Oil and Growth in Africa: A Comparative Analysis

Afeikhena JEROME
African Peer Review Mechanism Secretariat
P. O. Box 1236
Halfway House
Midrand 1685
E-mail: AfeikhenaJ@Nepad.org

Dipo BUSARI
United Nations African Institute for Economic
Development and Planning (UNIDEP)
BP. 3186 CP 18524
Dakar, Senegal
E-mail: dbusari@unidep.org

and

Senyo ADJIBOLOSOO
Fermanian School of Business
Point Loma Nazarene
San Diego, CA
E-mail: SenyoAdjibolosoo@pointloma.edu

Abstract

Drawing from neoclassical and endogenous growth theories, this paper appraises the impact of oil on growth in seven major Sub-Saharan African oil exporting countries. It uses a balanced panel data structure over the period 1987 to 2005. The results indicate that initial level of GDP, investment rate and terms of trade have a significant and positive impact of on the growth process while volatility in crude oil price had a negative effect on growth in the sampled countries. Although, the results are not very robust, the Solow model accounted for important features of cross-country growth differences in the sampled countries.

Key Words: **Oil, Growth, Sub Saharan Africa.**
***JEL* Classification:** **O49**

1. Introduction

Africa has experienced strong economic growth rates in recent years. In sharp contrast with the 1980s and early 1990s, economic performance has improved considerably, and some clear "high performers" are beginning to emerge. Since the late 1990s, 14 African countries have had average growth rates of above 5 percent and almost 20 countries are currently witnessing more than 5 per cent GDP growth and for the first time in 25 years, inflation has fallen to less than 10 percent.

Arguably, no other continent has witnessed so varied a growth process in the last three decades like Africa despite recent progress. The fortune of most of the countries in the continent has generally followed the trend in the market for their primary exports. Since the early 1980s, growth performance has been quite dismal culminating in the adoption of several reform measures. The literature is littered with mixed results on the impact of the several reform measures adopted by the various countries (see, for instance, a detailed report by Devarajan *et al*., 2001). A general observation is that the period 1980 to 1996 has been a period of poor growth performance for most Sub Saharan African (SSA) countries (see Lawrence *et al.* 1994). The period since 1998 seems to have witnessed a resumption of growth in the Africa. Analysts are of the opinion that there are two main factors behind this renewed growth in Africa. First is the resumption of growth in some so called "success stories" such as Botswana, Ghana and Mauritius and the second factor being the growth recorded by major oil and gas exporters on the continent.

Several cross country studies have attempted to examine the growth process in developing countries and specifically account for the so called 'African dummy'. The results are as varied as the number of studies[i]. However, the broad argument is that Africa failed to seize several development opportunities and did not initiate appropriate policy measures at the appropriate time to deal with the economic decline even long before it became manifest. However, since the late 1990s, the growth rate of SSA is once again steadily rising, thanks to the favorable international oil market which has led to favorable terms of trade. Improved governance is also seen as a major contributor to this renewed growth as it has helped attract foreign investment (Basu and Srinivasan, 2002). However, a critical examination of the flow of foreign investment in Africa reveals that much of it has gone into the extractive mineral sub sector (particularly oil and gas) and telecommunication sub-sector.

Africa is currently in the midst of an oil boom. Over the last decade, the Atlantic Ocean off the coast of Western and Southern Africa has become one of the most promising oil exploration areas in the world. A convergence of interests between African governments, multinational oil companies, International Financial Institutions and Northern governments is propelling the rush to exploit Africa's oil reserves. Six countries in the region, namely; Nigeria, Angola, Gabon, Equatorial Guinea, São Tome, Cameroon and, more recently, Chad and Sudan have become key players in the world's energy stake and more are likely to join their ranks in the near future. However, the economic record and livid experience of mineral-exporting countries has generally been disappointing. Twelve of the world's 25 most mineral dependent states, and six of the most oil dependent, are

classified by the World Bank as Highly Indebted Poor Countries. When taken as a group, all "petroleum rich" less developed countries has witnessed severe erosion in the living standards of their populations and many of them currently rank in the bottom one-third of the United Nations Human Development Index. In addition to poor growth records and entrenched poverty, they are characterized by high level of corruption and a low prevalence of democratization, all of which act to create high risks of civil war.

