Macroeconomic outcomes of trade facilitation reform: a productivity growth-based analysis in some selected African countries

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Abstract

The article investigates the contribution of trade facilitation to productivity growth in Sub-Saharan African (SSA) countries. We include four trade facilitation indicators (i.e., physical infrastructure, ICT, business and regulatory environment, border, and transport efficiency) as explanatory factors for productivity growth measured by both total factor productivity and labor productivity. The empirical evidence is based on both Pooled Ordinary Least Squares (POLS) and the Instrumental Variable Two-Stage Least squares (IV-2SLS) in a sample of 29 SSA countries over the period 2004-2017. The main results from the study show that trade facilitation contributes positively and significantly to total factor productivity as well as labor productivity in SSA. Based on this finding, SSA countries need to improve border procedures as well as the business and regulatory environment to generate substantial productivity gains and boost the competitiveness of micro, small and medium-sized enterprises (MSMEs), given the job creation potential of MSMEs.

Keywords: Trade facilitation, Productivity, Sub-Saharan Africa, 2SLS.

Jel Classification : F13 ; F14 ; O11 ; O47.

1- Introduction

During their economic take-off, developed countries were able to diversify away from agriculture, natural resources, and the production of traditional manufactured goods (e.g., food and beverages, clothing, and textiles). As a result of productivity improvements in agriculture, labor and capital have gradually shifted to industry and services, resulting in higher overall productivity and incomes (UNCTAD, 2016). In contrast, economies considered less developed have failed to achieve a similar transformation of their productive structures and have remained stuck in low or middle incomes (Moussir and Chatri, 2020). Many studies have confirmed the per capita income gap between rich and poor countries is associated with large differences in total factor productivity across countries[1] (Hall and Jones, 1999; Howitt, 2000 Klenow and Rodríguez-Clare, 1997, 2005) cited by (Ghosh, 2013).

Indeed, productivity measures the efficiency of production with which inputs are transformed into outputs. It is often used to assess the extent to which a firm, industry, or economy undertakes or invests in activities to improve the efficiency of production (Tang and Wang, 2020). Moreover, increasing productivity is a major asset for developing economies such as those in sub-Saharan Africa to achieve and maintain a higher standard of living. The processes required to achieve this include the use of improved technologies, investment in human capital, reduction of transaction costs facilitating the integration of economic activities, and more efficient allocation of resources. When this process is successful and sustained over decades, it leads to the process of structural transformation (Timmer and Akkus, 2008).

Given the importance of productivity for countries as recognized as one of the most important factors affecting the competitiveness of countries and economic growth (Jorgenson and Kuroda, 1991; Niebel, 2018; Shahnazi, 2021), the identification of factors affecting it becomes a necessity to improve it. Among these factors, there is a vast literature studying the effects of trade reforms on productivity. Trade reform is often seen as beneficial because the removal of trade barriers allows labor to be reallocated to sectors of the economy in which the country has a comparative advantage and thus to increase output, productivity, and welfare (Kambourov , 2009). In addition, new trade models with heterogeneous firms (Bernard et al., 2003 ; Melitz , 2003) suggest that international trade plays an important role in this reallocation process. According to these models, trade has a Darwinian effect i.e. eliminating low-productivity firms

[1]It represents the common indicator of productivity and measures the overall production efficiency of capital, labor and intermediate inputs (Tang and Wang, 2020).

and favoring high-productivity firms, and thus increasing the productivity of the economy (Blyde and Iberti, 2012). These trade reforms include trade facilitation, which is often associated with the reduction of trade costs, particularly those related to non-tariff measures. TF in the narrower sense is defining as the simplification and harmonization of international trade procedures, with trade procedures being the activities, practices, and formalities involved in the collection, presentation, communication, and processing of data necessary for the movement of goods in international trade (WTO, 2014). Broadly, for Portugal-Perez and Wilson (2012), TF refers to any policy measures aimed at reducing trade costs. For these authors, TF is associated with hard and soft infrastructure in SSA. According to Pavcnik (2002), for goods sectors, there is considerable empirical evidence that lower trade costs are associated with higher productivity at the firm and sector level. In light of this context, our objective is to assess the impact of trade facilitation on productivity growth in SSA.

This study contributes to the existing literature in several important ways. First, it extends the productivity literature in the context of developing economies. The study of productivity is relevant because it is a comprehensive measure of an economy's performance. Thus, productivity analysis can be relevant insofar as low productivity is indicative of poor economic transformation. To the best of our knowledge, this is the first study that examine trade facilitation and productivity growth in SSA. It therefore provides guidance to policymakers on the channels through which to increase productivity in Sub-Saharan Africa. Second, our work also explores the macroeconomic factors that influence productivity. Researchers have pointed to the role of several factors, both at the micro level, such as industry size and capital intensity, and at the macro level, such as industrial, financial, and trade policies, in productivity growth (Ghosh, 2013). However, in the specific case of trade policies, none of them considered non-tariff measures in the analysis. By taking non-tariff measures (captured by trade facilitation) into account, our study provides a much more complete picture of the effects of trade policies on productivity in Sub-Saharan Africa. The study focuses on Sub-Saharan Africa countries over the period 2004–2017. The results obtained show that TF indicators contribute favorably to productivity growth in SSA countries.

The rest of the study is organized as follows. Section 2 deals with the literature review. Section 3 is devoted to data and the methodological framework; section 4 analyzes and discusses the results. Section 5 concludes.

