Is Sub-Saharan Africa a Convergence Club?

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Abstract

The African growth effect has been found to be significant in many empirical growth research papers – suggesting that even after controlling for a wide range of variables that potentially affect growth, the Sub-Saharan African dummy has an adverse impact on economic growth. This has thus remained one of the unexplained empirical puzzles in the growth literature. Earlier studies have attributed this growth tragedy to factors such as macroeconomic instability; external shocks; human capital inadequacies, institutional and political uncertainty, geography, ethnic fractionalisation, etc. Moreover, the recent perspective about the effect of colonial, geographical and disease factors in previously colonised regions such as Africa, also offers significant insights about the growth situation in Sub-Saharan Africa. On the other hand, some have suggested that Sub-Sahara Africa could simply be an example of club convergence from the lower end. We evaluate the latter view, and provide some new evidence on long run growth dynamics in Sub-Sahara Africa. We make use of the dynamic panel GMM methodology, which by construction controls for such country-specific and time-invariant effects due to history, disease or geographic factors. Our findings suggest that Sub-Saharan Africa is not an example of a convergence club. Rather, countries conditionally converge to their own steady states, and this could explain the increasing heterogeneity in economic conditions across the sub-region. In addition, we found openness, the extent of financial development, and foreign direct investment provide beneficial marginal effects on the steady state growth path of each country in the region. By contrast, government consumption, inflation, and excessive monetization have a negative effect on growth.

Keywords: panel data estimation, steady state growth path, club convergence, β – convergence
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1. INTRODUCTION

Many studies have attempted to explain the growth tragedy[1] in Sub-Saharan Africa. The recent ones among them include, Azam et al [2002], Fosu [1999], Sachs and Warmer [1997], Temple [1998], Easterly and Levine [1997], Collier and Guning (1999), etc. and these have reported various factors that account for the region's relatively poor economic performance over the last half century. For example, Azam et al (2002) refer to five factors (that can broadly be classified into 'domestic' and 'external' factors) that affect the growth process in Africa. These are, macroeconomic factors, macroeconomic uncertainty, human capital and regional factors, regional spillover effects, external shocks, and institutional/political uncertainty. As seen in Table 1, the region lags behind other regions of the world in terms of almost all the socio-economic indicators as at the end of 2002.

Other schools of thought maintain that the stalling long run growth rates across the region can be attributed to a lack of productivity growth due to very slow pace of technological development. Yet still, another view is that the relatively low level of foreign direct investment (FDI) flows to the region is a major factor. The latter view is supported by the fact that the rate of domestic savings and investment in SSA are undoubtedly low compared to other regions, hence FDI could have been a worthy supplement to domestic resources to bring about capital accumulation, and hence growth. However, FDI can equally have undesirable effects, and hence there needs to be a clear empirical understanding of its role. Another perception is that the growth tragedy in Sub-Saharan Africa could be due to socio-economic instability and corruption. However, there are indeed other regions of the world where corruption measures are no less severe than Sub-Saharan Africa, and yet those countries continue to perform better than the latter.

In terms of the wider literature, some other growth researchers have recently offered the view that colonially established institutions, disease factors, as well as geographical endowments were responsible for growth in previously colonised regions such as Africa. These studies include, Acemoglu et al (2001, 2003), Easterly et al (2003), Rodrik et al (2004). In our paper, we focus on the alternative view that Sub-Saharan Africa might just be an example of a convergence club[2] (i.e. economic convergence from the lower end). We thus explore the economic convergence debate as well as the role of factors such as money growth, openness,

[1] Callisto Madavo, the World Bank's Vice President of the Africa Region noted at a recent World Bank Development Seminar – that while there have been many development and economic successes around the world, there have been many failures particularly in Africa (March 5, 2004).

[2] The view that per capita incomes of countries that are identical in their structural characteristics will converge provided their initial conditions are similar as well.

financial development, poverty, foreign direct investment, inflation, and government distortions that have been cited in most of the earlier papers on Africa's growth.

The convergence issue in particular has indeed been widely studied in the literature ever since Baumol (1986). Subsequent studies such as Barro [1991], Mankiw, Romer and Weil [1992], confirmed economic convergence among countries. More recent ones such as Lucas [2000] have even predicted that in about a century, diffusion of knowledge would ensure convergence in income distribution across all nations of the world. On the other hand, studies such as Bernard and Durlauf [1995], and Durlauf and Johnson [1995] etc. find no evidence of a tendency towards economic convergence in the wider context. Indeed, the endogenous growth literature and much of its empirical studies suggest that economic divergence could persist for a long time.

We argue that, if Sub-Saharan Africa were indeed an example of club convergence, then we expect that these countries will also converge in absolute terms as in the case of the OECD. These issues have indeed been explored by some of the earlier studies cited. However, as Levine and Renelt (1992) and McGrattan and Schmidt (1998) pointed out, a major drawback of the growth regressions approach used by most of these studies is that the findings vary among studies and seem to depend on the methodologies adopted. Hence, whereas some studies reported one form of convergence among Sub-Saharan African countries, other studies have reported divergence for the same sample. We maintain that such inconsistent findings could be attributed to econometric deficiencies. In particular, as pointed out in Caselli, Esquivel and Lefort (1996)[3], Nerlove (1996) and Bond, Hoefler and Temple (2002), most of the growth regressions studies probably suffer from two forms of biases. The first is omitted variable bias, which arises from the inadequate treatment of the correlated unobserved country-specific effects. The second bias arises from the presence of the lagged dependent variable that captures economic convergence. This also introduces endogeneity biases that result in inconsistent estimates. We address these biases and revisit the growth story in Sub-Saharan Africa.

The following results emerge from the analysis. We find that Sub-Saharan Africa is not an example of a convergence club. Rather, countries conditionally converge to their own steady states, and this might explain the increasing heterogeneity in economic conditions across the sub-region. In addition, we find that variables such as - openness, the extent of financial development, and foreign direct investment have beneficial marginal effects on long run growth in the sub-region. On the contrary, distortionary government consumption, inflation, and excessive money growth have a negative effect on growth. The data for the study is obtained

[3] Hereinafter denoted CEL

from the World Bank's World Development Indicators and also the Penn World Tables, and the sample of countries is shown in the Appendix. The period of study is 1965 – 2000, and we transform the set of observations into a panel of five-year non-overlapping averages.

2. SOME GROWTH FACTS ABOUT SUB-SAHARAN AFRICA

Figure 7 shows GDP per capita across countries in 1965, 1970, 1980, 1990, and 2002. It is clear that, countries that had higher per capita incomes in 1965 still had higher per capita incomes in 2002. At the same time, countries that had lower per capita incomes in 1965 still had lower per capita incomes in 2002, which indicates that there has been very little catching up among these countries over the period. Also, as seen in Figure 8, in terms of real GDP per capita growth over the period 1965 to 2002, the experience has been mixed across countries. Whereas countries such as Malawi recorded over 24 percent average growth in per capita GDP, others such as Congo, Madagascar, Niger and Djibouti recorded negative growth rates on average. On the other hand, most of the countries have actually stagnated.

When one looks at the composition of GDP across countries in the region (Figure 5), one notices that countries that had lower per capita GDP tended to have a higher share of agriculture in the GDP basket. On the contrary, for most such countries the share of industry tended to be smallest. For example, Guinea-Bissau has over sixty percent share of GDP from agriculture, which is the highest among the set of countries in Sub-Saharan Africa. On the contrary, its industry share accounts for only some eight (8) percent of GDP. The other countries that had between forty-percent and sixty percent of GDP coming from agriculture include; Congo, Central African Republic, Burundi, Ethiopia, Sierra Leone, Rwanda, Niger, Tanzania, Togo, Uganda, etc. Clearly, their industry shares are correspondingly small and their per capita incomes are among the lowest in the sub-region.

As seen in Figure 6, relatively few countries have per capita incomes in 2002 exceeding one thousand dollars. These include, South Africa, Botswana, Gabon, Mauritius, Congo Republic, Namibia, Equitorial Guinea, Swaziland, Cape Verde, and Djibouti. Most of the remaining countries have per capita incomes below six hundred US Dollars, and Ethiopia, Congo DR, and Burundi have the lowest per capita incomes in the region. In terms of population growth rates, average growth rates range between 2 percent and 3 percent. On the other hand Niger, Madagascar, Kenya, The Gambia, Djibouti, Cote d'Ivoire, Congo DR, and Botswana have consistently growth at over 3.5 percent on average. Clearly, these growth rates are very high relative to some of the OECD countries where growth rates are less than one percent. Finally, in terms of foreign direct investment, there has indeed been a steady rise in

flows to the region since 1992 (see figure 11). However, two issues can be observed with the flows. The first is that, relative to GDP, the flows appear to be going to the same countries (see figure 9 and 10). Secondly, in relative terms, the countries that appear to be most appealing to foreign investors are, Equitorial Guinea, Angola, Chad, and the Congo. Clearly, these are oil producing countries and hence it must be the case that foreign direct investment in the sub-region is largely driven by expected returns on such investment. Therefore it is not very surprising that the flows are attracted to the oil and minerals sector that is believed to yield the appropriate returns. We therefore summarise the growth facts reviewed so far as follows:

- Countries that had higher (lower) per capita incomes in 1965 still had higher (lower per capita incomes in 2002)
- Average GDP per capita growth over 1965-2002 varies widely across countries.
- Countries that have lower per capita incomes tend to have a higher share of agriculture in GDP
- Few countries in SSA have per capita incomes above $1000. These are, South Africa, Swaziland, Botswana, Mauritius, Namibia, Gabon, Equitorial Guinea.
- Average population growth ranges between 2-3% over the period.
- FDI flows have been increasing steadily since 1992.
- In relative terms, Congo, Angola, Chad, and Equitorial Guinea attract most of the FDI.
- Growth accelerations/decelerations (e.g. SSA grew in 2004 at eight-year record of 5.0 percent).

We revisit some of the above issues in the last section of the paper. We next discuss the literature on economic convergence as well as growth in Sub-Sahara Africa in a bit more detail.

3. LITERATURE REVIEW

3.1 Economic Convergence

According to neoclassical growth models for closed economies [Ramsey [1928], Solow [1956]], Cass [1965], and Koopmans [1965]], the per capita growth rate of a country tends to be inversely related to its starting level of income per person. In other words, given similar preferences and technology, the assumption of diminishing marginal product of capital means that poor countries grow faster to catch up with rich countries [since the former has a lower capital to labour ratio and consequently higher marginal product of capital], and hence this results in absolute convergence among countries. Even where country heterogeneities are allowed, so that countries differ in aspects such as technology, population, and propensities to save, convergence is expected to occur in conditional terms - convergence to different levels of

per capita income but to the same steady state growth rates. Barro and Sala-i-Martin [1995] refers to another type of convergence, σ convergence, which is based on cross-sectional dispersion of per capita incomes among countries. According to the latter, convergence occurs if the dispersion [measured as the standard deviation of the logarithm of per capita incomes] among a group of countries declines over time. It is explained that the first type of convergence, dubbed β convergence [where poor countries grow faster than rich ones] tends to generate σ convergence [reduced dispersion of per capita incomes]. However, this process could be "*…offset by new disturbances that tend to increase dispersion*" [op.cit].

Apart from the Neoclassical assumption of diminishing marginal returns to the capital input that underlines economic convergence, other causes of convergence have been identified in the literature. For example, the technology catch-up models [Abramovitz, 1986] postulate that being backward in productivity levels implies a potential for rapid growth. Barro and Sala-i-Martin [1995] explained this further with a diffusion of technology model [Leader-Follower Model]. They showed that technology diffusion occurs as followers copy the new ideas patented by the Leader. However, since the cost of imitation and adaptation rises as the pool of uncopied ideas gets smaller:

"…this cost structure implies a form of diminishing returns to imitation and thereby tends to generate a pattern of convergence…..In the steady state, the leading and following countries grow at the same rate. Thus equalisation of growth rates occurs in the long run even if countries differ in costs of research and development, levels of productivity, and the willingness to save" (ch.8).

