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# The role of trade policies in building regional value chains - some preliminary evidence from Africa

## Abstract

**Regional value chains (RVCs) are considered as an important step towards greater integration into global value chains (GVCs), but African countries trade very little value added with each other. Based on the UNCTAD-Eora GVC database this paper estimates a panel model from 2006 to 2012 for 37 African countries and sheds light on the role of trade costs in building RVCs in Africa. First evidence is provided for a significantly negative effect on foreign value added of charged tariffs on capital goods and higher time to trade. In addition, higher regulatory quality and a stronger telecommunication infrastructure seem to be positively correlated with a country's ability to participate in RVCs.**

**Key words:** Africa, global value chains, regional production networks, panel data, tariff barriers

**JEL classification:** F13, F14, F15, C23

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## Contents



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# 1. Introduction

International trade is increasingly shaped by the existence of value chains, regionally and globally. Decreasing transaction costs have encouraged multinational corporations to outsource stages of production, retaining the most profitable phases along the supply chain. More complex products and a greater division of labor allow more countries to participate in global trade by specializing in specific tasks without the need to produce the entire product. Developing countries can leverage participation in value chains as a stepping stone towards greater integration into the global economy which promises a rise in labor productivity and total factor productivity through knowledge spillovers and technology transfer.

African countries are highly under-represented in global value chains (GVCs) although their participation has significantly increased over the course of the last decade. The example of the great world factories in Europe, North America and Asia shows that building regional value chains (RVCs) is an important step towards participation in GVCs by increasing the market for exports and imports. However, the share of intra-African trade in value added is low at nine percent, compared to 45 percent in Asia and 18 percent in Latin America. Although it is essential to understand the dynamics and characteristics of RVCs in order to implement efficient policy instruments for facilitating regional trade in value added, the literature on RVCs in Africa is sparse.

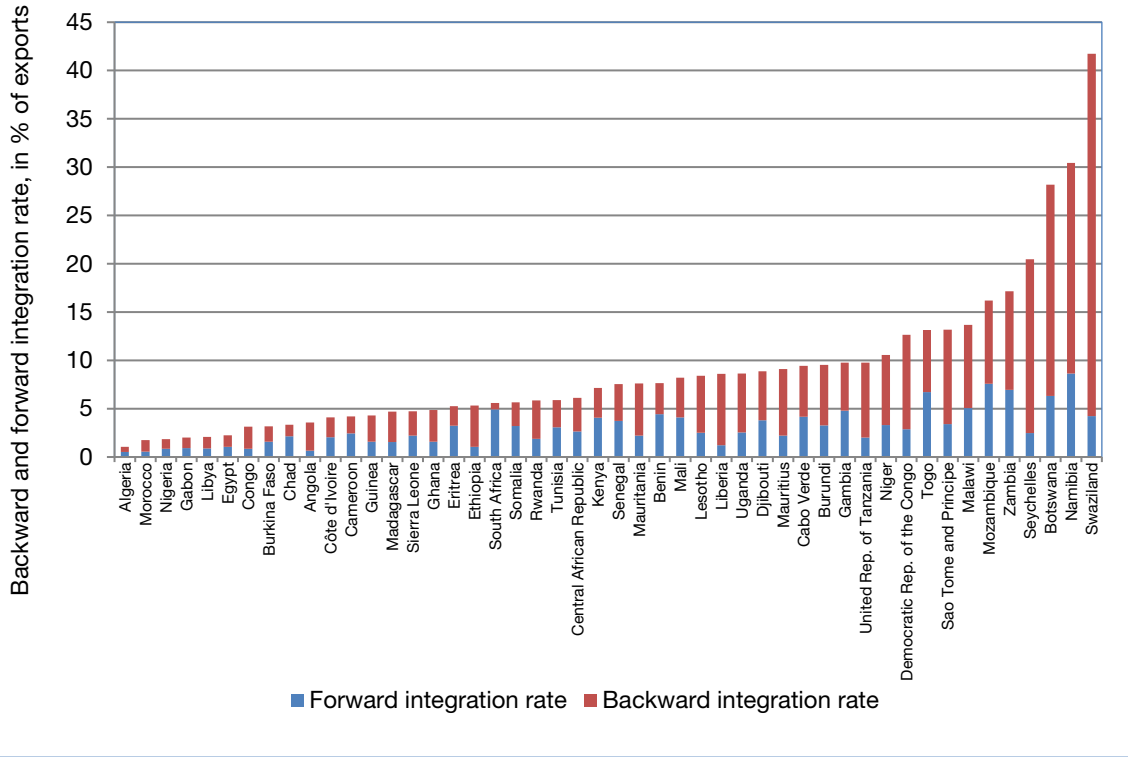
To the best of the author's knowledge there is no study which empirically explores determinants of RVCs in Africa. The study at hand attempts to close this gap in the literature. By doing this, the analysis builds on empirical literature on African *global* value chain participation on the one hand. Kowalski et al. (2015) and IMF (2016) are the only two publications that empirically address the determinants of African countries' trade in value added with the world. On the other hand, sector- and country-specific literature on African *regional* value chains (Banga et al., 2015; Morris and Staritz, 2013 and Morris et al., 2014) is discussed to show that a reduction of regional transaction and trade costs is even more crucial to increasing RVC integration than gross trade since products have to cross the border twice. This is theoretically underlined by the two-dimensional fragmentation model by Kimura (2007) which centralizes service link costs as a major constraint to the fragmentation of production processes. Service link costs arise by connecting production blocks and include trade and transportation costs, as well as economic transaction costs (e.g. telecommunication costs and deficiencies in legal systems and economic institutions).

This paper purely focuses on the role of trade policies in regional trade in value added within Africa. Policy makers are usually confronted with a set of trade policy instruments in the form of different tariff rates. High tariffs on important inputs such as production equipment might be more restrictive than tariffs on raw materials, especially for resource abundant countries. Despite recent integration efforts among African countries, intra-regionally applied tariffs are still high compared to cases in Asia and Latin America. In addition, time delays caused by poor infrastructure and border inefficiencies restrict intra-regional trade. For trade in parts and components, delays in arrival are even more prevalent than for trade in finished goods since the full production process could be interrupted. In light of the potential Continental Free Trade Area (CFTA) which is currently negotiated, the aim of this study in identifying the impact of these constraints becomes highly relevant.

This study uses newly published international input-output tables, obtained from the UNCTAD Eora[1] GVC database, to quantify trade in value added between African countries and to evaluate each country's position in the RVC. The empirical analysis concentrates on the backward integration perspective, defined as imported foreign value added (FVA) from the region embedded in a country's exports to the region. On average, 6.0 percent (in 2012) of the value added exports to African countries are also sourced from within the region.

[1] Environmental Accounting Framework Using Externality Data and Input-Output Tools for Policy Analysis.

**Figure 1. Participation in African RVCs, Backward and Forward Integration Rates, 2012**

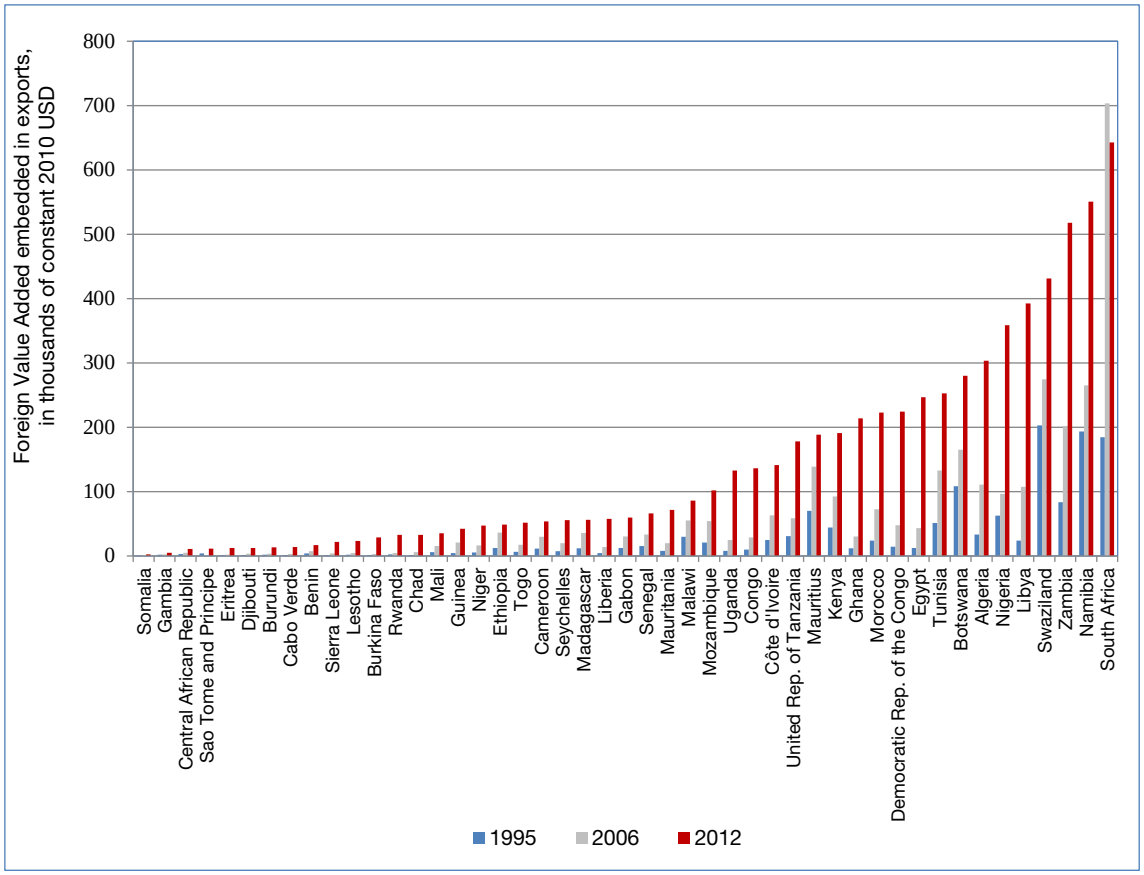



Source: Author's calculation based on Eora Database.

