Impacts of Trade Intensity in China and India on the Aggregated Sub-Saharan Africa Economic Growth

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Third Annual Conference 2008
Strengthening and deepening economic integration in LDCs: current situation, challenges and way forward

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Abstract

Recent years have shown the emergence of two major countries, China and India in the international trade area. This paper aims to examine how the increasing part of these two countries in trade impacts the African continent. The intensity of trade is measured by the share of exports plus imports in the gross domestic (GDP) while economic growth in the Sub-Saharan Africa is proxies by the GDP per capita. We focus on Sub-Saharan Africa as a whole during the period 1960-2005 to see how trade intensity in China and India and in Sub-Saharan Africa as well has impacted the GDP per capita growth rate in that African zone. For that purpose first we use an Autoregressive distributed lag (ARDL) Time series model to analyze both the short and long-run impacts of these variables on the GDP per capita growth rate of the aggregated SSA. Secondly using a VAR we perform impulse response analysis to see the impacts of trade intensity in China, India and Sub-Saharan Africa on the per capita growth in the Sub-Saharan Africa.

JEL Classification: C22, C32, C51, F13

Keywords: Economic Growth, Trade, Time Series, ARDL Model, VAR Model.

1. Introduction

Two major countries, namely China and India, have emerged in the international trade during the recent years with a large share of world trade, in exports as well as in imports. More importantly there is a debate of the increasing part of these two giant countries on the African continent as they need to import raw material from Africa and export manufactured goods to Africa continent and to other parts of the world.

About China, Zafar (2007) indicates that: *"China's economic ascendance over the past two decades has generated ripple effects in the world economy. Its search for natural resources to satisfy the demands of industrialization has led it to Sub-Saharan Africa. Trade between China and Africa in 2006 totaled more than $50 billion, with Chinese companies importing oil from Angola and Sudan, timber from Central Africa, and copper from Zambia. Demand from China has contributed to an upward swing in prices, particularly for oil and metals from Africa, and has given a boost to real GDP in Sub-Saharan Africa".*

In the same time China and India invest with sometimes rivalry in several sectors of Africa's economy (mining, hospital, banking, and telecommunication), creating jobs, and providing aid all over the continent.

A number of authors have examined specific countries' cases or specific questions or goods. Jenkins and Edwards (2004) investigated how China's growth affects poverty reduction in Asia, Africa and Latin America, while Kaplinsky (2006) deals with term of trade, indicating that the entry of China into the global market has played an important role in the augmenting the demand for many commodities (as metals). Streifel (2006) looked at the impact of China and India on global commodity markets focusing on metals, minerals and petroleum. Jenkins and Edwards (2006) examined the impact of the emergence of China and India as important players in the global economy on 21 sub-Saharan African countries. They assert that the ways in which Africa has been affected differs from country to country, with some such as Angola, Nigeria and Sudan being important exporters, others such as Ghana, Ethiopia, Kenya, Tanzania and Uganda mainly importers from Asia, and Lesotho facing competition from China in export markets.

Few works have specifically examined the impact of these growing countries on the aggregated Sub-Saharan African zone. Here we intend to examine empirically how trade intensity into these to Giants impacts the Sub-Saharan Africa growth by looking at the effects of the growth in the GDP

per capita of these two countries on trade and growth in the aggregated Sub-Saharan Africa.

This paper uses alternatively first an Autoregressive distributed lag (ARDL) Time series model to analyze both the short and long-run impacts of these variables on the GDP per capita growth rate of the aggregated SSA, and secondly a VAR model to perform impulse response analysis to see the impacts of trade intensity in China, India and SSA on the per capita growth in the SSA

Our empirical findings indicate that for the aggregated Sub-Saharan Africa area the trade intensity of the two emerging countries, namely China and India have differential short and long-run impacts on the GDP per capita growth rate in the aggregated Sub-Saharan Africa. We find that trade intensity in China is not significant in the short-run while an increase in the Indian trade intensity positively impacts the short-run GDP per capita growth in the Sub-Saharan Africa, and trade intensity in China negatively impacts the GDP per capita growth rate of the Sub-Saharan Africa.

