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Research Area
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Abstract

The most recent literature on international trade highlights the key role of global value chains (GVCs) in structural transformation, development and growth. The common perception is that Africa, unlike most Latin American and Asian countries, has neither been able to intercept the main changes in trade patterns nor enter massively into global production networks. This work provides some insight into this topic. Using the EORA Input-Output Tables, we analyze whether bilateral import tariffs and shifts in trade regimes associated with regional trade agreements affect the backward participation (i.e., the use of foreign inputs for exports) and forward participation (i.e., the use of domestic intermediates in third country exports) of the SSA countries' agriculture and food GVCs. Our results show that, despite their low world trade shares, GVC participation in SSA economies is increasing over time, mainly upstream as suppliers of unprocessed inputs. Furthermore, we show that the value added demand for SSA agricultural products primarily originates from the EU and emerging countries rather than from regional partners. Finally, by making use of a "gravity-like" identification strategy, we also find evidence that bilateral trade protection significantly affects GVC backward and forward participation in agriculture and food. These results call for a refinement of trade policy priorities in SSA.

Keywords: global value chains, agro-food activities, multi-region input-output tables, bilateral trade policies, gravity model, Sub-Saharan Africa.

JEL codes: F15, L23, O11, O55, Q17.

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1. Introduction

Since the last decade of the 20th century, the so-called agri-food global value chains (GVCs) keep growing as more products cross national borders and the international production networks become more organized under the lead of modern food processors and retailers (Lee et al., 2010; De Backer and Miroudot, 2014). The common wisdom is that the emergence of GVCs can represent a golden opportunity for supporting the on-going transformations of Sub-Saharan Africa, especially in agriculture and food markets, which could move from a subsistence oriented and farm-centered agri-food system to a more commercialized, productive and off-farm centered activity (IMF, 2015; Greenville et al., 2016).[1] A growing number of analyses highlight that GVC participation may stimulate public and private investments in infrastructure that would otherwise not be profitable, and spur local production in the agriculture sector through minimum scale achievements. This can translate into more competitive market restructuring effects potentially benefitting not only GVC suppliers, but also non-GVC participants (Del Prete et al., 2016b). By generating higher and more stable incomes, higher GVC participation can also have important spillovers on the food security of small-holder farmers since it is associated with increasing employment, better remunerated jobs, use of resources, governance, and political stability (Minten et al., 2009; Bellemare, 2012; Cattaneo et al., 2013; Swinnen, 2014; Swinnen and Vandeplas, 2014; Bellemare et al., 2016; Montalbano et al., 2017).

Despite these potential benefits, the economic literature did not have the chance until recently to: 1) quantitatively assess the participation and integration of SSA countries in the agriculture and food GVCs and – consequently – 2) formulate any evidence-based policy recommendations on how to increase this participation. In the first case, the lack of reliable measures raises concerns because the conventional trade statistics based on gross export flows are unable to capture the increasing role of vertical integration and product fragmentation. Nowadays, since different stages of the same production process are allocated to different countries, intermediate inputs cross borders multiple times. As a result, the final producer appears to capture most of the value of goods, while the role of countries providing inputs upstream – such as SSA countries in the agricultural and food supply chains – could be largely underestimated (Koopman et al., 2014). Indeed, assessing the level of SSA participation implies unpacking the different phases of the production process to identify the amount of each country's contribution to trade flows in terms of value-added[2]. This exercise has proved to be extremely data demanding since it requires the use of multi-region input-output tables (MRIO) capable of disaggregating the structure of the world economy between countries and sectors. Such a comprehensive database with information on Sub-Saharan countries was not available until recently when the EORA database was released (Lenzen et al., 2012; 2013).

In the second case, the spectrum of policies that can potentially influence GVC participation in agriculture and food is certainly wide. It ranges from agricultural-specific interventions aimed at increasing country's competitiveness and specialization to more general supportive policies that are capable of creating the right

[1]Some scholars stress that the impact of globalization on the structural transformation of Africa is occurring mainly via foreign direct investment (FDI) and – to a less extent – via international trade (Reardon and Timmer, 2007). According to this strand of the literature, in most developing countries, the liberalization of the FDI in the food industry during the 1990s allowed the diffusion of supermarkets, the transition from local sourcing to global procurement networks, and the diffusion of public and private standards (Reardon et al., 2009).

[2]In this work, the modalities of the supply chain relationships (e.g., sequential, roundabout, inside-outside firms; bargaining or market clearing input prices, etc.) are not relevant. This is a clear advantage because of the strong heterogeneity of GVCs in this dimension.

market environment for boosting production, processing, wholesale, retail, and export activities.[3] Among these, this paper focuses attention on the effect of trade policies which have been theoretically and empirically analyzed only recently in light of the emergence of GVCs (Antràs and Staiger, 2012; Blanchard and Matschke, 2015; Gawande et al., 2015; Caliendo et al., 2016). In particular, our aim is to study whether bilateral import tariffs and shifts in trade regimes associated with regional trade agreements (RTAs) affect the backward participation (i.e., the use of foreign inputs for exports) and forward participation (i.e., the use of domestic intermediates in third country exports) of the SSA countries' agriculture and food GVCs. The channels through which these policies are linked to the international fragmentation of production are not straightforward. The most recent literature underlines two potential effects of bilateral protection: i) the well-known "magnification effect" for which, on the one hand, goods that cross national borders multiple times incur tariffs several times and, on the other hand, the fact that tariffs are applied to gross imports, even though value added by the direct exporter may be only a fraction of this amount. Different ways of participating in global production chains affect the extent to which different countries are affected by this cost magnification (Yi, 2003; 2010); ii) a further "chain effect" which influences all the upstream and downstream activities of GVCs and, consequently, a country's backward and forward participation. In terms of forward participation, all else equal, domestic tariffs on imports may have a depressing impact also on the domestic value added content embodied in partner countries' exports. In terms of backward participation, tariffs on imports pass some of the benefits of protection from the domestic supplier of final goods on to their foreign suppliers of inputs. This could represent an incentive to foreign suppliers to move to countries/sectors characterized by higher tariffs to benefit from protectionist rents (Blanchard et al., 2016). Also, while the majority of observed bilateral preferences are unilateral, some of them are the result of free trade agreements or customs unions which can affect GVC participation differently and enlarge the notion of preferential trade regimes, including rules of origins and possible non-tariff issues such as general regulatory policies (Curran and Nadvi, 2015).

The relevance of the link between trade policies and participation in GVCs in the agricultural and food sector is remarkable for several reasons. First of all, the SSA countries' protection in these two sectors is the highest in the world with a high incidence of both tariff peak products and tariffs applied as specific duties, suggesting that there is a discrete margin for intervention (Bown and Crowley, 2016; Caliendo et al., 2016). Indeed, policy makers often pursue the stabilization of their domestic markets and isolate consumers from negative events in world markets mainly by means of trade barriers. A good example is the recent 2007/08 food price crisis in which a number of SSA governments imposed export restrictions and varied import duties in an attempt to insulate domestic consumers from rapidly rising international food prices (Anderson and Masters, 2009; Abbott and De Battisti, 2011; Anderson and Nelgen, 2012; Magrini et al., 2017). Second, understanding if and how trade policies incentivize or penalize SSA countries' participation in GVCs would be extremely relevant in a region where agriculture still generates about 25% of GDP (50% if we look at the broader agribusiness sector) and involves roughly 65% of the local population, mostly in family farming activities. Finally, the emerging interdependence between smallholders in exporting countries and processors and retailers in importing ones exacerbates the negative effects of these protectionist measures: even relatively low tariffs can have significant knock-on consequences for a chain such as discouraging foreign outsourcing (Yi, 2003) and the development of within-firm

[3]A recent strand of the empirical literature investigates the determinants of developing countries' involvement in GVCs (Elms and Low, 2013; Kowalski et al., 2015; Greenville et al., 2016; Taglioni and Winkler, 2016) and identifies a number of pre-conditions to be developed such as adequate professional skills and human capacity, efficient ancillary services (e.g., electricity, telecommunication capabilities, etc.) and more efficient physical infrastructure for transport and logistics (e.g., roads, railroads, airports, and ports).

vertical production networks (Hanson et al., 2005). In this perspective, GVCs may provide new scope for deeper bilateral and multilateral trade agreements, well behind the standard terms-of trade motives (Olper, 2016).

To the best of our knowledge, this paper is the first attempt to assess SSA GVC participation in agriculture and food and provide empirical evidence on the impact of trade policies on its forward and backward components. By applying the bilateral gross exports decomposition method developed by Wang et al. (2013) to the MRIO data, we provide two main contributions to the literature: i) an extensive investigation of sectoral and bilateral SSA GVC participation in agriculture and food; ii) a set of sound empirical "gravity like" tests to estimate the impact of bilateral trade protection in these sectors (net of multilateral integration) on the total, backward and forward participation of the SSA countries.

Our findings are consistent with the most recent literature and suggest that Africa is more integrated into GVCs than many other developing regions (Foster-McGregor et al., 2015). It also highlights that global linkages have been increasing over time even if much of Africa's participation in GVCs is essentially in upstream production activities, specializing in providing primary inputs to firms in countries further down the value chain (Del Prete et al., 2016a). Furthermore, we show that the value added demand for SSA agricultural products primarily originates from the EU and emerging countries rather than from regional partners. Finally, our gravity-like estimates reveal that bilateral trade policies are key determinants of both backward and forward GVC participation in agriculture and food for the SSA countries analyzed. In other words, these trade policies appear to have an important "chain effect" suggesting that a trade restriction imposed by one country actually impacts both other countries and itself through trade linkages. This has strong policy implications since optimal tariff policy no longer primarily depends on the location of the importing goods, but on the nationality of the value added content embodied in traded goods. In short, given the changes in the trade network that have taken place over the last twenty years, a new "thinking value chain" in trade policy should also be implemented (Hoekman, 2014).

The remainder of the paper is organized as follows: Section 2 presents the methodology for decomposing trade in value added and computing measures of backward and forward GVC participation. Section 3 provides a comprehensive map of agro-food GVC participation in SSA and relative trade partners. Section 4 describes the identification strategy and presents the outcomes of the empirical analysis. Section 5 provides some robustness checks whereas Section 6 concludes and suggests policy implications.

2. Measuring GVC participation: the methodological approach

Different stages of the same production process are now likely to be allocated to different countries while intermediate inputs cross borders multiple times and are then counted each time by gross trade flows. Consequently, conventional trade statistics become increasingly misleading as a measure of value produced by any particular country. The recent availability of new input-output data combined with bilateral trade statistics allows the sources and destinations of trade flows to be measured in value-added terms and gross exports to be decomposed into various components: the domestic value added (DVA); the foreign value added (FVA) and the

"pure double counting" term (PDC). The latter arises when intermediate goods cross borders multiple times[4] (Koopman et al., 2014). Looking at trade from this perspective better reveals how upstream and downstream domestic industries contribute to exports as well as how much (and how) they participate in GVCs (see, *inter alia*, Hummels et al., 2001; Johnson and Noguera, 2012; OECD, 2013; Timmer et al., 2015).

The trade flows in value-added and the measures of GVC participation are calculated using the methodology developed by Wang, Wei and Zhu (2013), hereafter WWZ. The authors generalize the gross exports accounting framework proposed by Koopman et al. (2014) from a country-level perspective to one that decomposes gross trade flows at the sector, bilateral, or bilateral-sector level. The WWZ framework is particular informative because it not only allows us to extract value added exports from gross exports, but also to recover additional useful information on the structure of international production with a high level of disaggregation. In this exercise, we calculate the indicators at their finest level which relies on the decomposition of the bilateral-sector trade flows. In the WWZ decomposition of bilateral-sector gross exports, each main component (i.e. DVA, FVA and PDC) is further disaggregated into sixteen value-added and double counting terms (see Figure 1A and Figure 2A in the Appendix). For the purpose of our analysis, we exploit some of these sixteen terms to retrieve three main components of value added exports:

i) the direct domestic value added (DirDVA), that is, the domestic value added absorbed by direct importers (calculated as the sum of the terms T1 and T2 of the WWZ decomposition, see Figure 1A). Since this component is the result of a single exchange of goods involving two countries, we do not use DirDVA as a measure of GVC participation;

ii) the indirect domestic value added (DVX), that is, the domestic value added in intermediate goods further re-exported by the partner country (i.e., from T3 to T8 in Figure 1A). The DVX is a proxy for the joint participation of the bilateral trade partners in a GVC since it contains the exporter's value added of a specific sector that passes through the direct importer for a (or some) stage(s) of production before it reaches third countries (or eventually returns home[5]). More specifically, it captures the contribution of the domestic sector to the exports of other countries and indicates the extent of involvement in GVC for relatively upstream industries. We use this component as a measure of *forward* GVC participation;

iii) the foreign value added (FVA) used in the production of a country's exports, which consists of the value added contained in intermediate inputs imported from abroad, exported in the form of final or intermediate goods (that sums the terms from T11 to T15 of the WWZ decomposition, see Figure 2A). It captures the extent of involvement in GVC for relatively downstream industries. We use this component as a measure of *backward* GVC participation.

To isolate the dyadic relationship of the bilateral-sector trade flow which involves only the country pairs without any influence from third countries, we identify other two sub-components:

[4]Some of the terms in the PDC bucket double count value added originated in the home country, while other terms in the double count value added originated in foreign countries (WWZ, 2013).

