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Trade Openness, Structural Transformation, and Poverty Reduction: Empirical Evidence from Africa

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Abstract

This paper examines the poverty reduction effects of trade openness and structural transformation in Africa. The study uses a panel data covering the period from 1981 to 2010 and constituting 43 African countries. Using System generalized methods of moments, findings show that trade openness initially exacerbates poverty by about 1.3% and after one period lag, it reduces it by about 1.2%. Structural transformation lagged two periods, on the other hand, led to poverty reduction of about 3%. Further, the results show that infrastructure development and fostering the participation of the private sector in the continent greatly contribute towards poverty reduction. The study also confirms the famous 'Bhagwati hypothesis' that growth is good for the poor, as an increase in GDP per capita found to have a proportionate reduction in poverty levels (0.7 to 1%). The study also investigated the causality between trade openness and structural transformation, and the results demonstrated that there is a bi-causality relationship between the two variables. As a robustness check, the results were validated using fixed effects, random effects, and panel vector auto regression (PVAR) models. Thus, the implication is that despite the initial costs inflicted on the poor, African economies need to focus on reforms that help them achieve structural transformation in its broader sense and boost international trade.

1. Introduction

In today's world globalization or the integration of economies and societies through trade, investment, information and labor flows has turned the world more flat. As a result, two strands of research have emerged, one in support and the other against globalization. The proponents assert that globalizing countries with few trade restrictions have shown more rapid economic growth than non-globalizers, which include countries putting restrictions on trade and having trade policies that are more restrictive. According to this view, the basis for supporting globalization is that trade openness causes growth and growth, in turn, helps in reducing poverty. Hence, developing countries need to embrace trade liberalization as a vital policy tool for substantially reducing poverty (Dollar & Kraay, 2004). This benign effect of trade on poverty was originated from the *Stopler-Samuelson theorem (SST)* that says, "Trade liberalization will raise the real income of the abundant (unskilled) labor in poor countries" (Stopler & Samuelson, 1941). As a result, trade openness believed to increase employment opportunities for the poor and enable them earn income far better than they earn prior to trade openness. This argument is supported by traditional trade theories that imply trade openness generates significant gains as productive resources would be reallocated towards activities where they are used with comparatively greater efficiency and away from less efficient activities; facilitates the improvement in overall productivity through improved access to new productivity-enhancing technologies, improved intermediate inputs, and increased investment in innovations. Consequently, the reallocation of resources from low to high productive activities leads to structural change of the economy.

On the other hand, the contrasting view states that openness, particularly trade liberalization, may harm the poorer actors in the economy, and there could be some section of the society that remain in the state of poverty. The criticism primarily hits on models underpinning the idea of trade is good for the poor. The workhorse in this regard is the SST. It is contested as far from the reality based on the evidence that the effects of trade liberalization appear to work against the predictions of the SST (Davis and Mishra, 2007). The counter argument is that as countries with low technology liberalize their trade regimes, competition from the outside world, or the incoming new firms would require skilled labor and hence the demand for unskilled labor falls, not increases, leading to a drop in real wages. Therefore, trade openness may not readily translate into poverty reduction. The idea behind this counter argument is that for trade openness to have a desired effect on poverty reduction countries need to build their human capital and reform their institutions so that the poor benefit from the opportunities that trade openness unfolds. Most importantly, openness to trade or investment benefits countries when they combine these policies with domestic investment and institution building strategies that enable domestic entrepreneurs prepare themselves to take up the opportunities offered by the world market (Rodrik, 2001).¹

Despite the contrasting view on the poverty reducing effects of trade openness, trade liberalization has been widely accepted and adopted by developing countries. Likewise, in a bid to substantially reduce poverty and enhance growth, African countries over various years

¹ Several studies show that the pressure from intensified import competition forced manufacturing industries in Latin America and everywhere to become more efficient and close their technological gap with the technology frontier; whereas the least productive domestic manufacturing industries have exited and the remaining firms reduced their employees (Ferreira & Rossi, 2003; Fernandes, 2007; Paus, Reinhardt, & Robinson, 2003; Mcmillan & Dani, 2011).

have implemented trade liberalization policies. During the 1980-1990 the growth rate of merchandise export from Africa was -1.5%, while it was 4.4% in Asia, 1.7% in Latin America, 3% for developing economies, and 6% for the world. In the decade 1990-2000, Africa overturned the negative annual growth rate of exports and registered a 3.3% annual growth rate. Similarly, the annual export growth rate over the same period picked up to 9.5, 10.5, and 9% in Asia, Latin America, and in developing countries, respectively. The global export growth rate also surged to 7% over the same period. The annual export growth rate of Africa (16.5%) surpassed that of Latin America (11.3%), Asia (15%), developing economies (14.4%) and the global average (11%) in the first decade of the 21st century. However, it does not seem that Africa is keeping up the pace of export growth as the export growth rate between 2010 and 2014 slowed to 1.2%, which is more than 4 times below the average for developing economies and more than 6 times less than that of developing Asia. More specifically, exports to the rest of the world declined by 6 and 8% in the years 2013 and 2014, respectively. On the other hand, the annual import growth rate in Africa increased from -0.6 in 1980s to 4.4% in 1990s, whereas over the same period it increased from 4 to 8.6% in the developing world, -0.25 to 12% in Latin America, 6.5 to 8.3% in Asia, and from 6 to 6.6% at the global level. The African annual import growth rate after the turn of the 21st century surpassed that of the global average and the average for all other developing regions and peaked to 16.5% in 2000s and 7.4% between 2010 and 2014. In 2000s, the global annual import growth rate was 10.6, and the growth rates in the developing world, Asia, Latin America were 14, 14.7, and 11%, respectively. The growth figures for the period between 2010 and 2014 were 4.4, 7, 6, and 7% for global, developing world, Latin America, and Asia, respectively.

However, despite such a remarkable improvement in import and export growth rates over the last three decades, Africa's share in global trade has shown no progress, rather it declined from 4% in 1980s to about 3% over the last decade, while the share of Asia and Latin America in the global trade nearly doubled (see Table 1).