Barro and Sala-i-Martin [1995 ch.9] also argue that migration of workers with low human capital from poor to rich economies tends to speed up the convergence of per capita income and product. Another contribution by Lane [2001(b)] showed that international trade also brings about convergence of per capita incomes across countries. Lane proposes a credit channel between international trade and economic convergence, which is transmitted through the positive effect of trade openness on a country's access to the international capital markets. Hence such countries can borrow to finance a more rapid domestic investment, and hence a faster output growth rate. Of course, the literature abounds with studies showing the positive effect of trade on growth [e.g. Grossman and Helpman, 1991; Frankel and Romer, 1999]. The main argument in this literature is that international trade brings about specialisation in production, transfer of technology, and increased competition among domestic firms. From the discussions, it is evident that the debate in the theoretical literature is shifting from whether growth convergence or divergence occurs, to the new frontier of determining how growth

convergence comes about[4]. Indeed, the concept of growth convergence has been widely researched in the empirical literature, especially beginning from William Baumol [1986]. In general, this was done by estimating a relationship such as:

$$\frac{1}{T}.\log\left(\frac{y_{i,t+T}}{y_{i,t}}\right) = \alpha - b.\log(y_{i,t}) + \gamma.X_{i,t} + \varepsilon_{i,t} \quad \text{.....[1]}$$

where i indexes economies and $X_{i,t}$ is a vector of variables [such as the savings rate, depreciation rate of the capital stock, and population growth rate] that control for the determinants of steady-state output per capita. The left hand side of equation [1] is the growth rate of economy i measured over an interval of T years. The term $-b.\log(y_{i,t})$ captures initial positions such that an estimated value of $b > 0$ is interpreted as evidence of conditional convergence.

To date, the empirical literature continues to expand as various studies employ a wide range of methodologies to test for convergence (See Table 2). However, the evidence about economic convergence remains inconclusive even in the wider empirical literature.

3.2 Empirical Evidence on Growth in Africa

In terms of the wider empirical growth literature, there has recently been a debate (Acemoglu, Johnson, and Robinson [AJR], 2001; Acemoglu, Johnson, Robinson and Thaicharoen [AJRT], 2002; Rodrik, Subramanian and Trebbi [RST], 2004; Acemoglu, Johnson, and Robinson [AJR], 2002; Rodrik, 2003) about the role of institutions, geography and disease factors in explaining economic outcomes across previously colonised regions of the world. These authors have clearly introduced a new dimension to empirical work on the varied growth experiences across the world. The seminal paper by AJR [2001] and later AJRT [2002] started it all, when the authors exploited differences in the mortality rates faced by European colonialists to estimate the effect of institutions on economic performance across regions that were colonialised before the pre-war years. They found that economic outcomes were largely dependent on the type of institutions that have persisted since the colonial era. In places where Europeans faced high mortality rates due to the different disease environment, they could not settle and they were much more likely to set up extractive institutions.

These institutions (e.g. political institutions that do not constrain politicians and political elites, ineffective enforcement of property rights for investors, widespread corruption, and a

[4] For example the Club convergence hypothesis, that proposes the existence of multiple steady state equilibria rather than a one globally stable steady state etc.

high degree of political instability, etc) have largely persisted even after independence. AJRT [2002] further argued that - distortionary macroeconomic policies, including high inflation, large budget deficits and misaligned exchange rates – were mere symptoms of the effect of such weak institutions. Consequently, when the authors corrected for the effect of institutions, they found that macroeconomic distortions had only a minor impact on economic outcomes. RST [2004] confirmed the earlier findings in AJR [2001] even when the former used a different instrument for the effect of institutions. They found that the effect of institutions "trumps" everything else. Once institutions were controlled for, conventional measures of factors such as geography and trade had at best very weak direct effects on incomes. However, Sachs [2003] disagrees with the finding that "institutions rule". Instead, the author argues that geographical factors still have potential direct effects on per capita incomes, even after controlling for the quality of institutions. Thus far, the recent wider empirical literature seems to reach a consensus that historical factors as well as geography explain the growth puzzles in regions such as Africa.

In terms of the specific empirical literature on growth in Africa, the causes of the region's growth tragedy have long attracted much empirical interest. As already mentioned in the introduction, studies in this area include – Easterly and Levine [1997], Sachs and Warner [1997], Montiel [1996], Ghura and Hadjimichael [1996], Temple [1998], Easterly and Levine [1997], Ojo and Oshikoya [1995], Savvides [1995], Collier and Gunning [1999], Gyimah-Brempong and Traynor [1999], Ghura [1995], Fosu [1996], Fosu [1999], Azam et al [2002] etc. Most of these studies employed different methodologies [Azam et al, 2002] but largely based on a general model specification often in line with the new growth theories. The range of explanatory variables often include [see table 8] – [i] initial conditions [ii] investment [iii] index for political structure, [iv] market distortion, [v] natural resource abundance [vi] trade openness, [vii] ethnic fractionalisation, [viii] population, [ix] neighbourhood effects, [x] inflation, [xi] climate and geography, etc. However, the argument in Caselli, Esquivel and Lefort [1996] implies that most of these studies suffer from either an omitted variable bias [due to inappropriate treatment of correlated unobserved country specific effects] or endogeneity bias due to the dynamic nature of growth regressions or weak exogeneity among the controls.

It is therefore clear why the studies tend to report varied range of findings [Azam et al, 2002 p.178-179]. For example, Ghura and Hadjimichael [1996] investigated long run growth in Sub-Saharan Africa over the period 1981-1992. Using feasible generalised least squares techniques on a panel of 29 Sub-Saharan African countries; the authors found support for conditional convergence, even though absolute convergence was rejected. On the control variables, the authors found that both private and public investment had a positive and

significant effect on growth. Other variables that affected long run growth significantly were the budget deficit, inflation, real exchange rate, and population growth.

Sachs and Warner [1997] presented one of the most comprehensive analyses of the sources of slow growth in developing countries with a particular emphasis on Sub-Saharan Africa over the period 1965 - 1990. The authors included a wide range of explanatory variables such as openness, geography, climate, natural resources, institutional quality, inflation, life expectancy, neighbourhood effects, ethnic fractionalisation, and population growth. They found that both natural factors and inappropriate economic policies were responsible for the slow growth in developing countries including Sub-Saharan Africa. Among the natural factors are - natural resource dependence, tropical climate, and limited access to the Sea. Examples of economic policy factors are - openness to international trade, government saving, market-supporting institutions, life expectancy, and demographic factors. Contrary to findings in other studies such as Barro [1991] and Easterly and Levine [1997], the authors found no support for factors such as - neighbourhood effects, ethnic diversity, and the so-called Sub-Saharan African "dummy".

Easterly and Levine [1997] also contributed some valuable empirical perspective on the growth tragedy in Sub-Saharan Africa in particular. The paper investigated both the direct and indirect effect of ethnic diversity on growth. The paper makes some interesting observations. First, it was reported that ethnicity had a significant negative direct effect on growth. Second, it was found that high levels of ethnic diversity were strongly linked to high black market premiums, political instability, poor financial development, low provision of infrastructure, and low levels of education. Since these variables were also found to have a negative effect on growth, this means that ethnic diversity has both a direct as well as an indirect effect on growth. The paper also found evidence of non-linear convergence in growth rates. Temple [1998] sought to extend the analyses in Easterly and Levine [1997] and Sachs and Warner [1997] by explicitly exploring the effect of initial conditions and social arrangements on growth in Africa. Using a novel estimation technique of "re-weighted least squares", the paper found that more than half of the variation in growth rates could be explained by observable variables capturing initial conditions. Further, it was found that social capital mattered for growth in the sense that countries that had relatively low social capital were more likely to have dismal policy outcomes, low investment and slow growth.

Some other earlier studies also explored this issue. For example, Saviddes [1995] studied the determinants of per capita growth rates across Africa for the period 1960-1987.

Using a fixed effects[5] panel model based on endogenous growth theory, the paper found support for both absolute and conditional convergence. It was further reported that both economic and political variables influence growth in Africa. The economic variables include - initial conditions, investment, population growth, trade orientation, inflation, financial development, and government expenditure. The study made the additional observation that growth in CFA countries was worse than in non-CFA countries over the period. Ojo and Oshikoya [1995] also studied the determinants of long-term growth in a cross-section of African countries over the period 1970-1991. As is usual in much of the growth regressions literature, the authors included variables such as initial per capita income, investment, population growth, macroeconomic policy [inflation and exchange rates], external factors [export growth, external debt, and terms of trade], political environment, and human capital development. The paper finds that, on average the most significant variables influencing long-term growth in the sample of African countries over the study period were - investment, external debt, population growth, and the macroeconomic environment.

Hence, even though the empirical studies described above do provide interesting insights into the long run growth process in Africa, yet they probably suffer from the potential biases as mentioned [Montiel, 1996p.79][6]. Hence the validity of the conclusions might have suffered as well. Moreover, the practice of studying the African case with a simple slope dummy [African dummy] in a general cross-country regression on developing countries is not satisfactory. Our paper takes a different approach by addressing the new empirical issues for a distinct panel of Sub-Saharan African countries.

4. METHODOLOGY

4.1 Convergence Tests

The empirical analysis proceeds on two fronts. In the first, we expect that if there is club convergence among SSA countries, then absolute convergence should also hold since no differences in structural characteristics will exist. We explore the three concepts of convergence – absolute, conditional and convergence in income distribution. We check this graphically and also use the regressions approach to confirm our results. We subsequently explore the effect of

[5] Nickell [1981] demonstrates that the inclusion of fixed effects in a dynamic model biases the coefficient of the initial value of the dependent variable included as an explanatory variable downward towards zero and therefore toward support for the convergence hypothesis.

[6] Montiel discusses some of these empirical problems [pp.79-82] associated with cross-country growth studies in Africa. The author cited some of the empirical difficulties as - heterogeneity biases, lack of robustness of the results, and endogeneity biases.

macroeconomic variables on long run growth in the region, based on the enhanced growth regressions approach as already discussed.

4.2 Dynamic panel data methods and growth regressions

The classic paper by CEL [1996][7], made an outstanding contribution to the cross-country growth regressions approach. The authors challenged the existing single cross-section empirical literature about the treatment of the country specific effect [which led to omitted variable bias] and also the issue of endogeneity among the explanatory variables. Consider the general specification often used in most cross-country studies of growth:

$$InY_{i,t} - InY_{i,t-\tau} = \phi InY_{i,t-\tau} + \gamma X_{i,t-\tau} + \eta_i + V_t + \varepsilon_{i,t} \qquad \ldots\ldots\ldots \qquad [2]$$

where $X_{i,t}$ is a vector of control variables determining economic growth, η_i is a country-specific effect, ξ_t is a time specific effect. V_t is a period specific constant, and $\varepsilon_{i,t}$ is an error term. ϕ, γ are parameters. Clearly, for cross-section regressions in particular, OLS will only be consistent if the individual country effect is uncorrelated with the explanatory variables. This is clearly not the case[8] if one looks at equation [4] below:

$$E\left[\eta_i (InY_{i,t-\tau})\right] = E\left[\eta_i (\phi InY_{i,t-2\tau} + \gamma X_{i,t-\tau} + \eta_i + V_{t-\tau} + \varepsilon_{i,t-\tau})\right] \neq 0, \qquad \ldots \qquad [3]$$

since $E\left[\eta_i^2\right] \neq 0$.

