, these elasticities jumped up to higher level, especially for the exporting country to around 0.9. Transactions costs, captured through the landlockness variable, are very informative in this case, as it has lost significance in the augmented gravity model, meaning that what matters the most is the infrastructure base and complementarity index, more than geographic constrains. It happens

to be that landlocked countries are just not well equipped in terms of infrastructure and/or are less prone to satisfy the ECOWAS demand, as their production fabric is not matching the demand. Besides, for bilateral trade, infrastructure base and production structure matter more within the ECOWAS than the ASEAN.

The next step is to "borrow the dynamics" observed in the ASEAN countries and try to replicate them over the ECOWAS region in order to predict the theoretical exports per country to the community itself. Subsequently, a ratio of actual exports to potential exports is calculated for the augmented model. The simulation results in Table 4 show that for all countries of the ECOWAS, their actual trade remain below the potential given by the gravity model. However, this result varies across countries. Indeed, some economies of the ECOWAS are characterized by trade levels that are relatively near their potential. Côte d'Ivoire and Nigeria for instance already harness more than 60% of their trade potential. If the ECOWAS market is relevant for Cote d'Ivoire, as it absorbs 24% of its total exports, for Nigeria it is not the case. The concentration of Nigeria supply over fuel products seriously hinders its capacity to expand trade in the medium term significantly above that level. Other countries such as Gambia, Liberia and Cape Verde are found to have a level of actual trade significantly below their estimated potential (less than 10%) and it happens to be that these economies are small and their intra-trade- except for Gambia- is relatively low and below the 10% average. This could indicate that they enjoy a scope for improvement in their integration rate. Senegal, whose intra-trade reaches almost 40%, also seem to exploit nearly 46% of its trade potential. For Benin, despite the importance of the ECOWAS market as it represents 44% of total exports, the room for improvement is still significant as only 25% of Benin's trade potential is exploited. Overall, economies that rely mainly on the ECOWAS market are likely to expand their intra-trade according to simulation analysis, but the scope of improvement is more important, especially for small economies, such as Liberia, Guinea and Sierra Leone.

Table 4: Intra-trade potential in the ECOWAS*

Countries	Ratio of Actual trade to Potential in (%)	Intra-trade 2015 (%)	Nominal GDP billions of current $ (2015)
	Augmented version		
Côte d'Ivoire	69	24.8	33.1
Nigeria	63	4.0	481.1
Senegal	46	38.3	13.6
Mali	26	8.7	13.1
Burkina Faso	25	11.9	8.3
Benin	25	44.2	10.4
Ghana	15	10.0	37.5
Sierra Leone	12	8.9	4.3
Guinea	10	4.7	8.8
Gambia	6	36.1	0.9
Liberia	3	1.7	2
Cape Verde	1	3.0	1.6

A simple simulation exercise has been conducted to evaluate to what extent ECOWAS integration can be fostered, if the infrastructure gap is closed, at least compared to ASEAN community, using the coefficients of the equation estimated over the ECOWAS itself. In addition, the same exercise is done regarding the complementarity index. Results that reflects the elasticity of trade to

infrastructure quality and complementarity depend also on the gap between these two communities in terms of infrastructure quality and complementarity. The simulation exercise indicates that if the catching up process in infrastructure investments is achieved, ECOWAS can witness an increase in its integration rate to 20%. The Complementarity issue that lacks in ECOWAS, if overcome, can result into an increase in integration rate to around 18.6%.

Table 5: Simulation results

Average	ECOWAS	ASEAN	Integration rate in the ECOWAS	
			Observed level	Simulated level
Infrastructure quality	2.7	4.1	10%	**20.1%**
Complementarity index	15.6%	25.5%		**18.6%**

International organizations, such as ADB (2017) and World Bank, pointed out the high numbers in transaction costs between African countries that challenge policy makers' ambition to further their integration. The regional integration does not respond mechanically to tariff eliminations. Issues ranging from complex administrative procedures to regulatory barriers raise transaction costs and depress trade integration. The quality of infrastructure additionally poses serious issues on the capacity of African economies to meet the challenge. Indeed, the infrastructure index as computed by the World Economic Forum shown in Table 6 highlights the weak state of overall infrastructure in countries of the ECOWAS in particular. The necessity to scale up intra-trade oriented infrastructure investment is imperative to contribute to trade facilitation. According to ADB assessment, the estimated financing requirement to close Africa's infrastructure deficit amounts around 100 billion annually until 2020. ADB (2017) indicated that transportation and communication infrastructure for intra-African trade is less developed than those that connect Africa to the rest of the world.

