Effects of regional trade agreements on strategic agricultural trade in Africa and its implications to food security: Evidence from gravity model estimation

The Horn Economic and Social Policy Institute (HESPI)

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HESPI is a non-profit, non-political research institute that conducts economic, social and policy oriented research to promote high quality policy analysis and advisory services to assist African governments, the private sector and other stakeholders with a special focus on the IGAD sub-region. HESPI conducts commissioned studies and interacts with principal institutions and entities to address the challenges the region faces. HESPI's focus also covers institutional capacity building and instilling values for better management of social and broad based sustainable economic growth aimed at prosperous future for the region.

Contents

Abstract

The problems of African agricultural development have been at the forefront of the debate on Africa's development since the Lagos Plan of Action in 1963. During the 2004 AU meeting in Sirte, Libya and subsequently in the 2006 AU/NEPAD Summit on Food Security in Africa, concrete steps have been taken to work towards Common African Market on 12 selected strategic agricultural products. Eight regional trade agreements which are to form the building blocks of the African Economic Community are engaged in trade liberalization and regional integration process on the selected strategic agricultural products with the ultimate goal being the formation of Common Markets for Agricultural products. However, the recent proliferation of regional trade agreements (RTAs) has intensified the debate on their merits especially the merits of south-south trade agreements. This study contributes to this debate by analysing trade creation and trade diversion effects of African RTAs on trade in nine of the twelve strategic agricultural products. An extended gravity model is estimated using PPML. Results indicate that African RTAs have mixed effect on trade creation and trade diversion. Net trade creation is positive in four of the eight RTA and it is negative in three. Further, for a significant number of the individual agrifood commodities, regional agreements in Africa have increased openness to non-members' trade while increasing trade among themselves. Although a lot remains to be done, RTAs in Africa are an attractive means to speed up the move towards common market for agricultural products in the continent. This will have positive implication for food security and sustainable agricultural development in the continent.

Keywords: Regional Trade Agreements, food security, gravity model, Africa

1. Introduction

Food security is recognised as being one of the major development challenges facing the African continent. According to FAO (2014), the prevalence of undernourishment in Africa was 20.3 and for SSA, it was 23.8 percent, the highest proportion of all developing regions. Africa is not achieving its potential in food trade, increasing the risk of widespread hunger and malnutrition.

Traditionally, food security is defined in terms of either food self-sufficiency or food self-reliance. The former requires production of various food items in the quantities consumed domestically while the latter requires domestic availability. Based on this distinction, self-sufficiency rules out imports as a source of supply while self-reliance admits them. In modern times, given much larger worldwide capacity to produce food than consume it, few restrictions on the exports of food items in countries with the excess capacity and the availability of the means of transportation that allows their rapid movement internationally, self-sufficiency makes little economic sense. Instead, what countries need is sufficient capacity to generate foreign exchange by specializing in goods of their comparative advantage and import the excess of quantities consumed over those produced.

One way to enhance food security in Africa is to facilitate trade within the continent. Regional integration is a strategy that has been recommended to, and embraced by African countries as the key to improved trade performance and economic development. The current process of regional integration on the continent dates back to the Lagos Plan of Action of 1980. It is based on eight Regional Economic Communities (RECs) which are to form the building blocks of the African Economic Community as set out in the June 1991 Treaty Establishing the African Economic Community (called Abuja Treaty). Each of these RECs is already engaged in a trade liberalization and regional integration process, with the ultimate goal being the formation of a common market and an African Monetary Union. However, the slow progress at overall integration and the worsening food security situation in the continent led African leaders to single out the agricultural sector for fast track creation of an African Common Market for agricultural products without prejudice to the objectives of the Abuja Treaty (FAO, 2008).

The vast majority of the studies on regional trade agreements deals with trade in manufacturing goods (Krueger, 2000; Gilbert, et al., 2011). A few empirical studies dealing with agrifood trade show that intraregional trade in agrifood products has grown over time (dell'Aquila, et al., 1999; Vollrath, 1998; Hertel, et al., 1999). Diao, Roe, and Somwaru (1999) show that, on average, agricultural trade under NAFTA, the EU-15, MERCOSUR, and APEC (Asia Pacific Economic Cooperation) grew more rapidly than did total world agricultural trade. In particular, the growth in intraregional agricultural trade exceeded the growth in extra regional agricultural trade of these RTAs. These studies employ descriptive statistical methods, which are not robust in identifying the trade effects of RTAs. While an RTA is formed to increase trade among members through preferential treatments, the

question is whether it comes at the expense of the rest of the world. Moreover, rigorous attempts at the effect of RTAs in Africa on agricultural trade are scanty at best.
The objective of this study is to analyze the effects of RTAs in Africa on trade in selected agricultural products, and its implication to food security and sustainable agricultural development. To assess the effects of RTAs in Africa on trade in agricultural products, our investigation relies on a gravity model and disaggregated data. The study analyzes the effects of RTAs on trade on agricultural commodities selected as strategic commodities by the African Union: beef, poultry, dairy products, legumes, cassava, maize, rice, sorghum, groundnut, oil palm and sugar.

The rest of the paper is divided into four sections. Section two reviews the relevant literature, followed by section three which introduces the gravity model and describes the dataset. Results and discussion are presented in section four and finally section five concludes.

2. Literature Review

Due to the rapid spread of regional trade agreements (RTAs) in the global trading system in recent years and slow progress in multilateralism, regionalism has emerged as a powerful alternative to multilateralism. African governments and policy makers are convinced more than any time before that regional integration is the key strategy that will enable them to accelerate the transformation of their fragmented small scale economies, expand their markets, widen the region's economic space, and reap the benefits of economies of scale for production and trade, thereby maximizing the welfare of their nations. They consider it as an important path to broad based development and a continental economic community, in accordance with the Treaty Establishing the African Economic Community (1991) and the Constitutive Act of The African Union (2000).

The formation of regional trade blocks has been an important and well-documented feature of economic integration in Africa. There are 8 regional trade blocks officially recognized by the African Union (UNCTAD, 2009). Although African regional economic communities were established mostly to promote economic cooperation, they are increasingly active in non-economic areas as well. Many are active in the promotion of peace and security within their regions.

The large number of regional trade blocs in Africa suggests that policy makers on the continent believe that trade blocs present opportunities for promoting regional trade, boosting growth and engendering development. The literature offers two views of the effects of RTA on trade. There is the so called "traditional" gains from increased trade in goods, services, and other factors (e.g. Krugman, 1991, Winters, 1993) and there are those who stress that if a RTA leaves all prices unchanged and goods are sufficiently strong substitutes, the elimination of internal tariffs may bring about a reduction in the demand for goods imported from third parties (e.g. Mundell, 1984).

In the presence of scale economies and imperfect competition, theory suggests that potential gains may also arise from market enlargement, both by reducing monopolistic distortion and avoiding firm fragmentation. Moreover, a market enlargement can attract foreign direct investment (FDI) to a region (Blomstrom and Kokko, 1997). Economies of scale therefore militate in favour of limiting the number of locations. If RIA is free trade arrangment, market size and access considerations reinforce cost considerations in convincing investors to locate in Africa. On the contrary, if the African market remains fragmented, a firm may prefer to locate, for instance, in Southern Europe, where despite higher labour costs, it can easily access the whole African market thanks to trade agreements between Europe and Africa. Without the dynamic advantages accruing from FDI – in terms of technology transfer, organizational know-how, market intelligence, etc. – Africa risks further marginalization. As Elbadawi (1997) notes, economic integration could generate the threshold scales necessary to trigger the much needed strategic complementarily, and to attract adequate levels of investment (especially FDI) necessary for the development of modern manufacturing cores and the transfer of technology within the region. There are, however, dissenting voices, most notably Venables (1999) who has demonstrated that, especially if an agglomeration effect is at play, South-South RIAs tend to aggravate income disparities between member countries.

The attempt to clarify empirically the ambiguous effects of RTAs predicted theoretically has so far failed to solve the puzzle. Several studies advanced pessimistic conclusions about the impact of RTAs on Africa. A recent World Bank research project on regionalism concluded that South-South regional blocs are problematic in several respects (World Bank 2000). According to the World Bank study, apart from doubtful non-economic benefits, South-South RTAs between two or more poor countries is very likely to generate trade diversion, especially when external tariffs are high (World Bank 2000: 42). Similarly, Yeats (1998) looked at detailed trade data from Sub-Saharan Africa and concluded that, judged by the variance in their trade patterns from what current comparative advantage would predict, intra-regional trade has potential adverse effects on members and on third countries. He concludes that "preferences for African intra-trade do not appear to have the potential to make an important impact on these countries' trade … [and] they may have a negative impact on Africa's industrialization and growth if they divert regional imports from low to higher cost sources" (Yeats 1998: 116). Based on a homogenous goods assumption, the same conclusion is advanced by Schiff (1997) who argues that any RTA between small developing countries will most likely induce a replacement of cheaper imports from the rest of the world with more expensive intra-RTA products from less efficient suppliers. Arguing from a rather different perspective, Park (1995) states that "the smaller the intra-regional shares in total trade ... the more likely the trading blocs would become trade diverting". Given the lower intratrade shares of South-South RTAs (especially African RTAs) compared to North-North or North-South RTAs, the suggestion is once again that South-South RTAs are potentially more trade diverting than other RTAs. Negative impacts of South-South RTAs were found or predicted not only in Africa but also in Latin America.

An equal amount of dissenting opinions are put forward by other studies. For instance, Elbadawi (1997:213) notes that "economic integration [in Africa] could generate the

threshold scales necessary to trigger the much-needed strategic complementarities…within the region". Other scholars used CGE analysis and found that trade creation is prevalent in the case of certain South-South RTAs. For instance Evans (1998) and Lewis et al. (1999) found positive net effects of regional integration initiatives in Southern Africa, while Flores (1997) advances similar conclusions about MERCOSUR. Cernat (2001) found that African trade blocs did have a positive impact on intraregional trade.

2.1.Regional integration and food security

The links between regional trade and food security are complex and multiple. Overall, trade is regarded as stimulant of long-term growth by serving as an important channel for diffusion of technology (Grossman and Helpman, 1955, cited in Dijk, 2011) which in turn contributes to poverty reduction and food security. The focus here is explicitly on trade in agri-food commodities and its impact on food security.

Agricultural trade can promote food security in two ways. First, agricultural trade promotes economic growth which in turn improves access to food by improving income. Growth in agriculture contributes more to poverty reduction in developing countries than similar growth in other sectors (Cervantes-Godoy and Dewbre 2010). This is due to the fact that most households in developing countries depend on agriculture for their living. Moreover, growth in agriculture enhances growth in the rest of the economy as agriculture is the main source of raw materials for the manufacturing sector. Second, agricultural trade increases food availability which in turn reduces food prices and food supply variability leading to increasing food security.

