Global Trade Analysis Project
https://www.gtap.agecon.purdue.edu/

This paper is from the
GTAP Annual Conference on Global Economic Analysis
https://www.gtap.agecon.purdue.edu/events/conferences/default.asp

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

Moukaila Mouzamilou TAKPARA

Pan-African University - African Union Commission - Institute of Governance, Humanities and Social Sciences, Yaoundé – Cameroon,
Tel : (+237) 652829794 E-mail : takpara2025@gmail.com

Constant FOUOPI DJIOGAP

University of Yaoundé II, Cameroon,

Tel : (+237) 674344216 E-mail : constantfouopi@yahoo.fr

Bouraima SAWADOGO

Pan-African University - African Union Commission - Institute of Governance, Humanities and Social Sciences, Yaoundé – Cameroon,

Tel. : (237) 650432750 E-mail : bouraimasaw@gmail.com.

`

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

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, foreign value added, Sub-Saharan Africa, two-stage least squares (IV-2SLS).

JEL CLASSIFICATION : F13 ; F15 ; F23.

`

1- 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 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 upgrading[1], 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.

However, 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, 2017).

Moreover, 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

[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).

`

costs (Moïsé, and Sorescu, 2015). These trade costs are thus a key determinant of trade 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 costs are related to hard and soft infrastructure.

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; Moïsé and Sorescu, 2013; Melo and Wagner, 2018) without considering trade in intermediate or value-added goods. Moreover, in sub-Saharan Africa, most of studies on GVCs focuses on the 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. 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. 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' participation in GVCs. 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 some 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, data sources and the estimation technique. Section 5 provides estimation results and a discussion of the results. Section 6 concludes and offers policy implications.

2- LITERATURE REVIEW

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.

Theoretically, participation in value chains is measured by three main indicators: 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 chain[2]. Forward integration is the share of exported domestic value added that will be found in the exports of other countries. In other words, a country with a high rate of forward integration exports a large amount of value added, which is often the case for the export of raw materials. Moreover, the presence of a high share of forward integration in total exports is indicative of an inability to process products in the country, and is often associated, in a negative sense, with the country's level of development (ECA, 2015).

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 an Van Assche, 2010 ; Saslavsky and Shepherd, 2014); on the other hand, we have studies that have focused on trade in value added (Moïsé, and Sorescu, 2015; Kowalski et al., 2015 ; Del Prete et al., 2018 ; Johnson and Noguera, 2012 ; Shepherd, 2017 ; Shepherd, 2021).

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

[2] Our article is essentially based on this component.

`

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 traded and is also 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, 2012). The OECD (2014) uses backward and forward integration indicators as measures of GVC activity, based on OECD-WTO TiVA data in their study. The results show 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 (Moïsé and Sorescu, 2015; Kowalski et al., 2015 ; Del Prete et al., 2018 ; Johnson and Noguera, 2012 ; Shepherd, 2017 ; Shepherd, 2021). For example, Moïsé and Sorescu (2015) study the Contribution of trade facilitation measures to supply chain operations in the OECD. Using a gravity model, they 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, in order to identify the determinants of the increasing fragmentation of supply chains, Johnson and Noguera (2012) analyze the value added to gross exports of 42 OECD countries and major emerging markets over the period 1970 to 2009. They estimate a gravity model showing that distance significantly reduces trade in value added. However, the negative effect of distance is smaller on value-added exports than on gross exports. Distance is a proxy that captures the costs associated with trade. This shows that trade costs constrain participation in GVCs in OECD countries. Kowalski et al., (2015) as their concern examine 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 capture participation in global value chains through backward and forward integration. They find 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 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) examines the role of trade facilitation, particularly infrastructure in the participation of SSA countries in global value chains as measured by value added trade. He finds that participation in GVCs is highly sensitive to improvements in logistics and trade facilitation. His results show that a 1% improvement in a country's 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 reveals 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 finds that the regional dimension of infrastructure and trade facilitation policies is a key determinant of the ability of SSA countries to connect to global value chains. In the same vein, Del Prete et al., (2018) analyze the participation and position of North African

`

countries in global value chains (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 reminds 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 to 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 the many stakeholders in the global value chain depend on the availability and level of development of information and communication technologies. 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 global value chains. 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, using a standard structural gravity model, Shepherd (2021) showed 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 those related to trade facilitation, contribute significantly to participation in global value chains. But it is noted that they 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.

3- 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 correlation between trade facilitation and participation of SSA countries in global value chains captured by foreign value added.

