10

Can Trade Openness and Global Value Chains Improve Real GDP Growth and Human Development Index in Sub-Saharan African Countries?

Beatrice Isah Dara

10.1 Introduction

In this chapter, the author analyses the role of trade openness on the human development index (HDI) and economic growth in five Sub-Saharan African countries with the lowest HDI, using unbalanced panel data from 1980 to 2016. The use of the Hausman test allows the researcher to determine the right estimate for analysing panel data.

The HDI highlights the importance of using people and their capabilities as the "ultimate" criteria for assessing the development outcome of a country alongside economic growth. It is a "composite index" that measures the human development achievements of a country in terms of (a) health–life expectancy at birth or living a long and healthy life, (b) education–average years of schooling for adults and expected average years of schooling for children and (c) standard of living–the Purchasing Power

B. I. Dara (✉)
Center for African Research in Enterprise & Economic Development—School of Business & Enterprise, University of the West of Scotland Paisley Campus, United Kingdom, Paisley, Scotland

A. Adewole, J. J. Struthers (eds.), *Logistics and Global Value Chains in Africa*, Palgrave Studies of Sustainable Business in Africa,
https://doi.org/10.1007/978-3-319-77652-1_10

Parity (PPP)-adjusted gross national income (GNI) per capita (see UNDP 2015). Over the years, the HDI measure has been accepted as an indicator for welfare comparison across countries due to its ability to capture multi-dimensional well-being variables (which are the life expectancy, knowledge and living standard) that extend beyond the purchasing power of personal income (Harttgen and Klasen 2012) and due to its simplicity (Hou et al. 2014). According to UNDP (2015), HDI can be used to examine national policy choices. It can compare countries with the same level of GNI per capita and question why they end up with different human development outcomes.

Nevertheless, this indicator has been criticised in terms of its methodology (Ravallion 1997; Grimm et al. 2008; Harttgen and Klasen 2012) as it does not measure variables such as inequalities, poverty, human security and empowerment. The indicator has also been criticised in terms of a development viewpoint. Literature has advocated that both social and development components, such as cultural freedom, human rights, access to social services, peace and security should be included in the measurement of the HDI (Noorbakhsh 1998; Sagar and Najam 1998; Anand and Sen 2000).

Correspondingly in the literature, trade openness has received positive recognition as a strong factor that influences economic progress, especially in the long run. Similarly, global value chains (GVCs) have received positive recognition as strong factors that influence economic progress through linking and co-ordinating global trade activities from the production of raw material, through the stage of finished product and to supplying the finished goods at global markets. GVCs link production stages from start to finish hence linking and co-ordinating activities of firms across countries. GVCs have provided poor countries with the opportunity to expand their export hence strengthening their integration into global economy. According to World Bank (2017), poor countries that are involved in GVCs have experienced rapid productivity growth, employment growth and an improvement in their standard of living and a decline in poverty. This chapter, therefore, aims to investigate the impact of trade openness, GVCs, education, foreign direct investment (FDI) and GDP per capita on the HDI in the sub-Saharan African countries that recorded the lowest HDI between 1980 and 2013, such as Chad,

Democratic Republic of Congo, Central African Republic, Niger and Sierra Leone. Data from UNDP's HDI show that these countries have the lowest rate of life expectancy, the lowest level of educational attainment and have the lowest standard of living in the world.

10.2 The Main Objectives of This Chapter

The contribution of this chapter lies in establishing the systematic link between trade openness, real GDP growth and human development for sustainable development and positive welfare outcomes in sub-Saharan African countries. The main objectives, therefore, will be to:

- explore the theoretical framework that links trade openness to economic growth, HDI and GVC;
- analyse the impact of trade openness on GVCs in sub-Saharan African countries;
- explore the impact of trade openness on HDI in five sub-Saharan African countries using panel data from 1980 to 2016;
- extend Cobb–Douglas production function by substituting technology growth with trade openness to estimate its relationship with economic growth within the context of the GVC; and
- use the Hausman test to determine the right estimation on HDI GVCs and economic growth models.

10.3 Theoretical Framework: Trade Openness and GDP Growth

The theory of trade openness or free trade can be traced back to the work of Adam Smith in 1723 and David Ricardo in 1772. They believed that trade surplus brought about economic progress. They also believed that trade with no restrictions was a channel that carried out the surplus produced in a country (export), for which there was little or no demand, to countries that had an increasing demand for the produce. This was a chan-

nel that also brought in products (imports) from other countries, which were not produced locally but where there was an increasing demand (Thirlwall 2006). Adam Smith, in his book *The Wealth of Nations*, highlighted that free international trade brings about global competition and economic growth. Furthermore, IIASA (2008) showed that free trade encourages: (a) exploitation of economies of scale in countries where more units of goods and services can be produced on a larger scale at a minimal cost; (b) an increase in economic wealth—GDP; (c) an efficiency of resource allocation; (d) R&D—competitiveness and technology spillover. The potential gains to trade openness are commonly classified into static and dynamic gains from trade as shown in the Fig. 10.1.

10.3.1 Static Gains from Trade: Ricardo's Comparative Advantage Theory

Ricardo's comparative advantage theory suggests which goods and services a country should produce and specialise in by allocating scarce resources to produce those goods and services at a lower cost. This will mean importing goods and services that are cheaper to import than produce internally. However, some analysts argue that importation of certain goods and services into a country will put its indigenous companies out of business. If the cost of producing those imported goods within a country is very high, the country will be better off importing them rather than producing them. For instance, suppose the resources that Niger uses to

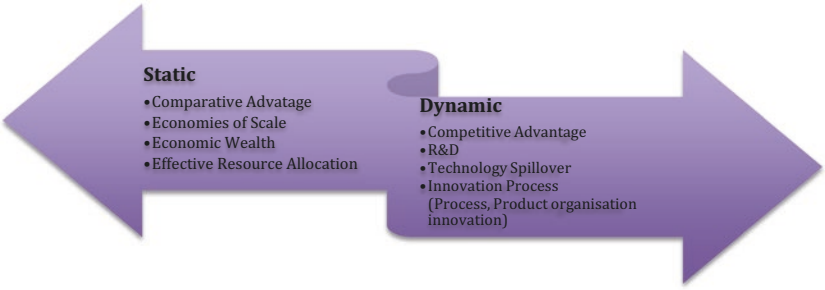

Fig. 10.1 Gains of trade. (Source: Author 2018)

refine crude oil could have produced 4057 tonnes of uranium instead, then the opportunity cost of refining crude is the 4057 tonnes of uranium. It would be cheaper for Niger to import petroleum from Nigeria and then produce uranium. This means Niger has a comparative advantage in uranium production, while Nigeria has a comparative advantage in producing petroleum.

10.3.2 Dynamic Gains from Trade

Trade openness will provide indigenous firms with the opportunity to access larger and more global markets, hence making indigenous firms more competitive and efficient in producing improved and innovative products for international markets. Research and development, technological spillover and innovations are the dynamic gains from trade openness.