It can be shown that omission of the country-specific effect η_i only leads to a downward bias in the convergence coefficient. Secondly, there is a possibility of endogeneity[9] of a subset of X_i, such that treating them as exogenous, only introduces endogeneity bias into the results. CEL also challenged the panel data studies at the time, such as Barro and Lee [1994], Barro and Sala-i-Martin [1995], Loayza [1994], and Islam [1995]. For example, Barro and Lee, in their paper, applied the GLS estimator and used instruments for the potentially endogenous variables [i.e. by using the lagged values of such variables]. However, CEL criticised their solution that it can only be consistent under the assumption of random individual effects[10]. Moreover, as

[7] Nerlove [2002]p.274-301 also makes interesting contribution to the literature by examining the properties of various estimators [excluding GMM] in a growth regression context. The author argues that most of the estimators yielded inconsistent results in growth regressions thereby calling into question some of the conclusions reached on convergence and determinants of growth in cross-country studies.

[8] CEL argue that the omission of the individual specific effect translates into a downward bias in the estimate of the convergence coefficient

[9] For example, investment in human capital and population growth

[10] Meaning that effects are correlated over time but not with other regressors

already shown in [3], the lagged dependent variable is expected to be positively and directly related to the country specific effect.

Hence, it can hardly be assumed that individual effects are random. By induction therefore, CEL argues that whereas these studies attempt to correct for endogeneity bias, they did not address the issue of correlated individual effects adequately and hence their results suffer from omitted variable bias. In the case of Loayza [1994] and Islam [1995], it is argued that these also ignored the endogeneity question completely. CEL summed it all up thus,

"*….almost all existing cross-country regressions, either based on cross-section or panel-data techniques, have been estimated inconsistently* [p.369]".

The authors therefore proposed a consistent estimator based on the general method of moments [GMM] approach (Arellano and Bond, 1991)[11], which is able to address both issues of omitted variable bias and endogeneity bias. Hence, one applies the GMM (differences) approach to the usual expression for the behaviour of a country's growth rate around the steady state [see Appendix]:

$$InY_{i,t} - InY_{i,t-\tau} = -(1-e^{-\lambda\tau})InY_{i,t-\tau} + (1-e^{-\lambda\tau})\frac{\alpha}{1-\alpha}\left[In(s) - In(n+g+d)\right] + \eta_i + \varepsilon_{i,t}$$

…….. ……..[4]

where $\lambda = (n+g+d)(1-\alpha)$.

Subsequent to the introduction of the GMM-systems estimator [Blundell and Bond, 1998], as an alternative to the GMM-differences estimator[12], a subsequent paper by Bond, Hoeffler and Temple[13] [2001] suggested an extension of the CEL approach further. BHT showed that, if time series are persistent, the first-differenced GMM estimator can be *"...poorly behaved since lagged levels of the series provide only weak instruments for subsequent first-differences"* [p.3]. This problem is worsened in finite samples. Hence in such circumstances, the use of a more efficient GMM-systems estimator is recommended for estimating empirical growth models. We thus contribute to the growth literature by revisiting the long run growth process in SSA based on the enhanced growth regressions framework as explained. The next section presents our findings.

[11] See appendix
[12] see Appendix 2 for detailed exposition
[13] Hereinafter denoted BHT

5. RESULTS

5.1 Absolute Divergence/ Rho- Divergence

It is quite apparent from Figure 1 that absolute convergence is unlikely to hold for our sample of Sub-Saharan African countries[14]. Compared to the OECD graph that shows a clear tendency for percapita growth rates to converge over time (Figure 2), the graph for Africa (Figure 1) suggests divergence in absolute terms. A further look at Figure 4 shows that there is also Rho-divergence, meaning that intra-regional income distribution has also been widening. Indeed this is confirmed econometrically, as the coefficient of initial income in a regression on the growth rate of log per capita incomes suggest a positive effect that is not significant at all (Table 3). Based on this finding, it is probably the case that countries in Sub-Saharan Africa do not have similar structural characteristics at all (i.e. production functions etc.). If they are converging to their respective steady states, this might explain why there is evidence of divergence in intra-regional income distribution. We therefore proceed to test for conditional convergence.

5.2 Conditional Convergence

Our estimation model for testing conditional convergence is based on both the restricted and unrestricted form of equation [4]. The behaviour of a country's growth rate around the steady state could therefore be expressed as [see appendix B]:

$$InY_{i,t} - InY_{i,t-\tau} = -(1-e^{-\lambda\tau})InY_{i,t-\tau} + (1-e^{-\lambda\tau})\frac{\alpha}{1-\alpha}In(s) - (1-e^{-\lambda\tau})\frac{\alpha}{1-\alpha}In(n+g+d)$$
$$+\eta_i + \varepsilon_{i,t}$$

where $\lambda = (n+g+d)(1-\alpha)$, [5]

$$InY_{i,t} - InY_{i,t-\tau} = -(1-e^{-\lambda\tau})InY_{i,t-\tau} + (1-e^{-\lambda\tau})\frac{\alpha}{1-\alpha-\beta}In(s^k) + (1-e^{-\lambda\tau})\frac{\alpha}{1-\alpha-\beta}$$
$$In(s^h) + (1-e^{-\lambda t})\frac{\beta}{1-\alpha-\beta}In(n+g+d) + \eta_i + \varepsilon_{i,t}$$

where $\lambda = (n+g+d)(1-\alpha-\beta)$ .....[6]

Tables 4 and 5 present results of our test of the conditional convergence hypothesis [textbook Solow and augmented Solow] based on different methodologies. Table 6 and 7 also present

[14] The concept of σ - convergence does not hold either. The dispersion of income distribution across the sub-region has been widening (see Fig. ??), as depicted by the linear trend in the plot of the coefficient of variation across our study period.

results for the two GMM estimators based on further augmentation of our model using selected macroeconomic variables. Table 8 compares our results with the existing literature.

For the purpose of comparison with existing studies, and illustrating the arguments in CEL, we present alternative results for the least squares and fixed effects estimation methods, in addition to our GMM estimates. In the case of the GMM estimates, we first discuss results for the differences estimator, and then subsequently compare to results for the systems estimator. The result for the unrestricted textbook Solow model shows that there is a clear tendency towards convergence both in the fixed effects and GMM methods. The pooled estimation results suggest no convergence at all, as the coefficient of initial income is positive and insignificant. This difference could therefore be accounted for by the presence of omitted variable bias and also endogeneity bias as already discussed. The results for the fixed effects method also shows that population growth has an insignificant effect on the transitional dynamics of growth in Africa. However, correcting for endogeneity bias in the GMM model indicates that population growth indeed has a significant and negative effect on growth. Of course, this confirms findings in earlier studies such as CEL [1996] and BHT [2001], albeit for a different sample of countries. The speed of convergence also shows that correcting for endogeneity bias changes the speed of convergence from 1.61% to 3.29%. For the case of the augmented Solow model, the effects of initial income, savings and population growth remain largely the same as in the textbook case. However, the literacy rate does not show a significant effect in any of the alternative methods.

We also used the variable ‘secondary school enrolment’ as a measure of human capital accumulation. However, the estimated effect on growth was negative, which suggested that school enrolment in Africa could be measuring the effect of government consumption through the provision of infrastructure, textbooks, and salaries for teachers. This is why we rather reported results for the literacy rate, which we believe to be a more appropriate measure of human capital accumulation. We notice that the augmented Solow model increases the speed of convergence from 1.61% to 2.67% for the fixed effects estimation, and from 3.29% to 4.26% for the GMM [differences] estimation. In terms of distance from the steady state, our preferred GMM estimation results for the Solow model shows that countries cover half the distance to the steady state between 16years and 21 years. Our results for the restricted Solow model are not very different from the unrestricted case even though the speed of convergence in the textbook Solow case using the GMM [differences] estimation is a bit higher than in the unrestricted case. According to Table 7 [column 1 and 2], the GMM 'systems' estimator yields coefficients that

are different in magnitude, but are equivalent in terms of significance. The speed of convergence significantly reduces with the systems estimator.

Whereas the 'differences' estimator suggests a rate of convergence of 3.29 percent and 4.26 percent respectively for the textbook and augmented Solow models, the 'systems' estimator suggests 1.62 percent and 2.5 percent respectively. Indeed BHT [2001] made similar findings when they applied the 'systems' estimator to the same dataset used by CEL [1996]. BHT found that the speed of convergence using the 'systems' estimator was between 2 percent and 4 percent, compared to 12.8 percent obtained using the 'differences' estimator. We also calculated the capital share in output for the restricted model [Table 5]. The fixed effects estimates show that the capital share in output is 43.5 percent while the GMM estimates show 46.5 percent. Of course these are more than the 33 percent assumed for the textbook Solow model to hold. This justifies therefore, the need for augmenting the textbook Solow model in order to explain the transitional dynamics of growth in Sub-Saharan Africa. Hence in addition to human capital augmentation, we consider the role of macroeconomic variables [Fischer [1993], Kormendi and Meguire [1985]] in the next section. Our particular interest is on variables such as government consumption, excessive monetization, inflation, openness, foreign direct investment, poverty and financial development.

5.3 The Effect of Macroeconomic Variables on Long Run Growth

The inclusion of socio-economic variables has no doubt yielded further insights into the growth process in Africa. We considered variables such as government consumption, excessive money growth, and inflation that have been explored in the recent growth literature on Africa. In addition, we also included other variables like openness and financial development that have been explored in studies such as Temple [1998] and Saviddes [1995]. We therefore used these variables to augment the Solow model. The results [Table 6 and 7] show that government consumption, inflation, poverty and excessive monetization have negative effects on growth. The effect of government consumption is believed to work through distortionary tax –financed government purchases, while inflation creates uncertainty [Barro, 1980] that affects the ability of economic agents to extract information from relative prices, thus leading to inefficient resource allocation, and hence lower growth.

We further used the infant mortality rate to proxy poverty, that probably leads to a cycle of lower savings and capital accumulation, hence lower growth in per capita incomes, and hence poverty over again. We used the M2GDP ratio to proxy excessive money growth in these

countries. Indeed some earlier studies made use of monetary aggregates such as the M1 or M2 as a ratio of GDP to rather proxy financial development. However, as argued in De Gregorio and Guidotti (1995), such indicators may provide a poor proxy for financial development, since they are rather related to the ability of financial systems to provide transactions services, rather than the ability of financial intermediaries to channel funds from savers to borrowers. Also, in regions such as Sub-Saharan Africa, money is used as a store of value in the absence of other, more attractive alternatives, and this could give the erroneous impression that high monetary aggregates imply a high demand for financial assets. As a result, studies such as Gelb (1989) and King and Levine (1993) made use of M3, which is also called liquid liabilities. But although using liquid liabilities could overcome the shortcomings of using narrower definitions of money, they may still be influenced by factors other than financial depth, since M3 still includes M1. For this reason, Neal (1988) subtracted M1 form M2, whereas King and Levine (1992) subtracted M1 from M3. Indeed, others such as De Gregorio and Guidotti (1995) used the ratio of domestic credit to the private sector to GDP as proxy for the degree of financial intermediation. However due to data problems, we subtract M1 from M2 and use the residual as a proportion of GDP, as our indicator of financial development. Thus we rather interpret increases in the simple M2GDP ratio as excessive money expansion (monetization), which probably feeds into higher inflation rates. On the contrary, financial development is proxied by the ratio ([M2-M1]/GDP).

