Borders effects in intra-industry trade within Africa

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Abstract

The study aims to analyze the border effect on intra African trade. We apply the gravity model based on the monopolistic competition model of trade introduced by Krugman (1980) in order to investigate the impact of border effects on intra African trade. The contribution of this paper to the related literature is twofold: on the one hand this paper is the first to use industry-level data in order to investigate intra -Africa trade flows to estimate a gravity model. On the other hand, it is the first to introduce consumer preference in order to explain intra African trade; previous studies on the border effect in the African countries have only considered non tariff barriers (NTB) as proxy to border effect. The study used data on 26 manufactured industries of 39 African countries over the period 1980 to 2006. This allows estimating a gravity model with about 30 000 observations. The first econometric results suggest that African industries trade more within their national border than with other African countries. When controlling for certain sub-region SADC came out to be the only one significant. The study found also that "*final goods*" faced heavily border effects than the "*capital goods*".

Keyword: Intra-African Trade, Monopolistic Competition Model, Border Effect

JEL Classification: F12, F14, F15

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1. Introduction

The last few years have seen the revival of interest in the determinants of long term growth in Africa. Amongst other regional integration remain the key strategies that will enable the continent to maximize the welfare of their nations this by boosting the intra African trade (i.e. trade among African countries). The relevance of Africa's regional integration on promoting intra African trade is obvious because regional integration is the major factor[3] that can boost intra African trade by fast-tracking the move toward a free trade area in Africa.

The emphasis on intra African trade by international organisations such as the World Bank, African Development Bank (AfDB), the economic commission for Africa (ECA) in their joint project called "Assessing Regional Integration in Africa (ARIA)" show the importance of intra African trade in order to improve African's welfare and economic growth. As pointed out in ARIA IV's final report, Intra African trade will help government in Africa to accelerate the transformation of their fragmented small economies, expand their markets, and widen the region's economic space for production and trade amongst other factor. Intra-African trade can also help the continent's industries to become more competitive by creating economies of scale, establish and strengthen product value chains and facilitate the transfer of technology and knowledge via spillover effects. It can also spur infrastructure development and attract foreign direct investment. Bearing this in mind, one might argue that the expansion of intra-African trade is a key to accelerating economic growth on the continent.

In the literature, numerous studies have been conducted in this regard. Even though trade integration might lead to gains[4] or losses[5] depending on each country within regional economic communities (REC), the literature supports the view that successful trade integration can enhance economic opportunities in Africa. Although intra-African trade is not the absolute condition for economic development, it is quite important. It is true that Africa cannot stop trading with the outside of the world, but the continent need to trade more between each in order to be less vulnerable to external shock. The recent global economic and financial crisis, which of course was not caused by African countries, had an adverse impact on the continent economic performance[6]. This impact could have been less if the intra-African trade was as significant as their trade with the rest of the world (Glick and Rose, 1999; Krugman, 1979).

Furthermore, the numerous small sizes of economies in Africa and the fact that many countries are landlocked (15 out of 52 African countries are landlocked) make it even more urgent for African countries to accelerate trade integration in order to boost intra African trade. This is because African countries will face tremendous challenges trading individually to the global world than if there were integrated as one big economy. Thus, there is a need to emphasize studies on intra-African trade in order to assess the main factors that impinge its development and to address them.

[3] African development Bank 2012
[4] increased openness (albeit regional) has positive effects on growth in per capita income (Sala-i-Martin and Barro, 1997)
[5] The preferential nature of regional trade agreement (RTAs) may actually impede the global process of trade liberalization Bhagwati (1992), or even reduce global welfare through inefficient trade flows that divert, rather than create, trade (Venables, 2003)
[6] African Union, zero draft October 2011

Although the regional trading block has been one of the major developments in recent year in Africa, the countries still do not trade much with each other within the continent, which result of the low level of intra-African. In 2009, intra-African trade accounted for about 10 percent of the continent's total trade (AfDB, 2012). This low level of trade between African countries reflects the failure of the continent to implement the regional integration agreements designed to eliminate all tariffs and non-tariff barriers. In addition, there are other factors which might hinder the growth of intra-African trade this includes among other the economic diversification, the conflict between African countries, the lack of infrastructure etc.

Previous studies which assessed the potential and performance of REC in Africa generally conclude that the experience of this latter has been disappointing in Africa when it comes to promote intra-Africa trade (Alemayehu and Kibret, 2008; Longo and Sekkat, 2001). It is crucial to understand the reason for this weak performance and determine whether it is attributable to the inherent characteristics of African economies or to other factors. Recently, research found that border effects might have a significant impact on trade, however very few studies have been conducted in this regard in Africa, this study intend to fill this gap by using the monopolistic competition model of trade, in order to investigate the effect of border on intra-African trade. From our acknowledge, this paper is the first to use industry level data in order to assess intra-African's trade. The remainder of the paper is organized as follow: Section II reviews the literature as well as existing studies on border effects. The outline of the methodology is highlighted in section III, section IV details the data used and data source. Section V interprets the results and finally, section VI concludes the paper with some few recommendations.

2. Literature review

The literature on border effect dates back long before, but was only revived after the seminal contribution of McCallum (1995).The underlying idea of the border effect is to measure the (inverse) level of trade integration between two countries, comparing their bilateral trade with the trade flow within their own borders. The estimated border effect shows the magnitude trade within countries is greater than international trade because of cross-border measures such as tariffs, NTBs, and all other factors that might impede trade. Thus, from this perspective, the border effect represents an indirect way of measuring overall market access issues.