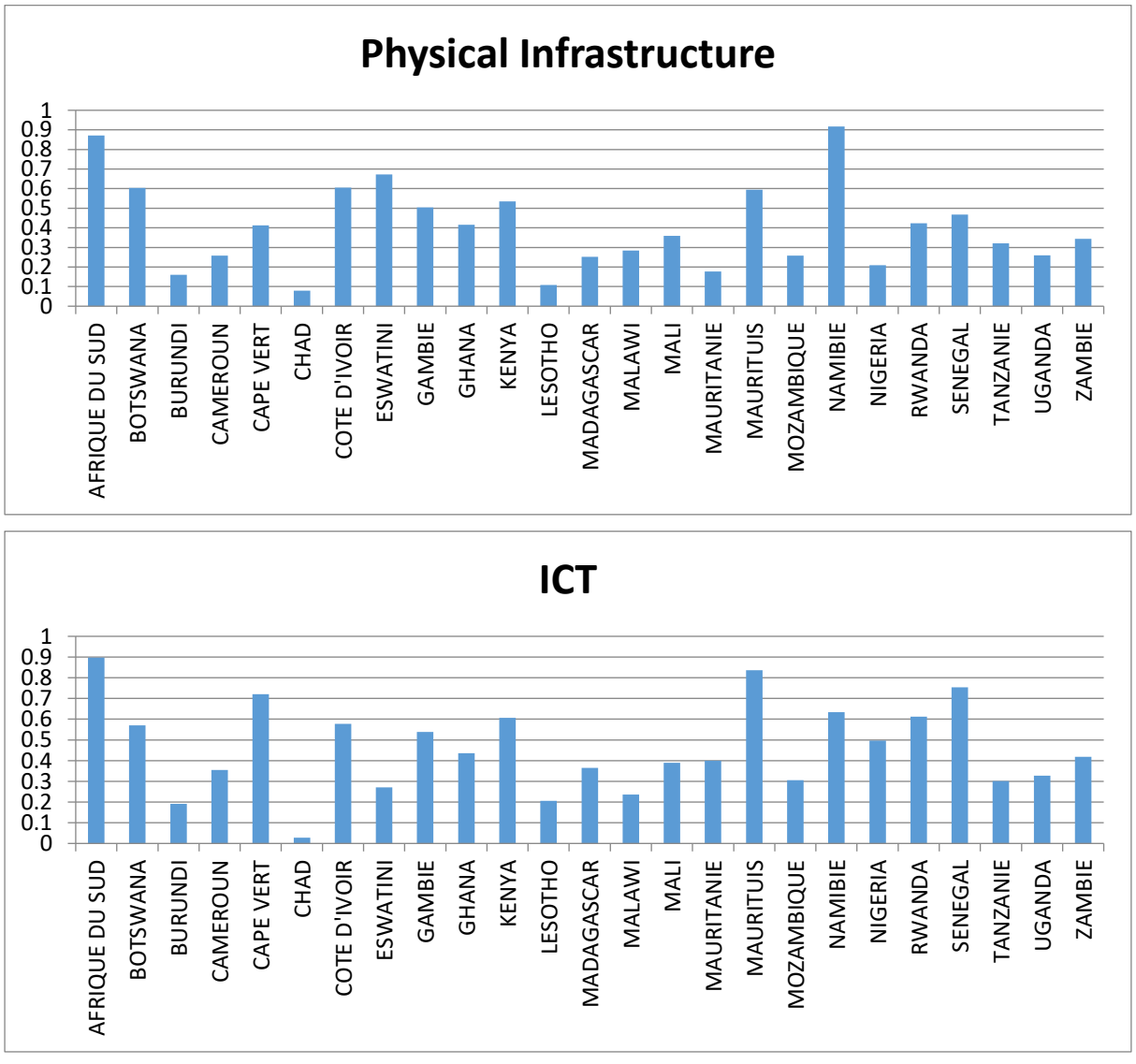
`

Foreign Value Added (FVA) is a measure of backward integration that corresponds to the imported intermediate input content of exports for each product. Its formula is as follows:

$$\mathbf{FVA}= \left(\boldsymbol{Imported\ intermediate\ inputs} \times \frac{\boldsymbol{Exports}}{\boldsymbol{Grossoutput}} \right)$$

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)

