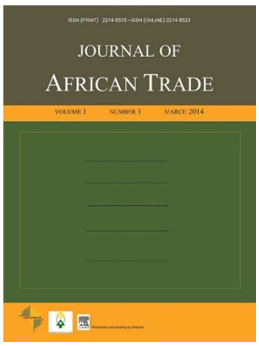

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Trade and economic growth in developing countries: Evidence from sub-Saharan Africa

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Abstract

This study investigates how trade openness affects economic growth in developing countries, with a focus on sub-Saharan Africa (SSA). We use a dynamic growth model with data from 42 SSA countries covering 1980 to 2012. We employ the Pooled Mean Group estimation technique, which is appropriate for drawing conclusions from dynamic heterogeneous panels by considering long-run equilibrium relations. The empirical evidence indicates that a trade threshold exists below which greater trade openness has beneficial effects on economic growth and above which the trade effect on growth declines. The evidence also indicates an inverted U-curve (Laffer Curve of Trade) response, robust to changes in trade openness measures and to alternative model specifications, suggesting the non-fragility of the linkage between economic growth and trade openness for sub-Saharan countries. Our findings are promising and support the view that the relation between trade openness and economic growth is not linear for SSA. Accordingly, SSA countries must have more effective trade openness, particularly by productively controlling import levels, in order to boost their economic growth through international trade.

JEL classification: F14; 040
Keywords: Trade openness; Economic growth; Sub-Saharan Africa

1. Introduction

Trade liberalization has become widespread over the past three decades, particularly among developing and transition economies, as a result of the perceived limitation of import substitution-

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based development strategies and the influence of international financial institutions, such as the International Monetary Fund and the World Bank, which have often made their support conditional on trade liberalization. The fundamental rationale for this degree of commitment to a program of trade reform is the obvious belief that liberalization is a prerequisite to a transition from relatively closed to relatively open economies. Economists generally agree that open economies grow faster than their counterparts do (Grossman and Helpman, 1991; Edwards, 1993). If openness is indeed positively related to growth, it then follows that liberalization is a requirement for growth. Despite their early promise, recent experience suggests that not all trade reforms have been as successful as anticipated (Singh, 2010).

The relationship between trade openness and economic growth has been theoretically controversial. While conventional wisdom predicts a growth-enhancing effect of trade, recent developments suggest that trade openness is not always beneficial to economic growth. Increased international trade can generate economic growth by facilitating the diffusion of knowledge and technology from the direct import of high-tech goods (Barro and Sala-i-Martin, 1997; Baldwin et al., 2005; Almeida and Fernandes, 2008). Trade facilitates integration with the sources of innovation and enhances gains from foreign direct investment. By increasing the size of the market, trade openness allows economies to better capture the potential benefits of increasing returns to scale and economies of specialization (Alesina et al., 2000; Bond et al., 2005). In their theoretical models, Grossman and Helpman (1991) show that trade openness improves the transfer of new technologies, facilitating technological progress and productivity improvement, and that these benefits depend on the degree of economic openness. This consensus rests on the assumption that trade creates economic incentives that boost productivity through two dynamics: in the short-run, trade reduces resource use misallocation; in the long run, it facilitates the transfer of technological development. Trade liberalization can also force governments to commit to reform programs under the pressure of international competition, thus enhancing economic growth (Sachs and Warner, 1995; Rajan and Zingales, 2003). Trade liberalization in developing countries has therefore often been implemented with the expectation of growth stimulation.

However, endogenous growth models postulate that the contribution of trade to economic growth varies depending on whether the force of comparative advantage orientates the economy's resources toward activities that generate long-run growth or away from such activities. Moreover, theories suggest that, due to technological or financial constraints, less-developed countries may lack the social capability required to adopt technologies developed in more advanced economies. Thus, the growth effect of trade may differ according to the level of economic development. Despite its potential positive effect on growth, some theoretical studies claim that trade openness may hamper growth. For Redding (1999), Young (1991), and Lucas (1988), opening up to trade might actually reduce long-run growth if an economy specializes in sectors with dynamic comparative disadvantage in terms of potential productivity growth or where technological innovations or learning by doing are largely exhausted. For such economies, selective protection may foster faster technological advances.

The empirical analyses are as inconclusive as the theoretical perspectives. Some studies have identified a positive association between trade openness and economic growth (Chang et al., 2009; Kim, 2011; Jouini, 2015), while others have found no association, or even a negative association (Musila and Yiheyis, 2015; Ulaşan, 2015). The literature is inconclusive partly because different analysts use different proxies for liberalization or trade openness and rely on different methodologies. The evidence for growth enhancements through trade liberalization displays mixed effects because of problems with misspecification and the diversity among the liberalization indices used.

Using cross-country data and initial real income per capita as the threshold variable, Kim and Lin (2009) found significant threshold effects in the relationship between trade and growth. Greater openness to international trade has positive impacts on economic growth for high-income economies.

