

Trade Policy and African Participation in Global Value Chains: Does Trade Facilitation Matter?

Moukaila Mouzamilou Takpara^{1*}, Constant Fouopi Djiogap², and Bouraïma Sawadogo¹

¹*Pan-African University, Institute of Governance, Humanities and Social Sciences, Cameroon*

²*University of Yaoundé II, Cameroon*

Abstract This study offers an empirical appraisal of the contribution of trade facilitation for Sub-Saharan Africa (SSA) countries participation in global value chains. We used new value-added data on a panel of 25 countries over the period 2004-2017. The results using pooled ordinary least squares (OLS) regression and instrumental variable-two-stage least squares (IV-2SLS) estimators reveal that trade facilitation indicators such as physical infrastructure, information and communication technology, and border and transport efficiency support SSA countries' participation in global value chains. More interestingly, these results are robust at the sectoral level, particularly in agriculture, manufacturing, and textiles & clothing sectors for physical infrastructure and ICT, while the business environment is conducive to upstream integration of GVCs in the agriculture and textiles & clothing sectors. These results underscore the increased importance of trade facilitation in the era of global value chains and call for well-targeted sectoral policies to reap the benefits of GVCs.

Keywords: global value chains, trade policy, trade facilitation, Sub-Saharan Africa, two-stage least squares (IV-2SLS)

JEL Classifications: F13, F14, F15, F23

Received 2 July 2022, Revised 17 January 2023, Accepted 19 January 2023

I. Introduction

Over the past two decades, trade policy aimed at reducing tariff/non-tariff barriers and increasing integration, as well as the revolution in information and communication technologies, have affected production, which is increasingly unbundled and shared among different countries

+Corresponding Author: Moukaila Mouzamilou Takpara

Ph.D., Pan-African University, African Union Commission, Institute of Governance, Humanities and Social Sciences (PAUGHSS), Yaoundé, Cameroon. E-mail: takpara2025@gmail.com

Co-Author: Constant Fouopi Djiogap

Associate Professor in Economics, Department of Economics, CEREG, University of Yaoundé II, Cameroon.

E-mail: constantfouopi@yahoo.fr

Co-Author: Bouraïma Sawadogo

Ph.D. Candidate, Pan-African University, African Union Commission, Institute of Governance, Humanities and Social Sciences (PAUGHSS), Yaoundé, Cameroon. E-mail: bouraimasaw@gmail.com

Acknowledgment: The authors would like to thank Cosimo Beverelli for his helpful comments and constructive suggestions.

The authors are grateful to the participants of the 25th Annual Conference on Global Economic Analysis (GTAP 25th Annual conference 2022).

generally at different levels of development (Del Prete et al., 2018). As a result, trade, especially in intermediate goods, and foreign direct investment have increased considerably. These developments are closely linked to the emergence of Global Value Chains (GVCs), a concept that encompasses all the activities required to bring a good to the final consumer, from product design to distribution (Cattaneo et al., 2010). This new landscape of international trade can be an opportunity for developing countries because GVCs include diverse activities belonging to different sectors of the economy (primary, secondary, tertiary). Such sectoral diversity opens up employment opportunities for all categories of workers (Okah Efogo, 2020).

Moreover, through the phenomenon of upgrading¹), GVCs can contribute to the industrialization, economic transformation and sustainable development of countries (UNCTAD, 2013; African Development Bank (AfDB) et al., 2017). Thus, most countries in the world are making efforts to integrate GVCs and/or upgrading within GVCs. According to the United Nations Economic Commission for Africa (UN-ECA), (2015), participation in value chains can be analyzed by three main components: the upstream component (Foreign Value Added (FVA) i.e., backward integration), the downstream component (Domestic Value Added (DVA) i.e., forward integration) and the total participation rate combining the first two. Backward integration is the share of imported value added that will be found in the country's exports; it corresponds to the country's place in the value chain²). Forward integration is the share of exported domestic value added that will be found in the exports of other countries.

The current literature on global value chains suggests uneven development of economic activities in the world, with increasing integration of Northern countries and increasing marginalization of those in Sub-Saharan Africa and other parts of the South (Ahmad and Primi, 2017). Unlike Asia, particularly China, Sub-Saharan Africa (SSA) has so far not been able to intercept major changes in business models, nor has it been able to massively enter production networks. The participation of SSA countries in global value chains is still limited and mainly in low value-added phases. Statistics at the global level, show that between 1991 and 2012, Africa adds value to only 14% of its exports, compared to 27% for emerging Asia and 31% for developed countries (International Monetary Fund (IMF), 2015; Dollar et al., 2017). Regionally, intra-African value-added trade is low (9%), compared to 45% in Asia and 18% in Latin America (Slany, 2019).

In addition, GVCs involve vertical fragmentation of production steps: parts and components are produced in different countries and then assembled either sequentially along the chain or at a final site (Prete and Rungi, 2015). Thus, within global value chains, goods may be traded across borders multiple times as intermediates and then as final products, further amplifying trade costs (Moïsé, and Sorescu, 2015). These trade costs are thus a key determinant of trade

1) It is defined as a process of strengthening the capacity of a firm/economy to migrate to more profitable or technologically sophisticated product niches (Gereffi, 1999).

2) This study is focus on that component since it associated with better economic performance.

and production patterns within the GVC paradigm. Saslavsky and Shepherd (2014) for example show that trade in parts and components which typically takes place within GVCs is more sensitive to improvements in logistics performance than trade in final goods. Trade Facilitation (TF) is an important component of trade costs (Arvis et al., 2016), so it is reasonable to assume that it affects a country's ability to connect to global value chains. In its broader sense, according to Shepherd (2016), TF refers to all measures that reduce trade costs other than lowering tariffs. These measures are related to hard and soft infrastructure (Portugal-Perez and Wilson, 2012).

Notwithstanding these general observations, the way forward is to find solutions that lead to deeper participation as well as upgrading into GVCs (Tian et al., 2019) and insertion into areas with higher value-added products and trade volume within GVCs (Kowalski et al., 2015). The question here is to examine the contribution of trade facilitation indicators to GVC participation. Indeed, most studies on trade facilitation only address these effects on trade in final goods (Martínez-Zarzoso and Márquez-Ramos, 2008; Wilson et al., 2003; Moïse and Sorescu, 2013; Melo and Wagner, 2018) without considering trade in intermediate or value-added goods. Moreover, in Sub-Saharan Africa, most of the studies on GVCs focus on one hand on firm and industry-level case studies in selected countries (Ponte and Ewert, 2009; Riisgaard, 2009; Riisgaard and Hammer, 2011), on the other hand on different sectoral policies that can support deep and rewarding participation in GVCs including trade in natural resources (Ferreira and Braun, 2016), trade in industrial goods or trade in services (Anyanwu and Kponnou, 2017; Efogo, 2020).

The present study contributes to existing literature in a number of ways. First, considering the importance of trade costs in the development of GVCs, we use a broader set of TF to identify which indicator influences SSA participation in GVCs and thus to identify which policies to implement. Second, this study analyzes participation in GVCs at the macro and sectoral level. It determines whether participation in GVCs benefits SSA economies in the context of economic transformation by analyzing it from the perspective of trade in foreign value added. This is for prime importance as Allard et al. (2016) noted that SSA countries are still in the start of their integration process into GVCs and have relatively lower levels of income than other regions in the world. Additionally, according to Alhassan et al. (2021), while East and Southeast Asia and Latin America heavily participate in GVC trade and benefit immensely therefrom, Africa participate less in the GVC. Third, investigating TF indicators that contribute to SSA participation in sectoral value chains provides a useful tool for policy makers to prioritize on which sectors to focus on. Van Biesebroeck and Mensah, (2019) stated that, over the period 1995-2018, Sub-Saharan Africa's engagement in manufacturing GVC is low and the regions' average performance in several indicators of GVC is negative. Fourth, we use the instrumental variable Two-Stage Least Squares (2STLS) approach which provide consistent estimates as it solves endogeneity problem that is common in panel data (Efogo, 2020; Kpognon et al., 2020).

Our study is close to that of Shepherd (2016) who analyzed in cross-section the effects

of infrastructure and TF in SSA countries participation in GVCs using only narrow TF indicators. The value addition of our study compared to his work is that rather than the narrow TF indicators, we use the broader TF indicators which is fundamental in the context of African countries. Further, we focus on the panel data relationship rather than cross-section relationship as in his work. The panel data is important in the context of value chains since it help to control for unobservable variables. The study focuses on 25 Sub-Saharan Africa countries over the period 2004-2017, period dictated by the availability of trade facilitation indicators. The results obtained show that TF indicators such as physical infrastructure, ICT, border and transport efficiency contribute favorably to SSA countries' backward participation in GVCs. The analysis in forward and total participation confirms the important role of TF in boosting SSA countries participation in GVC. At the sectoral level, the business environment favors backward integration of GVCs in agriculture and in the textile and clothing sector.

The remainder of the study is organized as follows. Section 2 deals with the literature review, followed by data and stylized facts on trade facilitation and participation of Sub-Saharan African countries in global value chains in section 3. Section 4 presents the methodology including our econometric specification, and the estimation technique. Section 5 provides estimation results and a discussion of the results. Section 6 concludes and offers policy implications.

II. Literature Review

A. Theoretical literature

GVCs take into account the design phase through production, distribution, marketing and sale of the product to its destruction (Webber and Labaste, 2010 ; Kaplinsky and Morris, 2002). In early theories of international trade, goods were considered to be produced in one place and then exported. Over time, the new GVC theories assume that the production of goods and services takes place along a global supply chain (Baldwin and Venables, 2013). In this sense, trade costs are more important and amplified when intermediate goods cross several borders before their final destination in contrast to finished goods (Yi, 2010). Classical theory highlights the role of trade costs, particularly transfer costs, which include transport costs, tariffs, cultural barriers in international trade (Ricardian model, Heckscher-Ohlin-Samuelson model). In these models, the existence of trade costs between two countries is a barrier to trade. The emergence of global value chains over the last twenty years has thus been built according to the comparative advantages of host countries. Indeed, the fragmentation of global production processes is justified by the reduction of transport costs with technological progress in the field of information and communication. Thus, according to classical theory, high trade costs

preclude the participation of countries in GVCs. Some authors confirm these theoretical predictions (Luo and Xu, 2018; Amoako-Tuffour et al., 2016; Baldwin, 2013; Christ and Ferrantino, 2011). For Amoako-Tuffour et al. (2016), TF stimulates integration in value chains (it will reduce trade costs and make the supply of final and intermediate goods more predictable and less susceptible to delays). Domestic firms supplying intermediate goods can fully participate in regional and global value chains by increasing the reliability of their supply. According to Luo and Xu (2018), infrastructure such as transportation and ICT condition the linkages between producers and buyers in value chains and influence the adoption of new technologies to meet international market requirements. Further, they conclude that an inefficient and unreliable customs clearance process could even make participation in global value chains impossible.