[5]The returned value added (RDV) is the portion of domestic value added that is initially exported but ultimately returned home by being embedded in the imports from other countries and consumed at home.

iv) from the DVX, we aggregate only the share of re-exported domestic valued added that ultimately returns home exclusively via the partner country (DirRDV, T6 and T8 in Figure 1A);

v) from the FVA, we aggregate only the share of the foreign value added that comes from the direct importing country (MVA, T11 and T12 in Figure 2A).

Summing up the DVX, the FVA and the PDC components of a single country across all partners for a specific sector, we get an overall measure of GVC participation (Rahman and Zhao, 2013; Cappariello and Felettigh, 2015; Borin and Mancini, 2015), namely the *GVC participation index* (Koopman et al., 2011) that we use for mapping agriculture and food GVC participation in SSA. The higher (or lower) the value of the GVC participation index, the larger (or smaller) the participation of a country in global supply chains.

3. Mapping agriculture and food GVC participation in SSA

In this section, we first describe the Agriculture and Food Global Value Chains in SSA, applying to the EORA Multi Region Input－Output (MRIO) database the WWZ decomposition depicted in Section 2, and then we focus on bilateral trade policy in the region.

The EORA Multi-Region Input－Output (MRIO) database brings together a variety of primary data sources including national I-O tables and main aggregates data from national statistical offices and combines these primary sources into a balanced global MRIO, using interpolation and estimation to provide a contiguous, continuous dataset for the period 1990-2013 (Lenzen et al., 2012; 2013).[6] The EORA tables are particularly useful since they provide access to each country's structure and function and also information on the interactions between trading partners. Hence, the world trading system can be viewed as a single entity with all trade flows reconciled in economic terms. EORA contains data for 186 countries - of which 43 are in SSA - and 25 harmonized ISIC-type sectors (see Table 11A).[7]

The left hand panel in Figure 1 shows the aggregate GVC participation in 2013 (the last available year) across regions, distinguishing between the FVA, DVX and DC components. As a preliminary remark, we can notice that the EU27and ASEAN countries are the most integrated in 2013.[8] Nevertheless, the SSA participation rate is surprisingly high (40%), matching the level found for China and India, in line with the previous literature applying different decomposition methods (see, among others, African Development Bank, 2015; Foster-McGregor et al., 2015; Kowalskiet al., 2015). This means that almost half of all trade activities in SSA are GVC-related. Then, looking at the different components of the GVC participation, Africa (especially North Africa) seems to be the best performer in providing value added to other countries in the world (DVX). About 25% of the domestic value added produced in SSA are inputs for other countries' exports (over 35% in the case of North Africa). As a comparison, these figures are in line with those of the Middle East region (25%) and higher than those of the EU,

[6]There are other similar efforts such as, for example, the Asian IO tables (IDE‐Jetro), the GTAP project, the OECD-WTO TiVA initiative and the WIOD project. However, none of them has the same extension in terms of country coverage and the same level of detail for end-use categories in Sub-Saharan Africa.

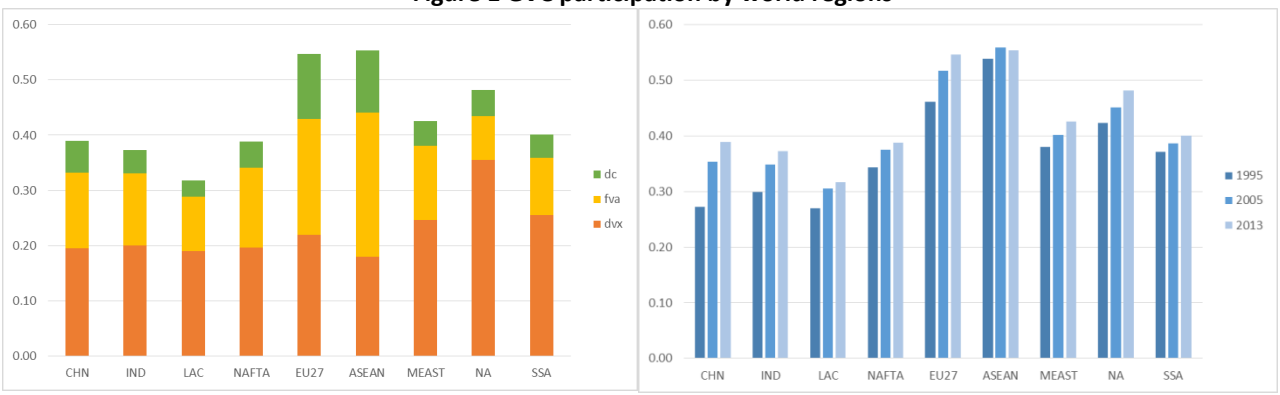
[7] We exclude from our analysis the recently born South Sudan (2011) and Sudan, and Zimbabwe for data inconsistency.

[8] Note that the reported measures tend to be inflated by intermediate flows between countries of the same region. This inserts a bias in favor of the EU relative to other large single countries or smaller regional groups (e.g., NAFTA).

China, and NAFTA that register rates of around 20% (see the DVX component in Figure 1a). Note, however, that as opposed to other methods, the WWZ methodology allows us to properly isolate the pure double counted term (i.e., DC in the figure) which appears to be substantial (e.g., 12% for the EU; 4% for SSA). Figure 1b, on the other hand, shows the emergence of the international fragmentation of production over the last two decades. Although GVC participation is increasing worldwide, China experienced the highest growth rate at 40% especially after WTO accession in 2001, whereas the SSA growth rate between 1995 and 2007 is about 7%.

In Figure 2 and Figure 3, we compute the sectoral contributions of agriculture and food to the measures of GVC participation described above. The sum across the sectors therefore equals the value of total GVC participation reported in Figure 1. Figure 2 shows that the SSA agricultural sector is the most involved in GVC if compared to other regions of the world (Figure 2a) and its participation is increasing over time (Figure 2b). About 3% out of 40% of total GVC participation is due to the agriculture sector, i.e. a contribution equal to 7% across all 25 EORA sectors. For instance, the same figure for the EU is only 2%. Furthermore, the sector presents a relatively high domestic value added components used by other countries' exports (DVX) with respect to foreign value added components (FVA), confirming its upstream position along the chain where it acts as a supplier of intermediate inputs.

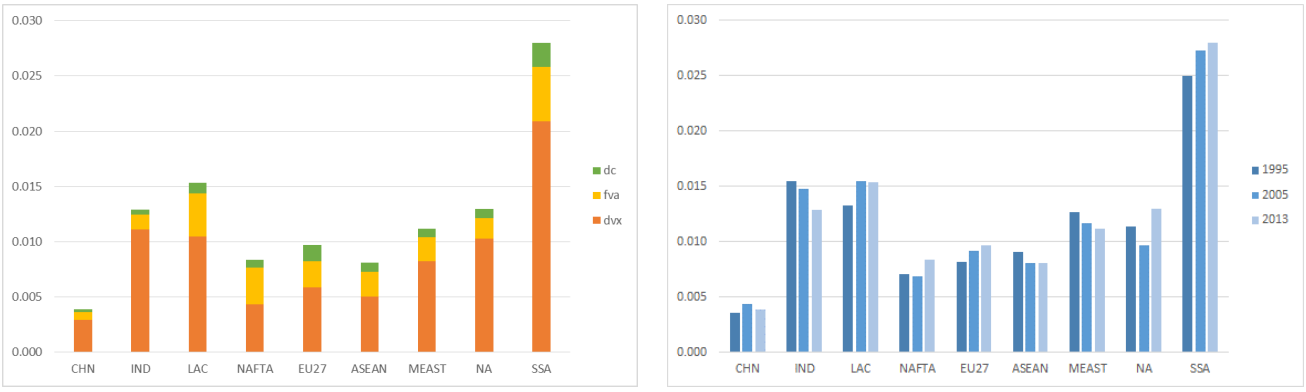
Figure 1 GVC participation by world regions



Source: Authors' elaboration on EORA data

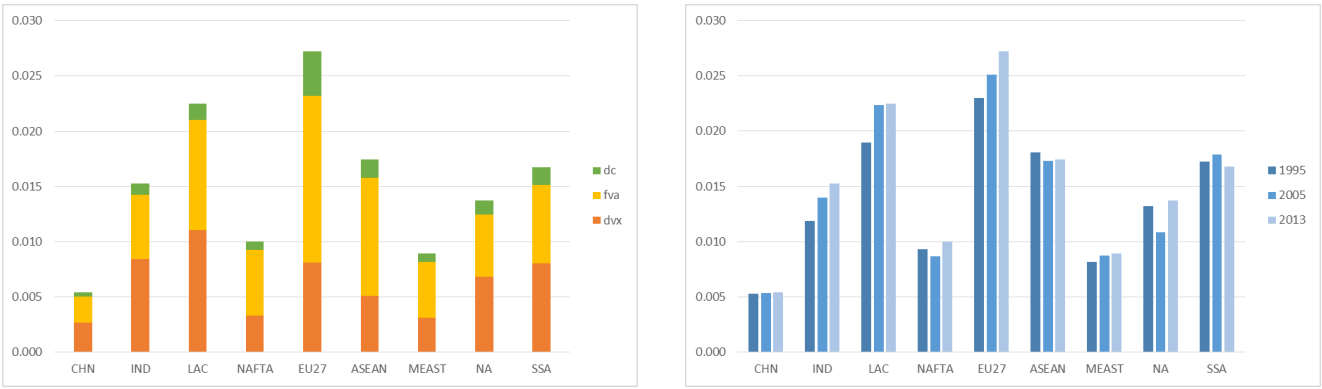
For the food sector, the EU and Latin American countries, on the other hand, present the highest participation rates (Figure 3a). Only 4% of the total GVC participation in SSA is due to food activities and its share does not change over time (Figure 3b). Unlike the agricultural sector, its position lies closer to the final consumers as shown by the more balanced ratio between the DVX and FVA components.

Figure 2 Agriculture GVC participation by world areas



Source: Authors' elaboration on EORA data

Figure 3 Food GVC participation by world areas



Source: Authors' elaboration on EORA data

To sum up, SSA takes part in GVCs by contributing mainly to the upstream phases, being confined to low value added stages of production, but with important heterogeneity in value added trade between agriculture and food exports. Also, these overall figures hide a substantial degree of heterogeneity within the region. To shed more light on this, in Table 1A (Appendix A) we report the same GVC components for the 43 SSA countries present in our data, together with the sectoral contribution of Agriculture and Food in 2013. Some SSA countries, such as DR Congo, Ethiopia, Lesotho and Guinea, register relatively high involvement in the international fragmentation of production compared with the other countries in the region, probably thanks to their production structure being biased towards the export of natural resources (DR Congo) or the small dimension of their economy (Lesotho). Others, such as Benin, Chad and Mali, seem to be more excluded from the global market probably because of geographical remoteness and/or lack of resources. Note also that in almost all SSA countries, GVC participation mainly relies on the supply of inputs for other countries' exports (DVX component), whereas only a few of them (mainly Botswana, Ethiopia, Lesotho, Namibia, Swaziland and Tanzania) participate mostly as buyers of foreign inputs for their exports (FVA component). In the latter group, it is interesting to note the peculiar case of Ethiopia where the GDP has been growing at a rate of about 10% over the last ten years. The country is among the most integrated in GVCs and the contribution of the agricultural sector to this process is

among the highest in the region (31%). Cote d'Ivoire (33%), Ghana (34%), Kenya (30%), Madagascar (38%), Malawi (39%) and Uganda (32%) are the other countries in the region where the contribution of the agricultural sector to their total GVC participation is quite remarkable, i.e. above 30%. Finally, the last column in Table 1A clearly shows that the contribution of the food sector to the countries' GVC participation is, on average, much smaller than the agricultural sector and it is usually below 10%. The only countries registering noteworthy performances are Cote d'Ivoire (15%), Kenya (15%), Mauritania (21%), Namibia (28%), Senegal (42%), and Swaziland (16%).

As underlined in Section 2, the WWZ (2013) decomposition method also allows us to disentangle the value added components of the bilateral gross trade flows. Tables 2A-7A (Appendix A) report the percentages of gross export flows and value added components (DVX and FVA) of the agriculture and food sector that go to groups of partner countries across the main destination regions (Europe, NAFTA, LAC, Africa, South and East Asia). Not surprisingly, the European countries absorb 51% and 49% of SSA agricultural and food exports, respectively. More interestingly, the percentage of imports from Africa is similar to other regions in the world, denoting a low level of effective regional integration between SSA countries. SSA countries are the main trading partners only for Uganda, Zambia and Niger. For the food sector, the picture looks slightly different with the intra-regional trade accounting for around 20% even if only Angola, Mozambique, Niger, South Africa, Togo, Uganda and Zambia are mainly trading inside the region. If we focus on the measures of GVC participation, we observe a similar pattern: the European countries are the main importers of both FVA and DVX from the SSA countries for both the agricultural and food sectors.

However, a significant difference exists: while the percentage of gross export and FVA absorbed by Europe is around or below 50%, the percentage of DVX is 68% for agriculture and 62% for food.[9] In other words, European countries are principally interested in importing intermediates to be processed domestically and re-introduced in the GVC. Conversely, European countries are less interested in importing final goods or intermediates which have been already processed with foreign inputs re-exported by the SSA countries. The same pattern does not apply to the other importing regions (especially Africa) where the FVA component is usually bigger than the DVX one.