McCallum (1995) studied trade flows between Canadian provinces and US states and found that the Canadian trade was heavily biased toward trade within its national borders. McCallum (1995) shows that, even when controlling for the impact of bilateral distance and region size, borders sharply reduce trade volumes between countries. According to the latter, for equal sizes and distances, regions trade much more between themselves if they are not separated by a national border. Similarly to McCallum, other studies which include Wei (1996), Helliwell (1996), Hillberry (1998), Anderson and Smith (1999), Head and Mayer (2000) also conducted research on whether similar border effects exist for trade between other country pairs.

However the lack and/or limited data are the main problem when studying the border effect, as pointed out in the literature. Wei (1996) came out with a new approach in order to solve the problem of lack of data, the author proposed a way to tabulate trade flow within countries as well as the internal distance. According to Wei (1996), trade flows within a country must be equal to the difference between total production and export to foreign countries and the internal distance is equal to half of the distance from the economic center to the border. When a country has a land border with a neighbour, Wei (1996) uses a quarter of the distance to the center of the nearest neighbouring country. Finally, Wei (1996) calculates the distance between the economic centers of a country pair, using the great-circle formula.

Using his approach on a study on OECD countries, Wei found that the border effect is smaller than the one of McCallum (1995). Using the same data set as Wei (1996), Helliwell (1997) found that the border effect is closer than the one of McCallum. Wei's approach was heavily criticised especially his measurement of the internal distance, which is supposed to be overestimated according to the literature and therefore translates into an inflated border effect. In order to tackle these problems researchers have developed two new ways to measure internal distance which are: Firstly, the internal distance based on the geographic area of the country. This purpose of this approach is to approximate the distance between firms and consumers within a country. Learmer (1996) was the first to introduce this approach, Head and Mayer (2000) also used this approach. Secondly, the internal distance is based on actual data on geographical distribution of the economic activity within a country. Proponent of this approach is Wolf (1997).

More recently Combes et al. (2003) came out with additional explanation on why border effects still matter even when controlling for distance is more problematic. Combes et al. (2003) argued that the literature has to focus on four major explanations: The first explanation is technical. Borders might appear to matter in trade because the estimated equation is not well specified and/or the covariates used are imprecisely measured or badly constructed. The model specification explanation has been recently investigated by Anderson and Van Wincoop (forthcoming), whose work shows that estimating structural parameters from the theoretical gravity equation can reduce border effects. Head and Mayer (2002) focus on how mis-measurement in distances can also inflate the estimated border effect and propose a theory-based distance variable that reduces the estimated impact of borders.

The second and perhaps most straightforward explanation is the protection (barriers to trade). If the countries in the sample considered still have significant (and not controlled for) formal barriers to trade such as tariffs or non tariff barriers, then the impact of those trade impediments is going to show up as a negative effect of the border on trade flows. Wolf (1997 and 2000) was the first to provide an indirect empirical test for the validity of the trade barriers explanation. The idea is that if national border effects are related to trade barriers, then those border effects should vanish when considering trade between and within regions inside a country. For those purposes, he uses trade flows between and within American states where the “standard” trade barriers are absent. He finds that US states borders have an impact that is less important than for international trade but still not negligible, suggesting

that there exists a minimal level of market fragmentation even within a nation as integrated as the United States.

Thirdly the transaction costs due to the use of different currencies have recently been proposed as a plausible explanation. The seemingly robust (although controversial) finding of Rose (2000) that monetary unions would triple bilateral trade flows, provides a potential cause for trade border effects. The fact that nations are almost by definition monetary unions could explain the seemingly excessive trade taking place inside their borders. Parsley and Wei (2001) and Taglioni (2001) provide some empirical support for this hypothesis, showing that exchange rate volatility explains a significant part of the border effect.

The last possible explanation has to do with the home bias in consumer or firm preferences, which would lead to the following plausible explanation to the impact of borders: People may have a higher valuation for the goods produced locally simply because they are more familiar. This increases the demand for these goods and consequently the observed intra-regional flows. In addition to the effect of distance, this creates a significant discontinuous drop in the flows when they cross the border. These Armington (1969) type home biased preferences can be easily introduced in monopolistic competition models to derive a structural specification of the gravity theory including border effects.

As pointed out by Helble (2007), the different methods to approximate internal distance show that until today there has been little consensus among trade economists on how to measure correctly internal distance. This dissent is very troublesome, since the estimated magnitude of the border effect is very sensitive to the value of the assumed internal distance.

Having reviewed the salient theories underlying the border effect on trade, it is important for this study to review some significant research that has been conducted in the field. Building on work by McCallum (1995) recent research has used different econometric methodologies and data sets to assess impact of border effect on trade. Without criticizing them, this study will list and group them according to their sample of country. For every group, the data, period, dependent variables, independent variables and econometric models will be discussed, with a few remarks on each. It is worth noting that, few studies have been conducted on border effect in Africa (see table 1 below). Studies conducted in Africa generally used the traditional gravity model (Agwara 2012; Xiaohua and Qui, 2012) and the data used are country data (data per country). The period covered by these studies is 1995-2008 and the mainly investigated either eastern or southern African countries. They mainly used dummy variable as proxy of border effects except for study conducted by Xiaohua and Qui, 2012 who used frequency index and coverage ratio. The findings from these studies suggested that the border effect is not that significant in African, except for the study of Versailles (2012) who found a small significance of border effects.

