Globalization and growth in the low Income African countries with the extreme bounds analysis

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ABSTRACT

The relationship between globalization and economic growth, especially in the poorer developing countries, is controversial. Many previous studies have used single globalization indicators such as the ratio of exports plus imports to *GDP*. This paper uses a comprehensive measure of a globalization of Dreher (2006), which is based on measures of globalization of the economic, social and political sectors. Panel data estimates with data of 21 low income African countries show a small but significant positive permanent growth effects. The sensitivity of this growth effect is examined with the extreme bounds analysis (*EBA*). Contrary to the findings by Levine and Renelt (1992) that cross country growth relationships are fragile, the effects of globalization and some other determinants of the long run growth rate are found to be robust by *EBA*.

Keywords: Globalization, Economic growth, Solow model, Africa and Extreme bounds analysis.

JEL: N1, O1, O4, O57

1. Introduction

In the growth and development literature the relationship between globalization and economic growth is contentious. The dominant liberal view is that globalization causes higher growth providing trade and investment opportunities for employment generation leading to a decline in income inequality and levels of poverty. This view, also known as the Washington consensus, is supported by international agencies such as the World Bank (WB) and the International Monetary Fund (IMF) etc. Consequently, especially in countries that needed assistance from these international agencies, there has been rapid globalization. Wacziarg and Welch (2008) have noted that while 22% of the countries have liberalized trade policies in 1960, this proportion has increased to 73% by 2000. However, a few skeptics contend that higher levels of globalization have adverse effects on the domestic economy leading to economic and social inequalities because globalization increases economic insecurity and risk, causing hardships. Stiglitz (2002) and Rodrik (2007a, 2007b) are some well known economists with skeptical views about the Washington consensus. Therefore, the question of whether globalization improves growth and development in the less developed countries is somewhat unresolved and needs further examination. The main objective of this paper is to examine the relationship between globalization and the long run economic growth in the low income African countries. The long run growth is the same as the permanent growth rate or the steady state growth rate (*SSGR*) of the theoretical growth models. These three terms will be used synonymously in this paper. Our sample includes African countries, which are classified as "low income countries" under the WB classification of country list.[1] Only 21 African countries are included in our sample from 1970 to 2005 because of a few data limitations and these are listed in Appendix-1.

Some new features of this paper are as follows. Firstly, unlike in the previous studies, which have frequently used the ratio of exports plus imports to *GDP* (*TRAT*) to proxy trade openness and globalization, we shall use a comprehensive index of globalization which combines several indicators of globalization from the economic, political, and social sectors. This index, denoted as *GLO* in this paper, is the contribution

[1] According to the World Bank countries with per capita Gross National Income (2006) equal or below US$935 are considered to be low income countries.

of Dreher (2006).[2] Secondly, there have been criticisms on the *ad hoc* nature of specifications used to estimate growth equations; see Rogers (2003), Easterly et. al., (2004) and Durlauf et. al. (2005). One main criticism is that it is not clear how the estimated specifications of the growth equations are derived from the claimed theoretical growth models. We shall estimate an extended production function, instead of a growth equation, and use the Solow (1956) growth model as a framework to derive the effects of globalization on the steady state growth rate (*SSGR)*. Thirdly, in addition to the standard panel data methods, the system-GMM method (*SGMM)* of Arellano and Bover (1995) and Blundell and Bond (1998) will be used for estimation. *SGMM* has some advantages. It minimizes the biases due to the endogeniety of the variables, weak instruments and persistence in the variables. However, as Roodman (2009) noted *SGMM* has also some limitations because it creates a large number of instrumental variables. Finally, the robustness of the growth effects of globalization and other determinants of *SSGR* is tested with the extreme bounds approach (*EBA*) of Leamer (1983).

The outline of this paper is as follows: Section 2 briefly reviews a few important studies on the growth effects of globalization. *GLO* and its components are described in Section 3. Section 4 discusses specification and estimation issues. Empirical results are in Section 5. The robustness of the effects of *GLO*, its components and other determinants of *SSGR* are examined with *EBA* in Section 6. Section 7 concludes.

2. Globalization and Growth

While most economists agree that globalization is an important factor in building an efficient economic system there is no consensus regarding the growth effects of globalization. According to Baldwin (2003), there are reasons for this disagreement and an important reason is due to differences in the way economists define and treat this question. Some are interested in the broad impact of outward-oriented policies not only on economic growth but also on its other effects e.g., on environment and welfare etc; see Dreher and Gaston (2008) and Dreher et. al., (2008). Others are looking at the narrower causal relationship between trade and growth. Another reason for different results is due to the differences in specifications, data and estimation methods. A variety

[2] His measure uses the principal components method to combine several variables from the economic, political and social sectors. It is updated every year and can be freely used from http://globalization.kof.ethz.ch/

of cross country methods have been used and they range from pure cross section techniques with a large cross section dimension to time series methods based on unit roots and cointegration with country specific data. Pritchett (1996) has also raised doubts on whether researchers have adequately measured openness. In Pritchett (1999) he examined the correlations between a number of measures of openness to see if they were capturing some common aspect of trade policy and found that the link between various empirical indicators are pair-wise uncorrelated. This finding raises questions on the reliability of these measures in capturing some common aspects of trade policy and the interpretation of the empirical evidence. Subast (2003) distinguishes between measures of trade liberalization (e.g., reductions in trade barriers) and trade intensity (e.g., ratio of exports plus imports to GDP) since they may not have the same effects on growth. In addition globalization may also bring new ideas and habits of thinking which may contribute to better methods of production and improvements to institutions. Therefore, a wider measure of globalization will be useful for studying its effects not only on economic growth but also on other variables of interest.

However, in spite of these observations, Dollar (1992) found that outward oriented economies with high exports and the ability to sustain imported goods, especially equipment, experience improved growth rates.[3] Barro and Sala I Martin (1995), Sachs and Warner (1995), Edwards (1998), Greenaway, Morgan, and Wright (1998), and Vamvakidis (1998) show, with cross-country regressions, that trade protection reduces growth rates. Ben-David (1993), and Sachs and Warner (1995) show that only open economies experience unconditional convergence. Quinn (1997) proposed an openness indicator based upon coding of the domestic and international laws of 64 nations from 1950 to 1994. The results suggest that capital account deregulation is a significant contributor to economic growth and investment. Frankel and Romer (1999) provide instrumental variables estimates with cross-country geographic indicators and find a significant and robust positive relationship between trade on growth. Brunner (2003) extended Frankel and Romer's approach to panel estimation and found a significant positive impact of trade on the growth of income.

On the contrary Rodriguez and Rodrik (2000) challenge the robustness of the openness-growth correlations found by Dollar (1992), Ben-David (1993), Sachs and

[3] Dollar's index of outward orientation was popular as a measure of globalization for several years but Subast (2003) argued that it has weaknesses and should be replaced with better measures.

Warner (1995), and Edwards (1998).[4] They argue that some of these studies did not control for other important growth enhancing variables and draw attention to some drawbacks in their measures of openness. However, Warner (2002) refuted these criticisms and reestablished the positive growth-openness link. In fact, Warner (2002) argued that Rodriguez and Rodrik (2000) base their claims on empirical specifications with low statistical power for testing the impact of trade restrictions on growth and development. Warner also presented additional tests of the growth-openness relation based on specifications similar to Sachs and Warner (1995). The weight of the evidence argues that in general protection is harmful to growth.

Vamvakidis (2002) and Clemens and Williamson (2004) examined longer-period historical data during 1870-2000 and 1865-1950 respectively. They found that the existing correlation between openness and growth becomes significant only in recent decades. Rodrik (1997 and 2007) argued that trade and financial openness by themselves are implausible to lead to economic growth, and may occasionally even backfire, in the absence of a wider range of complementary institutional and governance reforms. Stiglitz (2002) is critical of the Washington consensus, globalization and the manner of decision making with inadequate discussions at the IMF and the WB. However, he admitted that globalization may have positive growth effects but its adverse effects on income distribution and environment exceed their benefits. In this context it is worth noting that even such outstanding defenders of globalization like Blinder (2006), Summers (2006) or Krugman (2007) have acknowledged that globalization has also some adverse effects and increases inequality and insecurity.

