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Kossi Edem Baita

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IMPACT OF INFRASTRUCTURE ON TRADE: AN EMPIRICAL ASSESSMENT BY THE GRAVITY MODEL IN ECOWAS

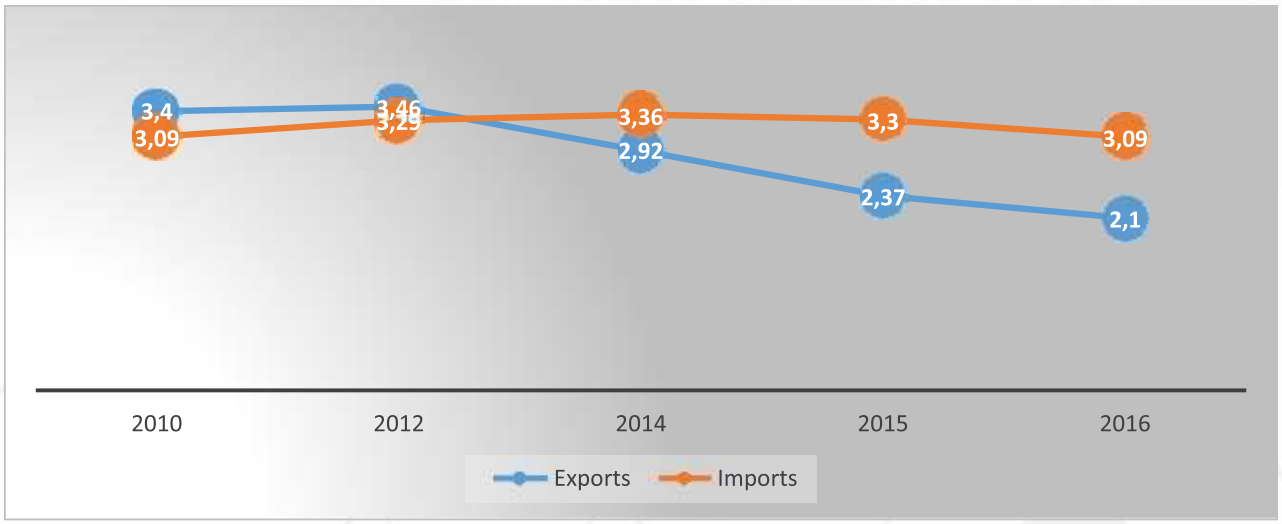
Kossi Edem Baita,
Economist & Expert in Regional Integration

ABSTRACT
Increased trade is seen as one of the channels that can boost economic growth in ECOWAS. However, we are witnessing a relative decline in intra-ECOWAS trade. This relative weakness in intra-African trade is said to be due to trade barriers and obstacles, like the quality of infrastructure and transportation costs. In this paper, research is made into understanding the impact of infrastructure quality on trade in ECOWAS countries by referring to the gravity model. Estimates show that bilateral trade increases as the quality of infrastructure improves. Also, the results show that the value of bilateral trade increases with the size of the economies. Overall, geographical and structural factors have a decisive impact on intra-regional trade.

Keywords: *Trade, infrastructure, gravity model, ECOWAS*

JEL Codes: F13, F15, N17, N77, 018, O55.**INTRODUCTION**
In the context of trade globalization, the aspiration of developing countries, particularly those in Africa, to achieve development through sustainable growth, employment creation, reduction of income inequality and poverty is linked to their interaction and integration into the world economy. The integration of the least developed countries into the global market offers the opportunity and potential for rapid growth and poverty reduction (Martinez & Poole, 2004). As a result, particular attention has been paid to trade as a real channel through which countries can interact economically. International trade theorists, particularly those from the Orthodox tradition, recognize a beneficial effect of trade and countries could benefit from their participation. Africa's share of world merchandise trade, valued in USD, fluctuated between 3.4% and 2.1% from 2010 to 2016 (see figure below). During this period, Africa's annual exports and imports have been relatively stable (around $500 billion), with imports slightly exceeding exports in recent years. The trade balance was positive until 2012 and negative until 2016 due to a decline in the value of exports.

SHARE OF AFRICA'S TRADE IN WORLD TRADE



Source: AUSTAT, 2017

Intra-African trade is very important for the economic development and integration of the continent. However, the share of intra-African trade in Africa's total imports and exports remains rather low at 13% for intra-African imports and 17% for intra-African exports over the last seven years (AUSTAT, 2017). While the value of total exports decreased, the intra-export share increased by 30% in 2016 compared to 2010. This relative weakness in intra-African trade is said to be due to trade barriers and obstacles. We can cite, for example, the quality of infrastructure and transport costs that reduce trade flows in Africa.