Studies conducted in developed countries, however, used new gravity model such as the monopolistic competition model introduced by Krugman, Tobit procedure and so on. Unlike studies conducted in Africa, these studies used industry level data for the period 1976-2002. The data usually used in this field are recent, this is due to the lack of data, even in recent studies such as the one of by Xiaohua and Qui, 2012; or Olper et al. (2002). The dependant variable mainly used was bilateral trade except the study of Helble (2007), and the

exogenous variables always include, amongst other variables commodity price, production, wage, preference for home produced goods, migrant (Olper et al.,2008). Referring from these studies, it shows that elements linked to information-related costs and consumer preferences matter a great deal in explaining the magnitude of border effects (Olper et al, 2008). Head and Mayer (2000), found that that border effects are significant and mostly and driven mostly by consumer preference than formal trade barriers. Chen (2004) found that controlling the relative prices might decrease the size of border effects and that technical barrier to trade and product-specific information costs increased border effects.

Unlike previous studies conducted in this regard in Africa, our study intends to follow the Head and Mayer approach, by using the monopolistic competition model and industries data in order to investigate the border effect in Africa.

Table 1: Empirical studies on border effect

Author	Countries	Time period	Method	Dependent Variables	Explanatory variables	Proxies of border	Results
Agwara (2012)	Eastern and southern Africa	2008	Traditional gravity model	Export	GDP, distance, contig, common colony, adjacent, common languages, landlocked	Dummy=1if there is trade 0 otherwise	Border effect is not significant
Versailles (2012)	Eastern Africa	2004-2008	Level regression to test the LOP	Price	Dist, NTB, tariffs real exchange rate, ,	Dummy variable	Border effect is significant but small
Xiaohua and Qui (2012)	Developed and developing countries	1995-2008	Gravity model	Export	GDP, Dist, dummies (contig, common language, colony, and history)	Technical trade barrier (frequency index and coverage ratio)	TBT has more effect on developed countries than developing ones
Studies conducted in other countries							
Head and Meyer (2010)	European union	1976-1995	Monopolistic competition model	Bilateral trade	Bilateral distance, production, price, language	Is a function of consumer preference and NTB	Border effect is significant but smaller the one of McCallum. border effects are more linked to variety in tastes than to formal barriers to trade
Combes et al (2012)	94 French regions (France)	1978-1993	Modified model based on monopolistic competition	Bilateral trade	wage, production, transport cost, contiguity, network level	ratio of intra-regional trade over inter-regional trade	border effects can be explained by the composition of local labour force in terms of birth place (social networks) and by inter-plants connections (business networks)
Helble (2007)	Germany and France	2002	Traditional gravity model	Export	Distance, border, dist* border, currency, adjac, day (quality of business infrastructure),	Dummy variable	Germany the border effect has been decreasing over the past eight years. German economy seems to be better integrated in the EU market than its French
Chen (2004)	7 EU countries	1996	Gravity model	Bilateral trade	Distance, adjacent, production, preference for home produced goods	Antilog of home produced goods	Controlling for relative prices decreases the size of border effects. Technical barriers to trade and product-specific information costs increased border effects
Alessandro Olper and Valentina Raimondi (2008)	13 developed countries	1996-2001	structural' gravity-like model	Bilateral trade	Distance, ratio production, ratio price, languages, contiguity, bilateral exchange of printed books, migrant	Antilog of a country –group dummy	elements linked to information-related costs and consumer preferences matter a great deal in explaining the magnitude of border effects.

3. Model

We follow the Head and Mayer (2000) approach of including border effects into a monopolistic competition model. Therefore, we use a fairly broad specification of preferences. The utility of the representative consumer in country i depends on the quantity of each variety h consumed from each country j. Representing the quantity consumed with c and the preference weight with a, the constant elasticity of substitution utility function is given by:

$$U_i = \left(\sum_{j=1}^{N} \sum_{h=1}^{n_j} (a_{ij} c_{ijh})^{\frac{\sigma}{\sigma-1}} \right)^{\frac{\sigma}{\sigma-1}} \quad (1)$$

While the implied budget constraint is

$$Y_i = \sum_{j=1}^{N} \sum_{h=1}^{n_j} p_{ijh} c_{ijh} \quad (2)$$

We may simplify the consumer optimization problem by assuming that all quantities of the varieties imported by country i from country j are symmetric. Then, we shift to the following optimization problem.

$$\text{Min} \quad \sum_{j=1}^{N} n_j p_{ijh} c_{ijh} \quad \text{s.t.} \quad \left(\sum_{j=1}^{N} n_j (a_{ij} c_{ij})^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} = U_i$$

After some algebra manipulation, one may obtain the following expression of bilateral imports

$$m_{ij} = \frac{n_j p_{ij}^{1-\sigma} a_{ij}^{\sigma-1}}{\sum_{k=1}^{N} n_k p_{ik}^{1-\sigma} a_{ik}^{\sigma-1}} m_i \quad (3)$$

A gravity equation may be derived from this expression. As the number of symmetric varieties is not observed, we may eliminate n_j and n_k in equation (3) by substituting them from equation

$$v_j = q p_j n_j \quad (4)$$

Where v_j denotes the value of production in country j, q represents the quantity produced by each firm and p_j denotes the mill price of each variety. Considering the determination of delivered prices, p_{ij} and of preferences, a_{ij} we assume that the price paid by consumers in country i for products of country j is a multiplicative function of the mill price p_j, distance d_{ij}, and Non Tariffs Barriers (NTBs). Furthermore, we assume constant ad valorem NTBs of