Concerning the impact of Trade intensity on the GDP per capita the two models (the ARDL and the VAR) deliver conflicting results for China and Sub-Saharan Africa while the results of the two models are concordant for India. Regarding the effect of the variables on the trade intensity in the Sub-Saharan Africa, the VAR model indicates negative impacts in the short and long-run, except for the impact of the GDP per capita of Sub-Saharan Africa on the trade intensity in the Sub-Saharan Africa.

Overall the findings suggest that the trade intensity of the two emerging countries, namely China and India have differential short and long-run impacts on the GDP per capita growth rate in the aggregated Sub-Saharan Africa.

The remaining of the paper organized as follows. Section 2 presents the model and the econometric methodology used in this study. Section 3 presents the estimations results and final remarks are provided in Section 4.

2. The Model Specification

The ARDL model

We adopt a simple model aiming to estimate the following relationship where the GDP per capita of the Sub-Saharan Africa (SSA) is explained by trade intensity in China, India and SSA:

$$GDP_{SSA,t} = f(TI_{Chin,t}, TI_{Ind,t}, TI_{SSA,t}) + \xi_t \quad (1)$$

In this equation the variable GDP_{SSA} denotes the per capita GDP of the SSA, while TI_{Chin}, TI_{Ind} and TI_{SSA} indicate trade intensity as measured by the share of exports and imports in GDP, for China, India and SSA respectively, ξ_t is a stochastic error term, and t is year index.

Expressing Eq. 1 in a natural logarithm form gives the following long run equation:

$$\ln GDP_{SSA,t} = \alpha + \gamma_1 \ln TI_{Chin,t} + \gamma_2 \ln TI_{Ind,t} + \gamma_3 \ln TI_{SSA,t}) + \xi_t \quad (2)$$

The assumptions concerning the preceding Eq. 2 are that trade intensity variables are supposed to positively impact the GDP per capita of the SSA.

The estimation will be performed using an unrestricted general to specific Hendry (1995) type error correction model (ECM) where the long-run

relationship is embedded within the dynamic specification, including the lagged dependent and independent variables as follows:

$$\begin{aligned}\Delta \ln GDP_{SSA,t} = \alpha + \gamma_1 \Delta \ln TI_{Chin,t} + \gamma_2 \Delta \ln TI_{Ind,t} + \gamma_3 \Delta \ln TI_{SSA,t} \\ + \gamma_4 (\ln GDP_{SSA} - \beta_1 \ln TI_{Chin} \\ + \beta_2 \ln TI_{Ind} + \beta_3 \ln TI_{SSA})_{t-1} + \nu_t\end{aligned} \quad (3)$$

This model is re-parameterized in the following estimable form:

$$\begin{aligned}\Delta \ln GDP_{SSA,t} = \alpha + \gamma_1 \Delta \ln TI_{Chin,t} + \gamma_2 \Delta \ln TI_{Ind,t} + \gamma_3 \Delta \ln TI_{SSA,t} \\ + \gamma_4 \ln GDP_{SSA,t-1} + \gamma_5 \ln TI_{Chin,t-1} \\ + \gamma_6 \ln TI_{Ind,t-1} + \gamma_7 \ln TI_{SSA,t-1} + \nu_t\end{aligned} \quad (4)$$

Although this model helps to explain the link between the variables by expressing the impacts of the exogenous right-hand side variables on the endogenous left-hand side variable, it does not give any cross relationships between all these variables. To allow for inter relationships analyses a VAR model appears more suitable.

The VAR Model

Methodologically without a formal explicative model the VAR models appear an appropriate alternative to estimate the relationships between variables in presence (see Bagliano and Favero, 1998 ; and Christiano et al., 2005).

The VAR model of 6 variables is expressed as followed:

$$X_t = \left[GDPpc_{SSA,t}, GDPpc_{Chin,t}, GDPpc_{Ind,t}, TI_{SSA,t}, TI_{Chin,t} TI_{Ind,t}\right] \quad (5)$$

with $GDPpc_{i,t}$ representing the GDP per capita of SSA, China and India at time *t*, and $TI_{i,t}$ is the trade intensity in SSA, China and India.

Next trade intensities and the GDP per capita in China and India are modelled in Eq. 6 bellow as a function of the information *I*, and a trade shock ε_t orthogonal to the information contained in *I*.

$$Y_{i,t} = f(I) + \varepsilon_t \tag{6}$$

Hypothesis: $GDPpc_{SSA}$ does not respond contemporaneously to shocks ε_t.