Our results also show that openness, financial development, and foreign direct investment have a positive effect on growth in Africa. The effect of openness confirms the earlier findings in Sachs and Warner [1997], Temple [1998] and Savvides [1995], that trade is beneficial for growth in Africa. The effect of foreign direct investment is also striking. The results show that despite the relatively low levels of foreign direct investment flows to Africa, yet their marginal effect is beneficial for the region's growth. Indeed the literature on foreign direct investment suggests that it can have either a positive effect or negative effect on growth. The positive effect might arise through productivity gains that are expected to occur through technology spillovers and the introduction of new methods as well as processes that could be learnt, and used to modernize the national economy, and spur productivity growth. On the other hand, the negative effects could arise due to unfair competition if multinationals use their technological and scale advantages over domestic firms to extend their monopolistic power into the domestic market. In that case, foreign direct invest would crowd-out domestic investment. Our results thus agree with the findings in Agosin and Mayer (2000) who reported that there

was crowding-in[15] of domestic investment in Africa. This apparently supports the view that poverty levels in Africa do prevent the required level of savings and capital accumulation that will lift the region out of the obvious growth trap. Hence, higher flows of foreign direct investment could help spur long-term growth in the region. Therefore, governments in the region can at best pursue policies that create more profitable investment opportunities and also maintain an attractive environment for foreign direct investment flows to the region. Such policies include; promoting the rule of law, reducing bureaucracy and corruption, improving on institutions and infrastructure, and enhancing general social and economic stability.

In order to check for robustness of our results, we considered several alternative specifications so as to isolate potential collinearity effects and interactions among the explanatory variables [Table 6 and 7]. Our results largely confirm robustness. Finally, we closely compared the estimates in Table 7 [based on the systems estimator] with the earlier estimates in Table 6 [based on the differences estimator). The striking finding is that the magnitudes of the estimates are reduced in most of the specifications based on the systems estimator, and the convergence rate falls to between 1.6 percent and 2.5 percent. Nonetheless, our findings for the macroeconomic variables based on the 'differences' estimator remain largely unchanged even under the systems estimation. The next section presents a summary and conclusion of our paper.

6. SUMMARY AND POLICY RECOMMENDATIONS

This study was focussed on the issue of club convergence and also the effect of macroeconomic variables on growth in Sub-Saharan Africa. The issue of club convergence has come into the limelight in recent times, as some researchers refer to the overwhelming evidence of convergence in the OECD as proof of the fact that the Neoclassical [Solow] predictions about cross-country growth still has empirical relevance. Thus Sub-Saharan Africa has been cited as a possible case of convergence on the lower end. We thus explored the convergence issue within the context of Sub-Saharan Africa, and also explored the effect of selected macroeconomic variables on long run growth in the Sub-region. It was found that SSA could not be an example of a convergence club, and that Rho-convergence was equally absent. In view of the apparent lack of robustness in growth regressions [McGrattan and Schmitz, 1998],

[15] The term 'crowding in' is used when the presence of foreign direct investment stimulates new downstream and upstream investments that would not have taken place in their absence. Similarly, 'crowding out' occurs when foreign direct investment displaces domestic investment.

our paper uses the dynamic panel GMM framework that has been shown to adequately address the two main sources of bias in growth regressions – omitted variable bias due to correlated country-specific effects, and also the issue of endogeneity among the right-hand side variables.

We however found evidence of conditional convergence among Sub-Saharan African countries[16]. Apparently due to the correction for omitted variable and endogeneity bias, our estimate for the speed of convergence is higher than the 2 percent generally reported in the empirical literature. Our speed of convergence ranges between 3.2 percent and 4.7 percent based on estimates from the dynamic panel GMM [differences] estimator. However, when the methodology suggested by BHT [2001] based on the systems estimator was applied, the convergence rate fell to a range of 1.6% and 2.5%. Indeed, similar findings were made in BHT [2001] even based on the earlier dataset of CEL [1996]. Thus we conclude that countries probably conditionally converge, but at a rate of between 1.6% and 4.7%. Further, we considered the effect of macroeconomic variables on growth in Sub-Saharan Africa. This exercise sought to make up for the perceived inability of the Solow model to adequately explain growth, as found in several studies. Our dynamic panel GMM estimates suggest that countries that are more open are likely to experience higher growth. Moreover, even though foreign direct investment flows to Africa has been very small compared to other developing regions, yet there is evidence that FDI flows have a beneficial marginal effect on growth in Africa.

On the contrary, variables such as distortionary government consumption, inflation, poverty and excessive money growth are found to retard growth in Africa. The results for excessive money growth in particular, have implications for the recent apparent shift in emphasis to medium-term poverty reduction and growth promoting policies. We argue that economic stabilisation remains key, and can only be a worthy complement for medium-term growth promoting and poverty reducing policies. We make the following recommendations:

a) The relative difference in per-capita income growth across Sub-Saharan Africa is attributable to the fact that countries converge to different steady states. Hence the need for increased savings and capital accumulation is just as important as efficiency and productivity growth coupled with technological development, in order to ensure sustained high growth rates in the region.

(b) Our study confirmed that openness has a positive effect on long run growth rates across the sub-region. Hence, policymakers in Sub-Sahara Africa must intensify their efforts to ease

[16] Similar findings were made by recent empirical studies as shown in Table ??

restrictions on international trade, and also lobby for better market access for their exports, so that the external sector is able to contribute directly to output growth.

(c) Efforts must be intensified to create a receptive environment for foreign direct investment. This requires enhanced economic infrastructure, improved legal systems, consistent policies and frameworks to reduce corruption, investor-friendly laws, developed financial systems, and general macroeconomic and social stability. Anecdotal evidence suggests that the level of FDI flows for example, to the Sub-region could be attributed to the structure of trade tariffs faced by these countries on their exports. For example, tariff escalation means that it is more profitable to keep exporting raw cocoa and coffee etc. than processed chocolates, coffee drinks etc. For example, tariffs on cocoa powder in Asia are nearly four times those for cocoa beans. Hence countries in the Sub-Region need to intensify their efforts in trade negotiations as well as designing strategic trade policies. The developed countries must also be urged to eliminate export subsidies, which together with the elimination of tariff escalation could help the competitiveness of developing country exports.

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APPENDIX

Table 1: Comparing socio-economic indicators

	GDP Percapita Growth (2001-2002)	Debt-Service to Exports Ratio (2001)	Gross Capital Formation (% GDP) 2002	Population Growth 1980-2002	Life Expectancy at birth (2002)	Under-5 Mortality Rate per 1000 (2002)	FDI Flow $'Millions (2002)
S.Sahara Africa	0.5	16.5	18	2.7	46	174	7,822
E.Asia/ Pacif.	5.8	5.5	32	1.4	69	42	54,834
Europe and Central Asia	5.1	7.6	21	0.5	69	37	32,931
L.America/Car.	-2.2	16.1	19	1.8	71	34	44,682
Middle East & N.Africa	1.0	-	23	2.6	69	54	2,653
South Asia	2.6	14.5	22	2.0	63	95	4,164

Source: 2004 World Development Indicators Database (World Bank)

Table 2: Convergence - Empirical Methodologies

METHODOLOGY	RESEARCH STUDIES
Numerical Simulation	Lucas [2000], Tamura [1996], Taylor and Rada [2003]
Clustering and Classification	Azariadis and Drazen [1990], Durlauf and Johnson [1995], Franses and Hobijn [1995]
Distribution Dynamics	Bianchi [1997], Jones [1997], Quah [1993, 1994, 1996, 1997]
Time Series Approach	Aubyn [1999], Lee, Pesaran and Smith [1997], Bernard [1992], Bernard and Durlauf [1995], Greasley and Oxley [1997]
Dynamic Panel GMM	Caselli, Esquivel and Lefort [1996], Benhabib and Spiegel [2000], Easterly, Loayza, and Montiel [1997], Forbes [2000], Levine et al [2000], Bond, Hoeffler, and Temple [2001]
Panel Data (π -Matrix) Approach	Islam [1995], Knight, Loayza and Villaneuva [1993], Loayza [1994]
Panel Data	Barro and Lee [1994], Barro and Salai-i-Martin [1995]
Cross-Sectional Estimation	Barro [1991], Barrow and Salai-i-Martin [1992], Baumol [1986], Delong [1988], Dowrick and Nguyen [1989], Mankiw, Romer and Weil [1992]
Technology Gap Approach	Chatterji [1992]

Table 3*: Absolute Divergence among SSA*

	Pooled	Fixed Effects	GMM (diff)	
Constant	0.661 (0.86)	0.2905 (1.21)	0.304 (0.01)	0.0026 (0.632)
Initial Income	0.0142 (0.199)	0.0487 (0.413)	0.152 (1.10)	0.192 (0.75)

Table 4*: Conditional Convergence in the Solow Model (Unrestricted)*

	Pooled		Fixed Effects		GMM (diff)	
	a	***b***	***a***	***B***	***a***	***b***
Constant	-0.0901 **(0.07)****	-0.046 (0.35)	0.2905 **(0.005)****	0.5342 **(0.00)****	0.304 **(0.01)****	0.0026 (0.632)
Initial Income	0.0142 (0.199)	0.0074 (0.54)	0.0487 **(0.019)****	-0.126 **(0.00)****	-0.152 **(0.10)***	-0.192 **(0.05)****
Savings	0.0131 **(0.00)****	0.061 **(0.00)****	0.0487 (0.019)	0.0540 **(0.00)****	0.099 **(0.001)****	0.103 **(0.001)****
Population	0.0133 **(0.00)****	-0.07 **(0.00)****	-0.1185 (0.119)	-0.0772 (0.162)	-0.163 **(0.000)****	-0.178 **(0.00)****
Literacy Rate	------	0.065 (0.97)	-------	-0.0506 (0.383)	------	0.081 (0.793)
Implied λ	xxxxxx	xxxxx	1.61%	2.67%	3.29%	4.26%

a *denotes the textbook Solow model.*

b *denotes the human capital augmented Solow model*

Table 5: *Conditional Convergence in the Solow Model (Restricted)*

	Pooled		Fixed Effects		GMM (diff)	
	a	***b***	***a***	***B***	***a***	***b***
Constant	2.189 (0.156)	-0.1099 (0.336)	0.2353 **(0.039)****	0.7228 **(0.002)****	-0.0780 (0.766)	-0.0038 (0.842)
Initial Income(Iny_o)	0.697 **(0.056)****	-0.0502 (0.370)	-0.0721 **(0.020)****	-0.1936 **(0.001)****	-0.1254 **(0.082)***	-0.1902 **(0.096)***
In(s)-In(n+g+δ)	0.0118 (0.183)	0.1447 **(0.005)****	0.0552 **(0.007)***	0.0929 (0.156)	0.1089 **(0.00)****	0.1482 **(0.092)***
In(h)-In(n+g+δ)	------	-0.0175 (0.794)	------	-0.0629 (0.250)	------	0.0935 (0.724)
Implied λ		1.03%	1.49%	4.30%	2.68%	4.22%
Implied α			43.5%		46.5%	