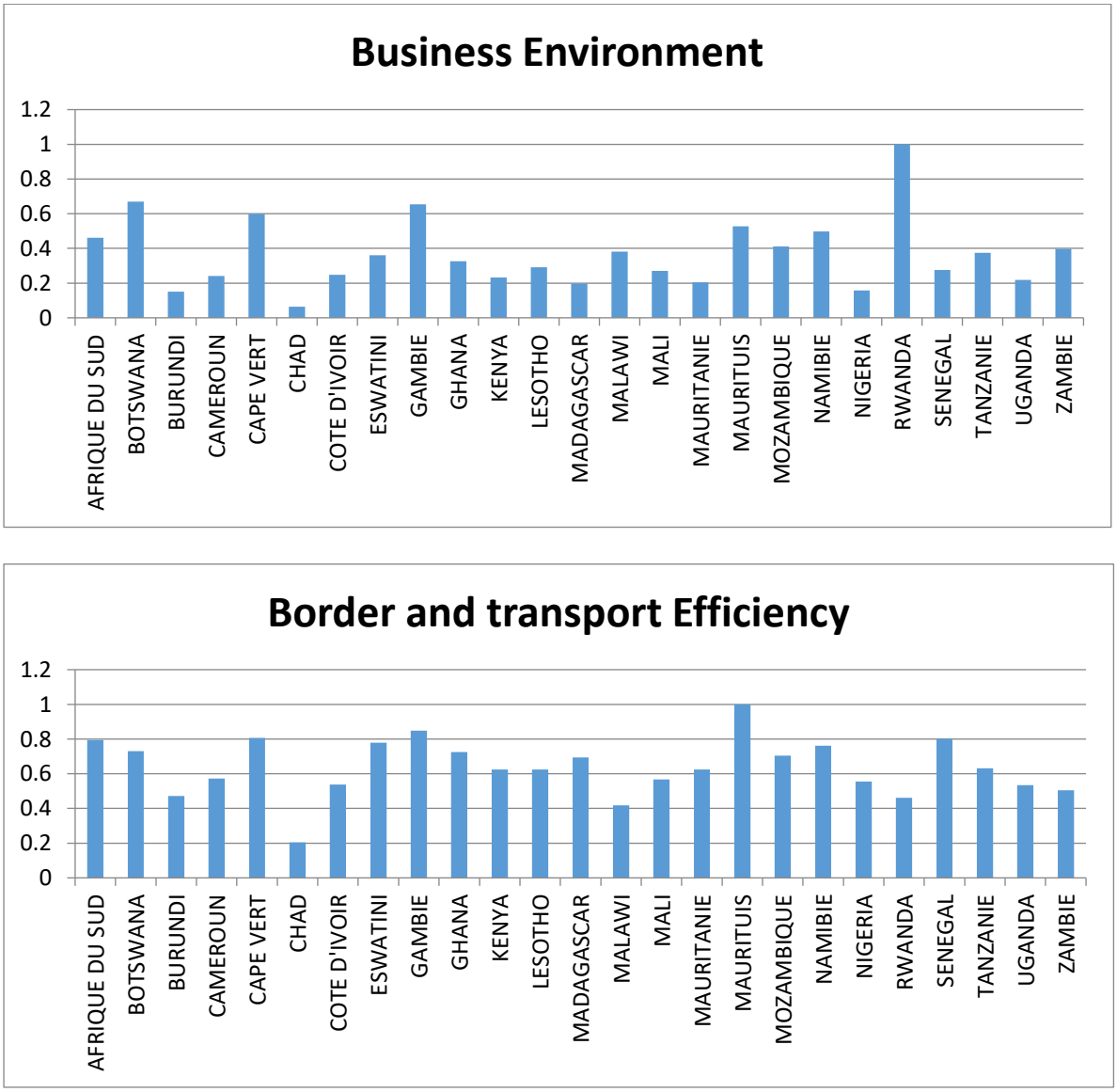


Source: Authors based on data from WEF (2017).

`

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)

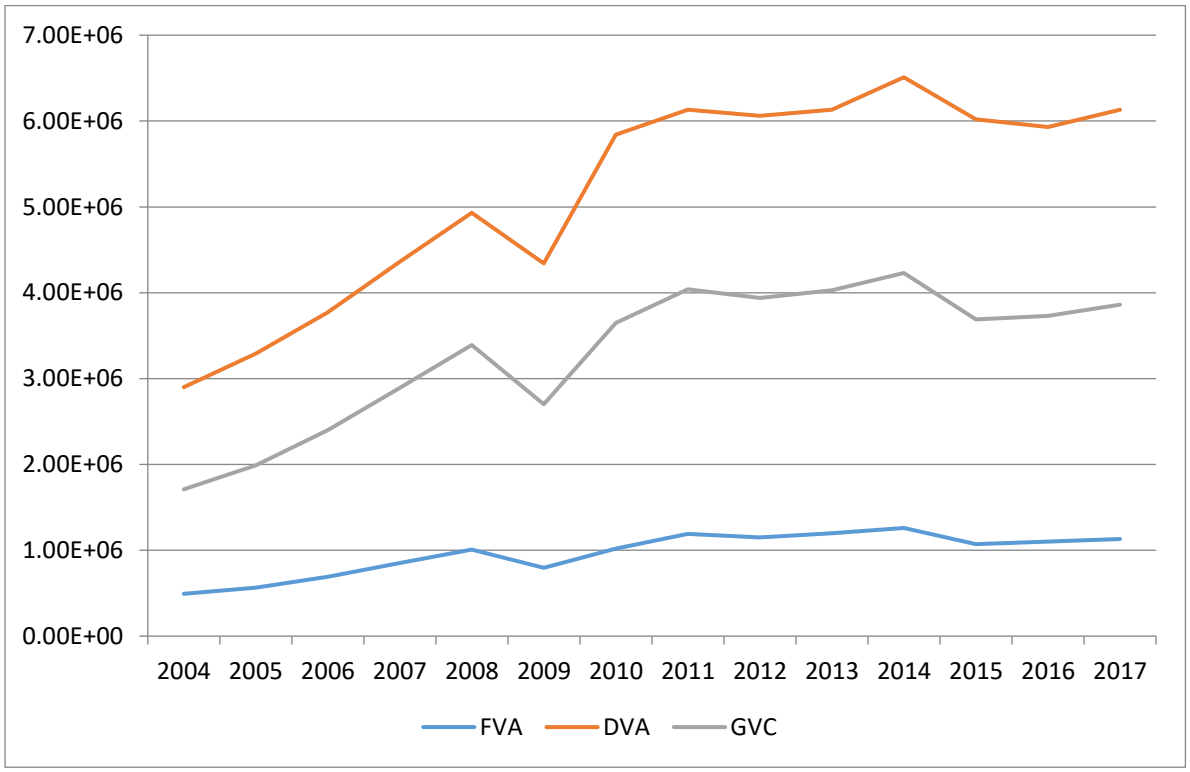


Source: Authors based on data from WEF (2017) and Doing Business DB (2017).