2- Literature Review

Theoretically, several channels including market access, returns/economies of scale help explain how trade facilitation can affect productivity. Indeed, the reduction of costs through TF, notably with the quality of infrastructure, determines the degree of market access. Better connectivity to intra- and international markets means, on the one hand, that firms can access more demand. For Jensen and Miller (2018), when consumers learn about non-local producers, firms gain market share and growth. On the other hand, firms compete more intensely with other producers of final goods, as increased market access allows consumers to access goods produced by firms in other locations. Greater demand and competition increase the potential gains to firms through improved total factor productivity, which results from lower input costs. This argument is consistent with previous findings in the literature, where greater market share (Lommerud et al., 2009) increased product market competition (De Loecker and Goldberg, 2014) and a combination of both (Desmet et al., 2020) are associated with productivity improvements. Moreover, TF reforms aimed at enhancing competition by reducing red tape and barriers to entrepreneurship and market entry could boost productivity by reallocating resources across sectors producing different goods and across firms with different productivity within each sector (allocative efficiency; Blanchard and Giavazzi , 2003 ; Melitz, 2003). In addition, quality of infrastructure appears to be the source of economies of scale, for example by reducing transportation costs through improved road and rail networks and better inventory management (Li and Li, 2009). Thus, firms located in locations with better roads have a greater incentive to increase productivity with lower input costs.

Regarding returns/economies of scale, it is worth noting that TF via the adoption and use of ICT for example can have an effect on cost reduction by saving labor and capital. It can affect the flexibility of the production process and induce an increasing return to scale (Arvanitis and Loukis, 2009 ; Milgrom and Roberts, 1990 ; 1995). Increasing returns of scale and labor economies increase labor productivity. In the manufacturing industry, ICT can affect productivity by reducing production time and speeding up inspections (Bartel et al., 2007). Also on the theoretical level, based on the models of Del Gatto et al. (2006) and Melitz and Ottaviano (2008) ; Corcos et al. (2007), cited by Arnold et al. (2011) find that removing barriers behind border can be even more important for productivity. In their models with heterogeneous firms, the relaxation of trade barriers generates a reallocation of resources to the most productive firms. The exit of low-productivity firms and the expansion into domestic and foreign markets of more productive firms leads to an increase in aggregate productivity growth.

Although the theoretical literature indicates the channels through which TF affects productivity, this relationship is more empirical (Dreger and Reimers, 2016).

The empirically studies between trade facilitation and productivity can be classified into two categories. On the one hand, we have studies on total factor productivity (Weiping and Ying, 2007; Fedderke and Bogetic, 2009 ; Blyde and Iberti, 2012 ; Spence and Karingi, 2011; Laborda and Sotelsek, 2019 ; Khanna and Sharma, 2020) and on the other hand those on labor productivity (Jalava and Pohjola, 2007; Ceccobelli et al., 2012 ; Relich, 2017 ; Shahnazi, 2021). In the first case, many authors have found positive effect of infrastructures on total factor productivity (see, Weiping and Ying, 2007; Sharma and Sehgal, 2010; Fedderke and Bogetić 2009; Arshed et al., 2019; Laborda and Sotelsek, 2019). Laborda and Sotelsek (2019) for example have studied the effects of road infrastructure on employment, productivity and growth. Using dynamic panel GMM estimation, they found a positive effects of road density and paved roads on TFP in middle- and low-income countries. In the same vein, Spence and Karingi (2011) have analyzed the impact of trade facilitation on export competitiveness, their result indicated that trade facilitation significantly enhances competitiveness, TFP, but the production effect in which trade facilitation reallocates resources to more productive sectors, represented by the impact on the level of export revenue, is less significant. Some authors have analyzed the effect of ICT on productivity growth with a focus on manufacturing industries confirming his positive and significant effect (Melka and Nayman, 2004; Mitra et al., 2016; Khanna and Sharma, 2020).

Regarding the studies that have measured productivity growth with labor productivity, Pohjola (2007); Arvanitis and Loukis (2009) as well as Shahiduzzaman et al. (2015) results provided strong evidence in country level of the positive impact of ICT on labor productivity. Luo and Bu (2016) have found that ICT is an essential investment that generates satisfactory returns for firms in emerging economies. In the same vein, Relich (2017) in his study in the European Union (EU) showed that different components of ICT have positive effects on labor productivity in EU countries. The results of Shahnazi (2021) confirm the important role of ICT in improving labor productivity in EU countries.

Concerning the soft infrastructure variables, Kinda et al. (2008) have investigate the relationship between business environment and firm-level productivity in MENA countries. The empirical results show that the business environment affects the productive performance of firms. For these authors, the results provide new empirical evidence of the importance of the business environment for firm-level productivity and competitiveness in the developing world,

and in MENA countries in particular. Along the same lines, Spence and Karingi (2011) found that a 0.01 increase in border efficiency and in the business and regulatory environment is associated with TFP growth of 0.36 and 0.37 percent respectively.

In sum, this review shows that TF indicators in relation to productivity has been the subject of several studies through some indicators around the world. However, there is a limited studies on Sub-Saharan Africa. Our paper adds new insights to the growing literature on the effects of trade facilitation on productivity growth with a focus on SSA. In addition, it should be noted that there are few studies concerning the soft aspect of TF. Our study fills this gap.

3- Data and methodology

3-1 Data

We use secondary data from international institutions databases on an unbalanced panel of 29 countries in Sub-Saharan Africa over the period 2004-2017 (the list of countries are presented in appendix 5). The choice of sample size and study period is dictated by the availability of trade facilitation data. Data on total factor productivity come from the Penn World Table (PWT) database (Feenstra et al., 2015). Data on trade facilitation indicators are extracted from the World Economic Forum (WEF) and Doing Business databases of the World Bank. We use four indicators of trade facilitation (Physical Infrastructure, ICT, Business and Regulatory Environment, Border and Transport Efficiency). Regarding control variables, data on total population, trade openness, Foreign Direct Investment (FDI), school enrolment, gross fixe capital formation, credit to the private sector, and natural resources are from the World Bank's World Development Indicators (WDI) database. For robustness checks, we use an alternative indicator of productivity growth: the labor productivity from the world development indicator database which is measured by the GDP per person employed. See details about the data in table 1.

