

Why Has Growth Slowed in Sub-Saharan Africa? A System IV-GMM Approach

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In this paper, we estimated the traditional cross-country growth model and corrected for model endogeneity bias and country-specific heterogeneity effects. Using the System-IV Generalized Method of Moments (GMM) approach, we identified the key factors that determine GDP per capita growth rate in a panel regression model of 100 countries. Parameter robustness test was applied to the models which also included: Within Fixed Effects; Pooled-Ordinary Least Square and Levels-IV GMM models, using the Extreme Bounds Analysis (EBA). We found that most of the estimated covariates that show significant coefficients in the regression model are actually fragile, except for initial income, institutions and real exchange rate over-valuation. More importantly too, the results suggested that natural resource endowment, such as oil, may not have accounted for why some resource rich developing countries (e.g. Nigeria) have grown slowly as is commonly argued in the literature.

Keywords: Fixed Effects Models, Growth, Endogeneity, Heteroscedasticity, Method of Moments.

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I. Introduction

Several studies⁷ have used cross-country regressions to search for the empirical links between long-term growth rates and a variety of

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⁷ See Rodrik (1997 and 2005), Barro and Sala-i-Martin (2004), Temple (2003)}

economic policies, political objectives and institutional factors. Generally, each of these studies has only considered a small number of explanatory variables to establish a correlation between growth and the identified variables of interest. In a survey of growth econometrics, Durlauf, et al. (2004) identified over 200 variables suggested in the literature to have been significantly correlated with growth. In most studies, researchers substantiate the validity of a growth determinant by developing a simple regression model or set of models and conduct inference as if the model generated the data. However, inference procedures based on a simple linear growth regression model which is conditional on the truth of that model can grossly overstate the precision of the inference above in a given phenomenon and ignore the uncertainty that surrounds the validity of the model.

In addressing the uncertainties associated with growth models, this paper investigates the inconsistencies that may be associated with the factors that have been argued to account for the growth stagnation in sub-Saharan Africa. Many studies which include: Barro and Sala-i-Martin (2002), Collier and Gunning (1999) and, Sachs and Warner (1997) have found that there is a significant negative correlation between natural resource endowment and economic growth, such that the negative relationship have accounted for why resource abundant countries, most especially in sub-Sahara Africa, have grown relatively slower than other countries. The methodologies adopted in these studies to arrive at this result follow the estimation of an 'endogenous' neoclassical growth model using a combination of traditional growth

determinants⁸ with other control variables which include an 'oil dummy' in a cross-country linearized growth regression. These models have as their dependent variable, the average GDP per capita growth rate over an extended time period and the right-hand variables are simultaneously estimated as parameters of growth but each parameter is interpreted holding all other parameters constant. Some of the results suggested that the channels through which growth is retarded included: long-term decline in terms-of-trade, oil revenue volatility, the "Dutch disease" syndrome, crowding-out effects, increasing state dominance, socio-cultural and political hindrance, etc.

This paper is a revisit to the analysis of growth performance in developing sub-Saharan countries, particularly as it relates to the estimation of parameters that account for economic growth and development. The paper used a battery of econometric techniques to investigate the robustness of growth covariates in a cross-country growth model in line with associated error components of the models. The paper is divided into five sections: Section one which is the introduction to the paper is followed by a survey of literature on the determinants of growth in section two. Section three highlights some stylized facts about the growth episodes of developing countries while section four presents the methodology and estimation techniques adopted in the study. Section five concludes and suggests policy options on the way forward.

⁸ These are the variables identified in Solow (1956), Mankiw, et al. (1992) and discussed in Barro et al. (1991) and Durlauf et al. (2004)

II. The Determinants of Growth: A literature Survey

The development of economic growth literature can be classified into two frameworks of applied analysis that involve the application of economic theory to growth estimations. The first framework addresses the issue of 'convergence' which relates to whether contemporary differences in aggregate economies transient over sufficiently long time horizons or converges to an 'initial equilibrium'. The second framework concerns the identification of growth determinants which suggest the factors that explain the observed differences in growth among countries. In addressing the growth phenomenon, two models that are legendary in growth literature on the appropriate specification of a growth equation are the neoclassical growth model-Solow-Swan, (1956) and the endogenous growth model-Romer (1986) and Lucas, (1988).

Many of the differences between the neoclassical and endogenous growth models can be narrowed down to issues that concern the long-run effects of initial conditions on growth. This paper will focus, particularly, on the second framework that concerns the identification of growth covariates and their robustness in a heterogeneous cross-country growth estimation model. In the literature, there are over 200 variables that have been identified to account for GDP per capita growth rate⁹, such that the specifications of growth models have become so complex and sophisticated that the generalization of the

⁹ For example see Levine and Renelt,(1991)}

intuitions from growth estimations for policy purposes have become even more complex. In this literature survey, we would discuss some of the theoretical framework that informed the choice of some of the key growth determinants and the order of their specifications in growth models. The major distinction between endogenous and neoclassical growth theories centered on the long-run effect of initial human and physical stocks (*Initial Income*) on current growth. The effect of initial conditions on long-run outcomes represents the primary empirical question that has been explored by growth economists. The suggestion that the effects of initial conditions eventually disappear is the basis for what is known as the 'convergence hypothesis' in growth literature¹⁰.

Durlauf, et al., (2004), in a review of growth econometrics, observed that the convergence hypothesis answers two fundamental questions concerning per capita income differences across countries. First, are the observed cross-country differences in per capita incomes temporary or permanent? Second, if they are permanent, does that permanence reflect structural heterogeneity or the role of initial conditions in determining long-run outcomes? Galor (1996), who coined the taxonomy '*convergence club*' explains that if the differences in per capita incomes are temporary, unconditional convergence - to a common long-run level- is occurring and if the differences are permanent solely because of cross-country structural heterogeneity, conditional convergence is occurring.

¹⁰ Bernard and Durlauf (1996), Caselli, (1996), Bliss (1999), Brock and Durlauf (2001), Bulli (2001) and Dollar and Kraay (2002) have shown that, the negative coefficient on initial income in a cross-country regression does not necessarily imply conditional convergence, because countries might instead simply be converging towards their own different steady-state growth paths.

The literature, therefore, suggests that it is important that initial income is included in any cross-country growth regression model to account for the effect of the differences in initial start-off point for the different countries. The variable is specified in the model with a negative sign, following the convergence postulate that countries with lower initial income should grow faster towards the steady state equilibrium than the countries with high initial income - given the rate of return to capital and technological progress¹¹.