Against this background, this study seeks to examine the impact of crude oil exportation on the growth process of major oil producing countries of SSA over the period 1987 to 2005. The findings from the study consistently indicate a significant and positive impact of initial level of GDP and investment rate on the growth process of the sampled countries.

The study observed a positive impact of growth in terms of trade on real per capita output growth and a negative effect of volatility in crude oil price on growth performance of the selected countries. The remaining sections of the paper are organized as follows. Section 2 appraises some stylized facts on growth in Africa while section 3 undertakes a comparative analysis of growth performance amongst selected major oil producing regions. Section 4 presents the model adopted in the study, while section 4 discusses estimation issues. The study is concluded in section 5.

2. Some Stylized Facts on Growth in Africa.

Sub-Saharan Africa is clearly enjoying its best period of sustained growth in recent years. In the decade to 1996, the African economy grew by 2.2% a year; in the ten years to 2006 annual growth averaged more than 5%, implying that real incomes per head are now rising at over 2% annually after two decades of decline. Growth for the region as a whole reached an estimated 5.3 percent in 2006 and the protracted economic boom is poised to accelerate from 6.1% in 2007 to 6.8% in 2008 according to IMF's forecast in its October 2007 edition of World Economic Outlook.

While the growth acceleration since 2002 reflects largely the coming on stream of new production facilities in the region's oil exporting countries such as Angola and Nigeria, there is more to the African boom than the upsurge in commodity prices. The regional growth did take off in the wake of the commodity price boom, buoyed, in part, by global price increases in other primary export commodities. This worldwide rise of commodity prices has been engendered in large part by the rapid growth of Asian developing countries, especially China and India.

On average, the oil producing countries of the region had a combined growth rate of 7.4 % from 1996-2005, buoyed by the rise in the world price of oil as shown in Table 1. Yet, most other non-oil producing countries are also growing strongly and outperforming historic trends. Excluding the oil-rich countries, the fastest growing group of African countries (totaling 18 countries) has had an average growth rate of at least 4.0 percent.

These countries host about 35 percent of the region's people. By contrast, the 21 slowest-growing economies in Africa have seen less than 3.6 percent growth on average, with some having near zero or negative growth. These countries, many either engaged in conflict or having recently emerged from conflict, account for 36 percent of the region's population.

Table 1: Africa GDP Growth Rates, 1996 – 2005
(Compound annual average)

Oil exporters (29% of population)		***Countries Growing at more than four percent*** (35% of population)		***Countries growing at less than four percent*** (36% of population)	
Equatorial Guinea*	20.9	Mozambique	8.4	Zambia	3.6
Angola*	7.9	Rwanda	7.5	Guinea	3.6
Chad	7.8	Cape Verde*	6.5	Niger	3.5
Sudan	6.4	Uganda	6.1	Togo	3.3
Nigeria	4.0	Mali	5.7	Malawi	3.2
Congo, Rep.*	3.5	Botswana*	5.7	South Africa*	3.1
Gabon *	1.7	Ethiopia	5.5	Sao Tome and Principe	3.1
		Tanzania	5.4	Swaziland*	2.8
		Mauritius*	4.9	Kenya	2.8
		Mauritania	4.9	Eritrea	2.2
		Benin	4.8	Lesotho	2.2
		Ghana	4.7	Comoros	2.0
		Senegal	4.6	Seychelles*	2.0
		Burkina Faso	4.6	Cote d'Ivoire	1.5
		Gambia, The	4.5	Burundi	1.2
		Cameroon	4.5	Sierra Leone	1.1
		Namibia	4.0	Central African Rep.	0.9
				Guinea-Bissau	0.6
				Congo, Dem. Rep.	0.0
				Zimbabwe	-2.4
Unweighted average	**7.4**	5.5		2.1	
Median	6.4	5.1		2.7	

Note: Asterisk (*) denotes Middle Income Country.
Source: Adapted from World Bank Africa Development Indicators 2006.