Heckscher–Ohlin and Stolper–Samuelson theorems suggests that economies should specialise in the production of tradable goods and services in which they have comparative advantages, using their most abundant factor of production so that they increase their prosperity. This means that in developing countries where labour is abundant, trade openness should lead to specialisation in labour-intensive goods, whereas trade openness should lead to specialisation in capital-intensive goods in developed countries that have abundant capital. This will lead to efficient productivity and economic growth. In the nineteenth century, Alfred Marshall in 1890 agreed with Smith and Ricardo, revealing that the major determinant of economic progress of any nation was an international trade with limited restrictions. The most recent empirical analysis has also revealed that an increase in trade openness accelerates economic growth in India (Chatterji et al. 2013) and in other developing countries (Babula and Anderson 2008; Bruckner and Lederman 2012). Similarly, Allard et al. (2016) found that increased trade has a significant and positive influence on growth in sub-Saharan Africa. Both the increase in trade openness and the improvement in terms of trade have contributed to the acceleration of real per capita GDP growth. However, Allard et al. (2016) added that while trade openness is found to have supported overall growth, labour productivity itself has not benefited as much as in sub-Saharan Africa as in other regions undergoing trade.

In terms of the equitable distribution of the gains from trade openness, Dollar and Kraay (2007) revealed that (a) fairly distributed gains from trade openness can accelerate GDP per capita growth (they found no evidence to suggest that as international trade increases, inequality increases); and (b) due to the increase of GDP per capita and reduction in inequality, the incidence of poverty is reduced considerably in the selected developing countries. Similarly, Barro and Martin (1997) revealed that in the long run, trade openness can enhance economic growth in developing countries through the import of technology and knowledge. As such, developing countries with trade liberalisation policies will tend to integrate and trade more with an advanced economy in the global market and hence gain access to technology, efficiency and competitiveness. The trade liberalisation policies were introduced to an import substitution strategy when growing evidence suggested that opened economies recorded a higher economic growth rate in East Asian economies, especially in China and Hong Kong (Stiglitz 1996).

However, Gourdon (2011) found no clear-cut empirical relationship between trade liberalisation, economic growth and inequalities in developing countries. Furthermore, Olufemi (2004) argued that trade openness may have a negative impact on economic growth in countries with infant industries and in countries exporting primary products, as they become vulnerable to terms of trade shocks.

Thirlwall (2006) showed that there are several channels through which trade openness might influence the long-term economic progress of an economy. Increased trade openness: (1) attracts foreign investment and external cash flows into the host country; (2) promotes technology transfer and faster productivity growth; and (3) encourages specialisation in sectors where a country has a comparative advantage. Due to specialisation and economies of scale, more real goods and services can be traded and exchanged between countries. Open market-oriented economies can promote trade through export-led growth policies. This in turn stimulates knowledge and technology transfers, and backward and forward linkages (Kabadayi 2013). However, several factors will need to be in place to facilitate trade and attract FDI, such as macroeconomic policies, limited trade restrictions and good infrastructure (see Fig. 10.2).

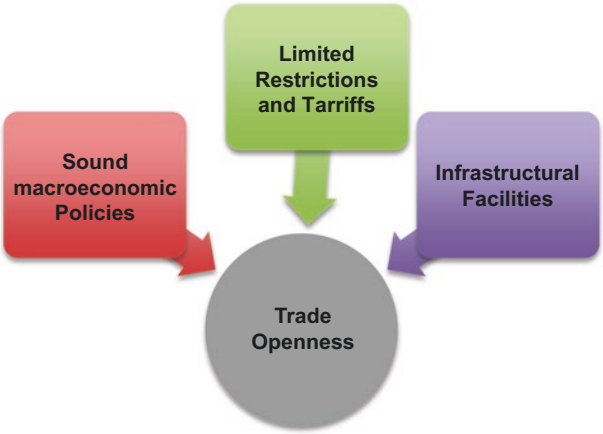

Fig. 10.2 Factors influencing trade openness. (Source: Author 2018)

Nevertheless, there are arguments that trade openness is a static trade strategy—it may work to the benefit of some countries like Taiwan, South Korea, Singapore and Hong Kong (Krueger 1997), but be detrimental to other countries. Some argue that trade openness might worsen the terms of trade ratio and balance of trade (BOP) deficit in developing countries (Le Goff and Jan Singh 2013); while others say that trade openness might encourage international dumping. Infant industries in developing countries might find it difficult to compete on international goods and services (Thirlwall 2006). White and Anderson (2001) argue that the policy reform of trade openness recommended in the Washington consensus failed to stimulate pro-poor growth in developing countries.

10.4 Trade Openness and GVCs

Through GVCs, production processes become interlinked, providing a unique opportunity for different firms from diverse countries to intensify their comparative and competitive advantages. Through the processes of making a product, which are carried out in different stages by different

enterprises in several countries (Tinta 2017), GVCs enhance economic integration and bring about the benefit of the shared value-added of goods and services from the various participants. GVCs are an important feature of international trade in almost all economies. The process begins with the production of raw materials and ends with finished products. GVCs link and co-ordinate the activities of companies at each stage of production across countries, hence enabling value creation and advancement. With the growing importance of GVCs across countries, trade openness and non-tariff barriers will help to influence interlinkages between domestic producers and foreign suppliers, creating room for inclusive growth and employment creation in most economies. This means the production of a product is no longer carried out start to finish in one place or country, but is a long series of steps and stages in a number of locations. For instance, crude oil can be produced in Nigeria in a number of stages, then transported to a different country for refining, again following a series of stages, and finally transported to a retail company for distribution and consumption.

The value chains in the oil and gas sector in terms of production and trade run through several stages. In the exploration stage, crude oil and natural resources are sought using seismic studies in the form of topographical maps, aerial photography, sound waves and 3D projections to reveal oil and gas reserves under the earth's surface. After establishing the location of oil and gas in the field, an extraction company drills for it (production). The next stage is transportation, which involves building and maintaining pipelines, and the use of large tankers and ships to transport oil and gas to refineries and customers worldwide. At the refinery stage, crude oil is transformed into petroleum products such as petrol, kerosene and diesel. The transformed products are then traded on the retail market for consumption (BP 2014; Oyejide and Adewuyi 2011). However, to make GVCs efficient it is important that firms reduce production costs and improve logistics along the production chain. Figure 10.3 shows the GVC interlinkage in the oil and gas sector in Nigeria.