The literature suggested that human capital can promote growth through different channels. For example, education determines the rate of technological innovation or absorption and exerts a countervailing effect on the diminishing returns to factors of production, such as capital. Countries with higher initial stock of human capital and knowledge have been found to be able to forge ahead through higher growth rates. Benhabib and Spiegel (1994) have found evidence that human capital affects total factor productivity growth (TFPG) through its impact on the capacity of a country to innovate and the capability of using and adapting foreign technology. Barro and Mootin (2002), also found that good level of health directly raise labor productivity and, hence, growth.

II.1 Macroeconomic Policy Variables

Bosworth and Collins (2003) found that growth is negatively associated with inflation, large budget deficits and distorted foreign exchange market. Easterly,

¹¹See Mankiw, et al., (1992) and Durlauf, et al (2004) for the production function optimization and the mathematical derivation of initial income sign in a growth model.

et al. (2000) also found that macroeconomic stabilization and crises-related variables, such as, price inflation, parallel market premium on foreign exchange, real exchange rate over-valuation, systemic banking and balance of payment crises, affect both cyclical output variability and long-term growth. It is argued in the literature that a key component to stabilization policy is sustenance of macroeconomic stability - which requires a thorough understanding of the interplay of both fiscal and monetary policy tools. Generally, one of the important variables considered in this interplay is average inflation rate, which represents an indication of the quality of interplay between fiscal and monetary policies. Loayza and Soto (2002) showed that inflation is a major channel through which fiscal and monetary policy distortions and external shocks are transmitted to other sectors of the economy. It is negatively correlated with long-term growth and positively correlated with other indicators of macroeconomic volatility, such as, fiscal deficits, black market premium and exchange rate overvaluation.

It has been shown that the domineering role of a state (government burden) can cause a significant drain on the private sector activities¹². Government consumption can have a positive effect on the economy; however, it could be detrimental to growth if it inappropriately imposes high tax levies to sustain ineffective fiscal spending, inefficient public service (bureaucratic bottlenecks)

¹²See Easterly (2001) and Makdisi, et al. (2001).

and engage in over-bearing state intervention in economic activities, thereby distorting efficient market mechanism and prices.

Acemoglu and Robinson (2001) found that institutions measured in historical terms, are significant determinants of growth and growth volatility, likewise policies that influence the structure of the economy, such as the degree of openness of the economy. Wacziarg and Welch (2003) found that openness affects growth positively to the extent that it magnifies the benefits of international knowledge spillover and technological diffusion, as well as enforcing cost discipline through import competition and the drive for export. Although the literature is divided on the importance of openness for long-term growth¹³, there are empirical evidences that suggest that the relationship between economic growth and international openness is indeed positive, and reflects the vicious cycle through which more openness leads to higher growth, which in turn leads to higher trade and more openness.

The significance of efficient public infrastructure in generating long-term growth, most especially for developing countries, has been highlighted in many of the literature¹⁴. Good and efficient public service infrastructure can impact positively on the economy by enhancing total factor productivity and boosting returns on private sector investment, which will facilitate fast and efficient

¹³ While Barro (1996), found that openness is positively related to growth, Makdisi et al. (2000) found that openness has accounted for the negative growth performance of the Arab oil-rich countries.

¹⁴ For example Loayza and Soto (2002) and Elbadawi (2006).

growth. Dhonte et al.(2000) and Williamson and Yousef (2002) found that demographic factors are important for growth such that when a country enters a period of demographic transition during which the proportion of working age population is increasing relative to the total population - a 'demographic window of opportunity' or a 'demographic gift' is opened up for the country.

These studies argued that, under such type of demographic transition, the high proportion of working-age population fosters accelerated and sustained economic growth by increasing labor participation and savings. However, if growth level continues to stagnate, this potential opportunity would instead become a social menace of rising unemployment. The impact of demographic transition on growth is captured by the extent to which the rate of growth of the economically active population (EAP) exceeds the rate of growth of the overall population. There are evidences in the literature suggesting that most developing oil-rich countries could not take advantage of the opened demographic window in their growth history and that has led to severe growth crises.

Elbadawi (2006), Acemoglu, et al. (2003) and Collier and Giennning (1999) found that growth is affected by conflicts - civil, regional or international. Collier (1999) found that while regional and international wars are likely to impact greatly on short-run development because they usually cause significant damage to physical and human capital, civil wars and ethnic conflicts can be more devastating to long-term growth due to the greater destruction of 'social

capital'. Bloom and Sachs (1998) and Gallup and Sachs (1998) found that favorable geographical and ecological conditions - in terms of access to long coastal line or sea navigable rivers and temperate climate, are robustly associated with superior growth records.

These studies suggested several channels through which favorable geography and ecology could promote overall economic growth. They also found that a high share of a country's area around coastal lines or sea navigable rivers and high economic density along the coast are important determinants of competitiveness, especially for transaction - intensive exports, such as manufactures. A high share of non-tropical (temperate) climate in a country is associated with less prevalence of vector-borne diseases and high agricultural productivity. Finally, Sachs and Warner (1997) found convincing evidence that countries with high initial share of natural resource exports to GDP in 1970 tend to grow slowly over time. They argued that natural resource abundance negatively affects growth through several channels, such that resource rich countries tend to exhibit the "dutch-disease" syndrome in terms of overvalued exchange rates, and hence the difficulty to develop a viable export-oriented or import-competing manufacturing sector.

III. The Growth Experience of Developing Economies: Some Stylized Facts

The growth experience of developing countries, in the last five decades or so, can be classified into four episodes: 1960 - 84; 1985 - 94; 1995 - 2000; and

2001 - 2007 (Table 1). The choice of these four classifications enabled us to capture the various major global shocks that characterize the growth pattern of the developing countries. The period 1960-84 captures the transition of developing economies from positive and strong growth in the 60's to slow and negative growth by the beginning of the 80s following the oil price boom of the early 70s and the oil price collapse of the early 80s. The second period, 1985 - 1994 corresponds to the decade that witnessed radical structural reforms to address the perceived negative macroeconomic consequences of resource dependence. The third period, 1995 – 2000, marks the beginning of positive growth in some resource rich countries and era of growth crisis in the Asian sub-region following the region's financial crisis. The last period, 2001 – 2007, marks the beginning of a new trend in oil price increase but with less negative consequences on the macroeconomic indicators of oil-rich countries.