Governments can adapt food self-sufficiency, which excludes imports of food items as a source of food supply, or self-reliance which argues that availability of food is most important either produced domestically or sourced by means of international trade. In the light of this paper, it is assumed governments adopt a self-reliance strategy to achieve food security, as this is superior to self-sufficiency in two ways. First, self-sufficiency fails to acknowledge potential gains of trade that are created by international differences in endowment of production factors and technology. Second, a crucial element of food security is a person's access to food, not the extent to which food commodities are produced in a country or region.

Studies on regional trade agreements mainly deal with trade in manufacturing good. Rigorous analysis of effects of RTAs on agricultural trade are scanty. Most studies that focus on effects of RTAs on agricultural trade use descriptive statistical methods, which may not be robust to identify trade effects of RTAs. Econometric techniques have seldom been used to study the effect of RTAs on trade in agricultural products. Jayasinghe and Sarker (2007) used extended gravity model on six agrifood products for the North American Free Trade Agreement (NAFTA). While their study does not generate specific information regarding the extent of trade creation and trade diversion for the six commodities attributable to NAFTA, the results do suggest the presence of significant trade creation and diversion effects. Similarly, Grant

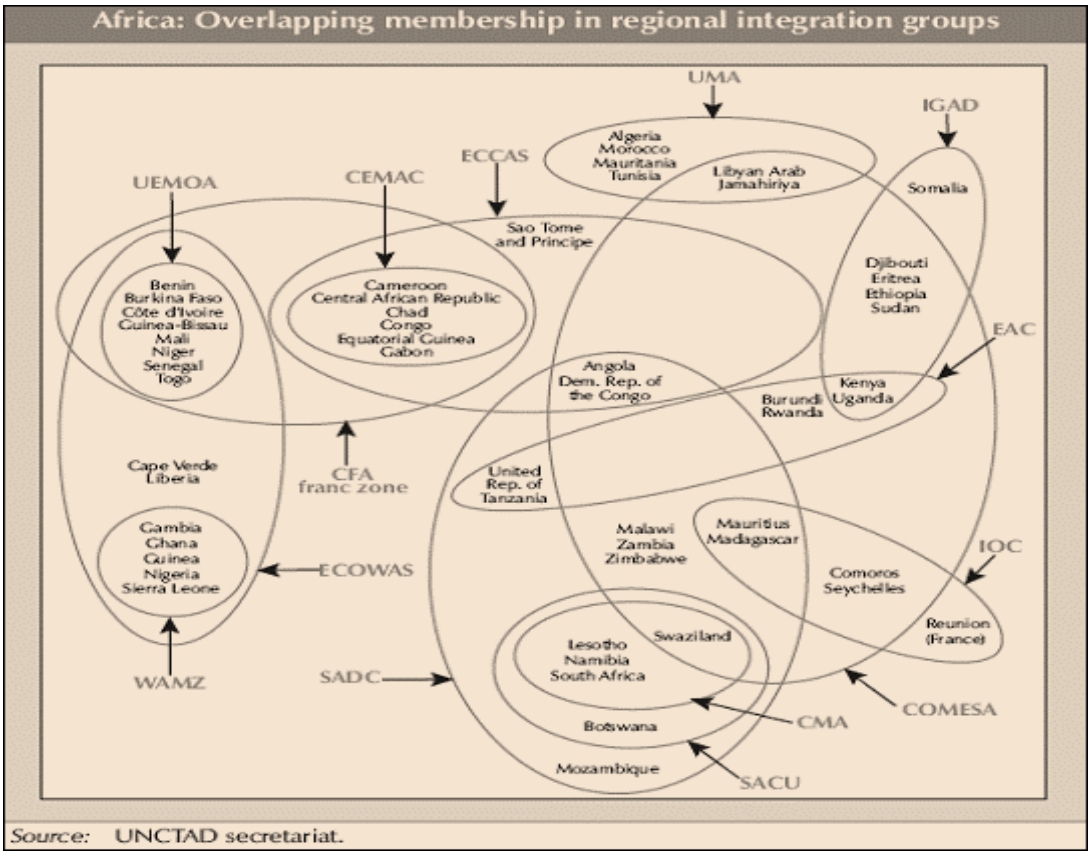
and Lambert (2005) used an extended gravity model to estimate the magnitude of trade creating and trade diversion across 9 individual agricultural commodities and for 8 RTAs. Results suggest that a majority of regional trade agreements are effective avenues to promote multilateral free trade. Furthermore, with only a few commodity specific exceptions, the authors find that regional trade agreements have increased trade with non-members even as the members have increased trade among themselves to a great extent.

The above empirical evidences either do not talk about RTAs in Africa or consider all RTA in Africa as one. Empirical evidences on effect of each RTA in Africa on trade in agricultural products are scanty. In this paper, analysis will be made on effects of RTAs in Africa on trade in selected strategic agricultural products.

2.2.Regional Integration in Africa

Even though Africa is the least integrated continent, regional integration dates back in the early twentieth century. In 1910 the South African Customs Union was formed among the Botswana, Lesotho, South Africa and Swaziland. The East African customs union followed suit in 1917 between Kenya and Uganda; and later in 1927 Tanganyika joined the union. Since then large number of economic communities has been formed. At present the African continent has around 14 overlapping regional economic communities (UNCTAD, 2013). Every country in the continent is at least a member of one REC. Of all the African countries, 25 countries belong to two RECs, 17 are member of three RECs, 6 are members of four RECs (figure 1).

Figure (1): Africa's overlapping Regional Economic Communities



Source: UNCTAD (2009)
Note: In this figure CEN-SAD is not included.

Out of the 14 regional economic communities, eight of them are recognized by the African Union Commission (AUC) as building blocks of the African Economic Community. These are CEN-SAD, COMESA, EAC, ECCAS, ECOWAS, IGAD, SADC and AMU.

Despite the fact that there exist many regional economic communities with overlapping membership in the continent and interests and political commitment of African leaders and policy makers towards regional integration, intra-regional trade in goods and services lags behind other developing regions of Asia and Latin America (UNCTAD, 2013). The low level of intra-regional trade in merchandise goods is observed in agricultural commodities in which most African countries heavily rely on for foreign exchange earnings and employment. These African RECs, as shown below in table 1, traded less among themselves compared to other RECs (such as ASEAN, NAFTA and EU). In 2012, COMESA and SADC recorded the highest intra-regional trade in agricultural commodities with 20.7 and 23.3 percent respectively. While the intra-regional trade in EU and NAFTA was well above 70 and 40 percent respectively.

Table 1: Intra-Regional trade (exports) among selected RECs in agricultural goods

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
CEN-SAD	13.1	12.0	11.2	10.5	11.3	11.7	12.1	13.5	13.8	14.7	15.1	15.5
COMESA	12.2	13.2	10.8	12.3	12.5	16.1	16.9	17.3	16.7	20.0	18.5	20.7
EAC	6.2	5.9	7.6	8.3	8.0	8.5	11.0	10.7	11.7	12.9	14.2	15.9
ECCAS	8.2	8.4	8.9	8.2	7.7	11.8	11.3	11.1	9.6	10.2	10.9	12.9
ECOWAS	11.1	9.9	10.0	10.8	10.4	10.7	11.1	12.5	12.2	11.3	12.2	11.8
IGAD	8.7	8.7	8.3	7.8	8.6	10.3	10.5	11.9	13.0	15.1	14.1	15.0
SADC	19.2	23.3	22.9	23.5	20.6	21.3	21.6	23.4	25.0	24.0	24.0	23.6
UMA	6.9	8.6	7.8	6.1	7.4	7.7	7.8	7.9	7.7	8.1	13.3	12.2
ASEAN	20.0	19.8	19.7	19.5	19.5	19.2	19.6	18.9	19.7	21.6	21.7	22.5
EU	75.2	75.5	76.4	77.2	77.3	76.9	77.3	77.1	77.7	75.8	74.8	73.7
NAFTA	42.8	44.8	43.9	45.5	47.0	47.3	43.6	40.5	41.6	40.8	40.9	40.5

Source: UNCTAD*stat*

2.3.Strategic agricultural products in African free trade agreements

Agriculture, including fisheries and forestry, continues to dominate the economies of most African countries and is an important vehicle for economic growth. The sector continues to produce the bulk of food consumed in Africa, accounting for about 60 percent of total employment and about 20 percent of total merchandise exports and GDP in many countries. The sector is the main source of raw material for industry, and as much as two-thirds of manufacturing value-added in most African countries is based on agricultural raw materials (FAO 2008 :3).

Despite the importance of agriculture in their economies, trade in agricultural products amongst the African countries remains at a relatively low level. Imports of agricultural products to the continent have been rising faster than exports since the 1970s and Africa as a whole has been a net agricultural importing region since 1980 (FAO 2008). Despite relatively abundant uncultivated land in the continent, agricultural productivity has been low due to inadequate capital formation and low level of technology. This coupled with manmade and natural disaster have significantly affected the lives of many poor African farmers mainly small subsistent farmers, most of whom are female.

Furthermore, it is increasingly being recognised that African food and agricultural markets are extremely fragmented along sub-region, national and even sub-national levels, resulting in segmented markets of sub-optimal size which hinder the profitability of sizeable private investment in the different stages of the commodity chain. These segmented gaps between regional/national production and regional demand are increasingly being filled by imports of non-African origin [in some cases through the use of unfair trade practices], even in case where tradable surpluses exists (FAO, 2008).

These problems and how to overcome them have been at the forefront of the debate on Africa's development since the Lagos Plan of Action in 1963 and the Abuja Treaty of 1991. A practical solution to this problem evolved during the 2004 AU Meeting in Sirte, Libya and subsequently in the December 2006 AU/NEPAD Summit on Food Security in Africa. The idea is that to achieve significant economies of vertical integration and scale in African agriculture, emphasis should be placed at the regional/sub-regional level around a limited number of *Strategic Commodities* without prejudice to ongoing efforts at sector-wide developments. Thus, for selected strategic commodities, a *Common African Market* that transcends national and sub-regional borders would offer an appropriate economic space to foster private investments at the level of regional economies. This implies that, for the selected strategic commodities, there is need to move market integration beyond the current pace of reform to create a free trade zone at the continental level. The strategic commodities would be those commodities that:

- Represent an important weight in the African food basket
- Weigh significantly in the trade balance in the region through their contribution to foreign exchange earnings or imported in large quantities to make up the gap Africa's production and demand; and
- Have considerable unexploited production potential in Africa, owing mainly to internal supply-side constraints as well as well as external impediments such as agricultural subsidies and support measures used by Africa's trading partners.

Table 2 lists the strategic agricultural products selected by the African Union.

However, rigorous analysis on how RTAs in Africa are faring in trade in the selected strategic agricultural products have not yet been made.