To test the impact of trade openness on GVC empirically, data is sourced from the World Bank to show whether trade openness can

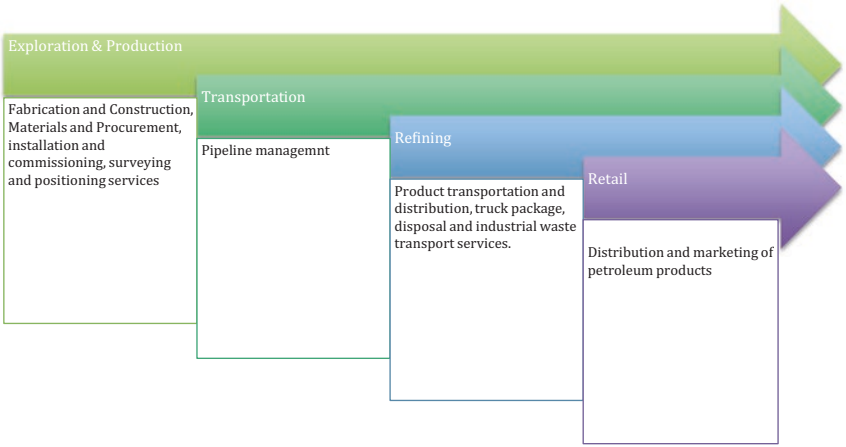

Fig. 10.3 Global value interlinkage in the oil and gas sector in Nigeria. (Source: Author 2018)

influence GVCs among countries in sub-Saharan Africa. The export value-added index is used as a proxy to measure GVCs, this proxy measure is suggested by Johnson (2017). The variables GVCs and trade openness are time series data from 1980 to 2016 sourced from World Bank National Accounts Data (2017). Based on the analysis shown in Fig. 10.4, trade openness can influence GVCs in sub-Saharan African countries. The figures show a positive relationship between trade openness and GVCs, though it is not strongly significant in most cases. This positive relationship indicates that sub-Saharan African countries will be able to increase their involvement in value chains and higher value-added activities with production and trade chains over time. Tinta (2017) found a positive relationship between trade openness and GVC. He explains that it has influenced greater integration in the value chain for ECOWAS countries, thus strengthening their position in international trade. Furthermore, Aichele and Heiland (2016) found a robust relationship between trade liberalisation and GVC in China. They say that GVCs were the driving force behind the strengthening of production networks with their trading partners, which led to significant welfare gains for China, Australia and Asian economies.

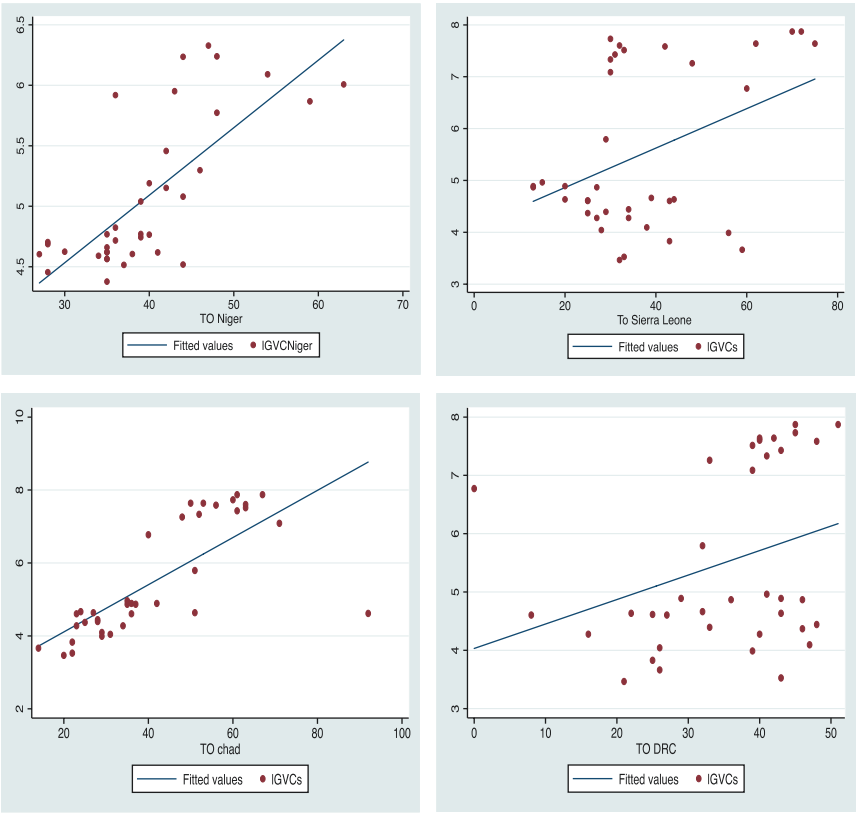

Fig. 10.4 Relationship between trade openness and GVCs in Chad, Niger, Democratic Republic of Congo and Sierra Leone. (Source: Author 2018)

10.5 Trade Openness and HDI

Trade openness has received numerous endorsements for its role in economic growth, in inequality reduction and poverty reduction. In this section, we review empirical evidence that interlinks trade openness and the HDI. Income distribution indicates how a country's total income is distributed among its population. A perfectly equal income distribution does not exist because individuals differ on the bases of skills, capabilities and education. Factors such as economic growth, economic development,

human capital, international integration and employment rate determine income distribution and standard of living.

The literature has shown that trade openness can affect overall social well-being through three channels (see conceptual framework linking trade openness to HDI below):

- revenue and income into the country—government might increase its expenditure on healthcare, education and facilities;
- income distribution due to price mechanism as a result of a competitive environment;
- firm profitability—generates employment and a potential increase in wages.

A significant body of empirical literature has established the relationship between trade openness and HDI. For instance, Fatah et al. (2012) studied the impact of life expectancy at birth, trade openness, human rights, FDI and HDI on economic growth. Their results showed that trade openness and HDI have a positive and significant effect on economic growth. Likewise, Kabadayi (2013) conducted a panel analysis to examine the effect of trade openness on the living standards of medium high-income countries between 1995 and 2010. He found a positive relationship between trade openness and HDI. Similarly, Davies and Quinlivan (2006) found a positive relationship between trade and social welfare. Moreover, Razmi and Yavari (2012) found a positive relationship between trade openness and the level of educational attainment, but revealed a negative relationship between trade openness and life expectancy. In terms of income distribution, Calderon and Chong (2001) used panel data from 1960 to 1995 and a generalised method of moments (GMM) estimation to study the relationship between trade openness and income inequality in both developed and developing countries. They found that the volume of trade was associated with changes in income distribution. But the real exchange rate and the intensity of capital controls had a negative effect on income distribution.

However, Gunduz et al. (2009) found a positive relationship between trade and social development in high-income countries, but found a neg-

ative relationship in low-income countries. Mahesh (2016) modified the work of Calderon and Chong (2001) and used GMM estimation for dynamic panel data models to test the impact of trade openness on standard of living and inequality. He found that an increase in trade volumes had in fact resulted in the worsening of income distributions and standard of living in Brazil and India. Similarly, Gourdon et al. (2008) found evidence that the effect of trade liberalisation on income distribution is conditional on the relative factor endowments of the trading partners. They used changes in tariff revenues to measure the degree of trade liberalisation and they focused on variations within countries in response to changes in trade policy. They found that trade openness increases income inequality in countries that are rich in highly skilled labour—a labour force requiring low levels of education—and capital (Fig. 10.5).