a *denotes the textbook Solow model.*

b *denotes the human capital augmented Solow model.*

Table 6: DYNAMIC PANEL GMM (DIFFERENCES) ESTIMATION - DEPENDENT VARIABLE $(Iny_{i,t} - Iny_{i,t-\tau})$								
Variable		SPECIFICATION						
		1	2	3	4	5	6	7
Initial Income		-0.152(0.10)*	-0.192 (0.01)**	-0.21(0.00)**	-0.196(0.00)**	-0.167(0.02)**	-0.200(0.01)**	-0.165(0.05)**
Savings		0.099(0.001)**	0.103 (0.001)**	0.189(0.00)**	0.187(0.01)**	0.189(0.01)**	0.192(0.00)**	0.194(0.072)*
Population Growth		-0.163(0.000)**	-0.178 (0.00)**	-0.17 (0.00)**	-0.17 (0.00)**	-0.167(0.00)**	0.149(0.00)**	-0.101(0.05)**
Literacy Rate		0.081 (0.80)	0.149(0.884)	0.129(0.700)	0.019(0.571)	-0.179(0.876)	0.183(0.886)	
Openness		------	0.147 (0.08)*	0.152(0.09)*	0.053(0.09)*	0.144(0.257)	0.155(0.07)*	
Govt. Consumption		------	------	------	-0.083(0.10)*	-0.127(0.068)*	-0.165(0.11)	
M2GDP		------	------	-0.297(0.06)*	-0.128(0.02)**	-0.122(0.04)**	-0.259(0.00)**	
Life Expectancy		------	------	------	------	-0.226(0.19)	-0.202(0.120)	
Financial Devt.		------	------	------	------	------	0.282(0.00)**	
FDI		------	------	------	------	------	0.153(0.00)**	
Infant Mortality		------	------	------	-----	-0.196(0.02)**	-0.199(0.06)**	
Inflation Rate		------	------	------	------	------	-0.164(0.05)**	
Implied Convergence		**3.3%**	**4.26%**	**4.71%**	**4.36%**	**3.65%**	**4.46%**	**3.61%**
Wald (Joint)		25.86(0.00)**	24.89(0.00)**	31.9 (0.00)**	34.3(0.00)**	31.1(0.00)**	39.10(0.00)**	67.38(0.00)**
Sargan Test		14.28(0.354)	16.75(0.211)	16.87 (0.21)	16.8(0.21)	16.87(0.21)	19.83(0.100)	10.46(0.656)
AR (1)		-3.40(0.001)**	-2.83 (0.005)**	-2.84 (0.00)**	-2.78(0.01)**	-2.59(0.01)**	-2.712(0.00)**	-2.21(0.027)**
AR (2)		-0.588 (0.556)	-0.092 (0.927)	-0.113 (0.91)	-0.095(0.92)	0.022(0.98)	0.061(0.952)	0.3855(0.700)

******All variables are in logs. ** denotes significant at 5%. * denotes significance at 10%***

******Probabilities are in parenthesis. The constants in the regressions have not been reported.***

Table 7: Dynamic Panel GMM (systems) estimation - dependent variable $(Iny_{i,t} - Iny_{i,t-\tau})$							
VARIABLE	SPECIFICATION						
	1	2	3	4	5	6	7
Initial Income	-0.118(0.059)**	-0.078 (0.09)*	-0.06(0.02)**	-0.058(0.09)*	-0.071(0.112)	-0.051(0.074)*	-0.19(0.05)**
Savings	0.194 (0.000)**	0.189(0.00)**	0.078(0.00)**	0.164(0.00)**	0.085 (0.052)**	0.047 (0.002)**	0.045 (0.08)*
Population Growth	-0.179(0.008)**	-0.169(0.0)**	-0.13(0.01)**	-0.10(0.01)**	-0.054 (0.096)*	-0.164(0.024)**	-0.17(0.03)**
Literacy Rate	------	0.207 (0.119)	------	------	------	-0.067(0.850)	-0.156(0.863)
Openness	------	------			------	0.210 (0.023)**	0.212(0.04)**
Govt. Consumption	------	------	-0.23(0.04)**		------	-0.151(0.076)**	-0.153(0.08)*
M2GDP	------	------	------	-0.085(0.07)*	------	-0.156(0.077)**	-0.156(0.07)*
Life Expectancy	------	------	------	------	-0.032 (0.068)*	------	-0.054(0.792)
Financial Devt.	------	------	------	------	0.036 (0.096)*	0.179 (0.049)**	0.177(0.05)**
FDI	------	------	------	------	0.182 (0.001)**	0.152 (0.018)**	0.151(0.02)**
Infant Mortality	------	------	------	------	-0.155 (0.469)	------	0.055 (0.930)
Inflation Rate	------	------	------	------	-0.171(0.047)**	-0.015(0.047)**	-0.16(0.05)**
Implied Convergence	**2.5%**	**1.62%**	**1.24%**	**1.2%**	**1.47%**	**1.1%**	**2.1%**
Wald (Joint)	17.57 (0.001)**	20.88(0.00)**	20.75(0.00)**	23.74(0.00)**	43.48 (0.000)**	40.20 (0.000)**	33.88(0.00)**
Sargan Test	26.66 (0.271)	48.83 (0.129)	53.69 (0.333)	89.14(0.496)	99.81 (0.000)**	266.9 (0.122)	265.6(0.762)
AR (1)	-3.74 (0.000)**	-3.3(0.001)**	-3.99(0.00)**	-3.96 (0.00)**	-2.29 (0.022)**	-2.318(0.020)**	-2.32(0.02)**
AR (2)	-0.739 (0.460)	-0.083 (0.933)	-0.343 (0.73)	-0.357 (0.721)	0.1333 (0.894)	0.099 (0.921)	0.121 (0.904)

******All variables are in logs. ** denotes significant at 5%. * denotes significant at 10%***

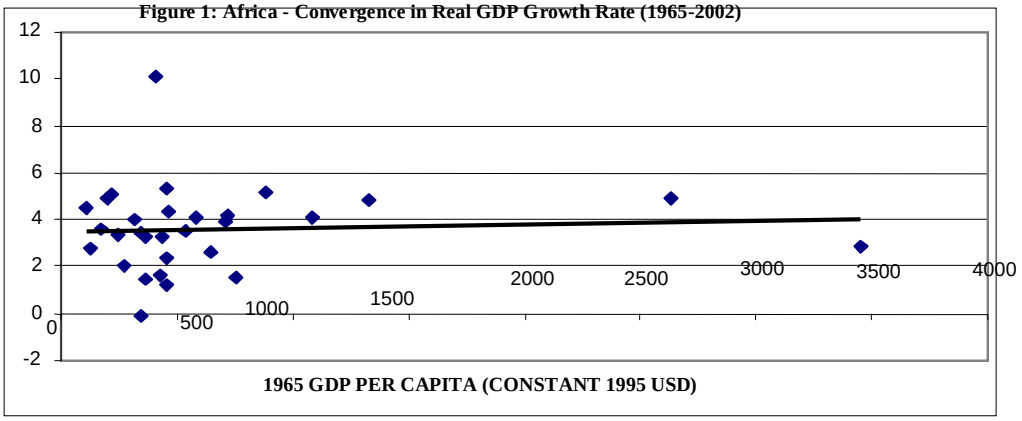
******Probabilities are in parenthesis. The constants in the regressions have not been reported.***

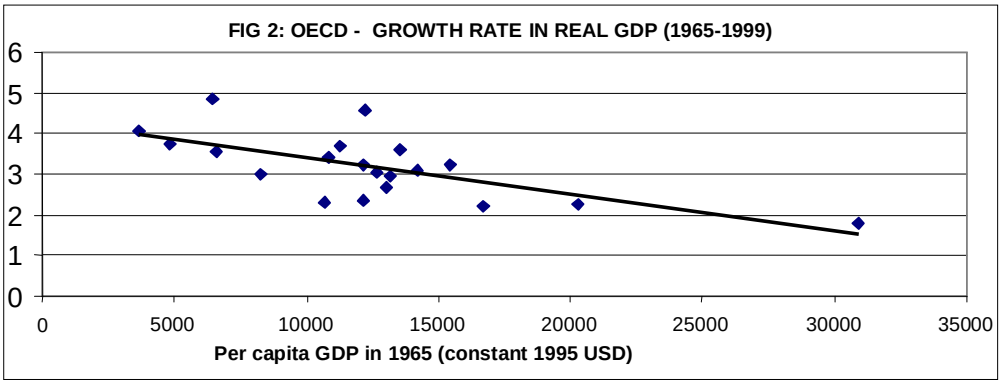
Table 8: Comparison with recent studies on the growth process in Africa

	Sachs & Warner (1997)	Easterly & Levine (1997)	Temple (1998)	Ghura & H.Michael (1996)	Savvides (1995)	This Paper
	Cross-Section	*SUR*	*Cross-Section*	*Feasible GLS*	*Fixed Effects Panel*	*Dynamic Panel GMM*
Initial Income	-	+	-	-	-	-
Initial Income Squared	-	-				
Savings	+			+	+	+
Population Growth			+	-	-	-
Literacy Rate						xxx
School Enrolment		+	+	+	xxx	
Life Expectancy	+		+	+		xxx
Government Consumptn					-	-
Infrastructure		+	+			
Black Market Premium		-	-			
Fiscal Deficit/Surplus		+	+	-		
Socio/Political Instability		-	-	-	-	
Openness	+		+		+	+
Geography	-		+			
Climate				-		
Natural Res. Abundance	-		-			
Institutional Quality	+		+	+		
Inflation				-	xxx	-
Financial Development		+	+		+	+
Dummy for Africa	+	-	-			
Foreign Direct Invest.						+
Poverty						-
M2GDP						-
Neighbourhood Effects	-	-				
Terms of Trade				+		xxx
Real Effective Exch. Rate				-	xxx	
Ethnic Fractionalisation	-		-			

- denotes a negative effect on growth
+ denotes a positive effect on growth
xxx denotes a non-significant effect on growth

Figure 1: Africa - Convergence in Real GDP Growth Rate (1965-2002)





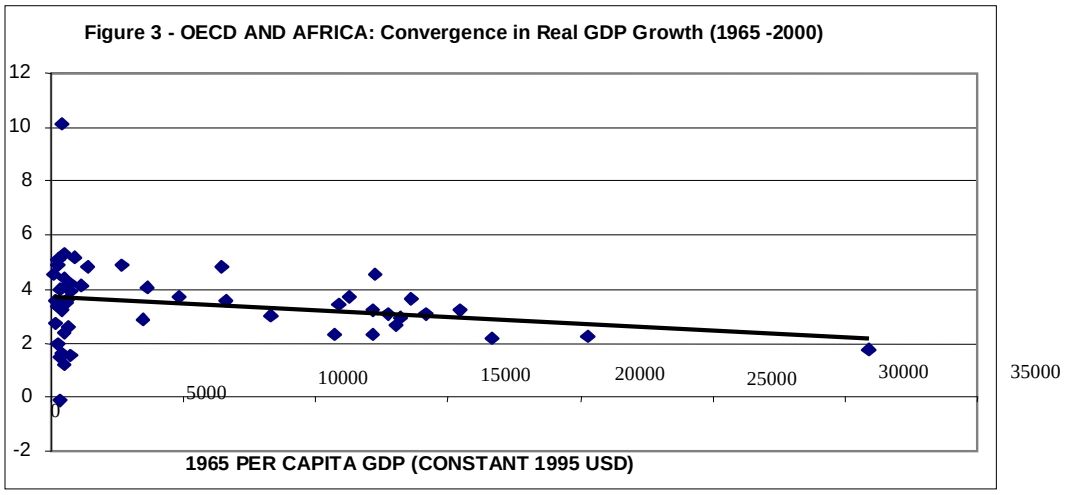


Figure 3 - OECD AND AFRICA: Convergence in Real GDP Growth (1965 -2000)
12
10
8
6
4
2
0
-2
0
5000
10000
15000
20000
25000
30000
35000
1965 PER CAPITA GDP (CONSTANT 1995 USD)