There is a consensus in the economics literature that improved infrastructure changes the comparative advantages of production, as it reduces production costs and increases the competitive prices of the product to be exported (Buys & al, 2006; Nordas & Piermartini, 2004; Limao & Venables, 2001). Improvements in infrastructure, both physical and non- physical, could promote trade by reducing the costs of doing business. Moreover, in the current economic environment, infrastructure-induced reductions in business costs have become relatively more important than direct policy barriers as a source of savings (Brooks & al. 2005).

There is extensive literature linking the incidence of trade costs due to poor infrastructure to the volume of trade (Lawrence, 2014; Clarke & al, 2004; Amadji & Yeats, 1995). Most of these studies show that the number of components of trade costs has a significant impact on the structure of international trade. De (2008) found that reducing tariffs and transport costs by 10% each would increase bilateral trade by about 2% and 6% respectively. Consequently, the propensity to increase the volume of trade is stronger with the reduction in transport costs than with the reduction in tariff costs. On the other hand, according to Khadaroo and Seetanah (2010), moving a firm to a labour-intensive country with poor transport infrastructure offsets any advantage that cheap labour offers.

Investing in a country's hard infrastructure has a relatively immediate effect and harder proof on economic performance compared to investing in soft infrastructure, which is more qualitative in the immediate term (Ahmad & al, 2015). Finding the right balance is the key to optimizing a country's economic performance. Given the above, the following question becomes pertinent: How does infrastructure development affect trade in sub-Saharan Africa?

Thus, the objective of this study is to determine the impact of infrastructure on trade flows in West Africa. From this main objective, we deduce the following specific objectives: (i) identify the various trade barriers in West Africa, (ii) examine intra-ECOWAS trade trends, (iii) quantify the effects of infrastructure development on trade in West Africa. In reviewing the literature, there is little work on the effects of infrastructure on trade flows in sub-Saharan Africa. From this point of view, the present work aims to fill this gap by focusing on West Africa, using the gravity model.

OVERVIEW OF THE LITERATURE

The economic literature generally shows a direct impact of transport infrastructure on trade. Investment in transport infrastructure has a direct impact on trade flows (Lawrence, 2014; Nordas & Piermartini, 2004). Port efficiency has a particular influence since the vast majority of port activity for developing countries' trade (by weight) passes through seaports. Airports and seaports can carry more goods, especially for container transport, when they are served by efficient rail and road networks. Infrastructure development beyond national borders can also have an equal effect on the length and variability of time to market as freight services between countries. This state of affairs is more justified in the case of landlocked countries and countries with a significant market share, where inland dry ports have partly evolved to absorb this lapse.

For a long time, infrastructure has played an important role in the integration of markets between countries. Unfortunately, there is little empirical work on the impact of infrastructure on trade. The realization of gains from trade liberalization will be hampered because high trade costs are a barrier to trade. The work of Anderson and van Wincoop (2004) argues that international trade costs and local distribution costs are very high and together dominate the marginal cost of production. This suggests that tariffs are no longer the sole

and main barrier to trade because of their substantial reductions over the past decades. An improvement in the quality of infrastructure is necessary to reduce business costs. Work by Aschauer (1989) examining the link between infrastructure and trade, showed a slowdown in U.S. productivity and a slowdown in infrastructure investment.

According to Brooks (2008), of all infrastructures, transport infrastructure has the most direct impact on trade. Airport and maritime infrastructure could have a significant impact on trade if served by efficient rail and road networks. In other words, a more developed transport system tends to have lower transport costs and may be able to increase business opportunities since it is more reliable and can handle more movements.

Other authors focus on access to maritime transport and the distance between major markets. The work of Limao and Venables (2001), using the gravity model on sub-Saharan African countries, confirms this argument of geography in explaining trade patterns. These authors find that the relatively low level of trade flows is largely due to poor infrastructure. This study estimated that the elasticity of trade flow concerning trade costs is about -3.0, while infrastructure differences account for 40 per cent of the variation in transport costs for coastal countries and up to 60 per cent for landlocked countries. De (2009) goes further and estimates that the cost of commercial transport would increase if the country were landlocked. Since almost all shipments from landlocked countries have to transit through neighbouring countries. This increases costs, thus multiplying transport costs. Besides, it found that commercial transport costs across South Asia are very high and vary by commodity because the region is landlocked. Landlocked countries have relatively high transport costs and trade can be facilitated by upgrading transport facilities and infrastructure.