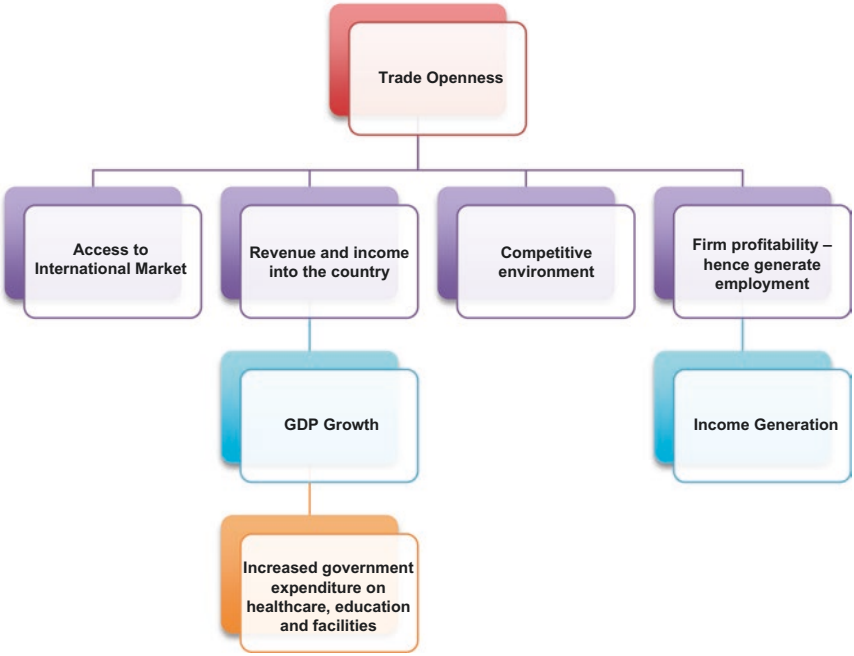

Fig. 10.5 The conceptual framework linking trade openness and human development. (Source: Author 2018; Thirlwall 2006; Razmi and Yavari 2012; Kabadayi 2013)

10.6 Data and Methodology

To measure the impact of trade openness on HDI, economic growth and GVC, a panel of data was constructed consisting of variables for Chad, Democratic Republic of Congo, Central African Republic, Niger and Sierra Leone over a 30-year period. The data has been sourced from World Bank National Accounts Data, UNESCO Institute for Statistics, UNDP and the African Development Bank because they have efficient and effective national statistical systems. This data set consists of multiple observations from five different countries *i* at different time t periods. In a linear regression, estimation bias or endogeneity bias might occur as a result of the omitted variable, a problem that arises when certain unknown variables (unobserved variables) are not included or measured in a model but are correlated or uncorrelated with the independent variables. However, with a panel model it is possible to control for some types of omitted variables even without including them or measuring them in the model by using a fixed or random effect model.

To be able to confidently eliminate omitted variable bias, it is important to understand the position of the time-variant unobserved variable μ. A fixed effect model (FEM) will be able to eliminate omitted variable bias if the time-variant unobserved variable μ has an effect on the dependent variable and is correlated with independent variable X included in the model. Similarly, the FEM will be able to eliminate omitted variable bias if the effects of the time-variant unobserved variables on the dependent variables are constant or fixed at different time t periods, that is, the effects are fixed at time 1980, 1981 and so on.

On the other hand, the random effect model (REM) in a panel of data can be used when there are no possibilities of omitted variables bias. In the real world this is impossible, as such an REM can still be used if those time-variant unobserved variables μ are uncorrelated with the independents variables X included in the model.

$$y_{it} = x_{it}\beta + \alpha + \mu_{it} + \varepsilon_{it} \tag{10.1}$$

In 10.1, y_{it} represents the dependent variable, x_{it} represents the observed or included variables in the model, α is the intercept, β is the estimated coefficient, μ_{it} is the unobserved variables and ε_{it} is the error term. For instance, in model (1) where country i = *Chad*, …Sierra Leone and time periods t are from 1980 to 2016, if the unobserved variables μ_{it} have an effect on y_{it} and are correlated with the observed variables x_{it}, the FEM will be appropriate for estimation. But if the unobserved variables μ_{it} have an effect on y_{it} and are uncorrelated with the observed variables x_{it}, the REM will be used for estimation. Nevertheless, the Hausman test will help to determine the right model to use in the panel data analysis (Table 10.1)

10.7 Models

To decide between an FEM and REM, a Hausman test was conducted to know whether the unobserved variables μ_{it} are correlated or uncorrelated with the observed variable x_{it} in the model. The Hausman test result indicates that the unobserved variables in the model μ_{it} are uncorrelated with the observed variable x_{it} (see Table 10.2) As a result REM is considered in this chapter.

Model (1)
The model is specified using the same structure as Brooks (2008) although using economic data instead. Brooks used financial variables to estimate their impact on banking growth using a REM. To investigate the impact of trade openness on HDI and real GDP growth while simultaneously controlling for other factors in the panel data, an REM is used in 10.2 and 10.5.

$$logHDI_{it} = a + \beta_1 logTO_{it} + \beta_2 logrGDP_{it} + \beta_3 ED_{it} + \left(\mu_i + \varepsilon_{it}\right) \quad (10.2)$$

Where the HDI is the dependent variable, it measures the human development achievements of a country in terms of health and standard

Table 10.1 Definition of variables and expected regression signs

Variables	Expected impact of variables on real GDP	Expected impact of variables on HDI	Definition of the variable	Justification	Data type	Source of data
TO_{it} Trade openness	(+) Increase in trade openness should influence real GDP growth	(+) Increase in trade openness should influence HDI increase	The sum of exports and imports of goods and services— measured as a share of GDP (gross domestic product)	Fatah et al. (2012), Dollar and Kraay 2007, Gourdon (2011)	Continuous	World Bank National Accounts Data (2017)
log $GVCs_{it}$	Dependent variable in model (3)	Dependent variable in model (3)	To measure GVCs, export value added index is used as a proxy for each country	Johnson (2017)	Continuous	World Bank National Accounts Data (2018)
ED_{it} Education	–	(+) Increase in educational level should influence HDI growth	Percentage of primary completion rate regardless of age	Razmi and Yavari (2012)	Continuous	UNESCO Institute for Statistics (2017)
$rGDP\hat{}_{it}$ Real GDP growth	Dependent variable in model (2)	(+) Increase in real GDP level should influence HDI growth	Annual percentage growth rate of GDP at market prices based on constant local currency	Dollar and Kraay (2007), Thirlwall (2006)	Continuous	World Bank National Accounts Data (2017)
$logK_{it}$ Capital accumulation	(+) As capital formation/ accumulation increases, real GDP increases	–	Proxy for measuring capital stock	Keho (2017)	Continuous	World Bank National Accounts Data (2017)
$logL_{it}$ Labour force	(+) As labour force increases, real GDP increases	–	People aged 15 and older who supply labour for the production of goods and services	Keho (2017	Continuous	World Bank National Accounts Data (2017)