Table 2 Strategic Commodities

Product group	HS Code	Product Description
Beef	102	Live bovine animals
	201	Meat of bovine animals, fresh or chilled
	202	Meat of bovine animals, frozen
Poultry	105	Live poultry
	207	Meat and edible offal, of the poultry
Dairy Products	401	Milk and cream, not concentrated
	402	Milk and cream, concentrated
	403	Buttermilk, curdled milk and cream, yogurt
	404	Whey, whether or not concentrated
	405	Butter and other fats and oils derived from milk
	406	Cheese and curd
Legumes	708	Leguminous vegetables, shelled or unshelled, fresh
	71021	Peas (pisum sativum)
	71022	Beans (vigna spp., phaseolus spp.)
	713	Dried leguminous vegetables, shelled
Cassava	71410	Manioc (cassava)
	110814	Manioc (cassava) starch
Maize and products	1005	Maize (corn)
	110220	Maize (corn) floor
	110313	Of maize (corn)
	110423	Of maize (corn)
	110812	Maize (corn) starch
Rice	1006	Rice
	110230	Rice flour
Sorghum	1007	Grain sorghum
Groundnut	1202	Groundnuts, not roasted
	1508	Groundnut oil and its fractions
Oil palm	120710	Palm nuts and kernels
	1511	Palm oil and its fractions
Sugar	17	Sugars and sugar confectionery
Cotton	52	Cotton

Source: FAO (2008)

3. Empirical Analysis

3.1.The Gravity Model

The gravity model has been used widely as a baseline model for estimating the impact of economic integration upon the volume and direction of international trade flows. It has performed remarkably well as an empirical framework for measuring the impact of regional integration arrangements (Frankel and Wei, 1998; Frankel et al. 1995).

Typically, in the case of gravity model of trade, bilateral trade flows are dependent upon the size of the two economies and the distance between them:

$$X_{ij}^{t} = f\left(Y_i^t, Y_j^t, D_{ij}\right) \dots\dots\dots\dots\dots\dots\dots\dots 1$$

Where X_{ij}^{t} are exports from country i to country j at time t, Y_i^t and Y_j^t are the GDPs at time t of countries i and j respectively. D is the distance between the capital cities of the two countries.

The rationale behind the gravity model is that trade is associated with economic size, measured as GDP, and is inhibited by distance (which increases transportation costs, as well as other transaction costs). Specifically, a high level of income in the exporting country indicates a high level of production, which increases the availability of products from export while a high level of income in the importing country suggests higher demand and therefore, higher imports. Therefore both Y_i^t and Y_j^t should be positively correlated with the level of bilateral exports. Since distance increases transport costs, its coefficient is expected to be negative.

For estimation purposes, the basic gravity model is most often used in its log-linear form:

$$ln\left(X_{ij}^{t}\right) = \beta_0 + \beta_1 ln(Y_i^t) + \beta_2 log\left(Y_j^t\right) + \beta_3 \ln(D_{ij}) + \varepsilon_{ijt} \dots\dots\dots\dots\dots\dots\dots 2$$

Where ε_{ijt} is the log normally-distributed error term.

We are interested in a model that captures the trade flow effects of regional trade agreements. Researchers typically experiment by including proxies for trade costs such as the distance between partners, and indicators for common language and contiguity (when countries share land borders). For example, two countries that share a common border or speak a common language may trade more with each other based on relative proximity and cultural similarity. Or, countries with access to sea port may have a comparative advantage in trade relative to neighbours who are landlocked. Controlling for these factors gives us more confidence that our regional block dummies are picking up structural increases in trade following the signing of an RTA.

Thus, the most commonly used version of the expanded gravity model assessing the impact of RTAs is the following:

$$\ln\left(X_{ij}^{t}\right) = \beta_0 +$$
$$\beta_1 \ln(Y_i^t) + \beta_2 \ln\left(Y_j^t\right) + \beta_3 \ln\left(\frac{Y_i^t}{N_i^t}\right) + \beta_4 \ln\left(\frac{Y_j^t}{N_j^t}\right) + \beta_5 \ln D_{ij} + \beta_6 \ln linder + \beta_7 cont_{ij} +$$
$$\beta_8 commlang_{ij} + \beta_9 landlck_i + \beta_{10} landlck_j + \sum_{h=1}^{8} \alpha_h TradeC_{ijh}^{t} + \sum_{l=1}^{8} \gamma_h TradeD_{ijl}^{t} +$$
$$TimeDummies + \varepsilon_{ij}^{t} \dots\dots\dots\dots\dots 3$$

Where $cont_{ij}$, $commlang_{ij}$ and $landlck_{ij}$ are dummy variables equal to one if exporter (i) and importer (j) share a common land border, speak a common language or are landlocked countries and zero otherwise, and the variable linder calculated as per capita difference between two trading partners shows differences in tastes.

The dummy variables $TradeC_{ijh}^{t}$ and $TradeD_{ijl}^{t}$ are designed to capture trade creation or trade diversion effects respectively in agricultural products trade for eight RTAs (h=1,2, ... ,8). The dummy variable $TradeC_{ijh}^{t}$ equals one if countries i and j belong to a particular RTA and the year (t) is greater than or equal to the year the agreement was signed. The sign and magnitude of the coefficient indicates whether the creation of a particular RTA has stimulated or depressed intra-regional agricultural trade.

The trade diversion dummy variable $\left(TradeD_{ijl}^{t}\right)$ is designed to estimate how much of the increase (if any) in trade creation came as a result of trade diversion from non-member sources. Trade diversion is defined in terms of import costs (Viner 1950). This variable takes the value one when the importer is an RTA member and the exporter a non-member and the year (t) is greater than or equal to the year the agreement was signed, and zero otherwise. Thus, the coefficient will capture the average increase (decrease) in trade diversion from non-member sources after the agreement came into force.

Because of the double logarithmic specification of the estimated function in equation (3), the parameter estimates of the variables that are not dummy variables as elasticities. For example, in equation (3), $\beta_1$represents the percentage change in X_{ij}^{t} induced by 1% change in Y_i^t holding per capita GDP constant. As dummy variables cannot be expressed in log form, the parameter estimates should be interpreted with care. The percentage effect of the dummy variable is calculated following Halvorsen and Palmquist (1980)[1]. Hence, for example, assume that the coefficient estimate of $TradeC_{ijh}^{t}$ dummy variable in equation (3) is α_1. This shows that two member countries of the same REC traded an extra $(e^{\alpha_1}-1)*100\%$ relative to the amount they traded with non-member country. More precisely, the mean (or average) trade between two members is higher than their mean trade with the rest of the world by$(e^{\alpha_1}-1)*100\%$. The benchmark here is when a member country trades with a non-member country.

Similarly, the $TradeD_{ijl}^{t}$ parameters (γ_h) should be interpreted with care. If the estimated coefficient γ_h is negative, total trade of the REC member (where the REC member is a net importer) with a non-member country is $(e^{(-\gamma_h)}-1)*100\%$ less than its net exports to non-members.

In the regression equation (3), Y_i^t and Y_j^t are expected to enter with positive coefficients because of the direct impact of GDP on import demand and the fact that larger exporting countries tend to trade more. Similarly GDP per capita ($\frac{Y_i^t}{N_i^t}$ and $\frac{Y_j^t}{N_j^t}$) would possess a positive coefficient for normal final goods, as higher per capita income would induce higher import demand. The coefficient of the distance variable, (D_{ij}), would likely have a negative sign as greater distances tend to increase transportation as well as information costs.

[1] If the estimated coefficient is α_1, we can calculate the change in the value of total trade (X) for a change of dummy variable from zero to one with the following: $\frac{(X_1-X_0)}{X_0}=e^{\alpha_1}-1$

We expect the coefficient on $TradeC_{ijh}^{t}$ in equation (3) to be positive as the elimination of significant border restrictions should encourage intra-regional bloc trade. The coefficient on $TradeD_{ijl}^{t}$ will be negative if trade creation within a particular RTA came at the expense of trade with non-member.

3.1.1. Zero trade flows and hetroskedasticity problem

Two of the problems commonly seen in using a log linear form of the gravity equation and estimating it using OLS are how to handle zero trade in a given year between two given countries and the presence of hetroskedasticity as is common in trade data.

Zero trade values in trade data can arise because the countries did not trade for a number of reasons including prohibitive transport costs due to excess distance or the smallness of the economies involved. Zero trade data may also arise due to rounding errors. If trade is measured in thousands of dollars, it is possible that for pairs of countries for which bilateral trade did not reach a minimum value, the value of trade is registered as zero. Finally, the zeros can just be missing observations that are wrongly recorded as zero.

Zero trade values have been treated in three different ways. The first which is commonly used by many authors is to drop the observation with zero values. However, the problem with this approach is if the zeros reported are really zero trade or if it reflects systematic rounding errors associated with very small trade flows. Dropping the zero values will result in a loss of useful information and will yield inconsistent results.

The second and third approaches used are retaining the zero values either by adding a small constant usually 1 to the values of trade before taking logarithms, or estimating the model in levels. However, retaining zero trade flows in the sample requires using appropriate estimation techniques. The use of OLS for such estimation will have two problems: First, the substitution of small values to prevent the omission of observations from the model is *ad hoc* and there is no guarantee that it reflects the underlying expected values, thus yielding inconsistent estimates. Second, the use of OLS estimation on levels is not supported by theoretically founded gravity equations that present a multiplicative form (UNCTAD/WTO, 2012).

Besides presence of zero trade values, hetroskedasticity is a severe problem in the log linear gravity models. Santos Silva and Tenreyro (2006) find overwhelming evidence that the error terms in the usual log linear specification of the gravity equation are hetroskedastic, which violates the assumption that the error term is statistically independent of the regressors and suggest that this estimation method leads to inconsistent estimates of the elasticities of interest. The authors argue that the gravity equation should be estimated in their multiplicative form and propose a simple Pseudo Poisson Maximum Likelihood (PPML) estimation technique. The method can be applied to the levels of trade, thus estimating directly the non-linear form of the gravity model and avoiding dropping zero trade. The authors further highlight that, in the presence of heteroskedasticity (as is usual in trade data), the PPML is a robust approach. This approach has been used in a number of estimations of gravity equations and in this paper the same technique is followed.

3.2.Data

Panel bilateral trade data for 9 strategic agricultural commodities is taken from the CEPII (which produces harmonized trade data at a disaggregated product level) for the period 1998 to 2010 for all African countries and selected Industrial and Emerging Economies. Exporters and importers' nominal GDP, GDP per capita income and population are obtained from World Development Indicators (WDI) database. Bilateral distance, area and other dummy variables (contiguity, official language, common colonizer, colonial relation and whether the countries are landlocked or not) are derived from CEPII database. The distance variable as developed by Mayer and Zignago (2011) is computed based on latitude and longitude of the capital cities.

4. Estimated Results and Discussion

The data set used in this analysis exhibits too many observations with zero trade values, and based on the Breusch-Pagan and the White tests, the data also exhibits heteroskedastic error, as is frequently the case with trade data. We employed PPLM estimation technique to deal both with the zero trade values and the hetroskedasticity.