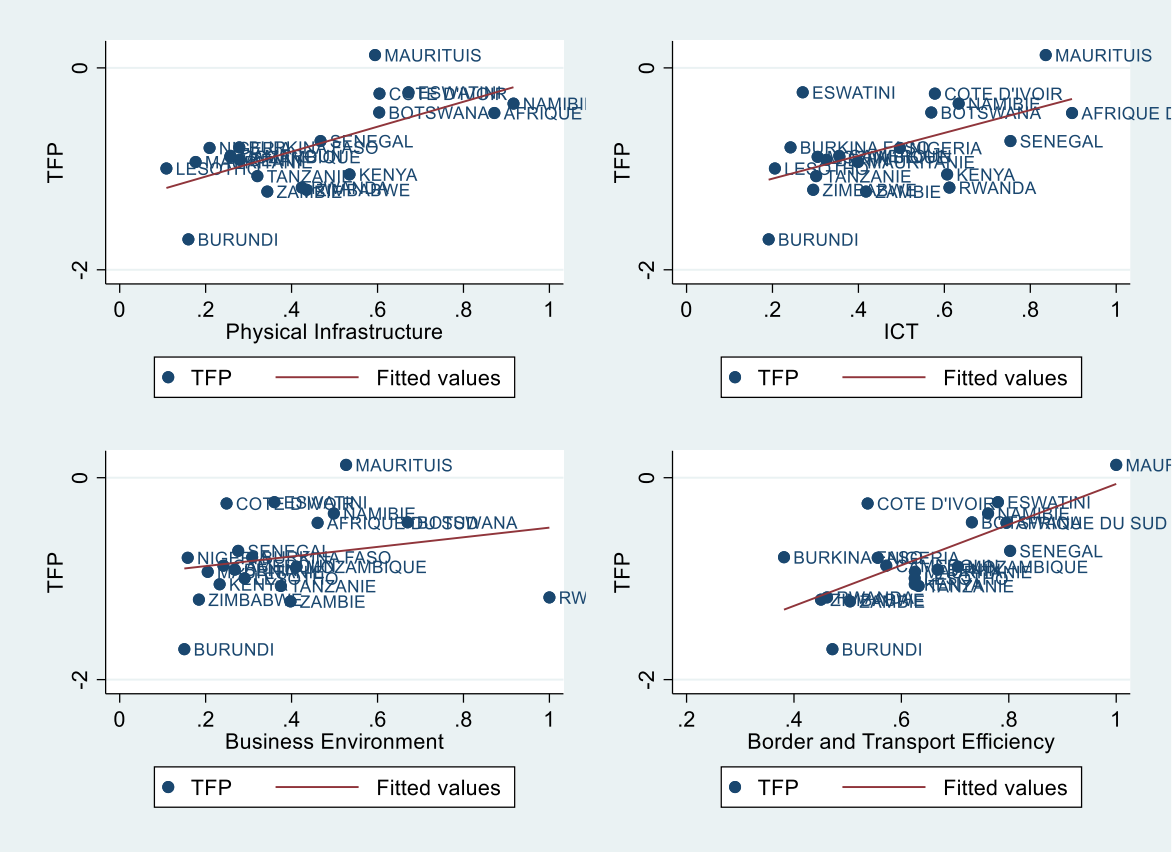
Table 1: Summary of variable

Variables	Definitions	Sources
Total Factor Productivity (TFP)	It represents the standard indicator of productivity and measures the overall production efficiency of capital, labor and intermediate inputs.	Penn World Table
Population	Total population is based on the de facto definition of population, which includes all residents regardless of legal status or citizenship	WDI
Human capital	It measured by the enrollment rate	WDI
Trade openness	The sum of exports and imports of goods and services as a percentage of gross domestic product.	WDI
Foreign direct investment (FDI)	FDI is the net investment inflows to acquire a sustainable management stake in a company operating in an economy other than that of the investor. It is the sum of equity, reinvestment of earnings, other long-term capital, and short-term capital, as reported in the balance of payments.	WDI
Gross Fixe Capital Formation (GFCF)	GFCF includes land improvements (fences, ditches, sewers, etc.); purchases of plant, machinery and equipment; and the construction of roads, railways and the like, including schools, offices, hospitals, private residential accommodation and commercial and industrial buildings.	WDI
Private sector credit	It refers to the financial resources provided to the private sector by financial corporations	WDI
Natural resource rents	Total natural resource rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mining rents and forestry rents.	WDI
Physical Infrastructure (IP)	It measures the 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)	It captures the use of ICT to improve efficiency and productivity and to reduce transaction costs (1 to 7 = best)	WEF
Business and Regulatory Environment (RE)	It measures the level of development of regulations and transparency (1=low to 7=high).	WEF
Border and Transport Efficiency (BE)	It aims to quantify customs and inland transport efficiency reflected in the time and number of documents.	DB

Note: The variables trade openness, FDI, gross fixe capital formation, credit to private sector, natural resources are in percentage of GDP.
Source: Author from the literature

Figure 1 analyzes the correlation between the four trade facilitation indicators and TFP. It can be seen that there is a positive trend between all the trade facilitation indicators and total factor productivity, which suggests that they are moving positively in the same direction. There is therefore a positive and statistically significant correlation between trade facilitation indicators and TFP at the 1% threshold (see the correlation coefficients in appendix 1). There is a disparity between countries. Indeed, countries with a high trade facilitation score, seems to favor TFP in SSA and vice versa. For example, countries with a high physical infrastructure score have a high TFP like Mauritius, Eswatini, Cote d'Ivoire, Botswana, Namibia and South Africa. In contrast, countries with low physical infrastructure scores such as Burundi, Lesotho, Mauritania, Zambia, and Tanzania appear to have low TFP. Thus, an improvement in the physical infrastructure indicator score that translates into better quality of road, port, airport and rail infrastructure could improve TFP. Also, having efficient borders with simplified procedures in terms of time and documents for export/import operations seems to favor TFP in SSA countries because countries like Mauritius, Eswatini, Namibia, Botswana and South Africa, which have efficient borders, have also high levels of TFP.