(*continued*)

Table 10.1 (continued)

Variables	Expected impact of variables on real GDP	Expected impact of variables on HDI	Definition of the variable	Justification	Data type	Source of data
Country dummies (interaction with trade openness)		(+/–)	Sub-Saharan African countries with the lowest HDI	–	Dummy variable	–
HDI	–	Dependent variable in model (1)	Measures the human development achievements of a country in terms of health, and standard of living	Fatah et al. (2012), Kabadayi (2013), Davies and Quinlivan (2006), Razmi and Yavari (2012), Gunduz, Hisarciklilar and Kaya (2009)	Continuous	UNDP (2017)

Author (2018)
Fatah et al (2012) showed that trade openness and HDI have a positive and significant effect on economic growth
(Dollar and Kraay 2007) showed that fairly distributed gains from trade openness can accelerate GDP per capita growth
Gourdon (2011) found no clear-cut empirical relationship between trade liberalization, economic growth and inequalities in developing countries
Razmi and Yavari (2012) found a positive relationship between trade openness and level of educational attainment but revealed a negative relationship between trade openness and life expectancy
Johnson (2017) suggest that export value-added index be used as a proxy to measure global value chains, he finds this proxy as an appropriate measure
Razmi and Yavari (2012) found a positive relationship between trade openness and educational attainment
Thirlwall (2006) supports the argument that trade surplus brought about economic progress
Keho (2017) found a long run relationship between economic growth and capital accumulation
Kabadayi (2013) found a positive relationship between trade openness and human development index
Davies and Quinlivan (2006) found a positive relationship between trade and social welfare
Gunduz, Hisarciklilar and Kaya (2009) found a positive relationship between trade and social development in high-income countries but found a low and negative relationship in low-income countries

Table 10.2 Hausman test for model (1) (HDI)

Test: Ho: difference in coefficients not systematic
Chi2 (3) = (b-B)'[(V_b-V_B)^(−1)](b-B)
= 6.05
Prob>chi2 = 0.1093
(V_b-V_B is not positive definite)

Author (2018)

of living. Trade openness (TO) is the sum of exports and imports of goods and services measured as a share of GDP, ED_{it} is the percentage of primary completion rate regardless of age and sex, μ is the observed variables, ε is the stochastic error term, a is the intercept, $\beta_{1\ldots n}$ are the parameters, i is the country vector and t is the time period.

Model (2)

To test the impact of trade openness on economic growth, we specified our model using the Cobb–Douglas production function by combining capital and labour.

$$Q_{it} = T_{it} + K_{it} + L_{it} \tag{10.3}$$

Where Q_t represents the real economic output of each country at a particular time, K_{it} represents the capital stock of each country; L_{it} is labour force of each country at time t and T_{it} represent technological progress. In this model, the Cobb–Douglas production function is extended by assuming that technological progress is the function of trade openness.

$$T_{it} = TO_{it} + \mu_{it} \tag{10.4}$$

Here, T_{it} represents technological progress, TO_{it} represents trade openness and μ_{it} represents unobserved factors that are also functions of technological progress. Using a substitution technique, (10.3) and (10.4) are used to develop a growth model for panel data analysis in (10.5).

$$rGDP\hat{}_{it} = \alpha + \beta_1 TO_{it} + \beta_2 logK_{it} + \beta_3 logL_{it} + +\left(\mu_i + \varepsilon_{it}\right) \tag{10.5}$$

Here, *rGDP^* represents real GDP growth, TO_{it} represents trade openness, $logK_{it}$ represents capital stock, L_{it} represents labour force, μ represents the observed variables, ε is the stochastic error term, a is the intercept, $\beta_{1\ldots n}$ are the parameters, i is the country vector and t represents the different time periods.

Model (3)

To measure the impact of trade openness on GVCs, the variable export value-added index is used as a proxy to measure GVCs as suggested by Johnson (2017). The variable is sourced from World Bank National Accounts Data (2017). The data are time series data from 1980 to 2016. A model similar to Aichele and Heiland (2016) is adopted. They derived a model for value-added trade flows based on the methodology developed by Johnson and Noguera (2012). The export values index is the current value of export converted to US dollars and expressed as a percentage of the average for the base period 2000. OLS regression is used to run the model to determine the impact of trade openness on GVCs at individual country level. The following regressions are used:

$$logGVCs\_Chad_t = \beta_0 + \beta_1 TO\_Chad_t + rGDP\hat{}_t + \varepsilon_t \tag{10.6}$$

$$logGVCs\_CAR_t = \beta_0 + \beta_1 TO\_CAR_t + rGDP\hat{}_t + \varepsilon_t \tag{10.7}$$

$$logGVCs\_DRC_t = \beta_0 + \beta_1 TO\_DRC_t + rGDP\hat{}_t + \varepsilon_t \tag{10.8}$$

$$logGVCs\_Niger_t = \beta_0 + \beta_1 TO\_Niger_t + rGDP\hat{}_t + \varepsilon_t \tag{10.9}$$

$$logGVCs\_Sierra\ Leone_t = \beta_0 + \beta_1 TO\_Sierra\ Leone_t + rGDP\hat{}_t + \varepsilon_t \tag{10.10}$$

In 10.6, 10.7, 10.8, 10.9, and 10.10, $logGVCs_t$ represents the variable GVCs for the five respective sub-Saharan African countries included in the analysis, TO_t represents trade openness and *rGDP^* represents real GDP growth, t represents the 37-year time period from 1980 to 2016

variables, ε is the stochastic error term, β_0 is the intercept and $\beta_{1\ldots n}$ represents the parameters. The OLS estimator is a method of estimating parameters $\beta_1 \ldots \beta_n$ in a linear regression model.

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n \tag{10.11}$$

OLS minimises the sum of the squared residuals (SSR). It calculates the slope coefficients so that the difference between the predicted Y and the actual Y is minimised (Wooldridge 2009, pp. 73).

$$\text{SSR} = \sum_{i=1}^{n} \left(y_i - \hat{\beta}_0 - \hat{\beta}_1 x_{i1} - \hat{\beta}_2 x_{i2} - \ldots - \hat{\beta}_n x_{in} \right)^2 \tag{10.12}$$

Here, subscript i denotes the observation number, n denotes the number of observations and $X_{i1} \ldots$n denotes the independent country variable. OLS seeks to estimate the parameters β_0, β_1, β_2, $\beta_3 \ldots \beta_n$ in the following equation:

$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x_1 + \hat{\beta}_2 x_2 + \ldots + \hat{\beta}_n x_n \tag{10.13}$$

The minimisation of residual by OLS is done through multi-variable calculus (Wooldridge 2009, pp. 74), hence leading to $n + 1$ linear equations in $n + 1$ unknowns $\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2, \hat{\beta}_3 \ldots \hat{\beta}_{n.}$[1]

10.8 Empirical Analysis and Results

In this chapter, the empirical analysis is sub-divided into the analyses for model (1), model (2) and model (3). In the analysis for model (1), the REM is used to analyse the impact of trade openness on HDI. In the analysis for model (2), both the REM and OLS model are used to examine the impact of trade openness on real GDP growth rate, and finally, to analyse model (3), the OLS model is used to estimate the impact of trade openness on GVCs.