For low-income economies, however, higher trade openness has negative impacts on economic growth. The beneficial effects of trade liberalization thus seem to increase as economies develop, confirming the arguments about the adoptive capacity of a country in determining knowledge accumulation and technology implementation.

This study contributes to research by assessing whether the relationship between trade and growth differs between more open and less open countries in SSA. This distinction is important, as various theoretical models and empirical results have suggested that the effect of trade on economic growth may vary according to the level of trade openness and level of income as a measure of economic development. Particularly for developing countries, the lack of investment in human capital and of a well-functioning financial system may hamper the growth expected from trade liberalization through technological innovation. For such countries, Kim and Lin (2009) suggest selective protection. If such a nonlinear relationship exists, we should be able to estimate the threshold at which the sign of the relation between trade and growth switches. This study reexamines the role of trade and contributes to the literature by empirically analyzing the threshold effects of trade on economic growth based on panel data for sub-Saharan African countries. The empirical evidence is based on a dynamic growth model using data from 42 sub-Saharan countries covering 1980 to 2012. We employ the Pooled Mean Group estimation technique, which is appropriate for drawing conclusions from dynamic heterogeneous panels by considering long-run equilibrium relations. Our findings support the view that the relation between trade globalization and economic growth is not linear for sub-Saharan Africa and point to an inverted U curve-type response.

The remainder of the paper is organized as follows. Section 2 reviews the theoretical and empirical literature linking trade and economic growth. Section 3 presents the study's model and discusses the relevant econometric issues. Section 4 presents the data used to implement the model. Section 5 summarizes and analyses the empirical results. Finally, Section 6 concludes the paper and outlines its main economic policy implications.

2. Trade openness and growth in the literature

Traditional trade theory predicts growth gains from openness at the country level through specialization, investment in innovation, productivity improvement, or enhanced resource allocation. The role of trade policy in economic development has been a key matter of debate in the development literature. Ricardo's theory suggests that openness abroad allows a country to reorient its scarce resources to more efficient sectors. The neoclassical growth models drawn from Solow's (1957) model consider technological change as exogenous and suggest that, consequently, trade policies do not impact economic growth. However, new economic growth theories assume that technological change is an endogenous variable and that trade policies can be combined with those on international trade. The existence and nature of the link between trade openness and economic growth have been the subject of considerable debate. However, neither the existing theoretical models nor empirical analyses have produced a definite conclusion.

The potential growth effects of trade liberalization are well known. While the intermediate impact is likely to be negative, as resources become redundant in areas of comparative disadvantage, their eventual reallocation into areas of comparative advantage will increase the growth rate; the evidence points to a J curve-type response (Greenaway et al., 2002; Falvey et al., 2012). Longer growth gains must be obtained through improvements in factor productivity (Kim and Lin, 2009), which can occur through a variety of channels such as technology diffusion and innovation. While trade openness facilitates the diffusion of technology and innovations (Krueger and Berg, 2003; Lucas, 1988), technology adoption depends on a country's absorptive capacity, which is determined by human

capital and R&D (Verspagen, 1991; Fagerberg, 1994), financial development (Aghion et al., 2005), governance, and national institutional settings (Haltiwanger, 2011; McMillan and Verduzco, 2011). Thus, developing countries—characterized by a lack of human capital, R&D, a well-functioning financial system, and a high-quality bureaucracy—may not take full advantage of technology transfer.

The empirical results, like the theoretical analyses, are controversial. The evidence has indicated that excessive regulations restrict growth because resources are prevented from moving into the most productive sectors and to the most efficient firms within sectors (Bolaky and Freund, 2008) and that institutions can help explain the heterogeneity in the trade–growth relationship (Sindzingre, 2005).

Falvey et al. (2012) employed threshold regression techniques on crisis indicators to identify the relevant crisis values and the differential post-liberalization growth effects in crisis and non-crisis regimes. Their findings indicate that an economic crisis at the time of liberalization does affect post-liberalization growth, in a direction that depends on the nature of the crisis. An internal crisis implies lower growth and an external crisis higher growth relative to a non-crisis regime. Based on an augmented production function, Fosu (1990) argued that export increases improve economic growth in African countries, whereas Ulaşan (2015) used a dynamic panel data framework to conclude that trade openness measures are not robustly significantly associated with economic growth, implying that trade openness alone does not boost economic growth. Trejos and Barboza (2015) provide robust empirical evidence that trade openness is not the main engine of the Asian economic growth "miracle."

The benefits of trade openness are not automatic. Policies, such as measures aimed at fostering macroeconomic stability and a favorable investment climate, must accompany trade openness (Newfarmer and Sztajerowska, 2012). Kim and Lin (2009) found that trade openness contributes to long-run economic growth, with effects varying according to the level of economic development. Herzer (2013) found that the impact of trade openness is positive for developed countries and negative for developing ones. The effect of trade liberalization on growth depends on the liberalization level. An income threshold exists above which greater trade openness has beneficial effects on economic growth and below which increased trade has detrimental consequences (Agénor, 2004; Liang, 2006).