Despite these positive signs, Africa is not growing rapidly enough to substantially reduce income poverty. The recent improvements are making only slow inroads in reducing poverty and reversing the prolonged divergence between SSA and other regions of the world. Despite the recent up tick, investment measured as a share of GDP is no higher than it was in the early 1990s. Foreign direct investment in Sub-Saharan Africa (SSA), other than in oil-exporting countries and South Africa, is still low, although South Africa has become a growing source of inward investment flows to other parts of SSA, and investment from China and India is picking up. Private sector development in SSA continues to be deterred not only by the costs of doing business, which range from administrative complexities to corruption and cumbersome legal systems, but also by the expense of such critical business services as energy.

Table 2: Baselines and Targets for Growth and the MDGs

	Baseline Data Year	Latest Available Data/Year	Goal/Year
Growth			
GPD Growth (%)	2.8 (1990)	5.5 2005)	7 (2010)
Millennium Development Goals (subset of indicators)			
Goal 1. Eradicate Poverty			
Population below the poverty line (%)	44 (1990)	46.4 (2001)	38 (2015)
Goal 2. Achieve Universal Primary Education			
Primary Completion Rate (% of relevant age group)	43 (1990)	58 (2004)	100 (2015)
Goal 3. Promote Gender Equality			
Ratio of Girls to Boys in Primary and Secondary School	78.4 (1991)	86.5 (2004)	100 (2015)
Women in Parliament (%)	9 (1990)	15 (2005)	-
Goal 4. Reduce Child Mortality			
Under Five Mortality Rate (per 1000)	161 (1990)	149 (2004)	54 (2015)
Goal 5. Improve Maternal Health			
Maternal Mortality Rate (per 100,000)	870 (1990)	826 (2005)	218 (2015)
Goal 6. Halt and begin to reverse the incidence of HIV/AIDS and Malaria			
HIV Prevalence among Adults Age 15-49 (%)	0.5 (1990)	6 (2005)	-
Annual Malaria Mortality (out of 100,000)	-	199 (2000)	-
Goal 7. Ensure Environmental Sustainability			
Forested Land area (% of total land area)	6.9 (1990)	6.3 (2005)	-
Proportion of people with access to Safe Water (%)	53 (1990)	65 (2004)	76 (2015)
Proportion of people with access to Sanitation (%)	29.8 (1990)	37 (2004)	66 (2015)
Goal 8. Develop a Global Partnership for Development			
Debt service (% of Exports)	13.5 (1990)	7.9 (2004)	-

Data source: World Bank WDI database and UN Millennium Development Goals Report, 2006

Although there are encouraging signs of sustained efforts by governments which have contributed to better progress on the MDGs, the region, together with Asia still is not on track to reach most of the MDGs by 2015 as shown in Table 2. There is, however, substantial variation among countries, both with respect to the level of attainment of the MDGs and with respect to the pace of progress. Mauritius has met four goals, Botswana has met three and will likely meet one more, and South Africa has met three. Among other countries, on current trends nine will meet two MDGs, 13 will meet only one, and 23 will not meet any.

Analytic work on the growth challenge in Africa shows that to move from the current 4-5 percent trajectory to high speed growth of 7 percent or more will require significantly increasing the pace of economic and institutional reforms and boosting investment to break the physical constraints— such as poor energy supply and transport— to private investment in export oriented industries and services. Better ideas and more investments will both be needed to help growth leaders emerge. And for the oil and mineral exporters, the crucial challenge is to avoid the boom-and-bust cycles of the past by investing their windfall gains properly.

3. Oil and Growth: Some Comparatives[ii].

Towards the end of the second half of the 1990s, the world witnessed resurgence in international price of crude oil (See Figure 1). The price of Crude which was about $20 in 1998 started an aggressive upward match which is still climbing by 2007. Analysts have attributed this phenomenal to the impressive growth in China, Indian and similar fast growing economies, the insatiable appetite of American for crude, and the relatively fixed supply of the product itself. With this growth in price of crude, the terms of trade of oil exporting African countries improved dramatically. Hitherto, many of these countries were experiencing balance of payment problems coupled to the external debt burden. This led to severe constraints on growth.

