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TRADING COSTS IN AFRICA: DOES INTERNATIONAL SUPPLY CHAIN CONNECTIVITY MATTER?

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Since Samuelson's seminal 1954 contribution, trade costs are recognized as an important determinant of country's ability to take part in Regional and Global Value Chains. Previous empirical studies, however, have analyzed the determinants of trade costs in the context of developing countries in general and have ignored the specific case of African countries. This paper use gravity model to assess the impact of international supply chain connectivity performance on trade costs. The model includes 169 countries over the 2006-2015 periods. Our results suggest that, the improvement of the African countries' international supply chain connectivity performance reduces trade costs in the region. This result hold when we estimate intra-African and extra-African trade costs separately suggesting that a country's ability to reduce trade costs and trade globally depends on its connectivity on international supply chain. The results also suggest that, deep regional integration within Africa, contiguity, colonial links, common language and common currency affect trade costs negatively.

Keywords: Trade Costs, Economic Integration, Gravity Model, Africa
JEL Classification: F15, O24, CO1, O55

1. INTRODUCTION

"Trade costs reduce trade flows in the same way that an iceberg melts while moving through the sea," Paul A. Samuelson (1954)

The importance of trade costs as a factor determining the competiveness of a country is developed in the literature. High trade costs disconnect the economy from international production networks and trade flows of goods and services. Anderson and

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Van Wincoop (2003) broadly define trade costs as all costs incurred in getting a good to a final user other than the marginal cost of producing the good itself. These include, transportation costs (both freight costs and time costs) policy barriers (tariffs and NTBs), information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs and local distribution costs (wholesale and retail).

African countries are among those having the highest trading costs. The average ad valorem equivalent for the period 1996-2009 was 250% in Sub-Saharan Africa and 200% in Latin America and Caribbean (Figure 1). Many factors justify this high level of trade costs in Africa (Njinkeu and Powo Fosso, 2006; Yang and Gupta, 2007; Njinkeu et al., 2009). The infrastructures are very weak. The transport infrastructures like roads, railway, ports and airports are often in a poor state and contribute to high transport cost. Deficiencies in logistics and telecommunications services also contribute to low level of African trade flows.

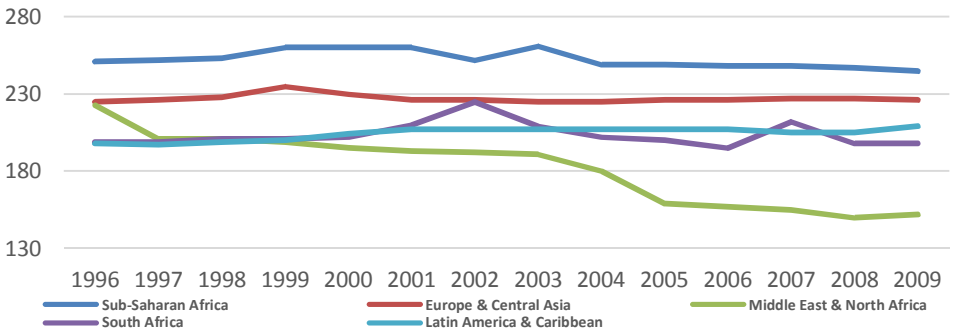

Figure 1. Trade Costs for Manufactured Goods in Developing Counties (1996-2010)

Source: Author, based on UNESCAP-World Bank Trade Costs Database.

African customs administrations are often inefficient. Traders are subject to uneven bureaucratic treatment by the customs administration and other nontariff measures (NTMs). The African customs delays are, average, longer than those of the rest of the world (World Bank, 2017). Other exogenous factors like geography also constrain the intra-continental trade. Many African countries are landlocked[1] and depend on their neighbours to export goods to reach overseas markets. All these hurdles raise the trade cost in Africa and highlight the need to better understand the main drivers of trade costs.

According to Mesut et al. (2018), the African Union Action Plan for Boosting

[1] The fifteen landlocked African countries are: Botswana, Burkina Faso, Burundi, Central African Republic, Chad, Ethiopia, Lesotho, Malawi, Mali, Niger, Rwanda, Swaziland, Uganda, Zambia and Zimbabwe (CEA and UA, 2010).

Intra-African Trade and the Establishment of a Continental Free Trade Area (CFTA) may not offer great opportunities if it doesn't accompanied by the measures to reduce trade costs. Then understanding the sources of trade costs in Africa can help to determine the types of policies that can be implemented to reduce them in order to improve the integration of African countries at regional and global level.

Despite the abundant literature on the determinants of trade flows in Africa (Yang and Gupta, 2007; Njinkeu et al., 2009), little is known about the determinants of trade costs. Apart from the study of Arvis et al. (2013) on the developing countries in general, there are no studies which address the issue of African countries in particular. The objective of this study is to analyze and evaluate the effect of international supply chain connectivity performance on trade costs regarding the intra-African trade and the trade between African countries and the rest of the world.