γ for all cross-border trade. We define B_{ij} as a dummy variable taking a value of one for $i \neq j$ hence we obtain

$$p_{ij} = (1 + \gamma B_{ij}) d_{ij}^{\delta} t_{ij}^{\rho} p_j \quad (5)$$

With $t_{ij} = (1 + \tau_{ij})$

Consumer preferences consist of a stochastic component ε_{ij} and a systematic preference for home-produced goods (or aversion to foreign-made goods) of α. Moreover, we hypothesize that a common language mitigates this home bias and therefore posit the following equation for preferences:

$$a_{ij} = \exp[\varepsilon_{ij} - (\alpha - \lambda L_{ij} - \mu E_{ij} - \theta C_{ij} - T'_{ij}\emptyset) B_{ij}] \quad (6)$$

where L_{ij} takes the value of one for pairs of countries that share a common official language, and zero otherwise; E_{ij} takes the value of one when a language is spoken by at least 9 % of the population in both countries i and j and $C_{ij} = 1$ if i and j had a common colonizer after 1945. T_{ij} depicts a vector of contiguity dummy and of indicator variables taking the value of one when both countries i and j pertain to regional groupings like SADC, ECOWAS, and COMESA while $\emptyset$ is the corresponding vector of parameters. Substituting for a_{ij}, p_{ij} and n_j in equation (3) and taking logs we obtain the formulation of the gravity equation:

$$\begin{aligned} \ln m_{ij} = \ln m_i + \ln v_j - (\sigma - 1)\delta \ln d_{ij} - (\sigma - 1)\rho \ln t_{ij} - \sigma \ln p_j - I_i \\ - (\sigma - 1)[\alpha - \lambda L_{ij} - \mu E_{ij} - \theta C_{ij} - T'_{ij}\emptyset + \ln(1 + \gamma)] B_{ij} + (\sigma - 1)\varepsilon_{ij} \end{aligned} \quad (7)$$

Where I_i depicts the Head and Mayer (2000) importer's "inclusive value" defined as follows:

$$\begin{aligned} I_i = \ln \left(\sum_{k=1}^{N} \exp[\ln v_k - \sigma \ln p_k + (\sigma - 1)(\delta \ln d_{ik} - \rho \ln t_{ij} \right. \\ \left. - [\alpha - \lambda L_{ij} - \mu E_{ij} - \theta C_{ij} - T'_{ij}\emptyset + \ln(1 + \gamma)] B_{ij} + \varepsilon_{ik}] \right) \end{aligned}$$

The inclusive value captures the impact of the full range of potential suppliers to a given importer by taking into account their size, distance and relative border effects. There is several problems in estimating the influence of I_i (Head and Mayer, 2000). Firstly, it relies on parameters that are already in the equation to be estimated. Moreover, the I_i term is supposed to convey features of all possible origin countries for the product. To sidestep those problems we set $j = i$ in (7) to obtain an expression for $\ln(m_{ij})$ .Then, subtracting $\ln(m_{ii})$ from $\ln(m_{ij})$ one obtains

$$\ln\left(\frac{m_{ij}}{m_{ii}}\right) = \ln\left(\frac{v_j}{v_i}\right) - (\sigma-1)\delta \ln\left(\frac{d_{ij}}{d_{ii}}\right) - \sigma \ln\left(\frac{P_j}{P_i}\right) - (\sigma-1)\rho \ln t_{ij} - (\sigma-1)[\alpha + \ln(1+\gamma)]$$

$$+(\sigma-1)\lambda L_{ij} + (\sigma-1)\mu E_{ij} + ((\sigma-1)\theta C_{ij} + (\sigma-1)T'_{ij}\emptyset + \varepsilon_{ij} \qquad (8)$$

With the error term $\varepsilon_{ij} = (\sigma-1)(\epsilon_{ij} - \epsilon_{ii})$

In other words, according to (8) the log of odds ratios is expected to increase with the log of ratio of exporter to importer with the fact that both importer and exporter share common languages and had a common colonizer after 1945 and to decrease with the logs of relative distance, $\ln\left(\frac{d_{ij}}{d_{ii}}\right)$, tariffs $\ln(1+\tau_{ij})$ and relative price, $\ln\left(\frac{P_j}{P_i}\right)$. The intercept in (8) clearly captures the impact of NTBs (γ) and home bias (α) as in Head and Mayer (2000). In this paper we estimate this intercept globally and for each industry. We will assess the part of the border effect caused by home-bias in a future contribution. We will also check the evolution on those borders as it may give a clear indication of whether trade integration increases within Africa or not.

Equation (8) implies unit elasticity on relative production; thus it may be rewritten as

$$\ln\left(\frac{m_{ij}}{m_{ii}}\right) - \ln\left(\frac{v_j}{v_i}\right) = -(\sigma-1)\delta \ln\left(\frac{d_{ij}}{d_{ii}}\right) - \sigma \ln\left(\frac{P_j}{P_i}\right) - (\sigma-1)\rho \ln t_{ij} - (\sigma-1)[\alpha + \ln(1+\gamma)]$$

$$+(\sigma-1)\lambda L_{ij} + (\sigma-1)\mu E_{ij} + ((\sigma-1)\theta C_{ij} + (\sigma-1)T'_{ij}\emptyset + \varepsilon_{ij} \qquad (9)$$

Imposing unit elasticity on relative production helps addressing two different econometric issues: first, output and trade are jointly determined in equilibrium (Harrigan, 1996; Head and Mayer, 2000). This entails an endogeneity problem. Moving relative production in the left-hand side as in (9) is a way to handle this simultaneity issue without resorting on instrumental variables. This strategy may address another problem: measurement error for production. As production information may be inexact especially for developing countries in Africa, we may obtain biased coefficients estimates.