Regression results from the 10 regression scenarios (separate regression for each of the 9 selected agricultural products and one regression for all the selected agricultural products) are displayed in tables 3 through 5. The regression scenarios are labelled 1 through 10 accordingly. The standard or traditional gravity estimates are reported on table 3. Tables 4 and 5 present the trade creation and trade diversion coefficients respectively.

We begin our discussion with the standard gravity variables. Table 3 shows that the estimated GDP coefficients have the expected sign and significance in all the 10 regressions. The parameter estimates of population size also are positive and significant in most cases especially the population size for the reporter countries, i.e., the importer countries. This implies that the higher the population of a country the higher the demand for imported goods all else constant.

Bilateral distance has a large effect on trade of the selected agricultural products. As expected the parameter estimates of the distance variable are negative and statistically significant at the 1 per cent significant level irrespective of the products. Thus, the volume of trade in each of the selected commodities diminishes as distance increases. The coefficients for all commodities are more than 1.

We used the log of air distance between the capital cities of the respective countries as the proximity measure. Like other studies on gravity, we presume that the direct air distance is a reasonable proxy for transportation cost. However, it should be noted that transportation cost will not always increase monotonically with distance because transaction costs associated with many operations such as loading, storage, and local distribution, are large compared to

the marginal cost per kilometre of distance travelled (Frankel, 1997, cited in Jayasignhe and Sarker, 2007).

The negative and significant effect of distance on agrifood products is in conformity with similar findings by Jayasignhe and Sarker (2007) and Grant and Lambert (2005). The other standard gravity variables such as being landlocked, common language, colonial history and contiguity all have the expected sign and are significant in most cases.

Table 3. Gravity model regression results for standard gravity variables

	(1) sorghum	(2) beef	(3) poultry	(4) dairy	(5) oilpalm	(6) groundnut	(7) legumes	(8) rice	(9) sugar	(10) total
Area_p	-0.316*	-0.394***	-0.330***	0.191***	0.301***	-0.246**	-0.535***	-0.975***	-0.817***	-0.567***
	(-2.10)	(-4.57)	(-3.94)	(3.68)	(4.15)	(-2.67)	(-9.20)	(-8.38)	(-15.07)	(-14.25)
Area_re	0.940***	-0.184*	-1.243***	-1.097***	-0.331***	0.221*	-0.0842	-3.175***	-1.963***	-1.727***
	(6.32)	(-2.10)	(-14.30)	(-21.39)	(-4.66)	(2.29)	(-1.47)	(-24.88)	(-30.80)	(-45.87)
Distance	-1.381***	-2.583***	-1.040***	-1.785***	-2.225***	-1.349***	-1.506***	-2.851***	-1.324***	-1.654***
	(-4.81)	(-11.95)	(-5.87)	(-13.04)	(-13.02)	(-7.38)	(-12.47)	(-9.76)	(-7.72)	(-13.14)
GDP_p	1.667***	0.789***	0.659***	0.162**	0.0980	1.034***	1.258***	2.132***	2.168***	1.645***
	(8.90)	(8.10)	(6.62)	(2.72)	(1.15)	(9.84)	(19.55)	(16.44)	(34.60)	(46.36)
GDP_re	1.395***	2.074***	2.682***	2.402***	0.835***	0.564***	1.353***	6.938***	4.302***	3.253***
	(7.39)	(25.53)	(19.04)	(34.78)	(9.80)	(5.01)	(19.29)	(34.51)	(49.96)	(79.97)
GDPPC_p	-0.384	0.414***	-0.298**	0.204**	0.392***	0.000588	-0.902***	-2.170***	-1.828***	-1.287***
	(-1.86)	(3.78)	(-2.81)	(3.21)	(4.00)	(0.00)	(-12.54)	(-16.17)	(-26.78)	(-33.83)
GDPPC_re	-1.692***	-0.607***	-2.760***	-2.149***	-0.689***	-1.011***	-1.229***	-7.666***	-4.189***	-3.334***
	(-7.38)	(-6.58)	(-15.48)	(-25.66)	(-7.04)	(-8.86)	(-16.43)	(-37.14)	(-45.46)	(-76.74)
Linder	0.482***	-0.0215*	0.175***	0.0886***	-0.113***	0.320***	0.301***	-0.0275***	-0.0236**	0.00208
	(8.32)	(-2.23)	(4.26)	(6.42)	(-7.29)	(11.94)	(21.69)	(-5.04)	(-3.15)	(0.66)
Landlocked_pa	3.049***	-1.687***	-1.182***	-0.763***	0.170	-0.192	-0.539**	-1.027**	-2.153***	-0.545**
	(8.32)	(-5.14)	(-4.86)	(-4.54)	(0.77)	(-0.67)	(-3.14)	(-2.65)	(-8.75)	(-3.00)
Landlocked_re	-1.973***	2.744***	-1.454***	-1.984***	-2.914***	-2.153***	0.0298	-0.529	1.302***	-0.183

	(-3.99)	(10.32)	(-5.32)	(-11.53)	(-11.37)	(-7.04)	(0.18)	(-1.26)	(6.19)	(-1.18)
Contiguity	3.447***	2.570***	2.535***	2.308***	0.823	2.980***	1.744***	2.308**	1.786***	2.735***
	(4.50)	(5.77)	(5.71)	(7.06)	(1.84)	(6.83)	(5.00)	(2.94)	(3.67)	(8.36)
Common language_off	0.894*	0.717**	0.190	-0.0508	0.545**	0.411	0.262	0.335	-0.0229	0.272
	(2.31)	(3.08)	(0.87)	(-0.32)	(2.71)	(1.65)	(1.73)	(0.96)	(-0.11)	(1.73)
Colony	0.0491	1.031*	1.993***	0.970**	0.486	1.733***	1.691***	0.0580	1.959***	0.878**
	(0.07)	(2.10)	(4.82)	(2.73)	(1.12)	(3.65)	(5.10)	(0.09)	(4.42)	(2.58)
Constant	-69.68***	-43.49***	-33.62***	-22.14***	-1.159	-25.89***	-30.91***	-71.42***	-62.75***	-38.10***
	(-17.42)	(-22.16)	(-15.80)	(-14.89)	(-0.64)	(-13.86)	(-23.71)	(-26.33)	(-32.44)	(-32.93)
lnalpha _cons	2.814***	2.525***	2.399***	2.157***	2.641***	2.629***	2.143***	3.018***	2.712***	2.220***
	(32.17)	(48.68)	(40.28)	(52.24)	(52.05)	(46.19)	(50.89)	(62.31)	(79.88)	(80.53)
N	42256	42256	42256	42256	42256	42256	42256	42256	42256	42256

t statistics in parentheses; for brevity time dummy variable are not reported
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.1.Trade creation and trade diversion

This section discusses the empirical results of trade creation and trade diversion effects of African RECs. Tables 4 and 5 show trade creation and trade diversion respectively.

4.1.1. Trade Creation

Empirical results on table 4 suggest that there is mixed effect of the regional integrations in Africa. Among the eight RTAs considered, SADC shows positive and significant trade creation effects for seven out of nine agrifood , and COMESA and EAC for five out of nine agrifood commodities each (table 4). In SADC, the largest trade creation effect is seen in sorghum with 61116% more trade over the period 1998-2010 followed by poultry with an additional trade of 1016%, groundnut (615%), beef (154%), legumes (131%), rice (87%) and the least being sugar with an additional 22% trade.

For the overall agrifood commodities, SADC has recorded a positive and significant trade creation effect with an additional 17% trade being created over the period 1998 – 2010. Using an elasticity of substitution of 5, the implied tariff equivalent of the pre-RTA border cost[2] for all agrifood commodities (regression 10) is 103 percent. With an elasticity of substitution of 10 percent, the pre-RTA border cost is 101. A similar pattern emerges for total agrifood trade in COMESA and EAC. Positive and significant trade creation effect is recorded leading to an additional trade of 104% and 31% respectively for COMESA and EAC. Using an elasticity of substitution of 5 percent, the ad valorem tariff equivalent of the pre-RTA border cost for COMESA and EAC respectively is 115 and 106 percent. This suggests that bound tariff costs alone which average 62% in world agricultural trade (Gibson et al., 2001 cited in Grant and Lambert, 2005) account for roughly one-half of total trade costs. On this criterion, these regional agreements would have to be considered a success.

In the next group of RTAs namely IGAD, ECOWAS and AMU, trade creation effect has been recorded in limited number of individual agrifood commodities. The trade creation coefficient is positive and significant in four out of nine commodities, in three out of nine commodities, and in two out of nine commodities for IGAD, ECOWAS and AMU respectively. As far as trade in total agrifood commodities is concerned, the trade creation effect, although positive, is not statistically significant for each of these three RTAs.

In the third group of RTAs, CENSAD and ECCAS, trade decreased after the formation of the agreements in five out of nine, and in four out of nine agrifood commodities respectively. Trade creation was positive and significant in only one case in CENSAD and in two cases in ECCAS. Moreover, trade in all agrifood commodities has decreased following the formation of the agreement in CENSAD over the period 1998 – 2010. However, in the case of ECCAS, the trade creation effect for two of the nine agrifood commodities, rice and sugar, is so large that trade creation effect for all agrifood commodities is positive and significant.

[2] Implied tariff equivalent of the pre-RTA border cost is calculated as $\exp(\alpha_h/\delta)*100$, where α_h is the regression coefficient of a given RTA and δ is elasticity of substitution (Grant and Lambert, 2005).