10.9 Results for Model 1 (HDI)

To decide between the FEM and the REM, the Hausman test was run to find whether the unobserved variables μ_{it} are correlated or uncorrelated with the observed variables x_{it} in model (1). The Hausman test result indicates that since the p value is greater than 0.05, the FEM is not consistent but the REM is more consistent and appropriate to estimate model (1). Random effect estimation will not be biased as a result of endogeneity since unobserved variables are uncorrelated with the error term. As such, the need for IV estimation will not be necessary.

But how consistent and appropriate is the random effect estimator? Is OLS regression a preferred option since μ_{it} is uncorrelated with x_{it}? To answer this question and ascertain whether RE is the most appropriate estimate for model (1), the Breusch and Pagan Lagrangian multiplier test for random effects is employed. This test indicates the use of either a random effect regression or a simple OLS regression (Table 10.3).

The null hypothesis for Breusch and Pagan Lagrange multiplier test is that variance across countries is equal to zero and if so, OLS is the best estimation of model (1), that is:

H0: Var (u) = 0,

H1: Var (u) ≠ 0.

Based on the result in Table 10.3, the variance across countries is not equal to zero because the p value is less than 0.05, therefore we reject the null hypothesis and accept the alternative hypothesis and thus conclude that random effect regression is indeed the right estimation for model (1) (Table 10.4).

Table 10.3 Breusch and Pagan Lagrangian multiplier test for random effects

Estimated results	Var	sd = sqrt (Var)
Log HDI	0.0448205	0.2117085
E	0.0185305	0.1361268
U	0.0013375	0.0365713
Test: Var (u) = 0 Chibar2 (01) = 11.07 Prob > chibar2 = 0.0004		

Author (2018)

Table 10.4 Random effect regression for model (1) (HDI)

HDI	Random effect	p values
TO_{it}	0.0946	0.094
	(1.68)	
$rGDP\hat{}_{it}$	0.0235	0.159
	(1.41)	
ED_{it}	0.301***	0.000
	(9.74)	
_Cons	−2.738***	0.000
	(−17.81)	
Overall R2	0.5479	–
Between R2	0.6607	–
No of observations	128	–

Statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (Author 2018)

Based on the results of random effect regression in Table 10.4, trade openness (TO_{it}) has no significant impact on HDI. This result is not surprising. Sub-Saharan African countries have not been able to utilise the gains of trade to boost human and economic development. They have not been able to create a systematic linkage between trade openness and HDI, such as having (a) a strong government institution, (b) strong trade policies and procedure of implementing and monitoring those policies and (c) strong policies on inequality—how to distribute the gains from trade fairly. The findings are consistent with the work of Gunduz et al. (2009): they found no significant relationship between trade openness and HDI in low-income countries.

The variable real GDP growth ($rGDP\hat{}_{it}$) has been included in the model to capture its effect on HDI. Growth in real GDP is expected to influence HDI, however, the result indicates otherwise; real GDP growth shows no significant impact on HDI. This means that economic growth is not reflected in countries' standards of living and growth is not properly managed. The growth is not channelled into providing public services to improve living standards. According to Friedman (2006), if economic growth is not properly distributed, its impact on standard of living will not be significant.

However, the education variable (ED_{it}) has shown a positive and significant impact on HDI. The result shows that an increase in education

increases HDI by 30%. The literature emphasises that acquiring a good education is an effective way of improving quality of life.

10.10 Results for Model 2 (Real GDP Growth)

For model (2), again a Hausman test was used to decide between FEM and REM. The Hausman test results in Table 10.5 indicate that random effect is more consistent and appropriate than a fixed effect for estimating model (2).

A Breusch and Pagan Lagrangian multiplier test was carried out to decide between using an OLS or REM. Based on the results in Table 10.6, the variance across countries is equal to zero because the p value is greater than 0.05, which means that OLS can be used to estimate model (2).

Both the pooled OLS and random effect estimation show that trade openness (TO_{it}) has a significant and positive impact on economic growth—that is, a 1% increase in trade openness will increase economic growth by 0.158. This finding is in line with the work of Barro and Martin (1997); Dollar and Kraay (2007); Babula and Anderson (2008);

Table 10.5 Hausman test for model (2) (real GDP growth)

Test: Ho: difference in coefficients not systematic
Chi2 (3) = (b-B)'[(V_b-V_B)^(−1)](b-B)
= 0.88
Prob>chi2 = 0.8298
(V_b-V_B is not positive definite)

Author (2018)

Table 10.6 Breusch and Pagan Lagrangian multiplier test for random effects

Estimated results	Var	sd = sqrt (Var)
$rGDP\hat{}_{it}$	62.81454	7.925562
E	49.6869	7.048894
u	0	0
Test: Var (u) = 0		
Chibar2 (01) = 0.00		
Prob > chibar2 = 1.0000		

Author (2018)

Bruckner and Lederman (2012); and Chatterji et al. (2013) who support the argument that trade openness can accelerate GDP growth. Barro and Martin (1997) further highlight that trade openness will enhance economic growth in the long run through the creation of access to international markets and importation of technology and knowledge into home countries.

Besides the trade openness variable, the regression included other potential determinants of economic growth (capital accumulation, and labour force) based on the Cobb–Douglas production function. From the pooled OLS and RE results in Table 10.7, we find capital accumulation ($logK_{it}$) is associated with economic growth. It has a positive and significant impact on economic growth: a 1% increase in a country's capital accumulation will increase economic growth by 0.619. The results are consistent with the work of (Keho 2017) who found a long-term relationship between economic growth and capital accumulation.

However, the variables of labour force and education did not show any significant relationship to economic growth. Research conducted by the International Institute for Applied Systems Analysis showed that countries with low levels of education tend to have a slow rate of economic growth.

Table 10.7 Results for model 2 (real GDP growth)

Real GDP growth	Random effect	Pooled OLS with robust standard error
TO_{it}	0.158***	0.158**
	(0.000)	(0.004)
$logK_{it}$	0.619***	0.619***
	(0.000)	(0.000)
$logL_{it}$	0.146	0.146
	(0.843)	(0.827)
ED_{it}	−0.0139	−0.0139
	(0.646)	(0.739)
_Cons	−20.17	−20.17*
	(−0.091)	(0.042)
R2	–	0.2431
Overall R2	0.2431	–
Between R2	0.2063	–
Number of observations	133	133

p values in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (Author 2018)

10.11 Results for Model 3 (GVCs)

To investigate the impact of trade openness on GVCs while simultaneously controlling for other factors, pooled OLS regression is used. It was assessed whether trade openness has a significant impact on GVCs on an individual country level and whether the influence of trade openness will differ systematically when an additional explanatory variable is included in the model.