In light of this, the study proceeds as follows. The next section brief the literature review, followed by a discussion of the modeling issues. Section 4 outlines the results and Section 5 concludes with a discussion of policy implications.

2. LITERATURE REVIEW

Extensive literature reviews can be found in Portugal and Wilson (2009), Novy (2013), WTO (2015) and Kabir et al. (2017). We summarize briefly the sources and the effects of trade costs, and discuss the empirical studies.

2.1. What are the Sources of Trade Costs?

The importance of trade costs has been highlighted by Samuelson (1954). On his seminal paper, he describes trade costs as a friction associated with trade. According to Samuelson (1954), "trade costs reduce trade flows in the same way that an iceberg melts while moving through the sea". Trade costs have a deleterious effect on a country's trade performance. They reduce the amount that exporting countries export and importing countries import. The price of the commodity from exporting country is higher than that of the importing country due to trade costs. Consequently, consumers in importing country experience lower consumer welfare through the higher prices of imported goods while producers face lower productivity because of their inputs and the high cost of final goods (Lisinge, 2005; Moisé and Sorescu, 2013). Trade costs can be analyzed through many dimensions. One strand of the literature distinguishes two main categories of trade costs sources (Figure 2):

- The exogenous factors which has nothing to do with the public policies of the trade partners (distance, geography of trading partners, common language, common history and the participation in the same economic community etc.);

- The endogenous factors (or policy factors) which has to do with the public choices of the trade partners (custom environment, infrastructure environment and institutional environment, tariffs and nontariff measures etc.).

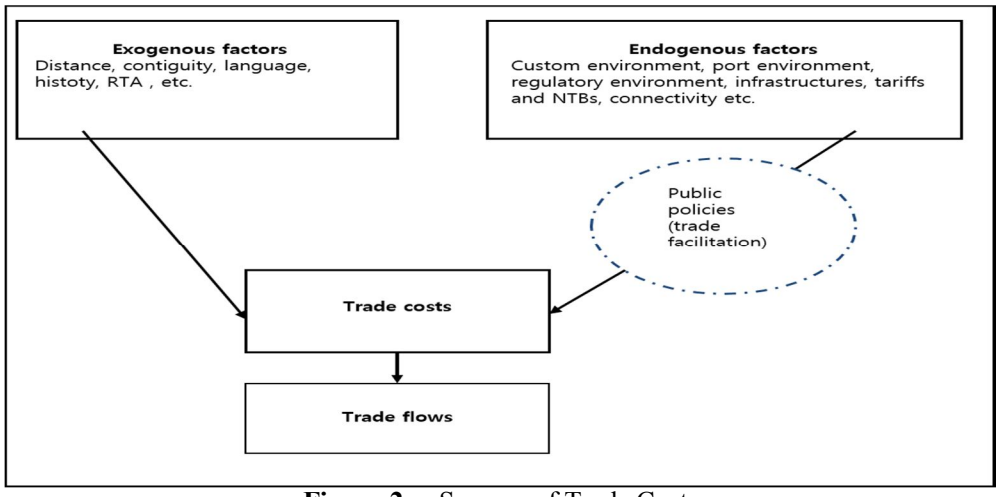

Figure 2. Sources of Trade Costs

Source: Author's work based on the literature.

Another strand of literature (Anderson and Van Wincoop, 2003; Novy, 2013) distinguishes between border-related costs and behind the-border (BTB) costs. While the first refer to trade policy barriers (tariffs and NTMs), the second refers to measures that are not a directly relate to trade policies but that can be reduced through other public policies such as social infrastructures and institutions.

2.2. What are the Effects of Trade Costs?

The theoretical analysis of the effects of trade costs is based on theories of international trade (WTO, 2015). The analysis ranges from comparative advantage theory of trade to Global value chain.

2.2.1. *The Effects of Trade Costs in the Theory of Comparative Advantage*

One of the fundamental differences between the Ricardian model and the Heckscher-Ohlin model is that, gains from trade result because countries are assumed to possess different relative productivities (Ricardo, 1817) in the former, and endowments of factors of production such as labour, capital and land (Heckscher, 1949; Ohlin, 1934) in the latter. In these two models, countries specialize in goods in which they have a

comparative technological advantage relative to other countries or in goods that use their abundant factors of production more intensively. Irrespective of their differences, trade costs work through the same mechanism: the relative prices. Trade costs drive a wedge between the relative prices faced by the trading countries. These relative prices move closer to the initial autarky price, reducing the scope for specialization and trade. By reducing trade costs, country leads to greater specialization in the sector that uses the abundant factor more intensively (WTO, 2015).