There are two possible explanations for this result. The first one is the so-called "Rotterdam effect"[10] for which some important European countries (Netherlands, Germany, France and the UK) are traditional gateways to third country markets. The very high share of the DVX component does indeed suggest that the SSA agricultural and food products are first exported to these hubs and, once processed, further re-exported to third countries. The second reason is associated with the fact that the closer the exported products are to the final consumers (the higher the FVA), the more difficult it is for the SSA producers to access the European market because of issues related to preferences as well as public and private safety and quality standards (Lee et al. 2010). The policy implications are not trivial for SSA economies. If the strategy to increase GVC participation in these two sectors is coupled with the ambition to acquire new downstream stages of production and increase the share of value-added captured by domestic producers, probably the simplest choice would be to reinforce the intra-regional

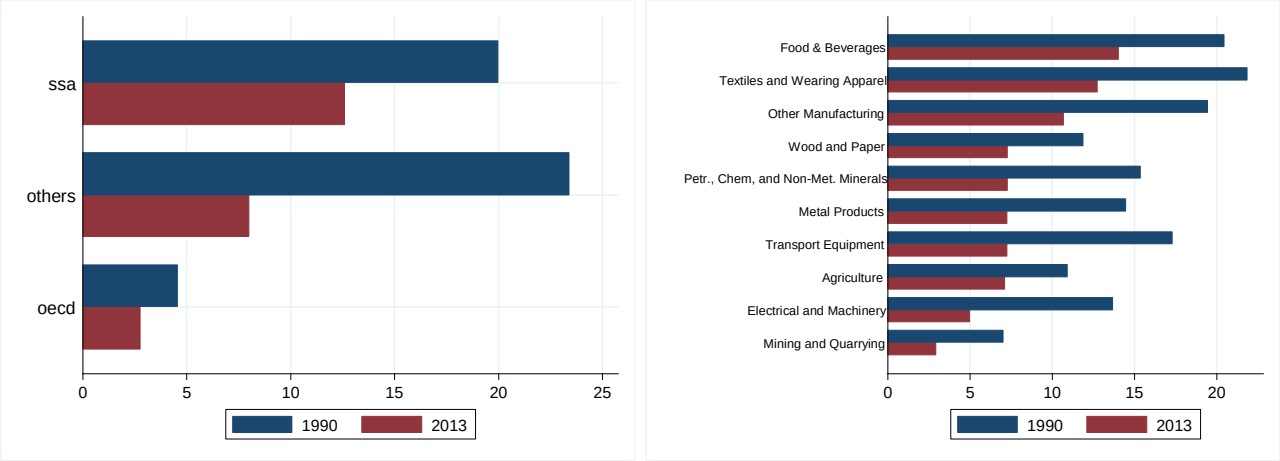
[9]In some cases, such as for Uganda, Zambia and Niger, the EU absorbs almost 80% of the DVX despite the fact that the main destination for their gross exports is Africa.

[10]"Rotterdam effect" refers to the fact that trade in goods with the Netherlands is artificially inflated by the goods dispatched from or arriving in Rotterdam even though the ultimate destination or country of origin being located elsewhere.

agricultural and food networks through the removal of trade and other barriers still standing between SSA countries (World Bank, 2012).

To identify the effects of trade policy on GVC participation in the agriculture and food sectors, we need detailed information on tariffs of both sectors at bilateral country-level, as well as trade agreements for a large set of countries. To this end, we derive the bilateral tariff schedules from the TRAINS and IDB databases accessed via the World Bank's WITS website[11], whereas Regional Trade Agreements are derived from the Egger and Larch (2008) database collected from WTO notifications as far back as 1990. Figures 4-6 show some stylized facts regarding bilateral level of protection, with a focus on SSA. Specifically, Figure 4a shows that the average import protection levels, although declining overall, are still significant especially in SSA. In 2013, the average level of tariff rates was still set at 13%. Figure 4b provides the average tariffs for 10 tradable sectors and shows that Food and Beverages and Agriculture sectors face the highest tariff rates. These results confirm the larger scope for tariff reductions in the Agriculture and Food sectors of the SSA region as already highlighted by the empirical literature (see, *inter alia*, Caliendo et al., 2016) compared with the OECD economies for example (Figure 5).

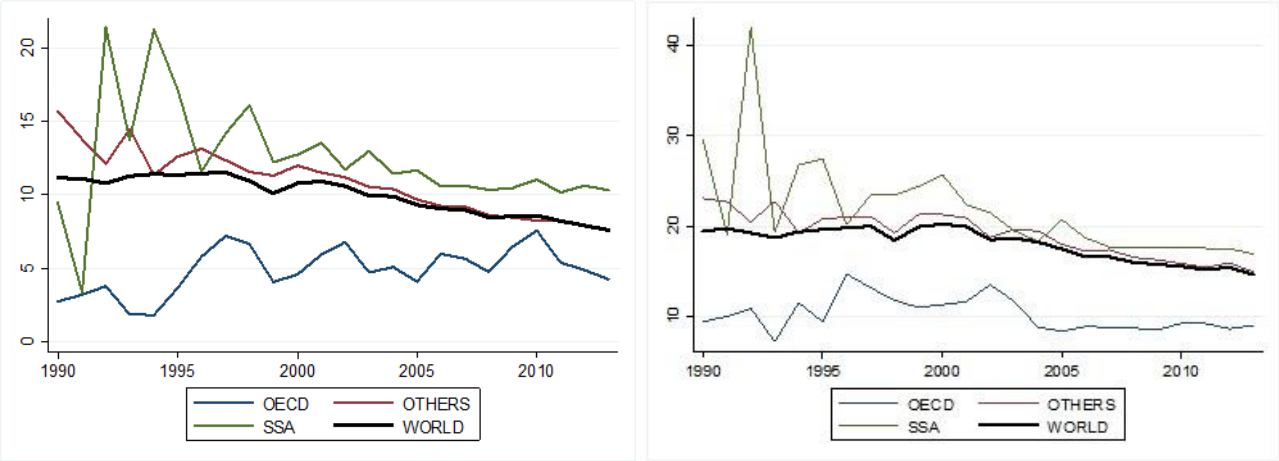
Figure 4 Average tariff rates, by area and sector, in 1990 and 2013



Source: Authors' elaboration on WITS data

[11] Since tariff schedules are often not available for each year, especially for smaller countries, as in Caliendo et al. (2016), rather than replacing missing tariffs by linearly interpolating observations, missing observations are set equal to the nearest preceding observation.

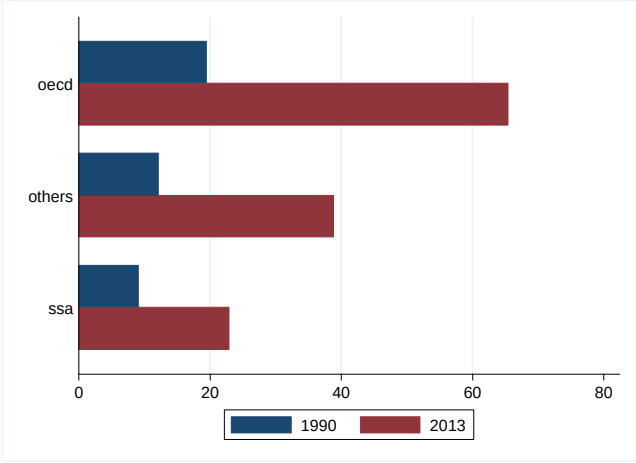
Figure 5 Average tariff rates for Agriculture and Food, by area



Source: Authors' elaboration on WITS data

Figure 6 shows that despite an increasing number of signed RTAs, SSA countries' involvement in trade agreements still lags behind. The average number of RTAs signed by each SSA country is about 20, well below the level of OECD economies (about 60), without taking into account the weak implementation abilities of SSA due to the lack of skills, knowledge, and political commitment (Torres and van Seters, 2016).

Figure 6 Signed RTAs by area in 1990 and 2013



Source: Authors' elaboration on Egger and Larch (2008) database

4. Identification strategy and empirical analysis

The aim of our empirical analysis is to identify the relevance and significance of bilateral trade protection in explaining SSA backward and forward GVC participation in the agriculture and food sectors. This task is not straightforward since the specialized literature does not provide a sound and clear-cut reduced form to investigate this relationship empirically (Kowalski et al., 2015). So far, the few available studies on the topic have focused on understanding the effect of a broad basket of possible determinants on the GVC participation of developing countries (see, inter alia, Kowalski et al., 2015; Greenville et al., 2016; Taglioni and Winkler, 2016) related to logistics performance, labor skills, geographical location, market size, industrial structure, economic dimension, level of development, and trade policy. These works generally provide cross-country panel estimates of the GVC integration at aggregate or sectoral level. Hence, they overlook the fact that trade is primarily the result of a network of bilateral preferences and that trade policy is meant at the level of industries or even products.

In this empirical exercise, we adopt a different identification strategy which relies on bilateral flows of trade in value added and bilateral preferences. We use a panel specification with fixed effects to filter out the effect of multilateral tariffs and non-tariffs barriers which have been the traditional focus of the literature. We can thus better identify the effect of bilateral trade policies on the participation of SSA countries in the agricultural and food GVCs. To do this, we use the well-established "gravity model" and insights from a very recent strand of the theoretical and applied literature (Johnson and Noguera, 2012; Baldwin and Taglioni, 2014) to estimate whether these measures of bilateral protection influence GVC participation. All that considered, our identification strategy leads us to the following "gravity like" specification:

$$GVC_{ijt} = \beta_0 + \beta_1 \mathrm{t}_{jit} + \beta_2 \mathrm{rta}_{ijt} + \theta_{it} + \gamma_{jt} + \phi_{ij} + \mu_{ijt} \qquad (1)$$

where *i* identifies the reporter country, *j* the partner country, and *t* denotes time. GVC stands for selected bilateral components of exports in value added derived from the WWZ (2013) decomposition (see Section 2). More specifically, we use three alternative dependent variables:

i) the exporting country's value added embodied in the agriculture and food gross exports absorbed by the direct importer (i.e. DirDVA);
ii) the exporting country's value added embodied in the agriculture and food gross exports which the direct importer re-exports to third countries or eventually returns home (the indirect value added, i.e. DVX); and
iii) the country's value added sourced from foreign countries embodied in the imports from the direct partner used as inputs for agricultural and food exports (the foreign value-added, i.e. FVA).

The DVX and FVA measures are used as proxies for GVC participation since they measure the share of value added flows belonging to a production process fragmented in at least two stages. The first variable – DVX – captures forward participation since it measures the reporter country involvement in upstream activities relative to the partner countries. The second variable – FVA – captures backward participation since it measures the degree of the reporter country involvement in downstream activities relative to the partner countries. DirDVA, on the other hand, captures the part of value added that does not enter into the GVCs (i.e., it does not entail any

production process fragmentation). It provides a baseline estimate to proxy the impact of bilateral trade policies on gross exports.

t_{jit} is the trade policy variable. More specifically, we use the applied tariff rate in agriculture (food) of the partner country j to the reporter i[12] and RTA as a dummy variable proxying the mutual participation to the same Regional Trade Agreement.[13] The applied tariff t_{jit} measures the direct effect of the trade policy on backward and forward participation.

According to the new theoretical framework of trade policy that includes cross-border supply chain linkages (Blanchard et al., 2016), the government should reduce tariffs to stimulate the country's GVC participation by fostering the foreign content embodied in domestic final goods, including the domestic value-added inputs embodied in its partner country's imports coming both from the direct importer and its foreign suppliers. Hence, if policymakers adopt the right incentives, we should find a positive sign on β_1 in all the specifications. Conversely, if we find a negative sign, it will mean that the existing bilateral trade tariffs are hampering, on average, a country's GVC participation characterized by multiple exchanges of intermediates and final goods.

RTA provides information on cooperation in bilateral tariff preferences as well as a broader measure of existing preferential trade regimes, including rules of origins and possible non-tariff issues such as general regulatory policies. Since RTAs are meant to introduce bilateral preferences between members, we should find a positive impact on trade in value added as a result of RTAs. However, this positive impact could be, totally or partially, offset by strict rules of origins (asking for additional domestic stages of production), prolonged phase-in periods, as well as a high influence of multilateral inputs on foreign value added that do not directly benefit from bilateral preferences (Blanchard et al., 2016; Curran and Nadvi, 2015).

Finally, $\theta_{it}$and γ_{jt} in equation (1) represent reporter-time and partner-time fixed effects, respectively; ϕ_{ij} represents country-pair fixed effect, and μ_{ijt} is the error term. While the panel specification controls for unobserved heterogeneity in the data, the exporter-time and importer-time effects control for all time-variant unobservable country characteristics. The country-pair effects account for any additional time invariant country pair influence on bilateral trade flows. This specification - with a full set of country-time fixed effects - absorbs all variations in multilateral MFN tariffs in the data and it allows us to account for time-varying Multilateral

[12] The use of the applied tariffs controls directly for the actual utilization rates. Here we use simple averages giving the same weight to all products (not imported as well as very large imports). This is because the level of nominal tariffs might influence the effective value of imports (e.g., a prohibitive tariff, wearing away imports, and tariff revenue could be interpreted as a zero tariff rate). This problem is not sufficiently significant to affect the analysis at the aggregate level (and indeed most of the previous literature actually applies weighted averages). However, since tariffs in developing countries are higher than in industrialized countries and are very high in absolute terms, specifically in the case of SSA countries and for agriculture and food products, the use of weighted average tariffs could lead to incorrect interpretations. Furthermore, weighted tariffs could lead to simultaneity bias in the estimated coefficients. For the sake of comparison, in Section 5 on robustness, we also present the outcomes of weighted average where the imports value (in US dollars) of the reporter country are used as weights, showing that there are no meaningful differences between the two estimates.

[13] RTAs are collected on the basis of the date the agreement entered into force and then lagged (t-n) to include the effects associated with implementation and phase-in. Data are sourced from Egger and Larch (2008) (for additional details, see also Grant and Lambert, 2008). Outcomes for alternative temporal lags for RTAs are available upon request.