`

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

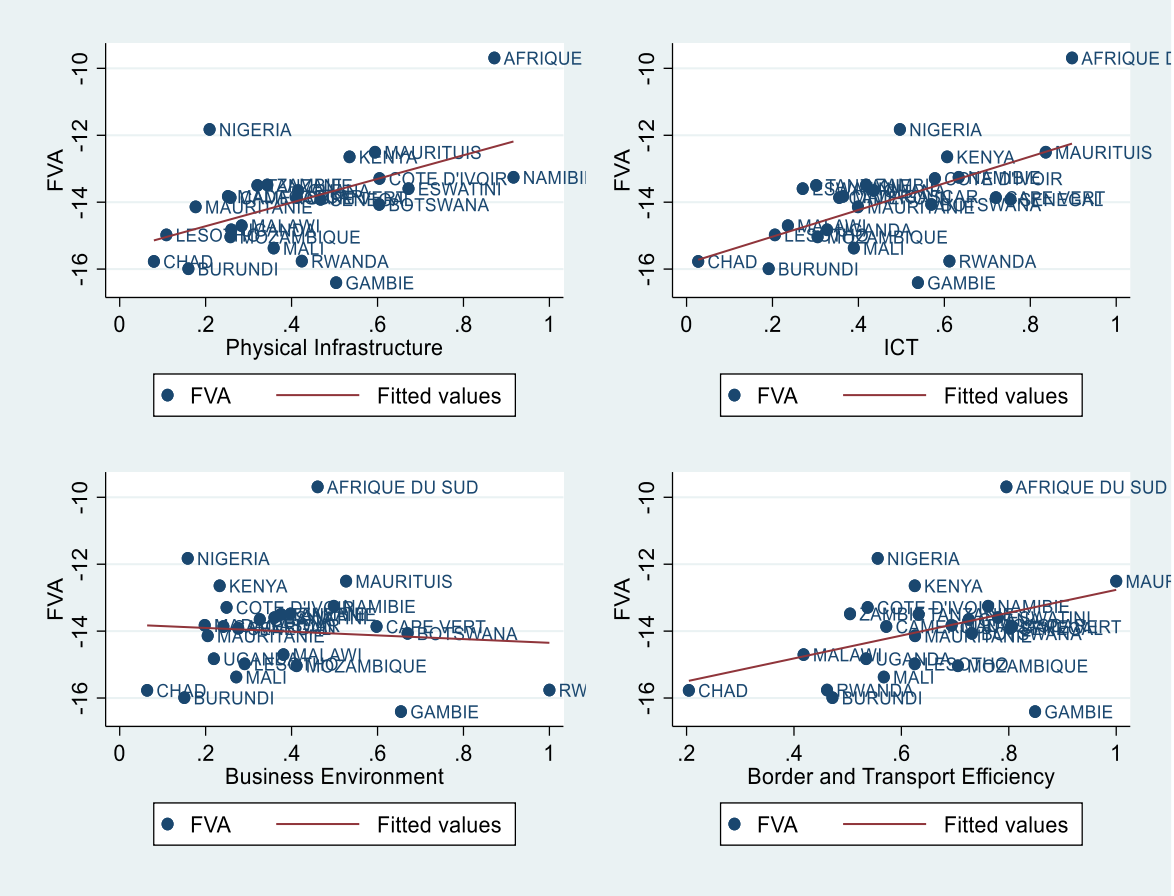


Source: Authors based on UNCTAD-EORA data (2021).

`

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 EF indicators could lead to a deeper upstream integration of GVCs.

Figure 4: Correlation between trade facilitation and FVA in SSA (average 2004-2017)



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

`

4- METHODOLOGY

4-1 Econometric specification

The literature argues that trade costs play a crucial role in GVC participation as intermediate goods cross the border multiple times. Many recent empirical studies use the gravity model and value-added trade flows are used as the dependent variable instead of gross trade flows (Choi, 2013; Nakazawa et al., 2014 ; Moïsé and Sorescu, 2015 ; Kowalski et al., 2015 ; Slany, 2017). However, the gravity approach ignores some key features of value chain trade and focuses on why countries trade with each other rather than why countries engage in production networks at the aggregate level.

To assess country participation in GVCs, we use an econometric specification that pays particular attention to country-specific factors and the influence of trade policies, especially those related to trade facilitation on GVC participation. Since backward integration indicates that a country is positioned at a higher stage of the production process, which is also related to better economic performance, an additional or joint analysis of downstream integration is not included in our study as in (Slany, 2017)[3]. Thus, the model to be estimated is inspired by those of (Kowalski et al., 2015 ; Moïsé and Sorescu, 2015 ; Slany, 2017).

$$\mathbf{FVA}_{it}= \boldsymbol{\beta}\mathbf{0}+ \boldsymbol{\beta}\mathbf{1}\mathbf{FVA}_{it\text{-}1} + \boldsymbol{\beta}\mathbf{2}\mathbf{X}_{it}+\boldsymbol{\beta}\mathbf{3}\mathbf{TFI}_{it}+\eta_t+\mu_i+\varepsilon_{it} \quad (1)$$

Where FVAit represents the foreign value added in country i in period t. It measures the share of foreign value added (backward integration) in the exports of sub-Saharan African countries; Xit represents the vector of control variables (GDP per capita, population, human capital, trade openness, credit to the economy, FDI, etc.) ; TFIit represents the vector of trade facilitation indicators (physical infrastructure, ICT, business and regulatory environment, border efficiency)[4]; ηt are the time fixed effects; μi is a vector representing country fixed effects; εit is the error term.