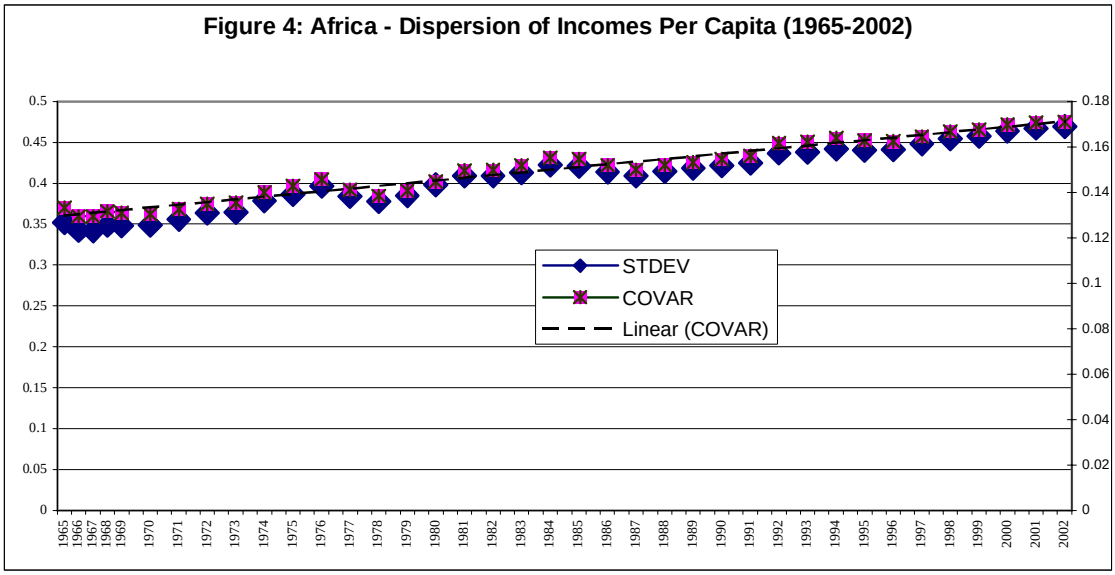


Figure 4: Africa - Dispersion of Incomes Per Capita (1965-2002)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
STDEV
COVAR
Linear (COVAR)
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002

Figure 5: Composition of GDP

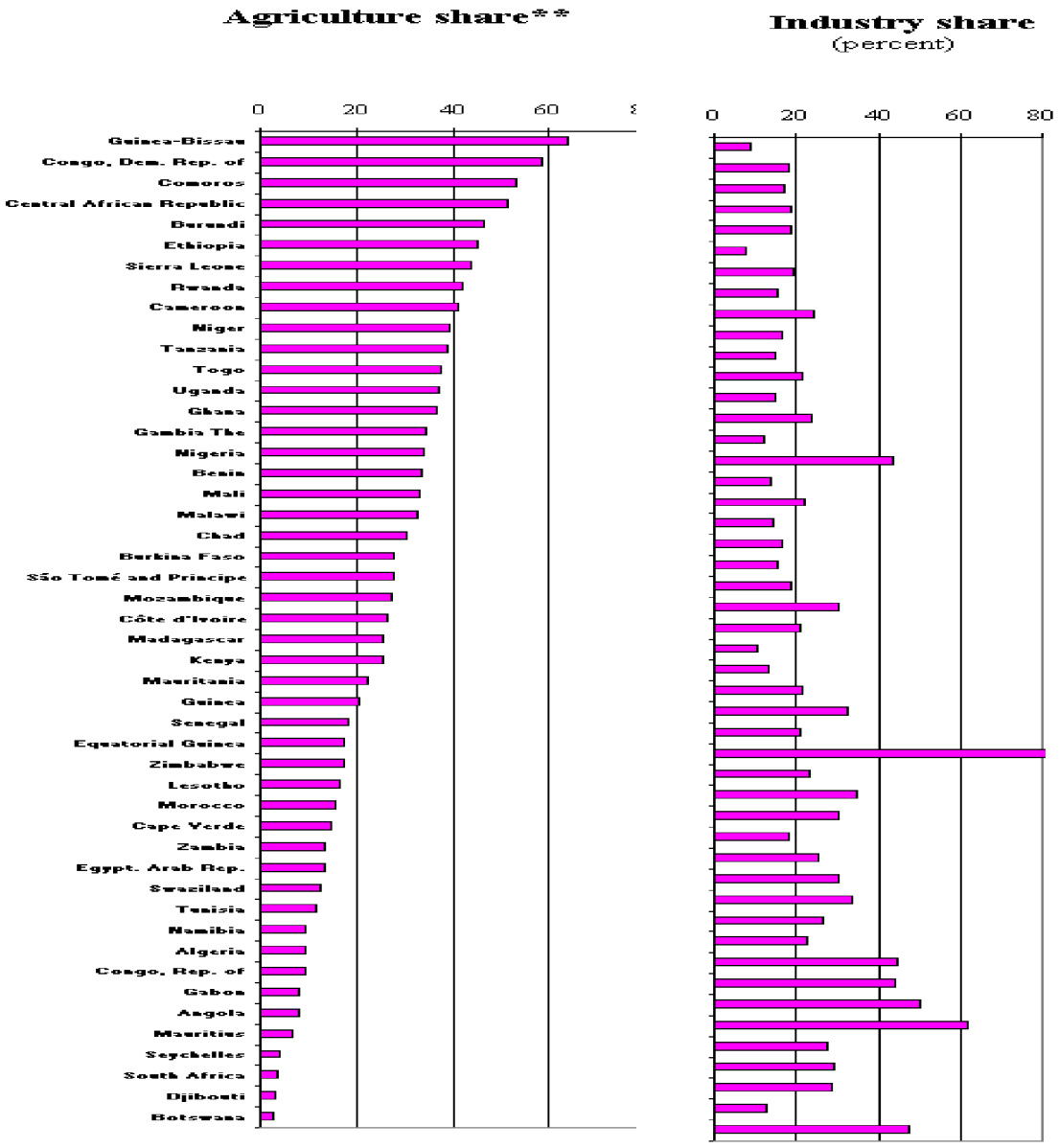
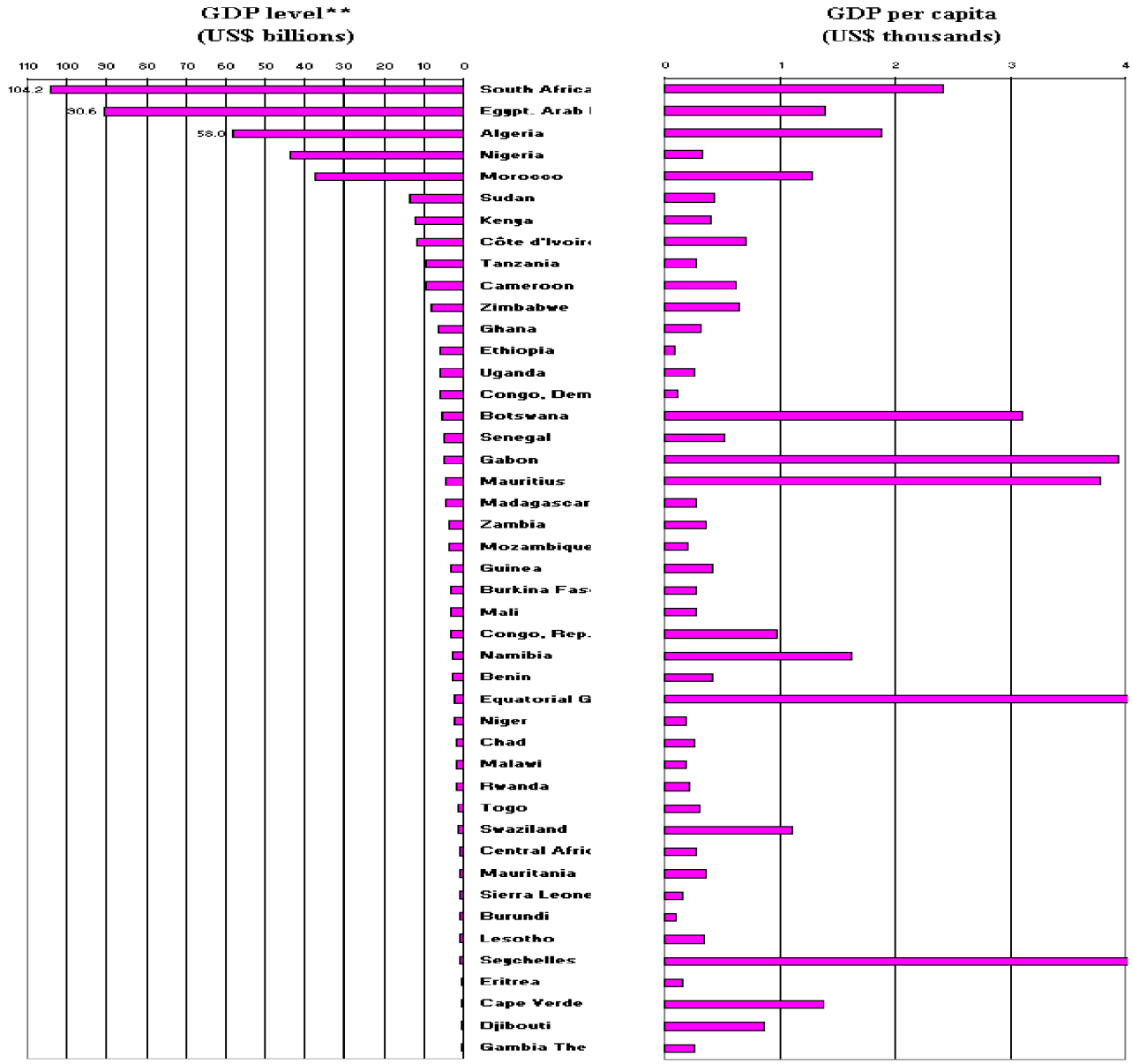


Figure 6: Sub-Saharan Africa - GDP per capita levels



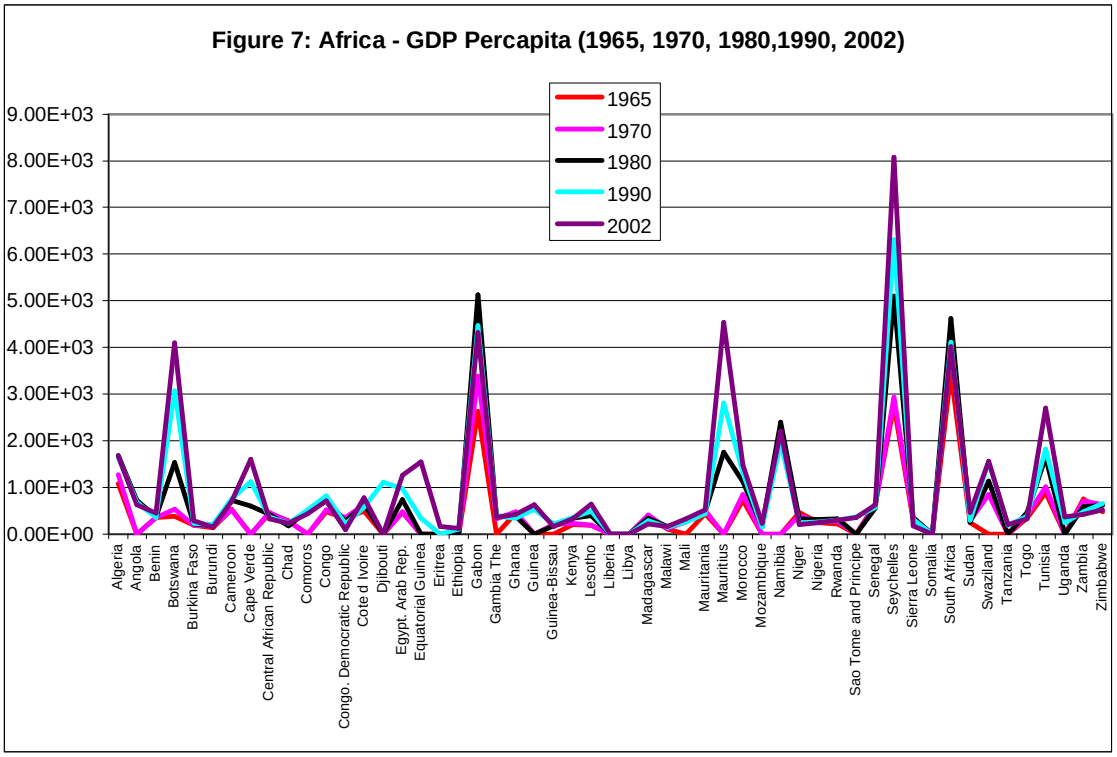


Figure 7: Africa - GDP Percapita (1965, 1970, 1980,1990, 2002)
1965
1970
1980
1990
2002
9.00E+03
8.00E+03
7.00E+03
6.00E+03
5.00E+03
4.00E+03
3.00E+03
2.00E+03
1.00E+03
0.00E+00
Algeria
Angola
Benin
Botswana
Burkina Faso
Burundi
Cameroon
Cape Verde
Central African Republic
Chad
Comoros
Congo
Congo. Democratic Republic
Cote d Ivoire
Djibouti
Egypt. Arab Rep.
Equatorial Guinea
Eritrea
Ethiopia
Gabon
Gambia The
Ghana
Guinea
Guinea-Bissau
Kenya
Lesotho
Liberia
Libya
Madagascar
Malawi
Mali
Mauritania
Mauritius
Morocco
Mozambique
Namibia
Niger
Nigeria
Rwanda
Sao Tome and Principe
Senegal
Seychelles
Sierra Leone
Somalia
South Africa
Sudan
Swaziland
Tanzania
Togo
Tunisia
Uganda
Zambia
Zimbabwe