Empirical studies have found a possible two-way causality in the trade–growth link, whereby countries that trade more may have higher income, while countries with higher income may be better able to afford the infrastructure conducive to trade, may have more resources with which to overcome the information search costs associated with trade, or may demand more traded goods (Kim and Lin, 2009). Zeren and Ari (2013) revealed positive bidirectional causal links between openness and economic growth for G7 countries.

Among the reasons for the inconclusive results in the literature on the trade–growth link is the fact that different studies use different proxies for trade openness and rely on different methodologies. Most empirical studies based on cross-country growth regressions suggest a significant growth-promoting effect of trade openness, although these have been criticized for poor data quality and inadequate control of endogeneity (Edwards, 1998; Le Goff and Singh, 2014). The inconclusive results may occur because trade liberalization must almost certainly be combined with other appropriate policies, and linear regression models cannot capture such complementary dynamics (Winters, 2004). Greenaway et al. (2002) provided evidence that misspecification and the diversity of liberalization indices are partly responsible for the inconclusiveness of the research. Using a dynamic panel framework and three different indicators of liberalization, their results indicate that liberalization does appear to impact growth, albeit with a lag. These results suggest that working in a panel context is more effective than working in a cross-country context. Such a technique extracts

more information and produces more reliable estimates than the time series and cross-section regressions do.

This study complements the literature on trade and growth by providing new cross-country empirical evidence that considers the threshold effects of trade across sub-Saharan Africa. Moreover, rather than just focusing on the direct effect of trade on growth, this study goes further and explores other channels through which trade can affect economic progress, such as governance, financial development, and education.

3. Model and econometric issues

The neoclassical augmented growth model developed by Mankiw et al. (1992) is utilized to estimate the effect of trade openness on economic growth. Two main motivations underlie the specification of this model. First, the model considers human capital, which enhances labor productivity and can boost growth. Second, as the objective is to see how growth is influenced by trade and the economic policy environment, several policy-related variables are used in the equation. Taking into account the variable of interest (trade) and the heterogeneity of the coefficients and other control variables, the model can be expressed as follows:

$$Y_{it} = \alpha_i + \lambda_i Y_{it-1} + \sum_{p=1}^{k} \beta_{pi} X_{it}^{p} + \gamma_{1i} trade_{it} + \gamma_{2i} trade_{it}^{2} + \varepsilon_{it} \tag{1}$$

where Y_{it} is GDP per capita for country i at time t, X is the vector of control variables, including education, rate of population growth, investment rate, financial development, institutions, crisis, and debt. *Trade* is a trade openness variable, ε_{it} is an error term, and α_i reflects country-specific effects. The logarithm of the initial GDP is included to control for convergence. However, it can also be interpreted as a proxy for a country's stock of capital. Under this assumption, economic growth in the poorest countries is more rapid than in the richest countries. The coefficient of this variable should be negative.

The transformation of Eq. (1) as an error correction equation gives

$$\Delta Y_{it} = \phi_i \left(Y_{it-1} - \theta_{0i} - \sum_{p=1}^{k} \theta_{pi} X_{it-1}^{p} - \delta_{1i} trade_{it-1} - \delta_{2i} trade_{it-1}^{2} \right) - \sum_{p=1}^{k} \beta_{pi} \Delta X_{it}^{p} - \gamma_{1i} \Delta \mathrm{tra}\, de_{it} - \gamma_{2i} \Delta \mathrm{tra}\, de_{it}^{2} + \varepsilon_{it} \tag{2}$$

with $\theta_{0i} = {}^{\alpha_i}/_{1-\lambda_i}$, $\theta_{pi} = {}^{\beta_{pi}}/_{1-\lambda_i}$, $\delta_{1i} = {}^{\gamma_{1i}}/_{1-\lambda_i}$, $\delta_{2i} = {}^{\gamma_{2i}}/_{1-\lambda_i}$, $\phi_i = -(1-\lambda_i)$.

Economic growth is captured by the log-difference of real GDP per capita *(ΔY_{it})*. The trade variable is captured by three indicators: the ratio of the sum of imports and exports to GDP, exports to GDP, and the ratio of imports to GDP. To address the possible causality between growth and trade, the Hodrick Prescott filter (HP) has been used in the denominator (filtered GDP) of the three measures to smooth the series by following the method of Arnone and Presbitero (2010).

Furthermore, θ_{0i} is introduced for country-specific effects, ε_{it} represents the term of error, θ_{pi}, δ_{1i} and δ_{2i} capture the dynamic of long-run effects, while β_{pi}, γ_{1i}, and γ_{2i} capture the short-run dynamics. Finally, the quadratic form is introduced to capture the nonlinear relationship or threshold effect between trade and economic growth. ϕ_i represents adjustment speed toward the long-run state; this should be negative and significant to confirm the long-run relationship between trade and economic growth.