B. Empirical literature

There is a large body of empirical study dealing with the effects of trade facilitation measures in international trade, particularly in the participation in GVCs. Those work can be classified into two categories. On the one hand, we have studies that have focused on trade in intermediate goods (Hummels et al., 2001; Hillberry and Hummels, 2002; Yi, 2003; Ma and Van Assche, 2010; Saslavsky and Shepherd, 2014); on the other hand, we have studies that have focused on trade in value added (Moisé, and Sorescu, 2015; Kowalski et al., 2015; Del Prete et al., 2018; Johnson and Noguera, 2012; Shepherd, 2017; Shepherd, 2022).

In the first case, for Yi (2003), intermediate goods, due to their repeated passage across borders, were more sensitive to a reduction in trade costs. Saslavsky and Shepherd (2014) used a gravity model to explain the effects of logistics performance on trade in parts and components as well as finished goods in the South Pacific region. Using this model, they concluded that parts and components trade was more sensitive than finished goods. Ma and Van Assche (2010) analyzed the role of trade costs on China's trade. They found that China's exports of intermediate goods depend not only on export distance costs but also on import distance costs and the interaction between the two. The trade costs faced by intermediate goods when crossing borders are higher than other types of final goods and services. Trade facilitation (customs performance, quality of infrastructure, etc.) appears to be a good determinant of participation in GVCs for both developed and developing countries. For developing countries, the effect of TF, especially highly efficient customs procedures, has a positive and more pronounced impact on the volume of goods and is a source of attractiveness for foreign investors (OECD, 2009).

Also, in the context of trade in intermediate goods, the OECD work on GVC/TiVA has highlighted the fact that, the more frequently products cross borders during their manufacture, the more important trade facilitation policies become. Importantly, trade in components is extremely time sensitive: the cost of an extra day spent in transit is 60% higher for importers

of intermediate goods than for importers of final goods (Hummels and Schaur, 2013). The OECD (2014) have used backward and forward integration indicators as measures of GVC activity, in their study. The results have shown that logistical performance, intellectual property protection, quality of infrastructure, and quality of institutions have particularly strong impacts on the integration of GVCs in developing countries. Gereffi et al. (2005) argue that, improved standards, information technology, and supplier capabilities provide more opportunities for integration and upgrading, within the value chain. According to Gereffi (2015), in some Central American countries, insufficient infrastructure investment in wet processing plants has limited the ability of small-scale producers to produce high-quality coffee, resulting in a loss of opportunity to benefit from price declines in the global value chain.

The second category of studies have focused on value-added trade to capture participation in GVCs (Moisé and Sorescu, 2015; Kowalski et al., 2015 ; Del Prete et al., 2018 ; Johnson and Noguera, 2012 ; Shepherd, 2017 ; Shepherd, 2022). For example, Moisé and Sorescu (2015) study in the OECD showed that trade facilitation measures have a strong impact on value-added indicators. In addition, these authors found that a 0.1 increase in the performance of TF indicators could potentially generate increases in the value added of a country's imports in the range of 1.5 to 3.5%, while in the case of exports, these increases could be between 1 and 3%.

In a similar vein, Johnson and Noguera (2012) have analyzed the value added to gross exports of 42 OECD countries and major emerging markets over the period 1970 to 2009. They estimated a gravity model showing that distance significantly reduces trade in value added. Distance is a proxy that captures the costs associated with trade. This shows that trade costs constraint participation in GVCs in OECD countries. Kowalski et al. (2015) as their concern examined the marginal effect of non-political factors (market size, level of development, level of industrialization, and remoteness) and political factors (regional trade agreements and tariffs, openness to foreign direct investment, logistics performance, and infrastructure) on participation in GVCs for high-income countries and developing regions (Eastern and Southern Africa, Middle East and North Africa, West and Central Africa, South Asia, Southeast Asia, and East Asia). They have measure participation in GVCs through backward and forward integration. They found that structural factors, such as geography, market size and level of development, are key determinants of participation in GVCs. Trade and investment policy reforms as well as improvements in logistics and customs, intellectual property protection, infrastructure and institutions also play an important role in GVC participation.

Regarding specific studies in Africa, Engel et al. (2016) investigate the participation in Regional Value Chains (RVCs) of the Southern African Customs Union (SACU) countries. For these authors, border and trade policy factors are more critical for the implementation of SACU RVCs. Specifically, these include tariffs, intra-SACU trade restrictions, limited access to containers, high transport costs and lack of harmonization of trade procedures. Shepherd

(2016) have examined the role of trade facilitation, particularly infrastructure in the participation of SSA countries in global value chains as measured by value added trade. He found that participation in GVCs is highly sensitive to improvements in logistics and trade facilitation. His results have shown that, a 1% improvement in a country's logistics performance index (LPI) score is associated with participation in GVCs by almost 4%, while a 1% improvement in trade facilitation performance is associated with participation in GVCs by almost 1.5%. Furthermore, this study has revealed that a 1% increase in LPI scores of neighboring countries increases participation in GVCs by 5%, while a similar improvement in trade facilitation performance is associated with a 1.8% increase in GVC participation. Thus, for this author, it is not only a country's performance that matters, but also that of its neighbors. Finally, the author also found that the regional dimension of infrastructure and trade facilitation policies is a key determinant of the ability of SSA countries to connect to GVCs. In the same vein, Del Prete et al. (2018) analyzed the participation and position of North African countries in GVCs. Exploiting Eora's multi-regional input-output tables on sectoral data, their results suggest that improving the participation of North African countries in GVCs could significantly benefit local industries, countries and the region as a whole. However, they remind that the ability to retain such benefits depends on specific local conditions, such as a favorable environment for foreign investment and lower trade barriers which confirms Shepherd (2016) findings on the importance of the LPI indicator as a determinant of African countries participation in GVCs.

In another dynamic, for the WTO (2011), the quality of infrastructure is increasingly seen as a determinant of developing countries' trade performance and as an important factor in global value chains. Moreover, instant access to information for decision-makers, e-commerce for consumers, logistics management and communication among many stakeholders in the global value chain depend on the availability and level of development of ICT. Finally, the WTO (2011) argues that the ability of firms and economies to integrate into the global supply chain is highly dependent on the efficiency of border processes and customs practices. The studies of Luo and Xu (2018) confirm that of WTO, (2011). These authors examine the role of infrastructure in participation in GVCs. They suggest that the removal of infrastructure bottlenecks is a necessary condition for providing an economy with a window of opportunity to develop according to its comparative advantage. Moreover, they argue that good infrastructure can help an economy, especially a less developed one, to reap the benefits of participating in global value chains to improve its economic structure. Finally, Shepherd (2022) has shown that observed changes in trade facilitation performance between 2015 and 2019 have strong explanatory power for observed changes in GVC trade over the same period.

The review shows that trade policies, especially trade facilitation, contribute significantly to participation in global value chains. However, it is noted that these studies are very limited in the case of Sub-Saharan African countries. Moreover, few or no studies address both hard

and soft infrastructure aspects in the analysis. Our study fills these gaps.

III. Data and Stylized Facts on Trade Facilitation and GVC

This section describes the state of SSA countries in terms of both trade facilitation and integration into global value chains, and analyzes the data and the correlation between trade facilitation and participation of SSA countries in global value chains (foreign value added, domestic value added and total participation). The study covers a panel of 25 Sub-Saharan African countries over the period 2004-2017. (See appendix 6 for the full list of countries). The sample and period are justified by the availability of trade facilitation data. Table 1 report descriptive statistics on all variables used in the analysis.

Table 1. *Descriptive Statistics of the Regression Variables*

Variable	Obs	Mean	Std. Dev.	Min	Max
Foreign Value-Added (FVA)	350	3.7E-06	0.00001	6E-08	0.00008
Domestic Value-Added (DVA)	350	0.00002	0.00006	1.72E-07	0.00036
Total Participation (GVC)	350	0.00001	0.00004	1.40E-07	0.00025
GDP per capita	350	2023.153	2188.178	128.337	10484.910
Populations	350	2.20E+07	3.22E+07	456617	1.91E+08
Human capital	322	1.851	0.429	1.154	2.885
Industrialization	334	11.027	6.119	0.233	35.215
Trade openness	350	70.289	28.462	0.000	161.894
Foreign direct investment	350	4.022	4.859	-4.846	39.456
Government effectiveness	350	-0.485	0.564	-1.626	1.057
Private sector credit	321	27.034	31.487	2.215	160.125
Gross Fixe Capital Formation	321	22.955	7.714	8.951	46.732
Tariffs	350	0.065	0.047	0	0.211
Physical Infrastructure (PI)	350	0.404	0.225	0.010	0.959
Technology (ICT)	350	0.459	0.221	0.002	1
Business Environement (RE)	350	0.369	0.220	0.035	1
Border and Transport Efficiency (BE)	350	0.639	0.181	0.104	1

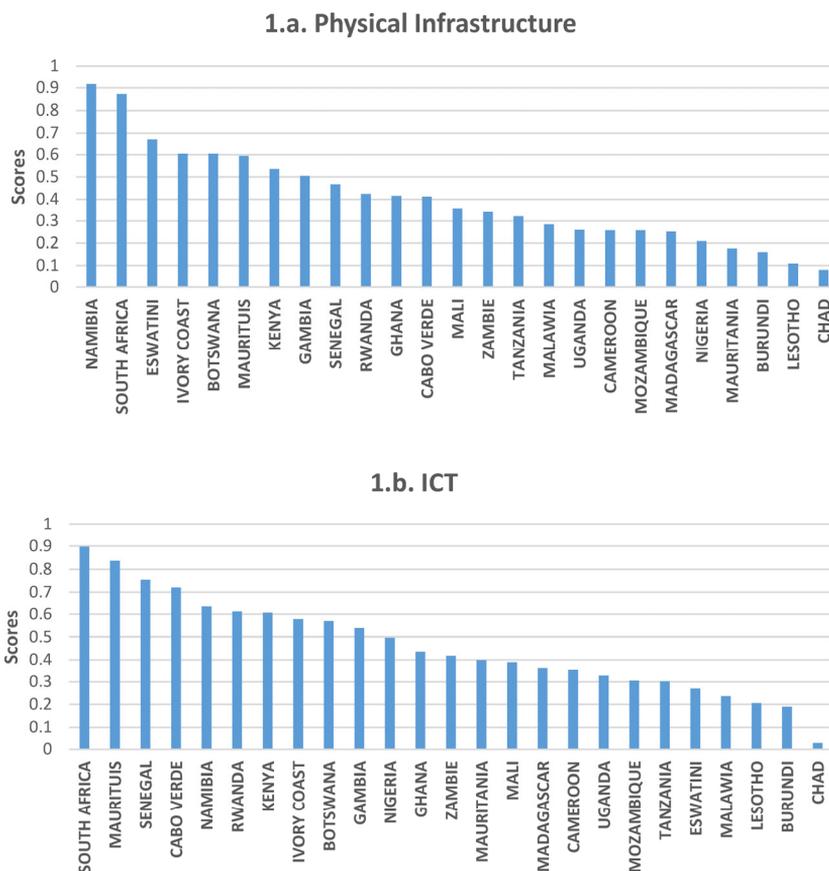
Note. Each trade facilitation indicators (PI, ICT, RE and BE) was standardized to values that range from 0 to 1 to facilitate comparison.