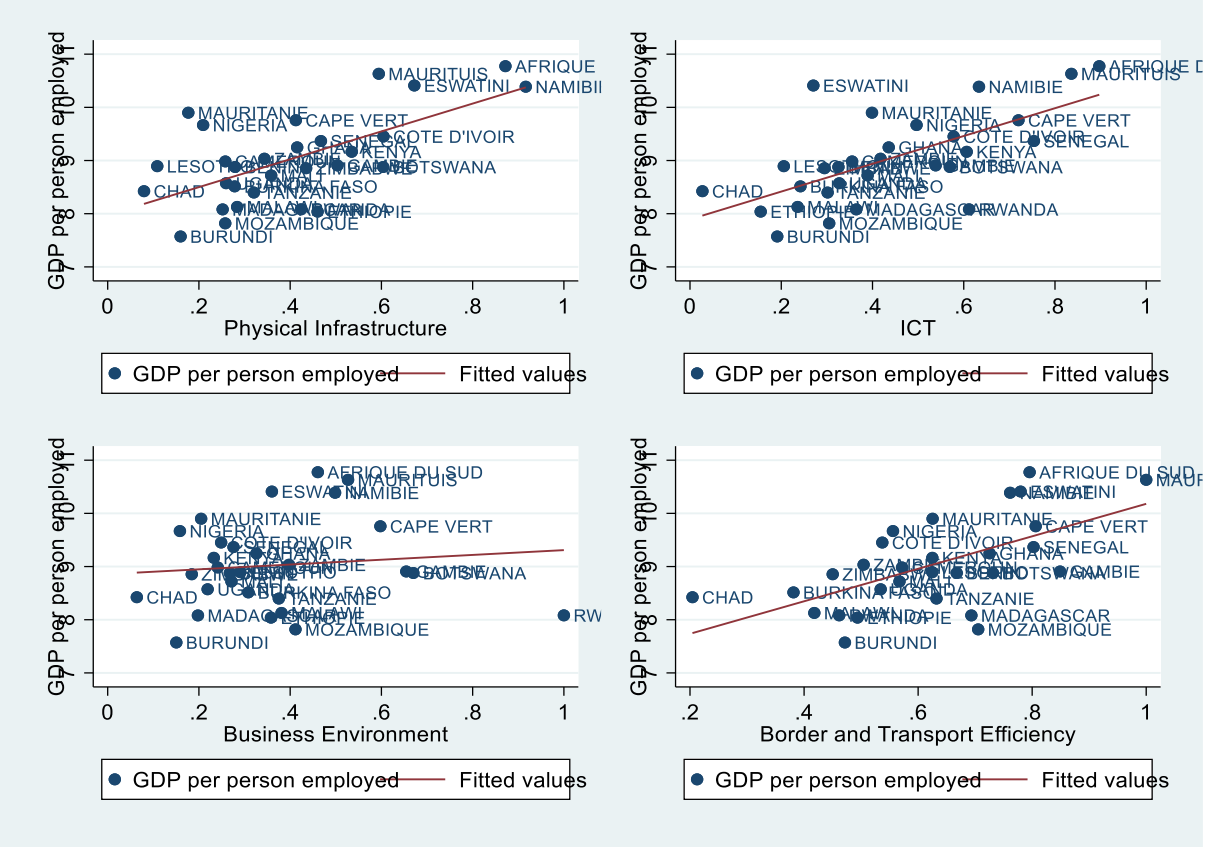
Figure 1: Trade facilitation indicators and TFP (average 2004-2017)



Source: Author based on data from WEF (2020) and Pen World Table (10.1).

An analysis of the correlation between trade facilitation indicators and GDP per person employed leads to the conclusion that both variables move positively in the same direction as shown in Figure 2. The correlation coefficient between trade facilitation indicators and GDP per person employed is positive and statistically significant at 1% threshold (see appendix 2). The graphical analysis shows that SSA countries with a high trade facilitation score, have a high level of GDP per person employed. For example, possessing a better business and regulatory environment, therefore, seems to favor a high level of GDP per person employed. The analysis in figure 2 is consistent with this finding as SSA countries that have high above-average scores experience higher GDP per person employed as well. On the opposite, countries with a low level of business environment also have the lowest GDP per person employed in SSA. Also, we have countries like South Africa, Mauritius, Namibia, which have high levels of ICT use that are also SSA countries with high levels of GDP per person employed. On the contrary, Chad, Ethiopia, Burundi, Mozambique, which have low levels of ICT use, also have the lowest GDP per person employed. Thus, an improvement in the information and communication technologies indicator score could improve GDP per person employed.

Figure 2: Trade facilitation indicators and GDP per person employed (average 2004-2017)



Source: Author based on WEF (2020) and WDI (2022) data.

3-2 Methodology

3-2-1 Empirical specification

To investigate the contribution of trade facilitation on productivity growth, we use the Cobb-Douglas production function framework (Cobb and Douglas, 1928). The Cobb-Douglas production function is a particular and very useful functional form that describes the relationship between factors of production and the maximum possible output under a given technology.