Table 1

The Growth Performance and Volatility of some Developing Countries 1960 - 2007

Countries/Regions	1960 - 84		1985 - 94		1995 - 2000		2001 - 2007	
	Growth	Growth	Growth	Growth	Growth	Growth	Growth	Growth
		Volatility		Volatility		Volatility		Volatility
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
UAE	-4.3	2.3	-4.4	2.1	-1.4	5.1	1.2	2.1
Kuwait	-6.6	1.5	4.5	9.8	-3.2	1.2	3.7	3.2
Bahrain	5.5	2.8	1.5	4.0	1.6	1.3	1.8	2.1
Oman	8.3	2.0	1.0	4.0	0.8	2.2	1.7	3.1
Qatar	12.4	2.4	0.6	19.3	21.6	0.4	3.1	2.4
Libya	13.0	1.4	1.4	6.8	12.8	1.1	3.0	1.6
S/ Arabia	3.2	2.1	-1.3	3.8	-1.0	1.8	1.7	1.8
Hong Kong	6.7	0.6	3.4	1.4	2.9	2.3	3.5	0.4
Indonesia	3.8	0.9	3.7	1.6	3.1	2.1	3.4	0.1
Malaysia	4.4	0.5	3.5	1.3	3.0	2.4	2.5	0.6
Singapore	6.9	0.6	5.2	0.7	3.3	1.9	4.2	0.1
S/ Korea	6.6	0.6	6.2	0.7	3.9	2.2	4.5	0.2
East Asia	4.3	0.6	5.2	0.3	2.9	2.2	5.1	0.7
SSA	1.1	3.5	-1.1	1.8	0.1	3.6	2.1	4.6
MENA	5.5	2.1	1.0	4.0	0.8	1.3	2.2	4.1

Sources: WDI World Bank (2008), Summers and Heston (2007), and Author's calculations.

MENA = Middle East and North Africa Region; SSA = Sub Saharan Africa Region.

Note:

Country-specific growth rates are the period averages of GDP per capita growth and the regional-type growth rates are measured as the median of average countries growth rates.

The calculation of growth rates uses the growth rate of Real GDP per capita measured in domestic currency.

Country-specific growth volatility is measured as the ratio of the standard deviation of growth over the absolute mean value of growth during the sample period and the region-specific volatility is measured as the median of the country-specific volatility.

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In the first period, GDP per capita grew at an annual average rate of 5.5% in the oil-rich region of the Middle-East and North Africa region. In the same period, GDP per capita grew at an annual average of 1.1% for the sub-Saharan Africa region¹⁵ and 4.3% for South-East Asian region¹⁶. However, following the collapse of oil prices in the early 1980s, the annual average growth rate of per capita GDP for the oil economies in the second period (1985 -1994) declined to a meager 1%, while the sub-Saharan African region recorded a negative annual average per capita growth rate of -1.1%. The average annual growth rate collapsed in the second episode for both the oil-economies of the Middle East and North Africa, as well as the sub-Saharan African economies, while the South-East Asian countries were able to sustain and increase their strong growth performance to 5.2% from 4.3% in the first episode. Associated

¹⁵ The sub-Saharan African countries include Nigeria, Angola, Ghana, Liberia, Sierra Leone, Botswana, Burkina Faso, Ivory Coast, Republic of Congo, Gambia, Kenya, Madagascar, Malawi, Niger, Senegal, Togo, South Africa, Democratic Republic of Congo, Zambia and Zimbabwe.

¹⁶ The South-East Asian region includes countries like: Indonesia, Malaysia, Singapore, South Korea, and Thailand.

with the per capita annual average GDP growth rate over the two episodes is the growth volatility in the regions and countries. In the first episode, growth volatility in the Middle-East and North Africa (MENA) region was 2.1%, sub-Saharan Africa 3.5%, and East Asia 0.6%, and in the second period between 1985 - 1994, growth volatility increased significantly to 4.0% from 2.1% in the Middle-East and declined in both the East Asian and sub-Saharan regions to 0.3% and 1.8%, respectively. In the third period, 1995 - 2000, the growth rate of the oil-rich economies dwindled further to an annual average rate of 0.8% though with a decline in growth volatility from 4.0% to 1.3%.

During the second growth episode, the East Asian economies performed reasonably well, in terms of growth volatility, compared to the Middle-East and sub-Saharan Africa. Even though annual average per capita GDP growth in the region increased from 4.3% in the first period to 5.2% in the second period, growth volatility declined further from 0.6% to 0.3%. However, at individual country level, most of the East Asian economies recorded marginal increases in growth volatility. Although the sub-Saharan African region recorded a negative growth of -1.1% in the second period, growth volatility declined from 3.5% to 1.8%, suggesting that they actually performed better than the Middle-East and North African economies in terms of growth volatility.

The third growth period, 1995 – 2000, witnessed the Asian financial crisis of the 1990s when the region's growth volatility increased considerably to more than 2.0% compared to the MENA region with 1.3%, and annual average GDP

per capita growth rate declined from an average of 5% in the second period to less than 3% in the third period. Even with the increased oil prices in the 1990s, the Asian economies still performed better than oil-economies in terms of GDP per capita growth rate, regardless of the financial crisis witnessed in the region. In the fourth period, 2001 - 2007, growth performance still remained low and more volatile in the oil-rich countries compared with the East Asian countries. The sub-Saharan African region was worse-off compared to the other two regions in both growth performance and growth volatility.

These growth experiences of developing countries over the period clearly showed that the sub-Saharan African countries and the oil-rich economies have witnessed slower and more volatile growth compared to other developing countries in the Asian sub-region and the developed economies. Nigeria, in particular, as an oil-rich country experienced slow, negative and volatile growth prior to the recent structural reforms and financial restructuring.

IV. Methodology

In order to address the endogeneity and country-specific heterogeneity effects associated with the estimation of endogenous growth model, we compared four econometric approaches of estimating growth models: pooled-ordinary least squares; Fixed (within) effects, level generalized method of moments and instrumental variable generalized method-of-moments. The pooled ordinary least squares estimator does not correct for both individual effects and regressors endogeneity; the fixed effects estimator controls for individual

effects but ignores endogeneity; the level generalized method-of-moments estimator controls for measurement errors and endogeneity, but ignores unobservable individual effects; and the system instrumental variable generalized method-of-moments estimator which simultaneously controls for country-specific effects, measurement error and endogeneity. We have adopted the above four estimation methodologies because they have received the most extensive application in cross-country growth regression, particularly in the studies we have earlier reviewed. We estimated a dynamic endogenous growth specification of the form:

$$y_{it} = \alpha_0 y_{i,t-1} + \alpha_1 (y_{i,t-1} - y_{i,t-1}^T) + \beta' X_{it} + \eta_i + \xi_t + \varepsilon_{it} \quad (1)$$

Where:

y_{it} = Log of output per capita for country (i) at time (t)

y_{it}^T = The trend component of output per capita

$(y_{it} - y_{it}^T)$ = Output gap at the start of the period

X_{it} = The control Variables (Determinants of Growth)