The VAR contains only one lag due to data constraints, and has the following general form:

$$X_t = AX_{t-1} + C\eta_t \tag{7}$$

The variable *C* in Eq. 7 represents a triangular 6x6 matrix with diagonal elements equal one, and η_t is a vector of dimension 6 with mean zero. The shocks ε_t are the 2nd, the 3rd, 4th, the 5th and the 6th elements of the vector η_t.

This representation is useful to test the dynamic response of the GDP per capita in SSA to trade intensity and GDP shocks. These responses will be performed using the impulse response functions of the VAR.

3. Data and Results

Data

We estimate the model using data from World Development Indicators (WDI 2007) and covering the period 1960-2005. Figure 1 shows the series in level and Figure 2 in first difference (growth rate).

The variable *LGDPpc* indicates the natural logarithm of the Gross domestic product per capita and *LTI* indicates the natural logarithm of trade intensity as measured by the share of exports plus imports in GDP.

From Figure 1 we could see that population in the aggregated SSA is lower than in both China and India. While the GDP per capita of the Sub-Saharan Africa was higher than those of China and India from 1969 to 1991, the GDP per capita of China overcomes those of the Sub-Saharan Africa and India since 1991, and the GDP per capita in India overcomes the one of SSA from 2003.

The trade intensity of the Sub-Saharan Africa is higher than both of China and India all over the period, but since 2001 trade intensity in China is the highest, overcoming the Sub-Saharan Africa one. The growth rate of the GDP and GDP per capita in China is higher than those of India and Sub-Saharan Africa.

Figure 1: Trade as percentage of GDP; GDP (Constant 2000 US$); Population; and GDPpc (Constant 2000 US$)

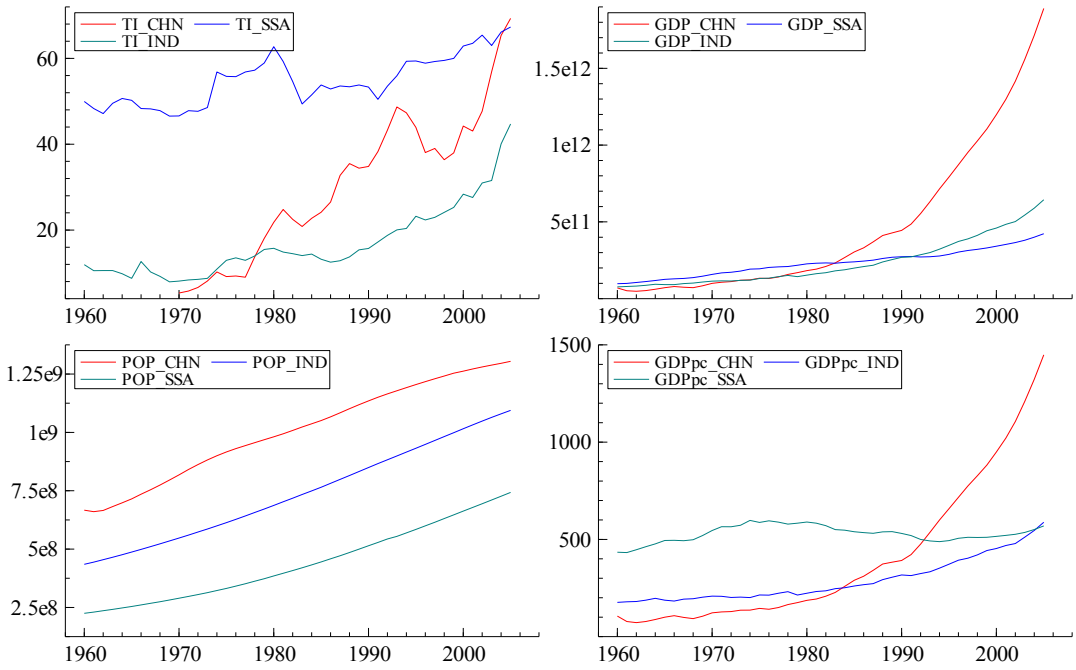
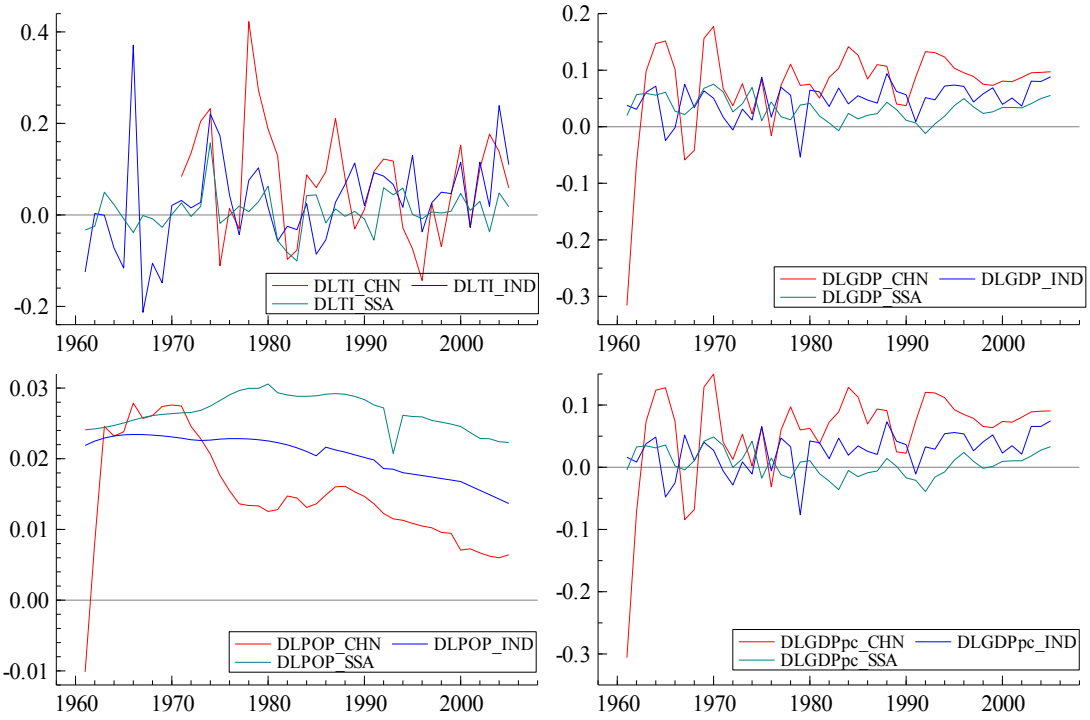