Table 4. Gravity model trade creation regression results

	(1) sorghum	(2) beef	(3) poultry	(4) dairy	(5) oilpalm	(6) groundnut	(7) legumes	(8) rice	(9) sugar	(10) total
AMU	0.290	-9.980***	0.654	-1.071	-0.478	3.170**	1.798*	-2.328	1.037	0.708
	(0.17)	(-5.28)	(0.65)	(-1.39)	(-0.51)	(2.99)	(2.34)	(-1.46)	(0.99)	(0.93)
CENSAD	0.397	1.135**	-0.497	-0.571*	-1.911***	-1.579***	-1.647***	0.726	-1.573***	-1.752***
	(0.54)	(2.72)	(-1.34)	(-2.41)	(-5.66)	(-3.91)	(-5.95)	(1.44)	(-4.44)	(-7.63)
COMESA	1.308**	0.114	0.315	1.474***	0.0610	-0.826***	0.430***	1.425***	0.764***	0.714***
	(2.99)	(0.73)	(1.69)	(20.31)	(0.56)	(-4.26)	(4.14)	(18.15)	(13.75)	(26.96)
ECCAS	0.838	-2.195**	-1.716	-4.166***	-4.313***	-1.335	-1.187*	8.944***	12.69***	4.743***
	(0.47)	(-2.64)	(-1.51)	(-6.16)	(-5.96)	(-1.73)	(-2.24)	(7.85)	(19.87)	(11.16)
ECOWAS	5.099***	-0.293	0.389	-0.459	1.018**	2.562***	0.508	0.379	0.270	0.113
	(4.80)	(-1.01)	(0.75)	(-1.95)	(2.64)	(9.60)	(1.29)	(0.92)	(0.86)	(0.79)
EAC	-0.804	1.600***	0.00969	0.336	0.522***	2.570***	-1.124***	0.892***	1.103***	0.271***
	(-1.40)	(6.18)	(0.01)	(1.62)	(7.26)	(6.69)	(-9.64)	(7.42)	(12.17)	(7.73)
IGAD	7.188***	4.075***	-2.572**	-2.613***	0.219	-0.235	1.153	3.218*	3.086***	-1.104
	(5.27)	(4.21)	(-2.67)	(-3.67)	(0.26)	(-0.24)	(1.61)	(2.44)	(3.41)	(-1.79)
SADC	6.417***	0.933**	2.412***	-0.125	0.106	1.967***	0.839***	0.624*	0.200***	0.154***
	(7.54)	(2.60)	(6.88)	(-0.80)	(0.45)	(5.60)	(4.42)	(2.10)	(4.39)	(4.00)
N	42256	42256	42256	42256	42256	42256	42256	42256	42256	42256

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.1.2. Trade diversion

Observing the level of changes in each of the eight RECS, the diversion dummy, can give insight into the presence of trade diversion effects. This will tell us whether there are reductions in the level of imports by each of the RECs member states from non-members relative to the level of exports by the REC members to non-members overtime. The relevant results are reported in table 5.

The signing of SADC appears to have come with no expense of trade diversion with non-members (table 5). The trade diversion coefficient entered with positive values for each of the nine agrifood commodities and it is statistically significant in six of these commodities. These results suggest that the imports of these commodities into SADC countries from the rest of the world were higher than the gravity model would predict, i.e., SADC tends to increase its openness to non-members' trade while increasing trade among its member countries. This result is in line with other findings such as Sattayanuwat (2011). The increased level of openness, i.e., positive and significant trade diversion effect, is also reflected when one considers trade in all the nine agrifood commodities.

For the rest of the RTAs, there are mixed results. The trade diversion coefficient is negative and significant for some individual agrifood commodities, and positive and significant for others.

If formation of a RTA leads to a decrease in trade among member states in individual commodities, it is natural to assume that there will be little or no trade diversion effects. This is well reflected in CENSAD. As can be seen in table 4 (trade creation), except in beef the formation of CENSAD has shown no trade creation effect in any of the individual agrifood commodities. On the flip side, trade diversion from CENSAD member states occurred only in one out of the nine agrifood commodities – sugar. For the remaining commodities, the trade diversion coefficient is either positive and significant (in six out of nine) or statistically insignificant.

The signing of COMESA appears to have come at little expense of trade diversion with non-members. Table 5 indicates that trade is diverted from COMESA member states in only three cases – poultry, rice and sugar. However, trade diversion is more than offset by the magnitude of trade creation in two of these products – rice and sugar. It is only in the case of poultry that trade diversion effect is not compensated by trade creation. On the other hand, the trade diversion coefficient is positive and significant in five out of nine agrifood commodities implying that imports by COMESA member states from non-member states has increased in these commodities. For trade for total agrifood commodities, the trade diversion effect is positive and statistically significant. This indicates that for the total agricultural commodities considered, imports from non COMESA member states to COMESA member states increased.

Table 5. Gravity model trade diversion regression results

	(1) sorghum	(2) beef	(3) poultry	(4) dairy	(5) oilpalm	(6) groundnut	(7) legumes	(8) rice	(9) sugar	(10) total
AMU	3.179***	-0.574	-0.614	-1.026***	-2.669***	1.844***	0.657*	-2.061**	-0.318	-0.215
	(4.47)	(-1.32)	(-1.65)	(-4.40)	(-6.55)	(4.85)	(2.41)	(-3.25)	(-0.87)	(-0.89)
CENSAD	1.953***	0.721**	1.603***	1.357***	-0.137	1.545***	-0.268	1.983***	-2.239***	-0.357*
	(3.79)	(2.65)	(7.09)	(8.16)	(-0.49)	(4.85)	(-1.46)	(5.40)	(-8.50)	(-2.00)
COMESA	1.348***	0.873***	-0.396***	0.123***	0.0532	0.572***	0.241***	-0.0829*	-0.0610**	0.240***
	(6.24)	(28.27)	(-11.67)	(8.05)	(0.42)	(5.08)	(7.02)	(-2.34)	(-2.88)	(29.66)
ECCAS	1.773**	0.416	2.241***	-0.743***	-1.787***	-1.018**	-0.443*	-0.442	-0.00410	-0.295
	(2.77)	(1.18)	(7.54)	(-3.72)	(-5.59)	(-2.67)	(-2.01)	(-1.04)	(-0.01)	(-1.57)
ECOWAS	3.029***	-0.601*	0.348**	-0.539***	-0.722**	0.255	-0.182	-0.104	0.481***	-0.0989**
	(4.29)	(-2.00)	(2.81)	(-10.23)	(-2.89)	(1.02)	(-0.85)	(-0.77)	(8.68)	(-2.81)
EAC	-0.469	-1.009**	0.253	-0.951***	-0.830*	-0.263	-1.762***	1.184***	0.447***	-0.218***
	(-0.91)	(-2.73)	(0.74)	(-6.14)	(-2.26)	(-0.58)	(-12.33)	(9.68)	(7.04)	(-5.09)
IGAD	5.617***	-2.582***	0.447	-0.730**	0.296	0.737	1.344***	-2.687***	0.0904	-0.624**
	(8.73)	(-5.19)	(1.16)	(-2.92)	(0.81)	(1.85)	(5.28)	(-5.60)	(0.24)	(-2.79)
SADC	4.898***	0.537*	1.085***	0.00998	0.163	1.217***	0.655***	0.258***	0.0782	0.159***
	(8.69)	(2.47)	(4.66)	(0.16)	(0.72)	(3.88)	(4.52)	(5.88)	(0.77)	(5.18)
N	42256	42256	42256	42256	42256	42256	42256	42256	42256	42256

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Similar to COMESA, three other RTAs – IGAD, ECOWAS and AMU, have recorded trade diversion effects in three out of nine agrifood commodities. However, unlike COMESA, trade loss in these three RTAs is not offset by trade creation except for one product out of the three in IGAD and ECOWAS. In IGAD the trade loss in beef is more than offset by the trade creation. Similarly, the trade creation effect more than offsets the trade diversion effect for oilpalm in ECOWAS. At the same time, these three RTAs have recorded a rise in imports from non-member states for few commodities. Imports of sorghum, poultry and sugar into ECOWAS from the rest of the world have increased. Similar trend is observed in three commodities (sorghum, groundnut and legumes) for AMU and in two commodities for IGAD (sorghum and legumes).

Trade diversion was relatively high among EAC and ECCAS where 4 out of 9 commodities show negative and significant trade diversion effects (table 5). Trade diversion exceeds trade creation in all of the four commodities for ECCAS and in three of the four commodities in EAC. On the other hand, imports of rice and sugar into EAC, and imports of sorghum and poultry into ECCAS from the rest of the world have increased since the formation of these RTAs.

4.1.3. Net Effect

We now turn to look into the net effect of the trade creation and trade diversion effects for each of the eight RECs on the nine selected agrifood commodities. But for simplicity, we limit the net effect analysis to the total agrifood products.

As indicated on table 5, the trade diversion coefficient for the total agrifood commodities is negative for six of the eight RTAs implying a trade diversion effect. However, in two of these – AMU and ECCAS, the coefficient is not statistically significant. For the remaining two RTAs – COMMESA AND SADC, the trade diversion coefficient is positive and statistically significant implying that member states of these two RTAs tend to increase their openness to non-members' trade while increasing trade among their members.

Comparing the trade creation and trade diversion coefficients, the sum of the two coefficients gives the net creation effect of trade agreements. Table 6 indicates that among the eight RTAs considered, CENSAD, ECOWAS and IGAD recorded a net diversion effect, while four RTAs – COMESA, ECCAS, EAC and SADC show a net creation effect. In the case of AMU, neither net creation nor net diversion effect was recorded.

In summary, results suggest that the African RTAs have a mixed effect. Many have resulted in trade creation especially at individual agrifood commodity level; although these trade creation effects are followed by trade diversion.

The net effect for total agrifood commodities is positive and significant in one-half of the trading blocs in Africa and it is negative or insignificant in the remaining half. In two of these four trading blocs with net trade creation effects – COMESA and SADC, trade among

member states has increased significantly while increasing their openness to the rest of the world. These trading blocs are good indications that trading blocs in Africa are favourable to both regional integration and formation of a common African market that transcends national and sub-regional borders as envisaged by the African Union. However, a lot remains to be done to have a full benefit of regional integration in all the trading blocs in Africa

Table 6. Net Trade Creation Effect

	Trade Creation	Trade diversion	Net effect
AMU	0.708	-0.215	0
CENSAD	-1.752***	-0.357*	-2.109
COMESA	0.714***	0.240***	0.954
ECCAS	4.743***	-0.295	4.743
ECOWAS	0.113	-0.0989**	-0.0989
EAC	0.271***	-0.218***	0.053
IGAD	-1.104	-0.624**	-0.624
SADC	0.154***	0.159***	0.313

4.2.Trade creation and trade diversion effects for the periods 1998-2006 and 2007-2010

End of 2006 or beginning of 2007 can be considered as the turning point in the trade creation and trade diversion effects of African RTAs on the selected strategic agricultural commodities. The idea of placing emphasis on at regional or sub-regional level around a limited number of strategic commodities without prejudice to ongoing efforts at sector-wide developments which evolved during the 2004 AU meeting in Sirte, Libya was subsequently developed in the December 2006 AU/NEPAD summit on food security in Africa. Thus, it might be interesting to analyse trade creation and trade diversion effects separately for the period from 1998 -2006 and 2007 – 2010 in order to show changes in trade creation and trade diversion effects, if any, of African RTAs on the strategic commodities.

Tables 7 and 8 respectively compare trade creation and trade diversion effects for the period 1998-2006 and 2007-2010. For brevity, the standard variables are not reported in these two tables.

Table 7 shows that there are more trade creations at individual commodity level after 2006 than before 2006 at least in six RTAs. The exceptions in this regard seem to be IGAD and ECCAS. For example, in SADC, the trade creation effect is positive and significant in all the nine agrifood commodities after 2006 but it was only significant in 7 out of nine before 2006; and almost in all cases, the trade creation coefficients are larger in the former than the later.