2.2.2. *The Effects of Trade Costs in "Iceberg" Model of Samuelson*

In the "Iceberg" model of Samuelson (Samuelson, 1954), inefficient trade procedures increase the costs of trade and drive a wedge between the price received by the producer of the good and the price paid by the consumer. Although it was originally designed to model transportation costs, the main results will continue to hold even in cases where trade costs are additive instead. In this framework, the implementation of trade facilitation by improving trade procedures would reduce trade costs and then the price wedge between producers and consumers.

2.2.3. *The Effects of Trade Costs in New Trade Theory*

In contrast to the previous theories which focus on inter-industry trade, the "New Trade Theory" (Krugman, 1979; 1980) provides a rational for intra-industry trade. In this monopolistic competition framework, the effect of trade costs is driven by the consumer's demand for variety and the increasing returns to scale. Inefficient trade procedures that lead to higher trade costs increase the price of foreign varieties. As a consequence, consumers in the foreign country substitute away from foreign varieties towards domestic varieties and loose the welfare of both foreign and domestic consumers.

2.2.4. *The Effects of Trade Costs in the "New Trade Theory"*[2]

The heterogeneous firms theory (Melitz, 2003), distinguish two trade costs: the fixe trade costs and the variable trade costs. The variable trade costs are costs that vary with the scale of trade. Fixed trade costs are costs that have to be incurred independently of the volume of exports (for example, a firm deciding on whether to enter a particular market might have to incur a cost to learn about the trade procedures in that country). In this framework, firms differ in productivity and there are two productivity thresholds: the minimum level needed for a firm to survive, and the level at which a firm starts exporting part of its production. The main result of the heterogeneous firms literature is that any reduction in trade costs leads into good reallocation of resources between firms.

[2] Also call "heterogeneous firms theory", see Melitz (2003) for more information.

The resources are released from the least productive firms and reallocated to the most productive firms. Consequently, the productivity of economy as all increase.

2.2.5. *The Effects of Trade Costs in the Supply Chain Models*

Contrary to traditional trade theory that assumes that each final good is produced entirely within one country, supply chain models assume that the production of final goods is made in many different countries (Baldwin and Venables, 2013). In this framework, trade costs are cumulated and amplified through the different stages of the value chain. This imply that trade costs have a far greater deterrent effect on global value chain-related trade than on trade involving only final goods (Yi, 2010). When trade costs are very high, supply chain trade is not worthwhile and it is difficult for developing countries to participate in Global Value Chains (GVCs). Then, any reduction in trade costs positively affects the expansion of GVCs and thereby allowing more developing countries to participate in global value chains GVCs.

2.3. Previous Empirical Research

Empirically, the literature distinguishes two approaches to analyze trade costs: the bottom up approach and the top down approach.

The bottom up approach is developed by Anderson and Van Wincopp (2003) who use the gravity model to determine the fundamental factors that have a significant impact on bilateral trade flows. The authors find that trade costs represent an equivalent tax of 170% for industrialized countries. The border-related trade barriers, wholesale and retail distribution costs and transportation costs are mentioned as the main factors that affect negatively bilateral trade flows.

Limao and Venables (2000), and François and Manchin (2007) find that others endogenous factors such as infrastructures, custom and institutional environment are also a major factors of trade costs. The results of the study of UNCTAD (2013) confirm that poor infrastructures contribute to high transport costs and blocks trade expansion in Africa. On average, transport costs in Africa represent 7.7 per cent of total export value, which is twice the world average of 3.7 percent. For instance, in Central Africa, transporting one ton of merchandises along the route from Douala (Cameroon) to N'Djamena (Chad) costs 0.11 dollar US per kilometer, which is more than twice the cost in Western Europe (0.05 dollar US), and more than five times the cost in Pakistan (0.02 dollar US). Portugal and Wilson (2009) shows in their study that a good custom environment is helpful to reduce the time needed to clear custom and trade costs. The delays in custom procedures increase costs, not only in terms of opportunity costs, but also represent additional costs such storage and wage charges. According to Lisinge (2004), African customs delays are, on average, longer than those of the rest of the world.

The top down approach is developed by Novy (2013) and extended by Arvish et al.

(2013). This approach infers trade costs indirectly from trade data. After building a bilateral trade costs of many countries, the trade costs indicator is in turn use in the gravity model in order to estimate the effect of policy factors and exogenous factors. Using the top down approach, Arvish et al. (2013) find evidence that maritime transport connectivity, logistics performance, market entry barriers and regional agreement are very important determinants of trade costs.

3. MODELING ISSUES

In this section, we present the computation of bilateral trade costs before the econometric model.