4 Data

In this paper we use trade and production data from the CEPII's[7]. This database proposes bilateral trade, production and protection figures in a compatible industry classification for developed and developing countries. It covers 26 industrial sectors in the ISIC Revision 2 (International Standard Industrial Classification) from 1980 to 2006. We restrict our analysis to the trade flows between African countries. The list of African countries considered in our analysis is listed in Appendix A.

We obtained production price indexes from the CEPII's database (TradePrice). This database provides aggregated and sectoral import and export price data for different

[7] TradeProd database (http://\\www.cepii.fr/anglaisgraph/bdd/TradeProd.htm) (De Souza et al. 2012)

industries according to the ISIC Revision 2 Classification, covering the period 1995-2004. The TradePrice database provides several indexes: Laspeyres and Paasche indices but also Fisher and Tornqvist indices, in both chained and fixed-base forms (Gaulier et al, 2008). To extend the countries and industries coverage, we use the Chained Tornqvist index.

Considering now the distances measures, the measurement of distance in general and particularly the way we measure intra-national versus international distances is a critical issue in the empirical implementation of the gravity model implied by the aforementioned models. Wei (1996) mentioned that the magnitude of the border effects can be strongly impacted by the method of computing a country's distance from itself. If internal distances are over-evaluated, then holding international distance constant, the negative effect of distance will be underestimated as the cost of shipping a good within the same country becomes closer to the cost of shipping it to abroad (Head and Mayer, 2000).

Bilateral information on the prevalence of common languages, contiguity and distances are obtained from CEPII's database (GeoDist). Four different measures of distance are computed in this database: the simple distance (between the most populated cities), the distance between capitals, the weighted distance (the weight considered is the population of each city[8], and the weighted distance computed with a CES distance function. Information about tariffs was also computed from the same database CEPII's under Tradeprod.

The study also create dummies variables in order to control certain sub-region this include southern African Development community (SADC), economic community of central African (ECCA), economic community of west Africa (ECOWAS), West African economic and monetary union (UEMOA) and common market for eastern and southern Africa.

5. Results

5.1 The general level of border effect in Intra-African trade

We start with an estimation of the magnitude of the border effect in intra-African trade by a regression imposing a common set of coefficients on the 26 industrial sectors of the sample; the results are reported on table 2 below.

The first fifth columns are estimations of equation (8). In column 1 the study uses OLS method, and from column two to five, Heckman two stages procedures were used but with different distance measurement in each column. Since distance is a very important factor when studying border effects as mentioned in the literature review, the study undertakes to uses four different types of distances measurement in order to see their impact on border effect.

According to equation (8), bilateral trade flow is supposed to: increase with the ratio of production, increase with the fact the two countries speak the same languages, increase if 9% of the population of two countries speak the same ethic language, increase with the proximity (contiguity), finally increase with the fact two countries have the same colonizer,

[8] The formula is given in Head and Mayer (2000), p. 293

and decrease with the ratio of distance, price, tariffs, and finally with the border effect which is the intercept.

Table 2: border effects in Intra African trade 1980-2006 averages, commons coefficients regression

Dependant variable ln(partner importer/internal flow importer country)						
	OLS	Heckman two stages procedures				
	1	2	3	4	5	6
Border	-7.4529*** .2438	-7.0398*** 0.3267	-6.574*** 0.3032	-7.0378*** .2878	-6.1152*** .3370	-7.239*** 0.2997
Ln.rel. production	.7527*** .0179	0.7378*** .01965	0.7413*** .02062	.7562*** .01926	0.7429*** 0.0182	/
Ln.rel. distance	-.1990*** .0656	-.0531 .1012	-.09771 .10998	-0.1954* .1109517	-0.2078** 0.1032	-0.8087*** 0.1046
Ln.rel. price	.0426 .0975	-0.0396 0 .1070	-0.10165 0.1054	-.0245 .1081548	-0.0619 0.1107	-0.0507 0.1132
Ln.tariff factor	-.3652*** .0476	-.3707*** .0476	-0.3633*** .04731	-.33897*** .0478215	-0.3588*** 0.0472	-0.3362*** .04937
Contiguity	1.7948*** .1676	1.7787*** .1675	1.5471*** .1715467	1.6165*** 0.1679	1.4589*** .1720572	1.3597*** .1726
Common languages	.0.6532*** .1363	.6450*** .1360	0.5733*** 0.1363	0.6110*** 0.1360	0.5366697 0.1365218	0.7243*** 0.1401
Common ethnic languages	0.5748*** .1226	.5485*** .1231445	0.5075*** 0.1229	0.5543*** 0.1225	.5195788 .1224656	.6473*** .1263
Common coloniser	.4634*** .1177	0.4883*** .118211	0.5277*** 0.1165	0.5026*** 0.1167	0.4350138 0.1181389	0.2468*** 0.1189
Mill ratio	/	-0.5120** 0.2703	-0.7323*** 0.2648	-0.3264 0.2705	-0.6484*** 0.2636	0.8505*** 0.2667
N	2423	16362	16362	16362	16362	16362
R^2 adjusted	0.4995					
RMSE	2.3476					
Number of censored obs		13939	13939	13939	13939	13939
Number of uncensored obs		2423	2423	2423	2423	2423
Column (1) ,(2) and (6) use distance between the most populated mains cities (pop, km), (3) distance between capitals, column (4) uses weighted distance (the weight considered is the population of each city) and (5) weighted distance computed with a CES distance function. (***), (**), (*) show significance at 1%, 5% and 10%. Robust standard errors in parentheses						

Using the OLS method, the study found that all the variables are similar in terms of the signs as predicted by the theory and that all the variables are highly significant (significant at 1%) except the relative price. The border effect heavily affect trade in Africa by -7.45 compared to - 2.75 found by Head and Mayer (2000) in developed countries and -5.97 found by Jose et al (2012) in the whole world (José et al, 2012 include both developed countries, developing countries in other region and developing counties in Africa). The coefficient of the border found shows that industries in Africa trade more within their national border than with other African countries. The coefficient of contiguity is very high 1.79 which means the closer are two countries the more they trade.