[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] Note that these are composite indicators constructed from 15 sub-indices using principal component analysis (see details in appendix 3).

`

4-2 Data source and description of variables

The study covers a panel of 25 sub-Saharan African countries over the period 2004-2017. (See appendix 4 for the full list of countries). The sample and period are justified by the availability of data on trade facilitation. The data used come from several sources: 1) UNCTAD (EORA data on the one hand) for the dependent variable i.e. global value chains, (TRAINS data for tariffs on the other hand); 2) World Economic Forum (WEF) and Doing Business for TF data (Physical Infrastructure, ICT, Business and Regulatory Environment, Border and Transport Efficiency); 3) World Bank World Development Indicators for control variables (GDP/capita, population, trade openness, FDI, financial development, fixed capital formation, and industrialization; 4) Penn World Table version 10.0 of Penn World Table (PWT) for human capital data; 5) Worldwide Governance Indicators of the World Bank for government effectiveness data.

4-3 Estimation technique

The empirical strategy adopted in this study consists in estimating equation 2 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, human capital 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 human capital or 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 especially the lagged variables of the endogenous variables (see table 1). The definition of the variables, the data sources and the expected signs of the model are also in Table 2.

Table 1: Classification of variables, sources of endogeneity and instruments used

Equations	Exogenous variables	Endogenous variables	Justifications	Instruments
FVA	GDP per capita, Total population, Human capital, Industrialization, Trade openness, Private sector credit, Government efficiency, GFCF, Tariffs.	FDI Trade facilitation indicators	Reverse causality Measurement problem	Lagged variables

Source: Authors based on the literature above

`

Table 2: Summary of model 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 (IP)	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	+

Source: Authors

`

5- RESULTS

5-1 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 generally valid from both an econometric and an economic perspective. 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.

As for the results of the estimations, the coefficients of our key variables with IV-2SLS method are similar to the initial results with OLS. 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.

`

Table 3: Pooled OLS Results with Fixed Effects

Dependent variable: Foreign Value Added (log_FVA)					
VARIABLES	1	2	3	4	5
log_GDP_per_capita	1.048***	1.052***	1.028***	0.956***	0.943***
	(0.0719)	(0.0696)	(0.0706)	(0.0709)	(0.0696)
log_Population	0.776***	0.756***	0.689***	0.716***	0.719***
	(0.0499)	(0.0479)	(0.0311)	(0.0499)	(0.0482)
Human_capital	0.486***	0.576***	0.390***	0.537***	0.746***
	(0.123)	(0.120)	(0.119)	(0.121)	(0.126)
Industrialization	0.0179*	0.0205**	0.0302***	0.0112	0.00707
	(0.00943)	(0.00901)	(0.00591)	(0.00967)	(0.00960)
Trade_Openness	0.00976***	0.00968***	0.00860***	0.00673***	0.00687***
	(0.00193)	(0.00195)	(0.00156)	(0.00192)	(0.00187)
Foreign_Direct_Investment	-0.0323***	-0.0321***	-0.0331***	-0.0355***	-0.0343***
	(0.00691)	(0.00662)	(0.00672)	(0.00664)	(0.00653)
Government_effectiveness	-0.190	-0.398***	-0.391***	-0.0246	-0.375***
	(0.131)	(0.130)	(0.107)	(0.158)	(0.127)
Private_Sector_Credit	0.0100***	0.00773**	0.00968***	0.00991***	0.00823**
	(0.00342)	(0.00359)	(0.00316)	(0.00342)	(0.00342)
GFCF (%GDP)	0.0191***	0.0231***	0.0172***	0.0210***	0.0201***
	(0.00511)	(0.00490)	(0.00452)	(0.00497)	(0.00491)
log_Tariff	-1.649**	-3.182***	-2.366***	-2.985***	-3.085***
	(0.714)	(0.717)	(0.731)	(0.716)	(0.706)
Physical_Infrastructure_(IP)		**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	-36.19***	-36.38***	-34.77***	-34.00***	-35.31***
	(0.944)	(0.925)	(0.696)	(1.076)	(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, 2017). 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 4 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, 2017). 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