Table 1 Africa and other regions share of global trade

Year	1981-1990	1991-2000	2001-2010	2011-2014
Developing Economies	24.5%	28.0%	34.3%	42.9%
Developed Economies	71.0%	70.1%	62.8%	53.3%
Transition Economies	4.5%	1.9%	2.9%	3.7%
Developing economies-Africa	3.8%	2.3%	2.7%	3.3%
Developing Economies-America	10.3%	12.6%	15.2%	19.0%
Developing Economies-Asia	10.3%	13.0%	16.4%	20.6%

Source: Author's computation using data from UNCTADSTAT (2014)

The continent's share in global trade is contested to be below potential, provided the resource endowment of the continent. This poor performance particularly ascribed to the following reasons. Firstly, in contrast to the theoretical predictions the commodity structure of its exports, dominated by primary products, and the commodity composition of its imports that include a wide variety of manufactured goods have shown a minimal change in post-liberalization trade regimes. Of its exports, raw materials such as fuel, ores and metals, and other primary products constitute more than 80% and manufacturing 12% (UNECA, 2014). Secondly, poor record in widening the industrial base and failure to combine domestic investment and institution building strategies with trade liberalization reforms may have hindered Africa's efforts to overcome its role as sole supplier of raw materials.

Furthermore, the similarity of production pattern across the continent and a declining terms of trade can be possible reasons for lack of change in Africa's trade structure. As primary products dominate the composition of exports of African economies, the simultaneous increase of productivity in each country results in oversupply of primary commodities in the world market for which the demand is highly inelastic. As a result, increased volume of exports could not be translated into increased gains from trade—*immiserising growth*—that comes out of the fallacy of composition. This, in turn, leads to a declining terms of trade that worsen the balance of payments deficit and perpetuate the low productivity cycle even in agriculture.² Owing to lack of structural shift in most of the African economies, as almost all are heavily dependent on Agriculture, the poverty reduction efforts have been daunting.

However, as of mid—1990s poverty has been falling in the continent and at the same time, Africa engaged itself in structural transformation, particularly attributable to the rising urbanization and demographic transition (see Figure 1). In general, poverty appeared to decline with an increasing structural transformation indicating that structural transformation is crucial for poverty reduction.

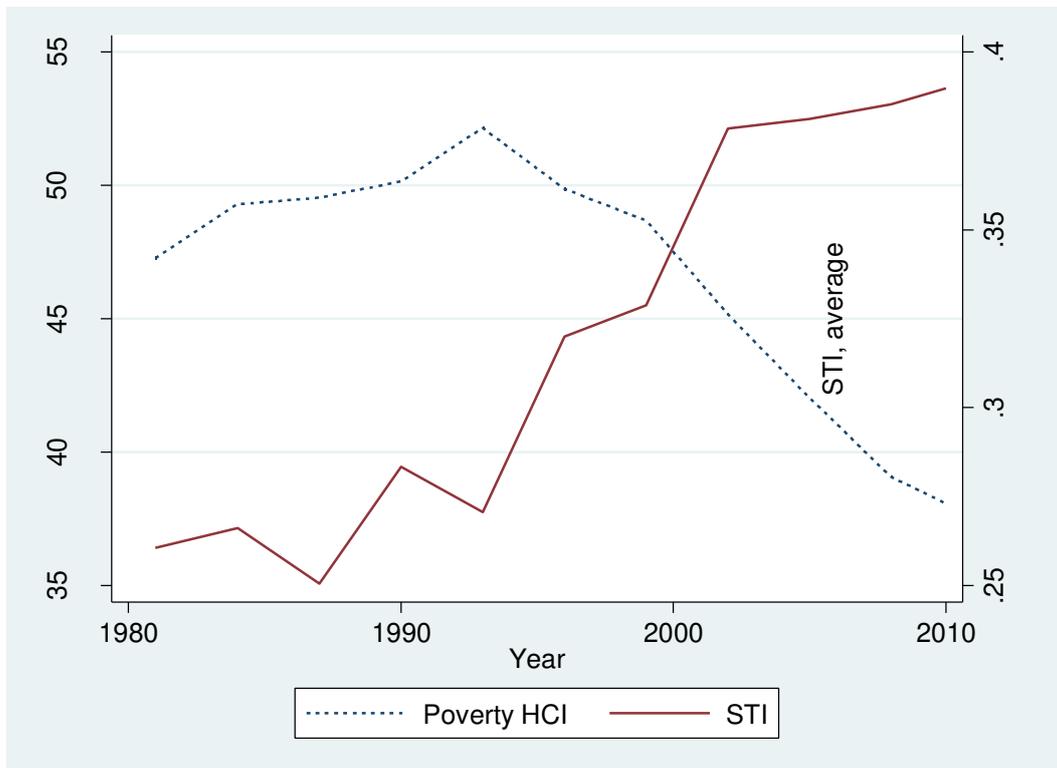


Figure 1 Average poverty and Structural Transformation overtime in Africa, 1981—2010
 Source: Author's computation using data from WDI (2014) and Kelbore (2015)

Lack of structural change and the perpetuation of low productivity cycle and the inability of countries to bring inclusive growth and substantially reduce poverty in the face of trade openness implies that trade openness may not have significantly contributed for poverty

² Worsening balance of payments may imply difficulties in settling import bills that help in getting the equipment, machineries, and other technological inputs to increase the productivity of agriculture and possible structural transformation.

reduction. This may relate to the failure of trade openness in significantly contributing towards structural change in the composition of what Africa trades. Against these odds, Africa has turned on average 5% a year growth, some countries turning up double digit growth, over the last decade while a large part of its population remained in economic poverty, rampant unemployment, and inequality (UNECA, 2014).

Nonetheless, over the last three decades, Africa has been more integrated into the world market. This has been manifested by a remarkable improvement in trade openness, that increased from 40% in 1981—1990 to 0.69 in 2001—2010, and increased telephone penetration rate that changed from 1 to 3.24 over the same period. This more integration and more trade openness resulted in an economic growth that ignited hopes of change in the way the world sees Africa. Similarly, over the three decades period poverty level has dropped from 49% to 40% and GDP per capita increased by 20%. The decline in poverty, huge improvement in trade openness, and sustainable growth in GDP per capita have confounded during the period 2001—2010 (see Appendix 3).

Figure 2 depicts the association between average poverty and average openness level over the last 3 decades. It shows that at the continental level poverty started to fall prior to a substantial change in trade openness, and continued to fall with increasing trade openness. Between 1990 and 2010, poverty declined from 50% to 40%, and trade openness increased from 43% to 69% (see Appendix 3).