Southern African countries such as Namibia, Botswana and Swaziland are considered to be the most integrated countries, mainly attributed to their proximity to the regional hub, South Africa. Moreover, all African countries, except South Africa, presently import more inputs from within region than they did in 2006. Between 2006 to 2012, real imported FVA increased by 114 percent while total value added trade increased by 53 percent (see figure 1 and figure 2). The stronger increase in FVA indicates a strengthening of regional production networks. The research question that naturally arises is why some African countries have experienced a stronger increase in value added trade and have managed to integrate into RVCs to a greater extent than other countries. Given the fact that imported foreign value added from the rest of the world is approximately zero, an analysis of trade diversion from third countries towards the region is not essential and allows a pure concentration on regional preferential trade liberalization.

An extensive literature review provides a theoretical framework for the empirical analysis. Qualitative literature on Africa, as well as examples from Asia and Latin America are particularly instructive in understanding the role of trade facilitation and structural factors in building RVCs. A panel of 37 African countries from 2006 to 2012 is estimated using a fixed-effects (FE) estimator, controlling for auto-correlation and cross-sectional correlation among standard errors. The results suggest that trade barriers are significant determinants of a country's ability to join and upgrade within RVCs. Among different tariff rates, the charged tariff on capital goods is most restrictive to imported FVA. The proxies for non-tariff barriers (NTBs) also indicate a negative effect on RVC participation. In addition, higher regulatory quality and a stronger telecommunication infrastructure are positively correlated with the evolution of RVCs.

**Figure 2. Participation in African RVCs, foreign value added in thousands of constant USD, 1995, 2006 and 2012**




Source: Author's calculation based on Eora Database.

The paper is structured as follows. Section 2 provides a review of the existing literature on GVCs and RVCs. The methodology and data set are described in section 3. Empirical evidence for the role of trade policy is presented in section 4 and further discussed in section 5. Section 6 concludes.

# 2. Literature review

A more segmented GVC and a greater division of labor allow more countries to participate in global trade and to increase competitiveness by specializing in the specific part of the supply chain in which they are most competitive (Cattaneo et al., 2013). Baldwin (2011) identifies this new era of globalization as globalization's second unbundling. Although the literature argues that most supply chains are regional and advance toward greater integration in GVCs, the issue of RVCs is marginally discussed, especially for African countries. The first part of this section provides a literature review on GVCs and RVCs in Africa relying almost exclusively on country and sector-level case studies. The second part discusses empirical literature which, to date, only exists on GVC participation.

The determinants and effects of African countries' GVC participation were mostly identified by relying on qualitative country case studies (e.g. ECA, 2012; Bamber et al., 2014; ADB et al., 2014 and ECA, 2015). All studies show that productive capacity, infrastructure and services, and trade and investment policy are the most important determinants of a country's competitiveness and influence a given country's ability to participate in GVCs. Focusing on trade policy and trade facilitation issues in strengthening the GVC participation of Southern African Customs Union (SACU) countries, Farole (2016) summarizes challenges emerging from his analysis of value chain trade of the SACU countries. Most critical for GVC competitiveness are port congestion

and access to rail and port services, and governmental support for standards compliance. Border and trade policy factors are more critical for building SACU RVCs. Specifically, those are tariffs, intra-SACU trade restrictions, limited access to containers, high transportation costs and a lack of harmonization of border procedures, including a poorly integrated electronics system.

The restrictive role of bilateral tariffs and border inefficiencies for intra-regional gross trade has been proven for developing countries in the traditional trade literature (e.g. Carrère, 2014; Iwanow and Kirkpatrick, 2009 and Portugal-Perez and Wilson, 2012). For instance, for the Economic Community of West African States (ECOWAS), the Central African Economic and Monetary Community (CEMAC), the Southern African Development Community (SADC) and the Common Market for Eastern and Southern Africa (COMESA), Carrère (2014) shows that formal trade agreements indeed can increase intra-regional trade when the regional transport network is improved. Iwanow and Kirkpatrick (2009) and Portugal-Perez and Wilson (2012) both find a significantly negative effect on bilateral manufacturing exports and total exports, respectively, using the simple average of applied tariffs on all incoming products from the world (TRAINS database). The effect of tariffs has also been examined for the upcoming COMESA-EAC-SADC Tripartite Free Trade Area[2] by means of ex-ante computable general equilibrium models. For instance, Willenbockel (2013) shows that all Tripartite countries benefit in terms of welfare gains and total exports from the elimination of remaining intra-COMESA and intra-SADC tariffs.

The Economic Report on Africa (ECA, 2015) emphasizes the importance of strong RVCs in GVC participation. The report states that many African countries only participate in lower value-added segments of GVCs and that higher integration rates are often driven by one or two firms which are poorly linked to the rest of the economy. Participation in GVCs is resource-intensive and requires a strong industrial base to be competitive. Furthermore, multinational companies control their value chains by setting product standards and rules. In this regard participation in RVCs would offer countries a platform for learning since they are easier to penetrate. The report also shows that Southern Africa is the most integrated African region, both on an intra-African and global scale.

Turning to existing literature on African RVCs, there are only a few studies that examine their structure and determinants. For COMESA, ECOWAS and SACU, Banga et al. (2015) investigate the potential of forming a RVC in the leather and leather products sector which experienced a rise in the share in global exports from 1.5 percent in 2000 to 3.6 percent in 2011. The authors undertake three analytical steps using all inputs and outputs in the leather industry according to the Broad Economic Categories (BEC) classification. First, they estimate a gravity model for bilateral trade of the leather industry showing that predicted intra-regional trade is much higher than actual intra-regional trade for all examined trading blocs, suggesting a greater potential for increasing regional trade. Second, they identify competitiveness and export potential for 52 leather products and 152 leather inputs using the contribution to trade balance index[3] and the international market position[4]. Third, by dis-aggregating tariff lines for 120 leather items the study derives potential RVCs and a list of products for each country where regional demand exists. For instance, the authors find that more than 50 percent of inputs can be sourced at a lower price from within the region. Furthermore they indicate the region's supply capacity as its global exports are much higher than the region's demand (Banga et al., 2015). The study recommends the creation of an intra-regional investment agreement that works to reduce remaining high tariffs, and to encourage knowledge and information sharing, learning from the Association of Southeast Asian Nations (ASEAN) Comprehensive Investment Agreement. The COMESA Leather and Leather Products Institute could be a motor in building such an association. Intra-regional cooperation is also crucial to harmonize technical standards and to reduce NTBs. Reducing transaction costs also implies an improvement of physical infrastructure where an intra-regional association for foreign direct investments could be a catalyst. Finally, regional resource mobilization, especially of capital, can play a crucial role in developing RVCs.

The occurrence of RVCs and their potential to lead to greater integration in GVCs can also be displayed with the example of Lesotho's apparel industry (Morris and Staritz, 2013). The largest African exporter of apparel to the United States used its integration with South Africa as a springboard towards greater competitiveness

[2] The Tripartite consists of the existing trade blocs COMESA, East African Community (EAC) and SADC.

[3] This index was suggested by CEPII as an indicator of comparative advantage, overcoming the shortages of the revealed comparative advantage index by considering imports *and* exports.

[4] This indicator measures the international competitiveness of the country in a certain product, or said differently, the relation of world trade of product *i* to country *j*'s gross domestic product.

on the global stage. Reasons why South African firms started to relocate production to Lesotho in the 1980s are diverse. Firstly, South African firms took advantage of lower labor costs; secondly, firms in South Africa wanted to avoid sanctions that were imposed on exports because of the Apartheid regime; thirdly and fourthly, Lesotho's duty free access to Europe under the Lomé Convention and its weaker rules of origin requirements on exports to the United States strengthened its competitiveness in exporting to these markets. Between 2006 and 2011, when South Africa allowed higher quotas on Chinese imports resulting in increased competition, South African firms further relocated production to Lesotho in order to reduce costs. Within an examination of the cassava value chain in Sierra Leone, Coulibaly et al. (2014) find that the Western African country has a comparative advantage and faces significant demand in the region. However, according to the study, remaining challenges to expand cassava production include high transportation costs, poor access to credit and poor linkages between producers and customers.

Albeit the literature on Africa identifies the challenges and potential of RVCs, knowledge on how they actually evolve is rare. The examples of Asia and Latin America can be particularly instructive when it comes to understanding how RVCs form. Intra-industry trade in East Asia rapidly increased in the 1990s, which was driven by vertical integration. The evolution of industrial production networks in the region is mainly explained by the relocation of production of Japanese firms to neighboring countries and the fact that Asian countries cut tariffs, associated with a deepening of regional industrial production networks. Several studies (Kimura, 2007; Ando, 2007 and ESCAP, 2011) prove that a reduction of bilateral and multilateral transaction costs was crucial for the formation of regional production networks in East Asia.