Figure 2: Trade as percentage of GDP; GDP (Constant 2000 US$); Population; and GDPpc (Constant 2000 US$); Growth Rate.



Econometric Results

- The ARDL Model

The final estimated dynamic ECM of Eq. 4 is reported in Table 1 along with the diagnostic tests and the long-run elasticities of the variables and their t-ratio regarding which all variables are significant. Figure 3 depicts the estimates and residuals. The dynamic ECM equation is reported as follows:

$$\Delta \ln GDP_{SSA,t} = 0.56 + 0.055\Delta \ln TI_{Ind,t} + 0.14\Delta \ln TI_{SSA,t} - 0.095 \ln GDP_{SSA,t-1} - 0.01 \ln TI_{Chin,t-1} + 0.29 \ln TI_{Ind,t-1} \quad (8)$$

This equation indicates that in the short run, a 1% increase in the trade intensity of India enhances the Sub-Saharan Africa's GDP per capita growth by 0.055%, while a 1% increase in the trade intensity of the Sub-

Saharan Africa leads to 0.14% increase in the Sub-Saharan Africa growth. The coefficient of trade intensity in China appears insignificant in the estimations meaning that trade intensity in China has no short run significant impact on the Sub-Saharan Africa's GDP per capita growth. The coefficient of the GDP per capita (-0.095) in Eq. 5 indicates the speed of the adjustment of the system to the long-run. The long-run equation derived from the preceding dynamic ECM in Eq. 5 is the following:

$$\ln GDPpc_{SSA,t} = 0.31 \ln TI_{Ind,t} - 0.10 \ln TI_{Chin,t} \quad (9)$$

In this long-run equation the trade intensity in India has a positive sign expressing thus the fact that the trade intensity in India does have a positive impact on the Sub-Saharan Africa's GDP per capita growth; whereas the trade intensity in China has a negative sign indicating that trade intensity in China is not beneficial to the long run GDP per capita growth in the aggregated Sub-Saharan Africa area. The trade intensity in the Sub-Saharan Africa is not significant in the long run.