(Source) Authors.

Figure 1 below shows the performance of SSA countries on the TF indicators (scores range from 0 to 1). It can be seen that Namibia and South Africa score better on the physical infrastructure indicator with a score of 0.91 and 0.87 respectively on a scale of 0 to 1. Chad with a score of 0.08 and Lesotho with a score of 0.10 have very poor physical infrastructure.

Regarding the use and availability of ICT, South Africa, Mauritius and Senegal are in the top positions, while Chad and Lesotho are in the bottom.

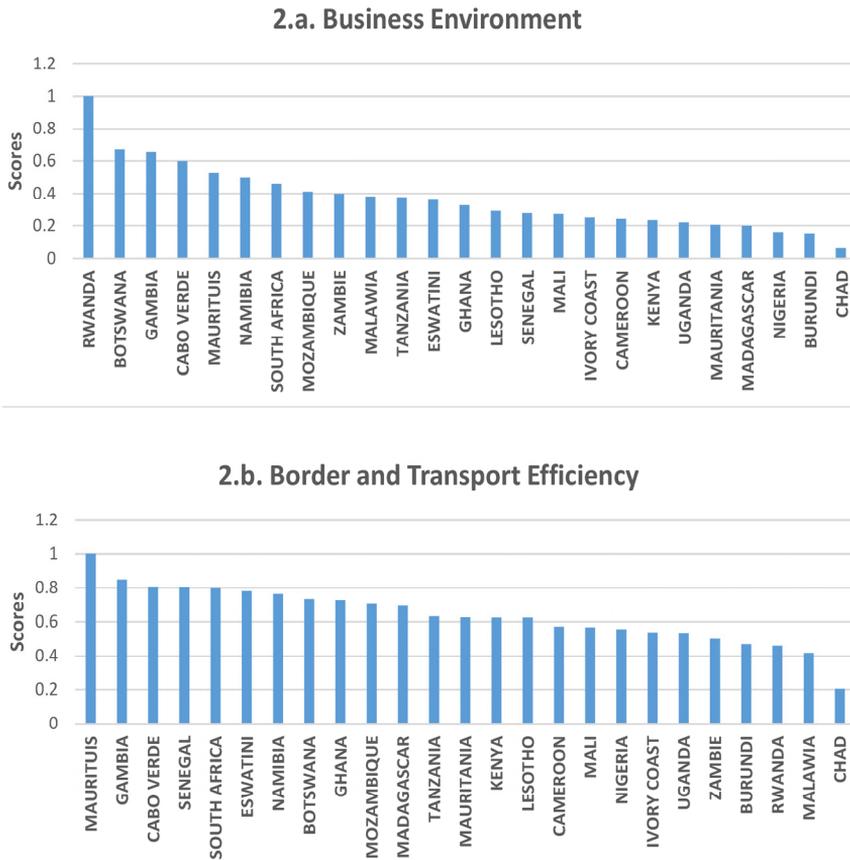
Figure 1. SSA countries' performance in hard infrastructure (average 2004-2017)



(Source) Authors based on data from WEF (2017).

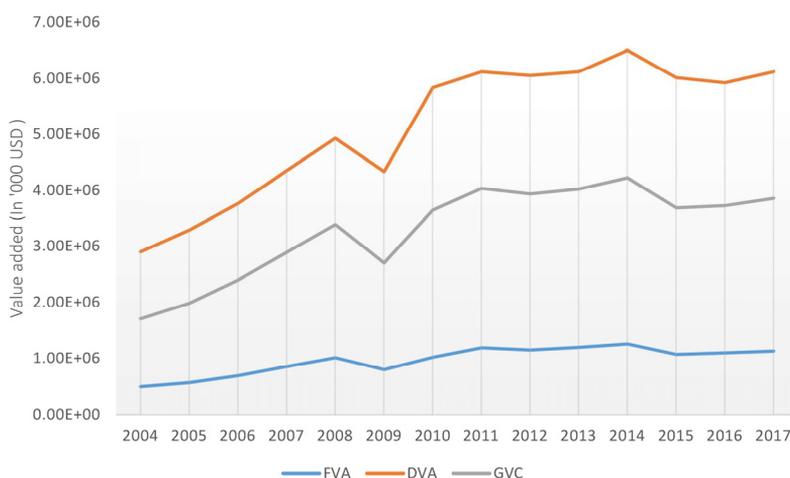
Figure 2 shows the performance of SSA countries in soft infrastructure. It can be seen that in terms of business environment, Rwanda is in first place with a score of 1 followed by Botswana (0.67). On the other hand, Chad (0.06) and Burundi (0.15) have very low scores. Furthermore, it is noted that out of 25 SSA countries, only 6 countries score above 0.5, thus indicating the level of the business environment in the region. With regard to border and transport efficiency, Mauritius is first in terms of efficiency in border procedures while Chad is inefficient.

Figure 2. SSA countries' performance in soft infrastructure (average 2004-2017)



(Source) Authors based on data from WEF (2017) and Doing Business DB (2017).

Figure 3 below shows the evolution of the three components that measure the participation of countries in global value chains, i.e., the upstream component (foreign value added (FVA)), the downstream component (domestic value added (DVA)) and the total participation rate combining the first two (GVC). The analysis of this graph shows that SSA countries participate in GVCs at all levels of integration. During the period 2004 to 2017, there was an overall upward trend in the three value chain components. Moreover, the domestic value-added curve is above that of foreign value added as well as that of the overall participation rate, which translates into a strong downstream integration of SSA countries. This situation is indicative of the inability of SSA countries to process products, thus reflecting a high export of raw materials. Furthermore, as shown in Figure 3, the overall integration rate as well as the foreign value added is very low, indicating that African countries are at the bottom of the ladder when it comes to GVCs.

Figure 3. Evolution of SSA countries in global value chains

(Source) Authors based on UNCTAD-EORA data (2021).

The following Figure 4 presents the cross-relationship between the four TF indicators and the upstream integration of SSA countries into value chains. The analysis of this graph indicates a positive correlation between the trade facilitation indicators and the upstream integration of SSA countries into GVCs; hence an upward trend between the TF indicators and foreign value added (FVA) apart from the business environment indicator which has a downward trend. This suggests that the two variables TF and FVA are moving in the same direction in SSA. An upward (downward) variation in one lead to an upward (downward) variation in the other. Moreover, there is a general disparity between SSA countries. Indeed, some countries such as South Africa, Nigeria, Mauritius have high above average scores on TF indicators but also a high level of foreign value added. This suggests that trade facilitation would certainly have played a role in the upstream integration of these countries into GVCs. On the other hand, countries such as Chad and Burundi have both very low scores in the TF indicators but also a very low level of backward integration. For these countries, it seems that an improvement in TF indicators could lead to a deeper upstream integration of GVCs.

that a country is positioned at a higher stage of the production process, which is also related to better economic performance, it is retained in this study such as (Slany, 2019)³). An additional analysis of downstream integration and total participation is included for the comparison purpose.

Thus, the model to be estimated is inspired by those of (Kowalski et al., 2015; Moïsé and Sorescu, 2015; Slany, 2019).

$$FVA_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 TFI_{it} + \eta_t + \mu_i + \varepsilon_{it} \quad (1)$$

Where FVA_{it} represents the foreign value added⁴) in country i in period t . It measures the share of foreign value added (backward integration) in the exports of Sub-Saharan African countries; X_{it} represents the vector of control variables; TFI_{it} represents the vector of trade facilitation indicators; η_t are the time fixed effects; μ_i is a vector representing country fixed effects; ε_{it} is the error term.

The vector of trade facilitation indicators is captured by four aggregate indicators⁵) presented below. These indicators are expected to have a positive effect on participation in global value chains.

- **Physical infrastructure:** measures the level of development and quality of road, port, airport and rail infrastructure. It is itself composed of four sub-indicators: quality of road network/ infrastructure, quality of rail infrastructure, quality of port infrastructure and quality of air transport infrastructure (airport connectivity). For Kowalski et al. (2015), access to good quality ports, roads, railroads, and airports can play a key role in participation in MVCs.
- **Information and Communication Technology (ICT):** is interpreted as the extent to which an economy uses ICT to improve efficiency and productivity as well as to reduce transaction costs. It contains indicators on the availability, use, absorption, and priority given by government to ICT. In addition to the benefits of access to knowledge, ICTs also enable the coordination of complex and geographically dispersed production processes. Finally, ICT allows for a greater degree of openness and, therefore, greater participation in the value chain.
- **Business and regulatory environment:** This indicator measures the level of development of regulations and transparency. It is based on indicators of improper payments, favoritism, government transparency, and anti-corruption measures.
- **Border and transport efficiency:** It aims to quantify the level of customs and inland transport efficiency reflected in the time, cost, and number of documents required for export and

3) Note that the IMF (2016) also focuses on backward integration as a measure of GVC participation, given the argument that backward integration is primarily associated with higher benefits to the economy.

4) It is a measure of backward integration that corresponds to the imported intermediate input content of exports for each product.

5) Note that these are composite indicators constructed from 15 sub-indices using principal component analysis (see details in appendix 2).

import procedures. For Blyde (2014), complex production processes that span multiple borders require efficient logistics, and as with customs duties, the costs of these border-related procedures can be amplified in value chain trade.