Following Pesaran et al. (1999) and Jouini (2015), we apply the maximum-likelihood method to estimate Eq. (2) by initially assuming that the error terms are normally distributed. The Pooled Mean Group (PMG) approach is used to estimate dynamic heterogeneous panels by considering long-run equilibrium relations, contrary to other techniques, such as the dynamic panel GMM method, that

purge any potential long-run linkage among variables. The PMG estimation approach allows identical long-run coefficients without assuming homogeneous short-run parameters. By doing so, the PMG estimation approach differs from techniques, such as the Mean Group (MG) developed by Pesaran and Smith (1995), that estimate a regression for each group and then calculate the coefficient means (Evans, 1997; Lee et al., 1996). The MG long-run estimators are consistent, but they are inefficient if coefficient homogeneity holds. Under these conditions, the PMG estimation approach is useful since it provides consistent and efficient long-run estimators when parameter homogeneity holds. The PMG approach is preferable to the MG method since it provides estimates that are less sensitive to outlier estimates.

We address endogeneity concerns by augmenting the PMG estimator with lags of regressors and dependent variables to minimize the resultant bias and ensure that the regression residuals are serially uncorrelated.

Eq. (2) is rewritten as follows:

$$\Delta Y_{it} = \phi_i\left(Y_{it-1} - \theta_{0i} - \sum_{p=1}^{k}\tilde{\theta}_p X_{it-1}^{p} - \tilde{\delta}_1 trade_{it-1} - \tilde{\delta}_2 trade_{it-1}^{2}\right) - \sum_{p=1}^{k}\beta_{pi}\Delta X_{it}^{p} - \gamma_{1i}\Delta trade_{it} - \gamma_{2i}\Delta trade_{it}^{2} + \varepsilon_{it} \quad (3)$$

The trade threshold by country $trade_i$* is obtained as follows: $\mathrm{trade}_{it}^{*} = -\delta_{1i}/2\delta_{2i}$; with the threshold $e^{-\delta_{1i}/2\delta_{2i}}$. To enhance robustness, the effect of the 2008–2010 crisis is taken into account in the model through a dummy variable. We consider 2008 as the breakpoint because this year is the beginning of the crisis. The crisis variable takes zero before 2008 and one after 2008. We conducted three stationarity tests: the test of Levine et al. (LLC, 2002), the test of Im et al. (IPS, 2003), and the test of Maddala and Wu (MW, 1999). These tests are a generalization of the Augmented Dickey–Fuller test (ADF). For cointegration, we applied the Pedroni (1999) and Kao (1999) tests.

4. Data and variable definitions

This study uses annual data covering 1980 to 2012 taken from 42 sub-Saharan African countries. The choice of the period of study is related to the availability of data on interest variables such as trade and economic growth. The dependent variable is economic growth, measured as the log difference of the gross domestic product per capita (GDP). We also include a set of control variables that are commonly used in growth equations.

4.1. Trade openness variables

Following Jouini (2015), Le Goff and Singh (2014), Zeren and Ari (2013), and Ulaşan (2015), we chose as our trade openness variable a measure of effective trade openness and not a measure of liberalization policies because the main concern of this study is the impact of actual globalization on economic growth. We employ three variables for trade openness: we use the sum of exports and imports as a share of GDP (TRADE); for a robustness check, we also consider exports (EXPORT) and imports (IMPORT) as a share of GDP separately.

4.2. Control variables

Since macroeconomic policies affect growth performance through their impact on the rate of inflation, financial development, the financial crisis, external debt, investment in human and physical

capital, and institutional quality, variables for these effects are used in the growth equation to capture the impacts of such policies. The effect of inflation (INF) is a controversial issue. Some studies claim that inflation has a positive impact on growth (Dornbusch et al., 1996), while other studies suggest that this effect is characterized by a nonlinear relationship (Fischer, 1993; Kremer et al., 2009). Inflation is proxied by the rate of change in price levels. Investment (INV) has been used in empirical studies because it is viewed as a direct proxy of contribution to capital accumulation, as well as an indicator of efforts to develop basic economic infrastructure. It is measured in this study as gross fixed capital formation. Human capital is a key determinant of technology adoption as permitted by trade openness (Benhabib and Spiegel, 2005; Cohen and Levinthal, 1989). The effect of human capital is captured by using two variables: the gross secondary enrollment rate (EDU) and the population growth rate (POP). The lack of a well-functioning financial system may prevent less-developed countries from taking full advantage of technology transfer from trade openness and may impact economic growth. Financial development (*FD*) is measured by private credit as a share of GDP. Institutional quality is included in the growth equation to capture the impact of political rights and civil liberties. It is hypothesized that the absence of political rights and civil liberties lowers the security of life and property, thus reducing the rate of accumulation and the efficiency of factor of production. Institutional quality therefore impacts economic growth (Asiedu, 2003; Acemoglu and Robinson, 2012) and may also impact trade openness (Falvey et al., 2012). Institutional quality is proxied by a governance index (IGOV) through the average of the six institution measures presented by Kaufmann et al. (1999): voice and accountability, political stability and absence of terrorist violence, government effectiveness, regulatory quality, rule of law, and control of corruption. We also add variables on external debt (DEBT) and crisis (CRISIS) to capture the effect of debt and financial crisis on economic growth. External debt is deleterious to economic growth (Fosu, 1999), and a financial crisis can reduce GDP growth. Fosu (2013) found that the 2008 crisis reduced growth by 60% in sub-Saharan Africa. Following Chang et al. (2009), we introduce interacting terms to allow the economic growth-trade openness relationship to vary with several country characteristics (i.e., governance, education, and financial development). Table A4 in Appendix 1 provides the data sources (World Bank, 2014), definitions, and descriptive statistics of the variables used in the model.