Similarly, empirical evidence from Latin America shows that a preferential tariff reduction in the automobile sector between Brazil and Argentina was among the driving forces in building RVCs. Ciravegna (2003) analyzes the insertion of the automobile sector into regional and global production networks through the example of Fiat (case study based on interviews). In the 1990s, improved macroeconomic conditions that attracted foreign investments, in combination with import tariff reductions, led to a boom in car sales. Although the automotive sector was a controversial theme across Mercosur (Mercado Común del Sur) countries, it became a motor of regional integration. Brazil and Argentina signed an auto sector trade agreement in 1988. Fiat made use of this preferential trade liberalization and created a regionally integrated value chain. The units in Brazil and Argentina "had to learn how to act as regional players" (Ciravegna, 2003, p. 15) in order to compete internationally. The author concludes that "regional integration can in certain circumstances create the appropriate conditions for multinationals to upgrade their operations in developing countries" (Ciravegna, 2003, p. 24).

The challenge of this paper is a quantification of value chain participation in Africa. Because of a lack of data, empirical assessment on value chains is still rare, but newly created databases, such as the OECD-WTO Trade in Value Added (TiVA) database, have led to a boom in the GVC literature (e.g. Baldwin and Lopez-Gonzales, 2015[5]; Timmer et al., 2014[6] and Backer and Miroudot, 2013[7]). This strand of literature provides guidance on how trade in value added is quantified and empirically examined. Johnson (2014) provides an overview of existing public databases for research on value added trade.

First empirical insights on the evolution of supply chains come from Johnson and Noguera (2017). They analyze value added to gross exports for 42 countries of the Organisation for Economic Co-operation and Development (OECD) and major emerging markets over a long time period (1970 to 2009) in order to identify causes of rising supply chain fragmentation. Based on various data sources (e.g. OECD Input-Output Database, IDE-JETRO[8] Asian Input-Output Tables) the authors estimate a gravity model showing that distance significantly reduces value added trade. However, the negative effect of distance is smaller on value added exports than on gross exports. Common borders, common language and common colonial origin have a similar, positive, but smaller, effect. Looking at bilateral trade agreements, the authors also find a positive link to value added

[5] The authors used World Input-Output Database (WIOD) and Organisation for Economic Co-operation and Development (OECD)-World Trade Organisation (WTO) Trade in Value Added (TiVA) data to evaluate the development of complex supply chain trade between 1995 and 2009. The authors underline existing literature (e.g. Johnson and Noguera, 2012) that supply chains are not global, but regional and that most intensive networks are within North America, despite a shift towards production in Asia.

[6] The authors explore the geography of value chain fragmentation using FVA data computed from the WIOD database.

[7] The authors use the OECD-WTO TiVA database to examine the depth and length of value chains by sector for selected OECD countries, and evaluate a country's distance to final demand which is proxied by the "upstreamness" index, introduced by Antrás et al. (2012).

[8] Institute of Developing Economies - Japan External Trade Organization.

exports. Based on an extensive literature review and comparative statistics, (Bruhn, 2014) also concludes that traditional trade barriers as well as behind-the-border policies seem to have a positive impact on developing countries' GVC participation. In addition, her findings indicate that formal preferential trade agreements play an important role by providing an institutional base for cross-border production networks.

First attempts in quantifying value chain participation of Africa have been made by IMF (2016), and Kowalski et al. (2015), using the newly created UNCTAD-Eora GVC database. Kowalski et al. (2015) examine the marginal effect of non-policy factors (market size, level of development, level of industrialization and remoteness) and policy factors (regional trade agreements and tariffs, openness to foreign direct investments, logistics performance and infrastructure) on GVC participation for high-income countries and the developing regions Eastern and Southern Africa, Middle East and North Africa, Western and Central Africa, South Asia, South-Eastern Asia and Eastern Asia. The authors separately use backward and forward integration as indicators for GVC participation as there seems to be a negative correlation between the two implying different policy implications. For developing countries, the authors show that distance to the closest manufacturing hub and effectively applied tariffs have a significantly negative effect on backward integration. In contrast, faced tariffs only have a significantly negative effect on forward integration. Interestingly, while openness to foreign direct investments is an important determinant of backward integration in high-income countries, this effect cannot be found for developing countries. However, it should be noted that the authors do not control for endogeneity. They refrain from including country-fixed effects in order to keep precious variation and to identify the effect of time-invariant variables.

The recently published study by the International Monetary Fund (IMF) also confirms the positive nexus between the role of trade integration and rising international supply chains (IMF 2016). The authors estimate a panel of 185 countries over the period 2007-2011 using the share of foreign value added in a country's exports (backward integration rate), obtained from the UNCTAD-Eora GVC database, as the dependent variable. The study controls for endogeneity by including country-fixed effects, a time trend and lagged independent variables. For a reduced sample of countries with a gross domestic product (GDP) per capita of lower than 22,000 US-Dollars (236 observations), the study finds a significantly positive effect of spending on education (as percent of GDP) and the rule of law, and a significantly negative effect of the charged weighted average tariff at the one percent level. However, given the chosen sample size the authors can only cautiously interpret the results with respect to Sub-Saharan Africa. Conclusions on the constraining role of trade barriers can only be drawn with consideration to the gravity model results and the centrality measure which shows that Sub-Saharan Africa is the least integrated region in the world.

Although there is still a lack of research on the GVC participation of African countries, the literature points to a strong negative effect of charged tariffs on imports. While there is no doubt that GVCs are equally important for Africa's economic development, it is also important to have a better understanding of the determinants of RVCs. The following section (3) discusses potential differences in the determinants of GVCs and RVCs, and the empirical model.

# 3. Methodology and estimation procedure

The literature argues that trade costs play a crucial rule in the formation of RVCs since intermediate goods cross the border several times. Furthermore, dominant countries, such as Japan and China, have been motors in East Asia, whereas the proximity to a manufacturing hub may influence RVC participation. Theoretically, the importance of trade costs in regional production networks has been conceptualized by Kimura (2007) in a two-dimensional fragmentation model. He argues that production networks among less developed countries are mainly explained by savings in production costs due to differences in firm-specific assets rather than income differences. In order to make use of better technology and managerial know-how, service link costs become even more important. Service link costs include all kinds of costs that arise from connecting production blocks. On the one hand, African countries need to cooperate in removing bilateral tariffs and increase trade facilitation, as well as institutional connectivity. On the other hand, national development agendas need to address poor physical connectivity (e.g. quality of roads) to the region and high transaction costs in economic activities (e.g. supply of electricity and telecommunication services). The study at hand focuses on the impact of a reduction in these service link costs on RVCs in Africa.

In addition to service link costs, network set-up costs (e.g. political stability and transparency, liberalization of financial services and investment liberalization) and production costs per se (e.g. support to small-medium enterprises, strengthening innovation and increasing network to share knowledge and information) are also crucial to building RVCs (Kimura, 2007; De, 2014 and ECLAC, 2014).

## Methodology

Measuring value added and GVC participation rates is subject to methodological challenges. There are various concepts and definitions of value chains. I follow the definition of value chains as activities involving "import to export", introduced by Baldwin and Lopez-Gonzalez (2015). The UNCTAD-Eora GVC initiative meets the methodological challenge and provides a database with a coverage of 187 countries, reduced to 26 harmonized sectors, in order to yield a balanced input-output table. It is the only database that covers a wide range of developing countries. The authors were able to collect national input-output tables from 74 countries for various years[9], but for many countries those data are not available, and had to be filled applying a constrained optimization algorithm (Lenzen et al., 2013). Hence, while the database is still quite instructive when it comes to understanding countries' integration in value chains and the role of trade policy, the size of the coefficients should be interpreted with caution.

International input-output tables from the UNCTAD-Eora GVC database are used to obtain the following matrix of "global value added exports" (Equation 3.1 for the simplified one-sector case):

$$\begin{bmatrix} VAE_{11} & \dots & VAE_{1n} \\ \vdots & \ddots & \vdots \\ VAE_{n1} & \dots & VAE_{nm} \end{bmatrix} = \begin{bmatrix} v_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & v_n \end{bmatrix} \times \begin{bmatrix} L_{11} & \dots & L_{1n} \\ \vdots & \ddots & \vdots \\ L_{n1} & \dots & L_{nm} \end{bmatrix} \times \begin{bmatrix} e_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & e_n \end{bmatrix} \quad (3.1)$$

where $v_n$ is the diagonal of direct value added as a share of total output by country n (for $n = 1,...,N$), $L$ is the Leontief inverse, and $e_n$ is the diagonal of total exports of country n to all its trading partners m (for m=1,..,M). N and M stand for all 187 countries included in the Eora database. The "regional value added exports" matrix for trade between African countries is a sub-matrix of $VAE_{nm}$ in equation 3.1, i.e. $VAE_{ij}$ where i and j are all 51 African countries included in the database.[10] Using this procedure, products that are sourced from Africa, but further exported to the world are not taken into account. Value added trade is only considered within the region. Nevertheless, a globally integrated country can be a driver of RVCs at the same time. Moreover, the buyer of the final product which is very often located in developed countries can influence product standards and interactions of RVCs in developing countries. Since integration in RVCs and GVCs could also occur as substitutes, especially for resource rich countries, the analysis controls for a country's trade in value added with the world. As already stated, there are two main indicators of value chain participation: backward and forward integration. Backward integration is the non-diagonal column sum in equation 3.1 and refers to the foreign value added embedded in exports. In other words, it looks upward the value chain at the imports which are used in the production of exports. Domestic value added that is further exported by third countries, obtained by the non-diagonal row sum of $VAE_{ij}$, describes the forward integration perspective (Koopman et al. 2014). This perspective looks downstream the value chain. In this paper, the focus is placed on the foreign value added embodied in total exports. Kowalski et al. (2015) find a negative correlation between backward and forward integration and although this relationship cannot be confirmed for RVCs in Africa,

[9] Among African countries, input-output tables only for Kenya (2003), Mauritius (1997, 2002) and South Africa (1997, 1998-2000, 2002) are included.