Dependent variable: Foreign Value Added (log_FVA)					
VARIABLES	1	2	3	4	5
log_GDP_per_capita	1.084***	1.157***	0.909***	1.050***	1.147***
	(0.0885)	(0.0845)	(0.0663)	(0.0903)	(0.0928)
log_Population	0.771***	0.683***	0.749***	0.745***	0.662***
	(0.0529)	(0.0254)	(0.0642)	(0.0542)	(0.0233)
Human_capital	0.489***	0.492***	0.243	0.445***	0.614***
	(0.153)	(0.139)	(0.181)	(0.149)	(0.155)
Industrialization	0.00137	0.0124**	0.0233*	-0.00340	0.0183***
	(0.0117)	(0.00596)	(0.0128)	(0.0126)	(0.00645)
Trade_Openness	0.00977***	0.00913***	0.0111***	0.00871***	0.00588***
	(0.00226)	(0.00158)	(0.00305)	(0.00247)	(0.00172)
Foreign_Direct_Investment	-0.0459***	-0.0366***	-0.0483***	-0.0476***	-0.0369***
	(0.00982)	(0.00718)	(0.0120)	(0.00967)	(0.00696)
Government_effectiveness	-0.423***	-0.571***	-0.622***	-0.251	-0.667***
	(0.123)	(0.101)	(0.139)	(0.154)	(0.102)
Private_Sector_Credit	0.0160***	0.00955***	0.0172***	0.0148***	0.0104***
	(0.00337)	(0.00301)	(0.00170)	(0.00316)	(0.00324)
GFCF (%GDP)	0.0275***	0.0240***	0.0243***	0.0281***	0.0227***
	(0.00443)	(0.00410)	(0.00579)	(0.00444)	(0.00393)
log_Tariff	-1.995***	-2.455***	-1.100	-2.190***	-2.751***
	(0.760)	(0.748)	(0.807)	(0.755)	(0.789)
Physical_Infrastructure_(IP)		**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	-37.01***	-36.38***	-35.51***	-35.88***	-36.32***
	(0.934)	(0.667)	(1.181)	(1.230)	(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
Underindentification Test	41.12	28.34	44.04	40.07	29.27
Prob>LM	0.0000	0.0000	0.0000	0.0000	0.0000
Weak Identification Test (Cragg-Donald Wald F stat)	80.603	83.907	59.550	60.103	73.138
Hansen_stat	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. Finally, as a determinant of trade policy, like the TF indicators, the average tariff charged 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, 2017; 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 the 1% threshold in all regressions.

5-2 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, 2017). 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}, VAE_{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 4, 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 favour 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. According 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 the efficiency of borders and transport 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, 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 those of Shepherd, (2017) and Slany, (2017) who have also conducted studies in these sectors.

`

Table 5: Two-stage least squares results (IV-2SLS) - Agriculture sector

	Dependent variable : Agriculture (log_FVA$_{Agriculture}$)				
VARIABLES	1	2	3	4	5
log_GDP_per_capita	0.0815	-1.639***	-1.656***	0.426**	-1.439***
	(0.167)	(0.124)	(0.166)	(0.174)	(0.143)
log_Population	0.384***	0.540***	0.485***	0.143	0.442***
	(0.0781)	(0.0692)	(0.0979)	(0.109)	(0.0891)
Human_capital	-1.847***	0.653***	0.222	-1.561***	-0.0424
	(0.465)	(0.239)	(0.294)	(0.433)	(0.329)
Industrialization	0.0277**	0.0553***	0.0490***	0.117***	0.0712***
	(0.0129)	(0.0123)	(0.0153)	(0.0257)	(0.0181)
Trade_Openness	-0.0173***	-0.0141***	-0.0217***	-0.0240***	-0.0255***
	(0.00456)	(0.00256)	(0.00334)	(0.00499)	(0.00275)
Foreign_Direct_Investment	0.0591***	0.0608***	0.0582***	0.0970***	0.0647***
	(0.0219)	(0.0122)	(0.0151)	(0.0263)	(0.0146)
Government_effectiveness	0.185	-1.501***	-0.919***	-1.122**	-0.699***
	(0.221)	(0.197)	(0.231)	(0.510)	(0.198)
Private_Sector_Credit	-0.0309***	0.0119*	0.0224***	-0.0287***	0.0270***
	(0.00257)	(0.00627)	(0.00749)	(0.00325)	(0.00841)
GFCF (%GDP)	-0.0139	-0.0178***	-0.00785	-0.0280**	-0.0123
	(0.0133)	(0.00653)	(0.00911)	(0.0130)	(0.00844)
log_Tariff	-2.545	0.567	1.203	-2.627	1.454
	(2.368)	(1.050)	(1.039)	(2.489)	(1.164)
Physical_Infrastructure_(IP)		**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	-29.17***	-28.37***	-24.85***	-29.90***	-23.78***
	(1.272)	(1.490)	(1.806)	(1.619)	(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
Underindentification Test	22.62	39.17	44.29	30.26	41.09
Prob>LM	0.0000	0.0000	0.0000	0.0000	0.0000
Weak Identification Test (Cragg-Donald Wald F stat)	107.009	51.038	49.250	63.965	51.492
Hansen_stat	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

	Dependent variable: Food and Beverage (log_FVA_{Food})				
VARIABLES	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	-0.0644	-0.165	0.197*	0.202*	-0.0835
	(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***
	(0.0145)	(0.0181)	(0.0226)	(0.0251)	(0.0161)
Trade_Openness	0.00806	0.00748	0.0200***	0.0166**	6.47e-05
	(0.00501)	(0.00648)	(0.00608)	(0.00673)	(0.00463)
Foreign_Direct_Investment	0.0186	0.0236	-0.00267	-0.000218	0.000434
	(0.0125)	(0.0157)	(0.0215)	(0.0216)	(0.0134)
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	0.00945	-0.0331***	-0.0292***	-0.0262***	0.000596
	(0.00765)	(0.00966)	(0.00326)	(0.00360)	(0.00684)
GFCF (%GDP)	0.0163**	0.00606	0.0646***	0.0589***	0.0248***
	(0.00813)	(0.00964)	(0.0118)	(0.0114)	(0.00827)
Log_Tariff	0.364	1.301	1.268	-0.276	-0.443
	(1.136)	(1.470)	(1.959)	(1.717)	(0.972)
Physical_Infrastructure_(IP)		**3.955****			
		(1.307)			
Technology_(ICT)			**2.212****		
			(0.754)		
Business_Environment_(RE)				0.0979	
				(0.543)	
Border_Efficiency_(BE)					**2.047****
					(0.730)
Constant	-29.30***	-25.09***	-34.89***	-35.79***	-33.02***
	(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
Underindentification Test	27.87	42.63	37.76	37.72	19.61
Prob>LM	0.0000	0.0000	0.0000	0.0000	0.000204
Weak Identification Test (Cragg-Donald Wald F stat)	50.402	34.951	49.958	53.328	27.036
Hansen_stat	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