5. Empirical results

The existence of a unit root is tested using the tests employed in Levine et al. (2002), Im et al. (2003), and Maddala and Wu (1999). These tests are performed on the variables in the model, levels, and difference. The null hypothesis of the presence of a unit root is rejected if the three tests confirm that hypothesis simultaneously. According to the statistics of the three types of unit root test, variables such as LGDP (logarithm of GDP), LDEBEXP (logarithm of ratio of external debt to export), LINV (logarithm of investment), EDU (education variable), LDEBGDP (logarithm of ratio of external debt to GDP), and LFD (logarithm of financial development variable) are non-stationary in level. Stationary variables in level are INF (inflation rate), LTRADE (logarithm of trade openness), IGOV (governance index), POP (population growth rate), LSDEBEXP (logarithm of external debt services to export), LEXPORT (logarithm of export), and LIMPORT (logarithm of import). The results of these tests on the variables in first difference fail to accept the hypothesis of the presence of a unit root for all variables at a 1% level (see Table A1 of Appendix 1). We also conduct cointegration tests using Pedroni (1999) and Kao (1999) tests. The results

Table 1
PMG long-run estimates of impact of trade openness ((X + M)/GDP)) on growth of per capita GDP, 1980–2012.

	Model 1	Model 2	Model 3	Model 4
	Coef.	Coef.	Coef.	Coef.
GDP(−1)	−0.0686***	−0.0759***	−0.0334***	−0.0968***
	(0.0124)	(0.0132)	(0.0137)	(0.0185)
LINV	0.4168***	0.4430***	0.5529***	0.2014***
	(0.0263)	(0.0243)	(0.0441)	(0.0179)
LFD	−0.1425***	−0.1227***	2.1508***	−0.1360***
	(0.0309)	(0.0291)	(0.3020)	(0.0190)
INF	−0.0001***	−0.0001***	−0.0004***	−0.0003**
	(0.0000)	(0.0000)	(0.0001)	(0.0001)
IGOV	0.2424***	−1.0389***	0.1398**	−0.0815***
	(0.0414)	(0.2442)	(0.0552)	(0.0288)
POP	−0.0317*	−0.0299**	0.1135***	−0.0213***
	(0.0164)	(0.0146)	(0.0245)	(0.0068)
EDU	0.0079***	0.0074***	0.0083***	−0.0229***
	(0.0012)	(0.0011)	(0.0023)	(0.0057)
CRISIS	−0.1063***	−0.1211***	−0.1302**	0.0171
	(0.0381)	(0.0361)	(0.0522)	(0.0273)
LDEBT	−0.0380**	−0.0585***	−0.0119	−0.1112***
	(0.0173)	(0.0137)	(0.0241)	(0.0149)
LTRADE	1.9357***	0.3480***	1.4348***	0.0084
	(0.5401)	(0.0515)	(0.2181)	(0.0520)
$LTRADE^2$	−0.1975***			
	(0.0644)			
IGOV*LTRADE		0.2918***		
		(0.0582)		
LFD*LTRADE			−0.6004***	
			(0.0789)	
EDU*LTRADE				0.0094***
				(0.0013)
Cons	−0.3316***	−0.1749***	−0.2760**	0.3521***
	(0.0667)	(0.0410)	(0.1350)	(0.0585)
Number of countries	42	42	42	42
Number of observations	1302	1302	1302	1302

Note: ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels respectively.
Standard errors in parentheses.
Source: Author's calculations with data provided.

suggest a cointegration relation between economic growth and trade openness (see Table A2 of Appendix 1).

The PMG estimation results are summarized in Tables 1 to 3. We present only the long-run coefficients for the analysis (short-run coefficients are available on request). The short-run error correction term (speed of adjustment) is significantly negative for all models, confirming the cointegration relationship between the variables of interest and implying that the linkage between economic growth and the explanatory variables is characterized by high predictability and that the spread movement is mean-reverting.

The estimation results indicate a nonlinear relationship between trade openness and economic growth, and the evidence is robust to alternative trade openness measures (i.e., sum of exports and

Table 2
PMG long-run estimates of impact of trade openness (X/GDP) on growth of per capita GDP, 1980–2012.