The control variables include the following variables:

- **Market size:** It determines the demand for primary, intermediate and final goods. Consequently, exports increase with market size. The gravity theory of trade posits that trade volume is positively associated to the economic mass of trading partners and negatively associated to the distance between partners (Anderson, 1979; Anderson and van Wincoop, 2004). Thus, according to Kowalski et al. (2015), as in the case of gross trade, market size is expected to be an important determinant of value-added trade flows. We measure market size by GDP per capita and population. Both variables are expected to have a positive effect on participation in global value chains regardless of country position.
- **Human capital:** The literature suggests that adequate human capital promotes technology and knowledge transfer and the ability to process intermediate products (Okah Efogo et al., 2021). Moreover, a high human capital index is an attractive factor for FDI, which induces multinationals to include local firms in their production chain, leading to greater participation in MVCs. The human capital index is measured in our study by the number of years of schooling and the return to education.
- **Industrialization:** The structure of an economy is likely to change along the development path and these changes may be reflected in rates of participation in GVCs. For example, countries at an early stage of economic development tend to specialize in primary products that serve as inputs into production processes (e.g., agriculture or natural resource extraction), which primarily stimulates the potential for backward participation. Backward linkages are thought to develop in the early stages of industrialization when a country engages in industrial-type activities such as assembly. The degree of industrialization of the economy, which is measured in this work by the share of manufacturing value added in GDP, tends to be positively correlated with backward integration.
- **Market access:** Market access is also an important factor in stimulating participation in global value chains. Market access is measured by trade openness. The more a country facilitates access to its market, the more foreign value added it imports and the more it attracts multinational firms that are the main actors in global value chains. In this work, trade openness is represented by the ratio of exports to imports and GDP.
- **Foreign direct investment:** The GVC revolution has been driven to a large extent by large multinational firms through FDI (OECD, 2013) and FDI is expected to be strongly associated with the type and participation in GVCs. In this work, FDI is measured by the ratio of net inward FDI flows to GDP.

- **Institutional quality:** A large literature supports the idea that institutional quality can be an important determinant of trade in value chains because it can determine the ability of firms to enforce contracts. Levchenko (2007), argued that institutional aspects can significantly influence trade flows, especially for products characterized by high complexity, including those characterized by the level of dispersion of intermediate inputs. Similarly, Costinot (2009) found that in complex industries characterized by high levels of complex tasks, good institutions can be an important determinant of firm performance. Institutional quality assesses the effect of the social and political environment on countries' participation in global value chains. Like Olczyk and Kordalska (2017), we use government effectiveness to capture institutional quality.
- **Access to finance:** This has been found to be an important determinant of trade and specialization (Choi, 2013) and is likely to play an important role in GVC participation. It is important not only for facilitating transactions, but also as a means for local firms to meet the standards and technological requirements for effective participation in the international production chain (Efogo, 2020). Access to finance is measured by the credit extended to the economy by financial institutions as a percentage of GDP.
- **Gross fixed capital formation (GFCF):** It includes land improvements (fences, ditches, drains, etc.), purchases of plant, machinery, and equipment, and construction of roads, railroads, and other infrastructure, including schools, offices, hospitals, private residential housing, and commercial and industrial buildings. The GFCF/GDP ratio is used in this study and measures physical capital (domestic investment).
- **Average applied tariff:** This is the average of the actual applied rates, weighted by the import shares of the products corresponding to each partner country. It is an indicator of trade costs and the higher it is, the less countries participate in global value chains. A negative effect on global value chains is expected regardless of the country's position.

B. Estimation technique

The empirical strategy adopted in this study consists in estimating equation 1 using the Pooled Ordinary Squares (Pooled OLS) estimator. Then, we use the instrumental variable-two-Stage Least Squares (IV-2SLS) estimator to take into account the potential endogeneity related to GVCs and TF indicators on the one hand and other control variables such as FDI, etc. on the other. According to Giroud and Mirza (2015), there is a bidirectional relationship between participation in global value chains and FDI. This hypothetical simultaneity bias leads to endogeneity. The same is true for human capital or TF variables that can be both a cause and a consequence of participation in GVCs. While, for example, human capital or infrastructural logistics may condition participation in GVCs, at the same time, greater participation in GVCs

may induce a specific demand for hard or soft infrastructure development (Okah Efogo, 2020). In the case of the IV-2SLS estimator, the Hansen p-value test, Kleibergen and Paap (2006) test for under-identification; Cragg-Donald Wald F test for weak identification are used to ensure the validity of the instruments selected. Note that we use internal instruments, i.e., for each indicator of TF and FDI we instrument with 1 or 2 or 3 lags of itself.

The summary of the variables, the sources and the expected signs of the model are in Table 2.

Table 2. Summary of Model 1 Variables, Sources and Expected Signs

Variables	Measure	Sources	Expected signs
FVA	Backward integration measured by FVA, i.e., the share of foreign value added in total exports	UNCTAD EORA	N/A
GDP per capita	Gross domestic product per capita (current \$)	WDI	+
Population	Population in millions	WDI	+
Human Capital	It is based on years of schooling and educational performance	PWT	+
Industrialization	Share of manufacturing value added in GDP		+
Trade openness	Ratio of imports and exports as a percentage of GDP (X+M)/GDP	WDI	+
Foreign Direct Investment (FDI)	FDI investment net inflow ratio as % of GDP	WDI	+/-
Financial development	Private sector credit provided by financial companies	WDI	+/-
Government effectiveness	It captures the quality of institutions (perceptions of the quality of public services, the quality of the civil service and its degree of independence from political pressures). It range from -2.5 to 2.5	WGI	+
Capital formation	It measures physical capital (GFCF)	WDI	+
Tariff	Weighted average rate applied to all products	WDI	-
Physical Infrastructure (PI)	Level and quality of road, port, airport and rail infrastructure (ranges from 1= extremely underdeveloped, to 7 = well developed)	WEF	+
Information and Communication Technology (ICT)	Use of ICT to improve efficiency and productivity and to reduce transaction costs (1 to 7 = best)	WEF	+
Business and Regulatory Environment (RE)	Level of development of regulations and transparency (1=low to 7=high).	WEF	+
Border and Transport Efficiency (BE)	Customs and inland transport efficiency reflected in the time and number of documents.	DB	+

Note. Each trade facilitation indicators (PI, ICT, RE and BE) was standardized to values that range from 0 to 1 to facilitate comparison as in Portugal-Perez and Wilson, (2012) study.

(Source) Authors

V. Results

A. Presentation and discussion of results

The regression results obtained using Pooled OLS and IV-2SLS estimator are presented in Tables 3 and 4 respectively. The regression with the Pooled OLS (Table 3), is globally and statistically significant. Indeed, the coefficient of determination R-squared is close to 1 (about 0.94) in all the specifications indicating that the variables used in the model explain 94% of the participation of countries in global value chains.

With respect to the IV-2SLS estimator (Table 4), our results are both theoretically and econometrically satisfactory. In line with economic theory, most of the coefficients of our variables have the expected signs. Econometrically, the use of IV-2SLS estimator is conditioned by the validity of the selected instruments, which should not be correlated with the error term. First, we note the rejection of the null hypothesis of under-identification since the p-values of Kleibergen and Paap, (2006) are zero for all specifications. Our model is therefore correctly identified. Second, when we compare the values of the Cragg-Donald Wald F statistics to the critical values of Stock and Yogo, (2005) to determine instrumental variable bias and size bias, we reject the weak instrument null hypothesis since the values of the statistics are greater than the critical values of (Stock and Yogo, 2005). Therefore, our instruments are valid. This conclusion is confirmed by the Hansen's statistic and p-value, which is greater than 10% for all specifications. Thus, these statistics indicate that the instruments are relevant, providing confidence that they are sufficiently strong.

As for the results of the estimations, the coefficients of our key variables with IV-2SLS estimator are similar to the initial results with OLS estimator. Our results show that among the four trade facilitation indicators, only the business environment indicator does not have a statistically significant contribution. Moreover, the signs of the indicators are consistent with the economic theory, which supports previous empirical results. Thus, these statistics indicate that the instruments are relevant, providing confidence that they are sufficiently strong.

Table 3. *Pooled OLS Results with Fixed Effects*

VARIABLES	Dependent variable: Foreign Value Added (log_FVA)				
	1	2	3	4	5
log_GDP_per_capita	1.048*** (0.072)	1.052*** (0.070)	1.028*** (0.071)	0.956*** (0.071)	0.943*** (0.070)
log_Population	0.776*** (0.050)	0.756*** (0.048)	0.689*** (0.031)	0.716*** (0.050)	0.719*** (0.048)
Human_capital	0.486*** (0.123)	0.576*** (0.120)	0.390*** (0.119)	0.537*** (0.121)	0.746*** (0.126)

Table 3. Continued

VARIABLES	1	2	3	4	5
Industrialization	0.018* (0.009)	0.020** (0.009)	0.030*** (0.006)	0.011 (0.010)	0.007 (0.010)
Trade_Openness	0.010*** (0.002)	0.010*** (0.002)	0.009*** (0.002)	0.007*** (0.002)	0.007*** (0.002)
Foreign_Direct_Investment	-0.032*** (0.007)	-0.032*** (0.007)	-0.033*** (0.007)	-0.035*** (0.007)	-0.034*** (0.007)
Government_effectiveness	-0.190 (0.131)	-0.398*** (0.130)	-0.391*** (0.107)	-0.025 (0.158)	-0.375*** (0.127)
Private_Sector_Credit	0.010*** (0.003)	0.008** (0.004)	0.010*** (0.003)	0.010*** (0.003)	0.008** (0.003)
GFCF (%GDP)	0.019*** (0.005)	0.023*** (0.005)	0.017*** (0.005)	0.021*** (0.005)	0.020*** (0.005)
log_Tariff	-1.649** (0.714)	-3.182*** (0.717)	-2.366*** (0.731)	-2.985*** (0.716)	-3.085*** (0.706)
Physical_Infrastructure_(PI)		0.928*** (0.279)			
Technology_(ICT)			0.431* (0.219)		
Business_Environment_(RE)				-0.591*** (0.199)	
Border_Efficiency_(BE)					1.108*** (0.276)
Constant	-36.194*** (0.944)	-36.381*** (0.925)	-34.768*** (0.696)	-34.002*** (1.076)	-35.312*** (0.900)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	261	261	261	261	261
R-squared	0.940	0.945	0.932	0.944	0.946

Note. Numbers in parentheses represent the robust standard errors of the estimated coefficients; *, **, *** represent significance at 10%, 5% and 1%.