Our brief survey did not indicate how robust are the estimated relationships with respect to the selected conditioning variables and specifications used to estimate the effects of globalization. In an influential study, based on the extreme bounds analysis of Leamer (1983), Levine and Renelt (1992) have found that the growth effects many growth enhancing variables—including trade openness but with the exception of the investment ratio—are fragile with respect to the selected control variables. A weakness in Levine and Renelt's findings is that they have used the usual *ad hoc* specification of

[4] Rodrik (2007, Section III pp-27-28) admits the benefits of globalization, e.g., higher growth rates, for the developing countries but stresses the adverse effects due to lack of institutions of global standards. He states this as follows "The dilemma that we face in the early years of the twenty-first centaury is that markets are striving to become global while the institutions needed to support them remain by and large national."

the growth equation and ignored alternative specifications. This paper is an attempt to fill this and a few other gaps in the literature.

3. Measuring Globalization

Previous studies on globalization used often single proxies such as trade openness (*TRAT),* the ratio of exports to *GDP,* the ratio of foreign direct investment to *GDP* (*FDIRAT),* black-market premium on the exchange rate and the ratio of portfolio investment flows to *GDP* etc. Therefore, there have been a few attempts to develop broad based measures of globalization. The well known Lockwood and Redoano (2005) discrete index of globalization from 1980-2004 is based on economic, political and social dimensions. Similarly, Kearney, Andersen and Herbertsson (2005) have used trade, finance and other political variables to develop discrete indices for 62 countries starting from 2000 to determine the annual rankings of countries. Using a similar approach the Andersen and Herbertsson index is developed for 23 OECD countries for the period 1979 to 2000. The Sachs and Warner (1995) openness index measures a country's openness to international trade during the period 1965 – 1990. An economy is deemed to be open to trade if it satisfies five tests: (1) average tariff rates below 40 percent; (2) average quota and licensing coverage of imports of less than 40 percent; (3) a black market exchange rate premium of less than 20 percent; and (4) no extreme controls (taxes, quotas, state monopolies) on exports; and (5) not considered a socialist country by the standard in Kornai (1992). Several prominent studies have used this index to find positive effect on economic growth (Sachs and Warner 1995, Sala-I-Martin 1997 and Edwards 1997). All these measure have some limitations. The Lockwood and Redoano (2005) index covers only trade and other economic variables but ignores trade and investment restrictions. Likewise, the Kearny index has an arbitrary weighting scheme and does not adjust for the size of the country. The Sachs-Warner index is a binary dummy variable and cannot measure the depth of globalization.

The advantage of using *GLO* of Dreher (2006) is that firstly it is a very comprehensive measure because it captures also the political and social dimensions, which are missing in other indices. Secondly, it combines several economic indicators like trade and restrictions on trade and investment (e.g., hidden import barriers, mean tariff rates, taxes on international trade and capital account restrictions). Thirdly, instead of using arbitrary weights the principal components approach is used to obtain an

Table 1 **G**lobalization Indicators and their Weights

	Indices and Variables	Weights
A.	**Economic Globalization**	**[38%]**
	i) Actual Flows	(50%)
	Trade (percent of GDP)	(19%)
	Foreign Direct Investment, flows (percent of GDP)	(20%)
	Foreign Direct Investment, stocks (percent of GDP)	(23%)
	Portfolio Investment (percent of GDP)	(17%)
	Income Payments to Foreign Nationals (percent of GDP)	(21%)
	ii) Restrictions	(50%)
	Hidden Import Barriers	(21%)
	Mean Tariff Rate	(29%)
	Taxes on International Trade (percent of current revenue)	(25%)
	Capital Account Restrictions	(25%)
B.	**Social Globalization**	**[39%]**
	i) Data on Personal Contact	(34%)
	Telephone Traffic	(26%)
	Transfers (percent of GDP)	(3%)
	International Tourism	(26%)
	Foreign Population (percent of total population)	(20%)
	International letters (per capita)	(26%)
	ii) Data on Information Flows	(34%)
	Internet Users (per 1000 people)	(36%)
	Television (per 1000 people)	(36%)
	Trade in Newspapers (percent of GDP)	(28%)
	iii) Data on Cultural Proximity	(32%)
	Number of McDonald's Restaurants (per capita)	(37%)
	Number of Ikea (per capita)	(39%)
	Trade in books (percent of GDP)	(24%)
C.	**Political Globalization**	**[23%]**
	Embassies in Country	(25%)
	Membership in International Organizations	(28%)
	Participation in U.N. Security Council Missions	(22%)
	International Treaties	(25%)

Note: Weights may not sum to 100 because of rounding errors.

aggregate measure of globalization and finally it is updated every year, freely downloadable and dates back to 1970. It covers 122 countries up to 2005.Table 1 lists the economic, political and social variables used with their weights to develop *GLO*.

4. Specification and Estimation Issues

The popular specifications used in both the cross country and country specific studies for estimating the growth effects of one or another growth enhancing variable need an examination. Although many empirical studies based on these specifications claim that they are estimating the long run growth effects, i.e., the steady state growth rate (*SSGR*) of the theoretical growth models, these specifications do not distinguish between the long and short run growth effects. While the annual growth rate of output is the dependent variable in the country specific studies, many cross country studies use a five or ten year average growth rate. In pure cross section studies with large cross section dimensions the dependent variable is 20 to 30 year average growth rate. None of these growth rates is a good proxy for the unobservable *SSGR*. Conceptually *SSGR* is similar to the natural rate of unemployment. Proxying *SSGR* with some average growth rate is somewhat similar to proxying the natural rate of unemployment with some average rate of unemployment. Likewise, many studies claim that their specifications are based on one or another endogenous growth model, but it is hard to understand how these specifications are derived from the claimed endogenous growth model. Commenting on the unsatisfactory nature of specifications used by the empirical works, Easterly, Levine and Roodman (2004) state that "This literature has the usual limitations of choosing a specification without clear guidance from theory, which often means there are more plausible specifications than there are data points in the sample." Rogers (2003) also took a similar view on the *ad hoc* nature of specifications but justified them because of the complexity of economic growth and the lack of an encompassing model. Consequently, as found by Durlauf, Johnson, and Temple (2005), the number of potential growth improving variables used in the empirical works is as many as 145.[5] Given these reservations it is hard to select a set of uncontroversial control variables to

[5] Sala I Martin (1997) has analysed with the extreme bounds analysis the robustness of the growth effects of 62 variables. Unlike Levine and Renelt he found that 22 variables have significant growth effects.

estimate the growth effects of globalization or any other growth improving variable like investment ratio or institutional reforms etc.

In light of such limitations, what can be estimated at best, with annual data or even with short panels, seems to be a modified production function but not the permanent growth effects of growth enhancing variables like globalization etc., by simply regressing the average growth rate of output on variables considered to have some growth effects. As stated earlier the long run growth rate or the *SSGR* of the theoretical growth models is conceptually similar to the natural rate of unemployment. Both should be derived by estimating an appropriate model and by imposing the steady state equilibrium conditions. Just like estimates of the natural rate of unemployment are derived by estimating an expectations augmented Phillips curve and by imposing the equilibrium condition that the actual and expected rates of inflation are equal, *SSGR* can be derived from the estimates of the production function and by using the steady state conditions of the Solow (1956) growth model. It is well known that in the Solow model *SSGR* equals total factor productivity (*TFP*). Therefore, Edwards (1998), Bernanke and Gurkaynak (2001) and Dollar and Kraay (2004) have suggested that the permanent growth effects of the growth improving variables should be estimated by estimating their effects on *TFP*. Senhadji (2000) has used this approach and estimated *TFP* for 88 countries using the growth accounting framework in Solow (1957). He then regressed *TFP* on some potential growth improving variables. Our approach is somewhat similar to the spirit of these works, but our method is different and simpler than Senhadji because there is no need to conduct the growth accounting exercises. We shall extend the production function by making *TFP* to depend on some growth improving variables, and thus directly estimate their permanent growth effects.