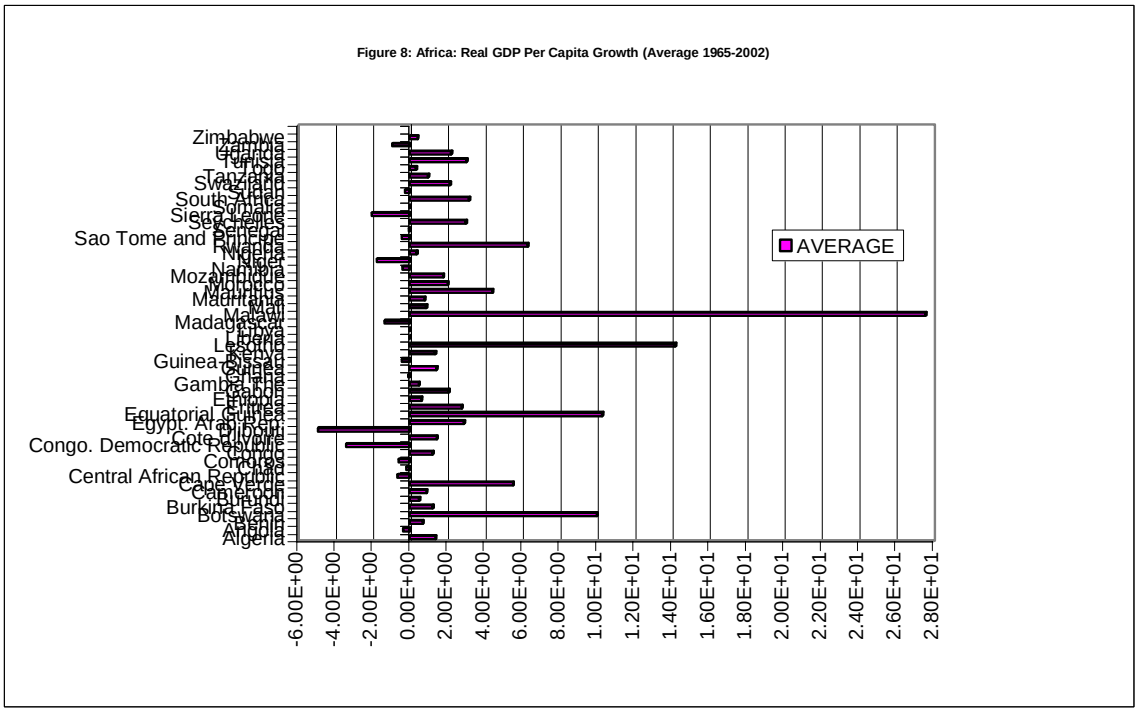


Figure 8: Africa: Real GDP Per Capita Growth (Average 1965-2002)
AVERAGE
-6.00E+00
-4.00E+00
-2.00E+00
0.00E+00
2.00E+00
4.00E+00
6.00E+00
8.00E+00
1.00E+01
1.20E+01
1.40E+01
1.60E+01
1.80E+01
2.00E+01
2.20E+01
2.40E+01
2.60E+01
2.80E+01

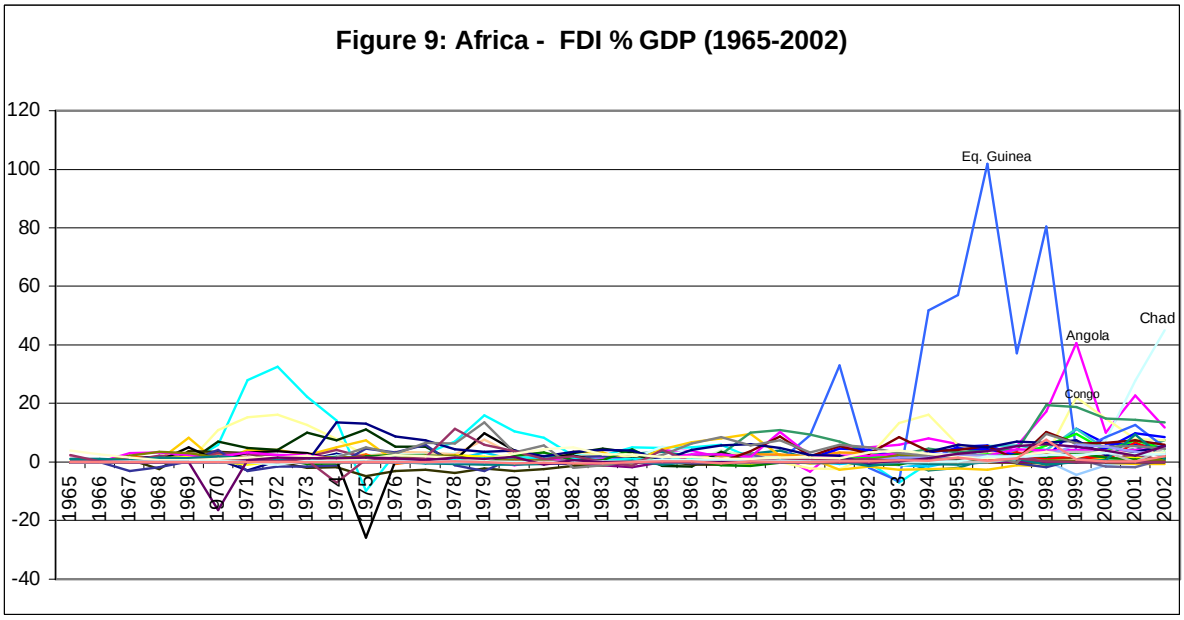


Figure 9: Africa - FDI % GDP (1965-2002)
120
100
80
60
40
20
0
-20
-40
Eq. Guinea
Chad
Angola
Congo
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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2002

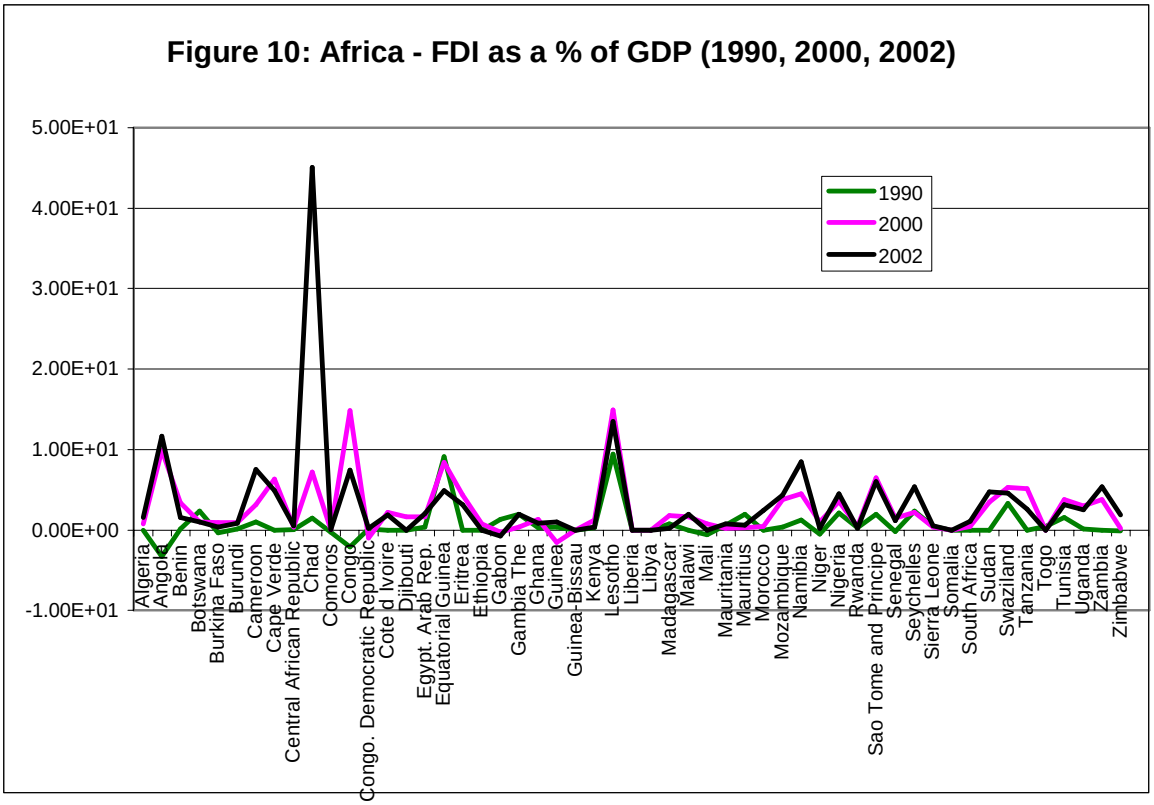


Figure 10: Africa - FDI as a % of GDP (1990, 2000, 2002)
5.00E+01
4.00E+01
3.00E+01
2.00E+01
1.00E+01
0.00E+00
-1.00E+01
1990
2000
2002
Algeria
Angola
Benin
Botswana
Burkina Faso
Burundi
Cameroon
Cape Verde
Central African Republic
Chad
Comoros
Congo
Congo. Democratic Republic
Cote d Ivoire
Djibouti
Egypt. Arab Rep.
Equatorial Guinea
Eritrea
Ethiopia
Gabon
Gambia The
Ghana
Guinea
Guinea-Bissau
Kenya
Lesotho
Liberia
Libya
Madagascar
Malawi
Mali
Mauritania
Mauritius
Morocco
Mozambique
Namibia
Niger
Nigeria
Rwanda
Sao Tome and Principe
Senegal
Seychelles
Sierra Leone
Somalia
South Africa
Sudan
Swaziland
Tanzania
Togo
Tunisia
Uganda
Zambia
Zimbabwe

Fig 11: Africa - FDI Flows (1965-2002)