Figure 7: Trade costs (2006-2015 average) and distance in the ECOWAS, ASEAN and MERCOSUR.

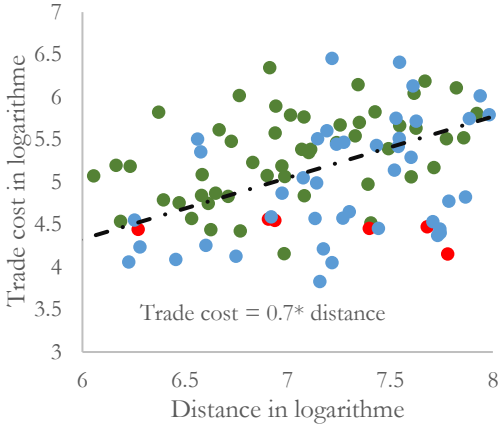
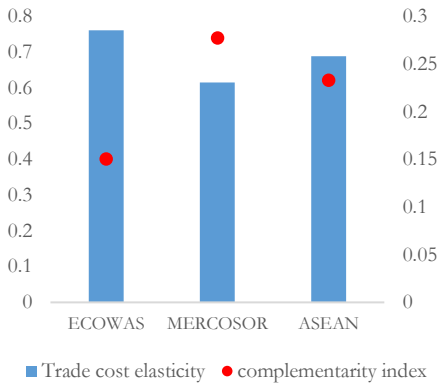


Figure 8: Trade cost elasticity to distance and complementarity index[15]



Green, blue and red marks relates to ECOWAS, ASEAN and MERCOSUR members respectively.

[15] The latest available data are for 2013.

Table 6: Infrastructure Index for ECOWAS member countries[16]

Countries	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Benin	2.3	2.2	2.3	_	2.4	2.6	2.7	2.7	2.6	2.6	2.4
Burkina Faso	_	_	_	2.0	2.1	2.2	2.1	2.1	2.6	2.6	2.4
Côte D'Ivoire	3.5	3.4	3.3	3.1	2.8	2.8	2.9	2.8	_	_	_
Cabo Verde	_	3.6	3.6	3.4	3.1	3.1	3.0	3.1	3.5	3.3	_
Ghana	3.6	3.4	3.3	3.3	3.4	3.6	3.7	3.8	4.0	3.7	3.1
Guinea	3.3	2.9	2.7	3.0	3.0	2.9	2.8	2.9	3.1	3.0	_
Gambia	2.4	_	1.8	1.8	1.7	1.9	_	_	_	_	_
Liberia	2.4	2.6	2.6		2.4	2.8	_	_	_	_	_
Mali	2.8	2.9	3.1	3.2	3.0	3.0	2.8	2.6	2.7	2.6	2.6
Nigeria	2.0	2.1	2.1	2.1	2.3	2.3	2.2	2.0	2.3	2.2	2.2
Senegal	3.1	3.0	3.0	2.9	2.8	2.5	2.6	2.7	3.3	3.0	2.6
Sierra Leone	2.6	2.3	2.1	2.1	2.1	2.1	_	_	_	_	_

Source: World Economic Forum

Referring to the trade cost indicator provided by the World Bank[17], a simple comparison of the average trade cost between the ECOWAS, the ASEAN and the MERCOSUR, show how far higher the costs are in Africa in comparison to the other regions. It is 2.7 and 1.3 times higher than MERCUSOR and ASEAN. Figure 8 presents how elastic the cost of trade is, as it's provided by the World Bank, to the distance separating a pair of countries. The average elasticity is around 0.7, suggesting that any increase in the distance by 1% would rise trade cost by 0.7%. However, 74% of the ECOWAS of each pair of ECOWAS members are located above the fitted trend curve, while this number is around 40% for ASEAN members. Regarding the matching issue between supply and demand in each of these RECs, the prevailing fact is that ECOWAS is lacking considerably complementarity between the structures of production and demand of each of its members, with an index around 15%. For the MERCOSUR and ASEAN, the index is well above that level.