We selected the Solow (1956) growth model for a few reasons. Firstly, the Solow model is easy to extend and estimate compared to a variety of endogenous growth models which need complex non-linear dynamic specifications and estimation of unobservable parameters like the inter-temporal elasticity of consumption substitution and the risk aversion rate etc. Bernanke and Gurkaynak (2001) and Greiner et al. (2004) have estimated such endogenous growth models, to estimate the permanent growth effects of variables like the saving rate and R&D expenditure etc. However, they have to make some assumptions about one or another crucial parameter to get plausible results. Secondly, there is no convincing evidence that endogenous growth models, with increasing returns, empirically perform better than the Solow model; see Jones (1995), Korcherlkota and Ke-Mu Yi (1996), Parente (2001) and Solow (2000).[6] Solow (2000) observed that "The second wave of runaway interest in growth theory—the endogenous-growth literature sparked by Romer and Lucas in the 1980s, following the neoclassical wave of the 1950s and 1960s—appears to be dwindling to a modest flow of normal science. This is not a bad thing." Finally Bernanke and Gurkaynak (2001) noted that the Solow growth model is also useful to evaluate other types of growth models if they have a balanced growth path.

Our extended Solow model may be called as Solow model with an endogenous framework. Our extension differs from the well known extension to the Solow model of Mankiw, Romer and Weil (1992, MRW hereafter). While our model directly estimates the permanent growth effects of variables, the MRW method is more appropriate for estimating the permanent level effects of human capital or improved measures of inputs. In our extension estimates both the non-observable steady state level of income and its steady state growth rate (*SSGR)* using the estimated parameters of the production function as follows.

Let the intensive form of the Cobb-Douglas production function, with the constant returns and Hicks-neutral technical progress, be[7]

$$y_t = A_t k_t^{\alpha} \qquad 0<\alpha<1 \tag{1}$$

where y = per worker output, A = stock of technology and k = capital per worker. It is well known that the *SSGR* in the Solow model equals the rate of growth of A which is the same as total factor productivity. It is common in the empirical estimates of the Solow model to assume that the evolution of technology is given by

$$A_t = A_0 e^{gT} \tag{2}$$

[6] Bernanke and Gurkaynak have tested the validity Solow model against the endogenous models of Lucas (1988) and Uzawa (1965) and found that more parameter restrictions are satisfied in the Lucas-Uzawa model. However, they admit that the Solow model, as extended by Mankiw, Romer and Weil (1992) is valid to analyse all types of growth models if eventually they reach a balanced growth path.

[7] It makes no significant difference if technical progress is Harrod neutral because *TFP* estimates differ by only a constant.

where A_0 is the initial stock of knowledge and T is time. Therefore, the steady state growth of output per worker equals g. The log-linear specification of the production function with the above assumption on the evolution of technology is:

$$\ln y_t = \ln A_0 + gT + \alpha \ln k_t \qquad (3)$$

which can be easily estimated and used to derive the steady state level of per worker income and its growth rate. It is also plausible to assume that

$$A_t = f(T, Z_t) \qquad (4)$$

where Z is a vector of *TFP* improving variables like globalization, investment ratio and foreign direct investment ratio etc. This is consistent with the views of Edwards (1998) and Dollar and Kraay (2004) that a more convincing and robust evidence between openness and growth should be derived from its effects on productivity.[8] The effect of globalization (*GLO)* or some other variable on *TFP* can be captured with a few alternative empirical specifications of (4) but we shall use a simple linear specification and express the extended production function as:

$$y_t = A_0 e^{(g_1 + g_2 Z_t)T} k_t^{\alpha} \qquad (5)$$

The Solow model with our modified production function implies that *SSGR* is:[9]

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[8] Edwards (1998) used an alternative method with panel data. He computed *TFP* as the residual from the growth accounting exercises for each country and ten year averages of *TFP* are used as the dependent variable. Using alternative measures of trade openness he found that they all have significant effects on *TFP*. Senhadji (2000) has also used a similar method.

[9] The steady state level of per worker income (y^*) in the Solow model can be estimated from the following:

$$y^* = \left(\frac{s}{g+n+d} \right)^{\frac{\alpha}{1-\alpha}} A$$

where s = saving rate, g = is growth rate, n = the rate of growth of employment and d = is rate of depreciation. Given the estimate of the share of profits α from the production function the steady state level income can be computed by making assumptions about $g+d$, and using data on *s* and *n*. (*cont…*)

$$\Delta \ln y^* = SSGR = g_1 + g_2 \ Z \tag{6}$$

where $\Delta \ln y^*$ is *SSGR* (see footnote 11) and g_1 can be interpreted as the parameter capturing the growth effects of other trended but ignored variables. g_2 captures the growth effects of *Z* vector (for simplicity we assume that Z has one variable). Our extended specification is well suited to test whether higher levels of globalization have permanent and long run growth effects.

We have selected 7 variables for inclusion into the Z vector, which broadly represent the effects of economic policy variables, political and institutional factors. The selected variables are *GLO*, an index of institutional reforms (*INSTI*), a dummy variable for civil wars and unrest (*CWAR*), rate of inflation (*DLP*), ratio of current government expenditure to GDP (*GRAT*), ratio of investment to *GDP* (*IRAT*) and the ratio of foreign direct investment to *GDP* (*FDIRAT*). Definitions of the variables and sources of data are in the appendix. *DLP* and *GRAT* proxy good economic policies and institutional reforms have been emphasized as a growth improving variable by aid giving agencies like the IMF and the World Bank. *IRAT* has been extensively used as a growth improving variable in many empirical studies due to some potential scale effects and it is the only variable found to have robust effects on growth in the *EBA* approach of Levine and Renelt.[10] Similarly *FDIRAT* may also have some scale effects because foreign firms usually bring better technologies. Our selected 7 variables are similar (if not identical) to the 7 variables selected by Levine and Renelt (2003).[11] In fact there is no end to the list

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Unless some assumption is made about the evolution of technology, for example as in equation (5), it is possible only to compute the steady state level of per worker income adjusted for skill improvements. The point we are making is that estimating a production function is adequate to estimate the unobservable steady state level of income instead of proxying it with some average level of income.

[10] Although *IRAT* has only level effects in the Solow growth model, it may have a positive effect on *TFP* if its scale effects are significant.

[11] In an influential paper analysing the poor growth performance of the African countries Easterly and Levine (1997) have found that ethnic diversity is an important variable for explaining the diversity in the long run growth rates of the African countries. They have used 7 other standard variables as control variables besides dummies for decades and 2 regional dummies for Africa and Latin America. Their sample consists of 10 year average values of the variables for the 1960s, 1970s and 1980s of 160 countries. Our variables *CWAR* and *INST* capture some effects of ethnic diversity.

of such variables with some potential to affect growth rate to be included into the *Z* vector (see Durlauf et. al., 2005). However, the intercept g_0 should capture the effects of some ignored but trended variables if they have any significant positive or negative growth effects.

5. Empirical Results

The specifications in equations (1) and (2) is estimated with the standard penal data methods of fixed effects (*FE*), random effects (*RE*) and with *OLS* of the population averages. Levine and Renelt and MRW and many others have used *OLS* to estimate their cross country regressions. In addition we have also used the systems based generalized of moments (*SGMM*) of Arellano and Bover (1995) and Blundell and Bond (1998). This method uses extra moment conditions that rely on certain stationarity conditions of the initial observation. *SGMM* combines the standard set of equations in first differences with suitably lagged levels as instruments, with an additional set of equations in the levels with lagged first differences as instruments. It minimizes the weak instruments problem and biases due to the endogeneity and persistence in the variables. However, recently Roodman (2009) has pointed that *SGMM* creates and uses a large number of instrumental variables and this may give somewhat unreliable estimates especially of the standard errors. Therefore, caution should be exercised in claiming that *SGMM* estimates are better than *FE* or *RE* or *OLS* estimates. We shall also report *SGMM* estimates with restrictions to reduce the number of instruments and these are denoted as *SGMMR* estimates and mainly use these estimates on the reliability of the conventional estimates.