[10] These countries are: Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cabo Verde, Central African Republic, Chad, Congo, Democratic Republic of the Congo, Côte d'Ivoire, Djibouti, Egypt, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Swaziland, Sudan, South Sudan, United Rep. of Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe.

backward and forward integration may still have different policy implications and should be analyzed separately. Since backward integration captures the "import to export" dimension and indicates that a country is positioned at a higher stage of the production process, which is also linked to better economic performance an additional or joint analysis of forward integration is not included.[11] However, it should be noted that backward integration taken to an extreme also indicates a lack of domestic value added and local production (Farole, 2016). Because of very low levels of backward integration, and since this study is interested in trade patterns and regional integration effects, higher backward integration can still be positively interpreted. Moreover, the fact that imported foreign value added from the rest of the world is approximately zero simplifies the analysis in a way that there is no need to control for trade diversion. Hence, any observed trade creation is indeed a rise in trade.

The Southern African countries Namibia, Zambia and Swaziland are among the most integrated countries in the region. Although South Africa is marginally integrated into RVCs in relation to its total value added exports, the country imports the highest nominal value of FVA from within Africa, thus confirming its role as a regional economic hub. In addition, there has been a significant increase in value chain participation over the last decade, but growth rates strongly vary across African countries (see figure 2). The numbers indicate the lowest growth rates for Ethiopia, Mauritius and Malawi (less than 60 percent between 2006 and 2012) and highest for Ghana and Burkina Faso (which more than quintupled over the same period). This heterogeneity provides the rationale for an empirical assessment of the determinants of within and between changes in RVCs. The hypothesis to be tested in this paper is that preferential tariff liberalization and a reduction of other trade costs facilitate a country's participation in RVCs. Moreover, the study distinguishes between charged and faced tariffs on different product groups because of sectoral heterogeneity in tariff rates. Amiti and Konings (2007) already prove that productivity gains arising from lower input tariffs are larger than from a reduction of output tariffs. Similarly, Estevadeordal and Taylor (2008) find that it is mainly tariffs on capital and intermediate goods that decelerate economic growth, while tariffs on consumer goods have a much weaker effect.

Econometric analysis of trade in value added further requires a differentiation of tariffs in different stages of processing (SoP). In doing so, the Broad Economic Categories (BEC) classification into four economic categories was followed and effectively applied tariffs on raw materials, intermediate products and capital goods are included. Raw materials and resources (UNCTAD-SoP1) are used in the first stages of productive process; intermediate products (UNCTAD-SoP2) refer to semi-finished products used in production of other products and are traded along the value chain; capital goods (UNCTAD-SoP4) are manufactured goods such as machinery used in all stages of the production of other goods.[12] The availability of machinery, and hence the charged tariff on capital goods, is particularly essential for productivity increases and upgrading at all stages of the value chain. In contrast, the restrictive impact of effectively applied tariffs on intermediates is likely to depend on a country's position in a value chain. In this regard, Co (2014) estimates the export response to capital goods imports for African countries and find a significantly positive relationship. The authors describe that capital goods are mainly imported from China and France, of which 18 percent are used in telecommunication equipment and 23 percent are used as industrial and service machinery. Despite an increase during the last decades, the current amount of imported capital is not sufficient to provide adequate telecommunication and power infrastructure (Co, 2014).

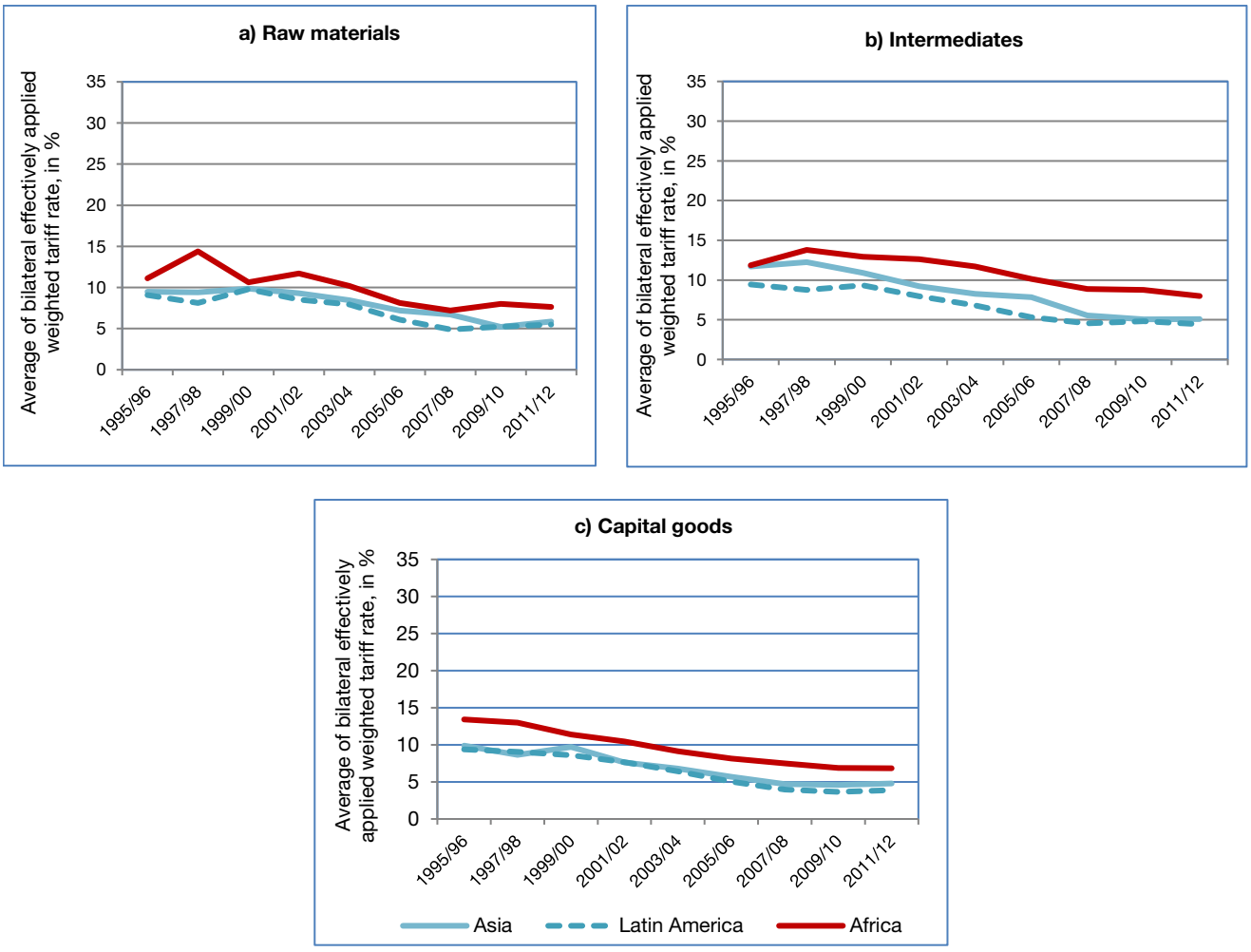
A comparison of charged tariff rates on the three product groups within the regions – Asia, Latin America and the Caribbean, and Africa - indicates that intra-regional tariff rates are much lower in Asia and Latin America (roughly five percent ad valorem) than in Africa. Despite a continuous reduction of formal trade barriers for all product groups, tariffs still increase the price of intra-African imports by eight percent. While the average bilateral tariff on capital goods is lowest at 6.8 percent ad valorem, it is highest on intermediates (8.4 percent in 2011/12, see **Error! Reference source not found.**). Individual applied tariff rates on imports from Africa strongly vary across regions. Southern African countries (mean: 1.8 percent ad valorem) impose lowest tariffs on intra-African imports compared to Eastern Africa (mean: 7.8 percent ad valorem), Central Africa (mean: 8.5 percent ad valorem) and Western Africa (mean: 8.7 percent ad valorem). Interestingly, Egypt, Libya and Tunisia (North African mean: 4.2 percent) all have average applied tariffs of less than one percent in ad valorem terms on imports from Africa which stands in contrast to a low integration into RVCs.

[11] IMF (2016) also focuses on backward integration as a measure of GVC participation given the argument that backward integration is mostly associated with higher benefits for the economy.

[12] Sectors are according to the Harmonized System classification. For more information see UNCTAD (2013).

The descriptive part indicates that tariffs may indeed affect RVC integration, but the determinants are more complex. Because of the continuous reduction of tariff barriers, non-tariff barriers (NTBs) are used as safeguards for the domestic industry and may hinder access to important inputs. NTBs include import licensing, rules for the valuation of goods at customs, pre-shipment inspections and rules of origin. Trade facilitation goes beyond NTBs and refers to all measures that affect transport costs and the efficiency of logistics services. Although most of the African Regional Economic Communities installed a monitoring system to report and eliminate such barriers, NTBs are still prevalent even within the established trade blocs. For instance, within the COMESA, variable transport documentation procedures, lengthy clearance processes and corrupt practices are identified as the three most trade-affecting NTBs (Imani Development, 2007). Similarly, despite some progress in removing road blocks, improved infrastructure and open border posts, trade among members of the East African Community (EAC) is still hampered by existing NTBs (TRADEMARK East Africa, 2014).