	Model 1	Model 2	Model 3	Model 4
	Coef.	Coef.	Coef.	Coef.
GDP(−1)	−0.0704***	−0.0782***	−0.0688***	−0.0606***
	(.0186)	(0.0136)	(0.0146)	(0.0131)
LINV	0.2718***	0.4568***	0.4393***	0.5051***
	(0.0171)	(0.0247)	(0.0248)	(0.0291)
LFD	−0.1900***	−0.1056***	−0.2981**	−0.0552*
	(0.0243)	(0.0295)	(0.1176)	(0.0332)
INF	−0.0018***	−0.0001***	−0.0001***	−0.0001***
	(0.0005)	(0.0000)	(0.0000)	(0.0000)
IGOV	0.1450***	−0.5467***	0.2100***	0.3174***
	(0.0365)	(0.1568)	(0.0423)	(0.0519)
POP	−0.0329***	−0.0135	−0.0374***	−0.0384**
	(0.0055)	(0.0138)	(0.0140)	(0.0161)
EDU	0.0148***	0.0075***	0.0077***	0.0170***
	(0.0007)	(0.0009)	(0.0010)	(0.0028)
CRISIS	0.0193	−0.1095***	−0.0672*	−0.1160***
	(0.0257)	(0.0376)	(0.0369)	(0.0383)
LDEBT	−0.0494***	−0.0764***	−0.1041***	−0.0770***
	(0.0123)	(0.0105)	(0.0116)	(0.0108)
LEXPORT	1.0118***	0.2940***	0.1929**	0.5411***
	(0.2876)	(0.0297)	(0.0916)	(0.0821)
$LEXPORT^2$	−0.0861*			
	(0.0442)			
IGOV*LEXPORT		0.2026***		
		(0.0462)		
LFD*LEXPORT			0.0572*	
			(0.0342)	
EDU*LEXPORT				−0.0032***
				(0.0009)
Cons	0.0040	−0.1675***	−0.0806***	−0.2231***
	(0.0170)	(0.0361)	(0.0269)	(0.0536)
Number of countries	42	42	42	42
Number of observations	1302	1302	1302	1302

Note: ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels respectively.
Standard errors in parentheses.
Source: Author's calculations with data provided.

imports as a share of GDP and exports and imports as a share of GDP separately). The results show the presence of a Laffer Curve of trade (inverted U) and confirm that trade openness has a positive and significant effect on economic growth but only up to a threshold; above this threshold, the effect declines. These results indicate that the openness variables are relevant drivers of economic growth for sub-Saharan countries over the long run but that openness should be controlled since the associated coefficients of such variables and their quadratic terms are (respectively) positively and negatively significant at conventional levels.

For the first measure of trade openness (sum of exports and imports as a share of GDP), the threshold is estimated to be 134.21%. In other words, trade is associated with higher levels of economic growth up to the threshold where the sum of exports and imports represents 134.21% of

Table 3
PMG long-run estimates of impact of trade openness (M/GDP) on growth of per capita GDP, 1980–2012.

	Model 1	Model 2	Model 3	Model 4
	Coef.	Coef.	Coef.	Coef.
GDP(−1)	−0.0771***	−0.0696***	−0.0477***	−0.0641***
	(0.0229)	(0.0118)	(0.0163)	(0.0129)
LINV	0.2774***	0.4118***	0.5694***	0.3909***
	(0.0165)	(0.0256)	(0.0363)	(0.0248)
LFD	0.0089	−0.0896***	1.5119***	−0.1444***
	(0.0214)	(0.0318)	(0.1995)	(0.0310)
INF	−0.0001*	−0.0001***	−0.0003***	−0.0001***
	(0.0000)	(0.0000)	(0.0001)	(0.0000)
IGOV	0.0419	−0.6107**	0.1512***	0.2754***
	(0.0288)	(0.2444)	(0.0481)	(0.0380)
POP	−0.1999***	−0.0757***	0.0910***	−0.0492***
	(0.0229)	“(0.0185)	(0.0191)	(0.0144)
EDU	0.0043***	0.0064***	0.0076***	−0.0095
	(0.0010)	(0.0011)	(0.0016)	(0.0062)
CRISIS	−0.0688*	−0.1234***	−0.1643***	−0.1114***
	(0.0375)	(0.0385)	(0.0410)	(0.0345)
LDEBT	−0.2558***	−0.1492***	−0.0357	−0.0848***
	(0.0231)	(0.0223)	(0.0255)	(0.0185)
LIMPORT	1.0690***	0.1625***	1.3083***	0.0116
	(0.2338)	(0.0437)	(0.1820)	(0.0734)
$LIMPORT^2$	−0.1526***			
	(0.0331)			
IGOV*LIMPORT		0.1965***		
		(0.0667)		
LFD*LIMPORT			−0.5152***	
			(0.0605)	
EDU*LIMPORT				0.0047***
				(0.0017)
Cons	0.1445***	−0.0184	−0.3593***	0.0445***
	(0.0339)	(0.0172)	(0.1400)	(0.0141)
Number of countries	42	42	42	42
Number of observations	1302	1302	1302	1302

Note: ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels respectively.
Standard errors in parentheses.
Source: Author’s calculations with data provided.