(Source) Authors

Specifically, the physical infrastructure indicator has a positive and significant contribution at the 1% level with both the OLS and IV-2SLS regressions. This result means that, all other things being equal, a 1% improvement in the quality of road, port, airport and rail infrastructure improves the upstream participation of SSA countries in GVCs by 0.90% (Table 4). Our result is consistent with those found by (Kowalski et al., 2015; Shepherd, 2017). For Kowalski et al., (2015), infrastructure quality plays a greater positive impact on upstream integration of

GVCs in both developing and developed countries. ICT indicator is also decisive in the participation of SSA countries in global value chains. It contributes positively and significantly at the 10% threshold both at the OLS and IV-2SLS levels. An increase in the availability of technology as well as its use in production of 1% is associated with an increase in foreign value added and thus an increase in the participation in GVCs of SSA countries of 0.56% (Table 4), all other things being equal. Thus, the use of ICT in value added trade enables innovation, which favours the introduction of new and more sophisticated production methods that allow SSA countries to integrate upstream GVCs. This result is consistent with that found by (Slany, 2019). Concerning border and transport efficiency indicator measured by the number of days as well as the number of documents required to export/import a product, it positively and significantly affects the participation in GVCs of SSA countries. The coefficient on border and transport efficiency as presented in Table 3 is positive and indicates that, all else being equal, a 1% improvement in border procedures increases SSA's upstream participation in GVCs by 0.95%. In other words, simplification of border procedures, especially the number of days and the number of import/export documents, contributes to the upstream integration of SSA countries in GVCs. This result supports those found in the literature that simplification of border procedures positively and significantly affects participation in GVCs (Slany, 2019). As for the business and regulatory environment indicator, it does not have the expected sign and is not as significant. Indeed, it negatively affects the participation of SSA countries in GVCs. This result is understandable in view of the sub-indices used for the construction of this aggregate indicator. The IMF (2016) in its study also found that backward integration into global value chains is hampered by difficult trading environments which is the case for SSA countries.

Table 4. *Two-stage Least Squares (IV-2SLS) Results with Fixed Effects*

VARIABLES	Dependent variable: Foreign Value Added (log_FVA)				
	1	2	3	4	5
log_GDP_per_capita	1.084*** (0.088)	1.157*** (0.085)	0.909*** (0.066)	1.050*** (0.090)	1.147*** (0.093)
log_Population	0.771*** (0.053)	0.683*** (0.025)	0.749*** (0.064)	0.745*** (0.054)	0.662*** (0.023)
Human_capital	0.489*** (0.153)	0.492*** (0.139)	0.243 (0.181)	0.445*** (0.149)	0.614*** (0.155)
Industrialization	0.001 (0.012)	0.012** (0.006)	0.023* (0.013)	-0.003 (0.013)	0.018*** (0.006)
Trade_Openness	0.010*** (0.002)	0.009*** (0.002)	0.011*** (0.003)	0.009*** (0.002)	0.006*** (0.002)
Foreign_Direct_Investment	-0.046*** (0.010)	-0.037*** (0.007)	-0.048*** (0.012)	-0.048*** (0.010)	-0.037*** (0.007)

Table 4. Continued

VARIABLES	1	2	3	4	5
Government_effectiveness	-0.423*** (0.123)	-0.571*** (0.101)	-0.622*** (0.139)	-0.251 (0.154)	-0.667*** (0.102)
Private_Sector_Credit	0.016*** (0.003)	0.010*** (0.003)	0.017*** (0.002)	0.015*** (0.003)	0.010*** (0.003)
GFCF (%GDP)	0.027*** (0.004)	0.024*** (0.004)	0.024*** (0.006)	0.028*** (0.004)	0.023*** (0.004)
log_Tariff	-1.995*** (0.760)	-2.455*** (0.748)	-1.100 (0.807)	-2.190*** (0.755)	-2.751*** (0.789)
Physical_Infrastructure_(PI)		0.903*** (0.224)			
Technology_(ICT)			0.563* (0.317)		
Business_Environment_(RE)				-0.393 (0.247)	
Border_Efficiency_(BE)					0.948*** (0.206)
Constant	-37.015*** (0.934)	-36.382*** (0.667)	-35.515*** (1.181)	-35.880*** (1.230)	-36.321*** (0.616)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	212	212	212	212	212
R-squared	0.955	0.954	0.936	0.955	0.956
Underidentification Test	41.12	28.34	44.04	40.07	29.27
Prob>LM	0.000	0.000	0.000	0.000	0.000
Weak Identification Test (Cragg-Donald Wald F stat)	80.603	83.907	59.550	60.103	73.138
Hansen_stat (overidentification test)	3.760	2.692	4.274	3.784	2.993
Hansen P_value	0.153	0.260	0.118	0.151	0.224

Note. Numbers in parentheses represent the robust standard errors of the estimated coefficients; *, **, *** represent significance at 10%, 5% and 1%.

(Source) Authors

With regard to the control variables, we note that in all specifications, both with OLS and IV-2SLS estimators, the market size measured by the gross domestic product per capita positively and significantly affects the participation in GVCs. This variable is significant at 1% level in all specifications, which allows us to say that the higher the market size, the more it favours the exchange of added value and thus increases the participation in upstream GVCs (IMF, 2016; Kowalski et al., 2015). According to Kowalski et al. (2015), more developed countries tend to buy and sell a larger share of their gross exports as intermediate goods. As

a determinant of trade policy, like the TF indicators, the mean applied tariff negatively influences the upstream participation of SSA countries in GVCs because, as shown in Table 3 and 4, its coefficient is negative in all specifications (both OLS and IV-2SLS estimator). This shows that the applied tariffs hinder the participation of SSA countries in GVCs. This result is in line with those obtained in the literature according to which, low tariffs favor integration in GVCs (Slany, 2019; Del Prete et al., 2018; Okah Efogo et al., 2021). This result is confirmed by that of trade openness which increases the participation of SSA countries in the GVCs as it is noted that this variable has a positive and statistically significant coefficient at 1% level in all regressions.

Finally, Tables 3 and 4 present some challenging and counterintuitive results. FDI and government effectiveness have a negative effect on developing countries' participation in GVCs. FDI becomes positive when it comes to total participation (see Appendix 4), and positive and significant as a determinant for forward participation (see colon 1 Appendix 3). The negative effect of government effectiveness which capture governance is in line with the finding of some authors in the literature (Okah Efogo et al., 2021).

Note that in term of comparison with DVA results, the finding also supports the contribution of TF indicators in forward participation and also in total participation. In fact, physical infrastructure, ICT, Border and transport efficiency contribute all in downstream participation in GVC (see Appendix 3). This is also true for total participation (see Appendix 4). With these results, we can conclude that TF indicators contribute positively to global value chains whatever the position.

B. Robustness of results

The results indicate that trade facilitation contributes positively to the upstream integration of SSA countries into GVCs. To check the robustness of our results, we perform additional analyses. These analyses are carried out at the sectoral level. In fact, it is of major interest for policy makers to identify the role of trade policies in certain sectors. In order to give a first indication of the importance of different sectors, our robustness test consists of a regression at the sectoral level to check whether the results obtained at the aggregate level can be applied to a number of sectors of SSA economies in terms of participation in GVCs. These are agriculture, food and beverages (manufacturing), textiles and clothing. These sectors have been highlighted in the literature because of their potential to upgrade within a value chain, and have also been put on the agenda in the Action Plan for Accelerated Industrial Development of Africa advocated by the African Union (Slany, 2019). Moreover, according to Alliance for a Green revolution in Africa (2016) cited by Balie et al. (2019), in SSA countries, agriculture sector for example still generates about 25% of the GDP, or 50% if we look at the broader

agribusiness sector, and involves roughly 65% of the local population, mostly in family farming activities. Also, during the past three decades, agro-food trade has more than quadrupled in nominal terms from \$230 billion in 1980 to almost \$1,100 billion in 2010; an increase driven by several factors, including GVC growth. Indeed, half of this total agro-food trade can be considered of intermediate usage for global production processes (Balie et al., 2019).

Thus, in equation 1, we replace FVA by FVA_{AGRI} , FVA_{FOOD} , $FVA_{TEXTILES}$ which represent respectively the share of FVA by sector (Agriculture', Food and beverages, Textile and clothing) as a % of total exports of SSA countries. The other variables of the model remain the same.

The results of the estimations are compiled in Tables 5, 6 and 7. The results of Table 5, which concerns agriculture, show that trade facilitation indicators positively influence the upstream integration of GVCs. We found that good quality of physical infrastructure, use of ICT in the production and processing of agricultural products, and a better business environment favor upstream participation in GVCs. This result suggests that SSA countries, being predominantly agricultural, have a range to become more integrated in the upstream GVCs. Regarding the food and beverage sector, in addition to physical infrastructure and ICT that promote backward integration of GVCs, border and transport efficiency captured by the number of days/documents to export/import as well is very crucial in the integration of SSA countries with GVCs. Referring to Table 6, its coefficient is positive and significant at 1% level and reveals that reducing border procedures by 1% favors the upstream integration of SSA countries in GVCs in the food and beverages sector by 2.04% *ceteris paribus*. In the case of textile and clothing industry (Table 7), physical infrastructure, ICT and the business environment play an important role. These three indicators contribute positively to the backward integration of SSA countries in GVCs.

In total, the physical infrastructure and ICT indicators favor upstream integration in all three sectors, while the business environment and borders and transport efficiency are determinants of upstream integration in agriculture and textiles and in food and beverages respectively. These sectors make heavy use of inputs from the agricultural sector, which suggests that lengthy administrative procedures as well as an unfavorable business and regulatory environment negatively impact integration in GVCs. Finally, the disaggregated results reveals also that TF measures can benefit more at the sectoral level than at the aggregate analysis. Indeed, we noticed that the coefficients of these TF indicators that favor sectoral integration to GVCs are very high compared to the coefficients of the baseline model and our results are broadly consistent with that of Slany(2019).

Table 5. Two-Stage Least Squares Results (IV-2SLS) - Agriculture Sector

VARIABLES	Dependent variable : Agriculture (log_FVA _{Agriculture})				
	1	2	3	4	5
log_GDP_per_capita	0.081 (0.167)	-1.639*** (0.124)	-1.656*** (0.166)	0.426** (0.174)	-1.439*** (0.143)
log_Population	0.384*** (0.078)	0.540*** (0.069)	0.485*** (0.098)	0.143 (0.109)	0.442*** (0.089)
Human_capital	-1.847*** (0.465)	0.653*** (0.239)	0.222 (0.294)	-1.561*** (0.433)	-0.042 (0.329)
Industrialization	0.028** (0.013)	0.055*** (0.012)	0.049*** (0.015)	0.117*** (0.026)	0.071*** (0.018)
Trade_Openness	-0.017*** (0.005)	-0.014*** (0.003)	-0.022*** (0.003)	-0.024*** (0.005)	-0.026*** (0.003)
Foreign_Direct_Investment	0.059*** (0.022)	0.061*** (0.012)	0.058*** (0.015)	0.097*** (0.026)	0.065*** (0.015)
Government_effectiveness	0.185 (0.221)	-1.501*** (0.197)	-0.919*** (0.231)	-1.122** (0.510)	-0.699*** (0.198)
Private_Sector_Credit	-0.031*** (0.003)	0.012* (0.006)	0.022*** (0.007)	-0.029*** (0.003)	0.027*** (0.008)
GFCF (%GDP)	-0.014 (0.013)	-0.018*** (0.007)	-0.008 (0.009)	-0.028** (0.013)	-0.012 (0.008)
log_Tariff	-2.545 (2.368)	0.567 (1.050)	1.203 (1.039)	-2.627 (2.489)	1.454 (1.164)
Physical_Infrastructure_(PI)		4.623*** (0.552)			
Technology_(ICT)			1.312*** (0.506)		
Business_Environment_(RE)				2.056*** (0.788)	
Border_Efficiency_(BE)					-1.134 (0.866)
Constant	-29.165*** (1.272)	-28.368*** (1.490)	-24.855*** (1.806)	-29.896*** (1.619)	-23.779*** (1.891)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	212	212	212	212	212
R-squared	0.759	0.960	0.942	0.784	0.942
Underidentification Test	22.62	39.17	44.29	30.26	41.09
Prob>LM	0.000	0.000	0.000	0.000	0.000
Weak Identification Test (Cragg-Donald Wald F stat)	107.009	51.038	49.250	63.965	51.492
Hansen_stat (overidentification test)	1.687	1.753	1.372	2.546	1.939
Hansen P_value	0.430	0.416	0.504	0.280	0.379