Following, Shahiduzzaman et al. (2015), Bah and Fang (2015), we postulate the following baseline model:

$$\boldsymbol{lnTFP_{it} = \beta_0 + \beta_1 lnX_{it} + \beta_2 lnTFI_{it} + \eta t + \mu i + \varepsilon it} \quad (1)$$

where TFPit represents total factor productivity in country i at time t. X it represents the vector of control variables (population, human capital, trade openness, FDI, inflation rate, government spending and natural resource rents); TFIit represents the vector of trade facilitation indicators (physical infrastructure, ICT, business and regulatory environment, border efficiency); ηt are the time fixed effects; μi is a vector representing country fixed effects; εit is the error term.

3-2-2 Estimation technique

Given the nature of the panel dataset used in the present analysis (a small time period and a small number of countries), we use the static specification to estimate the contribution of trade facilitation to productivity growth over the period 2004~2017. Also, if this model were to be estimated using the ordinary least squares (OLS), the standard fixed effects, or random effects estimators, the results should suffer from many biases like the endogeneity issue. Indeed, the endogeneity issue in the model (1) can come from a reverse causality between infrastructure and TFP (Khanna and Sharma, 2020). For these authors, while quality of infrastructure hard or soft can boost productivity, the growth of the later could also help countries to develop a better logistic infrastructure. The endogeneity can also concern the reverse causality between the dependent variable and other control variables.

To address the above-mentioned endogeneity concerns, the econometric literature has developed many estimators that use instrumental variable methods and the Generalized Method of Moments (GMM) (Arellano and Bond, 1991 ; Arellano and Bover, 1995 ; Blundell and Bond, 1998). However, the GMM estimator must respond to the large sample properties when N — ∞, T is fixed. Therefore, the well-known first differencing and system-GMM estimators are biased in our case. Given the difficulties encountered in finding appropriate instruments

that would help address the endogeneity concerns, we employ an instrumental variable estimation: a two-stage least square (2SLS) by considering the one-period lag and two-period lags of trade facilitation indicators[2]. Thus, equation (1) can be specified as:

$$\boldsymbol{lnTFP_{it} = \beta_0 + \beta_1 lnX_{it-1} + \beta_2 lnT\widehat{F}I_{it} + \eta t + \mu i + \varepsilon it} \quad (2)$$

$$\boldsymbol{T\widehat{F}I_{it} = \beta_0 + \beta_1 lnX_{it-1} + \beta_2 lnTFI_{it-1} + \eta t + \mu i + \varepsilon it} \quad (3)$$

$$\boldsymbol{ln\widehat{TFI}_{it} = \beta_0 + \beta_1 lnX_{it-1} + \beta_2 lnTFI_{it-2} + \eta t + \mu i + \varepsilon it} \quad (4)$$

Where $\boldsymbol{TFI_{it-1}}$ is the one-period lagged value and $\boldsymbol{TFI_{it-2}}$ is the two-period lagged value of TFI in country i and at time t. $\boldsymbol{X_{it-1}}$ are lag-one period of control variables in order to minimize their potential endogeneity except for variable total population and natural resources that are exogenous. The rest of other variables remain the same as in Equation (1). Equations (3) and (4) are the first stage equations where we isolate the effect of trade facilitation. In the second stage, the fitted values of trade facilitation ($\boldsymbol{T\widehat{F}I_{it}}$) derived from Equations (3) and (4) are inserted into Equation (2) to address the endogeneity issue between productivity and trade facilitation. We use three diagnostic tests to examine the consistency of this estimator. The Hansen test of over-identifying restrictions, the Kleibergen and Paap test for under-identification and the Cragg-Donald Wald F test for weak identification.

[2] The use of lags variable as instruments in the 2SLS approach is not uncommon in the literature. See for example Banerjee et al. (2022) who have also employed lag one and lag two as instruments and derived the predicted values in order to address the endogeneity issue. Also, we choose those lags to limit issues of degrees of freedom.

4- Results and discussion

4-1 Trade facilitation and total factor productivity in SSA

Table 2 presents the results of the contribution of trade facilitation to total factor productivity growth. We present both POLS and IV-2SLS results. Note that our preferred results are IV-2SLS however, we present the POLS results for comparison purpose.

The outcomes of the diagnostic tests that allow for the checking of the consistency of the two-stage least square approach are reported at the bottom of table 2. All outcomes are satisfactory. 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 Cragg-Donald Wald F statistics values 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). Also, the Hansen's p-values are greater than 10% for all specifications. On the basis of the above, we conclude that the two-stage least square estimator is appropriate for conducting the empirical analysis.

We now take up results in tables 2 (column 6-9) which show that our variables of interest have the expected sign according to economic theory. Our four trade facilitation indicators contribute positively and significantly to total factor productivity growth in SSA.

In particular, a 1 % increase in Physical infrastructure is associated with a 0.47 % increase in total factor productivity growth in SSA. Indeed, its coefficient is positive and statistically significant at 1% level and reveals that an improvement in the quality of port, airport, road and rail infrastructure by 1% promotes total factor productivity growth in SSA by 0.47%. Such a result implies that better physical infrastructure, other things being equal, not only reduces the transport costs associated with inputs to the production process but also facilitates the adoption of new imported intermediate inputs and production techniques, thereby encouraging higher total factor productivity. This result is consistent with those of (Weiping and Ying, 2007 ; Spence and Karingi , 2011 ; Laborda and Sotelsek , 2019 ; Khanna and Sharma, 2020). Khanna and Sharma (2020) for example, found in their study over the period 1980-2012 that a 1% increase in infrastructure leads to 0.16% productivity growth. Also, Laborda and Sotelsek (2019) using the GMM system find a positive and significant effect of road infrastructure on TFP.