In an unreported simple regression, the results show that GVCs have a robust and significant relationship to trade openness on an individual country level. Even after controlling for real GDP variables, the relationship still holds. The pooled ordinary least squares (OLS) results (column (1) in Table 10.8) indicate that the impact of trade openness is associated with positive GVC activities in Chad, Niger and Sierra Leone. However, the impact of trade openness on GVC is rather weak in Central African Republic (CAR) and the Democratic Republic of Congo.

Trade openness has influenced the emergence of GVCs together with technological progress, transportation, communication and policy reforms in support of trade. Production processes have spread among countries encouraging supply chains in which value is added at each stage before crossing the border to be passed on to the next stage. Trade openness and GVCs in Chad, Niger and Sierra Leone have allowed countries to better exploit their comparative advantages, by giving them the opportunity to

Table 10.8 Results for model 3 (GVCs)

GVCs	Pooled OLS coefficients with robust standard error	R^2	C^
$TO - chad_t$	0.0647**	0.5488	2.816***
	(0.002)		
$TO - CAR_t$	0.0138	0.0488	4.005***
	(0.058)		
$TO - DRC_t$	0.0205	0.1520	4.909***
	(0.138)		
$TO - Niger_t$	0.0558***	0.5372	2.859***
	(0.000)		
$TO - Sierra\ Leone_t$	9.981**	0.6861	−40.844*
	(0.002)		
Number of observations	37	37	37

p value in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (Author 2017)

join a production chain. Chad has oil, cattle, cotton, gum Arabic and a large pool of labour. This provides an excellent opportunity to the country to specialise in the production of cattle, cotton and gum Arabic, hence generating a portion of value-added goods. This means that a share of the value-added of exports is captured locally. Knowledge transfers from other producers in the value chain can support productivity and income growth (Allard et al. 2016). Sub-Saharan countries such as Niger and Sierra Leone have made progress in integrating value chains where uranium ore, diamonds, rutile, cocoa, coffee, livestock, cowpeas and onions are the commodities playing a major role. They further added that Democratic Republic of Congo and other oil exporters in sub-Saharan African countries are the least integrated into GVCs, suggesting that diversification of trade away from natural resources has stagnated if not gone backwards over the past 20 years. To improve the impact of trade openness on GVC in Central African Republic and Democratic Republic of Congo, and to take advantage of their comparative advantages, these countries need to create policies to improve their business environment, infrastructure (energy, good transportation and communication links), improve political transparency and uphold their rules of law. For GVCs to be more effective, the manufacturing sector and industries need to be revived because they are the most vital sector for stimulating economic growth, productivity and value chains.

10.12 Conclusion and Policy Implications

In this chapter, the role of trade openness on HDI, economic growth and GVCs in five sub-Saharan African countries with the lowest HDI was examined using unbalanced panel data from 1980 to 2016. The Hausman test determined the best estimate for analysing panel data and indicated that the unobserved variables in the test models μ_{it} are uncorrelated with the observed variables x_{it} and so random effect and pooled OLS were the right estimations for the analyses. The results showed that trade openness was not significant in explaining HDI but was significant in explaining economic growth and GVCs. This implies that trade openness as a concept is very important in accelerating economic growth and creating GVCs, and has impacted positively in increasing real GDP growth by almost 15% in

the selected sub-Saharan African countries. Books on trade openness have shown that rapid growth and generally better macroeconomic performance in emerging countries leads to growing trade flows. Better political stability, improved macroeconomic management and access to financing as well as an improved business environment have supported investment efforts, which in turn improved the productive capacity in emerging countries.

However, the gains from trade openness have not been fairly distributed among the citizens in Africa, which is why the variable is showing no significant impact on HDI. Mahesh (2016) suggests that trade openness does not reflect on the standard of living because the increased volume of trade may only benefit a small percentage of the population, as most sub-Saharan African countries are more labour intensive and not capital intensive (gains from trade are more easily distributed in capital-intensive countries than in labour-intensive countries). Moreover, countries that are abundant in unskilled and less educated labour may experience a worsening of the income distribution than countries that have a skilled and educated labour force.

As such, a strong inclusion action plan will be required by African governments to increase expenditure on:

- healthcare—to improve life expectancy;
- innovation and technology;
- education—to increase the skilled and educated labour force and to increase average years of schooling for adults; and
- social facilities—to increase standard of living.

The variable of education shows a significant impact on HDI. According the findings in Table 10.4, acquiring further education has increased HDI in Africa by 30%. However, the education variable does not have a significant impact on real GDP growth. Literature has emphasised the role of education in acquiring skills and knowledge that can be used for the production of goods and services to accelerate growth and productivity. The implication is that more investment is required in the area of education to boost skills and productivity in Africa.

Since trade openness has shown to be significant in accelerating real GDP growth and GVC in the few selected sub-Saharan African countries,

it is important that infrastructure systems are developed in Africa. Infrastructure appears to be the most significant obstacle to trade in sub-Saharan African countries. According to Allard et al. (2016), taking infrastructure to the average level of quality at the international level would help improve sub-Saharan African trade by as much as 42%, as this would substantially lower the cost of cross-border movements of goods and services. Aside from infrastructure, governance and a favourable business environment would also have a very positive effect in increasing trade in sub-Saharan African countries. According to Allard et al. (2016), growing the index of rule of law to the global average level would cause a 28% increase in sub-Saharan African trade flows. Actions to lower non-tariff obstacles to trade (export taxes and duties), eliminate corruption, reduce delays in clearing customs and reduce extra trade costs would greatly improve prospects for trade, especially at the regional block level. Lowering tariffs in sub-Saharan African would encourage the development of both international and regional trade. On average, bringing tariffs to the average global level could yield about 14% in foreign trade.

Furthermore, access to credit for businesses plays a significant role in accelerating trade. Allard et al. (2016) further added that financial deepening to the level observed elsewhere in the world would support an expansion of trade of as much as 29%. However, they added that financial deepening would need to be accompanied by adequate macroprudential frameworks to carefully manage the corresponding risks.

Notes

1. This is the act of differentiation, integration and vector calculus for functions involving more than one variable (multiple variables).

References

Aichele, R., & Heiland, I. (2016). *Where Is the Value Added? Trade Liberalization and Production Networks*. Accessed on line @ http://inga-heiland.de/pdfs/AicheleHeiland_201611.pdf

Allard, C., Kriljenko, J. I. C., Chen, W., Gonzalez-Garcia, J., Kitsios, E., & Treviño, J. (2016). *Trade Integration and Global Value Chains in Sub-Saharan Africa*, International Monetary Fund ISBN 978-1-49834-990-1.