VI. Supply Side Constraints: the Revealed Comparative advantage index analysis

The analysis of trade potential within the ECOWAS, once controlling for the quality of infrastructure and the production structure has shown how observed trade is relatively below its theoretical level, especially for small economies. Having said that, trade dynamics are much more complicated and depend on several factors ranging from short-term variables, such as macroeconomic policy or structural aspects dealing with trade facilitation initiatives or doing business climate in general. In addition, expanding trade between ECOWAS members is expected to come at the expense, at least in the short term, of classic suppliers of these countries, such as China or the United States. The competitiveness of local products are indeed a central element that determine how far ECOWAS's products can serve as a substitute for foreign products. That is why we are referring in the next section of what might be a proxy for competitiveness in ECOWAS' export fabric, such as Revealed Comparative Advantage index.

[16] 1=extremely underdeveloped, among the worst in the world; 7=extensive and efficient, among the best in the world.
[17] "This indicator provides estimates of bilateral trade costs. It is built on trade and production data collected in 178 countries. Symmetric bilateral trade costs are computed using the Inverse Gravity Framework (Novy 2009), which estimates trade costs for each country pair using bilateral trade and gross national output". (World Bank)

This indicator "*illustrates whether a country is in the process of extending the products in which it has a trade potential, as opposed to situations in which the number of products that can be competitively exported is static. It can also provide useful information about potential trade prospects with new partners*" (WITS, Trade Indicators). Therefore, countries displaying comparable RCA within the same category of product tend to trade less, whereas countries with different RCA tend to trade more. Within a regional economic community such as the ECOWAS, a country with a RCA similar to the world average will benefit more from integration in the sense that it can become the supplier of these goods instead of the world market. However, there is a risk of trade diversion since these goods are likely to be more expensive that those exported by the world market as they are not expected to be produced as efficiently as in the world market (Venables, 1998). The RCA indicator is calculated as follow:

$$RCA_{i,j} = \left(X_{i,j}/X_{i,t}\right) \Big/ \left(X_{w,j}/X_{w,t}\right)$$

Where $X_{i,j}$ and $X_{w,j}$ represents the values of export of country i of product j and values of export the world of the same product, and where $X_{i,t}$ and $X_{w,t}$ refer to the total exports of country i and the world. A value greater than one indicates that the country i displays a revealed comparative advantage in the product j, while a value less than one entails that the country i has a revealed comparative disadvantage in the product j (WITS, Trade Indicators).

Table 7 shows that revealed comparative advantages remain clustered among Food and Animal products and commodity exports (Minerals and Fuels), with the exception of Textiles and Clothing and Stone and Glass. The range of comparative advantages is relatively less concentrated for Togo and Senegal, who display RCAs for nine and eight group of products respectively, ranging from Vegetables, Food Products, and Chemicals to Textile and Clothing. Regarding Guinea and Niger, they have the strongest RCAs for Minerals with indexes ranging from 31.4 to 43.6. None of ECOWAS members has RCAs in Metals and Machinery and Electrics and only one country (Côte d'Ivoire) has a RCA in Transportation. As a result, aside from fuel products and other primary commodities like vegetables, ECOWAS's main imports such as Machinery and Electrics, Transportation, Chemicals and Metals (as shown in Table 1) originate from other countries of the world such as China and the United States. In fact, 60 percent of the top 10 products imported by the ECOWAS during the considered period come from countries outside the region who display stronger RCAs for these products.

Table 7: Revealed Comparative Advantage of ECOWAS members China and the United States with the world, 2015[18]