The study later implement the Heckman two stages procedure which accounts for the zero-valued trade observations discarded using traditional OLS methods. In order to implement the Heckman two step procedures, the study first estimate a probit regression whereby the dependant variable was an indicator for positive trade between two countries. The set of explanatory variables include in the probit equation were the level of exporter's piece, production and distance in addition to the relative values. As argued by Head and Mayer (2000) and Xiaohua and Qiu (2012), Language effects could not be included in the probit equation because countries with a common language have positive trade in every industry. Thus from the probit equation, the study generate the inverse of Mill ratio that was included in the original specification. The result of the probit regression is not reported in this study.

Result of Heckman two stages procedures are reported in column (2),(3),(4) and (5) Similarly to the OLS result, the coefficient are the same as predicted by the theory except the relative price which is still not significant. The mill ratio is significant throughout except in column (4). The Heckman procedure accounts for 16362 observations against 2423 observations with the OLS. The border effect coefficient is lower with Heckman than with OLS, the difference in term of the coefficient between the two method used, result of the Heckman selection correction, because Heckman consider the zero trade. The border effect varies according to the distance considered as mentioned in the literature. The study later imposes the unit elasticity in order to control for production error, which is quite obvious because data on small and medium enterprise might not have been taken into consideration. The result is reported in column 6, the border effect is still lower compare to the OLS, but the distance effect becomes higher as well as the common languages and the common ethnic languages. The other variables become lower and significant except the price, which still not significant. It worth to note that the sign of the mill ration does matter, what is important is the significance, the significance of the mill ration means that the sample selection is not biased and it is better to use Heckman than OLS.

5.2 The border effects when controlling for certain sub-region in Africa (Table 3)

When controlling for certain sub-region in Africa, we found the sign of the variables are similar than the theory, unlike the previous table (table 2), the relative price is significant. The coefficient of determination (R^2) is higher in table 3 than table 2, as well as the coefficient of the variables include in the model. The border effect becomes higher -7.97 (against 7.45 in Table 2) when using the OLS and varies when using the Heckman two stages procedure. SADC is the only sub-region which is significant in the OLS. The mill ratio is not significant, which means result in column 2,3,4,5 are not relevant, the study should rather stick with the OLS result.

When the study impose the unit elasticity, result in column 6 shows that the mill ratio becomes highly significant and the border effect also increase from -7.95 with OLS to -8.47. however the SADC is the only region which is significant using the OLS and the Heckman. When we compare the border effect is SADC only the study found that it changes slightly in column 1 and 6, from -6.31 with OLS compared to -6.44 with Heckman. Since border effect can only be seen when member within a regional and or continent trade amongst themselves, from our result one might state that trade within SADC member are consistent

compare to other African region. This is in line with Cassim (2001) who found in his study that intra SADC trade is not low by international standards and that it actually exceeds its potentials.

Table 3: border effects in Intra African trade 1980-2006 averages, commons coefficients regression (when controlling for certain sub-regions)

Dependant variable ln(partner importer/internal flow importer country)						
	OLS	**Heckman two stages procedures**				
	1	**2**	**3**	**4**	**5**	**6**
Border	-7.9560*** 0.2540	-7.8967*** 0.3365	-7.6775*** 0.3210	-8.1377*** .3053	-7.4086*** 0.3702	-8.4711*** 0.3455
Ln.rel. production	0.7951*** 0.0179	0.7930*** 0.0197	0.7947*** 0.0206	0 .7903*** 0.0191	0.7809*** 0.0182	/
Ln.rel. distance	-0.2188*** 0.0666	-0.1988* 0.1002	-0.2174*** 0.1074	-0.1492 0.1089	-0.1706* 0.1021	-0.6898*** 0.0930
Ln.rel. price	-0.1700* 0.0999	-0.1811 0.1078	-0.2076** 0.1051	-0.1511*** 0.1091	-0.1721 0.1102	-0.2312** 0.1128
Ln.tariff factor	-0.2247*** 0.0498	-0.2259*** 0.0499	-0.2257*** 0.0498	-0.2109*** 0.0502	-0.2269*** 0.0499	-0.2102*** 0.0509
Contiguity	1.4556*** 0.17110	1.4541*** 0.1707	1.3523*** 0.1730	1.5318*** 0.1706	1.4145*** 0 .1744	1.2585*** 0.1743
Common languages	0.3249*** 0.1376	0.3249* 0.1372	0.3047*** 0.1374	0.3372*** 0.1373	0.2904** 0.1379	0.3495*** 0.1403
Common ethnic languages	0.7418*** 0.1210	0.7375** 0.1218	0.7062*** 0.1223	0.7306*** 0.1217	0.7003*** 0.1221	0.8744*** 0.1239
Common coloniser	0.8240*** 0.1204	0.8260*** 0.1203	0.8500*** 0.1192	0.8404**** 0.1203	0.7839*** 0.1227	0.6781*** 0.1224
SADC	1.6436*** 0.1529	1.6383** 0.1538	1.5566*** 0.1556	1.5530*** 0.1556	1.4901*** 0.1574	2.0330*** 0.1530
ECOWAS	0.3351 0.3990	0.3292 0.3992	0.4209 0.3904	0.5040*** 0.3917	0.2505 0.4022	0.3975 0.4128
UEMOA	0.0176 0.7227	0.0220 0.7209	-0.1042 0.7176	-0.0730 0.7204	0.1159 0.7229	-0.0483 0.7402
COMESA	-0.1588 0.1429	-0.1565 0.1428	-0.1298 0.1427	-0.1106 0.1450	-0.1113 0.1438	-0.1855 0.1465
CEMAC	-0.3749 0.5794	-0.3709 0.5780	-0.3519 0.5770	-0.2827 0.5782	-0.3123 0.5776	-0.5133 0.5955
Mill ratio		-0.0712 0.2655	-0.17893 0.2626	-0.0371 0.2662	-0.2652 0.2599	1.0983*** 0.2548
N	2423	16362	16362	16362	16362	16362
R^2 adjusted	0.5230					
RMSE						
Number of censored obs		13936	13936	13936	13936	13936
Number of uncensored obs		2423	2423	2423	2423	2423