**Figure 3. Effectively applied tariff rates by region and product group, 1995/96 - 2011/12**




Source: Author's calculation based on World Bank World Integrated Trade Solution Trains database.

## Estimation procedure

In order to assess the role of tariffs and non-tariff barriers as well as structural factors in building African RVCs the following model is estimated:

$$\begin{aligned}\ln \mathrm{FVA}_{it} = {} & \beta_0 + \beta_1 \ln \text{GVC participation}_{it} \\ & + \beta_2 \ln \text{Manufacturing}_{it} + \beta_3 \ln \text{Market position}_{it} \\ & + \beta_4 \ln \text{Natural depletion rate}_{it} + \beta_5 \ln \text{Charged tariffs}_{it} \\ & + \beta_6 \ln \text{Faced tariffs}_{it} + \beta_7 \ln \text{Trade Costs}_{it} + \beta_8 X_{it} + \alpha_i + \lambda_t \\ & + \mu_{it}\end{aligned} \tag{3.2}$$

where $\ln \mathrm{FVA}_{it}$ is the logarithm of nominal imported foreign value added from Africa, embedded in country *i*'s exports to Africa in year *t*. A detailed description of all variables, their transformation and sources is provided in the Appendix. $\ln \text{GVC participation}_{it}$ refers to the backward integration rate into GVCs which controls for trade with the rest of the world. It may act as a substitute (trading more value added with the world instead of Africa), or as a demand driver for RVCs (higher demand for value added trade from the region in order to process goods for the world market). The share of manufacturing as percentage of GDP ($\ln \text{Manufacturing}_{it}$) proxies the demand for value added. A high share of manufacturing in GDP would result in greater value chain participation. According to the literature on East Asian production networks, the economic hubs Japan and China had been a major driver of intra-regional trade in value added. Similarly, South Africa already serves as a gateway for the region (Figure 2 and Farole, 2016). Therefore, a country's market position or market potential, is defined as $\ln \text{Market position}_{it} = \ln \left( \sum_i \frac{\text{nom GDP}_{jt}}{\text{DIST}_{ij}} \right)$ where *j* are the African trade partners. The closer the country is to its trade partners, controlling for their economic size, the higher their integration into RVCs. To complete the list of structural factors the estimation controls for a country's abundance of natural resources ($\ln \text{Natural Depletion Rate}_{it}$). On the one hand, a resource rich country might have a higher regional demand for inputs in order to quarry and process its resources. On the other hand, given high global forward integration rates, a resource rich country may focus on the export of raw materials to developed countries, which would imply a negative coefficient.

The core variables of interest are tariffs that are charged on imports from within Africa ($\ln \text{Charged tariffs}_{it}$) and tariffs that are faced on exports to Africa ($\ln \text{Faced tariffs}_{it}$). Using the World Bank World Integrated Trade Solution (WITS) Trains database, tariffs are measured by the country-specific import and export weighted average of intra-regional bilateral effectively applied tariffs on capital goods, intermediates and raw materials. The "import to export" dimension of the dependent variable requires an analysis of both, charged tariffs on imports and faced tariff rates on exports. When producers face high tariffs on their exports, we also expect a negative direct impact on their demand for FVA.

The variable is proxied in two ways because of a lack of appropriate data. Both proxies are based on a widely used database which is the *Doing Business* Trading Across Borders report. This database includes time to import/export (in days), costs to import/export (in US-Dollars), and the number of documents required to import/export. Model I includes the logarithm of the mean of time to import and export (in days). Hummels et al. (2007) highlight the importance of the induced trade costs of time, reflected in the costs of carry and market depreciation. Time delays are much higher in Africa's trade, mainly due to excessive inspections, poor procedural coordination, corruption, large within-country distances and poor infrastructure. However, the actual impact on trade in value added depends on the product-specific sensitivity to those measures. Hummels (2001) estimates product-specific per day values of time delays for US imports on the HS6 level. By multiplying these estimates of per-day values with time to trade, one obtains ad valorem tariff equivalents of time to import and export. Following this methodology ImpactEcon and Global Trade Analysis Project (GTAP) provide a data set that comprises data on bilateral and product-specific tariff equivalents for time in trade.[13] Using this data set, the tariff equivalent of time to trade in model II to account for a country's trade structure is included. Data is available for 24 African countries (see below). In order to come up with bilateral aggregated estimates of the per day tariff equivalents, following Hummels et al. (2007) and Minor (2013) the per day values *Tau*[14]are

[13] Minor (2013) constructs the data using Hummels' estimates for the product-specific per day values and matches the HS6 level tariff equivalents with the 57 GTAP categories (based on HS4 level). Doing this, he obtains three different estimates (named *Tau-1,-2,-3*) for the trade weighted per day tariff equivalents of time to import and export covering 134 countries and regions.

[14] *Tau-3* is used here as missing values are replaced by the average of all significantly positive estimates from the corresponding GTAP category. In contrast, in *Tau-1* missing values are replaced with zero (potential bias) and in *Tau-2* missings are replaced with Hummels' point estimates from US imports (inappropriate for my sample choice).

weighted with the bilateral sectoral export data from the GTAP database for the year 2007. Finally, the export weighted bilateral data is aggregated over all sectors and African countries. The coefficient $\beta_7$ is expected to be negative in both models.

*X* refers to a vector of control variables. To avoid multicollinearity, and an over fit of the model, the control variables are divided in four subsets. The first set controls for information and communication technology. The percentage of the population using telephone and mobiles is obtained from the International Telecommunication Union 2012 database. The second set includes the quality of roads and the quality of electricity supply variables which come from the Global Competitiveness Report (Pillar 2). These indicators are based on a survey, and only give a rough measure of physical infrastructure quality. However, data on road networks (e.g. World Bank Development Indicators) is not available for the number of countries and years. The third set controls for a country's business environment, proxied by political stability, regulatory quality and the control of corruption (Worldwide Governance Indicators). The percentile rank among all countries is utilized (ranges from 0 (lowest) to 100 (highest) rank). A higher rank in the index indicates a more stable business environment. The fourth set of control variables aims to identify the role of education, access to loans and services such as warehousing, marketing and rental of equipment. All variables should enter with a positive sign. In order to proxy education, the net primary education enrollment rate from the Global Competitiveness Index Pillar 4.1[15] and the quality of higher education and training (Global Competitiveness Index Pillar 5) are used. Access to loans is obtained from the Global Competitiveness Index (Pillar 8), reported as an index on a scale 1 to 7. Data on services as a share of GDP comes from the World Development Indicators. In addition, regional investment facilitation and cooperation in innovation was also proxied by bilateral investment flows, as well as a count variable represeting the number of bilateral investment agreements with African countries. However, missing data would dramatically reduce the number of observations by almost 50 percent when using foreign direct investment stock in the reporting country, and to even 30 percent when inflows of foreign direct investment are used. Hence, because of a selection bias, an interpretation of the obtained results is not presented.[16] The selection of variables is based on a sensitivity analysis and the Akaike Information Criterion (AIC).

In order to estimate a log-log model, all variables are in logarithm form. Omitted variables are controlled for by a country-fixed effect $\alpha_i$ and a time trend $\lambda_t$; $\mu_{it}$ is the standard error. With the inclusion of country-fixed effects, the regression coefficients are driven by the variation of FVA *over time within* each country. A panel data set is modeled from 2006 to 2012, including 37 African countries.[17] Data quality has improved only recently so the analysis is restricted to most recent data from 2006 to 2012. Moreover, trading across border measures from the *Doing Business* Report, as well as data from Global Competitiveness Index are only available from 2006 onwards. As already mentioned, the Eora database is based on estimates, which requires a sensible treatment of the data. Zimbabwe, Sudan and South Sudan are dropped from the sample because of many outliers. In addition, missing data most relevant for the tariff data must be accomodated,despite using the average of bilateral tariff rates. Whenever possible, missing values are replaced with the closest (one year) available tariff data. However, an unbalanced panel data set with a maximum of 236 observations is still obtained.

The estimation procedure is as follows. First, equation 3.2 is estimated using the fixed-effects (FE) estimator. There is a fixed set of countries, and the Hausman test also supports the choice of the FE model against a Random Effects model in all specifications. Because of the characteristics of regional production networks there is a high potential for cross-sectional correlation, group-wise heteroscedasticity and auto-correlation. The presence is identified by the Pesaran test for cross-sectional dependency, the Wald test for heteroscedasticity and the Wooldridge test for auto-correlation. Ignoring this correlation over time and between groups would lead to biased results. Moreover, reverse causality and omitted variables may result in an endogeneity problem which is partly controlled for with the country-fixed effect $\alpha_i$. One way to control for auto-

[15] The index combines data from UNESCO Institute for Statistics, the Organization for Economic Co-operation and Development (OECD), Education at a Glance 2013, and national sources.

[16] Neither the count variable, nor foreign direct investment stock are significant. Results are available on request.

[17] Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cabo Verde, Central African Republic, Chad, Côte d'Ivoire, Congo, Democratic Republic of the Congo, Egypt, Ethiopia, Gabon, Ghana, Guinea, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Rwanda, Senegal, South Africa, Swaziland, United Republic of Tanzania, Togo, Tunisia, Uganda and Zambia.

correlation is to include the first lag of the dependent variable. However, the FE estimator suffers from a Nickel bias when T is small. Therefore, using instrumental variable approaches and generalized method of moments (GMM) estimators have been proposed. The GMM estimator can also be severely biased when N is small such as in the presented model. Moreover, in the case of weak instruments the obtained bias might be even higher than in the FE estimation. Therefore, the FE estimator with Driscoll-Kraay standard errors is applied. Driscoll and Kraay (1998) follow the Newey-West type correction and apply a consistent non-parametric covariance matrix estimation procedure, which assumes an error structure that is heteroskedastic, auto-correlated up to some lag and correlated between the panels.