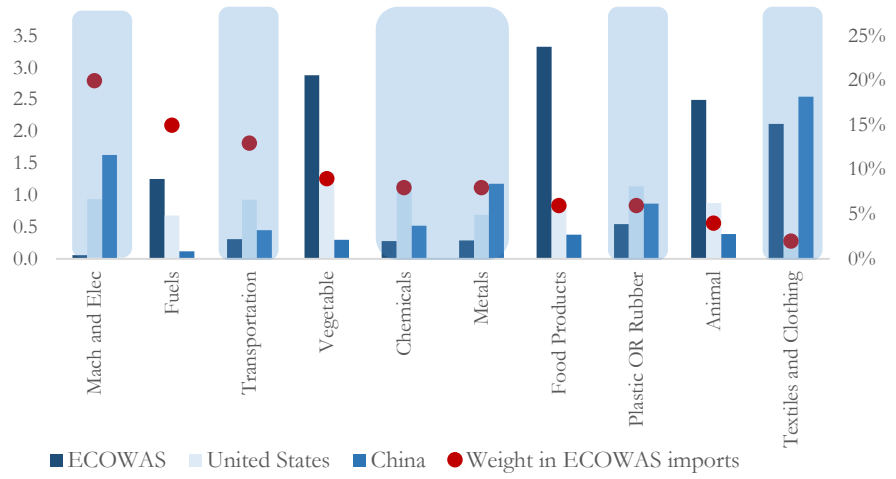
HS Classification	BEN	BFA	CPV	CIV	GMB	GHA	GIN	MLI	NER	NGA	SEN	TGO	Total*	USA	CHN
Animal	0.4	0.2	0.1	11.9	0.2	0.4	6.3	2.0	0.5	0.2	5.9	1.9	**5/11**	0.9	0.4
Vegetable	6.0	4.8	3.2	0.1	0.6	0.8	10.5	0.5	2.6	0.5	2.6	2.6	**7/11**	1.4	0.3
Food Products	0.6	0.2	14.6	5.1	6.8	0.4	3.5	0.2	1.4	0.6	3.6	3.1	**7/11**	0.9	0.4
Minerals	5.1	0.2	0.2	0.0	1.3	31.4	0.0	0.0	43.6	0.0	11.9	18.4	**6/11**	0.5	0.1
Fuels	0.4	0.0	1.7	3.6	0.0	0.0	0.3	0.1	1.8	5.8	1.4	0.1	**5/11**	0.7	0.1
Chemicals	0.1	0.1	0.3	0.0	0.1	0.0	0.4	0.2	0.0	0.1	1.1	1.1	**2/11**	1.2	0.5
Plastic or Rubber	0.1	0.0	1.3	0.1	0.5	0.6	0.5	0.1	0.0	0.3	0.4	2.9	**2/11**	1.1	0.9
Hides And Skins	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	5.9	1.0	0.1	**1/11**	0.5	2.2

[18] Latest data for Gambia is 2014, for Ghana and Mali is 2012 and for Nigeria is 2010. Not data available for Guinea-Bissau, Liberia and Sierra Leone.

Wood	0.9	0.0	0.9	0.0	1.7	3.3	1.4	0.1	0.0	0.1	0.4	1.1	**4/11**	1.1	0.8
Textiles and Clothing	9.3	3.0	0.6	0.6	0.1	0.1	6.2	2.0	0.6	0.2	0.4	2.6	**5/11**	0.4	2.6
Footwear	0.0	0.0	0.5	1.8	0.0	0.0	0.3	0.0	0.0	0.5	1.6	3.5	**3/11**	0.1	3.1
Stone And Glass	0.5	12.7	1.3	0.0	17.2	8.3	0.0	21.2	1.1	0.0	2.1	0.8	**7/11**	1.0	0.8
Metals	1.0	0.5	0.1	0.1	0.4	0.0	0.2	0.1	0.0	0.1	0.5	0.6	**0/11**	0.7	1.2
Machinery &Electrics	0.1	0.1	0.1	0.2	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.1	**0/11**	0.9	1.6
Transportation	0.8	0.1	0.2	1.1	0.0	0.6	0.1	0.0	0.6	0.1	0.1	0.3	**1/11**	0.9	0.5

*this column is interpreted as follow: for example, five countries out of eleven display a revealed comparative advantage in animal products. Source: World Integrated Trade Solution (WITS).

Figure 9: Revealed Comparative Advantages of top 10 products imported by the ECOWAS



Source: World Integrated Trade Solution (WITS).