Figure 1

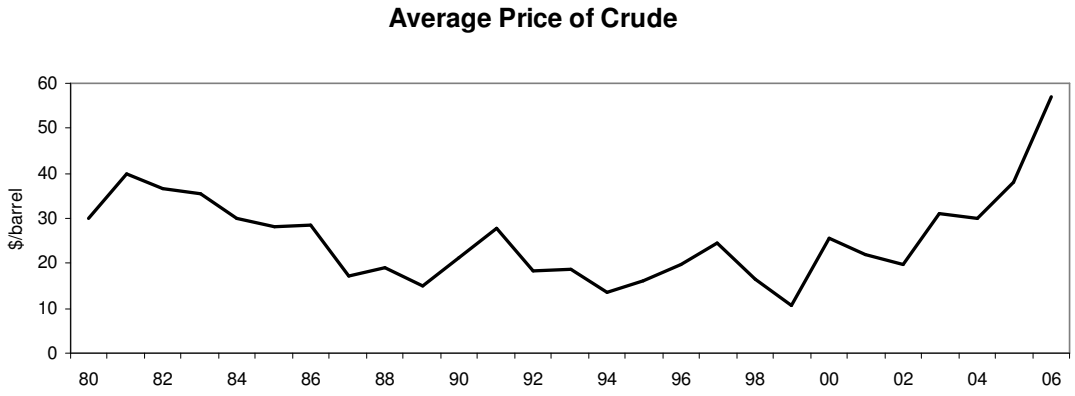


Figure 2

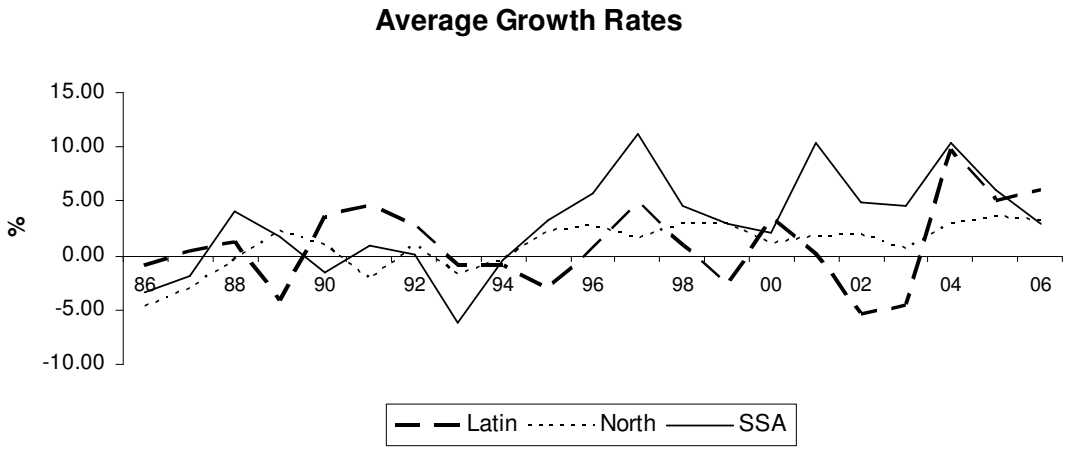
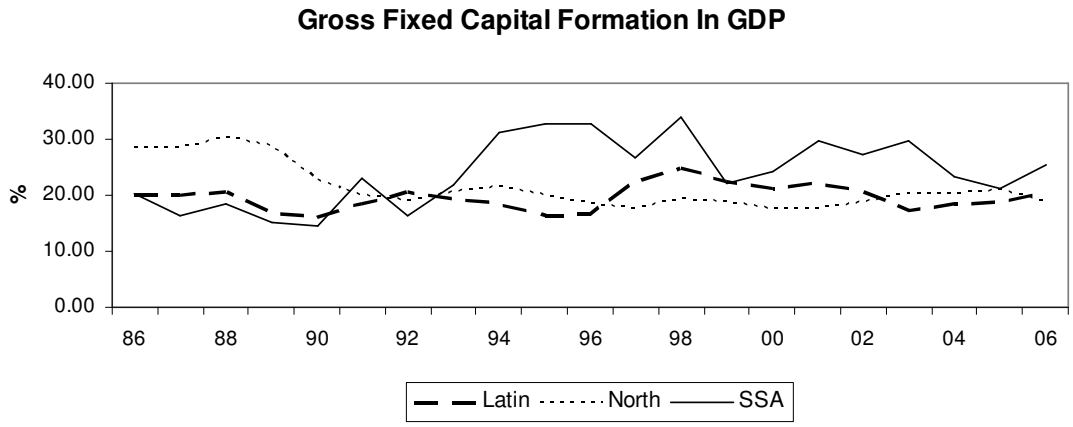