# 4. Results

## Baseline model

Table 1 presents the results from the FE estimation with clustered standard errors in parentheses, and Driscoll-Kraay standard errors in square brackets. Column (1) of table 1 reports the results for Model I which includes the logarithmised mean of time to trade in days and column (2) shows the results for Model II in which the product sensitive tariff equivalents of the time to export and import are used as a proxy for additional trade costs such as lengthy customs procedures, inefficient inland transport systems, and port waiting times. The results indicate a negative correlation between FVA and tariffs, as well as additional trade costs. Among tariffs, the charged tariff on capital goods is significantly negative regardless of the estimator used in both models. A one percent reduction of the average charged tariff on capital imports from within Africa seems to lead to an increase of FVA by one percent in Model I, and even two percent in Model II. The increase in the absolute coefficient and significance level is mainly due to the fact that mostly least developed countries are excluded from the sample in Model II[18], so the results may face a sample selection bias.

Nevertheless, the results suggest that higher tariffs on imports of capital goods are even more restrictive to value chain participation for higher income countries in Africa. The faced tariff on raw materials also becomes significantly negative when Driscoll-Kraay standard errors control for auto-correlation and cross-sectional dependence. In addition, although it is not reported here, the weighted faced tariff rate on all products enters with a significantly negative coefficient of -1.08, but the charged tariff on total products is not significant. This result suggests that demand for imports is lower when there is limited market access for exports. In contrast, in their analysis of the GVC participation of developing countries, Kowalski et al. (2015) find a larger and significant effect for the charged tariff rate instead of the faced tariff. This difference in the results may be explained by the fact that African countries enjoy higher market access to the rest of the world than to other African countries, but at the same time, charge higher tariffs on imports from industrialized countries. Therefore, the charged tariff may be more restrictive for integration in GVCs, but for trade in value added with African countries, the faced tariff is equally high and significantly reduces the export potential.The additional trade cost variables in Models I and II have the expected negative sign, but only the product sensitive tariff equivalent of time to import (in Model II) is significant at the five percent level. Evidence for the importance of time to trade has also been provided by Minor and Tsigas (2008) who show within a Computable General Equilibrium simulation for the year 2004 that by reducing the time to export by half, Sub-Saharan Africa (excluding South Africa) can increase the export shares of manufactured products (increase from seven to 26 percent). The share of vegetables, fruits and nuts would also increase by 13 percent. In contrast, the share of commodities, natural resources and processed nonferrous metal would decrease slightly by two to eleven percent. This finding provides strong evidence for time as a restriction to diversification and interrupting the value chain. Balistreri et. al. (2015) also assess the effect of a reduction in various trade costs between East African Community countries and the COMESA-EAC-SADC Tripartite countries in a multi-sector, multi-regional general equilibrium model. Going beyond simple tariff reductions[19], the authors show that the benefits of a reduction of the tariff equivalent of the time to trade, as well as lower non-tariff barriers are greater when such trade facilitation is extended to the whole Tripartite region.

[18] The panel reduces to 24 countries namely Benin, Botswana, Burkina Faso, Cameroon, Côte d'Ivoire, Egypt, Ethiopia, Ghana, Guinea, Kenya, Madagascar, Malawi, Mauritius, Morocco, Mozambique, Namibia, Rwanda, Senegal, South Africa, United Republic of Tanzania, Togo, Tunisia, Uganda and Zambia.

[19] The authors include measures of deep integration, such as the tariff equivalent of the time to trade (see Hummels et al., 2007), ad valorem equivalent for non-tariff measures (see Kee et al., 2009), and barriers against foreign suppliers of services.

**Table 1. Baseline regressions**

| | I | II |
|---|---|---|
| ln GVC participation | 0.289 | 0.0571 |
| | (0.220) | (0.301) |
| | [0.189] | [0.168] |
| ln Share of manufacturing | -0.121 | -0.0375 |
| | (0.211) | (0.350) |
| | [0.137] | [0.161] |
| ln Market position | 1.303 | 1.375 |
| | (0.489)** | (0.519)** |
| | [0.961] | [1.332] |
| ln Natural depletion rate | 0.0309 | 0.104 |
| | (0.054) | (0.087) |
| | [0.012]** | [0.036]** |
| ln Charged tariff raw materials | 0.793 | 0.487 |
| | (0.386)** | (0.360) |
| | [0.463] | [0.442] |
| ln Faced tariff raw materials | -0.366 | 0.0718 |
| | (0.287) | (0.346) |
| | [0.161]* | [0.126] |
| ln Charged tariff intermediates | 0.340 | 1.618 |
| | (0.469) | (1.140) |
| | [0.450] | [0.485]** |
| ln Faced tariff intermediates | -0.504 | -1.576 |
| | (0.692) | (1.774) |
| | [0.452] | [1.037] |
| ln Charged tariff capital goods | -1.066 | -2.095 |
| | (0.621)* | (0.984)** |
| | [0.537]* | [0.723]** |
| ln Faced tariff capital goods | -0.370 | -0.056 |
| | (0.513) | (0.665) |
| | [0.402] | [0.390] |
| ln Time to trade | -0.114 | |
| | (0.196) | |
| | [0.112] | |
| ln Time to import*Tau3 | | -1.008 |
| | | (0.389)** |
| | | [0.483]* |
| ln Time to export*Tau3 | | 1.101 |
| | | (1.158) |
| | | [0.683] |
| Observations | 236 | 158 |
| R-squared (within) | 0.775 | 0.758 |
| Number of countries | 37 | 24 |
| AIC | -130.83 | -65.07 |
| Wooldridge test (p-val) | 0.001 | 0.003 |
| Wald test (p-val) | 0.000 | 0.000 |
| Pesaran test (p-val) | 0.000 | 0.000 |
| Hausman test | 0.001 | 0.000 |

*Note:* ***significant at the 1%, **5%, *10% level. Dependent variable is ln FVA. Clustered (country) standard errors in ( ). Driscoll-Kraay standard errors in []. Auto-correlation up to the second lag is assumed. Time-effects always included but not reported for brevity.

Turning to the structural factors, only the natural depletion rate is significantly positive. Resource rich countries have a higher demand for imports in order to process their natural resources which are further exported.

Imports of capital goods are especially necessary for many production processes, and are often required to add value to the product. Furthermore, the market position variable is significant at the five percent level only in the standard FE regression, indicating that geographical proximity to a higher income country increases the level of regional integration. This finding confirms the hypotheses that high income countries such as South Africa can act as a regional hub. However, controlling for auto-correlation and cross-sectional dependence the market position variable becomes insignificant. The relatively small role of distance in trade in value added in contrast to gross trade is in line with the findings by Johnson and Noguera (2017), where the effect of distance on the ratio of value added exports is smaller, but significant, than the effect on gross trade. Indicated by insignificant estimates, irrespective of the model, GVC participation and the share of manufacturing do not seem to be driving forces of RVCs. This is in contrast to what Kowalski et al. (2015) found for developing countries' participation in GVCs. In their study, structural factors had a statistically larger impact than trade policy indicator variables. This finding suggests that the influencing factors behind participation in RVCs in the first step are different to GVCs participation. It again emphasizes the need for deeper regional integration and lower trade costs.

Because of the severe reduction of the sample from 236 to 158 observations, Model I is the preferred model with which to proceed. The $R^2$ of 77 percent and a lower AIC support this choice. In the following section, model extensions and robustness checks of equation 3.2 are reported only for Model I and using FE with Driscoll-Kraay standard errors.

## Extended model

In what follows, the results obtained from an extension of the model to various control variables are discussed. The main intention is to check the sensitivity of the estimates to this inclusion. Moreover, the analysis aims to detect additional factors that may have an effect on a country's ability to participate in RVCs. Results are reported in table 2. Shown in column (1), information and communication technology is positively associated with FVA, but only the number of mobile users is statistically significant. Turning to the quality of roads and the quality of electricity supply (Table 2, column (2)) none of these variables is significant, but the missing effect should be interpreted with caution given the poor quality of this proxy. A newly published IMF study (IMF, 2016) also includes these indices and finds no effect on the GVC participation of African countries. Most importantly, the estimate of the charged tariff on capital goods is robust to the inclusion, and to the reduction of the sample to 196 observations. The third set of control variables (Table 2, column (3)) proxies a country's business environment. Indicated by a significantly positive coefficient, the higher the regulatory quality, the better a country's integration into RVCs seems to be. Control of corruption and political stability do not significantly influence value-added trade.[20] The charged tariff on capital goods, and the faced tariff on raw materials are still significantly negative. The results from the baseline regression are also robust to the inclusion of primary education, higher education and training, access to loans and the share of services, but none of the indicators is positively correlated with FVA (Table 2, column (4)). This outcome is surprising given the importance of all measures in participating in more complex production processes. In addition to the charged tariff on capital goods, the faced tariff on intermediates now also seems to negatively influence imports of FVA at the ten percent level.

I find strong evidence that trade costs seem to be the driving force behind a country's ability to enter and upgrade their position in RVCs. Bilateral tariffs and trade costs have a higher negative effect than structural factors. African countries should especially reduce tariffs on capital goods in order to add value in regional trade. The results highlight the importance of the "import to export" dimension of RVCs.

[20] When the estimate of the indices instead of the rank is included, corruption becomes positively significant.