Our data covers the period 1970-2005 for 21 African countries and they are listed in the appendix. Their average per capita incomes ranges from a low U$ 122 for Burundi to a high of US$ 765 for Cote d'Ivoire. It is estimated by the WB that 46.4% of the population in Africa lives under US$ 1.0 per day (WDI, 2005). In contrast to other developing nations, the number of extremely poor people in the African region has almost doubled between 1981 to 2005, from 200 to 380 million and is likely to increase to 404 million by 2015 (WDI, 2005). Furthermore, most of the countries in the region have poverty rates over 50% to 70%. For example, the percentage of people living below poverty line in Mali, one of the low income African countries, is about 73%. Many agree that if Africa were to achieve the millennium development goal of reducing poverty, the best strategy is high and sustainable rate of economic growth. The average rate of growth of per capita income during 1970 to 2005 was about -0.1 percent and it is closely related to the average rate of growth of output per worker. The correlation coefficient between these two growth rates is 0.93. If policies can be implemented to raise the average rate of growth of per worker income permanently to about 3 percent, the growth rate of per capita incomes will permanently increase to slightly more than 2.5 percent. This target rate of growth is not difficult to achieve and these economies will experience much higher growth rates during the transition period; see Rao and Cooray (2009) for estimating the transitional growth rates. Therefore, one of our objectives is to understand, the scope for implementing growth policies to increase per worker incomes can grow at about 3% per year.

With these objectives in mind we proceed as follows. First, the basic specifications of the production function in equations (2) and (3) are estimated with the 5 alternative methods viz., *FE*, *RE*, *OLS*, *SGMM* and *SGMMR.*[12] To conserve space only estimates of equation (3) where *TFP* evolves with time are shown in columns (1) to (5) of Table 2. The Breusch and Pagan Lagrangian multiplier test statistic (*BP*) for random effects is significant ($\chi^2(1) = 8988.39$, $p = 0.00$) rejecting the assumption of the *FE* estimate that the variance of the error term is zero. All the 5 estimates yielded close and significant estimates for the coefficient of time and the share of profits (α).They imply that *TFP* is negative at about -0.4 percentage points. Estimates of the share of profits ranged from 0.17 in *SGMM* (column 4) to 0.20 in the *RE* and *SGMMR* estimates (column 2 and 4). Surprisingly *OLS* estimates (column 3) with the population means are close to *FE* and *SGMM* estimates (columns 1 and 4). We have reestimated the *FE* and *RE* models with the instrumental variables to minimize any endogenous variable bias and these are close to their estimates in columns (1) and (2) implying that the endogenous variable bias is negligible. These estimates are not reported to conserve space. Estimates of the 2 coefficients by all the 5 methods seem plausible. However, since the BP statistic is significant *RE* estimates are preferable. Its $\bar{R}^2$ is marginally higher than *FE* estimate.

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[12] STATA 11 is used for estimation. We have encountered a problem in estimating with *SGMM*, which is a new option in STATA 11 because it is has dropped time due to multicolinearity. Therefore, in all the *SGMM* estimates the coefficient of time (i.e., g_0) is constrained to equal to its estimate in the random effects model.

Table 2: Estimates of Production Function

$$\ln y_t = \ln A_0 + gT + \alpha \ln k_t$$

Variables	(1) *FE*	(2) *RE*	(3) *OLS*	(4) *SGMM*	(5) *SGMMR*
Constant	-1.645 *** (0.02)	-1.609 *** (0.14)	-1.638 *** (0.33)	-1.643 *** ($0.59E^{-2}$)	-1.594*** (0.01)
T	$-0.412E^{-2}$ *** ($0.47E^{-3}$)	$-0.424E^{-2}$ *** ($0.50E^{-3}$)	$-0.414E^{-2}$ *** ($0.46E^{-3}$)	$-0.424E^{-2}$ *** (C)	$-0.424E^{-2}$ *** (C)
$\ln k$	0.171*** (0.01)	0.199 *** (0.01)	0.176 *** (0.01)	0.171 *** ($0.48E^{-2}$)	0.212*** (0.01)
$\bar{R}^2$	0.871	0.873	0.870	0.876	0.876
Test for Serial correlation	F(1,20) = 46.97 (5%=248.01)+	F(1,20) = 46.97 (5%=248.01)+	F(1,20) = 46.97 (5%=248.01)+	0.344# (p = 0.73) -0.070 (p = 0.94)	0.312# (p = 0.76) -0.117 (p = 0.91)
F-Statistics	103.26 ***				
Wald χ^2		237.1 ***	216.9 ***	1252.5 ***	351.81***
BP test	---	8988.39 ***	---	---	---
Number of Instruments	---	---	---	614	69
No. of observations	756	756	---	756	756
No. of countries	21	21	21	21	21

Notes:

+ Wooldridge first order serial correlation test for panel data. CV stands for 5% critical value.

Test statistic for the first and second order serial correlation. p-values are in the parentheses.

- Standard Errors in the parenthesis below the coefficients. ******* Significant at 1% confidence level; ****** Significant at 5% confidence level; ***** Significant at 10% confidence level.
- *SGMMR* stands for *SGMM* estimates with restricted number of instrumental variables.
- ρ_1 & ρ_2 is the test for the first and second order serial correlations. This test is available in Stata for only *SGMM* and *SGMMR* estimates.
- $\bar{R}^2 s$ for *OLS* and the 2 *SGMM* estimates are computed from the actual and estimated values of the dependent variable.

Note that the serial correlation tests show that there is no first order serial correlation in the conventional estimates and no first and second order serial correlation in the two *SGMM* estimates. The first test is based on Wooldridge (2002) and Drukker (2003) and the second is due to Arellano and Bond (1991).[13] The test for over-identifying restrictions on the instruments in both the *SGMM* estimates is satisfied and this is not reported to conserve space in the table. *SGMMR* estimates in column (5) support Roodman's (2009) criticisms that too many instruments in the unrestricted *SGMM* may underestimate the standard errors. All the standard errors in *SGMMR* are higher and its estimate of profit share is also higher. Note that *RE* and *SGMMR* estimates are very close.

To conserve space we shall report from now on only estimates with the *RE, OLS, SGMM* and *SGMMR* of the extended production function in equation (5) because the *BP* test statistic is always significant favouring *RE* over *FE* estimates. In the first instance equations with the Dreher aggregate measure of globalization *GLO* to capture the growth effects of globalization are estimated. Next *GLO* is replaced with four of its main components. The other variables selected as the determinants of *SSGR* are the investment ratio (*IRAT*), foreign direct investment ratio (*FDIRAT*), current government expenditure ratio (*GRAT*), rate of inflation (*DLP*), a measure of institutional reforms (*INST*) and a dummy variable to capture the effects of civil wars and political unrest (*CWAR*). These six variables may be treated as control variables. The definitions and sources of these variables are in Appendix-2. The specification of the extended production function based on equation (5) with the aforesaid determinants of *SSGR* is as follows.

$$\begin{aligned} \ln y_t &= \ln A_0 + (g_1 + g_2 GLO_t + g_3 IRAT_t + g_4 GRAT_t \\ &+ g_5 \Delta LP_t + g_6 CWAR + g_7 INST + g_8 FDIRAT)T + \alpha \ln k_t \end{aligned} \qquad (7)$$

Its estimates are in Table 3. In the initial estimates the coefficient of *FDIRAT* was negative and insignificant except in *SGMM* estimates. These estimates are not reported to conserve space. Equation (7) is reestimated without *FDIRAT* with *OLS*, *RE*, *SGMM* and *SGMMR* and the estimates are reported in columns (1) to (4) of Table 3. There were no changes in these reestimates without *FDIRAT*. All 4 methods give qualitatively

[13] Tests for higher order serial correlation in the conventional panel data estimates are not available in Stata. The two serial correlation tests are implemented with the *xtserial* and *abond* commands.