Note. Numbers in parentheses represent the robust standard errors of the estimated coefficients; *, **, *** represent significance at 10%, 5% and 1%.
(Source) Authors

Table 6. Two-Stage Least Squares Results (IV-2SLS) - Food and Beverage Sector

VARIABLES	Dependent variable: Food and Beverage (log_FVA _{Food})				
	1	2	3	4	5
log_GDP_per_capita	0.259*	-0.250	0.192	0.481***	0.501***
	(0.137)	(0.215)	(0.182)	(0.174)	(0.148)
log_Population	-0.064	-0.165	0.197*	0.202*	-0.083
	(0.148)	(0.198)	(0.119)	(0.123)	(0.138)
Human_capital	-1.005***	-1.080***	-1.002***	-1.171***	-0.196
	(0.202)	(0.296)	(0.335)	(0.329)	(0.266)
Industrialization	0.200***	0.184***	0.118***	0.138***	0.187***
	(0.015)	(0.018)	(0.023)	(0.025)	(0.016)
Trade_Openness	0.008	0.007	0.020***	0.017**	0.000
	(0.005)	(0.006)	(0.006)	(0.007)	(0.005)
Foreign_Direct_Investment	0.019	0.024	-0.003	-0.000	0.000
	(0.012)	(0.016)	(0.021)	(0.022)	(0.013)
Government_effectiveness	-0.329	-1.854***	-1.050***	-0.860**	-0.176
	(0.404)	(0.439)	(0.289)	(0.390)	(0.372)
Private_Sector_Credit	0.009	-0.033***	-0.029***	-0.026***	0.001
	(0.008)	(0.010)	(0.003)	(0.004)	(0.007)
GFCF (%GDP)	0.016**	0.006	0.065***	0.059***	0.025***
	(0.008)	(0.010)	(0.012)	(0.011)	(0.008)
Log_Tariff	0.364	1.301	1.268	-0.276	-0.443
	(1.136)	(1.470)	(1.959)	(1.717)	(0.972)
Physical_Infrastructure_(PI)		3.955***			
		(1.307)			
Technology_(ICT)			2.212***		
			(0.754)		
Business_Environment_(RE)				0.098	
				(0.543)	
Border_Efficiency_(BE)					2.047***
					(0.730)
Constant	-29.305***	-25.092***	-34.891***	-35.788***	-33.019***
	(2.610)	(3.566)	(1.631)	(1.901)	(2.718)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	212	212	212	212	212
R-squared	0.937	0.898	0.749	0.736	0.949
Underidentification Test	27.87	42.63	37.76	37.72	19.61
Prob>LM	0.000	0.000	0.000	0.000	0.000
Weak Identification Test (Cragg-Donald Wald F stat)	50.402	34.951	49.958	53.328	27.036
Hansen_stat (overidentification test)	4.524	1.943	1.487	3.742	1.714
Hansen P_value	0.104	0.378	0.475	0.154	0.424

Note. Numbers in parentheses represent the robust standard errors of the estimated coefficients; *, **, *** represent significance at 10%, 5% and 1%.
(Source) Authors

Table 7. Two-Stage Least Squares Results (IV-2SLS) - Textile and Clothing Sector

VARIABLES	Dependent variable: Textiles and clothing (log_FVA _{textile})				
	1	2	3	4	5
log_GDP_per_capita	0.024 (0.149)	-0.528*** (0.160)	-0.431* (0.223)	-0.401*** (0.134)	-0.287** (0.126)
log_Population	-0.064 (0.147)	0.347*** (0.107)	-0.387*** (0.149)	0.042 (0.074)	0.186* (0.102)
Human_capital	-0.147 (0.203)	0.304 (0.244)	-0.805* (0.482)	0.125 (0.288)	0.152 (0.246)
Industrialization	-0.000 (0.016)	0.012 (0.017)	0.042 (0.032)	-0.014* (0.009)	-0.061*** (0.019)
Trade_Openness	0.007 (0.005)	0.008 (0.006)	-0.001 (0.005)	0.005 (0.005)	0.005 (0.005)
Foreign_Direct_Investment	0.009 (0.020)	0.024 (0.020)	0.018 (0.026)	0.019 (0.022)	-0.000 (0.021)
Government_effectiveness	-0.062 (0.348)	-0.332 (0.329)	0.807** (0.376)	0.009 (0.331)	0.330 (0.305)
Private_Sector_Credit	-0.015** (0.007)	-0.025*** (0.008)	-0.024*** (0.005)	-0.022*** (0.003)	-0.023*** (0.003)
GFCF (%GDP)	0.015 (0.009)	-0.000 (0.010)	-0.003 (0.009)	0.000 (0.009)	0.006 (0.008)
log_Tariff	-0.287 (1.014)	-0.495 (1.023)	0.853 (1.017)	0.452 (1.060)	0.129 (1.021)
Physical_Infrastructure_(PI)		3.665*** (0.674)			
Technology_(ICT)			2.083*** (0.775)		
Business_Environment_(RE)				1.362** (0.656)	
Border_Efficiency_(BE)					-1.318** (0.606)
Constant	-27.594*** (2.644)	-33.023*** (2.203)	-17.958*** (2.607)	-26.821*** (1.484)	-28.270*** (1.785)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	212	212	212	212	212
R-squared	0.805	0.782	0.817	0.807	0.807
Underidentification Test	27.87	27.36	27	27.79	20.51
Prob>LM	0.000	0.000	0.000	0.000	0.000
Weak Identification Test (Cragg-Donald Wald F stat)	50.402	38.316	17.262	24.665	27.959
Hansen_stat (overidentification test)	2.162	1.662	1.201	2.967	2.191
Hansen P_value	0.339	0.436	0.549	0.227	0.334

Note. Numbers in parentheses represent the robust standard errors of the estimated coefficients; *, **, *** represent significance at 10%, 5% and 1%.
(Source) Authors

VI. Conclusion

The objective of this paper was to analyze the contribution of trade facilitation indicators to the participation of Sub-Saharan African countries in global value chains over the period 2004-2017. The Pooled OLS and two-stage least squares (IV-2SLS) methods were used to identify trade facilitation indicators that contribute positively to GVC participation. The estimation results reveal that trade facilitation indicators such as physical infrastructure, ICT, and border and transport efficiency contribute positively to the upstream participation of SSA countries in GVCs. The results are even more interesting at the sectoral level: physical infrastructure, ICT and business environment contribute positively to the upstream integration of GVCs in the agriculture, food and beverages, and textiles and clothing sectors, while border and transport efficiency positively impact the upstream participation of SSA countries in the food and beverages sector.

Our results have policy implications. First, soft infrastructure, especially border and transport efficiency, plays an important role in the participation of SSA countries in GVCs. To this end, considering that Trade Facilitation Agreement fundamentally addresses the soft aspect of infrastructure, SSA countries need to accelerate its implementation to benefit from the facilities offered by this agreement and to be able to increase their integration into GVCs. Secondly, SSA countries need to continue to improve their performance in physical and ICT infrastructure. Physical infrastructure is an area that has long required attention in Sub-Saharan Africa, and this work underscores its increased importance in the era of global value chains. Third, and most encouragingly, improving hard and soft infrastructure is a way for Sub-Saharan African countries to better connect to global value chains at the sectoral level. This calls for well-targeted sectoral policies to reap the benefits of GVCs. It should be noted, however, that we did not include in our analysis the costs of infrastructure investments as well as the regional value chains aspects, which are increasingly put forward as a prerequisite for the upstream integration of developing countries in GVC. However, these different aspects could be evaluated in future research.

References

- Ahmad, N., & Primi, A. (2017). *From domestic to regional to global: Factory Africa and Factory Latin America* (Global Value Chain Development Report 2017). Measuring and Analyzing the Impact of GVCs on Economic Development.
- Alhassan, A., Zoaka, J. D., & Ringim, S. H. (2021). Africa as headwaiter at the dining table of global value chains: Do institutions matter for her participation? *African Development Review*, 33(3), 560-576.
- Allard, C., Kriljenko, M. J. I. C., Gonzalez-Garcia, M. J. R., Kitsios, E., Trevino, M. J. P., & Chen, M. W. (2016). Trade integration and global value chains in Sub-Saharan Africa. In *pursuit of the*