Figure 2 shows the growth performance of selected oil exporting countries in different continents. For Latin America (Latin) we have Mexico and Venezuela, For North Africa (North) we have Algeria, Egypt and Libya, while for Sub Saharan Africa (SSA) we have Angola, Chad, Congo Brazzaville, Equatorial Guinea, Gabon, Nigeria and Sudan. Figure 2 shows similar pattern in the growth process. Over the period 1986 to 1996, the growth rates were marginal and highly variable. This was when the international price of crude was relatively below $20per barrel. Since 1994, the growth rates of these countries started rising as their terms of trade improved. Figure 2 shows that oil exporting SSA enjoyed the highest growth when compared to other sampled oil producing regions. Tentative correlation shows some association between this observed growth in SSA oil exporting countries and the improved price of crude. One way to look at this relationship between the price of crude and growth in SSA countries is to examine the nature of gross fixed capital formation in the different regions. Unfortunately, the severe limitation of data could not allow for more disaggregated analysis of the issue.

Figure 3 indicate that over the period 1986 to 1994, gross fixed investment in the oil exporting countries of SSA was lower than in other oil exporting regions. However, when the price of oil started to rise, gross fixed capital formation rose in SSA more than in other oil exporting countries. There are several reasons for this. First is the entrance of countries like Chad and Sudan into the oil exporting club. Second was the rapid expansion in the upstream sector in many of the countries such as Nigeria and Angola which make them to rank as top oil producers in Africa. The oil sector attracted a lot of investment which tend to drive growth in these countries. Thus, the favorable price in crude makes investment in the sector attractive.

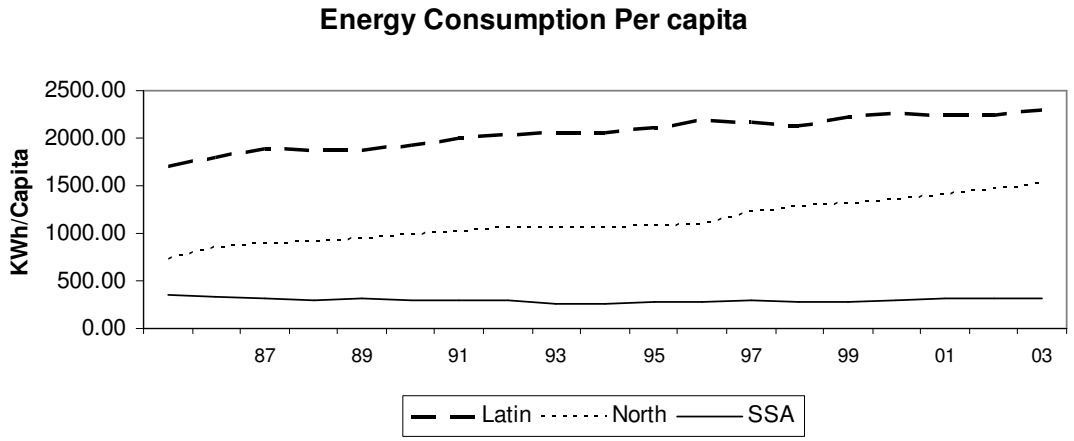
Figure 3



It will be very informative to compare human development indices in the different sampled regions over the sampled period to examine how the growth process has translated to improvement in welfare. The general dearth of relevant time series on many of these indices is a major limitation. However, we shall use some proxies which we consider useful. First we examine energy consumption (per capita) in the sampled regions. Figure 4 shows the amount of energy consumed in the different regions. It is clear that SSA countries are way far below the average consumption of other oil exporting countries. The amount of energy used in creating wealth (energy intensity) is increasingly being used as a measure of real growth. While the trend is broadly upward moving in other oil exporting regions, that in Africa seems to be stagnant if not on the decline.