Similarly, after 2006, additional positive and significant trade creation effect is seen in 5 and 4 individual agrifood commodities in EAC and ECOWAS respectively. These additional trade creation effects are not followed by loss of trade creation in other commodities. Similar trade

Table 7. Gravity model trade creation before and after 2006 regression results

	(1) sorghum	(2) beef	(3) poultry	(4) dairy	(5) oilpalm	(6) groundnut	(7) legumes	(8) rice	(9) sugar	(10) total
AMU_after2006	-3.294	-7.296	-1.083	1.666*	-0.933	1.846	-0.255	-0.0555	-0.755	1.986**
AMU_until2006	5.652**	-11.32***	-1.145	-0.769	0.290	1.740	2.570**	-4.673	-0.124	1.047
CENSAD_after2006	1.758	-6.036***	1.402**	-0.205	-1.639**	0.179	-0.276	0.455	1.217***	-0.909***
CENSAD_until2006	1.128	2.738***	-0.548	0.315	-1.194**	-1.937***	-2.091***	2.024*	-2.105***	-1.223***
COMESA_after2006	4.021**	3.986***	1.193*	1.408***	0.667	0.793	-0.359	1.337**	2.408***	1.804***
COMESA_until2006	0.629	0.334	0.363	0.157	0.326*	0.385	-0.443**	1.939***	0.561***	0.427***
ECCAS_after2006	1.202	-4.617*	-6.219	-1.032	-2.818*	-2.704	-0.785	-0.654	-2.310***	-0.0821
ECCAS_until2006	-17.40	-0.607	-1.688	-2.450***	-2.179**	-1.162	-1.128*	11.24***	6.778***	5.077***
ECOWAS_after2006	6.448**	11.82***	-0.487	2.501***	1.990**	2.146*	0.416	1.338**	-0.481	3.451***
ECOWAS_until2006	6.595***	-1.152***	0.465	-0.0868	0.572	2.152***	0.622	1.222	0.383	-0.0746
EAC_after2006	2.090	7.433**	1.532	0.677	5.501***	3.122*	0.263	2.113*	0.943	-0.187
EAC_until2006	-2.780	-1.308	0.902	-1.171	-1.855	-1.756	-2.527*	-16.59***	-2.136	-5.328***
IGAD_after2006	4.251	-0.727	-0.699	-1.487	2.361*	-3.416*	0.304	-2.355*	-2.328**	-1.471*
IGAD_until2006	10.85***	5.179***	-1.536	-0.775	-1.221	-1.196	2.017**	-0.497	2.122**	-0.187
SADC_after2006	8.919***	2.564*	4.219***	3.135***	3.298***	2.983***	1.945***	2.685***	3.774***	5.136***
SADC_until2006	9.823***	1.420***	2.147***	0.382*	-0.218	1.722***	0.978***	-0.786	0.291***	0.197***
N	31904	31904	10352	10352	10352	10352	10352	10352	10352	10352

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8. Gravity model trade diversion after and before 2006 regression results

	(1) sorghum	(2) beef	(3) poultry	(4) dairy	(5) oilpalm	(6) groundnut	(7) legumes	(8) rice	(9) sugar	(10) total
AMU_after2006	1.878	6.161***	-2.827***	1.784***	-3.410***	0.215	-0.0233	-0.426	-2.145***	0.931***
AMU_until2006	6.376***	-0.0533	-1.149***	-0.649**	-1.462**	1.371***	0.662*	-1.152	-0.530	0.541*
CENSAD_after2006	2.210*	1.790***	0.830*	0.707***	-0.596	0.852	0.605*	0.749*	1.327***	0.933***
CENSAD_until2006	5.002***	0.973**	0.802***	0.706***	-0.522	0.385	-0.707***	4.367***	-1.282***	-0.194
COMESA_after2006	0.639	4.671***	-0.830*	1.807***	-1.896***	-0.791	-0.396	0.314	0.265	0.868***
COMESA_until2006	-0.492	0.0607	-0.362***	0.102***	0.0421	0.706***	-0.0396	-0.0776	-0.0973***	0.238***
ECCAS_after2006	1.112	0.547	0.309	1.451***	-1.939**	-1.532*	-0.694*	-1.116**	-0.207	0.878***
ECCAS_until2006	1.949*	1.179**	0.816**	0.0240	-1.604***	-1.458***	-0.595**	3.312***	-0.526*	0.379
ECOWAS_after2006	3.129*	2.105***	0.0719	2.246***	-1.510**	-1.464*	-1.116**	0.211	-0.116	1.147***
ECOWAS_until2006	2.669**	-0.679*	0.0472	-0.364***	-1.105***	0.0704	-0.380	0.191	0.167**	-0.0598
EAC_after2006	-1.048	0.645	0.232	-1.230***	0.332	-0.545	-1.216***	0.358	3.733***	0.954**
EAC_until2006	-0.474	-0.490	0.223	0.334	-1.284**	-1.518**	-0.00432	-5.485***	1.030*	-0.783*
IGAD_after2006	6.430***	-3.718***	-0.0788	0.0205	0.975	1.317*	1.037**	-2.223***	-0.197	0.163
IGAD_until2006	8.138***	-1.863**	0.0674	-0.555*	-0.529	-1.258*	0.942***	-2.127*	-0.570	-0.255
SADC_after2006	5.682***	-1.266*	0.445	1.148***	-1.626**	-0.620	0.275	-0.832*	0.0254	0.314
SADC_until2006	9.345***	-0.574*	0.672**	0.106	0.329	0.824**	0.859***	0.356***	-0.300*	0.404***
N	31904	31904	10352	10352	10352	10352	10352	10352	10352	10352

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

creation effects are also observed in COMESA (in four commodities), CENSAD (in four commodities) and in AMU (in two commodities). In the case of IGAD and ECCAS, however, trade creation is negative and significant for large number of commodities after 2006 than before 2006 implying loss of trade creation.

Trade creations may come at the expense of trade diversion. Table 8 compares trade diversion for the period 1998-2006 and 2007-2010 for each of the nine selected agrifood commodities. Results on table 8 indicate higher or more trade diversion for some commodities but less trade diversion or more openness for others. The trend, however, is clearly reflected when one looks at the trade diversion effect for all the agrifood commodities (regression 10). It seems that there is more openness of African RTAs to the rest of the world for the period after 2006 than before. The only slight exception in this regard is SADC. Even in SADC, the trade diversion coefficient for the period after 2006 is positive but statistically insignificant. When this is compared to the positive and statistically significant coefficient for the period before 2006, the level of openness of the SADC economy to the rest of the world has come down.

Net effect:

Table 9 compares net trade creation effects for the period before 2006 and after 2006. The net effect is positive trade creation effect for all RTAs in post 2006 except IGAD where the net trade creation effect is negative. Comparing the net trade creation effect of the two periods, net trade creation effect is higher in the period post 2006 than before in six RTAs. Net trade creation effect deteriorated only in IGAD and ECCAS. In the case of the former, net trade creation effect moves from zero to negative and that of the later, the net trade creation effect remained positive but has declined in magnitude.

Table 9: Comparison of net trade creation effect before and after 2006

	2007 – 2010			1998 - 2006		
	Trade Creation	**Trade Diversion**	**Net Effect**	**Trade Creation**	**Trade Diversion**	**Net Effect**
AMU	1.986**	0.931***	2.917	1.047	0.541*	0.541
CENSAD	-0.909***	0.933***	0.024	-1.223***	-0.194	-1.223
COMESA	1.804***	0.868***	2.672	0.427***	0.238***	0.665
ECCAS	-0.0821	0.878***	0.878	5.077***	0.379	5.077
ECOWAS	3.451***	1.147***	4.598	-0.0746	-0.0598	0
EAC	-0.187	0.954**	0.954	-5.328***	-0.783*	-6.111
IGAD	-1.471*	0.163	-1.471	-0.187	-0.255	0
SADC	5.136***	0.314	5.316	0.197***	0.404***	0.601

4.3. Implications to food security

The analysis in previous sections demonstrates that regional integration of the selected agrifood markets in Africa is partial. For some of the selected agrifood commodities, trade creation effect is positive and significant and for others not. Similarly, trade diversion is negative and significant for some commodities and for others it is positive and statistically significant implying higher level of openness of the African trading blocs to outside members. Looking at the net effect for the total agrifood commodities, net trade creation has been seen in four trading blocs and net trade diversion in three trading blocs. In one trading bloc, the net trade creation is zero.

What does this mean for regional food security and sustainable agricultural development? This implies that the regional integration has not led to substantial allocation effects and the expected decrease in food prices caused by efficiency gains. Hence, the direct effect of African RTAs on food security, although different among trading blocs, seems to have been small. Although accumulation effects can have a potentially much larger and positive effect on improving food security by stimulating agricultural development and poverty reduction due to its dynamic nature, taking into account that allocation effects have been small, it seems likely accumulation effects have also been limited.

This does not mean that more and better regional integration does not offer important opportunities to improve food security in Africa. The above results also partly support this at least for some of the RTAs. As shown in table 1, intra-regional agriculture and food trade in Africa is relatively low in comparison with intra-regional agricultural trade in other regions. This means there is sufficient scope for expansion. In the sub-section that follows, we show the potential implication of regional integration in Africa to food security by comparing regional production instability index with individual countries instability index.

4.3.1. Production variability and intraregional trade potential

Empirical evidences lead to the conclusion that food consumption in a region will be more stable if its production is more stable than that in individual countries and if trade between countries is allowed (Koester, 1986). Following Koester (1086), Badiane (1991) and DeRosa (1995), food security is analysed here with reference to the instability of year-to-year food production (relative to their trend) which holds implications ultimately for the variability of food prices.

Instability is measured with the Cuddy Della Valle Instability index (Cuddy and Della Valle, 1978). The index is a modification of CV to accommodate for trend, which is commonly present in time series economic data. It is based on the coefficient of variation corrected by the fitness of a trend function. Thus,

$$I = CV\sqrt{1 - \bar{R}^2}$$

Where CV is the coefficient of variation and $\bar{R}^2$ is the adjusted coefficient of determination of an arithmetic linear or log-linear trend function. Formulated by Cuddy and Della Valle (1978), this index provides a cardinal measure of the instability of time series data relative to their respective trends. The instability of domestic production series indicates the food security circumstances that would prevail in countries under autarky.

Instability indexes (I), which are corrected coefficients of variation, have been calculated for ten of the twelve strategic agricultural products identified by the African Union on the basis of data from 1991-2012 for each of the eight RECs member countries[3]. Table 10 present the instability index of individual countries and the corresponding regions instability index. Thus one can see the relationship between the regions instability index and those of the individual countries.

One general observation from the individual countries instability index is that production of the strategic agricultural products is highly volatile almost in all African countries whose production data is available. For all countries where production data is available, production fluctuations are more than 10%. Some of the strategic products particularly oil palm and to some extent groundnut are produced in a few of the RECs. Production of oil palm is reported only for ECCAS and ECOWAS.