similar estimates. The coefficients are correctly signed and significant at the 5% level.[14] While estimates with *OLS* are close to *SGMM*, *RE* estimates are relatively close to *SGMMR*. The coefficient of the trend is negative and its absolute value has increased from -0.4 percent in Table 2 to -1.6 to 1.7 percent in Table 3. Estimates of the profit share range from 0.232 with *OLS* to 0.320 with *SGMMR*. The latter is almost the same as its conventional value in many growth accounting exercises. The permanent growth effects of *GLO* range between 2 to 3 percentage points. This implies that a 10% increase in *GLO* permanently increases the growth rate of output between 0.6 to 0.8 points. In other words a 20% increase in *GLO* is necessary to offset the negative trend of *TFP*. We have also estimated allowing for nonlinear effects for *GLO* but there is no indication that its growth effects will decrease even if *GLO* is doubled.[15] The growth effects of *IRAT* vary between 0.016 in *SGMMR* estimate to about 0.03 in the other 3 estimates. This implies that when investment increases by 20% it will increase the growth rate at best by 0.1 percentage points. Although the growth effects of other variables are correctly signed and significant, their effects—positive or negative—are very small compared to the growth effects of *GLO* and *IRAT*. A 20% decrease in $GRAT$ and $\Delta \ln P$ will increase the growth rate only by 0.07 points. It is of interest to note that the growth effects of institutional reforms are very small. A 20% improvement in institutions adds only 0.01 percentage points to growth.

[14] We have also estimated this equation with *FDIRAT* and two additional variables viz., the ratio of M2 definition of money to GDP (*M2RAT*), as a proxy for financial development and the Barro-Lee (xxxx) estimates of years of education (*EDU*), as a proxy for human capital. However, the coefficients of all these variables were insignificant. These estimates are not reported to conserve space.

[15] First we estimated with *GLO* and GLO^2 and then with the intercept and inverse of *GLO*. In both cases the growth effects of *GLO* were linear for *GLO* between 28.8 (its mean value) and 60.

Table 3: Estimates of Extended Production Function

$$\ln y_t = \ln A_0 + (g_1 + g_2 GLO_t + g_3 IRAT_t + g_4 GRAT_t + g_5 \Delta LP_t + g_6 CWAR + g_7 INST)T + \alpha \ln k_t$$

Variables	(1) *OLS*	(2) *RE*	(3) *SGMM*	(4) *SGMMR*
Constant	-1.516 *** (0.02)	-1.470 *** (0.12)	-1.509 *** ($0.85E^{-2}$)	-1.396*** (0.018)
Time	-0.016 *** ($0.15E^{-2}$)	-0.017 *** ($0.16E^{-2}$)	-0.017 (C)	-0.017 (C)
$\ln k$	0.232 *** (0.01)	0.264 *** (0.01)	0.236 *** (0.01)	0.320*** (0.01)
GLO×T	0.020 *** ($0.35E^{-2}$)	0.023 *** ($0.38E^{-2}$)	0.021 *** ($0.99E^{-3}$)	0.031*** ($0.19E^{-2}$)
IRAT×T	0.030 *** ($0.34E^{-2}$)	0.029 *** ($0.38E^{-2}$)	0.030 *** ($0.15E^{-2}$)	0.016 *** ($0.29E^{-2}$)
GRAT×T	-0.016 *** ($0.53E^{-2}$)	-0.019 *** ($0.58E^{-2}$)	-0.016 *** (0.21^{E-2})	-0.022 *** (0.46^{E-2})
ΔLP×T	$-0.30E^{-2}$*** ($0.65E^{-3}$)	$-0.30E^{-2}$*** ($0.71E^{-3}$)	$-0.30E^{-2}$*** (0.27^{E-3})	$-0.235E^{-2}$ *** (0.45^{E-3})
CWAR×T	$-0.14E^{-2}$** ($0.55E^{-3}$)	$-0.15E^{-2}$** ($0.61E^{-3}$)	$-0.13E^{-2}$*** ($0.23E^{-3}$)	$-0.170E^{-2}$ *** ($0.46E^{-3}$)
INST×T	$0.45E^{-2}$*** ($0.91E^{-3}$)	$0.47E^{-2}$*** ($0.98E^{-3}$)	$0.45E^{-2}$*** (0.38^{E-3})	$0.232E^{-2}$ *** (0.37^{E-3})
$\bar{R}^2$	0.850	0.854	0.822	0.822
Test for Serial correlation	F(1,20) = 47.84 (5%=248.01)+	F(1,20) = 47.84 (5%=248.01)+	-1.005 (p = 0.32) -1.505 (p = 0.13)	|-1.040 (p = 0.30) -1.220 (p = 0.22)
F-Statistics	74.36 ***	---	---	---
Wald χ^2	---	607.7 ***	9226.0 ***	6491.8 ***
BP test	---	7449.77***	---	---
No. of Instruments	---	---	692	239
No. of observations	756	756	756	756
No. of countries	21	21	21	21

Notes: See notes for Table 2.

Finally, *GLO* is replaced with 4 of its important components viz., economic globalization (*GLO1)*, globalization measured on the basis of restrictions on trade and investment (*GLO*2), globalization in the social sector (*GLO*3) and globalization in the political sector (*GLO4).* The specification of this equation is as follows.

$$\ln y_t = \ln A_0 + (g_1 + g_{21}GLO1_t + g_{22}GLO2_t + g_{23}GLO3_t + g_{24}GLO4_t$$
$$+ g_3 IRAT_t + g_4 FDIRAT_t + g_5 GRAT_t + g_6 \Delta LP_t + g_7 CWAR + g_8 INST)T + \alpha \ln k_t \qquad (8)$$

Estimates of (8) with the 4 methods are shown in columns (1) to (4) of Table 4. It can be seen that all the estimated coefficients, except that of *GLO*3 in *SGMMR*, are significant and similar but for minor differences. In these four estimates the coefficient of time and profit share are closer than their estimates in Table 3.

Economic globalization (*GLO*1) consisting of foreign direct investment and portfolio investment etc., and social globalization (*GLO*3), consisting of personal and social contacts have negative and significant growth effects with the exception of *GLO*3 in the *SGMMR*, where it is insignificant. The negative effect of *GLO*1 may be, as Rodrik (2007) observed, due to the inadequacy of economic integration of the financial and labour markets. The goods markets may also be inefficiently integrated due to high international and domestic distribution costs.[16] Arbitrage also works slowly in the economic sector. The negative effect of social globalization *GLO*3 is perhaps due to the imitation of superficial Western life styles in the developed countries by its urban elite, instead of learning more productive disciplines from the West. In contrast easing of various restrictions on international trade and capital account transactions (*GLO*2) and political globalization (*GLO*4) consisting of membership in international organizations, treaties etc., have positive growth effects. The positive effects due to *GLO*2 and *GLO*4 marginally exceed the negative effects of *GLO*1 and *GLO*3. A 20% increase in *GLO*2 and *GLO*4, if *GLO1* and *GLO*3 are kept constant at their mean values, will add about 1.6 percent points to the growth rate of output, offsetting the negative growth effects of trend. This is the same as the finding based on the results in Table 3. However, these

[16] Rodrik used estimates by Anderson and von Wincoop (2004). These authors estimate that the trade costs of goods is about 170% of the price of goods. Broadly defined trade costs include all costs incurred in getting a good to a final user other than the marginal cost of producing the good itself. Compared to this various import taxes are only a fraction of the prices of goods.