Furthermore, while life expectancy is about 69 years on the average in 1987 for the Latin American group, it was 66 years for the North group and 49.9 years for the SSA group. By 1998 when the oil market started to make some gains, life expectance in the Latin group had risen to about 72 years and about 70 for the North group. For the SSA group it average 50 years. By 2006, the figure has not changed much for the other countries but has actually declined for the SSA group to 48 years. Infant mortality rate is the highest for the SSA group with Chad and Equatorial Guinea toping the list and the Latin group having the lowest rates. By 2005, adult literacy rate in the Latin group is about 91 percent from 82 percent in 1987. For the North group the literacy rate in 2005 is over 75 percent with Libya achieving a rate of 85 percent. The average for the SSA group in 2005 is about 66 percent with countries like Gabon and Equatorial Guinea ranking high and Sudan and Chad being the poor performers.

Figure 4



A tentative observation form this comparative analysis is that SSA oil exporting countries have achieved rapid growth in recent times which is due largely to the favorable high price of crude and the massive investment such is attracting. However, in terms of welfare indicators, the SSA region is lagging behind other oil exporting regions. In the following section, we seek to examine the growth dynamics in the SSA group and see if it agrees with the above casual observation.

4. Model

Following Yanikkaya (2003), we specify a growth model in its general form as follows:

$$g_{yi,t} = F(\eta_{i,t}, k_{i,t}, h_{i,t}; Z_{(i,t)}) \qquad (1)$$

where $g_{yi,t}$ is the growth rate of per worker (or per capita) gross domestic product, gdp; $\eta_{i,t}$ is some measure of initial conditions; $k_{i,t}$ and $h_{i,t}$ are, respectively, some measures of (quality and/or quantity of) physical and human capital (per worker), all at time period *t* for country *i*. $Z_{(i,t)}$ represents a vector of some controlled variables. There are various ways in which researchers have attempted to operationalize equation (1) depending on how the vector *Z* is specified and/or measured and the specific production function adopted. In the sense of the Solow (1956) growth accounting framework, vector *Z* is regarded as total factor productivity (TFP) growth – growth not due to factor inputs. It is not uncommon in growth models to assume that TFP is driven (linearly) by a set of unobserved country specific (fixed effect) characteristics that are time invariant, μ_{0i}, a vector of observed non-input fundamentals, X_{it}, a set of time varying factors, represented by $\theta_{it}t + \nu_{it}$, where ν_{it} is a time varying residual and *t* is a time trend common to all countries. Hence, TFP growth is modeled as:

$$Z_{(i,t)} = \mu_{0i} + \theta_{it}t + X_{it} + \nu_{it} \qquad (2)$$

It is suggested in the literature that one can think of three different hypotheses: the TFP growth is the consequence of (i) good macroeconomic policies, (ii) just plain good luck, or (iii) a good institutional stance (Jadresic and Zahler. 2000). This implies that the vector *X* is composed of macroeconomic, external and institutional factors. Macroeconomic factors represent variables that capture the different macro policy decisions. In this study, the oil variables are seen as part of the external factor. In general, the linear panel growth regression can be specified by substituting equation (2) into equation (1) as follows:

$$g_{yi,t} = \mu_{0i} + \beta_W^{'} W_i + \beta_X^{'} X_i + \theta_{it} t + \upsilon_{it} \qquad (3)$$

where the vector *W* is a *q* dimensional (row) vector of the *q* variables suggested by the Solow (1957) growth model. The vector *X* is a *p*-dimensional vector of additional country specific fundamentals that augments the basic Solow model. The betas are coefficients to be estimated. As Kourtellos (2002) points out, the vector X usually includes proxies for the unobservable variables of technology level and technological growth. Kourtellos (2002) argues further that, it is usually the case that, for empirical purposes, vector *X* includes any covariates a researcher believes are important and as a result the empirical augmented model cannot be generally linked to any theoretical model. This approach is also followed in this study