Resistance Terms that influence the dyadic relationship (Anderson and van Wincoop, 2003).[14] This is considered a fair identification strategy for investigating the role of bilateral protection in value added bilateral trade flows since it actually softens the well-known "third-countries" effect problem[15], i.e. the fact that the flows in value added between any country pair are affected – even more than in the case of gross export flows - by trading partners' interactions with the rest of the world. The drawback is that we cannot exclude the fact that some of the policy impact we are interested in could be captured by fixed effects. Hence, we should assume that our estimated coefficients are prudent estimates of the phenomena we analyze. For this reason, in Section 5, we present a baseline exercise where we substitute the fixed effect specification with a broad set of observables in order to derive upper bound estimates. All the continous variables in equation (1) are in natural logs including the value added components of bilateral exports which are reported in monetary values (thousands of US dollars) and not as exports' shares as in the descriptive analysis in Section 3. In such a log-log setting, the coefficients can be interpreted as elasticities cleaned of both observable and unobservable confounding factors. Since all the other controls usually used in the gravity equation - including the mass variables - are time invariant or time-varying only for the reporter and/or the partner dimension alternatively, our specification cannot identify them separately because of collinearity constraints and, as a result, these controls cannot be taken into account (Head and Mayer, 2013).[16]

To soften the Anderson and van Wincoop (2003) bias further and include an additional term of interest for policy makers, we re-estimate equation (1) using only the dyadic relationship between reporter and partner, i.e. without the influence of third countries. To do this, we use as proxy for forward and backward participation the part of domestic value added re-exported that ultimately returns home via the partner country[17] (DirRDV), and the foreign value added that comes from the direct importing country (MVA), respectively. In this case, the specification takes the following form:

$$Dyadic\_GVC_{ijt} = \beta_0 + \beta_1 \mathrm{t}_{jit} + \beta_2 \mathrm{t}_{ijt} + \beta_3 \mathrm{rta}_{ijt} + \theta_{it} + \gamma_{jt} + \phi_{ij} + \mu_{ijt} \quad (2)$$

where t_{ijt} is the applied tariff rate of the reporter *i* to partner *j* in the agriculture (food) sector. The interpretation of this trade policy variable is less straightforward than the previous one (t_{jit}) because it shows the effect of a country's level of domestic protection on its ability to export. Such a link is virtually non-existent except in the case of vertical fragmentation of production whereby a multi-stage production system would facilitate trade in parts and components and bilateral protection on imports could have a significant effect on both dyadic forward (DirRDV) and backward (MVA) participation. In the first case, we expect the reporter country's tariff to also

[14] We acknowledge that the gravity approach needs improvements to take on board the key features of value added trade (Johnson and Noguera, 2012; Baldwin and Taglioni, 2014). The standard gravity equation is expected to fit less well value-added flows compared with gross exports because bilateral value added flows do not depend only on bilateral trade costs but also on costs with third countries through which value added transits from source to destination. Moreover, Johnson and Noguera (2012) show that the relative importance of these additional effects varies significantly across countries and types of trade costs, whereas Baldwin and Taglioni (2014) underline that when trade in parts and components is relevant, GDPs in both the exporting and importing countries are poor proxies for supply and demand.

[15] For additional details on this issue and to look at alternative network applications of MRT to gravity equations, see De Benedictis and Taglioni (2011) and Montalbano et al. (2015).

[16] In the Table Appendix, we also provide an empirical specification with the usual gravity like measures identified by the above literature in determining GVC participation (Tables 5A and 6A).

[17] Here DirRDV is given by the sum of the terms T6 and T8 of the WWZ decomposition (see Figure 1A in Appendix) excluding the value added of intermediate exports that return home via third countries (T7).

depress the domestic value-added inputs embodied in its partner country's imports. In the second case, the expected effect is less clear since the negative impact of the import taxation on the cost of the foreign value added sourced from the partner country may be counterbalanced by the fact that the protection can boost the development of the import-competing sectors - i.e. for agriculture and food - and increase the incentive of the direct importer to increase its input supply by taking advantage of the protectionist rents.

Table 1 Gravity-like estimates for Agriculture

	All countries					SSA countries (reporters)				
		forward	backward	forward dyadic	backward dyadic		forward	backward	forward dyadic	backward dyadic
	(1a)	(2a)	(3a)	(4a)	(5a)	(1b)	(2b)	(3b)	(4b)	(5b)
Dep Var:	dirDVA	DVX	FVA	dirRDV	MVA	dirDVA	DVX	FVA	dirRDV	MVA
tariff rate (applied mean)_ji	-0.007***	-0.005***	-0.007***	-0.007***	-0.004***	-0.004**	-0.004**	-0.004**	-0.004**	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
tariff rate (applied mean)_ij				-0.002***	0.002**				0.003	0.004
				(0.001)	(0.001)				(0.002)	(0.003)
RTA (yes=1)^	0.008***	0.007***	0.008***	0.018***	-0.002	0.007	0.013**	0.007	0.055***	0.010
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.007)	(0.006)	(0.007)	(0.008)	(0.009)
Observations	541,522	541,395	544,209	435,017	433,773	126,533	126,506	126,533	99,624	98,626
R-squared	0.995	0.995	0.995	0.997	0.997	0.991	0.993	0.992	0.994	0.996
Country pair fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Exporter*year fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Importer*year fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

^ three years lags from the entry into force of the agreement

Tables 1 and 2 report the outcomes of our "gravity like" estimates of eq. 1 and 2 over the period 1990-2013 for agriculture and food, respectively. The first five columns (from 1a to 5a) show the coefficients at the global level (for the 186 countries included in the EORA dataset), whereas the second set of five columns (from 1b to 5b) show the same estimates for the sub-sample of 43SSA countries. Table 1 shows that, as expected, the average bilateral tariff applied by the partner countries to the reporters' agricultural exports (t_{ji}) is negatively correlated with the direct domestic value added of the reporting countries' exports, both at the global level and for SSA economies (columns 1a and 1b). This is straightforward if we bear in mind that direct domestic value added is the component that best proxies the gross exports. Consequently, the above estimated coefficient reflects the standard negative impact of bilateral protection on agricultural exports. The table also shows the negative impact of the partner country bilateral protection on the reporter country's forward (DVX) and backward (FVA) GVC participation in agriculture, both at the global level (columns 2a and 2b) and for SSA countries (columns 3a and 3b). Therefore, bilateral trade protection is not only hampering the single exchange of goods between two countries, but it undermines the capacity of an exporting country to participate in longer value chains characterized by multiple exchanges of intermediates and final goods.

Columns 4a, 4b, 5a and 5b report the results on dyadic components estimated using equation (2). The coefficients on t_{ijt} are still significant and similar in magnitude to those associated with the DVX and FVA variables, confirming the goodness of fit of our estimates. The only exception is for the MVA of the SSA countries which is

still negative but not significant, probably because of the low influence of the foreign value-added sourced from their direct main importers of agricultural intermediates and final goods.

More interestingly, the estimated coefficients associated with the bilateral tariffs applied by the reporter country to its partners (t_{ij}) show a significant and negative effect on the dyadic forward participation (column 4a) and a significant and positive effect on the dyadic backward participation (column 5a) in the global case, whereas there is no effect for the SSA case (columns 4b and 5b). The global case certifies that where there is fragmentation of production with multiple border crossings, a country's GVCs performance does not only depend on the level of protection it faces from the rest of the world, but also on its own level of import taxation in the same sector. It is also interesting to note that for dyadic backward participation, the prevailing effect seems to be the positive impact of the protection on the supply of foreign value-added sourced from the direct importer. However, in terms of policy reccomendations, there is a need to take into account the fact that in the agricultural sector the domestic value added component is always predominant with regard to the foreign-value added (see Figure 2). Therefore, it would not be wise to try to stimulate the GVC participation through an increase in import taxation since the multiple costs would probably outweigh these limited benefits.

The third row in Table 1 shows the effects of the existing preferential trade regimes (RTAs) on backward and forward GVC participation in agriculture. The estimated coefficients register a positive and significant impact of the RTAs on almost all the components in the global case, except for the dyadic backward participation which is not significant. The results confirm the positive effect of the vertical integration between partners and downsize the potential negative diversion effect of the RTA on the GVC participation for this sector. A similar picture emerges from the impact of RTA on the GVC participation of the SSA countries even if the only significant coefficients are those of the two components associated with the domestic value added (DVX and dirRDV). As could be expected, this suggests that existing agreements in SSA focus mainly on enforcing the export capacity of domestic value-added of the members' countries. Although these first results show rather interesting patterns, we acknowledge that the role of RTAs in determining the degree of partner countries' participation in GVCs deserves additional careful investigation which is out the scope of this empirical analysis[18].

Table 2 reports the same analysis for the food and beverage sector. Results appear consistent. In the first row, the average bilateral tariff applied by the partner countries to the reporters' exports (t_{ji}) is always significant and negatively associated with all the components of trade in value added at both the global level and for the subsample of SSA economies. Also, the second row of coefficients – pertaining to the tariffs applied by the reporter country to its partners (t_{ij}) - shows a significant and negative impact on both the dyadic components for the global case (columns 4a and 4b) and on the forward participation for SSA countries (column 4b).

As for the agricultural sector, the negative impact of a country's import taxation on its capacity to participate in GVCs through food exports highlights the need for policy makers to reconsider their policy strategy by taking into account both virtuous and vicious cycles created by a globally integrated production process. It is worth noting

[18]RTAs are key since they can determine meaningful shifts in trade regime – also in terms of rules of origins - with pervasive effect on GVC participation of source countries apart from pure variations in applied tariffs. However, often they are characterized by gradualism in the implementation and also the various measures take time before impacting on trade flows. On top of that, these impacts change according to the different provisions. The recent literature is increasingly questioning the direction of causality between bilateral changing regimes (RTAs) and GVCs, who are the winner and the losers, and especially the time span of the causal evidences (Bair and Peters, 2006; Pickles and Smith, 2011; Curran and Nadvi, 2015). These further dimensions of investigation lie however outside the scope of the present analysis.

that the negative relationship also holds for the subsample of SSA and this is particularly relevant if we consider that the taxation on food imports in the region is the highest with respect to the rest of the world (see Section 3). This result contrasts with the case of agriculture and suggests, from a policy point of view, that there are ample opportunities to improve the SSA countries' participation in GVCs through the reduction of their bilateral level of protection.

Table 2 Gravity-like estimates for Food and Beverages

	All countries					SSA countries (reporters)				
		forward	backward	forward dyadic	backward dyadic		forward	backward	forward dyadic	backward dyadic
	(1a)	(2a)	(3a)	(4a)	(5a)	(1b)	(2b)	(3b)	(4b)	(5b)
Dep Var:	dirDVA	DVX	FVA	dirRDV	MVA	dirDVA	DVX	FVA	dirRDV	MVA
tariff rate (applied mean)_ji	-0.016***	-0.013***	-0.016***	-0.014***	-0.015***	-0.021***	-0.017***	-0.021***	-0.017***	-0.019***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
tariff rate (applied mean)_ij				-0.012***	-0.007***				-0.008***	-0.001
				(0.001)	(0.001)				(0.002)	(0.002)
RTA (yes=1)^	0.018***	0.019***	0.018***	0.029***	0.001	-0.035***	-0.024***	-0.035***	0.024***	-0.012
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.008)	(0.007)	(0.008)	(0.009)	(0.011)
Observations	542,307	542,189	544,209	435,320	434,007	126,533	126,503	126,533	99,632	98,672
R-squared	0.996	0.996	0.996	0.998	0.998	0.991	0.991	0.991	0.994	0.996
Country pair fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Exporter*year fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Importer*year fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

^ three years lags from the entry into force of the agreement

Finally, if we look at the third row, we can see that the estimated impacts of RTAs on GVC participation in food and beverages are highly consistent with those for agriculture at the global level: i.e., the presence of a general positive and significant impact of the existing RTAs on all the components except for dyadic backward participation that ultimately returns home (column 5a). Looking at the SSA economies, the outcomes are more mixed with the usual positive impact of the existing RTAs on DirRDV (column 4b) but a significant negative effect on the first three dimensions (columns 1b, 2b and 3b). Due to the presence of multiple factors that can in principle outweigh the positive benefits of RTAs, pointing to a specific reason behind this outcome is a complex task. In addition, we recognize that the over-ambitious objectives of the preferential agreements are usually followed by weak implementation due to the lack of skills, knowledge, and political commitment as well as the absence of real monitoring systems on trade policies (Torres and van Seters, 2016).

5. Robustness checks

Our previous findings on the effects of bilateral trade policy on backward and forward GVC participation are robust to several empirical checks. We first verify whether appreciable differences can be registered running the same estimates by using weighted measures of tariffs instead of the simple ones. Using weighted tariffs offers both advantages and disadvantages. On the positive side, weighted measures can adequately take into account

the strong heterogeneity of tariffs and likely peaks for products characterized by lower elasticity of demand. However, the weights are built using import flows causing additional sources of endogeneity in the estimates. For this last reason, we include one year lagged weighted tariffs. Table 3 and Table 4 report the same estimates of baseline equation using weighted tariffs instead of simple ones. The two outcomes do not differ significantly.