η_i = Unobservable country-specific effects

ξ_t = Country invariant period-specific effects

ε_{it} = Disturbance term

In the IV-GMM estimation, the lagged components of the regressors are used as instruments. The differenced transformation of the terms is given by:

$$(y_{it} - y_{i,t-1}) - (y_{i,t-1} - y_{i,t-2}) = \alpha_0 (y_{i,t-1} - y_{i,t-2}) + \beta' (X_{it} - X_{i,t-1}) + (\varepsilon_{it} - \varepsilon_{i,t-1}) \quad (2)$$

So that;

$$\Delta y_{it} = \alpha_o \Delta y_{i,t-1} + \Delta X_{it} \beta' + \Delta v_{it} \quad (3)$$

A system-GMM estimator is used to simultaneously estimate the models in equations 1 and 2, under the following moment conditions¹⁷:

$$E[(y_{i,t-1} - y_{i,t-1}).(\eta_i + \varepsilon_{i,t})] = 0 \quad (4)$$

That the dependent variable is not correlated with the unobserved individual effects and the error term – no serial correlation.

$$E[(X_{i,t-1} - X_{i,t-1}).(\eta_i + \varepsilon_{i,t})] = 0 \quad (5)$$

That the explanatory variables are not correlated with the individual effects and the error term – no endogeneity bias.

$$E[(y_{i,t-1} - x).(\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \quad (6)$$

That the lagged dependent variable is not correlated with the instrumented error term.

$$E[(X_{i,t-s} - x).(\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \quad (7)$$

¹⁷ Developed in Arellano and Bover (1995) and Blundell and Bond (1998).

For $s \geq 2; t = 3, \dots, T$

That the explanatory variables are uncorrelated with the instrumented disturbance term¹⁸

V. Data

In the four estimations, we have used an unbalanced panel data with 5-year period averaging. The sample period covers from 1960 – 2007 for 100 countries. We considered 13 growth determinants with average GDP per capita growth rate as the dependent variable to be explained. The data were obtained from the World Bank Development Indicators (WDI), Penn World table and Geographical Information System (GIS). The data set used in both the pooled OLS and fixed effects estimations are in log-level form, while the GMM estimation used first-difference order and the instrumental variable GMM (IV-GMM) used the lagged components of the variables as instruments.

VI. Measurements and Definition of Variables

In formalizing the significance of initial condition in our model, we used the logarithm (log) of GDP per capita (1970) in country (i) and time (t). Human capital is measured as the ratio of total secondary school enrolment (regardless of age) to the population of the age group that officially corresponds to that level of education. As a measure of inflation, we used the log of annual

¹⁸ Arellano (2003) shows that the system-IV GMM estimator can still generate consistent estimated parameters even with a first-order serial correlation in the model.

percentage change in consumer price index as against GDP deflator used in some studies, because our measure allows for no identification restrictions to be imposed on GDP per capita and initial income for consistency of the model. We used lagged value of the measured inflation as instrument for inflation in the instrumental variable IV-GMM estimations.

Government consumption is measured as the ratio of government expenditure to GDP net expenditure on education, infrastructure and defence¹⁹. Institution is measured using the International Country Risk Guide (ICRG) index. The index is based on political, economic and financial indicators which include; government repudiation and expropriation, corruption, rule of law, quality of bureaucracy, accountability and transparency, democracy and good governance. Each country is scored a ranking from 1 to 7, where 7 is highest score representing the best quality of institution and 1 is the least score representing autocratic regimes and highly corrupt and inefficient governments. Openness is measured as the ratio of exports plus imports to GDP²⁰. As a measure of public infrastructure, we used the total mileage of tarred road network in a country and controlled for the country size and population by taking the ratio of the kilometers of tarred road network to country size (squared kilometer in land coverage) and total population.

¹⁹ These three categories of expenditure are positive for growth and cannot be associated with distortionary effects which are negatively correlated with growth.

²⁰ The measure of openness accounts for the relationship of openness to the logs of population and country size.

Output-gap is measured as the difference between potential and actual GDP at the start of the period²¹ while time dummies are used to capture exogenous shocks that is country-invariant but time-specific, as a measure of period-specific variable. We measured demography (EAP/POP) as the average growth of the ratio of economically active population (16-64 years) over total population for the sample period. Using the Geographic Information System (GIS) data series, geography is measured as population density around 100km of the coast, and ecology is measured as the percentage of a country's land in temperate climate. The natural resource variable is measured using a dummy classification of 1 for a net oil-exporting country and 0 for non-oil exporting countries²². The descriptive statistics of each variable are contained in Table 2.

VII. Results and Empirical Analysis

Table 3 shows the results of the four approaches. Generally, the system IV-GMM approach shows more reliable results because the model corrects for both endogeneity and individual heterogeneity effect simultaneously. However, it is important to add that, given that we have used period averages, the estimated coefficients are average estimates which are more appropriately interpreted using the model descriptive statistics.

²¹ Potential output is obtained using the band-pass filter developed in Baxter and King (1999).

²² This method has been adopted in many other studies which include Elbadawi (2006) and Lederman and Maloney (2007).

Table 2**Descriptive Statistics.**

Variable	Mean	SD	Minimum	Maximum
GDP Growth Rate	0.011	0.018	-0.052	0.076
Log Initial GDP	8.22	1.45	4.81	9.66
Initial Output gap	-0.006	0.017	-0.011	0.013
Average EAP/POP	0.006	0.003	-0.003	0.011
Log Sec. School	6.1	0.214	5.116	6.041
Openness	0.097	0.466	-1.334	1.114
War/Conflict	0.221	0.911	0.010	9.871
Log Inflation	1.996	1.248	-1.231	6.443
Institution	0.711	0.210	0.321	1.001
Log Government	3.112	0.468	0.984	4.112
Infrastructure	2.433	0.080	-0.234	1.576
Coastal Density [(ln (100 + X)	4.876	0.312	3.661	8.112
Climate [(ln(100 + X)]	3.889	0.244	3.456	7.976
Oil	0.062	0.267	0.000	1.000

Table 3: The Determinants of Growth: Using Pooled-OLS, Fixed Effects, Level-GMM and System GMM estimators