Table 4: Estimates with the Components of *GLO*

$$\ln y_t = \ln A_0 + (g_1 + g_{21}GLO1_t + g_{22}GLO2_t + g_{23}GLO3_t + g_{24}GLO4_t$$
$$+ g_3 IRAT_t + g_4 FDIRAT_t + g_5 GRAT_t + g_6 \Delta LP_t + g_7 CWAR + g_8 INST)T + \alpha \ln k_t$$

Variables	(1) *OLS*	(2) *RE*	(3) *SGMM*	(4) *SGMMR*
Constant	-1.554 *** (0.32)	-1.502*** (0.13)	-1.537 *** ($0.90E^{-2}$)	-1.499*** (0.02)
Time	-0.014 *** ($0.15E^{-2}$)	-0.015 *** ($0.15E^{-2}$)	-0.015 *** (C)	-0.015 *** (C)
$\ln k$	0.214 *** (0.01)	0.244*** (0.02)	0.216*** ($0.63E^{-2}$)	0.243*** (0.02)
GLO1×T	-0.010 *** ($0.35E^{-2}$)	$-0.689E^{-2}$* ($0.37E^{-2}$)	$-0.798E^{-2}$*** ($0.15E^{-2}$)	-0.020*** ($0.44E^{-2}$)
GLO2×T	0.013 *** ($0.24E^{-2}$)	0.013*** ($0.27E^{-2}$)	0.011*** ($0.11E^{-2}$)	0.027*** ($0.32E^{-2}$)
GLO3×T	$-0.829E^{-2}$ ** ($0.42E^{-2}$)	$-0.832E^{-2}$* ($0.45E^{-2}$)	$-0.595E^{-2}$*** ($0.18E^{-2}$)	$0.226E^{-2}$ ($0.48E^{-2}$)
GLO4×T	$0.981E^{-2}$ *** ($0.23E^{-2}$)	0.010*** ($0.24E^{-2}$)	$0.946E^{-2}$*** ($0.87E^{-3}$)	0.010*** ($0.19E^{-2}$)
IRAT×T	0.035*** ($0.36E^{-2}$)	0.034*** ($0.39E^{-2}$)	0.034*** ($0.16E^{-2}$)	$0.675E^{-2}$** ($0.28E^{-2}$)
GRAT×T	-0.017 *** ($0.53E^{-2}$)	-0.020*** ($0.58E^{-2}$)	-0.017*** ($0.22E^{-2}$)	$-0.710E^{-2}$ ($0.47E^{-2}$)
ΔLP×T	$-0.223E^{-2}$ *** ($0.66E^{-3}$)	$-0.221E^{-2}$ *** ($0.72E^{-3}$)	$-0.23E^{-2}$*** ($0.28E^{-3}$)	$-0.952E^{-3}$** ($0.45E^{-3}$)
CWAR×T	$-0.153E^{-2}$ *** ($0.56E^{-3}$)	$-0.169E^{-2}$*** ($0.61E^{-2}$)	$-0.143E^{-2}$*** ($0.24E^{-3}$)	$-0.120E^{-2}$*** ($0.42E^{-3}$)
INST×T	$0.432E^{-2}$ *** ($0.91E^{-3}$)	$0.465E^{-2}$*** ($0.99E^{-3}$)	$0.457E^{-2}$*** ($0.40E^{-3}$)	$0.10E^{-2}$ ($0.88E^{-3}$)
$\bar{R}^2$	0.829	0.842	0.811	0.822
Test for Serial correlation	F(1,20) = 49.23 (5%=248.01)+	F(1,20) = 49.23 (5%=248.01)+	-1.011# (p = 0.33) -1.565 (p = 0.15)	|-1.146# (p = 0.35) -1.228 (p = 0.27)
F-Statistics	51.07 ***			
Wald χ^2		607.25 ***	6802.62***	4834.93***
BP		7048.92***		
No. of Instruments			696	273
No. of observations	756	756	756	756
No. of countries	21	21	21	21

Notes: See notes for Tables 2.

estimates should be interpreted with care because these four components of globalization do not fully measure globalization. Nevertheless, they imply that all the aspects of globalization do not have the same kind of positive or negative growth effects. The positive growth effects of *IRAT* and *INST* and the negative effects of $GRAT$ and $\Delta \ln P$ are similar to their effects in Table 3.

Using the results from Table 3 it can be stated that globalization in its aggregate measure has positive and significant long run growth effects. The magnitude of this effect is more dominant than the growth effect of the investment ratio. However, as found in Table 4 some of the components of globalization have also negative growth effects. These negative effects seem to be due to inadequate integration of the domestic financial, labour and goods markets with international markets due to high distributional costs. Needless to say our conclusions about the growth effects of these components of globalization are highly tentative and need further analysis.

6. Extreme Bounds Analysis

The purpose of this section is to examine the robustness of the regression results presented above and compare them with the robustness of the variables in the commonly used specifications of the growth equations. In these works, as pointed out earlier, virtually all cross country studies state that the dependent variable is the long run growth rate, but it is proxied with a 5 or 10 year average rate of growth of output. This growth rate is simply regressed on some potential determinants similar to the seven variables used in this paper. We stated that this is somewhat an *ad hoc* procedure. In order to compare and evaluate the results based on our approach with the commonly used approach in the cross country empirical work, we have subjected these two specifications to Leamer's (1983) extreme bounds analysis (*EBA*). For this purpose we shall use a similar approach in Levine and Renelt (1992). Our specification is:

$$\Delta LYPC = \alpha + \beta_1 LYPC_{1970} + \beta_2 GLO + \beta_3 IRAT + \beta_4 GRAT + \beta_5 \Delta LP + \beta_6 INST + \beta_7 CWAR \quad (9)$$

where the new variables are: $\Delta LYPC =$ average rate of growth of per capita income and $LYPC_{1970} =$ per capita income in the initial period which is 1970. All other variables are as stated before.

Levine and Renelt have used cross section data from 1960 to 1989 for 119 countries and found that only the investment ratio (*IRAT)* is a robust explanatory variable out of six other explanatory variables that capture the economic, political and institutional aspects. As stated earlier such a weak result may be partly due to the *ad hoc* nature of the specification to estimate the long run growth rate because use of an average rate of growth to measure the *SSGR* is similar to the use of an average unemployment rate to measure the natural rate of unemployment. Both are unobservable and need to be derived from the theoretical models by imposing the steady state conditions.

We shall make a few minor changes to Levine and Renelt's approach. Our sample of 21 African countries for the period 1970-2005 is divided into 3 panels of 12 years so that each panel has the same number of observations. This gives 63 observations instead of only 21 observations if we have used the Levine and Renelt pure cross section procedure. 12 year average growth rate is not much different from 10 year average growth rate used in several panel data studies. Second, we shall subject to *EBA* our specifications of the extended production function. Thirdly, we investigate the robustness of all the variables instead of a few selected variables. The general form of the regression which is usually estimated in *EBA* is:

$$\lambda = a_j + b_{yj} y + b_{zj} z + b_{xj} x + \varepsilon_j \qquad (10)$$

where y is a vector of fixed variables that always appear in the regressions, z denotes the variable of interest and x is a vector of three variables taken from the pool X of additional plausible control variables Adapted to our purpose for testing the robustness of equation (9), the only variable included in y is *LYPC1970*. All other explanatory variables viz., *GLO, IRAT, GRAT, DLP, CWAR* and *INST* are included in z. In testing the robustness of our specification of the production function, both time (*T*) and the log of per worker capital are included in y and all other variables are in z. In other words there are no variables in x. The software selects all possible combinations of 3 variables from z to compute the robustness of these explanatory variables. For each model *j* one estimate of b_{zj} and the corresponding standard deviation σ_{zj} are made. The lower extreme bound for this parameter is defined as the lowest value of $b_{zj} - 2\sigma_{zj}$ and the upper extreme bound is the largest value of $b_{zj} + 2\sigma_{zj}$. If the lower extreme bound is negative and the upper extreme bound is positive, the effect of the variable is fragile.

This criterion of Leamer (1983) was criticized by McAleer et.al., (1985) and Sala I Martin (1996, 1997) as too stringent. Sala I Martin proposed an alternative criterion based on the cumulative distribution function (*CDF*) of the estimated coefficients which are significant at the 5% level. If 95% of the estimated coefficients are significant, the effects of the variable is considered to be robust, whereas in Leamer's criterion if the estimated coefficient changes sign once, it is considered to be a fragile variable.