Table 3 Gravity-like estimates for Agriculture (weighted tariffs)

	All countries					SSA countries (reporters)				
		forward	backward	forward dyadic	backward dyadic		forward	backward	forward dyadic	backward dyadic
	(1a)	(2a)	(3a)	(4a)	(5a)	(1b)	(2b)	(3b)	(4b)	(5b)
Dep Var:	dirDVA	DVX	FVA	dirRDV	MVA	dirDVA	DVX	FVA	dirRDV	MVA
tariff rate (applied weighted mean)_ji ^^	-0.009***	-0.008***	-0.009***	-0.008***	-0.007***	-0.006***	-0.004**	-0.006***	-0.003	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
tariff rate (applied weighted mean)_ij ^^				-0.003***	0.001				0.003	0.003
				(0.001)	(0.001)				(0.002)	(0.002)
RTA (yes=1)^	0.006**	0.004	0.006**	0.015***	-0.004	0.006	0.011	0.006	0.058***	0.012
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.007)	(0.007)	(0.007)	(0.009)	(0.010)
Observations	518,017	517,890	520,676	407,729	406,447	121,069	121,042	121,069	92,528	91,601
R-squared	0.995	0.995	0.995	0.997	0.998	0.991	0.993	0.992	0.994	0.996
Country pair fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Exporter*year fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Importer*year fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
^ three years lags from the entry into force of the agreement
^^ one year lag

Table 4 Gravity-like estimates for Food and Beverages (weighted tariffs)

	All countries					SSA countries (reporters)				
		forward	backward	forward dyadic	backward dyadic		forward	backward	forward dyadic	backward dyadic
	(1a)	(2a)	(3a)	(4a)	(5a)	(1b)	(2b)	(3b)	(4b)	(5b)
Dep Var:	dirDVA	DVX	FVA	dirRDV	MVA	dirDVA	DVX	FVA	dirRDV	MVA
tariff rate (applied weighted mean)_ji ^^	-0.016***	-0.014***	-0.016***	-0.015***	-0.016***	-0.019***	-0.016***	-0.019***	-0.015***	-0.018***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
tariff rate (applied weighted mean)_ij ^^				-0.012***	-0.009***				-0.008***	-0.005**
				(0.001)	(0.001)				(0.002)	(0.002)
RTA (yes=1)^	0.014***	0.014***	0.014***	0.024***	-0.002	-0.039***	-0.027***	-0.039***	0.024***	-0.010
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.008)	(0.007)	(0.008)	(0.009)	(0.012)
Observations	518,805	518,687	520,676	407,867	406,667	121,069	121,039	121,069	92,536	91,647
R-squared	0.996	0.996	0.996	0.998	0.998	0.991	0.991	0.992	0.994	0.996
Country pair fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Exporter*year fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Importer*year fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
^ three years lags from the entry into force of the agreement
^^ one year lag

Furthermore, all main results discussed in Section 4 are valid when we substitute our preferred fixed effect specification with a baseline specification where the set of fixed effects are replaced by the usual set of controls applied by the previous empirical literature. Tables 9A and 10A in Appendix A, referring to Agriculture and Food respectively, report the latter specification. As can be seen when the tables in the Appendix are compared with Tables 1 and 2, our preferred specification which includes the full set of fixed effects provides a better fit of the above relationship, with R squared consistently higher in all the specifications, but usually lower and less significant estimated coefficients than the baseline (e.g., in the baseline estimates, tab. 10A, a positive and

significant relationship of RTAs can be detected). Although we are confident that our preferred specification controls more efficiently for possible sources of unobservability, we cannot exclude the possibility that some of the policy impacts of interest are captured by fixed effects. Hence, we look at the coefficients estimated with the fixed effects specification as prudent estimates of the phenomena analyzed, whereas the baseline coefficients can be considered as upper bound estimates. The high significance of the covariates in all baseline specifications (Tables 9A and 10A) confirms the plausibility of the baseline empirical estimates as well.

Finally, as a last check, we test the robustness of our outcomes by controlling for dyadic error correlation. This involves allowing for intragroup correlation in standard errors and relaxing the usual requirement that the observations are independent. This can result in larger standard errors especially when each individual is paired with many other individuals, i.e., when the network is particularly dense as is the case for the network of international trade flows. The use of country-pair fixed effects is supposed to not fully account for this further source of error correlation (Cameron and Miller, 2014). This is because trade flows between *i* and *j* are serially correlated with all the other country pairs that include also *i* or *j*. Table 5 reports the outcomes of the amended estimates for agriculture. They show, of course, the same results as those presented in Table 1, but with differences in terms of significance. More specifically, at the global level, all the estimated coefficients associated with the bilateral tariffs in agriculture applied by the partner countries (t_{ji}) keep their significance (first row) as well as the coefficients of the existing RTAs on RDV. However, it is no longer the case for the coefficients associated with the bilateral tariffs in agriculture applied by the reporter country to its partners (t_{ij}). All the estimated coefficients also lose significance when we look at the SSA economies as reporter countries.[19]

Table 6 reports the dyadic error correlation results for food and beverages. In this case, the results are in line with those of Table 2 for both the global and SSA cases.

[19]In this case, however, we can get even more significant results, even if limited to the bilateral tariffs applied by the partner countries (tji) if we remove all SSA economies acting as partner countries from the sample. This is probably because, as shown by the descriptive analysis (Section 3), SSA GVC participation is overwhelmingly related to trade linkages outside the region, mainly with the European Union and the emerging countries. These results are available upon request.

Table 5 Gravity-like estimates for Agriculture (country pair clustered SE)

	All countries					SSA countries (reporters)				
		forward	backward	forward dyadic	backward dyadic		forward	backward	forward dyadic	backward dyadic
	(1a)	(2a)	(3a)	(4a)	(5a)	(1b)	(2b)	(3b)	(4b)	(5b)
Dep Var:	dirDVA	DVX	FVA	dirRDV	MVA	dirDVA	DVX	FVA	dirRDV	MVA
tariff rate (applied mean)_ji	-0.007***	-0.005***	-0.007***	-0.007***	-0.004**	-0.004	-0.004	-0.004	-0.004	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)
tariff rate (applied mean)_ij				-0.002	0.002				0.003	0.004
				(0.002)	(0.002)				(0.005)	(0.006)
RTA (yes=1)^	0.008	0.007	0.008	0.018***	-0.002	0.007	0.013	0.007	0.055***	0.010
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.016)	(0.015)	(0.016)	(0.019)	(0.019)
Observations	541,522	541,395	544,209	435,017	433,773	126,533	126,506	126,533	99,624	98,626
R-squared	0.995	0.995	0.995	0.997	0.997	0.991	0.993	0.992	0.994	0.996
Country pair fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Exporter*year fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Importer*year fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Country pair clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

^ three years lags from the entry into force of the agreement

Table 6 Gravity-like estimates for Food and Beverages (country pair clustered SE)

	All countries					SSA countries (reporters)				
		forward	backward	forward dyadic	backward dyadic		forward	backward	forward dyadic	backward dyadic
	(1a)	(2a)	(3a)	(4a)	(5a)	(1b)	(2b)	(3b)	(4b)	(5b)
Dep Var:	dirDVA	DVX	FVA	dirRDV	MVA	dirDVA	DVX	FVA	dirRDV	MVA
tariff rate (applied mean)_ji	-0.016***	-0.013***	-0.016***	-0.014***	-0.015***	-0.021***	-0.017***	-0.021***	-0.017***	-0.019***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
tariff rate (applied mean)_ij				-0.012***	-0.007***				-0.008**	-0.001
				(0.001)	(0.002)				(0.003)	(0.004)
RTA (yes=1)^	0.018***	0.019***	0.018***	0.029***	0.001	-0.035*	-0.024	-0.035*	0.024	-0.012
	(0.006)	(0.005)	(0.006)	(0.006)	(0.007)	(0.018)	(0.015)	(0.018)	(0.019)	(0.024)
Observations	542,307	542,189	544,209	435,320	434,007	126,533	126,503	126,533	99,632	98,672
R-squared	0.996	0.996	0.996	0.998	0.998	0.991	0.991	0.991	0.994	0.996
Country pair fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Exporter*year fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Importer*year fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Country pair clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

^ three years lags from the entry into force of the agreement

6. Conclusions and policy implications

The capacity of Sub Saharan African economies to take advantages of agricultural and food GVCs as drivers for their structural transformation relies on a complex mix of factors that go beyond the simple narrative of upgrading. The most recent literature underlines the role of the characteristics of the comparative advantages of each country, but also the availability of ancillary services, including transport and logistics, as well as institutional and socio-economic country features and human and physical capital. The need to account for the

nature of backward and forward linkages between countries, the actual stage of maturity of the specific chain and the characteristics of the final destination markets is also highlighted. The fierce debate about the key determinants of increased participation in GVCs dedicates a special space to the role to be assigned to trade policy although the discussion is still open. Since the frontier between policy and non-policy factors is somewhat blurry and the specialized literature does not provide sound and clear-cut theoretical underpinnings, this task is not straightforward.

By exploiting the EORA global multi-region I-O (MRIO) tables and applying, for the first time, the most recent gross exports decomposition method provided by Wang et al. (2013) to these data, this work provides a robust empirical analysis of the relationship between bilateral trade policy and GVC integration in agriculture, food and beverages during the 1990-2013 period. This is, to the best of our knowledge, the first comprehensive study that looks at the phenomenon on a bilateral and sectoral basis with a focus on SSA regions.

First, our decomposition of bilateral gross exports shows that despite low trade shares at the global level, SSA countries are deeply involved in GVCs and often more than many other developing regions. Participation by SSA countries in agricultural GVCs is substantial at just below 3% which is much higher than any other regions in the world, whereas participation stands at 1.5 % for the food sector. We also find that the demand for SSA agricultural production in trade in value added is not regional, but mainly driven by the EU and emerging countries. What is more, the relevance of international linkages by SSA countries is increasing over time although still limited to upstream production stages suggesting that the region has been specializing in providing primary inputs to firms in countries further down the value chain.

Second, our empirical results highlight the relevance and significance of the most common trade policy measures as tariffs or RTAs. We find that trade policies are key determinants of the heterogeneity in GVC participation across SSA. We also find evidence of a "chain" effect of domestic trade policy vis-a-vis partner-countries upstream and downstream the chain. This has possibly important policy implications since trade policies no longer primarily depend on the location of the importing goods, but rather on the nationality of the value added content embodied in traded goods. Consequently, tariffs on imports may depress the domestic valued added used by trading partners as inputs. This means that there may be a need to reformulate trade policy priorities.

Finally, we believe that these results provide scholars and policymakers with a useful framework for testing the importance of alternative sectoral policy measures on bilateral trade relationships, including value chain interactions between pairs of countries that are the stepping stones of regional and global value chains.

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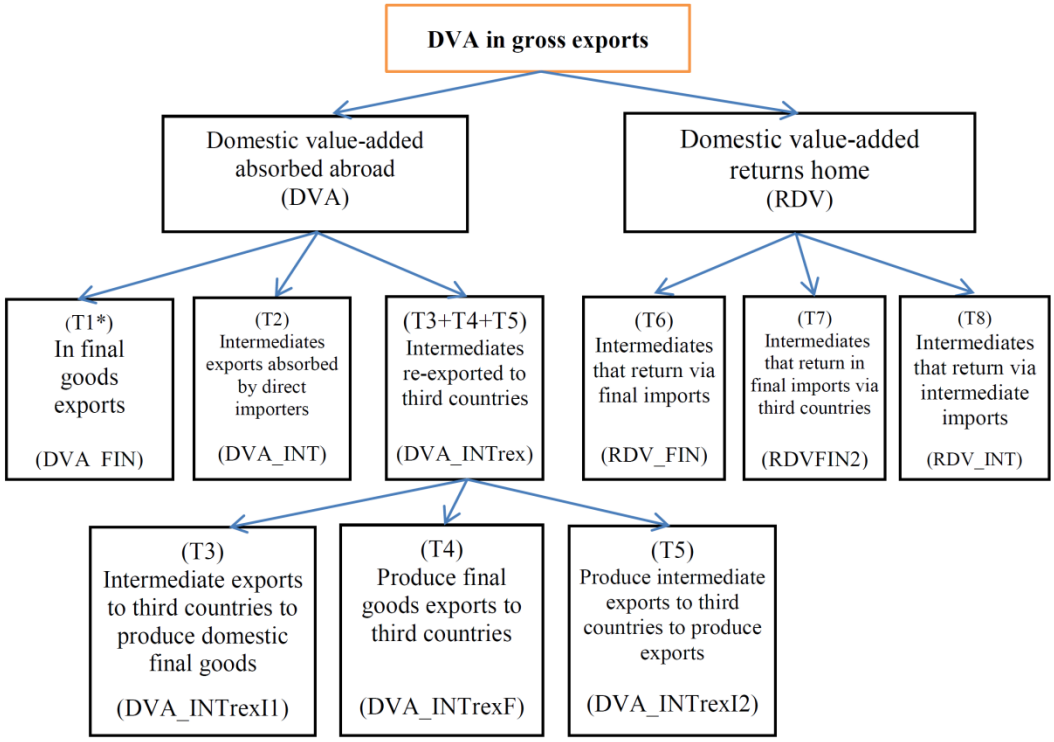
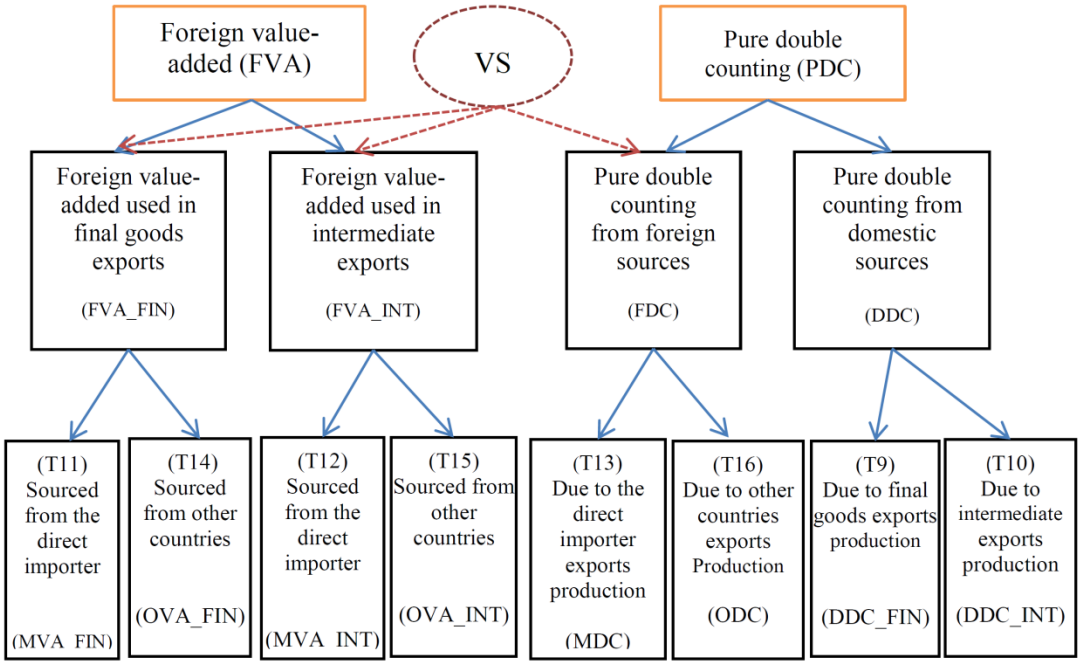
Appendix A: Tables and Figures