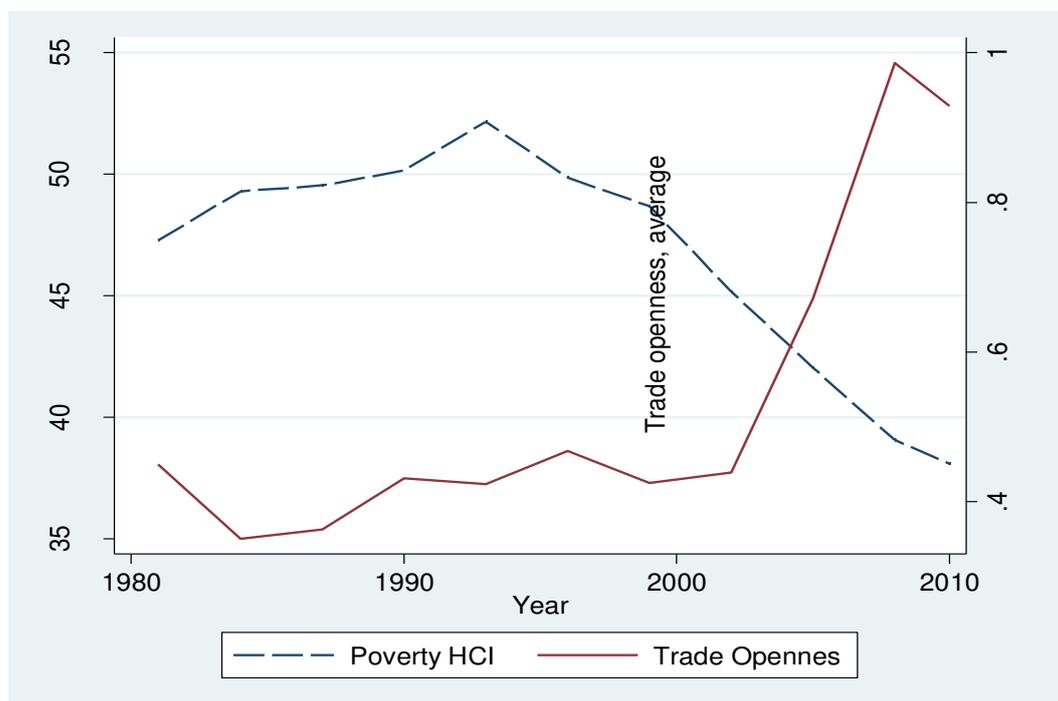


Figure 2 Average Poverty and Trade openness overtime in Africa, 1981—2010
Source: Author's computation using data from WDI (2014) and UNCTADSTAT

Against this background, this paper investigates the poverty reduction effects of trade openness and structural transformation. The paper aims to contribute to the trade—poverty debate by providing a cross—country empirical evidence focusing on Africa. It uses data from 1981—2010, for a panel of 43 African countries, compiled from various sources and employs a system generalized method of moments to examine the contribution of trade

openness to poverty reduction. The period of analysis and countries were selected based on data availability for poverty. The unique contribution of the paper is its introduction of structural transformation into the trade—poverty debate. The structural transformation variable was represented by a multidimensional structural transformation index (STI) constructed by Kelbore (2014). The system generalized method of moments (SGMM) was used to control the possible unobserved country and period specific effects; the individual or joint endogeneity of explanatory variables with the dependent variable, poverty. This, therefore, enables us control the biases resulting from simultaneous or reverse causation, and provides reliable and robust results. Further, using a panel auto regression Granger causality test the study investigates the interrelationships among poverty, trade openness, and structural transformation.

2 Trade Openness, Structural Transformation, and Poverty: Literature Review

Trade openness is favored based on arguments that date back to Adam Smith's analysis of market specialization: Openness promotes the efficient allocation of resources through comparative advantage, allows the dissemination of knowledge and technological progress, and encourages competition in domestic and international markets (Chang, Kaltani, & Loayza, 2009).

In addition, the literature on endogenous growth has emphasized the existence of various mechanisms through which trade openness may generate dynamic gains and thereby affect the economy's rate of growth in the long run. In particular, trade openness facilitates the acquisition of less expensive or higher quality intermediate goods, and improved technologies, which enhance the overall productivity of the economy. It enables efficient transmission of price signals from the international market to the national economy, enhances diffusion of production and management knowledge, and improves domestic efficiency because of intensive international competition. Consequently, undistorted price signals allow more efficient resource allocation in accordance with a country's comparative advantage, which in turn, leads to more rapid economic growth (Agenor, 2004; Dollar & Kraay, 2004; Tsai & Huang, 2007).

Through the resulting distribution effect, trade contributes to poverty reduction. Moreover, higher economic growth means more tax revenue, enabling the government to invest in infrastructure such as education, transportation, health services, and social safety net, which are of crucial importance for poverty alleviation ((Tsai & Huang, 2007; Dollar & Kraay, 2004). Trade restrictions reduce the range of intermediate inputs available and a full exploitation of technological possibilities that rely on broad range of inputs cannot be effectively exploited (Romer, 1994). Trade flows are a conducive transfer mechanisms through which advanced production techniques and technological knowledge are transmitted across countries (Coe, Helpman, & Hoffmaister, 1997). Restrictions that constrain trade flows effectively hinder the transfer of knowledge highly valuable to late industrializers to catch up. The knowledge transfer is not limited to the adoption of specialized intermediate inputs and machinery available from trading partners but can be in the form of information in production engineering and changing production patterns (Agenor, 2004).

Thus, the growth effect of trade openness comes through its contribution towards higher productivity that follows trade induced resource reallocation from low productive sectors to higher productive sectors or improved efficiency and productivity within a sector. This, in turn, translates into structural transformation of the economy with substantial implications on poverty level. In this regard, Teignier (2011) examines the role of international trade on structural transformation in the United States (1890—2007), United Kingdom (1800-1900),

and South Korea (1963—2007) in a general equilibrium framework and shows that international trade has positively contributed for the structural transformation in the United Kingdom and South Korea. The study finds that the transformation of the United States is attributable to productivity growth. Similarly, studies also show that countries that are more open to trade tend to have higher growth rates and income per capita (Frankel & Romer, 1999; Irwin & Terviö, 2002). Tsai and Chao-His (2007) show that in Taiwan openness to foreign trade has contributed to raising income of the poor not only in the long term, but also in the short term through its positive impacts on the share of income accruing to the poorest quintile. Further, they show that in the short term every 1% increase in the ratio of trade to GDP leads to a 0.17% increase in the mean income of the poor in addition to that come out of economic growth. The study also shows that apart from trade liberalization and other export promotion measures that facilitate Taiwan exploit its comparative advantage, the export led economic growth was small and medium enterprise (SME) oriented where by SMEs accounted for 60—80% of employment and 50—70% of manufacturing exports. Hence, their island wide presence and unskilled labor-intensive production technologies played a crucial role in creating jobs and non-farm income for the poor (Tsai and Chao-His, 2007).