Model:	Pooled-OLS	Fixed Effects(With-in)	Levels-IV GMM	System-IV GMM
Catch-up Effects	(1)	(2)	(3)	(4)
Initial GDP per capita	-0.0156 (0.000)	-0.0351 (0.000)	-0.02101 (0.000)	-0.0062 (0.000)
Cyclical Output Gap		-	-0.3142 (0.000)	-0.3562 (0.000)
Demographic Gift				
EAP-POP growth (60-07)	3.4481 (0.000)	-	2.8441 (0.000)	3.0214 (0.000)
Structural, Stabilization and Institutional Factors				
Human Capital	-0.151 (0.000)	-0.0352 (0.422)	0.0602 (0.001)	0.1125 (0.000)
Openness	-0.0372 (0.044)	0.0303 (0.000)	0.0134 (0.438)	0.0268 (0.000)
Public Infrastructure	0.0031 (0.145)	0.0722 (0.148)	0.0271 (0.001)	0.0582 (0.000)
Inflation	-0.0234 (0.421)	-0.0267 (0.002)	-0.0166 (0.032)	-0.0311 (0.001)
Institution(ICRG)	0.0622 (0.002)	0.0713 (0.001)	0.0624 (0.000)	0.0857 (0.000)
Govt. Consumption	-0.0348 (0.052)	-0.0215 (0.452)	-0.0121 (0.511)	-0.0364 (0.013)
Real Exchange rate Overvaluation	-0.0674 (0.006)	-0.1025 (0.022)	-0.0482 (0.403)	-0.0530 (0.000)
Conflict				
Intl. War	0.0022 (0.508)	0.0042 (0.736)	-0.0032 (0.663)	0.0061 (0.528)
Geography and Ecology				
Population Density(Coast)	0.0282 (0.644)	-	0.0312 (0.731)	0.0311 (0.001)
Temperate Climate	0.0442 (0.000)	-	-0.0471 (0.000)	0.0314 (0.000)
Oil Dummy	-0.6420 (0.003)	-	-0.0324 (0.457)	-0.0021 (0.621)
External Shocks				
Term of Trade Shocks		0.0110 0.041		
Period Dummy				
1975 - 1979	-	-	-	-0.0287 0.001
1980 - 1984	-0.0203 (0.032)	-0.0420 (0.01)	-0.0213 (0.000)	-0.0362 (0.000)
1985 - 1989	-0.0211 (0.006)	-0.0023 (0.02)	-0.0130 (0.000)	-0.0128 (0.000)
1990 - 1994	-0.0239 (0.000)	-0.0422 (0.000)	-0.0357 (0.002)	-0.0422 (0.000)
1995 - 1999	-0.0442 (0.000)	-0.0034 (0.003)	-0.0370 (0.001)	-0.0236 (0.000)
2000 - 2007	-0.0231 (0.428)	-0.0033 (0.006)	-0.0245 (0.003)	-0.1021 (0.001)
Intercept	-0.3022 (0.003)	0.0251 (0.006)	-0.3221 (0.001)	-0.2404 (0.001)
No. Countries / Observations	100 / 872	100 / 872	100 / 872	100 / 872
Sargan Test			0.622	0.034
Serial Correlation Test				
First Order	0.012	0.003	(0.000)	(0.000)
Second Order	0.311	0.462	0.263	0.241

Note: Dependent variable is growth rate of GDP per capita. P-values are in parentheses.

Period 1975 - 79 was controlled for the pooled OLS, fixed effects and levels-IV GMM in order to fix the sample size for all regressions

The pooled-OLS estimation result which is contained in column (1) shows a positive correlation between economic growth and openness, temperate climate, human capital, demography and institutions and a negative correlation with initial income, inflation and government consumption. There is also a significant negative correlation between exchange rate over-valuation and economic growth. Infrastructure, war and population density around the coast show an insignificant positive correlation with growth suggesting that they are not necessarily important determinants of cross country long-term growth. The result also showed a very significant negative correlation between oil abundance and economic growth²³.

Column (2) shows the regression results using fixed (within) effects estimator. In this result, we find a negative convergence coefficient of around 4% compared to the 2% when using pooled-OLS - suggesting that (*ceteris paribus*) countries with lower initial per capita income grew a lot faster than predicted, when we control for differences amongst the countries (country-specific heterogeneity). Inflation rate, government consumption and exchange rate over-valuation are negatively correlated with growth, while institution (ICRG) was found to be positively and significantly associated with growth. The non-traditional variables, such as demography, ecology and geography are found to be unimportant in explaining growth in the model. The level GMM estimation (column 3) shows a negative convergence coefficient of around 2% while the

²³ Many studies have relied on this correlation to explain why some developing oil-rich countries have experienced poor and slowed growth.

system GMM (column 4) shows a coefficient of around 1%²⁴. In column 4 (system IV-GMM), the cyclical output gap variable has a significant negative coefficient suggesting that cyclical reversion effects are indeed present in panel data, while demography is positively correlated with growth.

Human capital, openness, public infrastructure and institution have shown positive correlation with growth in both the level and system IV-GMM estimation (columns 3 and 4). In the system IV-GMM, we found that all variables are significantly important for growth, including openness, compared to the level GMM where openness is not significant. In both estimations, institution is an important and significant determinant of long-term growth. Inflation, government consumption and exchange rate over-valuation are negatively correlated with growth, although in the level GMM, government consumption and exchange rate over-valuation are not significant. In the system IV-GMM all variables are significant with high coefficients and robust p-values suggesting that these variables could provide important explanation for the growth experience of developing oil-rich economies as suggested in the literature. We also found that in the level-GMM estimation, conflicts, population density around the coast and oil resource endowment are particularly not important for growth, even though they are negatively

²⁴ This contradicts a convergence speed of 10% reported in Caselli et al.(1996) using a level GMM estimation but in line with Loayza and Soto (2002) and El-badawi (2006), which show a convergence speed of less than 1% - suggesting that the number of years required to half the income difference between two growing economies solely due to convergence effect is indeed longer than predicted in previous studies, including Barro and Sala-i-Martins (2004), and Mankiw et al. (1992).

correlated with growth as predicted in the theory. Temperate climate is positively correlated with growth in both regressions. It is important to note that in both the level GMM and system IV-GMM models, the oil dummy, though negatively correlated with growth, is not significant.

The period-specific dummies all show negative correlation with growth suggesting that country invariant period-specific external shocks are detrimental to growth. In both estimations, the Sargan test of the null hypothesis that the instruments are not correlated with the error term suggests that the instruments used in the model are valid, while the serial correlation test suggests that there is no evidence of either first-order or second-order serial correlation in the system-IV-GMM estimation model.

VII.1 Sensitivity Analysis

Using Extreme Bound Analysis (EBA) as proposed in Leamer (1983) and developed by Levine and Renelt (1992) and Sala-i-Martin (1997), we test the robustness of the parameters estimated in the models²⁵.

The model follows a specification of the form:

$$Y = \beta_I I + \beta_M M + \beta_Z Z + \mu \quad (8)$$

Where

Y is GDP growth rate

I is a vector of growth determinants

²⁵A growth determinant is robust if its statistical significance in the growth regression is not conditional on the choice of information set - for example on whether other variables are added to or excluded from the regression model.