Figure 1A Gross exports accounting: Domestic value added



Source: WWZ, 2013

Figure 2A Gross exports accounting: Foreign value added and Pure Double counting



Source: WWZ, 2013

Table 1A GVC participation by SSA countries in 2013

Country	DVX	FVA	DC	GVC	*of which:*	
					Agriculture	Food
Angola	0.26	0.04	0.02	**0.32**	0%	0%
Benin	0.15	0.09	0.02	**0.27**	11%	5%
Botswana	0.16	0.22	0.07	**0.44**	1%	10%
Burkina Faso	0.18	0.18	0.06	**0.41**	22%	3%
Burundi	0.26	0.13	0.05	**0.44**	15%	1%
Cameroon	0.33	0.05	0.03	**0.41**	15%	2%
Cape Verde	0.18	0.20	0.06	**0.44**	1%	3%
Central African Republic	0.36	0.08	0.04	**0.48**	11%	1%
Chad	0.24	0.04	0.02	**0.30**	28%	0%
Congo	0.28	0.06	0.03	**0.37**	3%	0%
Cote d'Ivoire	0.25	0.06	0.02	**0.33**	33%	15%
DR Congo	0.46	0.06	0.06	**0.58**	4%	1%
Djibouti	0.21	0.13	0.05	**0.38**	5%	3%
Eritrea	0.24	0.08	0.03	**0.35**	4%	2%
Ethiopia	0.15	0.31	0.12	**0.58**	31%	5%
Gabon	0.27	0.04	0.02	**0.32**	15%	0%
Gambia	0.22	0.14	0.05	**0.41**	6%	9%
Ghana	0.31	0.06	0.03	**0.40**	34%	14%
Guinea	0.44	0.06	0.05	**0.55**	3%	1%
Kenya	0.19	0.17	0.04	**0.39**	30%	15%
Lesotho	0.11	0.36	0.10	**0.58**	0%	1%
Liberia	0.31	0.06	0.03	**0.40**	15%	0%
Madagascar	0.22	0.10	0.03	**0.35**	38%	8%
Malawi	0.21	0.10	0.03	**0.34**	39%	8%
Mali	0.19	0.08	0.02	**0.30**	23%	2%
Mauritania	0.23	0.13	0.05	**0.41**	1%	21%
Mauritius	0.13	0.31	0.06	**0.50**	1%	15%
Mozambique	0.23	0.07	0.03	**0.33**	22%	7%
Namibia	0.15	0.23	0.05	**0.44**	3%	28%
Niger	0.24	0.12	0.05	**0.40**	3%	1%
Nigeria	0.28	0.06	0.02	**0.36**	4%	1%
Rwanda	0.23	0.20	0.08	**0.51**	9%	1%
Sao Tome and Principe	0.20	0.21	0.08	**0.50**	7%	2%
Senegal	0.23	0.09	0.03	**0.34**	11%	42%
Seychelles	0.21	0.14	0.05	**0.40**	1%	36%
Sierra Leone	0.20	0.16	0.06	**0.42**	5%	5%
Somalia	0.21	0.08	0.03	**0.33**	10%	4%
South Africa	0.25	0.12	0.06	**0.43**	4%	2%
Swaziland	0.13	0.28	0.08	**0.49**	5%	16%
Tanzania	0.15	0.24	0.06	**0.45**	15%	13%
Togo	0.16	0.12	0.03	**0.31**	15%	7%
Uganda	0.19	0.11	0.03	**0.32**	32%	11%
Zambia	0.23	0.10	0.04	**0.37**	6%	2%

Table 2A Regions of destination of the agriculture gross exports (%), by SSA (2013)

exporting country	EU	LAC	NAFTA	AFRICA	EAST ASIA	SOUTH ASIA	OTHERS
Angola	0.53	0.07	0.01	0.16	0.04	0.07	0.12
Benin	0.43	0.12	0.02	0.17	0.06	0.18	0.03
Botswana	0.30	0.15	0.02	0.24	0.06	0.09	0.14
Burkina Faso	0.62	0.12	0.01	0.08	0.11	0.05	0.01
Burundi	0.71	0.03	0.07	0.05	0.02	0.04	0.08
Cameroon	0.63	0.00	0.02	0.05	0.26	0.05	0.00
Cape Verde	0.27	0.20	0.04	0.14	0.08	0.10	0.17
Central African Republic	0.73	0.02	0.04	0.05	0.12	0.02	0.03
Chad	0.63	0.01	0.27	0.04	0.01	0.02	0.02
Congo	0.69	0.01	0.02	0.03	0.16	0.07	0.01
Cote d'Ivoire	0.75	0.01	0.10	0.02	0.03	0.09	0.00
DR Congo	0.87	0.01	0.01	0.06	0.02	0.01	0.03
Djibouti	0.40	0.06	0.03	0.10	0.11	0.18	0.11
Eritrea	0.55	0.07	0.03	0.11	0.05	0.07	0.12
Ethiopia	0.30	0.00	0.05	0.01	0.46	0.03	0.15
Gabon	0.14	0.00	0.00	0.01	0.82	0.02	0.00
Gambia	0.57	0.07	0.01	0.12	0.08	0.06	0.09
Ghana	0.72	0.00	0.09	0.01	0.11	0.07	0.01
Guinea	0.76	0.01	0.02	0.12	0.02	0.05	0.02
Kenya	0.70	0.01	0.04	0.05	0.09	0.04	0.07
Lesotho	0.29	0.13	0.05	0.14	0.10	0.11	0.18
Liberia	0.27	0.00	0.66	0.02	0.02	0.02	0.01
Madagascar	0.49	0.00	0.25	0.03	0.16	0.05	0.01
Malawi	0.44	0.01	0.25	0.15	0.07	0.07	0.02
Mali	0.46	0.06	0.03	0.07	0.03	0.34	0.01
Mauritania	0.47	0.10	0.02	0.17	0.04	0.08	0.12
Mauritius	0.50	0.03	0.17	0.08	0.08	0.04	0.10
Mozambique	0.44	0.00	0.01	0.15	0.18	0.21	0.01
Namibia	0.52	0.01	0.01	0.43	0.01	0.01	0.02
Niger	0.36	0.03	0.01	0.52	0.02	0.02	0.04
Nigeria	0.55	0.00	0.02	0.02	0.11	0.29	0.00
Rwanda	0.75	0.04	0.04	0.07	0.02	0.03	0.05
Sao Tome and Principe	0.53	0.10	0.02	0.17	0.03	0.06	0.10
Senegal	0.64	0.01	0.04	0.03	0.27	0.01	0.01
Seychelles	0.36	0.11	0.04	0.15	0.09	0.10	0.15
Sierra Leone	0.58	0.05	0.05	0.10	0.04	0.06	0.11
Somalia	0.22	0.02	0.01	0.03	0.03	0.24	0.44
South Africa	0.53	0.01	0.07	0.18	0.11	0.06	0.05
Swaziland	0.63	0.02	0.00	0.18	0.07	0.03	0.07
Tanzania	0.36	0.01	0.10	0.06	0.33	0.09	0.06
Togo	0.38	0.47	0.02	0.04	0.01	0.07	0.01
Uganda	0.38	0.01	0.06	0.44	0.07	0.01	0.04
Zambia	0.45	0.01	0.02	0.46	0.02	0.02	0.02
Average	0.51	0.05	0.07	0.12	0.11	0.08	0.07

Table 3A Regions of destination of the agriculture indirect value added DVX (%), by SSA (2013)

exporting country	EU	LAC	NAFTA	AFRICA	EAST ASIA	SOUTH ASIA	OTHERS
Angola	0.61	0.06	0.01	0.13	0.04	0.06	0.09
Benin	0.50	0.03	0.01	0.14	0.03	0.27	0.03
Botswana	0.39	0.10	0.02	0.16	0.08	0.11	0.14
Burkina Faso	0.82	0.02	0.01	0.05	0.02	0.07	0.01
Burundi	0.86	0.02	0.01	0.03	0.01	0.03	0.05
Cameroon	0.78	0.00	0.01	0.03	0.15	0.03	0.00
Cape Verde	0.33	0.16	0.03	0.10	0.09	0.12	0.16
Central African Republic	0.85	0.01	0.01	0.03	0.07	0.02	0.02
Chad	0.76	0.01	0.17	0.02	0.01	0.02	0.01
Congo	0.87	0.00	0.01	0.01	0.08	0.02	0.01
Cote d'Ivoire	0.91	0.00	0.03	0.01	0.01	0.03	0.00
DR Congo	0.95	0.01	0.00	0.02	0.01	0.01	0.01
Djibouti	0.58	0.06	0.03	0.08	0.07	0.09	0.10
Eritrea	0.61	0.06	0.01	0.08	0.05	0.08	0.10
Ethiopia	0.63	0.00	0.03	0.01	0.17	0.02	0.14
Gabon	0.23	0.00	0.00	0.02	0.72	0.02	0.00
Gambia	0.65	0.06	0.01	0.08	0.06	0.08	0.08
Ghana	0.90	0.00	0.02	0.00	0.05	0.02	0.01
Guinea	0.84	0.01	0.00	0.10	0.01	0.02	0.01
Kenya	0.90	0.00	0.01	0.02	0.03	0.02	0.03
Lesotho	0.37	0.10	0.03	0.10	0.11	0.13	0.16
Liberia	0.45	0.00	0.48	0.01	0.01	0.04	0.01
Madagascar	0.73	0.00	0.12	0.02	0.07	0.04	0.00
Malawi	0.72	0.01	0.07	0.07	0.04	0.07	0.02
Mali	0.48	0.01	0.01	0.03	0.02	0.44	0.01
Mauritania	0.49	0.09	0.01	0.14	0.04	0.10	0.11
Mauritius	0.57	0.03	0.07	0.08	0.05	0.05	0.14
Mozambique	0.69	0.00	0.00	0.09	0.15	0.06	0.01
Namibia	0.83	0.01	0.00	0.13	0.01	0.01	0.01
Niger	0.47	0.03	0.01	0.39	0.02	0.04	0.05
Nigeria	0.81	0.00	0.01	0.01	0.07	0.10	0.00
Rwanda	0.87	0.02	0.01	0.03	0.02	0.03	0.03
Sao Tome and Principe	0.71	0.05	0.01	0.07	0.03	0.06	0.07
Senegal	0.88	0.00	0.01	0.03	0.07	0.01	0.00
Seychelles	0.43	0.09	0.03	0.11	0.09	0.12	0.13
Sierra Leone	0.74	0.04	0.03	0.05	0.03	0.05	0.06
Somalia	0.45	0.03	0.01	0.04	0.03	0.13	0.31
South Africa	0.78	0.00	0.02	0.10	0.03	0.04	0.03
Swaziland	0.88	0.01	0.00	0.05	0.01	0.02	0.03
Tanzania	0.62	0.01	0.07	0.04	0.14	0.06	0.05
Togo	0.79	0.05	0.01	0.04	0.01	0.08	0.01
Uganda	0.82	0.01	0.01	0.09	0.02	0.01	0.03
Zambia	0.75	0.01	0.01	0.19	0.01	0.02	0.02
Average	0.68	0.03	0.03	0.07	0.07	0.07	0.05