Despite the empirical evidence with regard to the positive effects of trade openness on economic growth, evidences showing the economic and social costs of trade openness have emerged. In this regard, studies have shown that trade liberalization in some countries has led to reduced demand for unskilled labor and lower real wages in the short run; combined with a low degree of inter-sectoral labour mobility, job losses and income declines have often translated into higher poverty rates. Further, opening a country's markets to foreign firms tends to reduce the market power of domestic firms and increase competitive pressures on them, eventually forcing some of them out of business. Thus, the inability to compete, and the presence of labor market distortions and imperfect mobility of labor across sectors may hamper the presumed reallocation of all categories of labor from the non-tradables sector to the tradables sector (Harrison & Hanson, 1999).

Most importantly, the relationship between trade and poverty is often derived from the relationship between trade and growth. Based on the famous "Bagawathi hypothesis" that growth is always good for the poor and the empirical regularity in the literature showing that trade liberalization leading to more trade openness causes growth. Thus, trade liberalization is considered a suitable policy tool for poverty reduction. However, whether trade led economic growth indeed alleviates poverty depends on the accompanying income distribution effect, or on where a country's comparative advantage lies. Hence, who gains what out of trade led economic growth (distribution effect) matters most for poverty alleviation. The justification for pro-poor distribution effects of trade openness is presented relying on the celebrated Stolper-Samuelson theorem. Accordingly, either export promotion would result in a higher real wage rate for labor or more jobs would be created for the unemployed who are usually poor. Tsai and Chao-His (2007) and Agenor (2004) argue that rigidities in factor markets, especially in the labor market, may disregard the Stolper-Samuelson theorem and lead to more unemployment and poverty.

Further, Harrison and Hanson (1999) show that in a number of countries in Latin America and Asia, openness to trade during the 1980s and 1990s has coincided with an increase in the demand of, and the return to, skilled labor relative to unskilled labor, and worsening wage inequality. A possible explanation of this phenomenon is that trade liberalization has been associated with the introduction of higher-level technology, the use of which requires skilled labor. The corollary of this argument might be that the long run effects of trade openness on poverty partly come through the link between trade openness and the accumulation of human

capital. The implication, therefore, is that trade openness needs to be accompanied by investment in human capital. As some theoretical models actually predict that free trade may lead to a decrease in the accumulation of human capital in countries that are initially skill scarce. The contrasting view, therefore, may lead us to question whether trade openness lead to high investment in human capital in developing countries.

Agenor (2004) found that there is a reasonably robust, inverted U-shape relationship between poverty and globalization: at low degrees of globalization, globalization does hurt the poor. However, at higher levels, globalization leads to a decline in poverty.

Poverty reduction in a developing world, particularly in Africa, will continue to be an imperative for many government and international institutions in the near future. While still under hot debate, a consensus is emerging among researchers and policy makers that sustained economic growth is essential for successful poverty alleviation. This consensus along with the widely accepted empirical regularity asserting outward oriented economies indeed grow more rapidly implies that integration into the global market appear as critical relevance for combating poverty. Poverty is an extremely complex multifaceted phenomenon. There is no easy way to understand it, not to mention to attack it.

With this background, this study quantitatively examines the African experience to see whether it bears out the theoretical prediction that openness to foreign trade is generally conducive to poverty alleviation. Further, the study shows that the *prima facie* of positive outcomes of trade openness on poverty reduction largely relies on the effects of trade openness on structural transformation of the African economy.

More specifically, we address two fundamental issues pertaining to the trade—poverty debate focusing on Africa. First, we attempt to show whether Africa is benefiting from international trade in terms of enhanced structural transformation, economic growth, and poverty alleviation. Second, we examine the causal link between trade openness and structural transformation in Africa. In doing so, the study contributes to the debate on the importance of international trade on structural transformation and poverty alleviation in developing regions.

3. Data, Model specification and Methodology

3.1 Analytical Framework

There is an empirical regularity in the literature that trade causes growth, and growth is good for poverty reduction. The later is associated to the 1960 'Baghawati hypothesis'-growth is good under any circumstances; and emphasized by Dollar & Kraay (2004) and Dollar, Kleineberg, & Kraay (2013). However, the evidence on the direct effects of trade openness on poverty incidences and income inequalities within countries and across countries is mixed. It is inconclusive because the mechanism through which trade could affect poverty levels is complicated and hence leads to various ways of analyzing the effect using various measures of trade openness.

The traditional trade theory, for example Heckscher-Ohlin theorem, hypothesize that when countries increase their engagement in international trade, the productivity of the abundant resource in the economy, labor in the case of developing countries, increases and hence real wages increase. This increase in income helps the poor and unskilled labor escape out of poverty. This assertion may not hold in reality. Because as countries increase their involvement in the international trade, the competition in the export market may derive them to capital intensive and advanced production techniques in order to catch up with their

competitors. In doing so, they tend to shy away from labor-intensive production technologies that require unskilled labor, thereby lowering the demand for unskilled labor and increasing the demand for skilled labor. Consequently, the real wage of the unskilled labor drops (Davis and Prachi, 2007). This implies that trade openness, unlike the predictions in the traditional trade theories, may benefit a few skilled labor than the abundant unskilled labor. The upshot of this indicates that trade openness may substantially reduce poverty depending on the level of human capital of a particular country. Further, rigidities in labor market may defy the theoretical abstractions and trade openness could exacerbate poverty at least in the short run.

Further, we postulate that the benefits of trade openness to the poor may come through the effects of trade openness on structural transformation. That is we hypothesise that trade openness promotes structural transformation leading towards the production of value added export items whose price in the international market is likely to be less volatile and have higher income elasticity. This indicates that countries at the early stage of structural transformation where agriculture dominates the economy, the benefits from trade openness are not impressive. Rather trade openness may exacerbate the poverty incidence and the negative consequences outweigh the expected benefits. This is mainly due to the following three reasons. First, in the agriculture-dominated economy, the exportable items appear to be primary products whose terms of trade continue to drop overtime in the face of many challenges in the supply side. Second, in such setting, it is more likely that agriculture appears to be the largest employer, the production technology is rudimentary requiring lower skills; hence, the unskilled labor is not prepared to seize the opportunities that trade openness would create. Third, the existing few export-processing firms tend to employ the available technology imported from overseas and this requires skilled labour to work with the imported machineries and equipments. As a result, the improvement in production technologies of the existing few export-processing firms or incoming new foreign firms into the economy increases the demand for skilled labor thereby the demand for unskilled labor in the sectors other than agriculture drops or remains stagnant. Thus, at the early stages of development trade openness tends to benefit the skilled labor and the unskilled labors who seek employment may not be absorbed. This inverted U—shape effect of trade openness was raised in Agenor (2004) who shows the same characterizing the relationship between globalization and poverty. Thus, we anticipate an inverse relationship between trade openness and poverty, countries at the lower spectrum of structural transformation may not be able to reduce poverty substantially; however, if other complementary measures are introduced, for instance, to build the capacity of the poor, unskilled workers so that they can get at least the minimum technical knowledge the job market requires, the adverse effects could be reduced.

3.2 Data and Empirical Model

The empirical objective of this paper is to show the poverty reduction effect of trade openness and structural transformation. To this effect, we compiled a panel data for 43 African countries for the period from 1981 to 2010. The analysis period is selected based on the poverty data obtained from the poverty indicators dataset of the World Bank (*PovocALnet*) and the other variables are organized in such a way that the data points match the poverty data. Poverty is captured by the poverty head count index. Poverty head count index provides the percentage of the population living with consumption or income below a \$1.25 a day poverty line. Trade openness is measured as the sum of exports and imports as a share of GDP. Trade openness, unlike trade liberalization, is a performance indicator

outcome variable represented by the ratio of export plus import to GDP³. The performance outcome, i.e., the effects of trade openness on growth and poverty reduction, depends on the ability of agents and sectors to respond to the altered incentives that largely depends on the characteristics of the economy. For this reason, we use control variables including structural transformation index, GDP per capita, financial depth, education, inflation, and access for communication services (telephone) representing the importance of infrastructure. The structural transformation index is a composite indicator constructed from economic, social, and demographic indicators (see Kelbore (2014)). Financial depth is represented by the ratio of private sectors domestic credit to GDP. For the institutional index, we follow Dollar and Kraay (2004) and use Contract Intensive Money (CIM) introduced by Clague (1999) as an indicator of institutional quality. CIM is an objective measure of institutional quality and is defined as the ratio of non-currency money to the total money supply $[(M2-C)/M2]$, where M2 is a broad definition of the money supply and C is currency held outside banks. The intuition behind this index is that the type of governance helps firms and individuals decide in what form they want to hold their assets. When there is good governance (sufficient third party enforcement), individuals are more likely to allow other parties to hold their money in exchange for some compensation and hence CIM is correspondingly higher (Clague, 1999).

This study follows the basic trade—growth and trade—poverty models and approaches suggested by Ravallion (1997), Ravallion & Chen (1996), and (Chang et al., 2009). The underlying empirical model is:

$$[1] P_{i,t} = \beta_1 TO_{i,t} + \beta_2 X_{i,t} + \eta_t + \mu_i + \varepsilon_{i,t}$$

where the subscript i and t represent country and time period, respectively, P is the log of poverty indicator, X is the matrix of control variables, TO is a measure of trade openness, η_t corresponds to time effects, μ_i denotes unobserved country-specific effects, and $\varepsilon_{i,t}$ the error term.

The above regression model results in several econometric challenges. First, we may have unobserved country and period specific effects. Second, the explanatory variables can be individually or jointly endogenous with the dependent variable, poverty; hence, we have to control for the biases resulting from simultaneous or reverse causation. To this end, we estimate [1] using the System Generalized Method of Moments (SGMM) estimator developed by Blundell & Bond (1998). The GMM method assumes that the process is dynamic in which current realizations of the dependent variable are influenced by the past ones; there exist arbitrarily distributed fixed effects; some of the regressors are endogenous; and the idiosyncratic variables are uncorrelated across individuals.

The system GMM estimator also assumes that the only available instruments are 'internal' and combines two sets of equations to generate instruments from within the data. The first set includes first differenced equations where the dependent variable is instrumented by the levels of the series lagged one period or more. The second set consists of the equations in levels with the right hand side variables instrumented by lagged first or higher order differences. We use SGMM for two reasons. First, the estimation technique uses within instruments to control for endogeneity among variables. Second, it assumes that the first

³ Trade liberalization is a policy input that influences the outcome by altering the relative incentives. Trade performance is an outcome and policy is only one factor affecting the outcome. Thus, trade performance (trade openness) is preferred in measuring the effects on growth and poverty.

differences of instruments are uncorrelated with the fixed effects and hence allows for the introduction of more instruments and improves the efficiency (Roodman, 2009). Therefore, the model retains valuable information that would have been lost in estimating the first difference only while controlling for country fixed effects.

Thus, the estimated model appears much like the following:

$$[2] P_{i,t} = \alpha P_{i,t-1} + \beta_1 TO_{i,t} + x'_{i,t} \beta_2 + \varepsilon_{it}$$

$$\varepsilon_{it} = \mu_i + v_{it} \quad \varepsilon_{it} = \mu_i + v_{it}, \quad E(\mu_i) = E(v_{it}) = E(\mu_i v_{it}) = 0$$

The error term has two orthogonal components: the fixed effects, μ_i , and the idiosyncratic shocks, v_{it} .

4. Discussion of Empirical Results

The summary statistics and correlation analysis of the data are presented in Tables 2 and 3. The average poverty head count index level stood at 46% implying nearly half of Africa's population lives below the \$1.25 a day. The mean value of GDP per capita reached about \$2700. The higher GDP per capita and the higher proportion of poor people in the continent point out that income inequality is a huge concern in Africa. The mean value of trade openness was 0.54 implying that Africa's involvement in international trade stood at nearly half of its GDP. However, there is a considerable difference between the minimum and maximum values of trade openness (0.03—4.67).

Table 2 Variable Description and source of data

Variable	Acronym	Definition	Source
Poverty	<i>lnpvt</i>	Poverty head count index representing Percentage of population below \$1.25 a day poverty line (%)	World Bank
GDPPC	<i>lngdppc</i>	Gross Domestic Product per capita in 2005 USD	World Bank
Trade openness	<i>lnopen</i>	Trade openness calculated as the ratio of import plus export to GDP (%)	UNCTAD STAT
Domestic Credit	<i>inc_dom</i>	Domestic credit to the Private sector as a ratio of GDP (%)	World Bank
Telephone	<i>Intelep</i>	Fixed telephone line telephone subscription per 100 people	World Bank
STI	<i>lnSTI</i>	Structural Transformation Index	Kelbore (2014)
Inflation	<i>lninf</i>	Inflation as calculated from the GDP deflator	World Bank
CIM	<i>incim</i>	Contract Intensive Money	IMF/IFS
Education	<i>lnprmedu</i>	Primary education completion rate (%)	UNESCO

The mean value of the structural transformation index is stood at 0.32 showing that Africa is still at the very early stage of structural transformation. The mean value of education represented by primary education completion rate appears to be 56%. The average number of telephone users per 100 inhabitants stood at 2.12 implying that the infrastructure base of Africa is very low.

Table 3 Summary Statistics of variables used

Variable	Observations	Mean	Std. Dev.	Min	Max
Poverty	473	46.48	24.99	0.47	92.29
GDPPC	465	2693	3488.5	264.11	20640.00
Openness	464	0.54	0.51	0.03	4.67
Domestic Credit	439	19.42	20.51	0.49	153.12
STI	473	0.32	0.12	0.02	0.69
CIM	426	0.38	0.19	0.02	0.98
Education	312	55.94	25.22	7.43	122.65
Telephone	472	2.12	3.91	0.01	25.72
Inflation	464	35.30	271.54	-9.2	5399.53

Source: Author's calculation using data from WDI, UNCTADSTAT, UNESCO, and IMF/IFS.

The correlation analysis results in Table 3 show that poverty has a strong negative relationship with GDP per capita, 62%, showing that growth in average income is crucial for poverty reduction. The coefficient of correlation between structural transformation and poverty appears to be negative and stood at 46%. This may crudely show that structural transformation may play a substantial role in poverty reduction. The correlation coefficient between poverty and trade openness shows a weak negative relationship, 15%, possibly revealing that in Africa the poverty reducing effect of trade openness could be far less than that could be achieved through structural transformation. The correlation coefficient between poverty and domestic credit to private sector also witnesses that the expansion of the private sector is one of the decisive ways to tackle poverty. Similarly, access for telephone service, representing the role of infrastructure, and education demonstrated a strong negative relationship with poverty, 57% and 45%, respectively. Poverty and inflation appear to have a positive correlation of 21% showing that inflationary conditions can exacerbate poverty in Africa. The correlation analysis results also show that GDP per capita has a strong positive relationship with structural transformation, telephone (infrastructure), education, domestic credit to private sector.

Table 4 Pairwise correlation of Variables

	Poverty	GDPPC	Openness	STI	CIM	Domestic Credit	Telephone	Inflation	Education
Poverty	1.00								
GDPPC	-0.62	1.00							
Openness	-0.15	0.19	1.00						
STI	-0.46	0.74	0.20	1.00					
CIM	-0.22	0.37	0.16	0.37	1.00				
Domestic Credit	-0.43	0.48	0.14	0.28	0.35	1.00			
Telephone	-0.57	0.78	0.23	0.64	0.48	0.50	1.00		
Inflation	0.21	-0.17	-0.10	-0.10	0.01	-0.34	-0.24	1.00	
Education	-0.45	0.64	0.32	0.66	0.48	0.30	0.62	0.03	1.00

Source: Author's calculation using data from WDI, UNCTADSTAT, UNESCO, and IMF/IFS.

Following Love and Lea (2006), we employed panel auto regression Granger Causality test to investigate the bi-causality between trade openness and structural transformation, poverty and structural transformation, and finally the tri-variate interactions. The results confirm that

there is a bi-causality relationship between trade openness and structural transformation (see Table 5). Concerning the interdependencies, evidence from the tri-variate PVAR Granger causality test presented in Table 6 shows that trade openness does not Granger-cause poverty; structural transformation does Granger-cause poverty; and the two variables combined Granger-cause poverty. Poverty and structural transformation Granger-cause trade openness both individually and combined. It appears that poverty does not Granger-cause structural transformation while trade openness does, and both combined Granger-cause structural transformation. These results indicate that the relationship among the three variables is non-linear with potential reverse causality and warrant an estimation technique that account for the endogeneity among the variables.

Table 5 Panel VAR-Granger causality Wald test for trade openness and STI

Equation \ Excluded	chi2	df	Prob > chi2
Trade Openness			
STI	6.239	2	0.044
ALL	6.239	2	0.044
STI			
Trade Openness	5.86	2	0.053
ALL	5.86	2	0.053

Ho: Excluded variable does not Granger-cause equation variable;
Ha: Excluded variable Granger- cause equation variable

Table 6 Panel VAR-Granger causality Wald test for Poverty, trade openness, and STI

Equation \ Excluded	chi2	df	Prob > chi2
Poverty			
Trade Openness	2.159	2	0.340
STI	10.37	2	0.006
ALL	11.763	4	0.019
Trade Openness			
Poverty	9.117	2	0.010
STI	18.112	2	0.000
ALL	20.288	4	0.000
STI			
Poverty	1.581	2	0.454
Trade Openness	7.843	2	0.020
ALL	8.076	4	0.089

Ho: Excluded variable does not Granger-cause equation variable;
Ha: Excluded Variable Granger- cause equation variable

For this reason, the system GMM is estimated in levels where the potentially endogenous variables were instrumented by their lags. The estimation results are presented in Table 6. In model 1, we see that poverty is path dependent as its autoregressive coefficient is positive and significant at 1%. The increase in GDP per capita led to a decline in poverty as evidenced by a negative relationship between the two variables. A percentage rise in GDP per capita level

appeared to result in 0.72% decline poverty. This result is in line with Dollar and Kraay (2004) that poverty and an increase in average income has nearly a one to one relationship implying no systematic relationship between the two.

Trade openness led to poverty reduction with one period lag implying that initially trade openness may not benefit the poor due to the required institutional and skill adjustment to make the unemployed poor suitable to the job that come with trade openness. In the context of developing countries, the majority of the unemployed are rural poor who are unskilled and with little or no knowledge about urban jobs, thus they may not benefit from employment opportunities immediately and are required to prepare themselves to such opportunities. Structural transformation led to poverty reduction after three periods lag indicating that structural transformation led to poverty reduction but the effects are not statistically significant probably due to the low level of structural transformation that Africa achieved so far. Although the domestic credit to the private sector appeared to show negative relationship with poverty, the result is not statistically significant. Expanding infrastructure led to a decline in poverty, a 1% increase in access for telephone service resulted in 0.2% decline in poverty. Inflation had a negligible positive effect on poverty.

In model 2, we exclude structural transformation index and measure the poverty reducing effects of other variables. Table 7 column 3 shows that path dependence of poverty is maintained. An increase in average income, GDP per capita, also maintained its negative relationship with poverty showing that a rise in GDP per capita led to 0.8% decline in poverty. Then again, this confirms 'growth is good for the poor' hypothesis. Trade openness also maintained its influence on poverty with a period lag. The poverty reducing effects of domestic credit to the private sector turned statistically significant in Model 2, where increase in domestic credit led to 0.24% decline in poverty. This indicates that expansion of the private sector in Africa can be an important mechanism to fighting poverty. An increase in the number of telephone lines resulted in a 0.22% decline in poverty, suggesting that expanding infrastructure that improves communication help in reducing poverty. Inflation had a negligible positive impact on poverty. The model diagnostics are satisfactory.