Table 10 reveals that there are wide differences in individual countries instability index when compared to their region's instability index. For some products, regional instability index exceeds individual country's instability index. ECOWAS is the region with high volatility of production at regional level than at country level. For eight of the ten strategic agricultural products considered, regional instability index is higher than some member states instability index. This means that the countries with lower instability index than the regional index would not gain if integration is enhanced. This indicates that national incentives to cooperate regionally can vary widely. Next to ECOWAS, CENSAD reveals higher regional instability index than individual countries instability index for five strategic agricultural products namely legumes, maize, rice, sorghum and sugar. IGAD comes in third place with regional instability index exceeding some members' instability index in three products. These three RECs are the ones that revealed a net trade diversion effect in section 4.1 above. For the remaining RECs, regional instability index exceeds some member states instability index for either two products (in the case of EAC, ECCAS and SADC) or only one product (in the case of AMU).

To sum up, instability index at regional level is much lower than individual countries instability index for most strategic agricultural products in many of the RECs. This implies the fact that regional integration in Africa can enhance stability of production of the strategic

[3] Data for period 1991-2012 was obtained from FAOSTAT, 2015. For a significantly large number of countries, production data is missing either because the countries do not produce the products or it was not reported. Regional instability indices were constructed using the available data.

agricultural products significantly which in turn can improve food availability and hence food security.

Table 10: Instability of Strategic Agricultural Products production in Africa by REC, 1991 - 2012

		Strategic Agricultural Products									
REC	**Country**	**Beef**	**Dairy**	**Groundnut**	**Legumes**	**Maize**	**Oil Palm**	**Poultry**	**Rice**	**Sorghum**	**Sugar**
AMU											
	Algeria	19.1	22.9	--	42.8	238.6	--	18.4	148.4	--	--
	Mauritania	--	--	--	--	144.6	--	--	--	--	--
	Morocco	20.2	17.4	--	32.6	50.4	--	22.7	56.6	--	14.3
	Tunisia	--	11.4	--	44.3	--	--	16.8	--	--	73.3
	AMU	9.7	10.2	--	25.3	49.9	--	12.6	55.6	--	15
CENSAD											
	Benin	--	--	--	--	--	--	--	177.8	168	--
	Burkina Faso	--	--	42.2	36.5	31.2	--	--	73.4	31.8	--
	Chad	108.2	--	--	--	--	--	--	121.4	119.8	--
	Comoros	--	--	--	--	--	--	--	--	--	--
	Cote D'voire	21	23.5	23.1	41.7	13.7	--	26.6	60.6	102.9	19.4
	Egypt	26.4	21.7	36	20.6	12.2	--	27.1	20	17.5	32.9
	Eritrea	--	29	76.4	66.6	55.4	--	41.4	--	77.9	--
	Ghana	49.4	--	35.5	--	16.9	--	43.8	25.1	31.9	--
	Guinea	19.4	20.4	32	--	19.9	--	33.9	45.4	33.4	--
	Guinea-Bissau	109.2	119.6	--	--	85	--	108.4	43.1	36.8	--
	Gambia	19.1	--	24.3	--	35.1	--	23.4	65.9	39	--
	Kenya	22.4	28.8	41.6	34.7	16.5	--	24.1	82.4	44.2	22.2
	Mali	39.8	51.6	47.7	37.6	53.5	--	39.2	51.4	53.6	--
	Morocco	20.2	17.4	16.9	32.6	51.6	--	22.7	56.6	37.7	14.3
	Niger	--	--	76.5	59.3	68.6	--	--	48.8	66.6	15.4
	Nigeria	45.1	36.1	36.8	57.8	47.3	--	40.8	51.6	52.1	--
	Senegal	--	29.7	41.8	61	55.1	--	57.8	61.3	50.1	20.4
	Sudan	--	34.5	57.9	33.4	77.4	--	45.4	58	85.9	71.2
	Tunisia	--	11.4	--	44.3	--	--	--	--	--	73.3
	Togo	--	--	32	60.6	20.8	--	16.8	41	36.6	--
	CENSAD	13.7	7.3	14.9	34.8	24.4	--	13.3	23.2	32.3	19.1
COMESA											
	Burundi	28.6	45	--	27.1	28	--	43.5	40.4	33	--
	Comoros	--	--	--	--	--	--	--	--	--	--
	Egypt	26.4	21.7	36	20.6	24.6	--	27.1	20	17.5	32.9
	Eritrea	--	29	76.4	66.6	74.2	--	41.4	--	77.9	--
	Ethiopia	--	42.6	103.1	57.3	44.1	--	--	115.8	50.5	28.8
	Kenya	22.4	28.8	41.6	34.7	28.6	--	24.1	82.4	44.2	22.2
	Madagascar	37.3	--	30.8	23.1	40.8	--	24.7	31.7	--	97.5
	Malawi	44.4	--	38.6	45.1	54.6	--	--	49.7	48.4	--
	Mauritius	--	48	93.5	34	--	--	--	--	--	85.6
	Rwanda	44.4	27.3	40.3	42	97.3	--	46.3	51.9	27.4	56.9

	Sudan	--	34.5	57.9	33.4	81.5	--	57.8	58	85.9	71.2

Table 10 (cont'd)

		Strategic Agricultural Products									
REC	**Country**	**Beef**	**Dairy**	**Groundnut**	**Legumes**	**Maize**	**Oil Palm**	**Poultry**	**Rice**	**Sorghum**	**Sugar**
	Zambia	--	--	--	--	--	--	--	--	104.1	--
	Zimbabwe	--	--	--	--	--	--	--	--	230.2	--
	COMESA	19.9	9.5	30.7	14.7	14	--	20.2	13.6	43.9	33.3
EAC											
	Burundi	28.6	45	--	27.1	28	--	43.5	40.4	33	--
	Kenya	22.4	28.8	41.6	34.7	28.6	--	24.1	82.4	44.2	22.2
	Rwanda	25.8	27.3	40.3	42	41.9	--	46.3	51.9	27.4	56.9
	Tanzania	--	24.8	37.7	49	40.5	--	--	--	43.1	--
	EAC	19.9	25.2	30.7	21.2	21.5	--	18.8	27.1	32.4	21.7
ECCAS											
	Angola	--	--	--	--	--	--	--	222.9	252.8	--
	Burundi	28.6	45	--	27.1	28	--	43.5	40.4	33	--
	Cameroon	--	39	39.8	23.1	35.6	40.8	39.8	47.7	31.9	--
	Congo	52	--	29.1	29.9	28.9	40.1	28.5	212.1	--	32.8
	Rwanda	34	27.3	40.3	42	97.3	--	46.3	51.9	27.4	56.9
	Chad	108.2	--	--	--	--	--	--	121.4	119.8	--
	ECCAS	49.2	13.4	22.4	15.1	24.8	37.7	27.5	36.7	31.5	31.9
ECOWAS											
	Benin	--	--	--	--	--	--	--	177.8	168	--
	Burkina Faso	--	--	42.2	36.5	54.6	--	--	73.4	31.8	--
	Cote D'voire	21	23.5	23.1	41.7	19.4	44.1	26.6	60.6	102.9	19.4
	Cape Verde	26.6	42.5	--	212.8	69.5	--	40.1	--	--	--
	Ghana	49.4	--	35.5	--	31.9	18.4	43.8	25.1	31.9	--
	Gambia	19.1	--	24.3	--	47.5	21	23.4	65.9	39	--
	Guinea	19.7	20.4	32	--	22.7	24.9	33.9	45.4	33.4	--
	Guinea-Bissau	109.2	--	--	--	88.2	109.5	108.4	43.1	36.8	--
	Madagascar	--	--	30.8	--	--	0	0	0	0	0
	Mali	39.8	51.6	47.7	37.6	78.2	--	39.2	51.4	53.6	--
	Niger	--	--	76.5	--	95.2	--	--	48.8	66.6	15.4
	Nigeria	45.1	36.1	36.8	57.8	52.3	--	40.8	51.6	52.1	--
	Senegal	--	29.7	41.8	60.1	68.1	--	--	61.3	50.1	20.4
	Togo	--	--	32	60.6	35.9	--	45.4	41	36.6	--
	ECOWAS	28.8	23.5	19.9	51.4	37.3	29.2	26.1	32.9	40.3	11
IGAD											
	Eritrea	--	29	76.4	66.6	74.2	--	41.4	--	77.9	--
	Ethiopia	--	42.6	103.1	57.3	44.1	--	--	115.8	50.5	28.8
	Kenya	--	28.8	41.6	34.7	28.6	--	24.1	82.4	44.2	22.2
	Sudan	--	34.5	57.9	33.4	81.5	--	57.8	58	85.9	71.2
	IGAD	--	12.8	51.5	27.2	24.3	--	49.5	43.1	53.8	26.5
SADC											
	Angola	--	--	--	--	--	--	--	222.9	252.8	--

	Botswana	--	41.3	--	--	98.7	--	--	--	74.5	--

Table 10 (cont'd)

		Strategic Agricultural Products									
REC	**Country**	**Beef**	**Dairy**	**Groundnut**	**Legumes**	**Maize**	**Oil Palm**	**Poultry**	**Rice**	**Sorghum**	**Sugar**
	Congo	52	--	--	--	--	--	--	--	--	--
	Lesotho	--	--	--	--	--	--	--	--	--	--
	Madagascar	37.3	--	--	23.1	40.8	--	24.7	31.7	--	97.5
	Malawi	41.4	--	38.6	45.1	54.6	--	--	49.7	48.4	--
	Mauritius	--	48	93.5	34	--	--	--	--	--	85.6
	Mozambique	42	19.4	33.4	--	58	--	32.6	72.9	60.4	47.5
	Namibia	--	39.6	--	--	62.1	--	41.3	--	59.6	--
	South Africa	35.6	22.3	34.8	18.1	30	--	27.9	--	37.5	17.6
	Tanzania	--	24.8	37.7	49	40.5	--	--	--	43.1	--
	Zambia	--	--	--	--	--	--	--	--	104.1	--
	Zimbabwe	--	--	--	--	--	--	--	--	230.2	--
	SADC	26.5	18.5	15.9	19.8	15.9	--	23.8	27.5	30.1	45.3

5. Conclusion

Agriculture continues to dominate the economies of most African countries and is an important vehicle for economic growth. The sector continues to produce the bulk of food consumed in Africa, employs a significant proportion of the labour force and accounts for significant proportion of exports and GDP in many countries. Despite the importance of agriculture in their economies, trade in agricultural products amongst the African countries remains at a relatively low level. It is increasingly being recognized that African food and agricultural markets are extremely fragmented along sub-region, national and even sub-national levels, resulting in segmented markets of sub-optimal size which hinder the profitability of sizeable private investment in the different stages of the commodity chain.

The problems of food security and sustainable agricultural development have been at the forefront of the debate on Africa's development since the Lagos plan of Action in 1963 and the Abuja Treaty of 1991. In the December 2006 AU/NEPAD summit on Food Security in Africa, a practical solution to this problem evolved. Few strategic commodities, that represent important weight in African food basket, weigh significantly in the trade balance in the region and have considerable unexploited production potential, were identified and decided to move market integration beyond the current pace of reform to create a free trade zone at the continent level.

The objective of this research is to evaluate the trade creation effects on the selected agricultural products. It addressed the fundamental question of what effect RTAs in Africa have had on trade of the selected agricultural products, and what is the implication of this on food security. To answer this question, we developed an extended gravity model to estimate the magnitude of trade creation and trade diversion across 9 individual agrifood commodities

and for 8 RTAs. To address issues of how to handle zero trade values among pairs of countries, and hetroskedasticity problem which is common in trade data, we used PPML method.

The results indicate that RTAs in Africa have mixed effects on trade creation on the nine agrifood commodities. Looking at commodity-specific effects of African RTAs, we observe that the highest trade creation effect is shown in SADC with a positive and significant trade creation effects in 7 out of nine agrifood commodities, followed by EAC and COMESA with positive and significant trade creation effect on 5 out of nine commodities each, IGAD in 4 out of 9, ECOWAS in 3 out of 9 and the least being in AMU, ECCAS and CENSAD with positive and significant trade creation effects in 2 out of 9 commodities each for AMU and ECCAS and in only one commodity for CENSAD.

Similarly, trade diversion occurred for some of the agrifood commodities in the African RTAs the exception being SADC. In SADC trade creation for each of the individual commodities considered did not come at the expense of diverting trade from non-member states to member states. Rather, the level of openness to non-member states has increased with more imports into SADC from outside member states in six of the nine agrifood commodities.

Trade diversion occurred in four out of nine commodities for EAC and ECCAS; in three out of nine commodities in IGAD, ECOWAS, COMESA and AMU; and in one case for CENSAD. For all RTAs where trade diversion occurred, the loss in diversion is not fully offset by gain in creation except for COMESA. In COMESA, the trade diversion effects shown on three cases are more than offset by trade creation in the same commodities.

Although the welfare effects are ambiguous when trade creation and trade diversion effects occur, comparison of trade creation and trade diversion for total agricultural commodities reveal that in four of the 8 African RTAs, trade creation far outweighs trade diversion leading to net trade creation effects and hence welfare gain. But in three RTAs, trade diversion exceeds trade creation leading to a net trade diversion and hence welfare loss. Only in one case, trade creation is similar to trade diversion and hence difficult to tell the welfare effect.

Are regional trade agreements in Africa building blocks or stumbling blocks in the market integration of agricultural products in Africa? What is the implication of this on food security and sustainable agricultural development?

Our extended gravity model results suggest that a majority of African regional trade agreements especially agreements like SADC are effective avenues to promote common market for agricultural products in Africa. Furthermore, for a significant number of individual agrifood commodities, regional trade agreements in Africa have increased openness to non-members' trade while increasing trade among themselves to some extent. This in particular is clearly seen for the period post 2006. Thus, RTAs in Africa are an attractive means to speed up the move towards common market for agricultural products in the continent. This will

have positive implications for food security and sustainable agricultural development on the continent. Furthermore, production instability index is smaller at regional level than at individual country level despite some exceptions. This indicates the potential to stabilize production of the strategic agricultural commodities which in turn can enhance food security if integration process in Africa RTAs is enhanced.

References

Badiane, O., 1991. Regional agricultural markets and development strategies in West Africa. Quarterly Journal of International Agriculture, 30(1): 37-50.

Blomstrom, M. And Kokko, A., 1997. Regional integration and foreign direct investment. NBER Working paper No. 6019, NBER, Cambridge, Mass.

Brun, J.F., Carrere, C., Guillaumont, P., and Melo, J. de., 2005. Has Distance Died? Evidence from a Panel Gravity Model. *World Bank Economic Review*, 19(1): 99-120.

Cernet, L., 2001. Assessing regional trade arrangements: Are South South RTAs more trade diverting? Policy Issues in International Trade and Commodities Study Series no. 16, United Nations, New York.

Cervantes-Godoy, D. & Dewbre, J., 2010. Economic Importance of Agriculture for Poverty Reduction, OECD Food, Agriculture and Fisheries Working Paper No. 23

Cuddy, J.D.A., and P.A. Della Valle, 1978. Measuring the instability of time series data. Oxford Bulletin of Economics and Statistics, 40: 79 – 85.

dell'Aquila, C., R. Sarker, and K.D. Meilke, 1999. Regionalism and Trade in Agrifood Products. Working Paper 99-5, International Agricultural Trade Research Consortium, St. Paul, MN.

DeRosa, D.A., 1995. International trade, food security and regional integration in the Middle East. TMD discussion paper no. 3, Washington, D.C., International Food Policy Research Institute.

Diao, X., T. Rae and Somwaru, A., 1999. What is the cause of growth in regional trade: Trade liberalization or RTA? The case of Agriculture. Working Paper 56, International Agricultural Trade Research Consortium, St. Paul, MN.

Dijk M.V., 2011. African regional integration: Implications for food security. Available at SSRN: http://ssrn.com/abstract=1788157, (accessed August 15, 2014).

Elbadawi, I., 1997. The impact of regional trade and monetary schemes on intra Sub-Saharan Africa trade, in Ademola O., Elbadawi, I. and Collier, P.(eds.), regional integration and trade liberalization in Sub-Saharan Africa, Macmillan, Houndmills, Basingstoke, London.

Evans, D., 1998. *Options for Regional Integration in Southern Africa*, IDS Working Paper 94, Sussex: Institute of Development Studies.

FAO, 2014. “The State of Food Insecurity in the World 2014. Strengthening the enabling environment for food security and nutrition”. Rome: Food and Agriculture Organisation of the United Nations.

FAO, 2010. The State of Food Insecurity in the World: Addressing food insecurity in protracted crises, Rome: Food and Agriculture Organisation of the United Nations.

FAO, 2008. Towards an African common market for agricultural products, Rome: Food and Agriculture Organisation of the United Nations.

Flores, R. Jr., 1997. The Gains from MERCOSUL: A general equilibrium, imperfect competition evaluation, *Journal of Policy Modeling.* 19(1): 1-18.

Frankel, J., 1997. "Regional Trading Blocs in the World Economic System." Institute for International Eco-nomics, Washington, DC.

Frankel, J., Stein, E. and Wei, S.J., 1995."Trading Blocs and the Americas: The Natural, the Unnatural, and the Super Natural." J. Dev. Eco., 47: 61-95.

Frankel, J., and Wei, S.J., 1998. "Regionalization of World Trade and Currencies: Economics and Politics." In Frankel, j. (ed.), The Regionalization of the World Economy. National Bureau of Economic Research. Chicago: University of Chicago Press.

Grant, J., H. and Lambert, D., M., 2005. Regionalism in world agricultural trade: lessons from gravity model estimation. Selected paper prepared for presentation at the American Agricultural Economics Association annual meeting, Providence, Rhode Island, July 24 – 27, 2005.

Grossman, G.M. and Helpman, E., 1995. Technology and trade, in Grossman G.M. and Rogoff K. (eds) Handbook of International Economics, volume 3, 1995

Gilbert, J., Scollay, R., and Bora, B., 2011. Assessing regional trading arrangement in the Asia-Pacific. Policy Issues in International Trading and Commodities Study Series No. 15, United National Conference on Trade and Development, New York.

Halvorsen, R., and Palmquist, R., 1980. "The Interpretation of Dummy Variables in Semilogarithmic Equa-tions." Am. Eco. Rev., 70: 474-475.

Hertel, T.W., W.M. Masters, and M. Gehlhar, 1999. Regionalism in World Food Markets: Implications for Trade and Welfare, in G.H. Peters and V.T. von Braun, (eds.), Food security, diversification and resource management: Refocusing the role of agriculture. Aldershot,U K:A shgateP ress.

Jayasinghe, S. And Sarker, R., 2007. Effects of regional trade agreements on trade in agrifood products: Evidence from gravity modelling using disaggregated data. Review of Agricultural Economics, volume 30 (1): 61-81.

Koester, U., 1986. Regional cooperation to improve food security in Southern and Eastern African countries. Research report 53, Washington, D.C., International Food Policy Research Institute.

Krueger, C., 2000. Trade creation and trade diversion under NAFTA, NBER Working Paper No. W7429. National Bureau of Economic Research, Cambridge, MA.

Krugman, p., 1991. Geography and trade, in Gaston Eyskens lecture series, MIT press, Cambridge, Mass

Lewis, J. D., Robinson, S. and Thierfelder, K., 1999. "After the Negotiations: Assessing the Impact of Free Trade Agreements in Southern Africa", *TMD Discussion Pape*r. Washington: International Food Policy Research Institute.

Mayer, T. & Zignago, S., 2011. Notes on CEPII's distances measures : the GeoDist Database *CEPII Working Paper*

Mundell, R., 1964. Tariff preferences and the terms of trade, Manchester School of Economic and Scocial Studies, No. 1.

Santos Silva, J. and Tenreyro, S., 2006. "The log of gravity", The Review of Economics and Statistics 88: 641-58.

Sattayanuwat, W., 2011. Essays on international trade and Foreign direct investment. *Dissertations and Theses from the College of Business Administration, University of Nebraska, Lincoln.* Paper 18. Available at http://digitalcommons.unl.edu/businessdiss/18 (accessed on 20 August 2014)

Schiff, M., 1997. "Small is beautiful: Preferential trade agreements and the impact of country size, market share, and smuggling", *Journal of Economic Integration,* 12: 359–87.

UNCTAD, 2009. Economic Development in Africa Report 2009: Strengthening Regional Economic Integration for Africa' Development, New York and Geneva.

UNCTAD, 2013. UNCTADstat, available at http://unctad.org/en/pages/Statistics.aspx (accessed on 20 March 2014).

Venables, T., 1999. Regional integration agreements: A force for convergence or divergence? Policy Research Working Papers No. 2260, World Bank, Washington, D.C.

Viner, J., 1950. "The Customs Unions Issues." Carnegie Endowment for International Peace, New York.

Vollrath, T., 1998. RTAs and Agricultural Trade: A Retrospective Assessment. Regional Trade Agreements and U.S. Agriculture, in M.E. Burfisher and E.A. Jones (eds.), AER No. 771, U.S. Department of Agriculture, Economic Research Service, Washington, DC.

Winters, L.A., 1993. The European community: A case of successful integration, in De Melo and Panagariya (eds.), New dimensions in regional integration. Cambridge University Press, Cambridge, New York and Melbourne.

World Bank, 2000. Trade Blocks, Policy Research Report. Oxford University Press, Ney York, N.Y. 10016.

UNCTAD/WTO, 2012. A practical guide to trade policy analysis. Available at: http://vi.unctad.org/tpa (accessed on 10 August 2014).

Yeats, A., 1998. What can be expected from African Regional Trade Arrangements? Some empirical evidence, World Bank, mimeo.

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