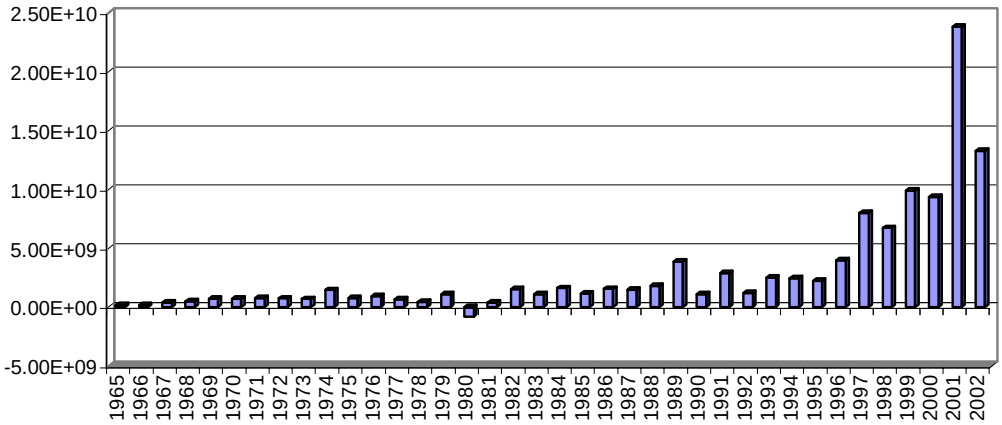
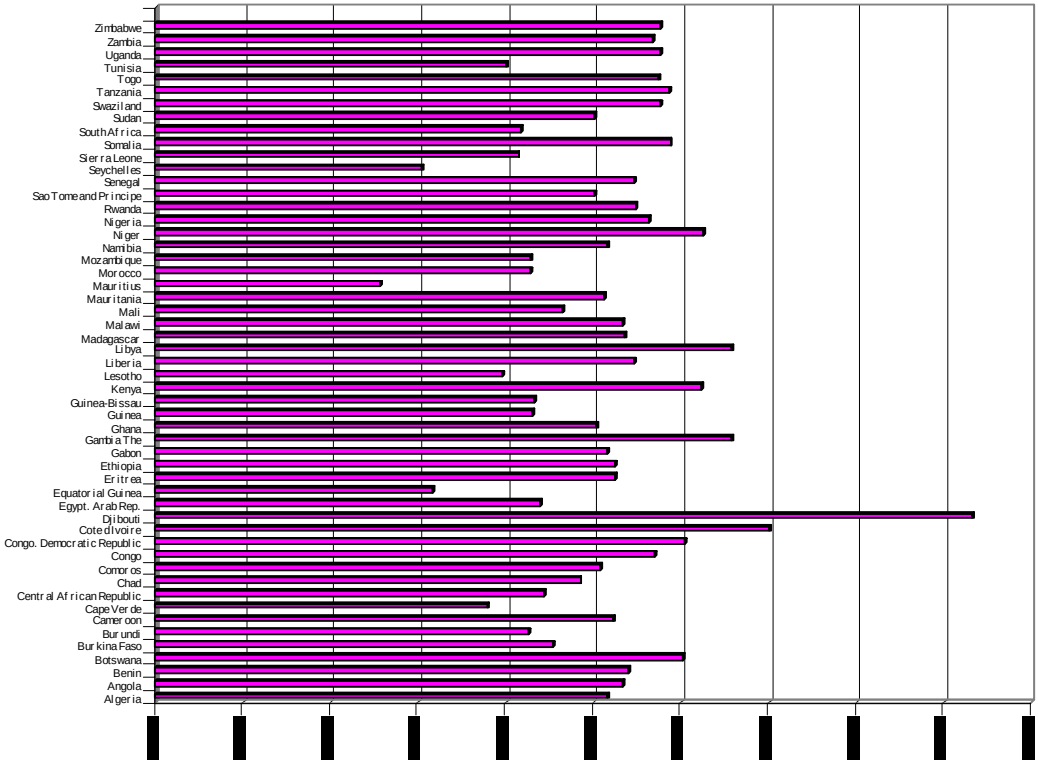


Figure 12: Africa - Average Population Growth Rates (1965-2002)



APPENDIX A

Assume a Solow model with a Cobb-Douglas production function and labor-augmenting technological progress:

$Y(t) = K(t)^{\alpha}[A(t)L(t)]^{1-\alpha}, \qquad 0 < \alpha < 1$

where *Y* is output, *K* is capital, *L* is labour, and *A* is the level of technology. Labour and capital are assumed to grow exogenously:

$L(t) = L(0)e^{nt}$

$A(t) = A(0)e^{gt}$

If we let $k = K/AL$, and $y = Y/AL$, then the reduced form of the production function is:

$$y = \left[\frac{Y}{AL}\right] = \left[\frac{K^{\alpha}(AL)^{1-\alpha}}{AL}\right] = k^{\alpha}$$

Suppose that *s* is the savings rate and δ is the depreciation rate. Then the evolution of *k* is given by:

$\dot{k}(t) = sy(t) - (n + g + \delta)k(t)$

$= sk(t)^{\alpha} - (n + g + \delta)k(t)$

Therefore *k* converges to a steady-state value k^* such that:

$sk^{*\alpha} = (n + g + \delta)k^*$. Hence,

$$k^* = \left[\frac{s}{n + g + \delta}\right]^{\frac{1}{1-\alpha}}$$

We can substitute the above into the production function; take logs to obtain steady state income per capita:

$$y^* = \frac{Y}{AL} = k^{*\alpha},$$

$$\frac{Y}{L} = Ak^{\alpha},$$

$$\frac{Y}{L} = A\left[\frac{s}{n + g + \delta}\right]^{\frac{\alpha}{1-\alpha}}$$

$$In\left(\frac{Y}{L}\right) = InA + \left[\frac{\alpha}{1-\alpha} Ins - \frac{\alpha}{1-\alpha} In(n + g + \delta)\right]$$

$$In\left(\frac{Y}{L}\right) = InA(0) + gt + \frac{\alpha}{1-\alpha} In(s) - \frac{\alpha}{1-\alpha} In(n + g + \delta)$$

Consider the value of output per worker at a particular time to be *y(t)*. Approximating around the steady state, the speed of convergence can be expressed as:

$$\frac{dIn(y(t))}{dt} = \lambda\left[In(y^*) - In(y(t))\right]$$

where, $\lambda = (n + g + \delta)(1 - \alpha)$

This leads to:

$In(y(t)) = (1 - e^{-\lambda t})In(y^*) + e^{-\lambda t} In(y(0))$

where $y(0)$ is output per worker at some initial date. Finally, subtract $y(0)$ from both sides and subtitute for y^* yields the textbook Solow model:

$$In(y(t)) - In(y(0)) = (1 - e^{-\lambda t}) In(y^*) - (1 - e^{-\lambda t}) In(y(0))$$

$$In(y(t)) - In(y(0)) = (1 - e^{-\lambda t}) \frac{\alpha}{1-\alpha} Ins - (1 - e^{-\lambda t}) \frac{\alpha}{1-\alpha} In(n + g + \delta) - (1 - e^{-\lambda t}) In(y(0))$$

APPENDIX B

Given that $y_{i,t} - y_{i,t-1} = \beta (y_{i,t-1} - y_{i,t-2}) + (e_{i,t} - e_{i,t-1})$, the vector of transformed error terms is therefore: $\Delta\varepsilon_i = \begin{bmatrix} \varepsilon_{i,2} - \varepsilon_{i,1} \\ ..... \\ \varepsilon_{i,T} - \varepsilon_{i,T-1} \end{bmatrix}$.

The associated matrix of instruments is:

$$Z_i = \begin{bmatrix} y_{i1} & 0 & ... & 0 \\ 0 & [y_{i1}, y_{i2}] & & 0 \\ M & & O & 0 \\ 0 & L & 0 & [y_{i1}, y_{i2}, ..., y_{i,(T-2)}] \end{bmatrix}$$

Hence the set of all moment conditions can be written concisely as $E\left[Z_i' \Delta\varepsilon_i \right] = 0$. (note that these are *1+2+3+4+…+(T-1)* moment conditions.). To derive the GMM estimator, rewrite the set of moment conditions as:

$E\{Z_i'(\Delta y_i - \beta \Delta y_{i,-1})] = 0$. Since the number of moment conditions will typically exceed the number of unknown coefficients, β can be estimated by minimizing a quadratic expression in terms of the corresponding sample moments:

$\min \left[\frac{1}{N} \sum_{i=1}^{N} Z_i'(\Delta y_i - \beta \Delta y_{i,-1}) \right]' W_N \left[\frac{1}{N} \sum_{i=1}^{N} Z_i'(\Delta y_i - \beta \Delta y_{i,-1}) \right]$, where W_N is a symmetric positive definite weighting matrix. Differentiating the above expression and solving for β gives the GMM estimator:

$$\hat{\beta}_{GMM} = \left(\left(\sum_{i=1}^{N} \Delta y_{i,-1}' Z_i \right) W_N \left(\sum_{i=1}^{N} Z_i' \Delta y_{i,-1} \right) \right)^{-1} \times \left(\sum_{i=1}^{N} \Delta y_{i,-1}' Z_i \right) W_N \left(\sum_{i=1}^{N} Z_i' \Delta y_i \right)$$

Clearly, a decision has to be made about the choice of weighting matrix. This would result in either one-step estimation or two-step estimation. In general however, the optimal weighting matrix is determined as:

$W_N^{opt} = \left(\frac{1}{N} \sum_{i=1}^{N} Z_i' G Z_i \right)^{-1}$, where $G = \begin{pmatrix} 2 & -1 & 0 & ... \\ -1 & 2 & O & 0 \\ 0 & O & O & -1 \\ M & 0 & -1 & 2 \end{pmatrix}$

The case of dynamic models with other exogenous explanatory variables is just a straightforward extension of the above. Assume a predetermined regressor x_{it} correlated with the individual effect is added to the model above:

$y_{it} = x_{it}'\gamma + \beta y_{i,t-1} + \alpha_i + \varepsilon_{it}$,

$E(x_{it} v_{is}) = 0$ for $s \geq t$

$\neq 0$ otherwise

$E(x_{it}\eta_i) \neq 0$

The instrument matrix can then be written as,

$$Z_i = \begin{bmatrix} [y_{i1}, x_{i1}, x_{i2}] & 0 & \ldots & 0 \\ 0 & [y_{i1}, y_{i2}, x_{i1}, x_{i2}, x_{i3}] & & 0 \\ \mathrm{M} & & \mathrm{O} & 0 \\ 0 & \mathrm{L} & 0 & [y_{i1}, y_{i2}, \ldots, y_{i,T-2}, x_{i1}, x_{i2}, \ldots x_{i(T-1)}] \end{bmatrix}$$

The first-differenced GMM estimator has been found to have poor finite sample properties in terms of bias and imprecision. In particular, this occurs when the lagged levels of the series are weakly correlated with subsequent first-differences[17]. Hence the instruments available for the first-differenced equations are weak [Blundell and Bond, 1998]. Blundell and Bond have shown that the first-differenced GMM estimator could be subject to a large downward bias. This is particularly severe when the time period being considered for each unit is small. For example, in most cross-country growth regressions that test convergence, the time period is reduced to a small number of τ -period averages. Also, it is known that variables such as output are highly persistent series. As a result, Blundell and Bond [1998] have suggested a system GMM estimator that simply considers lagged differences as instruments for an additional levels equation. These are stacked as follows:

$$Z_i^{++} = \begin{bmatrix} Z_i & 0 & \mathrm{K} & 0 \\ 0 & \Delta y_{i2} & 0 & 0 \\ \mathrm{M} & \mathrm{M} & \Delta y_{i3} & 0 \\ 0 & 0 & 0 & \Delta y_{i,(T-1)} \end{bmatrix}$$

SAMPLE COUNTRIES

Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroun, Central African Republic, Chad, Congo (Zaire), Congo (Republic of), Egypt, Ethiopia, Gabon, Gambia, Ghana, Guinea, Cote d'Ivoire, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Zambia, Zimbabwe, Sudan.

[17] For example, when the series are highly persistent