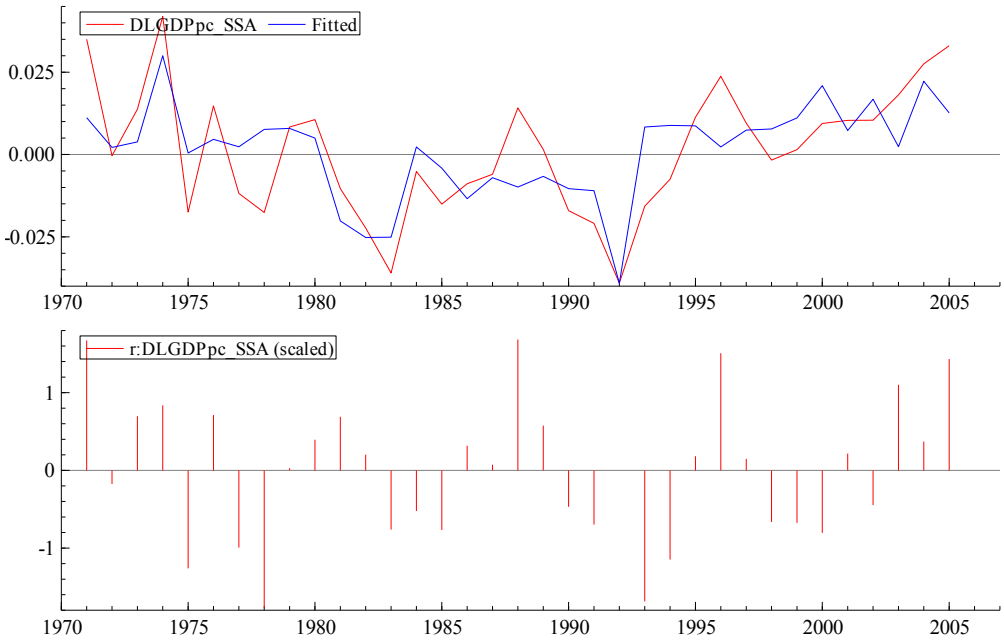
Table 1: Model estimation, OLS 1971 to 2005 (Dependent variable: DLGDPpc_SSA)[2]

	Coefficient		Std. Error	t-value
Constant	0.5628		0.4111	1.37
DLTI_IND	0.0557		0.0371	1.50
DLTI_SSA	0.1422		0.0660	2.16
LGDPpc_SSA_1	-0.0931		0.0636	-1.46
LTI_CHN_1	-0.0192		0.0086	-2.23
LTI_IND_1	0.0297		0.0124	2.39
DUM92	-0.0468		0.0151	-3.10
sigma	0.0142	RSS		0.00569
R^2	0.5473	F(6,28) =		5.643 [0.001]**
log-likelihood	102.987	DW		1.51
no. of observations	35	no. of parameters		7

Note: LGDPpc_SSA_1 indicates the log of GDPpc_SSA one period lag. DUM92 is a dummy variable.

[2] Estimations are performed using PcGive 10 (Hendry and Doornik 2001).

Figure 3: Estimates and Residuals



- The VAR Model

The impulse responses from the estimation of the VAR model are depicted in the following Figure 4. The responses of the GDP per capita in the SSA to a shock on Trade intensity in the Sub-Saharan Africa, in China and in India are reported in these Figures.

We could see that following a shock on the trade intensity in the Sub-Saharan Africa, the GDP per capita of the Sub-Saharan Africa increases immediately (one year period) and decreases in the short run (2 years), and then increases in the long run (after 3 years), while a shock on Trade intensity in China leads to an increase of the GDP per capita of the Sub-Saharan Africa over 9 years before decreasing during 10 years and increasing in the long run. On the other hand, a shock on the trade intensity in India has a positive growing impact on the GDP per capita of the Sub-Saharan Africa during 3 years before declining during 6 years. In the long run (after 9 years) the shock is positive.