**Table 2. Extended regressions**

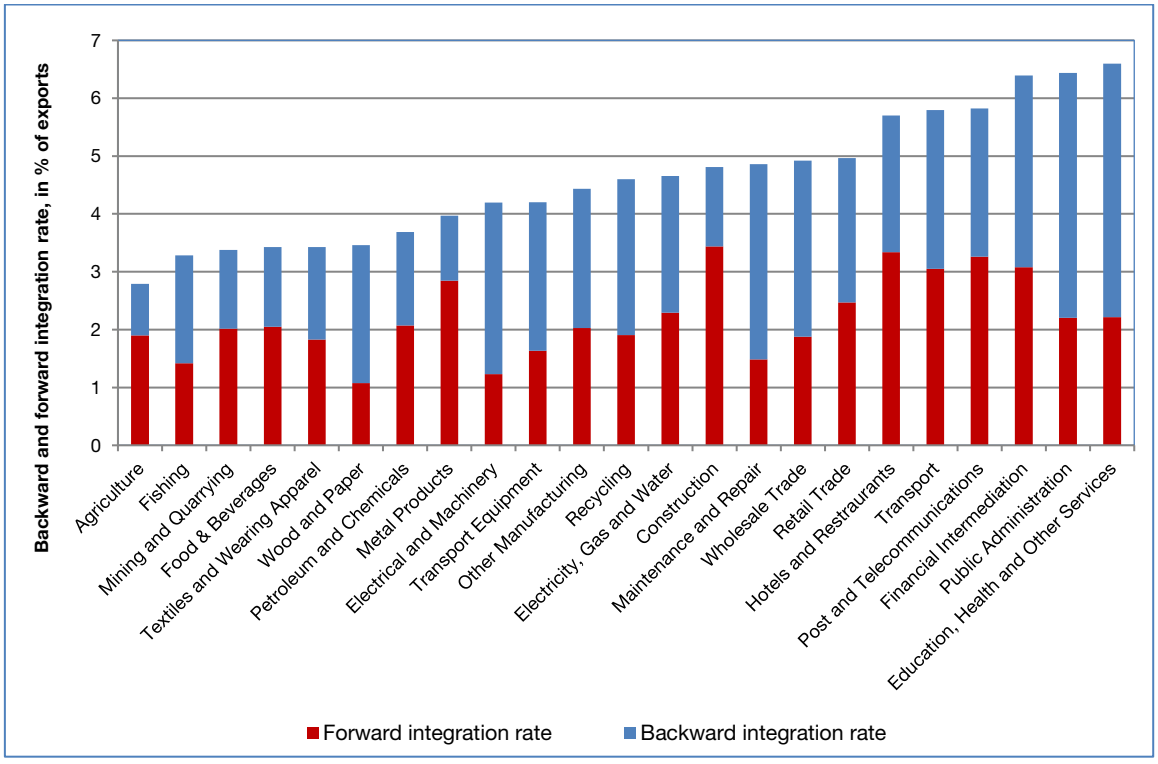
| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| ln GVC participation | 0.272 | 0.217 | 0.310 | 0.210 |
| | [0.183] | [0.221] | [0.192] | [0.231] |
| ln Share of manufacturing | -0.135 | 0.0117 | -0.116 | 0.044 |
| | [0.138] | [0.209] | [0.140] | [0.219] |
| ln Market position | 1.045 | 1.555 | 1.347 | 1.428 |
| | [0.842] | [1.156] | [0.958] | [1.109] |
| ln Natural depletion rate | 0.027 | 0.078 | 0.034 | 0.078 |
| | [0.012]* | [0.026]** | [0.010]** | [0.019]** |
| ln Charged tariff raw materials | 0.888 | 0.766 | 0.772 | 0.683 |
| | [0.481] | [0.308]** | [0.421] | [0.375] |
| ln Faced tariff raw materials | -0.381 | -0.0454 | -0.356 | 0.144 |
| | [0.179]* | [0.149] | [0.158]* | [0.141] |
| ln Charged tariff intermediates | 0.442 | 0.260 | 0.367 | 0.356 |
| | [0.475] | [0.622] | [0.411] | [0.622] |
| ln Faced tariff intermediates | -0.479 | -1.832 | -0.479 | -1.839 |
| | [0.490] | [1.029] | [0.423] | [0.822]* |
| ln Charged tariff capital goods | -0.871 | -1.245 | -1.015 | -1.380 |
| | [0.511] | [0.596]* | [0.519]* | [0.617]* |
| ln Faced tariff capital goods | -0.179 | -0.494 | -0.205 | -0.646 |
| | [0.366] | [0.536] | [0.345] | [0.625] |
| ln Time to trade | -0.097 | -0.092 | -0.105 | -0.018 |
| | [0.116] | [0.115] | [0.094] | [0.069] |
| ln Mobile users | 0.116 | | | |
| | [0.041]** | | | |
| ln Telephone users | 0.005 | | | |
| | [0.015] | | | |
| ln Quality roads | | -0.011 | | |
| | | [0.149] | | |
| ln Quality electricity | | -0.143 | | |
| | | [0.215] | | |
| ln Political stability | | | -0.002 | |
| | | | [0.052] | |
| ln Regulatory quality | | | 0.187 | |
| | | | [0.089]* | |
| ln Control of corruption | | | 0.006 | |
| | | | [0.008] | |
| ln Primary schooling | | | | 0.090 |
| | | | | [0.186] |
| ln Higher education | | | | -0.656 |
| | | | | [0.434] |
| ln Access to loans | | | | 0.043 |
| | | | | [0.182] |
| ln Share of services | | | | -0.284 |
| | | | | [0.347] |
| Observations | 236 | 196 | 236 | 196 |
| Number of countries | 37 | 32 | 37 | 32 |
| R-squared (within) | 0.779 | 0.766 | 0.779 | 0.770 |
| AIC | -130.61 | -85.85 | -128.66 | -85.44 |

*Note:* ***significant at the 1%, **5%, *10% level. Dependent variable is ln FVA. Fixed-effects regression with Driscoll-Kraay standard errors. Auto-correlation up to the second lag is assumed. Time-effects always included.

# 5. Robustness checks

This section provides two robustness checks and new insights into the analysis. An important caveat to the discussion of RVCs is the problem of data quality for African countries, especially at the sectoral level. Because of that, the use of a highly disaggregated data set in the baseline model is avoided. In comparison to the participation in GVCs at the lower value-added segments, which is mainly driven by exports of natural resources, RVCs in Africa are dominated by manufactured goods and trade in services. The agricultural sector is regionally the least integrated sector, followed by mining and quarrying, and the manufacturing of food and beverages. In contrast for GVCs, mining and quarrying is the most integrated sector from the forward perspective (42 percent of value added exports) and transport equipment is the most integrated from the backward perspective (43 percent). Similarly, textiles and apparel, and food and beverages manufacturing show relatively high global backward integration rates (25 percent and 20 percent, respectively), but both sectors are marginally integrated at the regional level (see figure 4).[21]

**Figure 4. Participation in African RVCs by sector, Backward and Forward Integration Rates, 2012**




Source: Author's calculation based on Eora database.

African countries could possibly benefit more from GVC participation if they strengthen RVC integration. Hence, it is of major interest for policy makers to identify the role of trade policies for selected industries. In order to give a first indication on the importance of various sectors, the model is separately estimated for selected industries. These are agriculture, food and beverages, textiles and wearing apparel, and transport equipment. These sectors have been emphasized in the literature because of their potential for upgrading within the value chain, and have also been put on the agenda in the Plan of Action for Accelerated Industrial Development of Africa of the African Union. Sectoral tariff data is now based on the Broad Economic Categories (BEC) classification reported at the same aggregation level as in the Eora database. The industries are also pooled to

[21] For a descriptive analysis of GVC participation across countries and sectors refer to ECA (2015).

examine the country-industry-year dimension with 1404 observations. Results are provided in column (1) to (4) for selected industries and column (5) for the pooled estimation).

Similar to the estimates of the tariff rate on total products, faced tariffs seem to be a greater hindrance to FVA embedded in exports than charged tariffs. This is shown in a significantly negative effect for the agriculture sector, the manufacturing sector in transport equipment and for pooled industries. Longer time to trade, caused by poor infrastructure and border inefficiencies, now significantly reduces FVA in all examined sectors. A reduction of the time to trade by roughly 8 hours (given a sample-mean of time to trade of 32 days in 2012) implies an increase of FVA by 0.198-0.394 percent. As already suggested by the coefficient estimates of Model II, time delays may be more trade-restrictive for some sectors than for others. Especially for the food and beverages industry which sources most of its inputs from agriculture, time delays have a stronger impact on interrupting the value chain. Moreover, indicated by a positive and significant coefficient of GVC participation, the RVCs in the agricultural sector, in manufacturing of food and beverages, and in textiles and apparel seem to be more connected to GVCs than manufacturing in transport equipment. However, the causality is not addressed in this setting.