M represents the combination of growth determinants for the sensitivity test

Z is the vector of other control variables included in the model

$\beta_1, \beta_m, \beta_z$ are parameters to be estimated.

We examine the sensitivity of the coefficient β_m on the various combinations of Z . For each M -variable we run a basic bivariate regression without including any Z -variables. We add from one of three of the Z -variables in every possible combination into the equation and compute the 'extreme bounds' of β_m from the estimated β_m . The upper extreme bound is the highest (maximum) estimated coefficient of $\beta_m + 2$ multiplied by its standard error

$$\beta_m^{\max} + 2\sigma(\beta_m^{\max})$$

And the lower extreme bound is the lowest (minimum) estimated coefficient of β_m minus 2 multiplied by its standard error

$$\beta_m^{\min} - 2\sigma(\beta_m^{\min})$$

An M -variable is considered as a robust growth determinant if all estimated β_m are statistically significant and the extreme bounds are of the same sign.

We constructed a cumulative distribution function (CDF) based on the non-weighted normality assumption.

We estimated the baseline model which contains a combination of 3 fixed I -variables and M -variable with GDP per capita growth rate as the dependent variable. We combine the group of 17 Z -variables in sets of 3 variables with

each M -variable and the 3 I -variables to estimate a total of $M = \frac{21!}{3!18!}$ models in this analysis. The results are contained in Table 4.

VII.2 The Result

Using the Leamer approach²⁶, all the (M)-variables failed the robustness test except government expenditure (Column 5). Using Sala-i-Martin (1997) approach, we found that more variables are robust at both 99% CDF (0) and 95% level of significance. Column (7) shows the normal non-weighted cumulative distribution function of the estimated β_m coefficient for all (M)-variables. If we use 99% CDF(0) we find that initial income and real exchange rate over - valuation and institution are robust, even though the variables failed the Leamer's EBA robustness test. If we use 95% CDF (0), we find that period specific shocks (1985-89 and 1990-94) are robust; however they are not significant in at least 95% of the regression - which is the second condition- and therefore failed the robustness test.

In all, all the variables failed the sensitivity test, except for initial income institution and real exchange rate over-valuation. This suggests that growth estimation results should be interpreted with caution because they vary significantly according to the specification of the growth models. The significance of a variable is dependent on the combination of other variables in

²⁶In the Leamer (1983) variant, a variable of interest (M) is robust, if the lower and upper extreme bounds are of the same sign.

the model. However, given that we have found that initial income, institution and real exchange rate over-valuation are robust in the sensitivity analysis test, they represent key factors that explain GDP per capita growth rate in an economy. The initial income variable is only important in the sense that technological progress and total factor productivity needs to be enhanced in order to drive economic growth faster to its steady-state equilibrium. The real exchange rate component requires that prices are competitive and transparent to encourage real export sector growth and for countries like Nigeria, non-oil export growth. It is confirmed in this analysis that central to fast and positive growth is strong and efficient political and economic institutions.

Table 4: Sensitivity Test Results: Extreme Bound Analysis

M - variables (1)	(2)	β_m (3)	Standard Error (4)	Extreme Bounds (5)	% of Significance (6)	CDF (0) (7)	Robustness/Fragile (8)
Initial Income	Baseline	-0.043	3.056				
	Maximum	-0.014	2.239	4.464	97.63	0.100	Robust
	Minimum	-0.026	2.624	-5.674			
Output Gap	Baseline	-0.126	2.347				
	Maximum	-0.046	2.672	5.298	76.24	0.8872	Fragile
	Minimum	-0.198	2.110	-4.418			
Demography (EAP / POP)	Baseline	0.065	3.442				
	Maximum	0.524	2.675	5.874	78.87	0.8691	Fragile
	Minimum	0.026	2.442	-4.859			
Human Capital	Baseline	0.661	1.789				
	Maximum	1.224	1.447	4.118	80.11	0.9121	Fragile
	Minimum	0.173	2.523	-4.873			
Openness	Baseline	0.326	3.116				
	Maximum	0.781	2.871	6.523	70.23	0.862	Fragile
	Minimum	0.057	2.446	-4.835			
Public Infrastructure	Baseline	0.067	1.897				
	Maximum	0.204	1.884	3.972	23.44	0.9026	Fragile
	Minimum	0.007	2.664	-5.321			
Inflation	Baseline	-0.061	3.481				
	Maximum	-0.024	3.261	6.546	87.66	0.9079	Fragile
	Minimum	-0.076	2.886	-5.848			
Institution	Baseline	0.074	2.881				
	Maximum	0.128	2.211	4.550	98.62	0.9988	Robust
	Minimum	0.023	2.863	-5.703			
Government Consumption	Baseline	-0.072	2.472				
	Maximum	-0.022	2.749	5.476	80.44	0.9162	Fragile
	Minimum	-0.110	3.462	6.814			
Real Exchange rate O / V	Baseline	-0.068	1.872				
	Maximum	-0.026	2.114	4.202	98.75	0.9995	Robust
	Minimum	-0.035	2.348	-4.731			

Dependent variable is growth rate of per capita GDP

The baseline β_m is the estimated coefficient from the regression with the M - variables and the I - variable only (without any Z - variable)

The Robust / Fragile designation indicates whether the variable of interest is robust or fragile

The % of significance indicates whether the estimated β_m is significant in at least 95% of the regressions

CDF (0) follow Sala-i-Martin (1997) calculations - with non-weighted normal distribution assumption

Table 4: Sensitivity Test Results: Extreme Bound Analysis (Cont.)