Below we summarize the results of *EBA*. In Table 5 results of the robustness of the variables in the conventional specification in (9) are reported. Here globalization is measured in its aggregate form *GLO*. *EBA* results with the four components of *GLO* of the conventional specification are in Table 6. Using the Leamer criteria in column (3) of Table 5, out of 7 variables 4 are found to be robust and 3 are fragile. Robust variables are the initial level of per capita income ($LYPC_{1970}$), aggregate measure of globalization (*GLO*), investment ratio (*IRAT)* and the index of the quality of institutions (*INST*). Fragile variables are the ratio of current government expenditure ($GRAT$), rate of inflation ($\Delta \ln P$) and the index of civil wars and political unrest (*CWAR*). However, the Sala I Martin criterion based on the *CDF* in column (4) implies that $\Delta \ln P$ is also a robust variable. In contrast to the findings by Levine and Renelt, in our *EBA* test at least 4 variables are found to be robust. This may be due to the difference in the selected samples, use of a comprehensive measure of globalization and estimation methods used by us compared to those in Levine and Renelt.

In Table 6 *EBA* test results of equation (9) with the four components of globalization are shown. It can be seen from column (3) test result that while $LYPC_{1970}$, *IRAT* and *INST* are found to be robust, only *GLO*3 component of globalization is found to be robust. However, in contrast to the results in Table 4 with our specification where the coefficient of this social globalization measure was negative, its coefficient in Table 6 is positive. Therefore, the finding that this is a robust variable has some reservations. The three other components of globalization, $GRAT$, $\Delta \ln P$ and *CWAR* are all fragile variables. The Sala I Martin criterion in column (4) implies, as before, that inflation rate is a robust variable.

Table 5 Results of *EBA*
Conventional Specification with *GLO*

$$\Delta LYPC = \alpha + \beta_1 LYPC_{1970} + \beta_2 GLO + \beta_3 IRAT + \beta_4 GRAT + \beta_5 \Delta LP + \beta_6 INST + \beta_7 CWAR$$

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Average Beta	Average Standard Error	% Sign	CDF	Lower Bound	Upper Bound
$LYPC_{1970}$	-0.0104	0.0041	1.000	0.9795	-0.0203	0.0000
GLO	0.0005	0.0006	1.000	0.9808	0.0000	0.0010
IRAT	0.1720	0.1721	1.000	0.9999	0.0000	0.2422
GRAT	-0.0894	0.0894	0.000	0.9180	-0.2164	0.0375
ΔLP	-0.0219	0.0219	0.000	0.9612	-0.0464	0.0025
CWAR	0.0003	0.0003	0.000	0.5168	-0.0161	0.0168
INST	0.0286	0.0286	1.000	0.9951	0.0000	0.0501

Note: Results are based on the random effects model. 'Average Beta' and 'Average Standard Error' report the unweighted average coefficient and standard error, respectively. '% Sign.' refers to the percentage of regressions in which the respective variable is significant at least at the 5% level. 1 indicates that the effects of the variable are robust and zero indicates that the effects are fragile. This criteria used by Leamer (1983) and Levine and Renelt (1992). 'CDF-U' is the unweighted CDF of the significant coefficients at the 5% level of significance. This is suggested by Sala I Martin **et al. (2004)** as an alternative criteria. The threshold to consider a variable robust is 0.95. 'Lower Bound' and 'Upper Bound' give the lowest and highest value of point estimate minus/plus two standard deviations.

Table 6: Results of *EBA*
Conventional Specification with Components of *GLO*

$$\Delta LYPC = \alpha + \beta_1 LYPC_{1970} + \beta_{21} GLO1 + \ldots + \beta_{24} GLO4$$
$$+ \beta_3 IRAT + \beta_4 GRAT + \beta_5 \Delta LP + \beta_6 INST + \beta_7 C\beta_{21} GLO1WAR$$

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Average Beta	Average Standard Error	% Sign	CDF	Lower Bound	Upper Bound
$LYPC_{1970}$	-0.0104	0.0049	1.000	0.9795	-0.0203	0.0000
GLO1	0.0003	0.0002	0.000	0.9401	-0.0001	0.0008
GLO2	0.0002	0.0002	0.000	0.9077	-0.0001	0.0006
GLO3	-0.0006	0.0003	1.000	0.9829	-0.0012	0.0000
GLO4	0.0003	0.0001	0.000	0.9630	-0.00002	0.0006
IRAT	0.1720	0.0351	1.000	0.9999	0.0000	0.2422
GRAT	-0.0894	0.0635	0.000	0.9180	-0.2164	0.0375
ΔLP	-0.0219	0.0122	0.000	0.9612	-0.0464	0.0025
CWAR	0.0003	0.0082	0.000	0.5168	-0.0161	0.0168
INST	0.0286	0.0107	1.000	0.9951	0.0000	0.0501

Note: See notes for Table 5.

EBA results with our specification in equation (7) and with the aggregate measure of globalization are in Table 7 and with the four components of globalization in equation (8) are in Table 8. It can be seen from the test results in columns (3) and (4) all the variables are robust in our specification. On the basis of these results it can be said that our specification and approach to estimating the long run growth effects of these variables are more convincing and robust than the current approach of regressing an average growth rate on the potential explanatory variables.

Table 7: Results of EBA
Growth effects of Aggregate Globalization

$$\ln y_t = \ln A_0 + (g_1 + g_2 GLO_t + g_3 IRAT_t + g_4 GRAT_t + g_5 \Delta LP_t + g_6 CWAR + g_7 INST)T + \alpha \ln k_t$$

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Average Beta	Average Standard Error	% Sign	CDF	Lower Bound	Upper Bound
Time	-0.0042	0.0004	1.000	1.000	-0.0052	0.0000
LKL	0.1994	0.0144	1.000	1.000	0.0000	0.2283
GLO×T	0.0383	0.0037	1.000	1.000	0.0000	0.0457
IRAT×T	0.0429	0.0037	1.000	1.000	0.0000	0.0502
GRAT×T	-0.0226	0.0065	1.000	0.999	-0.0356	0.0000
ΔLP×T	-0.0041	0.0008	1.000	0.999	-0.0056	0.0000
CWAR×T	-0.0032	0.0007	1.000	0.999	-0.0046	0.0000
INST×T	0.0085	0.0010	1.000	1.000	0.0000	0.0105

Note: See notes for Table 5.

Table 8: Results of EBA
Growth effects of the Components of Globalization

$$\ln y_t = \ln A_0 + (g_1 + g_{21} GLO1_t + g_{22} GLO2_t + g_{23} GLO3_t + g_{24} GLO4_t + g_3 IRAT_t + g_4 FDIRAT_t + g_5 GRAT_t + g_6 \Delta LP_t + g_7 CWAR + g_8 INST)T + \alpha \ln k_t$$

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Average Beta	Average Standard Error	% Sign	CDF	Lower Bound	Upper Bound
Time	-0.0042	0.0004	1.000	1.000	-0.0052	0.0000
LKL	0.1994	0.0144	1.000	1.000	0.0000	0.2283
GLO1×T	-0.0183	0.0028	1.000	1.000	-0.0239	0.0000
GLO2×T	0.0187	0.0021	1.000	1.000	0.0000	0.0230
GLO3×T	-0.0202	0.0039	1.000	0.999	-0.0281	0.0000
GLO4×T	0.0162	0.0022	1.000	1.000	0.0000	0.0206
IRAT×T	0.0429	0.0037	1.000	1.000	0.0000	0.0502
GRAT×T	-0.0226	0.0065	1.000	0.999	-0.0356	0.0000
ΔLP×T	-0.0041	0.0008	1.000	0.999	-0.0056	0.0000
CWAR×T	-0.0032	0.0007	1.000	0.999	-0.0046	0.0000
INST×T	0.0085	0.0010	1.000	1.000	0.0000	0.0105

Note: See notes for Table 5.