- missing link*. International Monetary Fund.
- Alliance for a Green Revolution in Africa (AGRA). (2016). *Africa agriculture status report: Progress towards agriculture transformation in Sub-Saharan Africa*. Nairobi, Kenya.
- Amoako-Tuffour, J., Balchin, N., Calabrese, L., & Mendez-Parra, M. (2016). *Trade facilitation and economic transformation in Africa*. ACET and ODI's.
- Anderson, J. (1979). A theoretical foundation for the gravity equation. *American Economic Review*, 69(1), 106-116.
- Anderson, J. E., & van Wincoop, E. (2004). Trade costs. *Journal of Economic Literature*, 42(3), 691-751. <https://doi.org/10.1257/0022051042177649>
- Anyanwu, J. C., & Kponnou, M. (2017). Accelerating agro-manufacturing to feed Africa. *African Development Review*, 29(S2), 78-95. <https://doi.org/10.1111/1467-8268.12264>
- Arvis, J.-F., Duval, Y., Shepherd, B., Utoktham, C., & Raj, A. (2016). Trade costs in the developing world: 1996-2010. *World Trade Review*, 15(3), 451-474.
- Baldwin, R. E. (2013). *Lessons from the European spaghetti bowl*. Social science research network (Working Paper, No. 2255911). Asian Development Bank Institute. <https://doi.org/10.2139/ssrn.2255911>
- Baldwin, R., & Venables, A. J. (2013). Spiders and snakes: Offshoring and agglomeration in the global economy. *Journal of International Economics*, 90(2), 245-254.
- Balié, J., Prete, D. D., Magrini, E., Montalbano, P., & Nenci, S. (2019). Does trade policy impact food and agriculture global value chain participation of Sub-Saharan African countries? *American Journal of Agricultural Economics*, 101(3), 773-789.
- Banque africaine de développement, OCDE, & Programme des Nations Unies pour le Développement. (2017). *Perspectives économiques en Afrique 2017: Entrepreneuriat et industrialisation*. OECD. <https://doi.org/10.1787/aeo-2017-fr>
- Blyde, J. S. (2014). *Synchronized factories: Latin America and the Caribbean in the era of global value chains* (p. 141). Springer Nature.
- Cattaneo, O., Gereffi, G., & Staritz, C. (2010). *Global value chains in a postcrisis world: a development perspective*. World Bank Publications.
- CEA (UN-ECA). (2015). *Rapport économique sur l'Afrique 2015: l'industrialisation par le commerce* (p. 43). Nations Unies.
- Choi, N. (2013). *Measurement and determinants of trade in value added* (Working Paper, No. 13-01). KIEP. <https://doi.org/10.2139/ssrn.2317706>
- Christ, N., & Ferrantino, M. J. (2011). Land transport for export: The effects of cost, time, and uncertainty in Sub-Saharan Africa. *World Development*, 39(10), 1749-1759.
- CNUCED. (2013). *Les chaînes de valeur mondiales: L'investissement et le commerce au service du développement* (p. 53). Nations Unies.
- Costinot, A. (2009). On the origins of comparative advantage. *Journal of International Economics*, 77(2), 255-264. <https://doi.org/10.1016/j.jinteco.2009.01.007>
- Del Prete, D., Giovannetti, G., & Marvasi, E. (2018). Global value chains: New evidence for North Africa. *International Economics*, 153, 42-54.
- Dollar, D., Inomata, S., Degain, C., Bo, M., Wang, Z., Ahmad, N., Primi, A., Escaith, H., Engel, J., &

- Taglioni, D. (2017). *Measuring and analyzing the impact of gvcs on economic development*. Washington, DC.: International Bank for Reconstruction and Development/The World Bank. Available from: <https://www.Brookings.Edu/Research/Measuring-and-Analyzing-the-Impact-of-Gvcs-Oneconomic-Development>
- Efogo, F. O. (2020). Does trade in services improve African participation in global value chains? *African Development Review*, 32(4), 758-772.
- Engel, J., Winkler, D., & Farole, T. (2016). *SACU in Global value chains: Measuring GVC integration, position, and performance of Botswana, Lesotho, Namibia, South Africa, and Swaziland*. Available from: <http://hdl.handle.net/10986/23789>
- Ferreira, J. D., & Braun, M. B. (2016). The Insertion of Brazilian industry in global value added chains. In *20th Annual Western Hemispheric Trade Conference, 2016, Laredo, TX, USA. 20 years - 20th Annual Western Hemispheric Trade Conference, 2016*, 441-460. Available from: <http://freetrade.tamui.edu/pdf/conf/20ConfSessions.pdf>
- Gereffi, G. (1999). International trade and industrial upgrading in the apparel commodity chain. *Journal of International Economics*, 48(1), 37-70.
- Gereffi, G. (2015). *Global value chains, development and emerging economies* (MERIT Working Papers, No. 2015-047). United Nations University - Maastricht Economic and Social Research Institute on Innovation and Technology.
- Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy*, 12(1), 78-104.
- Giroud, A., & Mirza, H. (2015). Refining of FDI motivations by integrating global value chains' considerations. *The Multinational Business Review*, 23(1), 67-76.
- Hillberry, R., & Hummels, D. (2002). *Explaining home bias in consumption: The role of intermediate input trade* (NBER Working Paper, No. 9020). National Bureau of Economic Research, Inc. Available from: <https://econpapers.repec.org/paper/nbrnberwo/9020.htm>
- Hummels, D., Ishii, J., & Yi, K.-M. (2001). The nature and growth of vertical specialization in world trade. *Journal of International Economics*, 54(1), 75-96.
- Hummels, D. L., & Schaur, G. (2013). Time as a trade barrier. *American Economic Review*, 103(7), 2935-2959.
- International Monetary Fund. (2015). *Regional economic outlook, April 2015, Sub-Saharan Africa: Navigating headwinds*. International Monetary Fund. Available from: <https://www.elibrary.imf.org/view/books/086/22256-9781498329842-en/22256-9781498329842-en-book.xml>
- International Monetary Fund. (2016). Trade integration and global value chains in Sub-Saharan Africa: In pursuit of the missing link. *IMF Departmental Papers/Policy Papers*, No. 2016/004. International Monetary Fund. Available from: <https://ideas.repec.org/p/imf/imfdps/2016-004.html>
- Johnson, R., & Noguera, G. (2012). Accounting for intermediates: Production sharing and trade in value added. *Journal of International Economics*, 86(2), 224-236.
- Kaplinsky, R., & Morris, M. (2002). A handbook for value chain research. Institute of development studies. Available from: <http://www.ids.ac.uk/ids/global/pdfs/VchNov01.pdf>
- Kleibergen, F., & Paap, R. (2006). Generalized reduced rank tests using the singular value decomposition. *Journal of Econometrics*, 133(1), 97-126.

- Kowalski, P., Gonzalez, J. L., Ragoussis, A., & Ugarte, C. (2015). *Participation of developing countries in global value chains: Implications for trade and trade-related policies* (No. 179). OECD Publishing.
- Kpognon, K., Ondo, H. A., & Bah, M. (2020). Trade openness and youth employment in Sub-Saharan Africa: Should we regulate the labor market? *Journal of Economic Integration*, 35(4), 751-777.
- Levchenko, A. A. (2007). Institutional quality and international trade. *The Review of Economic Studies*, 74(3), 791-819. <https://doi.org/10.1111/j.1467-937X.2007.00435.x>
- Luo, X., & Xu, X. (2018). *Infrastructure, value chains, and economic upgrades* (Working Paper, No. 8547). World Bank.
- Ma Alyson, & Van Assche, Ari. (2010). *The role of trade costs in global production networks: evidence from China's processing trade regime* (Policy Research Working Paper). Washington, DC.: World Bank. <https://doi.org/10.1596/1813-9450-5490>
- Martínez-Zarzoso, I., & Márquez-Ramos, L. (2008). The effect of trade facilitation on sectoral trade. *The B.E. Journal of Economic Analysis & Policy*, 8(1), 1-46.
- Melo, J. de, & Wagner, L. (2018). *Les coûts à commercer en UEMOA: Impacts Potentiels de la mise en oeuvre de l'Accord sur la Facilitation des Echanges (AFE)* (hal-01877242; Post-Print). HAL. Available from: <https://ideas.repec.org/p/hal/journal/hal-01877242.html>
- Moïsé, E., & S. Sorescu. (2015). *Contribution of trade facilitation measures to the operation of supply chains* (OECD Trade Policy Papers, No. 181). Paris: OECD Publishing. <https://doi.org/10.1787/5js0bslh9m25-en>
- Moïsé, E., & Sorescu, S. (2013). *Trade facilitation indicators: The potential impact of trade facilitation on developing countries' trade* (OECD Trade Policy Papers, No. 144). OECD Publishing.
- Nakazawa, E., Norihiko, Y., & Webb, C. (2014). *Determinants of Trade in Value-Added: Market Size, Geography and Technological Gaps*. The Third World KLEMS Conference, Tokyo, Japan.
- OCDE. (2009). *Surmonter les obstacles à la frontière: Coûts et bénéfices de la facilitation des échanges*.
- OCDE. (2013). *Economies interconnectées: Comment tirer parti des Chaînes de Valeur Mondiales* [Rapport de synthèse].
- OCDE. (2014). *Developing countries' participation in global value chains-Implications for trade and trade related policies* (Draft Report. No. TAD/TC/WP (2014) 12/REV1).
- Okah Efogo, F. (2020). Financial development and African participation in global value chains. In D. Seck (Ed.), *Financing Africa's development: Paths to sustainable economic growth* (pp. 33-52). Springer International Publishing. https://doi.org/10.1007/978-3-030-46482-0_3
- Okah Efogo, F., Wonyra, K. O., & Osabuohien, E. (2021). Foreign direct investment and participation of developing countries in global value chains: lessons from the last decade. *International Review of Applied Economics*, 1-21.
- Olczyk, M., & Kordalska, A. (2017). Gross exports versus value-added exports: Determinants and policy implications for manufacturing sectors in selected CEE countries. *Eastern European Economics*, 55(1), 91-109. <https://doi.org/10.1080/00128775.2016.1254564>
- OMC. (2011). *La structure des échanges et les chaînes de valeur mondiales en Asie de l'Est: Du commerce des marchandises au commerce des tâches* (p. 132). OMC.
- Ponte, S., & Ewert, J. (2009). Which way is "Up" in upgrading? trajectories of change in the value

- chain for South African wine. *World Development*, 37(10), 1637-1650.
- Portugal-Perez, A., & Wilson, J. S. (2012). Export performance and trade facilitation reform: Hard and soft infrastructure. *World Development*, 40(7), 1295-1307.
- Prete, D. D., & Rungi, A. (2015). *Organizing the global value chain: a firm-level test* (Working Papers, No. 4/2015). IMT School for Advanced Studies Lucca. Available from: <https://ideas.repec.org/p/ial/wpaper/4-2015.html>
- Riisgaard, L. (2009). Global value chains, labor organization and private social standards: Lessons from East African cut flower industries. *World Development*, 37(2), 326-340.
- Riisgaard, L., & Hammer, N. (2011). *Prospects for labour in global value chains: Labour standards in the cut flower and banana industries* (SSRN Scholarly Paper ID 1745762). <https://doi.org/10.1111/j.1467-8543.2009.00744.x>
- Saslavsky, D., & Shepherd, B. (2014). Facilitating international production networks: The role of trade logistics. *The Journal of International Trade & Economic Development*, 23(7), 979-999. <https://doi.org/10.1080/09638199.2013.811534>
- Shepherd, B. (2016). Infrastructure, trade facilitation, and network connectivity in Sub-Saharan Africa. *Journal of African Trade*, 3(1), 1-22. <https://doi.org/10.1016/j.joat.2017.05.001>
- Shepherd, B. (2022). Modelling global value chains: From trade costs to policy impacts. *The World Economy*, 45(8), 2478-2509.
- Slany, A. (2019). The role of trade policies in building regional value chains-some preliminary evidence from Africa. *South African Journal of Economics*, 87(3), 326-353.
- Stock, J., & Yogo, M. (2005). *Identification and inference for econometric models*. Cambridge University Press.
- Tian, K., Dietzenbacher, E., & Jong-A-Pin, R. (2019). Measuring industrial upgrading: applying factor analysis in a global value chain framework. *Economic Systems Research*, 31(4), 642-664. <https://doi.org/10.1080/09535314.2019.1610728>
- Van Biesebroeck, J., & Mensah, E. B. (2019). *The extent of GVC engagement in Sub-Saharan Africa* (World Bank Policy Research Working Paper, No. 8937). World Bank.
- Webber, C. M., & Labaste, P. (2010). *Building competitiveness in Africa's agriculture: A guide to value chain concepts and applications*. The World Bank. Available from: <https://econpapers.repec.org/bookchap/wbkwbpubs/2401.htm>
- Wilson, J., Mann, C., & Otsuki, T. (2003). Trade facilitation and economic development: A new approach to quantifying the impact. *World Bank Economic Review*, 17(3), 367-389.
- Yi, K. M. (2003). Can vertical specialization explain the growth of world trade? *Journal of Political Economy*, 111(1), 52-102.
- Yi, K. M. (2010). Can multistage production explain the home bias in trade? *American Economic Review*, 100(1), 364-393.