Table 4A Regions of destination of the agriculture foreign value added FVA (%), by SSA (2013)

exporting country	EU	LAC	NAFTA	AFRICA	EAST ASIA	SOUTH ASIA	OTHERS
Angola	0.50	0.08	0.01	0.17	0.04	0.07	0.13
Benin	0.41	0.15	0.02	0.18	0.07	0.15	0.03
Botswana	0.28	0.17	0.03	0.26	0.05	0.08	0.14
Burkina Faso	0.56	0.15	0.01	0.09	0.14	0.04	0.01
Burundi	0.61	0.04	0.11	0.07	0.02	0.05	0.10
Cameroon	0.54	0.00	0.03	0.06	0.31	0.05	0.00
Cape Verde	0.24	0.22	0.05	0.15	0.08	0.09	0.18
Central African Republic	0.67	0.02	0.05	0.06	0.15	0.02	0.03
Chad	0.57	0.01	0.32	0.05	0.01	0.02	0.02
Congo	0.56	0.01	0.03	0.04	0.22	0.11	0.02
Cote d'Ivoire	0.66	0.01	0.13	0.02	0.04	0.12	0.01
DR Congo	0.77	0.03	0.01	0.10	0.03	0.02	0.04
Djibouti	0.34	0.06	0.03	0.11	0.12	0.21	0.12
Eritrea	0.53	0.08	0.03	0.12	0.05	0.06	0.13
Ethiopia	0.19	0.00	0.06	0.01	0.56	0.03	0.15
Gabon	0.11	0.00	0.00	0.01	0.85	0.02	0.00
Gambia	0.53	0.07	0.01	0.13	0.09	0.06	0.10
Ghana	0.58	0.00	0.13	0.01	0.15	0.11	0.01
Guinea	0.71	0.02	0.02	0.14	0.02	0.06	0.03
Kenya	0.57	0.01	0.06	0.07	0.14	0.05	0.09
Lesotho	0.26	0.14	0.05	0.16	0.09	0.10	0.18
Liberia	0.21	0.01	0.73	0.02	0.02	0.02	0.01
Madagascar	0.40	0.00	0.30	0.04	0.19	0.06	0.01
Malawi	0.33	0.01	0.32	0.18	0.08	0.06	0.02
Mali	0.45	0.08	0.04	0.08	0.04	0.29	0.02
Mauritania	0.46	0.10	0.02	0.18	0.04	0.07	0.13
Mauritius	0.47	0.03	0.20	0.08	0.09	0.04	0.09
Mozambique	0.35	0.00	0.01	0.17	0.19	0.27	0.01
Namibia	0.38	0.01	0.01	0.57	0.01	0.01	0.02
Niger	0.33	0.03	0.01	0.56	0.02	0.02	0.04
Nigeria	0.46	0.00	0.02	0.02	0.13	0.36	0.01
Rwanda	0.66	0.05	0.06	0.10	0.03	0.04	0.07
Sao Tome and Principe	0.42	0.12	0.02	0.23	0.03	0.06	0.11
Senegal	0.50	0.01	0.05	0.04	0.39	0.01	0.01
Seychelles	0.33	0.12	0.04	0.17	0.09	0.09	0.15
Sierra Leone	0.49	0.07	0.07	0.13	0.04	0.07	0.14
Somalia	0.17	0.02	0.01	0.03	0.03	0.27	0.47
South Africa	0.42	0.01	0.09	0.21	0.14	0.07	0.06
Swaziland	0.43	0.03	0.00	0.29	0.12	0.03	0.09
Tanzania	0.29	0.01	0.10	0.07	0.37	0.09	0.07
Togo	0.28	0.57	0.02	0.04	0.01	0.07	0.01
Uganda	0.25	0.01	0.07	0.54	0.09	0.01	0.04
Zambia	0.33	0.01	0.03	0.57	0.02	0.02	0.02
Average	0.43	0.06	0.08	0.15	0.12	0.08	0.07

Table 5A Regions of destination of the food gross exports (%), by SSA (2013)

exporting country	EU	LAC	NAFTA	AFRICA	EAST ASIA	SOUTH ASIA	OTHERS
Angola	0.27	0.04	0.00	0.20	0.34	0.09	0.06
Benin	0.17	0.02	0.00	0.73	0.01	0.02	0.04
Botswana	0.87	0.01	0.00	0.09	0.01	0.01	0.01
Burkina Faso	0.23	0.50	0.01	0.16	0.02	0.03	0.05
Burundi	0.36	0.13	0.03	0.15	0.06	0.11	0.17
Cameroon	0.51	0.01	0.24	0.24	0.00	0.01	0.01
Cape Verde	0.45	0.10	0.02	0.18	0.05	0.08	0.12
Central African Republic	0.42	0.09	0.03	0.18	0.06	0.08	0.13
Chad	0.29	0.13	0.05	0.17	0.09	0.11	0.17
Congo	0.60	0.06	0.02	0.12	0.06	0.06	0.09
Cote d'Ivoire	0.68	0.00	0.18	0.06	0.05	0.01	0.03
DR Congo	0.69	0.04	0.02	0.08	0.02	0.04	0.11
Djibouti	0.39	0.11	0.03	0.17	0.06	0.10	0.15
Eritrea	0.39	0.11	0.03	0.13	0.07	0.10	0.16
Ethiopia	0.07	0.01	0.22	0.02	0.03	0.01	0.63
Gabon	0.61	0.04	0.01	0.20	0.05	0.04	0.06
Gambia	0.52	0.06	0.01	0.25	0.04	0.05	0.07
Ghana	0.78	0.01	0.11	0.05	0.03	0.01	0.01
Guinea	0.39	0.03	0.01	0.14	0.37	0.03	0.03
Kenya	0.65	0.01	0.06	0.15	0.07	0.01	0.05
Lesotho	0.43	0.10	0.03	0.14	0.06	0.09	0.15
Liberia	0.28	0.13	0.10	0.18	0.05	0.09	0.17
Madagascar	0.75	0.01	0.02	0.09	0.10	0.03	0.01
Malawi	0.65	0.01	0.03	0.28	0.00	0.01	0.02
Mali	0.57	0.05	0.01	0.22	0.02	0.05	0.08
Mauritania	0.64	0.00	0.00	0.09	0.25	0.02	0.01
Mauritius	0.72	0.01	0.03	0.04	0.18	0.02	0.02
Mozambique	0.24	0.01	0.04	0.51	0.18	0.01	0.01
Namibia	0.67	0.01	0.00	0.17	0.08	0.01	0.07
Niger	0.31	0.07	0.04	0.36	0.03	0.09	0.10
Nigeria	0.87	0.00	0.02	0.10	0.00	0.00	0.00
Rwanda	0.30	0.13	0.03	0.18	0.08	0.11	0.18
Sao Tome and Principe	0.47	0.09	0.03	0.11	0.07	0.11	0.13
Senegal	0.89	0.00	0.01	0.05	0.04	0.01	0.00
Seychelles	0.85	0.01	0.00	0.04	0.05	0.04	0.01
Sierra Leone	0.66	0.10	0.12	0.04	0.02	0.03	0.04
Somalia	0.33	0.05	0.01	0.09	0.04	0.05	0.42
South Africa	0.31	0.02	0.07	0.34	0.16	0.04	0.07
Swaziland	0.64	0.01	0.09	0.18	0.04	0.02	0.02
Tanzania	0.49	0.01	0.07	0.20	0.08	0.04	0.11
Togo	0.32	0.02	0.01	0.60	0.01	0.01	0.02
Uganda	0.21	0.05	0.02	0.41	0.16	0.03	0.12
Zambia	0.07	0.02	0.00	0.87	0.01	0.01	0.02
Average	0.49	0.06	0.04	0.20	0.07	0.04	0.09

Table 6A Regions of destination of the food indirect value added DVX (%), by SSA (2013)

exporting country	EU	LAC	NAFTA	AFRICA	EAST ASIA	SOUTH ASIA	OTHERS
Angola	0.36	0.06	0.01	0.26	0.08	0.15	0.09
Benin	0.35	0.05	0.01	0.42	0.03	0.05	0.08
Botswana	0.89	0.01	0.00	0.04	0.02	0.02	0.02
Burkina Faso	0.46	0.18	0.01	0.12	0.05	0.08	0.10
Burundi	0.43	0.10	0.02	0.11	0.07	0.12	0.15
Cameroon	0.81	0.01	0.08	0.08	0.00	0.01	0.01
Cape Verde	0.49	0.08	0.02	0.16	0.05	0.09	0.11
Central African Republic	0.49	0.07	0.02	0.11	0.07	0.10	0.13
Chad	0.37	0.10	0.03	0.11	0.10	0.13	0.16
Congo	0.63	0.06	0.01	0.08	0.05	0.07	0.10
Cote d'Ivoire	0.85	0.00	0.09	0.02	0.00	0.01	0.02
DR Congo	0.83	0.02	0.01	0.03	0.02	0.03	0.06
Djibouti	0.47	0.09	0.02	0.12	0.06	0.11	0.13
Eritrea	0.50	0.08	0.02	0.09	0.07	0.10	0.14
Ethiopia	0.21	0.03	0.16	0.04	0.02	0.03	0.50
Gabon	0.55	0.06	0.01	0.16	0.05	0.08	0.10
Gambia	0.73	0.04	0.01	0.11	0.03	0.05	0.05
Ghana	0.93	0.00	0.04	0.01	0.00	0.01	0.00
Guinea	0.46	0.04	0.02	0.18	0.17	0.07	0.06
Kenya	0.89	0.00	0.01	0.04	0.02	0.01	0.03
Lesotho	0.52	0.08	0.02	0.09	0.07	0.10	0.13
Liberia	0.38	0.10	0.06	0.12	0.07	0.12	0.16
Madagascar	0.87	0.01	0.01	0.04	0.02	0.05	0.01
Malawi	0.82	0.01	0.01	0.12	0.01	0.01	0.02
Mali	0.62	0.05	0.01	0.13	0.04	0.06	0.09
Mauritania	0.73	0.01	0.00	0.05	0.15	0.05	0.01
Mauritius	0.89	0.01	0.00	0.02	0.04	0.01	0.02
Mozambique	0.30	0.02	0.03	0.52	0.08	0.02	0.03
Namibia	0.89	0.01	0.00	0.07	0.01	0.01	0.01
Niger	0.44	0.07	0.04	0.19	0.05	0.09	0.12
Nigeria	0.96	0.00	0.00	0.02	0.00	0.00	0.00
Rwanda	0.35	0.11	0.02	0.13	0.09	0.13	0.17
Sao Tome and Principe	0.49	0.08	0.02	0.08	0.07	0.11	0.13
Senegal	0.94	0.00	0.00	0.03	0.01	0.01	0.00
Seychelles	0.92	0.00	0.00	0.02	0.01	0.04	0.01
Sierra Leone	0.71	0.04	0.09	0.04	0.02	0.04	0.05
Somalia	0.43	0.07	0.01	0.09	0.06	0.09	0.26
South Africa	0.55	0.01	0.04	0.23	0.08	0.05	0.04
Swaziland	0.83	0.01	0.04	0.07	0.03	0.01	0.01
Tanzania	0.80	0.00	0.00	0.11	0.02	0.03	0.03
Togo	0.66	0.03	0.01	0.20	0.02	0.03	0.04
Uganda	0.62	0.04	0.00	0.17	0.05	0.03	0.08
Zambia	0.31	0.05	0.00	0.47	0.03	0.05	0.07
Average	0.62	0.04	0.02	0.12	0.05	0.06	0.08

Table 7A Regions of destination of the food foreign value added FVA (%), by SSA (2013)

exporting country	EU	LAC	NAFTA	AFRICA	EAST ASIA	SOUTH ASIA	OTHERS
Angola	0.25	0.03	0.00	0.19	0.39	0.08	0.05
Benin	0.15	0.02	0.00	0.77	0.01	0.02	0.03
Botswana	0.86	0.01	0.00	0.10	0.01	0.01	0.01
Burkina Faso	0.19	0.55	0.01	0.17	0.01	0.02	0.05
Burundi	0.33	0.14	0.03	0.17	0.06	0.10	0.17
Cameroon	0.44	0.00	0.27	0.27	0.00	0.00	0.01
Cape Verde	0.43	0.10	0.02	0.19	0.05	0.08	0.12
Central African Republic	0.39	0.09	0.04	0.20	0.06	0.08	0.14
Chad	0.25	0.14	0.05	0.20	0.08	0.10	0.18
Congo	0.59	0.06	0.02	0.13	0.06	0.06	0.09
Cote d'Ivoire	0.64	0.00	0.20	0.06	0.06	0.01	0.03
DR Congo	0.60	0.05	0.03	0.12	0.02	0.04	0.14
Djibouti	0.36	0.11	0.03	0.19	0.05	0.10	0.15
Eritrea	0.34	0.13	0.04	0.15	0.07	0.09	0.17
Ethiopia	0.06	0.01	0.22	0.02	0.03	0.01	0.64
Gabon	0.62	0.04	0.00	0.21	0.04	0.03	0.05
Gambia	0.42	0.07	0.02	0.32	0.04	0.05	0.08
Ghana	0.74	0.01	0.14	0.06	0.03	0.01	0.01
Guinea	0.38	0.02	0.01	0.14	0.40	0.02	0.03
Kenya	0.57	0.01	0.08	0.19	0.08	0.01	0.06
Lesotho	0.40	0.11	0.03	0.16	0.06	0.09	0.16
Liberia	0.25	0.13	0.11	0.20	0.05	0.08	0.17
Madagascar	0.72	0.00	0.02	0.10	0.12	0.03	0.01
Malawi	0.60	0.01	0.04	0.32	0.00	0.01	0.02
Mali	0.56	0.05	0.01	0.25	0.02	0.05	0.07
Mauritania	0.63	0.00	0.00	0.09	0.26	0.01	0.00
Mauritius	0.66	0.01	0.03	0.05	0.22	0.02	0.02
Mozambique	0.23	0.01	0.04	0.51	0.19	0.01	0.01
Namibia	0.63	0.01	0.00	0.19	0.09	0.01	0.08
Niger	0.27	0.07	0.04	0.42	0.03	0.08	0.10
Nigeria	0.83	0.00	0.03	0.13	0.00	0.00	0.00
Rwanda	0.28	0.14	0.03	0.21	0.07	0.10	0.18
Sao Tome and Principe	0.46	0.09	0.03	0.12	0.06	0.11	0.13
Senegal	0.88	0.00	0.01	0.06	0.04	0.01	0.00
Seychelles	0.82	0.01	0.00	0.05	0.07	0.04	0.01
Sierra Leone	0.64	0.12	0.13	0.04	0.02	0.02	0.04
Somalia	0.31	0.05	0.01	0.09	0.04	0.04	0.46
South Africa	0.26	0.02	0.07	0.36	0.18	0.04	0.07
Swaziland	0.59	0.01	0.11	0.21	0.04	0.02	0.02
Tanzania	0.41	0.01	0.08	0.23	0.09	0.05	0.13
Togo	0.27	0.01	0.01	0.66	0.01	0.01	0.02
Uganda	0.13	0.05	0.03	0.46	0.18	0.03	0.13
Zambia	0.05	0.01	0.00	0.90	0.01	0.01	0.02
Average	0.45	0.06	0.05	0.22	0.08	0.04	0.09