Likewise, a 1 % increase in information and communication technology as well as in business and regulatory environment are respectively associated with an increase in total factor productivity growth by 0.23% and 0.33%. The ICT result is in line with the literature. In fact, Dahl et al. (2011); Spence and Karingi (2011); Shahnazi (2021) in their respective works found a positive impact of ICT on TFP growth. Dahl et al. (2011) found in Europe a positive and significant impact of ICT on TFP growth. The business and regulatory environment result suggests that an improved business and regulatory environment contributes positively to total factor productivity growth. Note that Bah and Fang (2015) analyzing the impact of the business and regulatory environment on productivity in SSA and using the general equilibrium model found that this indicator positively affects TFP growth in Africa.

Border and transport efficiency measured by the number of days as well as the number of documents required to export/import a product is found to be an important explanatory factor for total factor productivity growth in SSA. The border and transport efficiency coefficient is positive and significant (at the 1 percent level) and indicates that a reduction in border procedures by 1 % increases total factor productivity growth by 0.56 %, all else equal. In other words, simplifying border procedures, particularly the number of days and the number of import/export documents, promotes total factor productivity growth in SSA. This result confirms those found in the literature that simplification of border procedures positively affects total factor productivity growth (Spence and Karingi , 2011). Spence and Karingi (2011) find in their study on the impact of trade facilitation on competitiveness in SSA that a 1% increase in border and transport efficiency is associated with a 36% growth in TFP.

Thus, among trade facilitation indicators, border and transport efficiency indicator appears to exert the highest positive effect on total factor productivity. The contribution of this indicator is followed by that of physical infrastructure. The other two indicators namely business and regulatory environment as well as ICT followed respectively in terms of contribution to total factor productivity. Additionally, the coefficients in 2SLS results are small comparing with OLS results and can be explained by the endogeneity issue that is not considered in OLS estimator.

Whereas the objective of this study was to establish the significance of the empirical link between trade facilitation and productivity growth, it is worthwhile to discuss briefly the rest of the results regarding the control variable. We note that in all specifications, trade openness is positive and significant at 1% in colunm (6-8) and 5% in colunm 9. Trade openness positively

and statistically influences total factor productivity growth. This result remains consistent with the economic theory that trade openness allows access to a greater variety of inputs. This result is also consistent with that found by Ben Hammouda et al. (2010) and Dimelis and Papaioannou (2010). The later have found that trade openness promotes TFP growth in both developing and developed countries. Also, the private sector credit is positive and significant in all specifications. This indicator captures the financial development. From this result, we can say that, a developed financial structure allows for better mobilization of savings, which promotes investment. Also, in a developed financial sector, the information available on investment projects will be processed more efficiently and will serve to enhance investment in productive sectors (Berthélemy and Chauvin, 2000). Population which measured the country size and thus the size of the market contributes positively and significantly to productivity growth in SSA (Colum 6-9). The larger the market size, the easier it is for the products produced to find outlets. Similarly, population is an important force in supplying the labor force and an important factor in structural transformation. Our result is in line of a strand of the literature which states that an increase in a country's population is associated with an increase in the labor force that can be used as a factor of production (Elhiraika and Mbate, 2014) and thus a factor in productivity growth.

The estimation results show that the school enrollment rate, which is a measure of human capital, the FDI and GFCF affect negatively the productivity growth in SSA. The negative effect of FDI can be explained by the fact that it is probably misdirected in the host country. The counterintuitive result of the school enrollment rate can be explained by the fact that the secondary school enrollment is not effective in capturing human capital in the sense that it says little about actual school completion because of likely dropouts, which are likely to differ particularly across countries (Fosu and Abass, 2019).

Tableau 2: Contribution of Trade Facilitation to Total Factor Productivity in SSA

	Dependent variable: Total Factor Productivity (lnTFP)								
	Pooled OLS					IV-2SLS			
VARIABLES	1	2	3	4	5	6	7	8	9
ln _ Population	0.099***	0.148***	-0.029	-0.093***	-0.019	0.147***	0.077***	0.088***	0.117***
	(0.020)	(0.023)	(0.018)	(0.034)	(0.016)	(0.026)	(0.024)	(0.026)	(0.020)
Trade_openness	0.003***	0.004***	0.003***	0.003***	0.005***	0.003***	0.007***	0.007***	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Foreign_Direct_Investment	-0.000	0.001	0.004	-0.003	-0.007***	-0.0001	-0.007***	-0.005**	-0.001
	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)
Enrollment_Rate	-0.002**	-0.002**	-0.007***	0.003***	-0.002**	-0.002**	-0.005***	-0.006***	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GFCF_ (% GDP)	-0.012***	-0.014***	-0.005**	-0.007***	-0.011***	-0.013***	-0.009***	-0.011***	-0.014***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Private_Sector_Credit	0.006***	0.004**	0.003***	0.004***	0.003***	0.005***	0.001*	0.002***	0.003**
	(0.002)	(0.002)	(0.001)	(0.001)	(0.003)	(0.002)	(0.001)	(0.0003)	(0.002)
Natural_resources	-0.014***	-0.014***	-0.025***	-0.013***	-0.0111***	-0.011***	-0.026***	-0.024***	-0.009***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)
Physical_Infrastructure		**0.569****				**0.465****			
		(0.133)				(0.179)			
Technology_ (ICT)			**0.333****				**0.229****		
			(0.097)				(0.093)		
Business_Environment				**0.468****				**0.332****	
				(0.076)				(0.073)	
Border_Efficiency					**0.654****				**0.557****
					(0.098)				(0.084)
Constant	-2.296***	-3.357***	0.171	0.115	-0.798**	-3.148***	-1.752***	-1.767***	-2.874***
	(0.395)	(0.453)	(0.370)	(0.548)	(0.361)	(0.548)	(0.474)	(0.490)	(0.422)
Observations	229	229	229	229	229	199	199	199	199
R-squared	0.931	0.937	0.804	0.961	0.896	0.942	0.836	0.869	0.952
Underindentification (Prob>LM)						0.000	0.000	0.000	0.000
Weak identification test						62.92	382	616.8	271.2
Hansen P_value						0.554	0.522	0.406	0.739

Note: Values in brackets represent robust standard errors; *, **, *** represent significance at 10%, 5% and 1% respectively. In all specifications, TF indicators are instrumented by 1 and 2 years of their lag values. Regressions include dummy variables to account for country and time fixed effects.