M - variables (1)	(2)	β_m (3)	Standard Error (4)	Extreme Bounds (5)	% of Significance (6)	CDF (0) (7)	Robustness/Fragile (8)
Intl. War	Baseline	-0.003	2.664				
	Maximum	-0.001	2.872	5.743	10.38	0.847	Fragile
	Minimum	-0.012	3.114	-6.24			
Coastal Pop. Density	Baseline	-0.016	4.225				
	Maximum	0.062	3.447	6.956	44.63	0.8941	Fragile
	Minimum	0.004	2.886	-5.768			
Temperate Climate	Baseline	0.056	4.416				
	Maximum	0.164	3.427	7.018	71.88	0.8676	Fragile
	Minimum	0.024	3.208	-6.44			
Oil Dummy	Baseline	-0.165	3.611				
	Maximum	-0.114	3.862	7.81	16.78	0.8961	Fragile
	Minimum	-0.186	3.276	-6.738			
Terms of Trade	Baseline	0.007	0.345				
	Maximum	0.016	0.274	0.564	12.9	0.9072	Fragile
	Minimum	0.002	0.117	-0.232			
Time Dummy (75 - 79)	Baseline	-0.032	0.118				
	Maximum	-0.014	0.151	0.288	60.87	0.7963	Fragile
	Minimum	-0.046	0.096	-0.238			
Time Dummy (80 - 84)	Baseline	-0.012	0.765				
	Maximum	-0.006	0.221	0.436	78.8	0.9096	Fragile
	Minimum	-0.012	0.187	-0.399			
Time Dummy (85 - 89)	Baseline	-0.064	0.087				
	Maximum	-0.023	0.091	0.159	78.23	0.9572	Fragile
	Minimum	-0.046	0.096	-0.238			
Time Dummy (90 - 94)	Baseline	-0.064	0.076				
	Maximum	-0.036	0.089	0.142	77.23	0.9616	Fragile
	Minimum	-0.086	0.049	-0.184			
Time Dummy (95 - 99)	Baseline	-0.006	0.093				
	Maximum	-0.003	0.071	0.139	47.64	0.8352	Fragile
	Minimum	-0.01	0.077	-0.164			
Time Dummy (00 - 07)	Baseline	-0.021	0.063				
	Maximum	-0.012	0.055	0.098	55.87	0.9244	Fragile
	Minimum	-0.038	0.064	-0.166			

Dependent variable is growth rate of per capita GDP.

The baseline β_m is the estimated coefficient from the regression with the M - variables and the I - variable only (without any Z - variable)

The Robust / Fragile designation indicates whether the variable of interest is robust or fragile

The % of significance indicates whether the estimated β_m is significant in at least 95% of the regressions

CDF (0) follow Sala-i-Martin (1997) calculations - with non-weighted normal distribution assumption

VIII. Conclusion and Policy Recommendations

In this paper we have looked at empirical issues relating to the estimation of cross-country growth regression models and the policy implications following from the estimated results. We investigated whether the factors that have been attributed to the slow growth performance of developing sub-Saharan African countries (within the context of a global growth model) could really account for the slow growth in the sub-region. We particularly emphasized the problems in pooling together a heterogeneous sample of countries in a cross-country growth regression without controlling for the effects of such heterogeneous intercepts in the general outcomes of the regression results. These, to a great extent, will bias the generalization of the outcomes of such heterogeneous clustering of different countries if appropriate error correction mechanisms are to be included in the models.

Using a panel data approach, we identified four variants of panel estimation procedures of cross-country growth model in line with existing literature. In addition to the well known and theoretically supported growth determinants in Levine and Renelt (1992) and Barro and Sala-i-Martin (2002), we have adopted other intertemporal growth correlates in Loayza and Soto (2002) and El-badawi (2006). The four estimators adopted include: the pooled ordinary least squares estimator which ignores both individual effects and regressors endogeneity; the fixed effects estimator which controls for individual effects but ignores endogeneity; the level generalized method-of-moments estimator which controls for measurement errors and endogeneity, but ignores

unobservable individual effects; and the system instrumental variable generalized method-of-moments estimator which simultaneously controls for country-specific effects, measurement error and endogeneity.

We observed that while the results of growth regressions have varied significantly amongst the various modeling approach, the instrumental-variable GMM estimation approach provides more consistent and unbiased parameters of long-run growth determinants. We found that, in all specifications adopted in the study, initial income, institution and real exchange rate over-valuation are robust determinants of long-run growth differentials amongst countries. These findings enable us to conclude that growth has been slow in sub-Saharan African principally, because of low income, weak institutions and over-valued exchange rate.

All other variables that have been attributed to the growth dilemma of developing countries can be connected, one way or the other, to these three channels. Issues, such as, corruption, poor infrastructure, bureaucracy, conflicts and government expenditure could all be captured in poor and weak institutions. Therefore, developing sub Saharan African countries can reverse their poor growth trends by evolving a strong and efficient institutional and legal framework. Issues, such as, inflation “dutch disease”, black market premium, balance of payments disequilibrium, terms of trade deficits and export growth could all be channeled through optimal real exchange rate valuation. Exchange rate over-valuation discourages domestic export and

encourages import, thereby making the developing countries persistently import dependent at the detriment of the growth of the domestic real sector such as manufacturing and agriculture.

REFERENCES

- Acemoglu D, S Johnson and J A Robinson (2001): 'The Colonial Origins of Comparative development - An Empirical Investigation', *American Economic Review*. Vol. 91, No. 5. pp 1369 - 1401.
- Acemoglu D., S Johnson, J A Robinson and Y Thaicharoen (2003): 'Institutional Causes, Macroeconomic Symptoms - Volatility, Crises and Growth', *Journal of Monetary Economics*, Vol. 50. pp 49 - 123.
- Arellano, M. (2003): 'Panel Data Econometrics', Oxford University Press.
- Arellano, M. and O. Bover. (1995): 'Another Look at the Instrumental-Variable Estimation of Error-Component Models', *Journal of Econometrics*, vol. 68, pp 29-51.
- Barro R. J. (1991a): 'Economic Growth in a cross section of countries.' *Quarterly Journal of Economics*, vol.106, pg 407-433.
- Barro R. J. (1996): 'Democracy and Growth.' *Journal of Economic Growth*, vol.1 (4), pp 449-486.
- Barro Robert J and Xavier Sala-i-Martin (2002): 'Determinants of Growth - A Cross-Country Empirical Study'; McGraw - Hill Publishers, New York, USA.
- Barro Robert J and Xavier Sala-i-Martin. (2004): 'Economic Growth'; Second Edition, Cambridge, MIT Press, USA.
- Baxter M. and R. G. King (1999): 'Measuring Business Cycles. Approximate band-pass filters for Economic Time Series.' *Review of Economic and Statistics*, vol. 81, pp 575-593.
- Benhabib J. and M. M. Spiegel (1994): 'The Role of Human Capital in Economic Development: Evidence from Aggregate Cross-Country Data.' vol. 34(2), pp 143-173.