Anand, S., & Sen, A. (2000). The Income Component of the Human Development Index. *Journal of Human Development, 1*(1), 83–106.

Babula, R., & Anderson, L. (2008). The Link Between Openness and Long-Run Economic Growth. *Journal of International Commerce and Economics, 1*(20), 31–50.

Barro, R. J., & Salai Martin, X. (1997). Technological Diffusion, Convergence, and Growth. *Journal of Economic Growth, 2*, 1–26.

BP. (2014). *The British Petroleum Magazine: A New Era. Issue 1.* http://www.bp.com/content/dam/bp/pdf/bpmagazine/BP_Issue_1_2014.pdf.

Brooks, C. (2008) *Introductory Econometrics for Finance* (2nd ed.). Cambridge: Cambridge University Press. ISBN-13 978-0-511-39848-3.

Bruckner, M., & Lederman, D. (2012). *Trade Causes Growth in Sub-Saharan Africa* (The World Bank Policy Research Working Paper No. 6007).

Calderon, C., & Chong, A. (2001). External Sector and Income Inequality in Interdependent Economies: Using a Dynamic Panel Data Approach. *Economic Letters, 71*(2), 225–231.

Chatterji, M., Mohan, S., & Dastidar, G. S. (2013). *Relationship Between Trade Openness and Economic Growth of India: A Time Series Analysis SIRE* (Dundee Discussion Working Paper No. 274).

Davies, A., & Quinlivan, G. (2006). A Panel Data Analysis of the Impact of Trade on Human Development. *Journal of Socio-economics, 35*(5), 868–876.

Dollar, D., & Kraay, A. (2007). *Trade, Growth, and Poverty, a Compilation of Articles from Finance and Development IMF,* pp. 70–73 ISBN 1-58906-571-9

Fatah, F. A., Othman, N., & Abdullah, S. (2012). Economic Growth, Political Freedom and Human Development: China. *Indonesia and Malaysia; International Journal of Business and Social Science, 3*(1), 291–299.

Friedman, B. M. (2006). The Moral Consequences of Economic Growth. *Society, 43*(2), 15–22.

Gourdon, J. (2011). *Openness and Inequality in Developing Countries: A New Look at the Evidence; CERDI, Etudes ET Documents E 2007.*

Gourdon, J., Maystre, N., & de Melo, J. (2008). Openness, Inequality and Poverty: Endowments Matter. *The Journal of International Trade & Economic Development, 17*(3), 343–378.

Grimm, M., Harttgen, K., Misselhorn, M., & Klasen, S. (2008). *A Human Development Index by Income Groups* (Ibero-American Institute for Economic

Research Discussion Paper No. 155), Ibero-American Institute for Economic Research, University of Goettingen.

Gunduz, U., Hisarciklilar, M., & Kaya, T. (2009). The Impact of Trade on Social Development. *World Academy of Science Engineering and Technology, 3*(6), 1300–1303.

Harttgen, K., & Klasen, S. (2012). A Household-Based Human Development Index. *World Development, 40*(5), 878–899.

Hou, J., Paul, P. W., & Zhang, J. (2014). The Dynamics of Human Development Index. *The Social Science Journal, 52*(3), 331–347.

IASA International Institute for Applied Systems Analysis. (2008). *Economic Growth in Developing Countries: Education Proves Key IIASA Policy Brief Number 03.*

Johnson, C. R. (2017). *Measuring Global Value Chains, National Bureau of Economic Research* ((NBER) Working Paper No. 24027).

Johnson, R. C., & Noguera, G. (2012). Accounting for Intermediates: Production Sharing and Trade in Value Added. *Journal of International Economics, 86*(2), 224–236.

Kabadayi, B. (2013). Human Development and Trade Openness: A Case Study on Developing Countries. *Advance in Management and Applied Economics, 3*(3), 193–199.

Keho, Y. (2017). The Impact of Trade Openness on Economic Growth: The Case of Côte d'Ivoire , General and Applied Economics Research. *Cogent Economics & Finance, 5*, 1–14.

Krueger, A. O. (1997). Trade Policy and Economic Development. *American Economic Review, 87*(1), 1–22.

Le Goff, M., & Jan Singh, R. (2013). *Does Trade Reduce Poverty? A View from Africa* (The World Bank Policy Research Working Paper 6327).

Mahesh, M (2016) The Effects of Trade Openness on Income Inequality—Evidence from BRIC Countries. *Economics Bulletin*, *36*(3), 1751–1761.

Noorbakhsh, F. (1998). The Human Development Index: Some Technical Issues and Alternative Indices. *Journal of International Development, 10*(5), 575–698.

Olufemi, S. M. (2004). Trade Openness and Economic Growth in Nigeria: Further Evidence on the Causality Issue. *SAJEMS, 7*(2), 229–315.

Oyejide, T. A., & Adewuyi, A. O. (2011). *Enhancing Linkages of Oil and Gas Industry in the Nigerian Economy*. MMCP Discussion Paper No. 8.

Ravallion, M. (1997). Good and Bad Growth: The Human Development Reports. *World Development, 25*(5), 631–638.

Razmi, J. M., & Yavari, Z. (2012). Reviewing the Effect of Trade Openness on Human Development; Interdisciplinary. *Journal of Contemporary Research in Business, 4*(6), 970–978.

Sagar, A. D., & Najam, A. (1998). The Human Development Index: A Critical Review. *Ecological Economics, 25*(3), 249–264.

Stiglitz, J. E. (1996). Some Lessons from the East Asian Miracle. *The World Bank Research Observer, 11*(2), 151–177.

Thirlwall, A. P. (2006). *Trade and Development, A Chapter in Growth and Development with Special Reference to Developing Economies* (8th ed.). ISBN-10: 1–4039–9601-6.

Tinta, A. A. (2017). The Determinants of Participation in Global Value Chains: The Case of ECOWAS. *Cogent Economics & Finance, 5*, 1–14.

UNDP. (2015). *Human Development Index (HDI) Accessed on line @* http://hdr.undp.org/en/content/human-development-index-hdi

UNDP. (2017). *Human Development Index Database*. http:/hdr.undp.org/en/data. Accessed Sep 2017.

UNESCO Institute for Statistics. (2017). *Gross Enrollment Ratio, Primary, Both Sexes*. Accessed Dec 2018. https://data.worldbank.org/indicator/SE.PRM.ENRR.

White, H., & Anderson, E. (2001). Growth Versus Distribution: Does the Pattern of Growth Matter? *Development Policy Review, 19*(3), 267–289.

Wooldridge, M. J. (2009). *Introductory Econometrics: A Modern Approach*. Basingstoke: Macmillan Publishing Solutions. isbn:978-0-324-58162-1.

World Bank. (2017). *Measuring and Analyzing the Impact of GVCs on Economic Development* (Global Value Chain Development Report 2017). ISBN 978-92-870-4125-8

World Bank National Accounts Data. (2018). *Trade as Percentage of GDP*. Accessed Jan 2018. https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS.