

Effects of Trade Openness on Economic Growth in Sub-saharan Africa (ssa)

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Abstract

The debate among researchers on the factors that drive economic growth is still on. The theoretical and empirical literatures on growth have considered so many indicators but this study attempt to examine the effects of trade openness on economic growth in SSA. The new growth theory (NGT) through investment and technology was adopted for 24 selected countries. The robust fixed effects result is more efficient to draw inference and suggest that trade openness affect growth positively when factors such as Population growth, human capital development and government budget are considered. However, Population growth reduces economic growth and the level of school enrolment affects growth negatively. Trade openness is very important to improve the level of economic growth as well as the interaction between trade openness and the availability of physical capital. That is, for trade to affect growth positively, investment in physical capital is very necessary. Governments in SSA should channel towards improving the available infrastructure and enabling environment should be created to attract investors within and outside the region. In general, trade openness affect economic growth indirectly through the growth rate of physical capital.

Keywords: *Openness, Economic Growth, Fixed Effects, Investment*

Background to the Study

Africa emerged the poorest region in the World at the lunch the millennium (WDI, 2000). There were retrogression in key areas for example, average per capita income is less than as it was at the end of the 1960s. The distribution of income and access to essential services are unequally distributed between household in the region. More so, Africa has largely being confined to a series of development problems. These problems include: high child mortality, prevalence of endemic diseases- Malaria, HIV/AIDS and a lagging primary school enrolment. All of these challenges assert costs on the region more than any other region in the world. Since the 1980s, many countries have made concerted efforts towards economic reforms such as: trade and market liberalization aimed at encouraging the private sector to thrive. Although, the continent has been making news headlines over the years with regards war, political instability as well as diseases outbreak a number of countries in the region form part of the world's fastest growing economies in the world in recent times. Despite the economic progress recorded, it has not been adequate to overcome low house hold income level, deteriorating capacity, weak institutions and inadequate infrastructure.

Economic growth as suggested by Ranieri & Ramos, (2013) is supposed to be inclusive. They suggested that economic growth should be inclusive and everyone should participate in the process and share the benefits of growth equitably. In 2001, the International Monetary Fund (IMF), reported that globalization of the world economy has been significant in enhancing economic growth, development and fight against poverty. The establishment of the General Agreement on Tariffs and Trade (GAAT) in 1947 paved way for about eight rounds of multilateral trade liberalization, unilateral and regional liberalization all aimed at fostering a conducive trading environment in the world trading system.

In 1994, the World Trade Organization was established to assist in administering the growing body of multilateral trade agreements. The new orders of trading have seen the developing countries increase their share of World trading dramatically. However, progress recorded in regions across the globe has been uneven in recent decades. A number of developing countries in Asia are doing very impressive and studies have attributed their success to greater openness to world trade. Latin America countries have also not being doing bad in terms of progress recorded due to trade openness but the countries in Africa and Middle East have benefitted less and this is due to high barrier to trade (Tupy, 2005).

Economists have it that more opened economies will do better than closed ones in terms of economic progress in the long run. A number of countries in Africa have reduced or even eliminated barriers to trade and accept the ideas behind trade liberalization; Yet, it seems that the gains attached to opening up to international economic forces is limited in Africa, mostly for the poor ((Le Goff & Singh, 2014).

The burgeoning literature that seek to establish the link between trade liberalization or openness and economic growth is receiving different points of views from both theoretical and empirical angles in recent times. Scholars have investigated this relationship using cross-country and time series regression analysis but yet, the result is mixed. Earlier scholars suggest that trade have positive impact on economic growth (Barro, 1991; Dollar, 1992; Sach

& Warner, 1995; Dollar & Kraay, 2004, 2003; Edwards, 1998). Recently, the debate has taken a different dimension with scholars faulting the earlier studies to be plagued by a number of problems. These problems are: weak theoretical foundation, poor data quality, inappropriate econometric technique and failure to address the possibility of mutual causation (Rodriguez & Rodrik, 2001 Baldwin, 2003).

This paper attempt to show the effects of trade openness on economic growth among selected countries in Sub-Saharan Africa (SSA) using panel dat unlike the conventional approach, this study adopted an indirect link between trade and rate of economic growth through investment. The main link between trade openness and economic growth is investment (Baldwin & Seghezza, 1996a,b; Musila & Yiheyis, 2015). The paper is organized into five sections with section 1 as the introduction. Section 2 presents the theoretical and empirical literature. Section 3 outlines the data and methodology and section 4 presents the results. The summary and conclusions of the study are presented in section 5.

Objective to the Study

To examine the effect of trade openness on economic growth among selected countries in sun sahara Africa (SSA).

Literature Review

Theoretical Framework

The link between trade and openness and economic growth according to the new growth theory (NGT) are investment and technology. Those in support of the link through investment argue that openness fosters investment for the following reasons. (i) The traded sector is more capital intensive than non-traded sector (ii) The production of investment goods used imported intermediate goods to some extent and (iii) Competition in international trade market of machinery and capital equipment lowers the price of capital (Baldwin & Seghezza, 1996a).

Also, trade openness is argued to somewhat improve technology because an expanded international market can provide (i) Technology spillover (ii) Economies of scale in R & D and (iii) Promote higher profits to innovators (see Krugman 1990; Grossman & Helpman, 1991; Rivera-Batiz & Romer, 1991). The technology spillover (or imitation) channel appears more important for Sub-Saharan African (SSA) Countries. Considering two trading partners with different levels of innovativeness and one being technologically advanced and the other less technologically advanced (i.e developed countries and SSA). When developed countries innovate and SSA imitate, such imitation can expand product variety in the less technologically advanced country which might lead to long term economic growth. On the other hand, Grossman & Helpman (1991) suggest that if less technologically advanced country is far behind in stick of human capital, trade between more technologically advanced countries and less technologically advanced country may retard growth. This might be because the less technologically advanced countries lack the ability to exploit an international pool of knowledge in order to catch up. The impact of trade on economic growth becomes ambiguous because of the divergent views. It is expected that trade openness should affect the rate of economic growth among SSA countries positively because most of her trading partners are technologically advanced countries.

This study adopts the NGT to examine the impact of trade openness on rate of economic growth. Stylized fact suggests that real GDP depends positively on the quantities of labour, physical capital, human capital, and technology. Following Gross & Helpman (1991) & Jin (2004), the state of technology is assumed to depend on trade in goods and other factors. The theoretical model is presented based on the aggregate production function as:

$$y = f(k, h, b(OPEN, ?)) \quad (1)$$

Where y is the level of real GDP per capita, k is the level of physical capital and h is the level of human capital per capita, $OPEN$ is the level of trade openness and $?$ represents other factors that might affect the state of technology.

Empirical Literature

Literature on trade liberalization and economic growth has received substantial contribution from trade researchers in recent years. Some of most prominent among the openness-growth nexus in literature are studies by (Dollar, 1992; Sachs & Warner, 1995; and Frankel & Romer, 1999). A number of dimensions have been considered to investigate the relationship between trade and economic growth. Some researchers consider growth in export, increased investment while others considers improvement in current account of a country. The bottom line here is that, the impact of trade on economic growth might be positive or negative but positive cases are more in literature. Some of the literatures are: Greenaway & Nam (1988) classified developing countries into: Strongly inward, Moderately Outward & Strongly outward using a descriptive statistic for the year 1988. They conclude that countries that adopt outward oriented trade strategies tend to grow faster than the others. In a study involving Asia, Latin America and Africa, Dollar (1992) asserts that reduction of real exchange rate distortion improve the level of per capita growth of the countries in each quartiles. Similarly,. More so, more opened economies grow faster than closed ones (Sach & Warner, 1995). They examine index based on five socio-economic and political criteria. These criteria are: average tariff rate exceed 40%, non-tariff barriers covered more than 40% of imports; economic system practiced a socialist economic system; state monopoly of major exports; and whether black market premium exceeded 20% during either the decade of the 1970s or the decade of the 1980s. They conclude that Open economies grow faster than closed economies by 2 to 2.5 percentage points. Open economies have higher investment ratios, better macroeconomic balance and a larger role of the private sector as the engine of growth. Closely related to Sach and Warner (1995) is the study by Harrison (1996) who examined trade-growth nexus for developing countries using granger causality test. Found positive relation between trade and economic growth in developing countries for the periods 1960-1984 & 1978-1988.

Furthermore, Greenaway (1997) adopted a dynamic econometric model approach to investigate trade openness and economic growth relationship. Growth in merchandise exports, growth of the capital sock, growth in labour force were the relevant explanatory variables considered to explain economic growth in a difference GMM framework. Found that growth rates experiences have undergone a smooth nonlinear transition through time between two distinct values. Trade liberalization is associated with deterioration in growth

for the selected countries. Again, Greenaway, Morgan, & Wright (2002) argued that diversification of trade liberalization measures and problems of misspecification can be attributed to the inconclusiveness in trade-growth literature. In a dynamic growth model, and applying several measures of liberalization, they conclude that liberalization may impact growth favourably for 32 developing countries selected for this study. Existing literature on trade liberalization-growth nexus suggest four major channels through which increased openness affect economic growth. These channels are: increased capital accumulation, factor price equalization, knowledge, spill-overs and trade mediated technology. The critiques of trade-growth relationship are based on the following inadequacies: measurement and quality of data, endogeneity problems, problem of omitted variables bias and possibility of not including other policies such as: financial liberalization/development which are very important for trade to thrive.

More recently, Falvey, Foster, & Greenaway (2012) revisited the trade liberalization-growth nexus by applying quartile regression method and found that countries with lowest per capita income gain from trade liberalization in the long run but suffers a negative effect in the short run. Trade liberalization increase the cost of intermediate imports of production during the period of structural adjustment program and this impacted on the rate of economic growth negatively. Also, opening up the market witnessed the collapse of several factories because domestic firms could not compete with cheap imports (Musila & Yiheyis, 2015).

Materials and Methods

The data used for this study was obtained from World Bank's African Development Indicator (2013) the period of the study span from 2005 to 2013 based on data availability. Samples of 24 countries were selected based on data availability on key variables (see appendix for list of countries).

Model Specification

The regression model estimated to investigate the effects of trade openness on long-term rate of economic growth included some relevant control variables. Budget deficit ratio to GDP captures the role of macroeconomic environment and population growth controls for market size. Based on the theoretical model, the model for this study is specified as:

$$GDPCG_{it} = \beta_0 + \beta_1(GBD)_{it} + \beta_2(POPG)_{it} + \beta_3(HCG)_{it} + \beta_4(LOPEN)_{it} + \beta_5(IV * GBD)_{it} + V_i + \varepsilon_{it} \quad (2)$$

Where GDPCG is rate of economic growth, GBD is growth in budget deficit ratio to GDP, POPG is population growth, HCG is growth human capita, OPEN is growth in trade openness measure (IV*OPEN) is the interaction term between growth in physical capital stock and growth in trade openness, Vi is country specific effect and ε_{it} is the error term.

Results and Discussion

This section presents the empirical findings of the study using three approaches. The methods used for the data analysis are the traditional pooled OLS, random effects and fixed effects. The country specific effect was considered and this renders the pooled OLS unfit for

the estimation because results based on pooled OLS will be biased. However, the Hausman test was applied to select the most appropriate technique and the result favoured the fixed effects model. Therefore, conclusions for this study are based on the fixed effect model.

Table 1: Summary Statistics & Correlation matrix: Trade Openness & Economic Growth in Sub-Saharan African countries, annual data (2005-2013)

Variable	Source	Unit of Measurement	Observations	Mean	Standard Deviation	Minimum	Maximum
Real GDP per capita growth	WDI		225	2.803	4.289	-37.264	18.507
Growth in Physical Capital	WDI		204	12.051	26.391	-36.527	231.417
Budget Deficit ratio to GDP	WDI		153	-1.238	5.926	-12.317	40.416
Population Growth	WDI		225	2.421	0.9501	0.160	4.182
Secondary School Enrolment	WDI		146	45.954	26.580	10.100	110.764
Trade Openness	WDI		219	4.246	0.405	3.433	5.188
Correlation Matrix							
	Real GDP per capita growth	Growth in Physical Capital	Budget deficit ratio to GDP	Population growth	Secondary School Enrolment	Trade Openness	
Real GDP per capita growth	1.0000						
Growth in Physical Capital	0.4613	1.0000					
Budget Deficit ratio to GDP	0.2624	0.1749	1.0000				
Population Growth	-0.0559	0.1330	-0.2277	1.0000			
Secondary School Enrolment	0.0479	-0.1500	0.0147	-0.7854	1.0000		
Trade Openness	0.1164	0.0465	0.4374	-0.5364	0.2758	1.0000	

The variables used for this study are described in table 1. From the table, it is evident that the average rate of economic growth in SSA is about 2.8 percent and trade openness growth in the region is about 4.2 percent annually. The growth rate in physically capital is tremendous with a speed of about 12 percent annually. The budget deficit as a percent of grows at the rate of 1.24 percent and the population growth rate is also increasing at the rate of 2.4 per cent annually. The correlation results shows that trade openness have a positive but weak relationship with the level of economic growth in the region. Growth in physical capital has a stronger relationship with the rate of economic growth compared to other indicators. The correlation matrix results have revealed the relevance of the two variables (i.e investment and trade openness) in determining the rate of economic growth in the region. The regression results will expose this relationship better and this can be found in table 2.

Table 2 Regression Results, Dependent Variable: GDPCG

	Pooled OLS	Random Effects	Fixed Effects	Fixed (Robust)
Constant	6.964	-0.8175	-18.892	-18.892
GBD	0.1004	0.1295*	0.1890**	0.1890**
POPG	-0.6446	-0.1994	-0.1702	-0.1702
HCG	-0.0158	-0.0073	-0.0926	-0.0926
LOPEN	-0.5646	0.9466	6.2059***	6.2059**
(IV*OPEN)	0.0150***	0.0140	0.0121***	0.0121***
Breusch Pagan- LM test	3.67(0.55)			
Hausman Test		12.51(0.0284)		
Hetero (2-stat)			7954(0.000)	
Serial Correlation Test			0.034(0.857)	

Note: values in parenthesis denote p-values & indicate significance at 1%, 5% & 10% levels respectively

The results presented in table 2 reveal the relationship between trade openness and economic growth in SSA for the period 2005 to 2013. The Hausman tests have suggested the use of the fixed effect model to draw inference. However, the test for heteroscedasticity found the residual not to be constant across time. Therefore, the fixed effect robust standard error test was conducted and this rectified the problem of heteroscedasticity. The results suggest that government budget is significant and positively related to economic growth in SSA. These suggest that promotion of a budget geared towards capital projects is necessary to accelerate growth in the region. Trade openness is significantly positive to improve economic growth by a large percentage. From the table, a 1 percent increase in trade openness will result to a 6.2 percent increase in economic growth. However, the interaction of trade openness with physical capital (investment) is positive and significant to improve the level of economic growth. This implies that trade openness will be effective if physical capital are put in place.

Summary and Conclusions

The debate among researchers on the factors that drive economic growth is still on. The theoretical and empirical literature on growth have considered so many indicators but this study attempt to examine the effects of trade openness on economic growth in SSA. Scholars have revealed that trade openness is an important engine of growth through technology spill over and foreign direct investment (FDI) (see Such and Warner, 1995; Dollar, 1992, Dollar and Kraay, 2001). As seen in the results, trade openness affects growth positively when factors such as population growth, human capital development and government budget are considered. However, Population growth reduces economic growth and the level of school enrolment affects growth negatively. Trade openness is very important to improve the level of economic growth as well as the interaction between trade openness and the availability of physical capital. That is, for trade to affect growth positively, investment in physical capital is very necessary and this is supported by (Trejos & Barboza, 2015). Government budget should be channeled towards improving the available infrastructure and enabling environment should be created to attract investors within and outside the region. In general, trade openness affect economic growth indirectly through the growth rate of physical capital.

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Appendix: Data used

Country	Time	Code	GDP growth (annual %)	Cash surplus/deficit (% of GDP)	Population growth (annual %)	School enrollment, primary (% gross)	Gross capital formation (annual % growth)	Trade (% of GDP)
Angola	2005	1	18.26147368	0.899323738	3.49138756	110	..	139.6556
Angola	2006	1	20.73512488	24.3139392	3.434184809	..	158.9829377	118.8235
Angola	2007	1	22.5930543	14.65252942	3.390082358	114.9002304	27.17005439	119.9131
Angola	2008	1	13.81714581	7.216002988	3.340097732	122.2297211	67.23894373	129.325
Angola	2009	1	2.412869693	-10.98190214	3.288110745	121.3511505	-15.7915017	110.4156
Angola	2010	1	3.407654794	0.859708441	3.235949546	123.8367615	3.530573056	104.3397
Angola	2011	1	3.918596986	11.44313623	3.178581885	140.4537048	12.88991481	107.5157
Angola	2012	1	5.155440545	6.661445766	3.122298291	146.8420734	28.17124627	101.6801
Angola	2013	1	6.800058482	1.879755306	3.079269101	153.230442	5.924323286	96.49377
Benin	2005	2	2.865236818	-0.61723032	3.223668816	98.54522705	-16.08048696	50.11996
Benin	2006	2	3.752154478	2.43257371	3.143630466	98.79341888	27.68175976	46.21304
Benin	2007	2	4.626396471	8.982020387	3.076640817	88.3783474	4.436267633	47.86009
Benin	2008	2	5.014638407	2.557205596	3.006914648	110.0342636	3.265547064	47.2816
Benin	2009	2	2.663222588	-1.038176193	2.937390102	114.8736725	4.12371134	40.89286
Benin	2010	2	2.611487073	2.064040299	2.869601321	116.2895432	-4.273058885	39.73968
Benin	2011	2	3.26371861	2.739283669	2.799588715	118.6075211	4.681545999	38.23769
Benin	2012	2	5.395889626	1.703581384	2.732396013	122.7661209	11.59646386	39.6027
Benin	2013	2	5.640149161	-3.306516906	2.67778485	124.3434067	41.42590867	51.77262
Botswana	2005	3	4.556645752	11.2345	1.129391527	105.1909866	-0.522984048	88.50535
Botswana	2006	3	7.959531063	12.50055387	1.067896691	105.384407	-0.444490491	86.33459
Botswana	2007	3	8.682340667	5.216185143	1.009840046	104.4940338	18.91321974	95.10457
Botswana	2008	3	3.90146671	-6.44874656	0.962982375	104.5676575	13.09483385	95.25467
Botswana	2009	3	-7.84100187	-12.31683596	0.926338148	106.0060806	1.885215584	88.06041
Botswana	2010	3	8.594135564	-7.015486589	0.899049579	106.762104	14.57731876	82.08056
Botswana	2011	3	6.182819889	-0.407237206	0.877650512	107.5181274	10.29974883	97.72635
Botswana	2012	3	4.314165732	1.377235805	0.86247979	108.2741508	12.09159462	102.9051
Botswana	2013	3	5.827030816	-6.895227472	0.85634157	109.0301743	-10.25201143	115.0171
Burkina Faso	2005	4	8.661861605	-5.396658403	2.93087398	58.32049942	15.4294941	35.53572
Burkina Faso	2006	4	6.253158606	-5.856799261	2.939025714	62.06523895	2.581278234	36.77824
Burkina Faso	2007	4	4.111381646	-5.432263615	2.942887038	67.66017914	9.115719351	35.78303
Burkina Faso	2008	4	5.800005065	-3.956582044	2.938955941	73.22734833	7.931555883	36.28576
Burkina Faso	2009	4	2.866699541	-4.691131516	2.926282817	77.68096161	17.42019659	40.59079
Burkina Faso	2010	4	8.446221244	-4.537518508	2.907424319	78.35542297	10.23760953	50.44877
Burkina Faso	2011	4	6.626915077	-2.287620355	2.886012163	82.23842621	36.65350273	59.22173
Burkina Faso	2012	4	8.995216194	-2.992954158	2.864601961	84.96495056	3.413408397	57.95181
Burkina Faso	2013	4	6.647165888	-2.279118377	2.843121785	86.86219025	8.90286044	57.12318

Congo, Dem. Rep.	2005	5	6.135151155	-0.603873206	2.893138402	..	16.56684119	43.97502
Congo, Dem. Rep.	2006	5	5.321014838	-0.870336146	2.851591728	..	18.63344552	44.66371
Congo, Dem. Rep.	2007	5	6.258047314	-0.653577654	2.832466846	93.10769653	12.26021712	86.65582
Congo, Dem. Rep.	2008	5	6.227795416	-0.064724712	2.812250604	102.1836319	6.381350171	86.31301
Congo, Dem. Rep.	2009	5	2.855285914	0.264650145	2.795091832	102.1093826	65.96754744	64.2756
Congo, Dem. Rep.	2010	5	7.107234593	2.323241372	2.779638721	102.6823502	20.83756771	90.68851
Congo, Dem. Rep.	2011	5	6.874000001	3.121635751	2.759950183	105.1772537	12.0537522	85.55135
Congo, Dem. Rep.	2012	5	7.087571172	3.121635751	2.736405614	110.8988724	9.660739033	68.04443
Congo, Dem. Rep.	2013	5	8.481956636	3.121635751	2.715375806	..	7.999859179	74.66286
Congo, Rep.	2005	6	7.755758978	9.621748101	2.689022511	110.2512894	4.661517545	138.6636
Congo, Rep.	2006	6	6.235997013	18.65450453	2.887347423	110.3239822	24.8547986	149.7796
Congo, Rep.	2007	6	-1.58222275	11.55773949	3.030542726	107.6147079	-0.304711384	132.0526
Congo, Rep.	2008	6	5.572264173	27.91616258	3.081104768	105.2289429	2.37143008	122.154
Congo, Rep.	2009	6	7.468878032	34.01430074	3.015388869	109.0378494	16.81626297	120.6234
Congo, Rep.	2010	6	8.751655799	39.13423281	2.876009218	111.1690369	2.221955185	139.8176
Congo, Rep.	2011	6	3.42062127	48.32639726	2.72640112	111.6498108	36.57833763	145.1188
Congo, Rep.	2012	6	3.799995854	55.12980882	2.609039645	109.4158096	4.00014263	144.1044
Congo, Rep.	2013	6	3.440705249	62.16831151	2.517719565	107.1818085	16.54567129	142.6044
Equatorial Guinea	2007	7	13.13581614	21.98862174	2.87078594	..	3.462201672	173.487
Equatorial Guinea	2008	7	12.26966844	18.6933119	2.837180137	86.00562286	16.9003774	146.2951
Equatorial Guinea	2009	7	-8.071928976	-10.38989046	2.820823554	85.85640717	20.55049756	186.0751
Equatorial Guinea	2010	7	-1.308484385	-26.57914656	2.813841402	87.06970215	7.623312588	169.5417
Equatorial Guinea	2011	7	4.997797207	-49.21537578	2.808500627	87.35736847	8.543426459	160.178
Equatorial Guinea	2012	7	3.219445883	-68.62811845	2.795763144	90.72975159	-3.716166753	157.9209
Equatorial Guinea	2013	7	-4.840126662	-89.65260439	2.774953553	92.55977631	2.330686464	156.8326
Gambia, The	2005	8	-0.941675912	-9.118054126	3.154956255	90.82814789	-12.84722532	70.31098
Gambia, The	2006	8	1.124099702	-8.40143179	3.136741692	88.79995728	8.431184283	61.95015
Gambia, The	2007	8	3.631025533	-1.579214772	3.126829827	90.1696701	0.276211523	56.80197
Gambia, The	2008	8	5.734641946	-4.354553951	3.126865823	87.86593628	-6.517493269	56.0538
Gambia, The	2009	8	6.449695858	-4.669749276	3.140809504	85.56220245	8.02276661	64.61083
Gambia, The	2010	8	6.524632607	-0.900329599	3.161849526	85.15329742	-29.76610786	69.81484
Gambia, The	2011	8	-4.328681349	1.12310932	3.181314341	82.45314789	33.47827026	80.63927
Gambia, The	2012	8	5.862228177	-0.422157932	3.191192666	85.21061707	-3.434836323	86.44829
Gambia, The	2013	8	4.802165004	1.304954244	3.189933457	86.57315826	-8.282718274	87.80149
Ghana	2005	9	5.900003953	-1.408885142	2.598563421	90.36096954	..	98.17151
Ghana	2006	9	6.399912419	-4.204931514	2.602138108	95.34689331	..	65.92277
Ghana	2007	9	6.459591207	-4.68737873	2.598910956	100.9564209	18.34752893	65.35432
Ghana	2008	9	8.430637957	-5.873828927	2.561637953	106.7091599	30.06802355	69.51423
Ghana	2009	9	3.991570633	-5.646445813	2.484628795	105.5337906	-14.08763003	71.59292
Ghana	2010	9	8.008593391	-7.199752644	2.3830749	111.2865295	18.57344526	75.37634

Ghana	2011	9	15.00888576	-3.91789739	2.272974825	106.7352371	44.88543249	93.81587
Ghana	2012	9	8.785038523	-5.076070891	2.174968366	109.9172516	23.76325815	101.1785
Ghana	2013	9	7.585001485	-5.018664066	2.099257407	108.7796173	-4.334131123	89.3986
Kenya	2005	10	5.90666082	1.494808867	2.693755731	106.9910736	13.2404856	64.47887
Kenya	2006	10	6.330632805	-2.029856389	2.67933568	104.7348175	22.45241995	55.23649
Kenya	2007	10	6.993285154	-2.539957799	2.670427489	111.5635223	16.12697271	53.89479
Kenya	2008	10	0.232282746	-3.460423718	2.668476528	111.0759506	14.13622278	57.5786
Kenya	2009	10	3.306939815	-4.39214981	2.675690432	111.8762436	11.09291756	50.86364
Kenya	2010	10	8.405699224	-4.728395515	2.686665341	112.6765366	11.37193701	54.22686
Kenya	2011	10	6.122050598	-3.648243973	2.697863935	113.4768295	6.566664072	60.4465
Kenya	2012	10	4.452270391	-3.850317772	2.700090251	114.3560867	9.724490277	55.30489
Kenya	2013	10	5.743139176	..	2.686155782	115.1958618	-1.1635713	50.89603
Lesotho	2005	11	2.704500225	4.241419512	0.720299237	117.1377335	-13.89190465	169.7492
Lesotho	2006	11	4.307444107	13.94107813	0.753652381	117.408989	0.483936059	172.6495
Lesotho	2007	11	4.733465098	7.949272758	0.789029905	110.9038696	26.03240201	170.1011
Lesotho	2008	11	5.733473897	5.630843019	0.83580278	110.1778793	27.29570949	176.5516
Lesotho	2009	11	3.357932789	15.33050164	0.892165374	109.3598938	-1.862750417	158.7061
Lesotho	2010	11	7.09126399	9.338696265	0.952694441	110.4693832	20.04498184	156.6017
Lesotho	2011	11	2.836935329	7.020266526	1.019957897	110.9912186	-13.81954774	154.0549
Lesotho	2012	11	6.511439037	16.71992515	1.079582685	111.0006027	22.96753288	150.6161
Lesotho	2013	11	5.489400292	10.72811977	1.111012128	108.0296631
Liberia	2005	12	9.481315987	1.277587185	2.638434451	..	66.71257744	100.0694
Liberia	2006	12	9.779340349	3.151396237	3.456762213	92.52455139	38.44733818	173.5419
Liberia	2007	12	15.68803967	3.390628306	3.982032041	..	-13.285355	153.7635
Liberia	2008	12	10.53119282	0.662644812	4.181841641	93.25601196	-18.03299749	179.1209
Liberia	2009	12	13.76159475	-2.065338683	3.969641664	99.63831329	30.93315622	91.68989
Liberia	2010	12	10.9425022	-0.87747748	3.510900571	..	49.13582262	101.2817
Liberia	2011	12	9.131658925	-1.610826224	3.02864003	102.3847122	18.7907162	120.317
Liberia	2012	12	10.23864203	-2.568862711	2.678182621	105.4276123	3.3696411	121.8799
Liberia	2013	12	11.30674508	3.456762213	2.443208413	108.4705124
Madagascar	2005	13	4.602899965	-4.647391686	2.923770107	138.3220825	-9.197215139	73.76518
Madagascar	2006	13	5.022607002	-0.394357525	2.886958198	138.1116943	19.3361691	75.4971
Madagascar	2007	13	6.240578451	-2.664455725	2.853270368	139.2682037	10.77624322	82.3908
Madagascar	2008	13	7.128513539	-1.927734224	2.828651696	142.3452454	66.67599328	83.4498
Madagascar	2009	13	-4.013860583	-2.54091723	2.815005748	149.9512634	-18.88238257	73.99668
Madagascar	2010	13	0.263110856	-0.861107045	2.80876582	144.5773163	-12.27190281	68.02269
Madagascar	2011	13	1.454392168	-1.67748445	2.803848333	144.4774628	1.255099492	69.07646
Madagascar	2012	13	3.027536044	2.575549711	2.79727208	145.1860046	5.818104577	72.97672
Madagascar	2013	13	2.414297692	0.305451511	2.790779225	145.2480927	-1.932889557	73.05434
Mali	2005	14	6.079794351	-2.493855655	3.133019381	80.11179352	46.3806777	62.92913
Mali	2006	14	8.578286908	30.72007557	3.167447547	83.04335785	12.67464518	69.31191
Mali	2007	14	4.298178176	-4.727628448	3.194405345	85.57691193	0.272510517	61.75994
Mali	2008	14	4.978529163	-1.743695265	3.191356115	87.61859131	160.3167244	72.19817
Mali	2009	14	4.457421986	-2.062956851	3.154081114	89.25071716	-11.84098956	55.10881
Mali	2010	14	5.819314829	-2.497432589	3.098167701	90.31070709	-1.275526512	65.8759
Mali	2011	14	2.730111011	-3.492171871	3.033578254	91.66346741	-3.422460533	62.50369
Nigeria	2007	17	6.828398348	-0.559670019	2.666191559	92.89025879	41.703274	64.46291
Nigeria	2008	17	6.270263697	-0.192173244	2.695061599	83.76664734	-0.719934066	64.97297
Nigeria	2009	17	6.934416004	-3.209693267	2.722339258	85.03594208	34.74563776	61.80285
Nigeria	2010	17	7.839739477	-1.992992516	2.746547633	84.80487823	18.33527755	42.65138
Nigeria	2011	17	4.887386611	-1.818613884	2.769633801	75.85455322	-29.54940308	52.7941
Nigeria	2012	17	4.279277314	-1.34367076	2.787254854	66.90422821	2.509851878	44.38014
Nigeria	2013	17	5.394416311	-4.361190784	2.792753424	57.9539032	10.13816084	31.02589

Rwanda	2008	18	11.16246001	0.628152845	2.926281734	115.3289566	31.92982456	36.66667
Rwanda	2009	18	6.267988487	-0.129173383	2.956052784	118.2645798	2.925531915	36.36364
Rwanda	2010	18	7.312669275	-1.078380504	2.874467786	122.1980362	6.976744186	36.07748
Rwanda	2011	18	7.851934941	-0.922618424	2.798802787	128.2294159	9.299516908	43.19482
Rwanda	2012	18	8.788351534	-3.961668546	2.774130565	133.7203064	22.20994475	38.34935
Rwanda	2013	18	4.684512428	-2.962582237	2.743708039	133.8303528	7.775768535	39.30184
Senegal	2009	19	2.423175917	-4.966843283	2.804029318	84.56285858	-14.73043325	43.47374
Senegal	2010	19	4.266247626	-5.189933967	2.848854845	84.41316223	-3.196543915	44.14882
Senegal	2011	19	2.066645293	-6.153447969	2.893308216	83.52570343	23.87942579	45.39474
Senegal	2012	19	3.452902581	-5.300736985	2.922095294	83.78816223	9.730142766	65.48721
Senegal	2013	19	2.803807191	-6.264250988	2.923892555	..	9.308867096	65.11009
Seychelles	2005	20	9.005761179	2.444438296	0.48367688	112.8079376	51.32131477	66.8533
Seychelles	2006	20	9.75698118	2.162814121	2.029920447	..	-29.86125323	66.61544
Seychelles	2007	20	10.06471193	-5.382622887	0.510514983	107.8607864	-1.07292484	73.62257
Seychelles	2008	20	- 2.140515242	7.004007319	2.236282715	106.0007324	-15.3932883	178.7291
Seychelles	2009	20	- 1.107181169	3.856400342	0.392530948	104.6221008	-5.107380855	184.3066
Seychelles	2010	20	5.945430656	1.417144968	2.792329069	106.2239609	47.69626853	178.2629
Seychelles	2011	20	7.915108502	5.555794226	- 2.628656355	106.9364166	1.886029983	208.3502
Seychelles	2012	20	2.805618878	5.25162624	0.98098019	107.6723175	16.79613368	217.3047
Seychelles	2013	20	5.275872708	9.390275498	0.980422107	..	19.2800565	194.0784
South Africa	2005	21	5.277051974	-0.181362947	1.320896646	107.0351563	6.291622128	201.4568
South Africa	2006	21	5.58504596	0.874523834	1.348208381	107.290947	12.75359198	205.4806
South Africa	2007	21	5.360474055	1.028631902	1.375747197	108.9699631	8.406728146	164.0274
South Africa	2008	21	3.191043885	-0.649412845	1.403526813	108.1631699	8.614844287	53.1491
South Africa	2009	21	- 1.538089134	-4.916542524	1.431560682	106.5101166	-8.504242976	60.27723
South Africa	2010	21	3.039747085	-3.964167052	1.459867637	104.3761368	1.123599744	63.68312
South Africa	2011	21	3.212451757	-4.223990115	1.488461432	102.347702	9.299389427	72.86539
South Africa	2012	21	2.219824004	-4.473709248	1.517358493	101.5859604	5.196533597	55.41826
South Africa	2013	21	2.212354433	-4.728480346	1.546573579	100.7871399	1.537291234	55.98899
Tanzania	2009	22	5.395174414	0.028245781	2.991056867	105.2969131	-9.777826661	60.02125
Tanzania	2010	22	6.354268068	-1.862915133	3.010116932	101.6785278	22.60148726	60.73873
Tanzania	2011	22	7.918823381	-0.895055077	3.025103557	..	29.74047927	64.22334
Tanzania	2012	22	5.147252362	-5.263031579	3.035148402	93.00811005	-5.901287554	43.61956
Tanzania	2013	22	7.281728924	-9.631008081	3.030067069	89.51817322	10.84052777	48.16736
Togo	2005	23	1.180406953	-5.737283924	2.603221677	113.3226776	23.31938687	57.21295
Togo	2006	23	4.052412549	-3.526851488	2.594662475	117.5621414	10.25441743	54.50127
Togo	2007	23	2.290453889	-0.822974493	2.586126462	111.93116	-9.867322914	49.4875
Togo	2008	23	2.225480228	0.269453076	2.583144206	113.1158524	-4.094516304	98.6993