3.1. Deriving Bilateral Trade Costs in General Equilibrium

Since the seminal work of Jan Tinbergen in 1962, the gravity model has been widely used to estimate the impact of a variety of policy issues, including bilateral trade flows and currency unions (Frankel and Rose, 2002; Wilson et al., 2003; Kabir and Salim, 2010). Nevertheless, the first important attempt to provide a theoretical basis for gravity models was the work of Anderson (1979). By assuming Armington hypothesis, he derives the gravity equations in the context where consumers have preferences defined overall the differentiated product. On the base of multi-country general equilibrium framework, Anderson and Van Wincoop (2003) derive the following gravity equation:

$$X_{ij} = \frac{Y_i Y_j}{Y^w}\left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma}, \quad (1)$$

where X_{ij} denotes nominal exports from country i to country j, Y_i and Y_j are the exogenously given GDP's of the two countries respectively, Y^w is the world GDP, and σ is the elasticity of substitution across goods ($\sigma > 1$). The terms Π_i, P_j represent price indices[3] in countries i and j respectively while the expression t_{ij} denotes bilateral trade costs. To obtain bidirectional gravity equations, Novy (2013) suggests to multiply the equation (1) by the trade flows in opposite direction, X_{ji}.

$$X_{ij}X_{ji} = \frac{Y_i Y_j}{Y^w}\left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma}\frac{Y_j Y_i}{Y^w}\left(\frac{t_{ji}}{\Pi_j P_i}\right)^{1-\sigma} = \left(\frac{Y_i Y_j}{Y^w}\right)^2\left(\frac{t_{ij}t_{ji}}{\Pi_i P_i \Pi_j P_i}\right)^{1-\sigma}. \quad (2)$$

The expressions $\Pi_i P_i$ and $\Pi_j P_j$ can be deriving from (1) as follow:

[3] Anderson and Van Wincoop (2003) call these price indices multilateral resistance variables.

$$\Pi_i P_i = (X_{ii}/Y_i/Y_i/Y^w)^{1/\sigma-1}, \quad (3)$$

$$\Pi_j P_j = \left(X_{jj}/Y_j/Y_j/Y^w\right)^{1/\sigma-1}. \quad (4)$$

Substituting the equations (3) and (4) in equation (2) and rearranging yields:

$$\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}} = \left(\frac{X_{ii}X_{jj}}{X_{ij}X_{ji}}\right)^{1/\sigma-1}. \quad (5)$$

By taking the average mean of the expression (5) and deducted one, we get the expression of trade costs as tariff equivalent.

$$\tau_{ij} = \left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{1/2} - 1 = \left(\frac{X_{ii}X_{jj}}{X_{ij}X_{ji}}\right)^{1/2(\sigma-1)} - 1. \quad (6)$$

Then, trade costs is express as the geometric average of international trade costs between two countries i and j relative to domestic trade costs within each country. This trade costs expression is the departure of our econometric model.

3.2. The Econometric Model

Following Novy (2013) and Arvis et al. (2013), our regression equation takes the form:

$$\begin{aligned}\ln tradecost_{ijt} = {} & \beta_0 + \beta_1 \ln dis\tan ce_{ijt} \ln GDP_{it} + \beta_3 \ln GDP_{jt} + \beta_4 contiguity_{ij} \\ & + \beta_5 commonofficiallanguage_{ijt} + \beta_6 commonethonlanguage_{ijt} \\ & + \beta_7 colony_{ijt} + \beta_8 commoncurrency_{ijt} + \beta_9 landlocked_{it} \\ & + \beta_{10} landlocked_{jt} + \beta_{11} rta_{ijt} + \beta_{12} \ln iscc_{ijt} + \beta_{13} custom_{it} \\ & + \beta_{14} custom_{jt} + \beta_{15} businesscost_{it} + \beta_{16} businesscost_{jt} + \delta_i + \lambda_t + \varepsilon_{ijt}. \end{aligned} \quad (7)$$

The parameters β_0 represents the intercept while the parameters β_i's ($i \neq 0$) are the coefficients; δ_i is the country-specific effect (reporter or partner) and λ_t, the time-specific effect. The parameter ε_{ijt} is the error term that is assumed to be normally distributed with mean zero. Our principal variable, the ISCC index measures the supply chain connectivity performance of a country (the higher the value, the better the connectivity). The definitions of variables and data sources are presented in annex (Table A1).

The study includes the total of 169 (49 African countries) countries over the 2006-2015 periods.

4. RESULTS AND DISCUSSION

4.1. Descriptive Analysis

In this section, we analyze the magnitude of trade costs in African region and the connectivity performance before showing the correlation between the two. As Figure 3 shows, the extra-regional trade costs are remarkably high. It represents above 200% of the value of goods. But, there are large differences between countries. The highest trade costs countries are Rwanda, Burundi, Lesotho, Botswana, Central African Republic and Swaziland; in contrast, South Africa, Egypt, Morocco, Mauritania and Seychelles enjoy the lowest trade costs.