Ramli and Ismail (2014), considering a panel data set from 1980 to 2009, found that railways and paved roads significantly reduce the costs of trade in ASEAN countries. This supports the theoretical and empirical literature that the development of basic infrastructure increases the accessibility of goods from the producer to the consumer, thereby significantly minimizing trade costs. Based on data on US imports of electrical and electronic products from Malaysia, Tham et al (2009) showed that average freight and insurance rates for all modes are higher than average tariff rates for almost all products due to the progressive liberalization of tariffs under Malaysia's World Trade Organization (WTO) commitments. The results imply that relative shipping costs significantly determine the relative quantity of exports transported by air. The relationship is negative, indicating that the higher the relative average costs of air transport compared to sea transport, the fewer exports of electrical and electronic products are shipped by air.

Almost all discussions of the contribution of infrastructure to trade take into account the state of the infrastructure and a summary description of the quality of the infrastructure. Also, most of the studies carried out only take into account transport infrastructures, and forget about telephone, electricity, etc. infrastructures, which is why this study tries to contribute to the empirical analysis by taking all these factors into account.

The contribution of this study is twofold: Firstly, the positive aspect of this research intends to enrich existing theoretical models that seek to explain the relationship between infrastructure development and trade in ECOWAS based on the gravity model. Second, the research will include a normative component providing a series of recommendations to policymakers to enable them to (i) better understand the challenges of infrastructure development as an engine of economic growth, and (ii) support their arguments and proposals in international trade negotiations at the national, regional and global levels.

METHODOLOGICAL FRAMEWORK

Theoretical framework

In this study, the gravity model was employed to analyse the data and explain the effect of the variables in this model on the volume of trade in sub-Saharan Africa. This model based on the determinants of trade flows has been used in several variants by several authors to determine trade flows between two countries. Many

authors using this model agree that the determinants of bilateral trade are distance, income levels, and country size (Rose, 2001; Feenstra, 2002; Anderson & Van Wincoop, 2004;). The application of the gravity principle to trade volumes is probably one of the most stable and robust empirical relationships in economics (Mucchielli & Mayer 2005).

In its simplest expression, the gravitational equation for any pair of countries (i, j) is as follows:

$$com_{ij} = A * dist_{ij}^{\beta_1} (y_i * y_j)^{\beta_2}$$

Where

Comij represents the value of bilateral trade between country i and country j.

Yi and yj represent respectively the Gross Domestic Products (GDP) of countries i and j; Distij measures the distance between country i and country j.

A, $\beta 1$ and $\beta 2$ are coefficients; $\beta 1$ is assumed to be negative while $\beta 2$ is assumed to be positive.

Econometric Form

The variable of interest is the quality of infrastructure, the engine of trade growth since the aim of this study is to examine the effect of infrastructure development on trade in West Africa. All other variables are control variables. The gravitation equation can be written as:

$$\ln (xi_{ij}) = \beta_0 + \beta_1 Comlang + \beta_2 comcol + \beta_3 fta + \beta_4 ldist_{ij} + \beta_5 lgdp_i + \beta_6 lgdp_j + \beta_7 lpop_i + \beta_8 lpop_j + \beta_9 trans\_infr\_i + \beta_{10} trans\_infr\_j + \beta_{11} elect\_i + \beta_{12} elect\_j + \beta_{13} overall\_i + \beta_{14} overall\_j + \varepsilon_{ij}$$

Where xij is the total exports from country i to country j.

GDPi and GDPj refer to the gross domestic product (GDP) of countries i and j respectively;

popi and popj refer to the population size of countries i and j respectively;
Distij is the relative distance between trading partners
Fta is the regional trade agreement (RTA) dummy variable, which is 1 if the trading partners are in the same RTA and 0 otherwise,
comLangij is the language dummy variable, which is 1 when the partners have a common language and 0 otherwise.
Comcolij is the common colonizer variable, it is equal to 1 if both partners were colonized by the same colonizer and 0 otherwise.
trans_infr_i and trans_infr_j refer to the transport infrastructure quality index of countries i and j respectively while;
elect_i and elect_j refer to the index of the quality of the electricity and telephone infrastructure of countries i and j respectively and,
overall_i and overall_j refer to the overall infrastructure quality index for countries i and j respectively,

εij is the error term.