GDP. Beyond this threshold, the effect of trade on growth declines. According to the second measure of trade openness (exports as a share of GDP), the findings indicate a threshold of 355.68%, suggesting that trade affects economic growth positively until exports account for 355.68% of GDP. After this threshold, trade’s impact on economic growth declines. For the third measure (imports as share of GDP), trade is associated with a higher level of growth when imports account for 33.16% of GDP; the effect declines after this threshold (see Table A3 of Appendix 1). The probability of reaching these threshold proportions of trade (134.21% or 355.68% of GDP) is small, practically non-existent, indicating that openness to exports may not reduce economic growth for sub-Saharan African countries. For the third measure, the result suggests that imports

can reduce economic growth. Thus, sub-Saharan African countries must efficiently control trade openness, particularly import levels, when seeking to boost their economic growth through international trade. Trade provides developing countries with access to the investment and intermediate goods that are vital to their development and the transfer of foreign technology, but such countries should productively reduce the import of consumption goods, by creating an environment that is conducive to efficiently producing domestically competing products in which there is dynamic comparative advantage.

These findings suggest that the openness of African economies to international trade should be associated with growth, which is in line with other empirical works (Ismail et al., 2010; Erçakar, 2011). Unlike in previous studies, however, the relation is not linear, confirming the fragility of the links between trade openness and economic growth for sub-Saharan African countries. This result is in line with the findings in Ulaşan (2015) on Organization for Economic Cooperation and Development (OECD) and non-OECD countries.

While the first regression considers only trade openness effects, we then examine the influence of several structural country characteristics in the trade–growth relationship. The results with the interaction terms are shown in Models 2, 3, and 4 (see Tables 1 to 3). We first test whether the trade–growth relationship changes with the development of the financial sector (Model 3). The coefficient of the interaction term with financial development is negative and significant for the first and third measures of trade openness and is positive for the second measure. These results suggest that a greater openness to trade via exports is associated with strong economic growth when the financial sector is more developed. In other words, easier access to credit may allow the export-oriented sectors to benefit more from trade openness. However, greater openness via imports is associated with lower economic growth, suggesting that easier access to credit among import-oriented sectors may reduce economic growth.

Model 4 shows the results of the estimations testing the role of human capital in the trade–growth relationship. The beneficial impact of an increase in trade openness on growth is greater when investment in human capital is higher. We find that an increase in the gross secondary enrollment rate is associated with a higher growth rate. This result is consistent with theoretical models suggesting that the effect of trade on growth may depend on the adoption of technology determined by human capital. Finally, we examine whether the relationship between openness to trade and economic growth may hinge on a country's institutional environment (Model 2). The results suggest that trade openness may be favorable to economic growth when institutional quality improves. In others words, an environment with high-quality governance seems to be more favorable to the emergence of new enterprises, allowing the economy to grow faster.

6. Conclusion

In this study, we have tested a dynamic growth model for sub-Saharan African economies using three measures of trade openness. Our results suggest that trade openness may impact growth favorably in the long run, but the effect is not linear. Our results show the presence of a Laffer Trade Curve (inverted U) and confirm that trade openness has a positive and significant effect on economic growth only up to a threshold, above which the effect declines. These results are robust to changes in trade openness measures. The non-linear relation between trade openness and economic growth suggests that the benefits of trade are not automatic. The growth effects of trade openness may differ according to the level of trade openness. Accordingly, sub-Saharan African countries must productively control trade openness, particularly the import of consumption goods, in boosting their economic growth through international trade. Our results suggest that trade openness must be

accompanied by complementary policies aimed at encouraging the financing of new investment and enhancing the quality of institutions and the ability to adjust and learn new skills. These policies would then allow resources to be reallocated away from less productive activities and toward more promising ones. Trade globalization should therefore not be seen in isolation. Additional policies are needed to enhance its impact on economic growth. Sub-Saharan countries should carry out relevant policy reform to encourage investment, allow effective governance, and promote human capital accumulation.

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Appendix 1. Panel unit root, panel cointegration, and threshold effects

Table A1
Panel unit root test.