Appendix

Appendix 1. Correlation Matrix between Trade Facilitation Indicators and Foreign value Added

	Foreign Value Added	Physical Infrastructure	Information and Communication Technology	Business Environment	Border and Transport Efficiency
Foreign Value Added	1.0000				
Physical Infrastructure	0.5162***	1.0000			
Information and Communication Technology	0.5618***	0.6815***	1.0000		
Business Environment	-0.0645	0.4450***	0.4395***	1.0000	
Border and Transport Efficiency	0.3668***	0.5249***	0.5773***	0.3163***	1.0000

***represent significance at the 1% levels. Positive signs indicate a positive correlation between these indicators and foreign value added.

(Source) Authors.

Appendix 2. Trade Facilitation Indicators and the Contribution of Each Variable in (%) Using Principal Component Analysis

Aggregate indicators	Variables/indices	F1
PHYSICAL INFRASTRUCTURE (PI)	Quality of port infrastructure	23,896
	Quality of the airport infrastructure	23,542
	Quality of the road infrastructure	29,333
	Quality of the railway infrastructure	23,228
INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)	Availability of ICT	37,776
	Level of ICT absorption	35,393
	Use of ICT	26,831
BUSINESS AND REGULATORY ENVIRONMENT (RE)	Transparency of government policies	21,186
	Public trust in politicians	27,703
	Irregular payments and bribes	24,387
	Government favoritism to business	26,725
BORDER AND TRANSPORT EFFICIENCY (BE)	Number of documents to export	19,498
	Number of documents to import	20,866
	Number of days to export	29,295
	Number of days to import	30,341

Note. Each variable was standardized to values that range from 0 to 1 to facilitate comparison.

F1 represent the weight of each sub-indices.

(Source) Authors based on data from WEF 2020 and Doing Business DB 2020.

Appendix 3. Forward Participation in Global Value Chains

VARIABLES	Dependent variable: Domestic Value Added (log_DVA)				
	1	2	3	4	5
log_GDP_per_capita	1.498*** (0.086)	1.497*** (0.068)	1.146*** (0.134)	1.318*** (0.078)	1.327*** (0.071)
log_Population	0.844*** (0.065)	0.848*** (0.057)	1.026*** (0.132)	0.757*** (0.062)	0.933*** (0.041)
Human_capital	0.719*** (0.179)	0.717*** (0.158)	0.454* (0.238)	0.578*** (0.194)	0.856*** (0.163)
Industrialization	0.013 (0.013)	0.015 (0.011)	0.020 (0.015)	0.008 (0.014)	-0.011* (0.006)
Trade_Openness	0.001 (0.003)	0.004* (0.002)	0.006** (0.003)	-0.003 (0.002)	0.003* (0.002)
Foreign_Direct_Investment	0.025*** (0.009)	0.021** (0.009)	-0.024* (0.012)	0.011 (0.010)	0.009 (0.009)
Government_effectiveness	-0.929*** (0.138)	-1.143*** (0.134)	-1.197*** (0.220)	-0.759*** (0.197)	-1.018*** (0.122)
Private_Sector_Credit	0.007** (0.003)	0.003* (0.002)	0.009** (0.004)	0.011*** (0.004)	0.009*** (0.003)
GFCF (%GDP)	-0.007 (0.006)	-0.006 (0.006)	0.001 (0.008)	-0.001 (0.006)	0.002 (0.006)
Log_Tariff	-1.098 (0.884)	-1.794** (0.890)	-1.959** (0.804)	-2.212*** (0.820)	-2.257** (0.885)
Physical_Infrastructure_(IP)		1.363*** (0.378)			
Technology_(ICT)			1.866*** (0.490)		
Business_Environment_(RE)				-0.862*** (0.292)	
Border_Efficiency_(BE)					1.306*** (0.311)
Constant	-39.007*** (1.094)	-39.920*** (1.090)	-40.847*** (2.768)	-35.596*** (1.313)	-40.626*** (0.793)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	212	212	212	212	212
R-squared	0.958	0.960	0.966	0.961	0.957
Underidentification test	41.06	36.27	17.75	38.95	29.27
Prob>LM	0.000	0.000	0.000	0.000	0.000
Weak Identification Test (Cragg-Donald Wald F stat)	81.311	62.640	28.846	53.856	73.138
Hansen_stat (overidentification test)	4.037	4.410	1.574	3.799	4.155
Hansen P_value	0.133	0.110	0.455	0.150	0.125

Note. Numbers in parentheses represent the robust standard errors of the estimated coefficients; *, **, *** represent significance at 10%, 5% and 1%.

(Source) Authors.

Appendix 4. Total Participation in Global Value Chains

VARIABLES	Dependent variable: Total Participation (log_GVC)				
	1	2	3	4	5
log_GDP_per_capita	1.528*** (0.089)	1.552*** (0.083)	1.404*** (0.073)	1.461*** (0.089)	1.448*** (0.087)
log_Population	0.822*** (0.053)	0.825*** (0.053)	0.826*** (0.029)	0.776*** (0.059)	0.768*** (0.052)
Human_capital	0.582*** (0.171)	0.557*** (0.158)	0.689*** (0.150)	0.519*** (0.170)	0.789*** (0.160)
Industrialization	-0.004 (0.013)	-0.003 (0.012)	0.003 (0.007)	-0.012 (0.014)	-0.016 (0.013)
Trade_Openness	0.005** (0.002)	0.007*** (0.003)	0.006*** (0.002)	0.003 (0.003)	0.003 (0.002)
Foreign Direct Investment	0.004 (0.009)	0.003 (0.009)	0.003 (0.008)	0.001 (0.008)	0.003 (0.008)
Government_effectiveness	-0.615*** (0.125)	-0.731*** (0.126)	-0.864*** (0.100)	-0.336** (0.136)	-0.859*** (0.127)
Private_Sector_Credit	0.003 (0.003)	-0.001 (0.003)	0.006*** (0.001)	0.001 (0.003)	-0.000 (0.003)
GFCF (%GDP)	0.004 (0.005)	0.005 (0.005)	0.008 (0.005)	0.005 (0.005)	0.004 (0.005)
Log_Tariff	-1.397* (0.797)	-1.666** (0.785)	-1.846** (0.794)	-1.846** (0.769)	-2.158*** (0.799)
Physical_Infrastructure_(PI)		0.858** (0.379)			
Technology_(ICT)			0.852*** (0.253)		
Business_Environment_(RE)				-0.666*** (0.252)	
Border_Efficiency_(BE)					1.508*** (0.328)
Constant	-39.184*** (0.951)	-39.835*** (1.026)	-39.432*** (0.653)	-37.204*** (1.402)	-38.915*** (0.979)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	212	212	212	212	212
R-squared	0.959	0.961	0.958	0.960	0.962
Underidentification test	41.12	41.70	24.78	40.07	39.79
Prob>LM	0.000	0.000	0.000	0.000	0.000
Weak Identification Test (Cragg-Donald Wald F stat)	80.603	58.555	80.656	60.103	58.656
Hansen_stat (overidentification test)	1.808	1.550	2.086	2.134	1.649
Hansen P_value	0.405	0.461	0.352	0.344	0.439

Note. Numbers in parentheses represent the robust standard errors of the estimated coefficients; *, **, *** represent significance at 10%, 5% and 1%.

(Source) Authors.

Appendix 5. Multicollinearity Test for Our Model

Variables	1		2		3		4		5	
	VIF	1/VIF								
GDP per capita	3.39	0.29	3.77	0.27	3.8	0.26	3.4	0.29	3.7	0.27
Population	2.26	0.44	2.3	0.44	2.29	0.44	2.52	0.40	2.34	0.43
Human capital	3.9	0.26	3.9	0.26	4	0.25	4.09	0.24	4.03	0.25
Industrialization	1.57	0.64	1.61	0.62	1.66	0.60	1.6	0.63	1.59	0.63
Trade openness	2.59	0.39	2.73	0.37	2.63	0.38	2.85	0.35	2.59	0.39
Foreign direct investment	1.68	0.60	1.68	0.60	1.69	0.59	1.69	0.59	1.74	0.57
Government effectiveness	3.46	0.29	3.57	0.28	3.91	0.26	5.21	0.19	3.85	0.26
Private sector credit	2.35	0.43	2.52	0.40	2.55	0.39	2.45	0.41	2.36	0.42
Gross Fixe Capital Formation	1.54	0.65	1.64	0.61	1.59	0.63	1.54	0.65	1.55	0.64
Tariffs	1.35	0.74	1.36	0.73	1.36	0.74	1.36	0.73	1.36	0.74
Physical Infrastructure			2.51	0.40						
Technology (ICT)					2.55	0.39				
Business Environement							2.24	0.45		
Border Transport Efficiency									1.99	0.50
Mean VIF	2.41		2.51		2.55		2.63		2.46	

(Sources) Authors.

Appendix 6. List of Countries Included in the Sample

COUNTRY/CODE	
SOUTH AFRICA (ZAF)	MALAWIA (MWI)
BOTSWANA (BWA)	MALI (MLI)
BURUNDI (BDI)	MAURITANIA (MRT)
CAMEROON (CMR)	MAURITUIS (MUS)
CABO VERDE (CPV)	MOZAMBIQUE (MOZ)
CHAD (TCD)	NAMIBIA (NAM)
IVORY COAST (CIV)	NIGERIA (NGA)
ESWATINI (SWZ)	RWANDA (RWA)
GAMBIA (GMB)	SENEGAL (SEN)
GHANA (GHA)	TANZANIA (TZ)
KENYA (KEN)	UGANDA (UGA)
LESOTHO (LSO)	ZAMBIA (ZMB)
MADAGASCAR (MDG)	

(Source) Authors.