- Bernard A. and S. Darlauf, (1996): 'Interpreting Test of Convergence Hypothesis.' *Journal of Econometrics*, vol. 71(1-2), pp 161-173.
- Bliss C. (1999): 'Galton's Fallacy and Economic Convergence.' *Oxford Economic papers*, vol. 51, pp 4-14.
- Bloom D. and J. Sachs (1998): 'Geography, Demography and Economic Growth in Africa.' mimeo, Harvard Institute for International Development.
- Blundell R. and S. Bond (1998): 'Initial Conditions and Moment Restrictions in Dynamic Panel Data Models.' *Journal of Econometrics*, vol. 87(1), 115-143.
- Bosworth B. and S. Collins (2003): 'The Empirics of Growth: An Update (with discussion)'. *Brookings Papers on Economic Activity*, } vol. 2, pp 113-206.
- Brock W. and S. Daulauf (2001); 'Growth Empirics and Reality'. *World Bank Economic Review*, vol 15(2), pp 229-272.
- Bulli S. (2001): 'Distribution Dynamics and Cross-Country Convergence: New Evidence.' *Scottish Journal of Political Economy*, vol. 48, pp 226-243.
- Caselli F., G. Esquivel and F. Lefort, (1996): 'Reopening the Convergence Debate: A New Look at Cross Country Growth Empirics.' *Journal of Economic Growth*, vol. 1(3), pp 363-389.
- Collier P. and J. Gunning (1999): 'Why Has Africa Grown Slowly?' *Journal of Economic Perspectives*, } vol.13 (3), pp 3-22.
- Dhonte P., R. Bhattacharya and T. Yousef, (2000): 'Demographic Transition in the Middle East: Implications for Growth, Employment and Housing.' *IMF Working Paper No. WP/00/41*, International Monetary Fund, Washington DC.

- Dollar D. and A. Kraay (2002): 'Growth is Good for the Poor.' *Journal of Economic Growth*, vol.7 (3), pp 195-225.
- Dornbusch R., I. Goldfajn and R. Valdes (1995): 'Currency Crises and Collapses.' *Brooking Papers on Economic Activities*, pp. 219-294.
- Durlauf S. (2001). A Manifesto for a Growth Econometrics.' *Journal of Econometrics*, vol. 100(1), pp 65-69.
- Durlauf S. N., P.A. Johnson and J.R.W. Temple, (2004): ' Growth Econometrics.' *Vassar College Economics Working paper*, No. 61, USA.
- Easterly, W., R. Islam and J. Stiglitz, (2000): 'Shaken and Stirred, Explaining Growth Volatility', *Annual Bank Conference on Development Economics*, April 2000, World Bank, Washington DC, USA.
- Easterly, W. (2001): 'The Lost Decades: The Developing Countries Stagnation in spite of Policy Reform.'. *Journal of Economic Growth*,} vol.9, pg.135-157.
- Eastwood R.K. and A.J. Venables (1982): 'The Macroeconomic Implications of a Resource Discovery in an open Economy.' *Economic Journal*, vol. 92, pp 285-299.
- Elbadawi I. A. (2006): 'Reviving Growth in the Arab World.' *Economic Development and Cultural Change*, pp 293-326.
- Galor O. (1996): 'Convergence? Inferences from Theoretical Models'. *Economic Journal*, vol. 106, pp 1056-1069.
- Gallup J. L. and J. Sachs (1998): 'Geography and Economic Growth'. World Bank Annual Conference on Development Economics, April 20-21, Washington DC.

Leamer, Edward E. (1983): 'Lets take the Con out of Econometrics'. *American Economics Review*, vol 73, pp 31-43.

Lederman D. and W.F. Maloney (2007): 'Trade Structure and Growth in; Natural Resources, Neither Curse nor Destiny, Stanford University Press and World Bank.

Levine R. and D. Renelt (1991): 'Cross Country Studies of Growth and Policy: Methodological, Conceptual and Statistical Problems.' World Bank Working Paper No. 608.

Levine R. and D. Renelt (1992): 'A Sensitivity Analysis of Cross Country Growth Regressions.' *American Economic Review*, vol. 82(4), pp 942-963.

Loayza N. and R. Soto (2002): 'The Sources of Economic Growth: An Overview.' In *Economic Growth: Sources, Trends and Cycles*, ed. Central Bank of Chile.

Lucas R. (1988): ' On the Mechanics of Economic Development.' *Journal of Monetary Economics*, vol. 22(1), pp 3-42.

Makdisi S., Z. Fattah and I. Limam (2000): 'Determinants of Growth in the Arab World.' Arab Planning Institute, *API-Working Paper Series* No. 0301. Kuwait.

Mankiw N. G., D. Romer and D. Weil (1992): 'A Contribution to the Empirics of Economic Growth' *Quarterly Journal of Economics*, vol. 107(2), pp 407-437.

- Rodrik, D. (1999): 'Where did all the Growth go? External Shocks, Social Conflict and Growth Collapse', *Journal of Economic Growth*, vol.4, (4), pg 385-412.
- Rodrik, D. (2005): 'Why we learn nothing from Regressing Economic Growth on Policies' www.ksghome.harvard.edu
- Rodrik D. (ed.) (2003): 'In Search of Posterity; Analytic Narratives on Economic Growth.' Princeton - Princeton University Press.
- Romer P. (1986): 'Increasing Returns and Long-run Growth.' *Journal of Political Economy*, vol. 94(5), pp 1002 - 1037.
- Romer P. (1990); 'Human Capital and Growth: Theory and Evidence.' Carnegie-Rochester Series on Public Policy, vol. 32, pp 543-573.
- Sachs, J.D. and A. Warner (1997): 'Fundamental sources of Long-run Growth', *American Economic Review*, Papers and Proceedings.
- Solow R. (1956): 'A Contribution to the Theory of Economic Growth.' *Quarterly Journal of Economics*, vol 70(1) pp 65-94.
- Sala-i-Martin X. (1997): 'I just Ran 2 Million Regressions.' *American Economic Review*, vol. 87(2), pp 178-183.
- Summers R., A. Heston and B. Aten (2007): 'Penn World Table Version 6.1' *Center for International Comparisons*. University of Pennsylvania (CICUP). July, 2005.
- Swan T. (1956): 'Economic Growth and Capital Accumulation.' *Economic Record*, vol. 32, pp 334 -361.

- Temple J. (2003): 'The Long-run Implications of Growth Theories.' *Journal of Economic Survey*, vol. 17(3), pp 497-510.
- Wacziarg R. and K. Welch (2003): 'Trade Liberalization and Growth: New Evidence.' *NBER Working paper* No. 10152.
- Williamson J. G. and T. Yousef (2002): 'Demographic Transition and Economic Performance in the Middle East and North Africa.' In *Human Capital: Population Economics in the Middle East*, ed., Ismail Siragelin, pp 16-36, American University, Cairo.
- World Bank (2008): *World Development Indicator and Statistical Bulletin*, World Bank, Washington DC, USA.
- Yucel M. and S. Brown (2004): 'The Effect of High Oil Prices on Today's Texas Economy.' *Southwest Economy*, Issue 3, Sept. /Oct. Federal Reserve Bank of Dallas, TX, USA.