Column (1) ,(2) and (6) use distance between the most populated mains cities (pop, km), (3) distance between capitals, column (4) uses weighted distance (the weight considered is the population of each city) and (5) weighted distance computed with a CES distance function. (***), (**), (*) show significance at 1%, 5% and 10%. Robust standard errors in parentheses

5.3 The border effect by sector.

The study split the industries into two, *Capital goods* are industries producing capital goods and *final goods* are industries producing final goods. By definition capital goods are any tangible assets that an organization uses to produce goods or services such as office buildings, equipment and machinery. Consumer goods are the end result of this production process. The list of industries producing capital and capital goods are reported in appendix B. the result of the estimation is reported in table 4 below.

Table 4: border effects in Intra African countries 1980-2006 averages: Capital goods vs capital goods

Dependant variable ln(partner importer/internal flow importer country)						
	Capital Goods			**Consumer goods**		
	(2)	**(5)**	**(6)**	**(2)**	**(5)**	**(6)**
Border	-6.3079*** (0.3701)	-5.6430*** (0.4565)	-5.9135*** (0.3845)	-8.1055*** (0.4589)	-7.026*** (0.4707)	-8.7339*** (0.4773)
Ln.rel. production	0.7106*** (0.0262)	0.7218*** (0.0248)	/	0.7554*** (0.0291)	0.7569*** (0.0270)	
Ln.rel. distance	-0.0388 (0.1102)	-0.1991* (0.1156)	-0.5309 (0.1044)***	-.11030 (0.1345)	-0.2911** (0.1337)	-0.6246*** (0.1270)
Ln.rel. price	-0.2156 (0.1431)	-0.1958 (0.1428)	-0.3421 (0.1473)	0.0349 (0.1454)	0.0199 (0.1486)	-0.0362 (0.1538)
Ln.tariff factor	-0.3772*** (0.0738)	-0.3629*** (0.0734)	-0.4490*** (0.0776)	-0.2814*** (0.0631)	-0.2733*** (0.0626)	-0.2769*** (0.0648)
Contiguity	1.4142*** (0.2380)	1.1280*** (0.2481)	1.1713*** (0.2490)	2.1278*** (0.2317)	1.7884*** (0.2342)	1.9800*** (0.2386)
Common languages	0.7762*** (0.1942)	0.6693*** (0.1944)	0.9299*** (0.2041)	0.4881*** (0.1876)	0.4050** (0.1879)	0.6315*** (0.1920)
Common ethnic languages	0.2829 0.1750	0.2853 (0.1738)	0.4099** (0.1842)	0 .7179*** (0.1692)	.6796*** (0.1686)	0.8241*** (0.1734)
Common coloniser	0.8783*** 0.1764	0.8145*** (0.1777)	0.3661** (0.1795)	0.3825*** 0.1609	0.3310** (0.1601)	0.1541 (0.1634)
Mill ratio	-0.9306*** (0.2005)	-0.9047*** (0.1936)	-0.0830 (0.1898)	-0.0406 (.3567)	-.1679 (0.3447)	1.1796*** (0.3502)
Number of censored obs	5846	5846	5846	8044	8044	8044
Number of uncensored obs	1129	1129	1129	1280	1280	1280
(2) and (6) use distance between the most populated mains cities (pop, km), (5) weighted distance computed with a CES distance function. (***), (**), (*) show significance at 1%, 5% and 10%. Robust standard errors in parentheses						

Follow the literature the result presented in table 4 above, clearly show that industries producing final goods faced heavily border effect than the one producing capital goods. In the capital goods all the coefficients have the excepted sign except the relative price which is not significant in column (2). The mill ratio is significant throughout the regression using “capital goods”. It is worth to note that, in this particular sector the common ethnic language does not have any impact on trade, whereas the common official languages, common coloniser and contiguity do. When imposing the unit elasticity, we note that the border effect drop to -5.91, whereby the mill ratio is not significant.

In the "*final goods*", the mil ratio is not significant in the first two columns, it only become significant after imposing the unit elasticity. Unlike the "capital goods" the common ethnic languages turn to be highly significant and the common coloniser not. The border effect increase when imposing the unit elasticity on the production and the mill ratio become highly significant.