Figure 4: Response of the SSA per Capita Growth to Trade and GDPpc Shocks

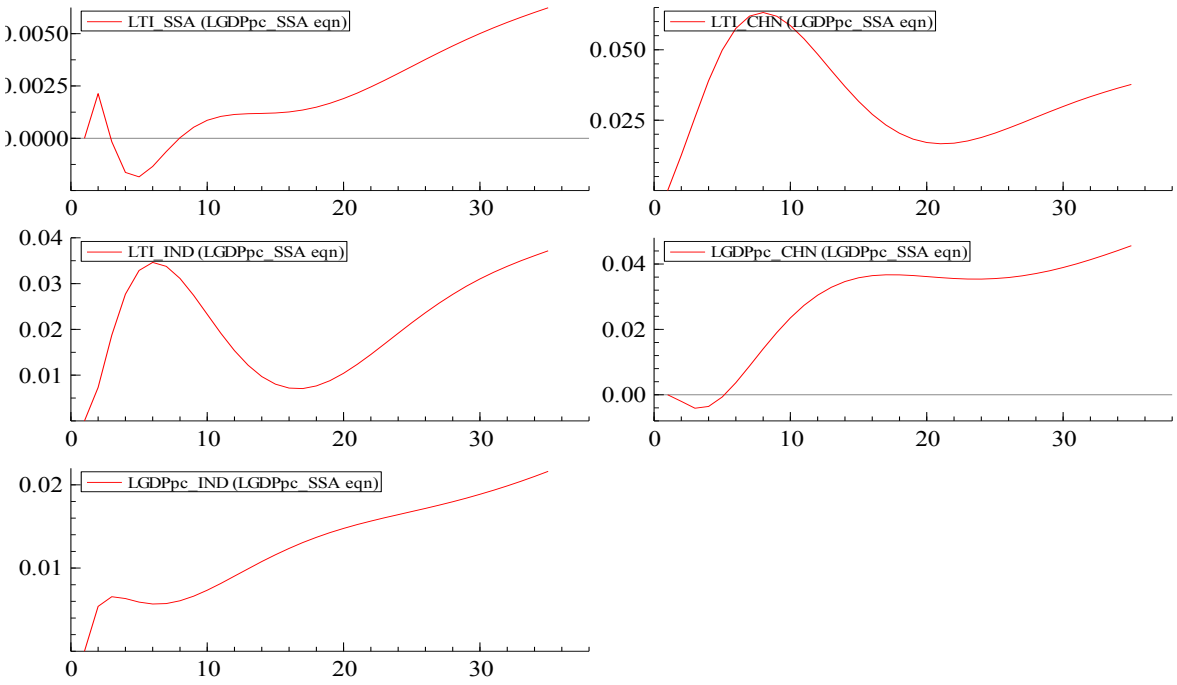
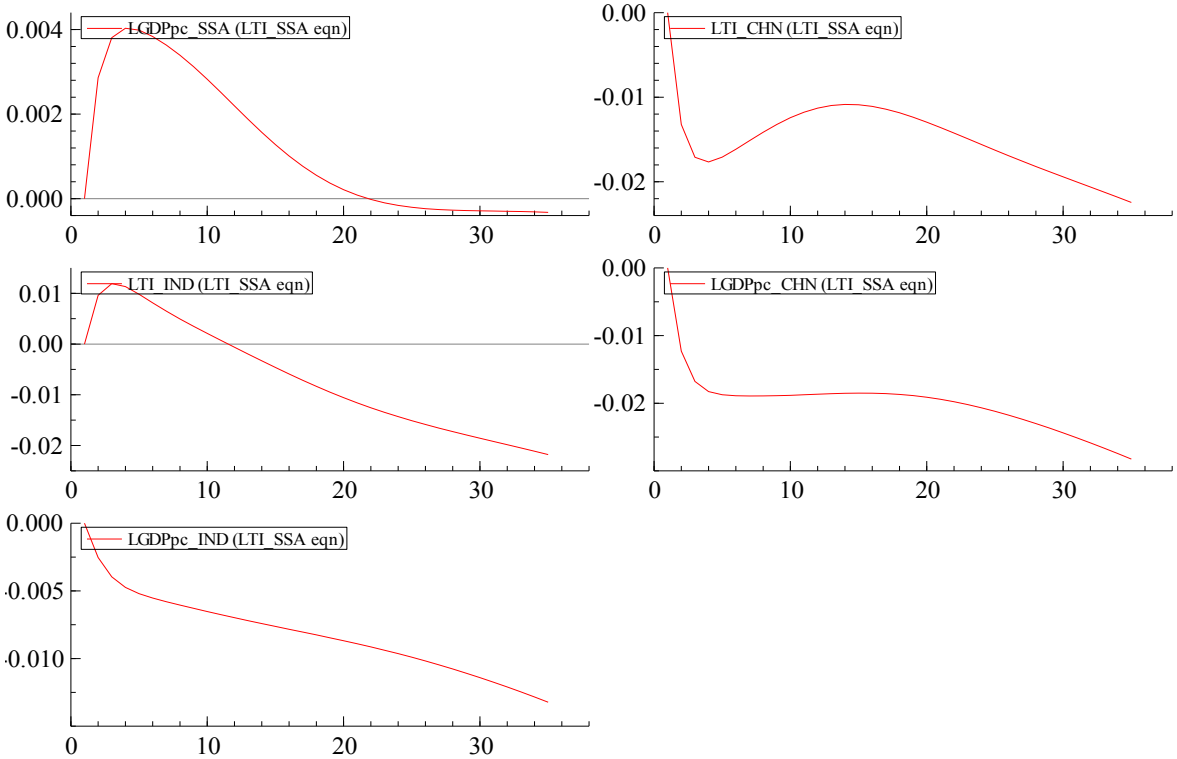