In model 3, we investigate the effects of institutions on poverty alleviation. The results show that CIM, the institution variable, had an insignificant negative impact on poverty. This is may be due to the objective measure of the institutional quality that we adopted. An increase in GDP per capita and telephone service maintained their significant contribution for poverty reduction even in the absence of structural transformation. Trade openness was correctly signed, but appeared not statistically significant. Model 4 examines how the institution variable behaves with the inclusion of structural transformation variable into Model 3. The results revealed that increases in average income and trade openness lagged one period led to poverty decline, and the results are statistically significant at 10 and 5%, respectively.

Several studies show that education is undisputable tool to fight poverty in developing countries. In this study, we used primary education completion rate and investigated its relationship with poverty. The result in Model 5 shows that education was signed correctly, but not statistically significant. However, with the inclusion of education into the model, structural transformation has significant negative effect on poverty after two periods lag. Increase in access to telephone service and increase in GDP per capita, similar to previous models maintained strong contribution for poverty reduction. Increased inflation also maintained its positive relationship with poverty and it is statistically significant at 5%. In all versions of the model, the diagnostics are satisfactory.

Table 7 System GMM estimation results

<i>Dep. Var. Inpvtv</i>	Model 1	Model 2	Model 3	Model 4	Model 5
<i>L.Inpvtv</i>	0.9716* (0.3090)	0.9143* (0.1422)	0.8983* (0.0811)	0.8849* (0.1820)	0.8101* (0.1486)
<i>lngdppc</i>	-0.7176*** (0.3763)	-0.8049*** (0.4027)	-0.8840* (0.2995)	-0.7756*** (0.4705)	-1.0393** (0.5099)
<i>lnopen</i>	1.1328*** (0.6084)	1.3031* (0.4309)	1.0545 (1.0658)	1.3293** (0.5852)	
<i>L.lnopen</i>	-1.0192*** (0.5865)	-1.2486* (0.4432)	-0.9902 (0.9157)	-1.2401** (0.5510)	
<i>lnSTI</i>	0.8040 (0.5582)			0.8216 (0.7469)	
<i>L3.lnSTI</i>	-0.5975 (0.8938)				
<i>L2.lnSTI</i>				-0.4260 (0.9016)	-2.8474*** (1.4495)
<i>inc_dom</i>	-0.06899 (0.1286)	-0.2439*** (0.1328)	0.05157 (0.2072)	-0.1904 (0.1772)	-0.01752 (0.0980)
<i>intelep</i>	-0.1754*** (0.1034)			-0.1940 (0.1606)	
<i>L.intelep</i>		-0.2175*** (0.1240)	-0.1687** (0.0703)		-0.1373*** (0.0781)
<i>L.lninf</i>	0.007375 (0.0399)				
<i>L2.lninf</i>		0.02885 (0.0529)	0.03895 (0.0362)	0.008217 (0.0430)	0.08733** (0.0430)
<i>L.lncim</i>			-0.5340 (0.4253)	-0.6916 (0.6472)	
<i>lnprmedu</i>					-0.09334 (0.1573)
<i>_cons</i>	0.8940 (1.5337)	-0.1797 (0.9438)	-0.2469 (0.6196)	0.2701 (0.9708)	1.0157 (1.1436)
Diagnostics					
<i>No. of Obs.</i>	284	314	316	317	210
<i>No. of Instruments</i>	40	35	42	42	39
<i>Ar(1)</i>	[0.069]	[0.002]	[0.008]	[0.043]	[0.014]
<i>Ar(2)</i>	[0.505]	[0.382]	[0.248]	[0.378]	[0.890]
<i>Hansen test</i>	[0.940]	[0.647]	[0.315]	[0.729]	[0.614]
<i>F-stat</i>	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

Note: *, **, *** represent 1%, 5%, and 10% significance, respectively. Robust standard errors are in parenthesis and *p*-values in square bracket. Source: Author's estimation using data compiled from WDI, UNCTADSTAT, UNESCO, and IMF/IFS.

4.1 Robustness Check

Validity and the reliability of the model results were checked by running different robustness tests. First, the results are verified by the criteria that the autoregressive coefficients of models 1 to 4 fall within the OLS and fixed effect estimates range (Rodman, 2009), confirming the model results are in the credible range. Second, the estimated coefficients of random and fixed effects models found to be in line with the estimates of GMM, despite the difference in significance levels

5 Conclusion

As more than 40% of Africa's population lives on less than \$1.25 a day, poverty reduction remains the biggest challenge faced by the continent. Therefore, attacking poverty will be a priority of African countries in the foreseeable future. Almost a consensus has been reached among the scholars that sustained economic growth is good for the poor. Therefore, if growth is good for the poor, all policy options that ensure sustainable growth can be considered among the cocktails of poverty reduction strategies.

This study investigated the poverty reducing effects of growth, trade openness, structural transformation, private sector and infrastructure expansion using a dynamic panel data estimation technique. The study used panel data between 1981 and 2010 for 43 African countries. Findings indicate that growth is indeed good for the poor in all specifications estimated; an increase in growth had nearly proportional negative effect on poverty. The study found that trade openness and structural transformation led to poverty reduction, albeit the effects were observed with a time lag. The study also observed that fostering the private sector and expanding infrastructure appeared crucial instruments to reduce poverty in Africa.

Therefore, prioritizing infrastructure development and embracing policies that enhance the private sectors economic participation, Africa has to pursue trade openness and structural transformation as decisive mechanisms to substantially reduce poverty in the continent. These compounded together increase job opportunities, bring about inclusive growth, and overcome the constraints in tackling poverty.

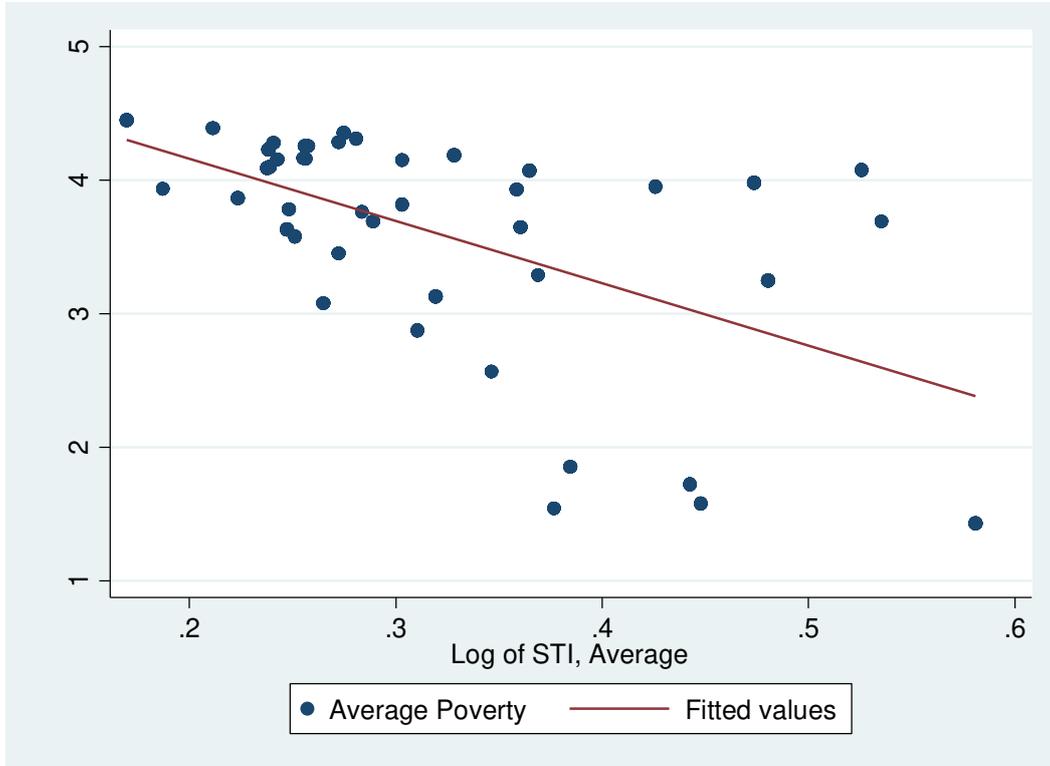
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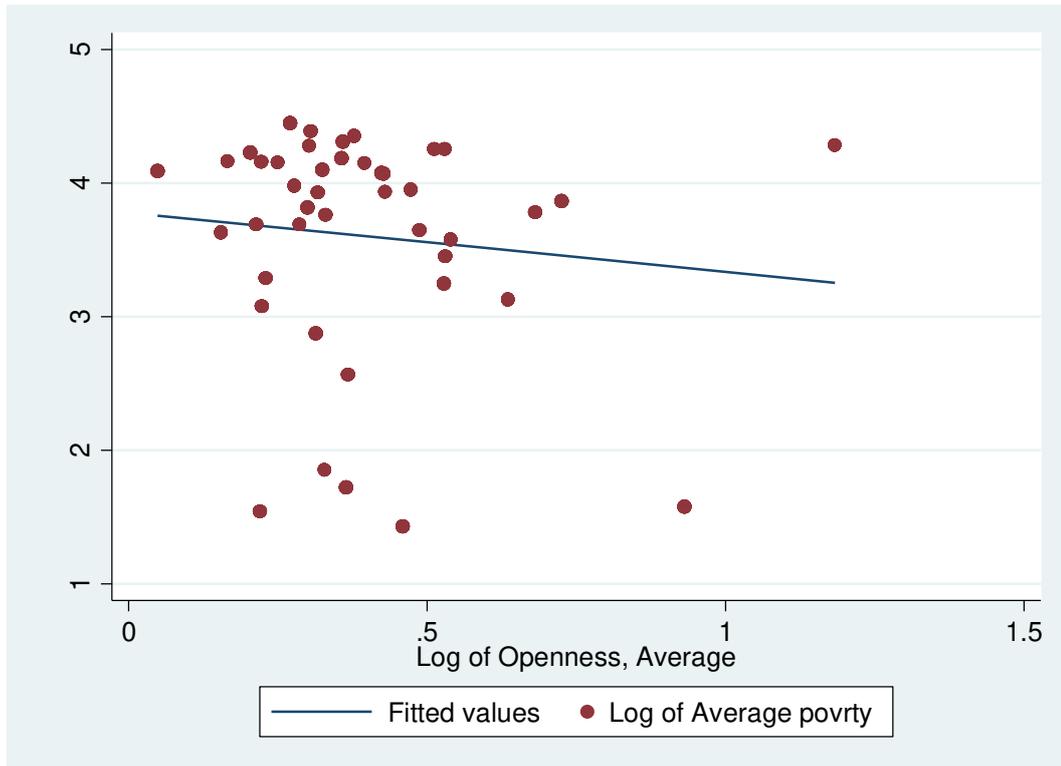
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Appendix

1. Poverty Head count and STI



2. Poverty Head Count and Trade Openness



3. Summary Statistics by decade

	Poverty	GDPPC	Openness	STI	Domestic Credit	CIM	Education	Telephone
1981-1990								
Mean	49.45	2418.78	0.40	0.27	20.21	0.34	48.79	1.00
Std. Dev.	25.33	3017.21	0.33	0.12	15.29	0.19	25.15	1.80
Min	1.17	308.23	0.04	0.05	1.59	0.04	7.43	0.01
Max	92.29	16689.60	2.44	0.60	80.95	0.98	122.65	12.49
Observations	176	168	175	172	153	161	120	180
1991-2000								
Mean	50.28	2522.67	0.43	0.31	16.84	0.41	51.05	2.07
Std. Dev.	24.66	3411.26	0.37	0.14	20.74	0.17	24.08	3.68
Min	2.18	302.24	0.03	0.04	1.21	0.03	13.97	0.02
Max	88.92	18110.10	2.36	0.70	134.44	0.77	104.30	24.94
Observations	132	132	131	129	125	127	76	135
2001-2010								
Mean	40.96	2890.08	0.69	0.38	19.85	0.42	63.96	3.24
Std. Dev.	23.81	3728.86	0.61	0.07	22.60	0.18	23.02	5.01
Min	0.32	264.11	0.04	0.24	0.49	0.02	21.92	0.02
Max	90.12	20337.40	4.62	0.64	147.35	0.81	120.46	25.72
Observations	135	135	135	172	133	132	100	134

4. List of the sample countries

Algeria	Ethiopia	Niger
Angola	Gabon	Nigeria
Benin	Gambia, The	Rwanda
Botswana	Ghana	Sao Tome and Principe
Burkina Faso	Guinea	Senegal
Burundi	Guinea-Bissau	Seychelles
Cameroon	Kenya	Sierra Leone
Cabo Verde	Lesotho	South Africa
Central African Republic	Madagascar	Sudan
Chad	Malawi	Swaziland
Comoros	Mali	Tanzania
Congo, Dem. Rep.	Mauritania	Togo
Congo, Rep.	Morocco	Tunisia
Cote d'Ivoire	Mozambique	Uganda
Egypt, Arab Rep.	Namibia	Zambia