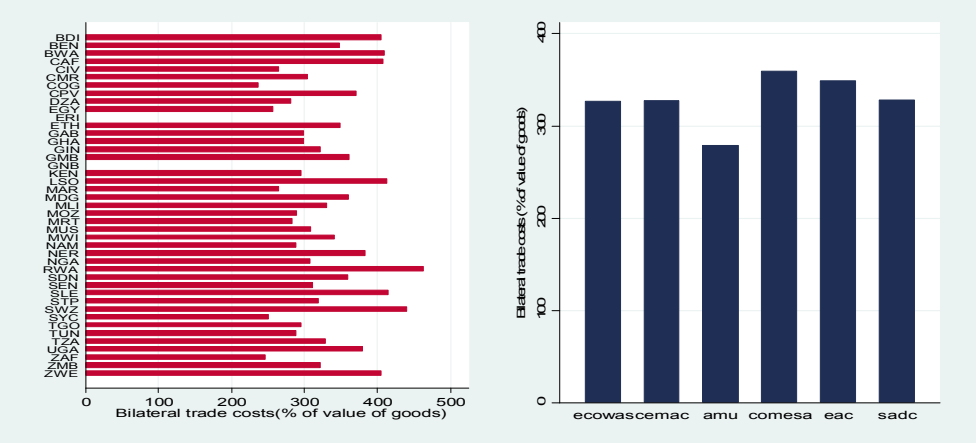

Figure 3. Extra-Africa Trade Costs (2006 - 2015)

Source: Author, based on UNESCAP-World Bank Trade Costs Database.

Not less importantly, the intra-regional trade costs are also high. As Figure 4 shows, the bilateral trade costs between Soudan, Madagascar, Ethiopia, Central African Republic, Uganda and their African partner are more than 300 percent. For example, the ad-valorem tariff equivalent of bilateral trade costs between Soudan and its African partners is more than 400 percent. At sub-regional level, the Common Market for Eastern and Southern Africa (COMESA), the Central African Economic and Monetary Community (CEMAC) and the Economic Community of West African States (ECOWAS) experience the high bilateral trade costs. The high bilateral trade costs can explain why these three communities are among which intra-regional trade is low.

Compared to the previous regions, the bilateral trade costs are relatively low for the Arab Maghreb Union (AMU), the East African Community (EAC) and the Southern African Development Community (SADC) intra-regional trade.

The high extra and intra- African trade costs can be explained by many factors among which the quality of supply chain connectivity. Figure 5 shows that trade costs

and supply chain connectivity are strongly negatively correlated. This finding supports the basic intuition that countries improvement of supply chain connectivity quality reduce trade cost.

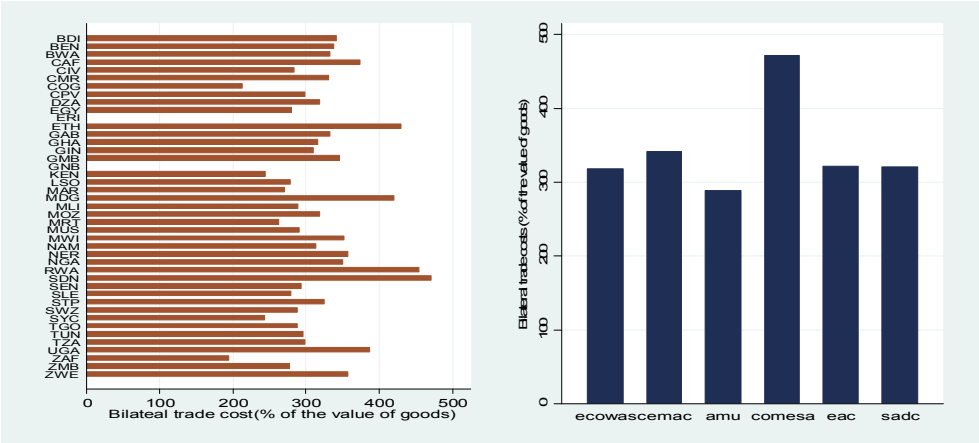

Figure 4. Intra-Africa Trade Costs (2006-2015)

Source: Author, based on UNESCAP-World Bank Trade Costs Database.