Figure 5: Response of Trade Intensity to the SSA per Capita GDP Shock



A shock on the GDP per capita in the Sub-Saharan Africa leads to a 2 years increase in trade intensity in the Sub-Saharan Africa and a decrease in the long run. A shock on the GDP per capita in China and India has a decreasing effect on the trade intensity in the Sub-Saharan Africa. A shock on the trade intensity in China has a decreasing effect on the short-run Sub-Saharan Africa's trade intensity (2 years), and increasing effect over 6 years and a decreasing impact in the long run. A shock on the trade intensity in India has a decreasing effect on the Sub-Saharan Africa's trade intensity in the short and long-run.

Table 2: Models Results Comparison

Model	**1% Increase in**	**Short-run**	**Long-run**
		Impact on $GDPpc_{SSA}$	
ARDL	TI_{SSA}	Increase (+)	non significant
	TI_{Chin}	non significant	Decrease (-)
	TI_{Ind}	Increase (+)	Increase (+)
VAR	TI_{SSA}	Decrease (-)	Increase (+)
	TI_{Chin}	Decrease (-)	Increase (-)
	TI_{Ind}	Increase (+)	Increase (+)
		Impact on $Trade\text{-}Intensity_{SSA}$	
	$GDPpc_{Chin}$	Increase	Decrease
	$GDPpc_{Ind}$	Decrease	Decrease
	TI_{Chin}	Decrease	Decrease
	TI_{Ind}	Decrease	Decrease

4. Final remarks

This paper examined the impact of trade intensity in China and India proxies by the share of imports plus exports in the GDP per capita growth in the Sub-Saharan Africa over the period 1971-2005. These relationships are analyzed using firstly an autoregressive distributes lag ECM approach, and secondly using impulse responses from a VAR model.

We find diverse impacts of the Chinese and Indian trade intensity on the Sub-Saharan Africa's GDP per capita growth. While trade intensity in China is not significant in the short run, an increase in the Indian trade intensity positively impacts the short run GDP per capita growth in the Sub-Saharan Africa, while the trade intensity in China negatively impacts the short run Sub-Saharan Africa's GDP per capita growth rate.

Concerning the impact of trade intensity on the GDP per capita the two models (ARDL and VAR) deliver conflicting results for China and Sub-Saharan Africa while the results are concordant for India. In the case of the effect of the variables on the trade intensity in the Sub-Saharan Africa, the VAR model indicates negative impacts in the short and long-run, except for the impact of the GDP per capita of sub-Saharan Africa on the Trade intensity in the Sub-Saharan Africa.

The findings suggest that the trade intensity of the two emerging countries, namely China and India have differential short and long-run impacts on the GDP per capita growth rate on the aggregated SSA.

The intensity of trade, which is an aspect of the increasing globalization phenomenon of Sub-Saharan Africa economies and China and India as well, does have a significant and beneficial long-run impact on the GDP per capita in this zone. In the long-run, the impact of the variables on the trade intensity will decrease. The beneficial long-run aspects of the trade intensity in the Sub-Saharan Africa, China and India on growth in the Sub-Saharan Africa should be considered by policy markers concerned with new growth strategies in the Sub-Saharan Africa.

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