Source: authors

4-2 Robustness check

The results obtained so far indicate that trade facilitation through its indicators contributes favorably to productivity growth in sub-Saharan Africa. To verify the robustness of our results, we perform an additional analysis using a proxy for TFP. Indeed, instead of TFP, we use labor productivity as an alternative measure of productivity growth (Table 3). Additionally, we use also an alternative control variable. We replaced the secondary education enrollment rate that is compiled from the world development indicators with the human capital index of the Pen World Table (Table 4). This index is based on years of schooling and educational performance.

The main results of the estimates that are compiled in table 3 are similar to those in table 2. All trade facilitation indicators are positive and statistically significant (at 1 percent level), suggesting that, on average, economies with relatively good trade facilitation scores achieve higher labor productivity. Moreover, the coefficient of trade facilitation indicators with labor productivity are higher than the one in Table 2. Also, trade openness always has a positive and significant effect on labor productivity, implying that promoting trade liberalization in SSA countries tends to increase labor productivity. The others control variables are mostly similar to the results in Table 2.

Table 4 results show once again the critical role of trade facilitation in the promotion of total factor productivity. By using human capital index of Pen World Table, three out of four trade facilitation indicators affect positively and significantly productivity growth in SSA countries. A 1 % increase in physical infrastructure as well as border and transport efficiency contribute in the productivity growth by 0,55% and 0,49% respectively in SSA. Concerning the ICT indicator, it contributes positively and significantly at 10% level.

In sum, we can say that our results are robust to the alternative measure of total factor productivity as well as an alternative control variable.

Table 3: Contribution of Trade Facilitation to Labor Productivity in SSA

	Dependent variable: GDP per person employed (ln_GDP_L)			
VARIABLES	1	2	3	4
ln _Population	0.124***	0.190***	0.184***	0.357***
	(0.026)	(0.030)	(0.036)	(0.039)
Trade_openness	0.001**	0.005***	0.005***	0.011***
	(0.001)	(0.002)	(0.002)	(0.002)
Foreign direct investment	0.003**	-0.006	0.004	0.002
	(0.001)	(0.004)	(0.005)	(0.004)
School_enrolment	0.006***	-0.005***	-0.002	-0.006***
	(0.001)	(0.002)	(0.002)	(0.001)
GFCF_GDP	-0.002	0.014***	0.009**	-0.014***
	(0.001)	(0.003)	(0.004)	(0.005)
Private_Sector_Credit	0.0116***	0.008***	0.012***	0.010***
	(0.001)	(0.001)	(0.001)	(0.001)
Natural_resources	-0.001	-0.023***	-0.033***	-0.022***
	(0.002)	(0.004)	(0.004)	(0.003)
Physical_Infrastructure	**0.488****			
	(0.129)			
Technology_(ICT)		**1.175****		
		(0.169)		
Business_environment			**0.545****	
			(0.193)	
Border_efficiency				**0.821****
				(0.138)
Constant	5.794***	5.282***	5.296***	2.632***
	(0.479)	(0.611)	(0.689)	(0.734)
Observations	269	269	269	269
R-squared	0.990	0.948	0.947	0.919
Underindentification test	57.12	59.08	60.83	41.20
Prob>LM	0.000	0.000	0.000	0.000
Weak identification test	103.4	212.7	245.7	542.4
Hansen_stat	2.505	2.153	1.418	1.008
Hansen P_value	0.114	0.142	0.234	0.315

Note: the numbers in parentheses represent the robust standard errors of the estimated coefficients; *, **, *** represent the significances at 10%, 5% and 1%. Regressions include dummy variables to account for country and time fixed effects

Source: Author

Table 4: Estimation results with alternative control variable: the human capital index of Pen World Table

	Dependent variable: Total Factor Productivity (TFP)			
VARIABLES	1	2	3	4
ln _ Population	0.163***	0.138***	0.122***	0.122***
	(0.021)	(0.020)	(0.026)	(0.015)
Trade_openness	0.004***	0.003***	0.008***	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Foreign_Direct_Investment	-0.006***	-0.004**	-0.008***	-0.004**
	(0.002)	(0.002)	(0.003)	(0.002)
Human_Capital index	-0.224***	-0.185***	-0.004	-0.100***
	(0.034)	(0.033)	(0.057)	(0.038)
GFCF_ (% GDP)	-0.013***	-0.011***	-0.007***	-0.014***
	(0.001)	(0.002)	(0.003)	(0.001)
Private_Sector_Credit	0.001*	0.003***	0.002***	0.002***
	(0.001)	(0.000)	(0.000)	(0.000)
Natural_resources	-0.008***	-0.012***	-0.027***	-0.008***
	(0.002)	(0.002)	(0.003)	(0.002)
Physical_Infrastructure	**0.553****			
	(0.166)			
Technology_ (ICT)		**0.169***		
		(0.095)		
Business_Environment			0.085	
			(0.075)	
Border_Efficiency				**0.494****
				(0.100)
Constant	-3.320***	-2.941***	-2.934***	-2.836***
	(0.403)	(0.387)	(0.450)	(0.296)
Observations	199	199	199	199
R-squared	0.947	0.942	0.834	0.953
Underindentification test	52.83	39.84	36.59	11.75
Prob>LM	0.000	0.000	0.000	0.000
Weak identification test	69.61	179.1	769.7	238.1
Hansen_stat	1.999	1.828	0.0488	0.573
Hansen P_value	0.157	0.176	0.825	0.449