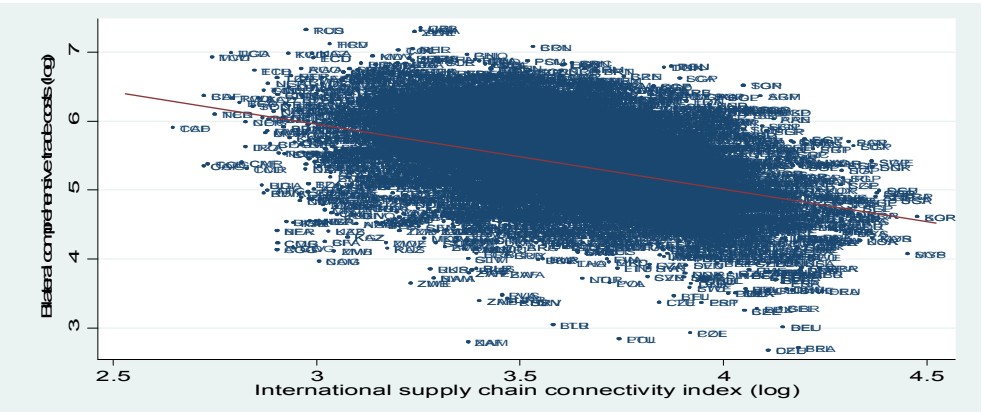

Figure 5. Trade Costs and Supply Chain Connectivity

Source: Author, based on UNESCAP-World Bank Database.

However, with the basic analyses conducted so far, it is impossible to determine the main characteristics which influence trade costs. To address this issue, we conduct a econometric analysis that allows us to assess how changing one factor influences trade costs.

4.2. Econometric Analysis

Table 1 and Table 2 show the estimation results. The estimations are corrected for heteroscedasticity. In Table 1 we estimate the determinants of trade costs between African countries and the rest of the world. Table 2 reports the results of the bilateral trade costs between African countries. The results show that all trade cost variables have the expected signs based on the gravity model literature. The geographical variables like distance and contiguity appear to be significant with expected sign.

Table 1. Trade Costs between African Countries and the Rest of the World

	(1)	(2)	(3)	(4)
GDP_reporter	0.021	0.010	0.009	0.002
	(0.005)	(0.002)	(0.003)	(0.001)
GDP_partner	-0.004	-0.002	-0.001	-0.000
	(0.003)	(0.002)	(0.002)	(0.001)
Distance	0.107	0.184	0.173	0.310
	(0.011)***	(0.005)***	(0.005)***	(0.014)***
Contiguity	-0.219	-0.491	-0.505	-0.491
	(0.044)***	(0.018)***	(0.018)***	(0.041)***
Common lang_off	-0.086	-0.087	-0.082	-0.160
	(0.015)***	(0.006)***	(0.006)***	(0. 014)***
Colony	-0.634	-0.421	-0.456	-0.268
	(0.038)***	(0.020)***	(0.020)***	(0.041)***
Common currency	-0.363	-0.345	-0.347	-0.302
	(0.037)***	(0.019)***	(0.019)***	(0.019)***
Business cost_reporter	0.004			
	(0.001)***			
Business cost_partner	0.006			
	(0.001)***			
Custom_reporter	-0.004			
	(0.002)*			
Custom_partner	-0.014			
	(0.002)***			
LSC_reporter	0.000			
	(0.001)			
LSC_partner	-0.006			
	(0.001)***			
RTA	-0.314	-0.263	-0.250	-0.168
	(0.017)***	(0.009)***	(0.009)***	(0.015)***
ISCC_reporter		-0.316		-0.111
		(0.009)***		(0.023)***
ISCC_partner		-0.500		-0.245
		(0.007)***		(0.027)***
ISCC			-0.912	
			(0.012)***	
Cons	4.181	6.638	7.042	6.638
	(0.238)***	(0.124)***	(0.124)***	(0.124)***
Fixe effecs	None	None	None	Yes
Adj R-squared	0.3	0.4	0.4	0.4
Observtions	5,302	26,548	26,548	26,548

Note: All non-dummy variables are in logs. The notations * p<0.1; ** p<0.05; *** p<0.01 denote significance at 10, 5 and 1 percent levels, respectively. Standard deviation in parentheses.

Source: Authors' calculations.

For geographical contiguity for example, we find that countries that share a common border see their trade costs reduced by 11 percent[4] than those that do not. The geographical distance is positive and statistically significant. The estimated coefficient is consistent with empirical findings which is included between 0.7 and 1.5 (WTO, 2012). According Arvis et al. (2013), distance not only induces transportation costs, but also creates barriers to information and reduces the probability that a trade connection between two countries will take place.

The impact of speaking the same official language, and sharing colonial ties on international trade are negative and statistically significant, in line with the literature. Sharing colonial ties reduce trade cost by 47 percent. Similarly, the countries that share the same official language see their trade costs reduced by 8 percent than those that do not.