Conclusion

The process of regional economic integration in the ECOWAS has not reached its full potential yet, as intra-regional trade remains low compared to other developing regions of the world. Stemming from empirical literature, this paper aims to analyze the potential for intra-regional trade in the ECOWAS. Two models have been estimated using the Pseudo Poisson Maximum Likelihood. The first model is standard and includes GDP for exporting and importing countries, bilateral distance, contiguity and landlockeness, while the augmented version adds infrastructure and complementary indexes. These estimations have been conducted over the ASEAN community, which display high trade integration across its members as well as the ECOWAS in order to identity the divergence between these two communities. Using the coefficients of the augmented ASEAN model that accounts for infrastructure and complementary variables, a simulation has been performed in order to predict the theoretical intra-regional exports and hence calculate the trade potential per country in the ECOWAS.

The results imply that trade dynamics between ASEAN and ECOWAS are different and show that the effort of export in ECOWAS, captured through the elasticity to export, is surprisingly higher than that of the ASEAN. In fact, in the standard version the elasticity for either the exporting or the importing country, the ASEAN outperforms the ECOWAS. However, once we control for the infrastructure and complementarity, these elasticities jumped up to a higher level for the ECOWAS, especially for the exporting country to around 0.9. The landlockness variable, capturing partially

transactions costs, is very informative in this case, as it has lost significance in the augmented gravity model, meaning that what matters the most in this case is infrastructure base and complementarity index, that allows the country to overcome geographic constrains. It happens to be that landlocked countries are just not well equipped in terms of infrastructure and/or less prone to satisfy ECOWAS' demand, as their production fabric is not matching the demand. Besides, for bilateral trade, infrastructure base and production structure matter more within the ECOWAS than the ASEAN, for both the importing and the exporting country. The availability and the quality of infrastructure could be considered as an *international or regional public good* that serves foreign companies to penetrate domestic markets. Share cost behavior within the ECOWAS is one option to consider in dealing with infrastructure lag issue.

Trade potential in the ECOWAS, when applying the same coefficients estimated for the case of the ASEAN, end up with higher untapped trade potential. Fostering regional integration is confronted with several obstacles, which lie, as demonstrated above, in the deficit in infrastructure stock and the lack of complementarity between ECOWAS members. A simple simulation shows that if ECOWAS upgrades its infrastructure base to the ASEAN level or has a complementarity index in average around the ASEAN level, it could witness a doubling of its integration rate.

Policy measures to advance regional economic integration of the ECOWAS through intra-regional trade should hence focus on the challenges regarding the lack of infrastructure on one hand and the lack of diversification and competitiveness of ECOWAS exports on the other hand. Therefore, **improving and investing in adequate infrastructure** between member countries of the ECOWAS is crucial, since improved stock of infrastructure can mitigate the geographic constrains and the high transportation costs, which leads to a greater level of intra-regional trade.

Furthermore, **developing trade complementarities** between members of the ECOWAS is found to play a crucial role in determining the intensity of bilateral trade. Indeed, economies in which demand and supply seem to match are likely to increase their trade. In addition, supply side factors related to the extent to which ECOWAS economies are likely to substitute for already foreign products pose serious challenges to the capacity of these countries to increase their integration. Revealed comparative advantage indexes display how specialized and concentrated ECOWAS countries are.

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Annex 1- Data Description

The bilateral trade data, just as the bilateral complementarity index are taken from the UNCTAD database, while nominal GDP is extracted from the World Bank Database (World Development Indicators). The infrastructure index refers to the infrastructure quality index published by the World Economic Forum (WEF) within The Global Competitiveness Report. It contains assessment of the quality and availability of transport, electricity and communication infrastructures. In fact, a survey is conducted among business leaders around the world to captures their opinions on the quality and availability of infrastructure, from which an aggregated indicator is constructed (WEF). A higher indicator means higher quality of infrastructure. The contiguity and the distance are taken from Le Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)[19].

The countries used in the gravity estimation as well as the simulation:

Table: Member countries of ASEAN and ECOWAS used in the gravity model and simulation

ASEAN members (model estimation)	ECOWAS members (simulation)[20]
Brunei Darussalam	Benin
Cambodia	Burkina Faso
Indonesia	Cabo Verde
Laos	Côte D'Ivoire
Malaysia	Gambia
Myanmar	Ghana
Philippines	Guinea
Singapore	Liberia
Thailand	Mali
Vietnam	Nigeria
	Senegal
	Sierra Leone

[19] For a detailed description of the data, see CEPII website.

[20] Infrastructure data are not available for Guinea Bissau, Niger and Togo. They were excluded out of the simulation analysis.