	Dependent variable: Textiles and clothing (log_FVA$_{Textile}$)				
VARIABLES	1	2	3	4	5
log_GDP_per_capita	0.0236	-0.528***	-0.431*	-0.401***	-0.287**
	(0.149)	(0.160)	(0.223)	(0.134)	(0.126)
log_Population	-0.0639	0.347***	-0.387***	0.0417	0.186*
	(0.147)	(0.107)	(0.149)	(0.0740)	(0.102)
Human_capital	-0.147	0.304	-0.805*	0.125	0.152
	(0.203)	(0.244)	(0.482)	(0.288)	(0.246)
Industrialization	-2.31e-05	0.0122	0.0423	-0.0144*	-0.0612***
	(0.0160)	(0.0168)	(0.0320)	(0.00859)	(0.0195)
Trade_Openness	0.00723	0.00800	-0.00101	0.00521	0.00546
	(0.00524)	(0.00573)	(0.00512)	(0.00458)	(0.00465)
Foreign_Direct_Investment	0.00880	0.0240	0.0185	0.0194	-4.28e-05
	(0.0195)	(0.0200)	(0.0256)	(0.0216)	(0.0215)
Government_effectiveness	-0.0625	-0.332	0.807**	0.00945	0.330
	(0.348)	(0.329)	(0.376)	(0.331)	(0.305)
Private_Sector_Credit	-0.0151**	-0.0245***	-0.0242***	-0.0218***	-0.0231***
	(0.00718)	(0.00794)	(0.00497)	(0.00290)	(0.00300)
GFCF (%GDP)	0.0148	-0.000249	-0.00339	0.000432	0.00558
	(0.00918)	(0.00959)	(0.00933)	(0.00876)	(0.00818)
log_Tariff	-0.287	-0.495	0.853	0.452	0.129
	(1.014)	(1.023)	(1.017)	(1.060)	(1.021)
Physical_Infrastructure_(IP)		**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	-27.59***	-33.02***	-17.96***	-26.82***	-28.27***
	(2.644)	(2.203)	(2.607)	(1.484)	(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
Underindentification Test	27.87	27.36	27	27.79	20.51
Prob>LM	0.0000	0.0000	0.0000	0.0000	0.000133
Weak Identification Test (Cragg-Donald Wald F stat)	50.402	38.316	17.262	24.665	27.959
Hansen_stat	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

`

6- 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.

`

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*.

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., Neil Balchin, Linda Calabrese, & Max Mendez-Parra. (2016). *Trade Facilitation and Economic Transformation in Africa* (p. 26). African Center for Economic Transformation (ACET).

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. https://doi.org/10.1017/S147474561500052X

Baldwin, R. E. (2013). *Lessons from the European Spaghetti Bowl* (SSRN Scholarly Paper ID 2255911). Social Science Research Network. 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., Del Prete, D., & Magrini, E., et al. (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

Cattaneo, O., Gereffi, G., & Staritz, C. (2010). *Global value chains in a postcrisis world: a development perspective*. World Bank Publications.

CEA. (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*. 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. https://doi.org/10.1016/j.worlddev.2011.04.028

CNUCED. (2013). *Les Chaînes de Valeur Mondiales: L'investissement et le Commerce au Service du Développement* (p. 53). Nations Unies.

Del Prete, D., Giovannetti, G., & Marvasi, E. (2018). Global value chains: New evidence for North Africa. *International Economics*, *153*, 42–54. https://doi.org/10.1016/j.inteco.2017.03.002

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. *International Bank for Reconstruction and Development/The World Bank. Washington, DC. Available at: 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*.

Ferreira, J. D., & Braun, M. B. S. (2016). The insertion of Brazilian industry in global value-added chains. *The International Trade Journal*, 1–17.

FMI. (2016). *Trade Integration and Global Value Chains in Sub-Saharan Africa: In Pursuit of the Missing Link* (2016/004; IMF Departmental Papers / Policy Papers). International Monetary Fund. https://ideas.repec.org/p/imf/imfdps/2016-004.html

Gereffi, G. (1999). International trade and industrial upgrading in the apparel commodity chain. *Journal of International Economics*, *48*(1), 37–70. https://doi.org/10.1016/S0022-1996(98)00075-0

Gereffi, G. (2015). *Global value chains, development and emerging economies* (No. 2015–047; MERIT Working Papers). United Nations University - Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT). https://ideas.repec.org/p/unm/unumer/2015047.html

Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy*, *12*(1), 78–104. https://doi.org/10.1080/09692290500049805

Giroud, A., & Mirza, H. (2015). Refining of FDI motivations by integrating global value chains' considerations. *The Multinational Business Review*, *23*(1), 67–76. https://doi.org/10.1108/MBR-12-2014-0064

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. 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., & Schaur, G. (2012). *Time as a trade barrier*. National Bureau of Economic Research.