Not surprisingly, the policy variables such as RTA and Common currency have expected sign and are significant. Countries that are members of an RTA exhibit trade costs that are around 27 percent than those that are not. Sharing the same currency reduce trade costs by 3 percent.

Another important results are related to our supply chain connectivity variables. All have the expected sign and are statistically significant. The Business cost (cost to start business), positively affects trade costs. The custom efficiency and Shipping Connectivity (LSC) affect negatively trade costs. These results suggest that the improvement of countries' supply chain connectivity is a key factors for reducing trade costs among countries. Result for the International Supply Chain Connectivity (ISCC) index is also interesting. It is negative and significant. This imply that the improvement of ISCC reduce trade costs (by 1 percent for reporter and 3 percent for partner). This result is conform with the WTO (2015) suggestion that trade facilitation performance of a country can be effective levers in reducing trade costs.

However in equation 2 reporter and partner ISCC index could perfectly collinear with the fixed effect that is why we create in new variable equal to the geometric average of the two index, which will by definition vary bilaterally. Column 3 presents results from this approach. Again, we find that policy variable ISCC is a significant determinant of trade costs: improving the average of two countries' ISCC index (reporter and partner) by one point decreases trade costs by about 91 percent.

The OLS estimation (column 1, 2 and 3) could suffer from heterogeneity bias in the gravity model context (Cheng and Wall, 2005). Trade costs between any pair of countries are likely to be influenced by certain unobserved individual effects. If these effects are correlated with the explanatory variables, this will lead to pooled OLS estimates being biased. Column 4 accounts for this possibility by including reporter and partner fixed effects. The coefficient of ISCC index of reporter and partner decrease but remain significant.

[4] To quantifying the effect of some geographical and historical variables like contiguity, we compute the semi-elasticity as follow: $exp(-0.219) - 1$.

Table 2. Trade Costs between African Countries

	(1)	(2)	(3)	(4)
GDP_reporter	0.002	0.001	0.001	0.000
	(0.003)	(0.002)	(0.002)	(0.000)
GDP_partner	0.002	0.001	0.001	0.000
	(0.003)	(0.002)	(0.002)	(0.000)
Distance	0.122	0.175	0.175	0.336
	(0.009)***	(0.004)***	(0.004)***	(0.004)***
Contiguity	-0.166	-0.471	-0.470	-0.259
	(0.041)***	(0.017)***	(0.017)***	(0. 021)***
Common language	-0.094	-0.079	-0.078	-0.184
	(0.012)***	(0.005)***	(0.005)***	(0.007)***
Colony	-0.634	-0.469	-0.468	-0.217
	(0.025)***	(0.013)***	(0.013)***	(0.019)***
Common currency	-0.322	-0.316	-0.314	-0.086
	(0.036)***	(0.017)***	(0.017)***	(0.017)***
Business cost_reporter	0.004			
	(0.001)***			
Business cost_partner	0.004			
	(0.001)***			
Custom_reporter	-0.005			
	(0.002)***			
Custom_partner	-0.005			
	(0.002)***			
LCI_reporter	-0.005			
	(0.001)***			
LCI_partner	-0.005			
	(0.001)***			
RTA	-0.308	-0.243	-0.243	-0.171
	(0.013)***	(0.007)***	(0.007)***	(0.007)***
ISCC_reporter		-0.431		-0.1845
		(0.005)***		(0.011)***
ISCC_partner		-0.431		-0.184
		(0.005)***		(0.011)***
ISCC			-0.891	
			(0.009)***	
Cons	4.561	7.057	7.191	7.057
	(0.165)***	(0.090)***	(0.091)***	(0.090)***
Fixe effects	None	None	None	Yes
Adj R-squared	0.3	0.3	0.3	0.7183
Observtions	9,246	45,822	45,822	126,334

Note: All non-dummy variables are in logs. The notations * p<0.1; ** p<0.05; *** p<0.01 denote significance at 10, 5 and 1 percent levels, respectively. Standard deviation in parentheses.

Source: Authors' calculations.

5. CONCLUSION AND POLICY IMPLICATIONS

The purpose of this paper has been to assess the impact of international supply chain connectivity performance on trade costs. For this aim, we use gravity model. The model includes 169 countries over the 2006-2015 periods. Our descriptive analysis shows the importance of trade costs for the participation of African countries in international value Chains. The trade costs remain high in Africa. But, large differences exist within the region. The extra-regional trade costs and intra-regional trade costs are remarkably high and are above 400 percent in terms of ad-valorem tariff equivalent in some African countries like Rwanda, Swaziland, Lesotho. At sub-regional level, three economic communities (COMESA CEMAC ECOWAS) experience the high bilateral trade costs.

Our analysis also find that there is a strong correlation between trade costs and supply chain connectivity. This result is confirmed by the econometric analysis. In fact, the improvement of International Supply Chain Connectivity negatively and significantly affects trade costs. This result holds when we estimate intra-African and extra-African trade costs separately suggesting that the improvement of countries' supply chain connectivity is a key factors for reducing trade costs among countries. In particular, the trade facilitation aspects such as custom efficiency, maritime connectivity, negatively affect trade costs. In addition, trade policy variables such as regional trade agreement plays an important role in reduction trade costs in Africa.

The policy implications of our results for African countries are double. The first is to confirm that improving country's international supply chain connectivity through trade facilitation reforms, reduces trade costs and increases trade. The second is to highlight the need for reinforcing regional integration.

APPENDIX

Table A1. Definitions of Variables and Data Sources

Variables	Definitions	Sources
Trade costs	Geometric average of international trade costs between two countries i and j relative to domestic trade costs within each country (see box 1).	UNESCAP-World Bank Trade Cost Database
GDP	Gross Domestic Product (constant, 2000)	World Bank, World Development Indicators (WDI)
Distance	Great circle distance between the two pr	CEPII
Landlocked	Dummy variable equal to unity if countries i and j are both landlocked.	CEPII
Contiguity	Dummy variable equal to unity if countries i and j share a common land border.	CEPII
Common Currency	Dummy variable equal to unity if countries i and j share the same currency.	CEPII
Common Official Language	Dummy variable equal to unity if countries i and j share a common ethnic language.	CEPII
RTA (Regional Trade Agreement)	Dummy variable equal to unity if countries i and j are members of the same RTA.	WTO
Custom	Logistics performance index: Efficiency of customs clearance process (1=low to 5=high)	World Bank
business cost	Cost of business start-up procedures (% of GNI per capita)	World Bank, Doing Business
LSC	Liner Shipping Connectivity index captures how well countries are connected to global shipping networks. The index generates a value of 100 for the country with the highest average index in 2004.	United Nations Conference on Trade and Development (UNCTAD)
International Supply Chain Connectivity (ISCC) index	The Index measures the overall trade facilitation performance of a country along the international supply chain. The index is based on the trading across border (TAB) indicators from the World Bank Doing Business Report and the Liner Shipping Connectivity Index (LSCI) of UNCTAD. The index ranged from 0 to 100; the higher the value, the better the connectivity.	UNESCAP

Source: Author's compilation based on the literature.

Table A2. List of Countries

African Countries	Partners
Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad Congo, Côte d'Ivoire , Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe	Afghanistan, Albania, Antigua and Barbuda, Argentina, Armenia, Austria, Australia, Azerbaijan, Bahamas, Bahrain, Bangladesh , Barbados, Belarus, Belgium, Belize, Bhutan, Bolivia, Bosnia and Herzegovina, Brazil, Brunei, Bulgaria, Cambodia, Canada, Chili, China , Colombia, Comoros, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, , Estonia, Dominican Republic, Ecuador, Faeroe, Fiji, Finland, France, Georgia, Germany, Greece, Grenada, Guatemala, Guyana, Netherlands, Honduras, Hungary, Hong Kong, Iceland, India, Indonesia, Iraq, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Republic of Korea, Kiribati, Kuwait, Kyrgyzstan, Lao PDR, Latvia, Lebanon, Lithuania, Luxembourg, Macedonia, Malaysia, Maldives, Malta, Marshall Islands, Mexico, Micronesia Fed. Sts, Moldavia, Mongolia, Nepal, Netherlands, New Zealand, Nicaragua, Norway, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, United Kingdom, Russia, Samoa, El Salvador, Saudi Arabia, Singapore, Slovakia, Slovenia, Spain, Sri Lanka, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sweden, Switzerland, Suriname, Syrian Arab Republic, Tajikistan, Thailand, Trinidad &Tobago, Tonga, Turkey, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Uzbekistan, Vanuatu , Venezuela, Vietnam, Yemen.

Table A3. Countries by RTA

ECOWAS	CEAMAC	AMU	COMESA	SADC
Côte d'Ivoire Nigeria, Ghana, Burkina Faso, Benin, Cape Verde, Côte d'Ivoire, Mali, Senegal, Gambia, Guinea, Guinea-Bissau Niger, Sierra Leone, Togo	Cameroon, Congo, Gabon, Central African Republic, Chad, Equatorial Guinea	Algeria, Morocco, Mauritania, Tunisia	Egypt, Mauritius, Malawi, Zimbabwe, Zambia, Kenya, Madagascar, Uganda, Sudan Djibouti Eritrea , Ethiopia	Botswana, Lesotho Madagascar, Malawi, Mozambique, Namibia, Mauritius, Rwanda Seychelles South Africa, Swaziland Tanzania, Zambia, Zimbabwe

Note: AMU is Arab Maghreb Union.

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