5.4 Evolution of the border effect

In this section the study intends to see the evolution of border effect over time in Africa. The results are presented in Table 5. The period decreased from 1980-2006 to 1992-2003 this is due to the lack of certain variables especially tariffs in the missing year. The regression were undertaken using the OLS procedure due to the fact that in certain period the dependent did not have any censored data, then conducting the Heckman two stages procedures was not possible.

Table 5: evolution of border effect in intra-African trade 1992-2003

Dependant variable ln.(partner importer/internal flow importer country)				
	1992-1994	**1995-1997**	**1998-2000**	**2001-2003**
Border	-6.0679*** .59450	-6.6418*** .6686	-7.4917*** .4888	-7.7572*** .4394
Ln rel. production	.7993*** .0425205	.6152*** .0374	0 .7636*** .0419	0.8020*** 0.0337
Ln rel. distance	-.4609*** .1705414	-.5676*** .2103	-.1600 .1060	-.1725 .1229
Ln rel. price	.2429* .1404868	.1732 .1901	.5326 .4498	.0887 .3886
Ln tariff factor	-.6611*** .1273	-0.2298** 0.1006	-.4566 *** .1116	-.2737*** .0801
Contiguity	2.0987*** .3370	1.4339 .3505	1.0227*** .4279	.9786*** .3828
Common languages	.9456*** .3261	-0.3288 .2628	1.2357*** .2722	.6589** .2862
Common ethnic languages	.4726* .2610018	.4256* .2273	.7689*** .2441	0.7847*** .2731
Common coloniser	0 .0798 .283675	1.4170 .23461	.8007*** .2685	0 .1027 .2214
R^2 adjusted	0.5276	0.4220	0.5668	0.5535
RMSE	2.269	2.3346	2.1752	2.3792
N	573	666	484	644

(***), (**), (*) show significance at 1%, 5% and 10%. Robust standard errors in parentheses

The border effect increased over the year in Africa from 6.06 (1992-1994) to 7.75 (2001-2003) and heavily affect the intra African trade. This is surprising since the tariffs dramatically and significantly decreased during the same period from 0.6 (1992-1994) to 0.27 (2001-2003). Since distance between countries does not change over the year the increase in border effect might be explained either by the increase in non tariffs barriers or the consumer preferences. It is also worth to note that the common ethnic languages start affecting trade positively only after 1998.

6. Conclusion

The study employs the monopolistic competition model of trade to estimate border effect on intra African trade. The results suggest a high border effect across industries in Africa. The average of border effect found within African countries is higher than border effects of the whole world. When controlling for six sub-regions in Africa, SADC was the only sub-region significant. The study also found larger border effect in final goods than capital goods. Our results also suggest that common coloniser and common official languages significantly and positively affect bilateral trade within the capital goods sector. Whereby in the final goods common ethnic language significantly affect bilateral trade. The evolution of border effect in Africa during the period 1993 - 2002 show that, it has increase over the period while the tariffs barrier to trade significantly decrease over the same period. The development of trading block in Africa has reduced the tariffs and might have increased the non-tariffs barriers. The recommendation for future research is to evaluate the part of the border effect which is explained by tariffs, non-tariffs and consumer preference in Africa.

Appendix A

African countries			
1	Burundi	20	Morocco
2	Benin	21	Madagascar
3	Burkina Faso	22	Mozambique
4	Central African republic	23	Mauritius
5	Ivory coast	24	Malawi
6	Cameroon	25	Niger
7	Congo	26	Nigeria
8	Cape Verde	27	Rwanda
9	Algeria	28	Sudan
10	Egypt	29	Senegal
11	Eritrea	30	Sierra Leone
12	Ethiopia	31	Seychelles
13	Gabon	32	Togo
14	Ghana	33	Tunisia
15	Gambia	34	Tanzania
16	Equatorial guinea	35	Uganda
17	Kenya	36	South Africa
18	Liberia	37	Zambia
19	Libya	38	Zimbabwe
		39	Somalia

Appendix B

ISIC	**Industry name**	**Final goods**	**Capital goods**
311	Food	X	
313	Beverages	X	
314	Tobacco	X	
321	Textiles	X	
322	Apparel (Manufacture of wearing apparel, except footwear)	X	
323	Leather (Manufacture of leather, leather goods and leather substitutes and fur, except footwear and wearing apparel)	X	
324	Footwear (Manufacture of footwear, except vulcanized rubber shoes or molded and plastic footwear)	X	
331	Wood (Wood and manufacturing wood products and cork, except furniture)	X	
341	Paper (Manufacture of paper and paper products)	X	
342	Printing (Printing, publishing and allied industries)	X	
353	Petroleum (Petroleum Refineries)	X	
361	Pottery(Manufacture of pottery, china and earthenware)	X	
362	Glass	X	
356	Plastic (Manufacture of plastic products not elsewhere classified)	X	
332	Furniture (Furniture and fixtures, except furniture and fixtures primarily of metal)		X
351	chemical industry		X
352	Manufacture of other chemical products		X
354	Misc. petrol (Manufacture of miscellaneous products of petroleum and coal)		X
355	Rubber		X
369	Non-metal(Manufacture of other non-metallic mineral products)		X
371	Iron/steel (Steel and first processing of iron and steel)		X
372	Production and primary transformation of non-ferrous metals		X
381	Metal production except machinery and equipment		X
382	Machinery, except electrical machinery		X
383	Manufacture of machinery and electrical supplies		X
384	Construction of transport equipment		X

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