**Table 3. Robustness check - Industry level**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | Agriculture | Food and beverages | Textiles | Transport equipment | Pooled industries |
| ln GVC participation | 0.390 | 0.306 | 0.491 | 0.400 | 0.651 |
| | [0.055]** | [0.080]*** | [0.052]*** | [0.259] | (0.132)*** |
| ln Share of manufacturing | -0.304 | -0.623 | -0.025 | -0.287 | -0.372 |
| | [0.256] | [0.281]* | [0.304] | [0.253] | (0.151)* |
| ln Market position | 0.571 | 1.493 | 1.817 | 2.045 | 1.799 |
| | [0.781] | [1.128] | [1.624] | [1.394] | (0.605)** |
| ln Natural depletion rate | -0.060 | 0.005 | 0.035 | 0.048 | -0.012 |
| | [0.044] | [0.015] | [0.034] | [0.019]** | (0.036) |
| ln Charged tariff | 0.347 | 0.194 | -0.215 | -0.078 | 1.314 |
| | [0.197] | [0.144] | [0.267] | [0.438] | (1.356) |
| ln Faced tariff | -0.623 | 0.142 | -0.381 | -0.854 | -1.650 |
| | [0.198]** | [0.482] | [0.416] | [0.396]* | (0.374)*** |
| ln Time to trade | -0.291 | -0.394 | -0.267 | -0.198 | -0.355 |
| | [0.140* | [0.119]** | [0.092]** | [0.075]** | (0.074)*** |
| Observations | 235 | 240 | 241 | 239 | 1,404 |
| R-squared (within) | 0.609 | 0.548 | 0.569 | 0.672 | 0.772 |

Note: ***significant at the 1%, **5%, *10% level. Dependent variable is ln foreign value added. Column (1)-(4) Fixed-effects regression with Driscoll-Kraay standard errors. Auto-correlation up to the second lag is assumed. Time-effects always included. Column (5): OLS with country-effects, industry-effects and time-effects. Clustered country standard errors.

A major drawback of the analysis is the short time span. Production networks evolve over years and are unlikely to change from one year to another. Instead of estimating a dynamic model, which would raise additional problems, this issue is addressed by including the independent variables as lags. In order to keep a sufficient number of observations only the first lag (Table 4, column (1)) and the second lag (Table 4, column (2)) of the independent variables are generated. In this setting, auto-correlation is controlled to a maximum of one lag. There are some interesting changes. After one year, the charged tariff on capital goods still has a significantly negative effect on FVA. The faced tariff on exports of capital goods which are usually located at a higher stage of the value chain now also enters with a significantly negative coefficient.

**Table 4. Estimation Result - Lag structure**

| | (1) | (2) |
|---|---|---|
| | first lag | second lag |
| ln GVC participation | 0.659 | 0.665 |
| | [0.285]* | [0.210]** |
| ln Share of manufacturing | 0.237 | 0.168 |
| | [0.287] | [0.163] |
| ln Market position | 1.121 | 0.791 |
| | [1.152] | [1.080] |
| ln Natural depletion rate | 0.013 | 0.018 |
| | [0.010] | [0.015] |
| ln Charged tariff raw materials | 1.090 | 0.919 |
| | [0.436]* | [1.030] |
| ln Faced tariff raw materials | 0.084 | 0.409 |
| | [0.100] | [0.105]** |
| ln Charged tariff intermediates | 0.034 | 0.515 |
| | [0.443] | [0.692] |
| ln Faced tariff intermediates | -0.686 | -0.478 |
| | [0.466] | [0.143]** |
| ln Charged tariff capital goods | -1.889 | -1.978 |
| | [0.580]** | [1.347] |
| ln Faced tariff capital goods | -0.583 | -0.634 |
| | [0.144]*** | [0.090]*** |
| ln Time to trade | -0.0614 | -0.182 |
| | [0.077] | [0.053]** |
| Observations | 205 | 172 |
| Number of groups | 37 | 37 |
| R-squared (within) | 0.767 | 0.762 |

*Note:* ***significant at the 1%, **5%, *10% level. Dependent variable is ln foreign value added. Fixed-effects regression with Driscoll-Kraay standard errors. Auto-correlation up to the first lag is assumed. Time-effects always included.

Moreover, GVC participation in the previous year is also positively correlated with RVC participation. The coefficient and the significance level is roughly the same when considering a lag of two years. Furthermore, after two years, a reduction in time to trade by one percent increases the level of FVA by 0.18 percent. Interestingly, the charged tariff on capital goods is no longer significant, but the negative coefficient of the faced tariff on capital exports decreases to -0.634. This indicates that while charged tariffs have a higher direct effect on RVCs the faced costs and time to trade seem to be important for their development over time. Similarly, a lower faced tariff on intermediates is positively associated with value chain participation after two years. However, the faced tariff on raw materials is now positive and significant. The sign switch compared to the baseline model raises the question of a non-linear relationship, and an optimal tariff rate for value chain participation in the long-run.

# 6. Conclusion

Regional value chains in Africa are poorly exploited, although they could serve as a step towards greater global integration. Trade in value added within the region is still by far the lowest in comparison with Asia and Latin America, but the recent increase allows for an optimistic outlook with respect to the evolution of regional production networks. It has been argued in the literature that regional integration and trade liberalization are an important component in strengthening RVCs. Since intermediate goods have to cross the border twice, low trade costs are crucial.

Looking at foreign value added data for 37 African countries from 2006 to 2012, first evidence is provided on the effect of (i) charged and faced tariff rates on capital goods, raw materials and intermediates and (ii) additional trade costs capturing border inefficiencies and poor infrastructure. Auto-correlation and cross-sectional correlation are controlled for using a fixed effects estimator with Discroll-Kraay standard errors.

The results are consistent with the hypothesis that preferential trade liberalization facilitates a country's participation in RVCs. Empirical evidence is provided for a value added trade enhancing effect of a reduction of tariffs and time to trade. The results indicate that a lower tariff on capital goods improves a country's position in RVCs. In order to be able to add value to its natural resources, the country needs to have access to affordable inputs in the form of production equipment. The only structural variable that is significant irrespective of the model is the natural depletion rate. The more resource abundant a country is, the higher its demand for FVA (e.g. machinery) in order to add value to its resources. Furthermore, higher regulatory quality and a greater percentage of mobile users significantly increase a country's ability to participate in RVCs. In addition, time to trade seems to be even more restrictive to value chain participation at the sectoral rather than at the aggregated level, which is mainly driven by a higher sensitivity to trade delays of agricultural and manufactured goods.

National governments need to take action in improving access to capital imports which are necessary to add value to products and to upgrade within a given value chain. Regarding the negotiations on the African Continental Free Trade Area (CFTA), the agenda needs to center on deeper integration that goes beyond a reduction of tariffs. In order to boost the emergence of RVCs which promise productivity increases and economic transformation through spillover effects, member countries need to facilitate customs procedures, improve inland transportation, remove road blocks, and simplify and harmonize rules of origin. Greater attention needs to be given to the agriculture sector and the agro-food industry where time delays and remaining tariffs seem to be more restrictive to value chain integration than in other manufacturing sub-sectors. In addition to reducing trade costs, local governments need to strengthen regulatory quality and institutional linkages to foster vertical coordination between buyers and suppliers.

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# Appendix

## Table 5. Data availability

| Variables | Transformation | Data Sources |
|---|---|---|
| Foreign value added | Imported FVA from Africa in 1000 USD embedded in exports to Africa | UNCTAD-Eora database |
| GVC backward integration rate | Imported FVA from the world as a share of value added exports to the world | UNCTAD-Eora database |
| Market position | $\ln \text{Market position}_{it} = \ln\left(\sum_i \frac{\text{nom GDP}_{jt}}{\text{DIST}_{ij}}\right)$ , $\text{DIST}_{ij}$ is the distance in km between capitals and $\text{nom GDP}_{jt}$ is nominal GDP in USD | CEPII and UNCTADStat |
| Natural depletion rate | Natural depletion rate (as % of GNI) | World Development Indicators |
| Share of manufacturing | Manufacturing, value added (as % of GDP) | World Development Indicators |
| Weighted average tariff rate faced on exports | Country-specific average of bilateral tariff rate; $\ln \text{Faced tariffs}_{it} = ln\,(1 + (\sum_{j=1} \text{importtariff}_{jit} \frac{\text{exports}_{ijt}}{\sum_{j=1}\text{exports}_{ijt}}/100))$ importtariff is the effectively applied tariff rate on imports | WITS Trains Database |
| Weighted average Tariff Rates charged on its imports | Country-specific average of bilateral tariff rate; $\ln \text{Charged tariffs}_{it} = ln\,(1 + (\sum_{j=1} \text{importtariff}_{ijt} \frac{\text{imports}_{ijt}}{\sum_{j=1}\text{imports}_{ijt}}/100))$ importtariff is the effectively applied tariff rate on imports | WITS Trains Database |
| Mean time to trade | Mean of time to export and time to import (in days) | World Bank Doing Business Report (see http://www.doingbusiness.org for details on data set and methodology) |
| Per day ad valorem tariff equivalent of time to trade | Aggregated export and import weighted per day values (Tau-3) | Minor (2013) and GTAP (2007) |
| Mobile users | Mobile-cellular subscriptions per 100 inhabitants | International Telecommunication Union's (ITU) Indicators 2012 database |
| Telephone users | Fixed-telephone subscriptions per 100 inhabitants | International Telecommunication Union's (ITU) Indicators 2012 database |
| Quality of roads | Index 1-7(best) | Global Competitiveness Index Pillar 2 |
| Quality of electricity supply | Index 1-7(best) | Global Competitiveness Index Pillar 2 |
| Political Stability | Percentile Rank 0-100 | Worldwide Governance Indicators |
| Regulatory Quality | Percentile Rank 0-100 | Worldwide Governance Indicators |
| Control of Corruption | Percentile Rank 0-100 | Worldwide Governance Indicators |
| Primary education | Net enrollment rate in primary education | Global Competitiveness Index Pillar 4.1 |
| Quality of higher education and training | Index 1-7(best) | Global Competitiveness Index Pillar 5 |
| Access to loans | Ease of access to loans Index 1-7(best) | Global Competitiveness Index Pillar 8 |
| Share of services | Services, value added (as % of GDP) | World Development Indicators |