Note: the numbers in parentheses represent the robust standard errors of the estimated coefficients; *, **, *** represent the significances at 10%, 5% and 1%. Regressions include dummy variables to account for country and time fixed effects

Source: Author

5- **Conclusion**

This article analyzed the contribution of trade facilitation indicators to productivity growth in Sub-Saharan Africa. In order to achieve our objective, we first reviewed both the theoretical and empirical links between trade facilitation and productivity. Theoretical studies show that trade facilitation can contribute to productivity growth through the market access and innovation channel. Regarding the empirical review, we have realized that, there is also an absence of studies addressing the soft aspect of TF in relation to productivity. Concerning the methodology of our work, the two-stage least squares estimator which has the advantage in correcting the endogeneity problem was retained. The results from the two-stage least squares estimator over the period 2004-2017 show that trade facilitation indicators contribute favorably to productivity growth in sub-Saharan Africa. The magnitude of the effects depends on the measure of productivity growth (TFP or labor productivity). Based on the estimation results, it can be concluded that border and transport efficiency as well as physical infrastructure are the main trade facilitation indicators that show the highest and positive effect on total factor productivity in SSA. The same is true for ICT and border and transport efficiency in boosting labor productivity. These results have some policy implications for Sub-Saharan African countries. First, given our interesting finding on the impact of border efficiency as well as the business and regulatory environment indicators on productivity growth, improving them would generate substantial productivity gains and greatly boost the competitiveness of micro, small and medium-sized enterprises. These results should be considered of prime importance for policy makers, giving the job creation potential of MSMEs. Moreover, while some improvements in trade facilitation indicators are costly and will take considerable time to achieve, others can be achieved at lower cost if the political will is strong. For example, the time companies spend dealing with government regulations can be reduced by simplifying the business and regulatory environment as well as border procedures. Governments in SSA countries can simplify their tax codes, reform labor laws and reduce the number of licenses and inspections required for businesses. Second, considering the importance of physical infrastructure in productivity growth, improving the quality of infrastructure can greatly contribute to Africa's long-term economic transformation, but it is costly. Building more roads, ports, airports and railways requires big investments. To finance these investments, SSA countries need to explore new financing mechanisms including public-private partnerships, licensing of access to mineral resources against infrastructure development, etc.

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Appendix

1- Correlation matrix between trade facilitation indicators and TFP

	TFP	Physical Infrastructure	Information and Communication Technology	Business and Regulatory Environment	Border and Transport Efficiency
TFP	1.0000				
Physical Infrastructure	0.6222***	1.0000			
Information and Communication Technology	0.4939***	0.6352***	1.0000		
Business and Regulatory Environment	0.2397***	0.4397***	0.4413***	1.0000	
Border and Transport Efficiency	0.631***	0.4923***	0.5892***	0.3238***	1.0000

*** represent the significance at 1%.

2- Correlation matrix between trade facilitation indicators and GDP per person employed

	GDP per person employed	Physical infrastructure	Information and Communication Technology	Business and Regulatory Environment	Border and Transport Efficiency
GDP per person employed	1.0000				
Physical Infrastructure	0.6606***	1.0000			
Information and Communication Technology	0.5977***	0.6352***	1.0000		
Business and Regulatory Environment	0.1571***	0.4397***	0.4413***	1.0000	
Border and Transport Efficiency	0.539***	0.4923***	0.5892***	0.3238***	1.0000

*** represent the significance at 1%.

3- Table 1: Descriptive statistics in the TFP and GDP per person employed equation

Variable	Observation	Mean	standard deviation	Minimum	Max
TFP	280	0.496531	0.2276399	0.1423074	1.233877
GDP_per _ Employee	406	11865.31	11769.61	1746.069	49659.6
Physical_Infrastructure	406	0.3979552	0.2125264	0.0097676	0.9587838
Technology_ICT	406	0.4304463	0.2206147	0.0015104	1
Business_Environment	406	0.3562806	0.2088964	0.0348538	1
Border_Efficiency	406	0.6198749	0.1804677	0.103641	1
Population	406	2.34E+07	3.26E+07	456617	1.91E+08
Trade_Openness	406	67.20096	28.91406	0	161.8937
Foreign_Direct_Investment	406	3.696519	4.611891	-4.84583	39.4562
Enrollment_rate	369	105.7307	19.71108	53.8744	149.3075
GFCF	370	22.1586	7.841602	2.000441	46.73224
Private_Sector_Credit	366	25.72987	29.72465	2.215311	160.1248
Natural resources	406	8.586071	7.258245	0.0011713	38.65062

Source: Authors based on WDI (2021), WEF (2020) and Penn World Table 10.1 data.

4- 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: Author based on data from WEF 2020 and Doing Business DB 2020.

5- List of countries in TFP and GDP per person employed equations

Countries	
SOUTH AFRICA	MADAGASCAR
BENIN	MALAWI
BOTSWANA	MALI
BURKINA FASO	MAURITANIA
BURUNDI	MAURITIUS
CAMEROON	MOZAMBIQUE
CAPE VERDE	NAMIBIA
CHAD	NIGERIA
COTE D'IVOIR	RWANDA
ESWATINI	SENEGAL
ETHIOPIA	TANZANIA
GAMBIA	UGANDA
GHANA	ZAMBIA
KENYA	ZIMBABWE
LESOTHO	

Source: Author