Table 8A Variables applied in the empirical analysis: summary statistics

Variables	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
DirDVA	813,109	3.25	2.48	-5.16	16.33
MVA	810292	-6.26	3.79	-20.61	14.10
DirRDV	811535	-5.00	3.30	-19.38	13.68
FVA	815,689	0.95	2.63	-6.48	14.72
DVX	812,236	1.98	2.50	-7.19	14.99
tariff	563,408	1.80	1.09	0.00	6.62
RTA	816,960	0.14	0.35	0.00	1.00
FDI	724,592	5.47	23.67	-82.89	466.56
Manufacturing value added (%)	674,912	14.36	7.34	0.24	45.67
GDP	717,048	8.99	1.25	5.51	11.83
Population	794,880	15.54	2.06	9.71	21.03
Distance from hub	786,048	8.03	0.78	5.71	9.23
Contiguity	764,688	0.02	0.13	0.00	1.00
Common language	764,688	0.14	0.34	0.00	1.00
Common colonizer	764,688	0.09	0.29	0.00	1.00
Colonizer 1945	764,688	0.01	0.08	0.00	1.00
Distance ij	764,688	8.74	0.76	4.11	9.89

Table 9A Agriculture Gravity-like estimates without Fixed effects

	All countries					SSA countries (reporters)				
		forward	backward	forward dyadic	backward dyadic		forward	backward	forward dyadic	backward dyadic
	(1a)	(2a)	(3a)	(4a)	(5a)	(1b)	(2b)	(3b)	(4b)	(5b)
Dep Var:	dirDVA	DVX	FVA	dirRDV	MVA	dirDVA	DVX	FVA	dirRDV	MVA
tariff rate (applied mean)_ji	-0.166***	-0.181***	-0.165***	-0.137***	-0.248***	-0.208***	-0.220***	-0.206***	-0.126***	-0.323***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)	(0.008)
tariff rate (applied mean)_ij				0.062***	0.057***				0.011	-0.019
				(0.005)	(0.006)				(0.012)	(0.014)
RTA (yes=1)^	0.308***	0.298***	0.308***	0.584***	0.697***	0.054***	0.044**	0.055***	0.128***	0.195***
	(0.009)	(0.009)	(0.009)	(0.011)	(0.013)	(0.018)	(0.018)	(0.018)	(0.023)	(0.028)
FDI i	0.000	0.000	0.000	0.001**	0.000	-0.001	-0.001	0.003***	0.001	0.003**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
FDI j	-0.002***	0.001***	-0.002***	0.002***	-0.001***	-0.001***	0.002***	-0.001***	0.004***	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)
Manufacturing value added (%) i	0.002	0.002**	0.006***	0.007***	0.008***	-0.005**	-0.004	-0.008***	-0.009***	-0.009**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
Manufacturing value added (%) j	-0.004***	0.027***	-0.004***	0.017***	-0.002***	-0.010***	0.022***	-0.010***	0.011***	-0.010***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GDP i	0.606***	0.596***	0.429***	1.444***	0.451***	0.266***	0.252***	0.454***	0.757***	0.595***
	(0.021)	(0.020)	(0.021)	(0.031)	(0.037)	(0.041)	(0.041)	(0.041)	(0.062)	(0.077)
GDP j	0.690***	0.679***	0.687***	0.398***	1.638***	0.495***	0.500***	0.495***	0.025***	1.165***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)	(0.008)
Population i	0.746***	0.769***	0.202***	1.553***	0.505***	1.831***	1.829***	0.571***	3.080***	0.881***
	(0.034)	(0.034)	(0.035)	(0.048)	(0.058)	(0.089)	(0.091)	(0.089)	(0.157)	(0.189)
Population j	0.522***	0.408***	0.520***	0.270***	1.214***	0.462***	0.357***	0.462***	0.096***	0.995***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)
Distance from hub i	1.143***	1.143***	-1.351***	0.707***	-5.239***	18.009***	16.576***	12.842***	15.622***	17.567***
	(0.097)	(0.095)	(0.261)	(0.126)	(0.454)	(0.563)	(0.571)	(0.561)	(0.844)	(1.050)
Distance from hub j	-0.190***	-0.502***	-0.187***	-0.317***	-0.260***	-0.202***	-0.501***	-0.202***	-0.339***	-0.324***
	(0.004)	(0.004)	(0.004)	(0.006)	(0.007)	(0.008)	(0.008)	(0.008)	(0.011)	(0.012)
Contiguity	1.722***	1.567***	1.729***	2.540***	2.767***	1.340***	1.319***	1.336***	2.280***	2.489***
	(0.028)	(0.027)	(0.028)	(0.037)	(0.041)	(0.054)	(0.051)	(0.054)	(0.073)	(0.081)
Common language	0.437***	0.432***	0.434***	0.664***	0.875***	0.369***	0.407***	0.369***	0.571***	0.823***
	(0.009)	(0.009)	(0.009)	(0.012)	(0.014)	(0.014)	(0.014)	(0.014)	(0.018)	(0.022)
Common colonizer	0.155***	0.098***	0.152***	0.300***	0.290***	0.064***	-0.033**	0.064***	0.076***	0.067***
	(0.010)	(0.009)	(0.010)	(0.012)	(0.016)	(0.015)	(0.015)	(0.015)	(0.018)	(0.023)
Colonizer 1945	1.338***	1.226***	1.337***	2.115***	2.199***	1.824***	1.686***	1.830***	3.250***	3.565***
	(0.038)	(0.035)	(0.038)	(0.050)	(0.053)	(0.071)	(0.065)	(0.071)	(0.102)	(0.108)
Distance ij	-0.545***	-0.492***	-0.540***	-1.077***	-0.998***	-0.225***	-0.162***	-0.226***	-0.518***	-0.409***
	(0.005)	(0.005)	(0.005)	(0.006)	(0.007)	(0.009)	(0.009)	(0.009)	(0.012)	(0.015)
Constant	-31.849***	-30.096***	-2.387	-45.078***	5.750*	-196.791***	-182.342***	-134.866***	-195.323***	-201.140***
	(1.210)	(1.175)	(1.875)	(1.638)	(3.325)	(6.167)	(6.249)	(6.147)	(9.630)	(11.890)
Observations	386,615	386,525	388,746	349,645	348,560	99,938	99,916	99,938	84,546	83,612
R-squared	0.682	0.698	0.703	0.747	0.718	0.555	0.577	0.583	0.505	0.619
Country fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

^ three years lags from the entry into force of the agreement

Table 10A Food Gravity-like estimates without Fixed effects

	All countries					SSA countries (reporters)				
		forward	backward	forward dyadic	backward dyadic		forward	backward	forward dyadic	backward dyadic
	(1a)	(2a)	(3a)	(4a)	(5a)	(1b)	(2b)	(3b)	(4b)	(5b)
Dep Var:	dirDVA	DVX	FVA	dirRDV	MVA	dirDVA	DVX	FVA	dirRDV	MVA
tariff rate (applied mean)_ji	-0.127***	-0.135***	-0.125***	-0.086***	-0.234***	-0.203***	-0.197***	-0.202***	-0.107***	-0.367***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.006)
tariff rate (applied mean)_ij				0.104***	0.113***				-0.050***	-0.082***
				(0.004)	(0.005)				(0.010)	(0.013)
RTA (yes=1)^	0.392***	0.339***	0.391***	0.647***	0.810***	0.117***	0.105***	0.113***	0.166***	0.249***
	(0.009)	(0.008)	(0.009)	(0.010)	(0.013)	(0.018)	(0.015)	(0.018)	(0.019)	(0.027)
FDI i	0.001***	0.001***	0.001***	0.002***	0.001***	0.002**	0.002***	0.006***	0.007***	0.009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
FDI j	-0.000	0.003***	-0.000	0.003***	0.001*	-0.001*	0.002***	-0.001*	0.004***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Manufacturing value added (%) i	0.011***	0.011***	0.014***	0.016***	0.019***	0.017***	0.018***	0.015***	0.020***	0.018***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
Manufacturing value added (%) j	-0.006***	0.025***	-0.006***	0.016***	0.002***	-0.009***	0.023***	-0.009***	0.008***	-0.004***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GDP i	0.661***	0.610***	0.517***	1.378***	0.514***	0.390***	0.366***	0.262***	0.646***	0.129*
	(0.021)	(0.019)	(0.021)	(0.030)	(0.037)	(0.038)	(0.034)	(0.038)	(0.053)	(0.073)
GDP j	0.761***	0.679***	0.759***	0.399***	1.743***	0.402***	0.372***	0.402***	-0.096***	1.094***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.008)
Population i	0.555***	0.553***	0.139***	1.212***	0.380***	0.674***	0.654***	0.188*	1.697***	0.682***
	(0.036)	(0.032)	(0.036)	(0.047)	(0.060)	(0.096)	(0.088)	(0.097)	(0.147)	(0.197)
Population j	0.524***	0.363***	0.523***	0.227***	1.247***	0.366***	0.244***	0.366***	-0.017***	0.927***
	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.005)
Distance from hub i	0.433	0.300	-0.077	-1.651***	-2.921***	3.076***	3.179***	0.450	0.155	2.660***
	(0.268)	(0.239)	(0.266)	(0.360)	(0.463)	(0.563)	(0.512)	(0.561)	(0.771)	(1.029)
Distance from hub j	0.031***	-0.292***	0.032***	-0.147***	0.026***	0.049***	-0.232***	0.050***	-0.113***	0.013
	(0.004)	(0.004)	(0.004)	(0.006)	(0.007)	(0.008)	(0.007)	(0.008)	(0.010)	(0.012)
Contiguity	1.566***	1.332***	1.579***	2.358***	2.678***	1.793***	1.479***	1.791***	2.430***	3.169***
	(0.028)	(0.026)	(0.028)	(0.037)	(0.041)	(0.057)	(0.049)	(0.056)	(0.073)	(0.088)
Common language	0.548***	0.450***	0.549***	0.690***	1.082***	0.368***	0.304***	0.366***	0.463***	0.846***
	(0.010)	(0.009)	(0.010)	(0.012)	(0.015)	(0.014)	(0.012)	(0.014)	(0.015)	(0.021)
Common colonizer	0.157***	0.076***	0.153***	0.267***	0.294***	-0.068***	-0.128***	-0.067***	-0.042***	-0.052**
	(0.011)	(0.009)	(0.011)	(0.012)	(0.017)	(0.015)	(0.013)	(0.015)	(0.016)	(0.023)
Colonizer 1945	1.713***	1.477***	1.723***	2.321***	2.642***	2.513***	2.116***	2.520***	3.557***	4.322***
	(0.042)	(0.038)	(0.041)	(0.052)	(0.055)	(0.095)	(0.087)	(0.095)	(0.124)	(0.137)
Distance ij	-0.692***	-0.549***	-0.687***	-1.142***	-1.203***	-0.286***	-0.136***	-0.288***	-0.511***	-0.556***
	(0.005)	(0.004)	(0.005)	(0.006)	(0.008)	(0.009)	(0.008)	(0.009)	(0.010)	(0.015)
Constant	-25.029***	-20.583***	-14.609***	-19.161***	-16.025***	-46.051***	-45.231***	-15.723**	-34.188***	-61.307***
	(1.915)	(1.717)	(1.903)	(2.622)	(3.362)	(6.304)	(5.717)	(6.300)	(8.854)	(11.824)
Observations	387,032	386,954	388,746	349,928	348,769	99,938	99,915	99,938	84,553	83,659
R-squared	0.729	0.736	0.737	0.781	0.733	0.543	0.566	0.576	0.579	0.618
Country fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year fe	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

^ three years lags from the entry into force of the agreement

Table 11A Common 25 ISIC-type classification

Sector name	ISIC Rev.3 correspondence
Agriculture	1,2
Fishing	5
Mining and quarrying	10,11,12,13,14
Food and beverages	15,16
Textiles and wearing apparel	17,18,19
Wood and paper	20,21,22
Petroleum, chemical and non-metallic mineral products	23,24,25,26
Metal products	27,28
Electrical and machinery	29,30,31,32,33
Transport equipment	34,35
Other manufacturing	36
Recycling	37
Electricity, gas and water	40,41
Construction	45
Maintenance and repair	50
Wholesale trade	51
Retail trade	52
Hotels and restaurants	55
Transport	60,61,62,63
Post and telecommunications	64
Financial intermediation and business activities	65,66,67,70,71,72,73,74
Public administration	75
Education, health and other services	80.85,90,91,92,93
Private households	95
Others	99

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