International Monetary Fund, I. M. F. A. (2015). *Regional Economic Outlook, April 2015, Sub-Saharan Africa: Navigating Headwinds*. International Monetary Fund. https://www.elibrary.imf.org/view/books/086/22256-9781498329842-en/22256-9781498329842-en-book.xml

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* [Other]. Institute of Development Studies. 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*.

`

Kpognon, K., Ondoa, 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.

Luo, X., & Xu, X. (2018). Infrastructure, value chains, and economic upgrades. *World Bank Policy Research Working Paper*, *8547*.

Ma Alyson, & Van Assche, Ari. (2010). (PDF) The Role of Trade Costs in Global Production Networks: Evidence from China's Processing Trade Regime. *Policy Research Working Paper, World Bank, Washington, DC*. 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. https://ideas.repec.org/p/hal/journl/hal-01877242.html

Moïsé, E., & S. Sorescu. (2015, May 29). *Contribution of Trade Facilitation Measures to the Operation of Supply Chains*. *181*. 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* (No. 144; OECD Trade Policy Papers). OECD Publishing. https://ideas.repec.org/p/oec/traaab/144-en.html

Nakazawa, E, Norihiko, Y, & Webb, C. (2014, May 19). *Determinants of Trade in Value-Added : Market Size, Geography and Technological Gaps*.

OCDE. (2009). *Surmonter les obstacles à la frontière : Coûts et bénéfices de la facilitation des échanges*.

OCDE. (2014). *Developing Countries' Participation in Global Value Chains–Implications for Trade and Trade Related Policies: Draft Report*. TAD/TC/WP (2014) 12/REV1, 19 September.

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*, *0*(0), 1–21. https://doi.org/10.1080/02692171.2021.1962255

OMC. (2011). *La structure des échanges et les chaines de valeur mondiales an 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.

Prete, D. D., & Rungi, A. (2015). *Organizing the Global Value Chain: a firm-level test* (4/2015; Working Papers). IMT School for Advanced Studies Lucca. 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). Social Science Research Network. 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. (2021). *Modeling Global Value Chains: From Trade Costs to Policy Impacts*. *Working Paper DTC-2021-1*.

Slany Anja. (2017). *The Role of Trade Policies in Building Regional Value Chains - Some Preliminary Evidence From Africa*. http://researcher.tools4valuechains.org/article/role-trade-policies-building-regional-value-chains-some-preliminary-evidence-africa

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

Webber, C. M., & Labaste, P. (2010). *Building Competitiveness in Africa's Agriculture: A Guide to Value Chain Concepts and Applications* [World Bank Publications]. The World Bank. 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

1- Correlation matrix between trade facilitation indicators and foreign value added

	Foreign Value Added	Physical Infrastructure	Information and Communication Technology	Business Environement	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 Environement	-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

2- Descriptive statistics of foreign value-added equation

Variable	Observations	Mean	Standard deviation	Min	Max
Foreign Value-Added (FVA)	350	3.72e-06	.0000122	6.20e-08	.0000808
GDP per capita	350	2023.153	2188.178	128.3366	10484.91
Populations	350	2.20e+07	3.22e+07	456617	1.91e+08
Human capital	322	1.850903	.4294709	1.153554	2.8853
Industrialization	334	11.0267	6.119199	.2326077	35.21546
Trade openness	350	70.28873	28.46169	0	161.8937
Foreign direct investment	350	4.021913	4.858767	-4.84583	39.4562
Government effectiveness	350	-.4851595	.5642716	-1.626121	1.056994
Private sector credit	321	27.03447	31.48723	2.215312	160.1248
Gross Capital Formation	321	22.95456	7.713785	8.95112	46.73224
Tariffs	350	.0646517	.0466834	0	.211
Physical Infrastructure	350	.4035215	.2248833	.0097676	.9587838
Technology (ICT)	350	.4586395	.2210617	.0015104	1
Business Environement	350	.3685556	.2198851	.0348538	1
Border and Transport Efficiency	350	.639331	.1809628	.103641	1

Source: Authors

`

3- Trade facilitation indicators and the contribution of each variables in (%) using principal component analysis

Aggregate indicators	Variables/indices	F1
PHYSICAL INFRASTRUCTURE (PI)	Quality of port infrastructures	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 favouritism 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

Source: Authors based on data from WEF 2017 and Doing Business DB 2020

4- List of countries included in the sample

Country	
SOUTH AFRICA	MALAWI
BOTSWANA	MALI
BURUNDI	MAURITANIA
CAMEROON	MAURITUIS
CABO VERDE	MOZAMBIQUE
CHAD	NAMIBIA
IVORY COAST	NIGERIA
ESWATINI	RWANDA
GAMBIA	SENEGAL
GHANA	TANZANIA
KENYA	UGANDA
LESOTHO	ZAMBIA
MADAGASCAR	

Source : Authors