To compare the implications for policies with the two types of specifications and methodologies we shall use the *RE* and *OLS* estimates from Table 3 and estimate with *OLS* and *RE* of the conventional specification. In both equations the aggregate measure of globalization is used. These two sets of estimates are in columns (1) to (4), respectively, in Table 9. They give qualitatively similar estimates of the coefficients. We have estimated the conventional specification in equation (9) with 63 panel observations of 12 year average values and with all the 5 estimation methods viz., *FE*, *RE*, *OLS*, *SGMM* and *SGMMR*. In all estimates *FDIRAT* was insignificant and therefore, it is ignored. To conserve space we report only the *RE* and *OLS* estimates in columns (3) and (4) of Table 9. In general the growth effects of *IRAT*, *GRAT* , $\Delta \ln P$, *CWAR* and *INST* are higher in the conventional estimates in columns (3) and (4) compared to estimates with our specification in columns (1) and (2). However, the growth effects of *GLO* are insignificant in the conventional estimates although in *EBA* its effects are found to be robust. This may be due to the particular set of control variables we have used in the conventional specification. The larger growth effects for the other variables may be due to the unsatisfactory nature of proxying the *SSGR* with an average growth rate. The latter may capture some transitional growth effects causing overestimation of these growth effects. In particular the growth effects of *IRAT*, *GRAT* and $\Delta \ln P$ are implausibly high. It may also be expected that the growth effects of *INST* are overestimated in the conventional specification.

Table 9
Comparison of Alternative Specifications

Variables	(1) *RE*	(2) *OLS*	Variables	(3) *RE*	(4) *OLS*
Constant	-1.470 *** (0.12)	-1.516 *** (0.02)	*Constant*	0.045* (0.02)	0.039** (0.02)
Time	-0.017 *** (0.16E^{-2})	-0.016 *** (0.00)	$LYPC_{1970}$	–0.011*** (0.41E^{-2})	–0.011*** (0.32E^{-2})
LKL	0.264 *** (0.01)	0.232 *** (0.01)	---	---	---
GLO×T	0.023 *** (0.38^{E-2})	0.020 *** (0.00)	*GLO*	0.156E^{-3} (0.25E^{-3})	0.216E^{-3} (0.21E^{-3})
IRAT×T	0.029 *** (0.38E^{-2})	0.030 *** (0.34E^{-2})	*IRAT*	0.182*** (0.04)	0.183*** (0.03)
GRAT×T	-0.019 *** (0.58E^{-2})	-0.016 *** (0.53E^{-2})	*GRAT*	-0.131*** (0.05)	-0.102** (0.04)
ΔLP×T	-0.30E^{-2}*** (0.71E^{-3})	-0.30E^{-2}*** (0.65E^{-3})	$\Delta \ln P$	-0.012 (0.01)	-0.012 (0.01)
CWAR×T	-0.15E^{-2}** (0.61E^{-3})	-0.14E^{-2}** (0.55E^{-3})	*CWAR*	0.012* (0.67E^{-2})	0.016*** (0.57E^{-2})
INST×T	0.47E^{-2}*** (0.98E^{-3})	0.45E^{-2}*** (0.91E^{-3})	*INST*	0.019** (0.01)	0.018** (0.01)
$\bar{R}^2$	0.854	0.850	$\bar{R}^2$	0.503	0.488
Wald χ^2	607.7 ***	74.36 ***	Wald χ^2	55.6***	68.57***
Serial Correlation Test	F(1,20) = 47.84 (5%=248.01)+	F(1,20) = 47.84 (5%=248.01)+		F(1,20) = 0.18 (5%cv=248.01)+	F(1,20) = 0.18 (5%cv=248.01)+
No. of observations	756	756	No. of observations	63	63
No. of countries	21	21	No. of countries	21	21

Notes: See notes for Table 2

7. Summary and Conclusions

This paper has analyzed the long run growth effects of globalization in the relatively poor African countries and found that these effects are positive and significant. Our results support the more optimistic view of the effects of globalization. In fact these growth effects are larger compared to the growth effects of the investment ratio. The trend rate of growth of *GLO* is about 1.85 percent and at this rate it will take about 10 years for *GLO* to offset the negative trend of *TFP*. If globalization is more rapid and takes place at the rate of 4 percent per year, the negative *TFP* effect can be offset in less than 5 years. To raise this growth rate to near 3% per year, investment rate should be increased from its mean value of about 16% to about 25% with marginal reductions of 5% in the rate of inflation and government expenditure.[17] These figures should be treated with caution and they are only indicative of the roles that globalization and investment policies can play to increase the growth rate in these poor African countries. If a 3% long run growth can be sustained through these two policies, perhaps supplemented by small reductions in *GRAT* and the rate of inflation, average per worker income can be increased by 50% in about 12 to 13 years. Needless to say this is not an ambitious target but it is better than allowing incomes to decrease at the trend negative rate of *TFP*.

We also found a few other useful results. The combined negative growth effects of *GRAT* and inflation and the positive growth effects of *INST* are very small. The estimated share of profits at about 0.25 is plausible, which will be useful for growth accounting exercises. The growth effects of some components of globalization are negative. *EBA* showed that while the growth effects of all the explanatory variables in our specification are robust, in the conventional cross country specification some variables like *GRAT* , $\Delta \ln P$ and *CWAR* are found to be fragile. In general the

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[17] The average per worker income is $146 and if the growth of *GLO* can be increased to 4 percent per year, the average per worker income will be $153 in 5 years implying a modest rate of growth of 1% per year. However, in the absence of globalization policies the average per worker income will decrease due to a negative trend rate of *TFP*. The increase in poverty rates etc., may be due to these negative effects of *TFP*. The implications for achieving a target rate of 3% growth are computed by using *RE* estimates in Table-9 and the sample mean values for all variables except for *GLO, IRAT* , *GRAT* and $\Delta \ln P$. *GLO* is assumed to grow at 4% pear year and *IRAT* is set at 25%. *GRAT* and $\Delta \ln P$ have been decreased by 5% from their mean values.

conventional specification seems to underestimate the growth effects of globalization (*GLO* or trade ratio) and overestimate the growth effects of the other variables.

Needless to say there are limitations in our paper. While we have used the standard estimation methods, there are reservations on the merits of the *SGMM* estimates. Therefore, we have used *RE* estimates to draw a few policy conclusions. The validity of our conclusions, therefore, needs validation or refutation with more empirical investigations and refinements. We hope that our paper will encourage further research into the quality and reliability of *SGMM* estimates as well as the robustness of our specification and methodology.

Appendix-1: Low Income African countries in the panel

Benin	Ghana	Nigeria	Uganda
Burundi	Kenya	Rwanda	Zambia
Central African Republic	Madagascar	Senegal	Zimbabwe
Chad	Malawi	Sierra Leone	
Congo, Democratic Republic	Mali	Tanzania	
Cote d'Ivoire	Niger	Togo	

Appendix 2: Data Sources

Indicator	**Source**
Y is the real GDP at constant 1990 prices (in millions and national currency)	Data are from the UN National accounts database.
L is labour force: working age group (15-64),	World Development Indicator CD-ROM 2002 and new WDI online. URL:http://www.worldbank.org/data/onlinedatabases/onlinedatabases.html
K is real capital stock estimated with the perpetual inventory method with the assumption that the depreciation rate is 4%. The initial capital stock is assumed to be 1.5 times the real GDP in 1969 (in million national currencies).	Investment data includes total investment on fixed capital from the national accounts. Data are from the UN National accounts database.
Globalization Index	Data obtained from the study of Dreher (2006) from http://globalization.kof.ethz.ch/
Inflation	Data obtained from the World Development Indicator CD-ROM 2002 and new WDI online. URL:http://www.worldbank.org/data/onlinedatabases/onlinedatabases.html
Government Consumption	World Development Indicator CD-ROM 2002 and new WDI online. URL:http://www.worldbank.org/data/onlinedatabases/onlinedatabases.html
Conflicts dummy	Gleditsch et al. (2002) from PRIO
Institutions index (Political Constraints Index)	Witold J. H. and Zelner, B. A. (2008) from http://www-management.wharton.upenn.edu/henisz/_vti_bin/shtml.dll/POLCON/ContactInfo.html

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