	Level			First difference		
Variable	LLC	IPS	MW	LLC	IPS	MW
LGDP	−3.123***	−0.476	123.232***	−23.396***	−25.361***	953.534***
	(0.001)	(0.316)	(0.003)	(0.000)	(0.000)	(0.000)
INF	−20.200***	−21.707***	795.128***	−54.469***	−51.631***	2342.69***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LTRADE	−5.189***	−4.640***	163.589***	−39.362***	−37.658***	1613.635***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
IGOV	−13.660***	−10.802***	1531.543***	−120.00***	−121.000***	3005.901***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LDEBTEXP	−4.631***	1.226	81.059	−30.446***	−28.976***	1123.340***
	(0.000)	(0.889)	(0.570)	(0.000)	(0.000)	(0.000)
LINV	−4.568***	−0.722	90.878	−29.067***	−29.069***	1141.552***
	(0.000)	(0.234)	(0.285)	(0.000)	(0.000)	(0.000)
POP	−7.162***	−2.015**	230.614***	−17.582***	−21.896***	814.422***
	(0.000)	(0.021)	(0.000)	(0.000)	(0.000)	(0.000)
EDU	−4.143***	−0.692	126.890***	−26.748***	−29.656***	1217.673***
	(0.000)	(0.244)	(0.001)	(0.000)	(0.000)	(0.000)
LDEBGDP	−2.511***	3.875	52.314	−23.812***	−23.843***	848.934***
	(0.006)	(0.999)	(0.997)	(0.000)	(0.000)	(0.000)
LSDEBTEXP	−9.731***	−6.977***	227.586***	−38.191***	−37.062***	1607.242***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LFD	−2.037**	1.644	70.877	−29.279***	−26.213***	931.556***
	(0.020)	(0.950)	(0.845)	(0.000)	(0.000)	(0.000)
LEXPORT	−4.2118***	−4.2080***	163.371***	−36.683***	−32.198***	1235.9***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LIMPORT	−5.6871***	−6.819***	265.09***	−39.383***	−34.966***	1341.3***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Source: Author's calculations with data provided.
Note: LLC, IPS, and MW indicate (respectively) unit root tests in Levine et al. (2002), Im et al. (2003), and Maddala and Wu (1999; Fisher–ADF). The values in parentheses represent the probabilities associated with the test statistics. ***, **, and * the rejection of the null hypothesis of the presence of a unit root at 1%, 5%, and 10%.

Table A2
Panel cointegration test.

Ltrade	Panel statistics	Group statistics
PEDRONI		
V-statistic	13.16927***	————
	(0.000)	
Rho-statistic	0.22481	1.0013
	(0.5889)	(0.8417)
PP-Statistic	−1.50571*	−2.7078***
	(0.0661)	(0.0034)
ADF-statistic	1.03177	0.04023
	(0.8489)	(0.5160)
KAO	ADF-statistic: −7.243***	
	(0.000)	

Lexport	Panel statistics	Group statistics
PEDRONI		
V-statistic	14.08436***	———
	(0.000)	
Rho-statistic	−1.2184	0.2702
	(0.1115)	(0.6065)
PP-statistic	−3.0474***	−3.2900***
	(0.001)	(0.0005)
ADF-statistic	−0.4126	−0.6122
	(0.3399)	(0.2702)
KAO	ADF-statistic: −7.645***	
	(0.000)	

Limport	Panel statistics	Group statistics
PEDRONI		
V-statistic	13.5655***	————
	(0.000)	
Rho-statistic	0.38369	1.30834
	(0.6494)	(0.9046)
PP-statistic	−1.43443*	−2.396713***
	(0.0757)	(0.0083)
ADF-statistic	1.07839	0.31785
	(0.8596)	(0.6247)
KAO	ADF-statistic: −7.143117***	
	(0.000)	

Source: Author's calculations with data provided.
Note: Standard errors in parentheses; ***, **, and * specify that coefficients are statistically significant at the 1%, 5%, and 10% levels.

Table A3
Threshold effects.

	Openness indicators		
	Ltrade	Lexport	Limport
Growth model	134.21	355.68	33.16

Notes: The threshold values are in percentage of GDP.

Table A4
Data sources, definitions, and descriptive statistics.

Variable	Definition	Source	Average	Standard deviation
Dependent variable				
GDP	Growth of per capita GDP	WDI	2069.86	3293.117
Trade variables				
(X + M)/GDP	The sum of exports and imports as a share of GDP (TRADE)	WDI	70.02633	35.54374
X/GDP	Exports as a share of GDP (EXPORT)	WDI	29.31413	18.14106
M/GDP	Imports as a share of GDP	WDI	40.7122	23.04476
Human and physical capital variables				
EDU	Gross secondary enrollment rate	WDI	30.3445	22.98946
POP	Population growth rate	WDI	2.505688	1.104741
INV	Gross fixed capital formation	WDI	2.15e + 09	6.54e + 09
Macroeconomic stability variables				
INF	Rate of change in price level	WDI	52.19921	756.5322
DEBT	External debt as share of GDP	WDI	92.33425	125.7139
CRISIS	Financial crisis, set at 0 before 2008 year and 1 after 2008	WDI		
FD	Private credit as a share of GDP	WDI	17.50941	19.18839
Institutional quality variable				
IGOV	Governance index	Kaufmann indicators (WDI)	−.2723996	.5050246

Source: Author's calculations with data provided.

Appendix 2. List of countries in the sample

Country	Country	Country
Angola	Gabon	Niger
Benin	Gambia, The	Nigeria
Botswana	Ghana	Rwanda
Burkina Faso	Guinea	Senegal
Burundi	Guinea-Bissau	Seychelles
Cameroon	Kenya	Sierra Leone
Cape Verde	Lesotho	South Africa
Central African Republic	Liberia	Sudan
Chad	Madagascar	Swaziland
Comoros	Malawi	Tanzania
Congo, Dem. Rep.	Mali	Togo
Congo Rep.	Mauritania	Uganda
Cote d"Ivoire	Mauritius	Zambia
Ethiopia	Mozambique	Zimbabwe

Source: Author.

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