Estimation Technique

Santos Silva and Tenreyro (2006) argue that it is not advisable to estimate the coefficients using a log-linear model. Instead, they suggest using a technique for estimating the pseudo-Poisson Maximum Probability (PPML). PPML is not only consistent in the presence of heteroscedasticity but also deals with null values of

the dependent variable. Estimates based on Poisson probability are consistent even if the data do not follow a Poisson distribution. This estimator thus has the advantage of being convergent in the presence of heteroscedasticity and of dealing robustly with the problem of the high concentration of zero values in the dependent variable.

Results And Discussions

The research used the gravity model to examine trade relations between ECOWAS countries and their major trading partners. Table 2 below presents the results of the estimates based on the PPML estimator. The estimation results show that the coefficients are consistent with the expected signs and are statistically significant for our variables of interest. The coefficients associated with GDP are positive and statistically significant, meaning that a larger economic space offers greater trade potential between the two countries. It also indicates that trade increases when GDP increases. Also, the coefficients associated with market size (LPOP) are positive and significant, meaning that as market size increases, so does the volume of trade between trading partners. The transport infrastructure of the importing country has a positive and significant influence on trade within ECOWAS. An increase of one unit of investment in improving the quality of infrastructure leads to an increase in trade by 2.47 points. Good road accessibility reduces restrictions on market access, reduces opportunity costs and increases the likelihood of participating in capturing the benefits of trade. This also confirms the importance of air transport as a channel for transporting goods and services between the two countries.

The electricity and telephone sectors also have an impact on the volume of trade between countries. The results of the estimates show that the higher the index of the quality of electricity and telephone infrastructure, the greater the volume of trade in the exporting country. Overall, we can retain those investments in trade-related infrastructure by taking the aggregate index (Overall) positively impact trade in ECOWAS countries. A 1% increase in infrastructure investment expenditure in ECOWAS could lead to a 10% increase in trade, all other things being equal. The results confirm the existing theoretical literature on the subject and call for an improvement in the quality of trade infrastructure in the ECOWAS region.

Table 2: Econometric results

xij	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
comlang	.1855134	.3331403	0.56	0.578	-.4674297	.8384565
comcol	-.5959008	.3972069	-1.50	0.134	-1.374412	.1826105
fta	1.341477	.2784904	4.82	0.000	.7956455	1.887308
ldist	.1157323	.0524998	2.20	0.027	.0128346	.2186301
lgdpi	.3484859	.4212169	0.83	0.408	-.4770839	1.174056
lgdpj	.5182304	.147827	3.51	0.000	.2284947	.807966
lpopi	.6755889	.1066602	6.33	0.000	.4665388	.884639
lpopj	.1215178	.0842222	1.44	0.149	-.0435547	.2865902
trans_infr_i	-1.229891	.8178518	-1.50	0.133	-2.832851	.3730695
trans_infr_j	2.471497	.4712469	5.24	0.000	1.54787	3.395124
elec_i	.0083142	.310327	0.03	0.979	-.5999156	.616544
elec_j	-.5830596	.1775828	-3.28	0.001	-.9311154	-.2350038
overall_i	.1086288	.5749745	0.19	0.850	-1.018301	1.235558
overall_j	-1.033209	.4272347	-2.42	0.016	-1.870573	-.195844
_cons	-10.51374	3.624312	-2.90	0.004	-17.61726	-3.410222

Source: Author

CONCLUSION AND RECOMMENDATIONS

For more than a decade, issues related to the quality of transport infrastructure have begun to receive more attention from international trade actors. Indeed, infrastructure represents an increasingly crucial part of international trade and investment, as developing countries will have difficulty integrating into the global economy and exporting products at comparable prices in the absence of adequate and sound infrastructure. Increased trade, especially exports, is expected to increase foreign exchange earnings, create more employment opportunities and expand international markets.

This study analysed the role of infrastructure on trade in ECOWAS using the gravity model. The model is regressed by including infrastructure variables, which are classified as physical infrastructure. The result showed that all infrastructure variables had a positive impact on the volume of exports in ECOWAS.

The results agree with previous studies and most of the documents reviewed. The results of all the regressions carried out within the framework of this analysis show that an improvement in infrastructure can enable West African trade to achieve the objectives set out in the ECOWAS vision and the African Union's Agenda 2063 as well as the Agreement on the African Continental Free Trade Area. Future studies could pay more attention to improving the trade infrastructure quality index by including aspects of non-physical infrastructure, as it could increase the volume of exports and subsequently assist political and economic decision-makers in formulating development programmes and plans to boost trade in ECOWAS.

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