4.1 Determinants of Growth Considered

The W Vector

Initial Conditions

This is usually proxied by (log of) some level of income at a given past period (the beginning of the period over which growth is measured, in this case, 1987). Generally, initial level of per worker (or per capita) gdp is a common variable (see Harn and Lim, 2000). Based on the convergence hypothesis, this variable is expected to be negatively related to growth. Variable such as initial life expectancy rate have also been used in the literature (see for example O' Connel and Ndulu, 2000 and Yanikkaya 2003). Another measure of initial condition is the use of the log of adult literacy rate which is defined as the fraction of population over the age of 15 that is able to read and write at the beginning of the sample period (Kourtellos 2002).

Factor inputs

According to the Solow growth model, other relevant variables in the *W* vector are the logs of $s_{k,i}$, $s_{h,i}$ which are, respectively, the savings rate for physical and human capital accumulation out of real output (having positive impact on growth), and the log of $(n_i + \rho + \delta)$, where n_i is the population growth rate of country *i* while ρ and δ represent common rates of technical change and depreciation of human and physical capital stocks, respectively. A common practice in the empirical literature is to assume that $(\rho + \delta) = 0.05$ (see for example, Kourtellos 2002). Hence the variable $(n_i + \rho + \delta)$ can be measured as logarithm of average growth rate of the population plus 0.05 for

depreciation. The neoclassical (Solow) growth model predicts a negative impact of this variable on growth.

The measurement of human capital has always been quite problematic in growth regressions (see Lin 2006 for a detailed discussion on this). Hoeffler (1999) argues that educational attainment – defined as average year of schooling achieved by the population aged 15 or older – is more appropriate than school enrollment rates in the measurement of human capital. Some authors, like O'Connel and Ndulu (2000), prefer to use 25 years and above. It is agreed that, in general, the human capital variable is also to include measures of health and nutrition of the labor force. Though this is somewhat difficult to incorporate and hence ignored by most studies. A typical implementation of the Hoeffler (1999) measure, as expressed in Lin (2006), is to define human capital as the average number of years of formal education per person among employed people [i.e., the average number of years of formal education per person = (primary stock x 6 + junior stock x 9 + senior stock x 12 + college stock x 16) / total employed people]. This approach is adopted in this study. It should be noted that some authors have used cost based measures of education to measure human capital (see Judson 2002). The cost based approach is particularly difficult to implement in our case due to severe data limitations. Virtually all the sampled countries do not report public expenditure per level of education. Also, the absence of private cost on education makes the approach unattractive in this case. Hence we adopt the average year of schooling approach. In terms of physical capital stock, a popular approach is to adopt the perpetual inventory approach following the work by Nehru and Dhareshwar (1994). In this study, we simply use an investment rate measured by the log of average proportion of real investment (including government) to real gdp.

The X vector

As argued by Levine and Renelt (1992), there are well over 50 potential variables that can be included in a typical growth regression. In practical terms, it is difficult to include all such variables. Hence, it is the practice to include the traditional variables (in vector *W*) and some others judged to be more relevant. As discussed earlier, the *X* vector will be made up of policy and institutional factors as well as some elements of good luck. The macroeconomic factors considered here include ratio of non productive government consumption to gdp, inflation rate and index of real exchange rate misalignment. The external factors considered include measures of external debt burden and real growth rate of the main industrialized economies, the G7. To examine the impact of oil on growth we consider the following variables; growth in terms of trade, volatility in growth in terms of trade and volatility in average crude oil price. We omit any measure of openness in this study.

A measure of openness for oil exporting countries in Africa would be relatively difficult to compute using either price or quantity index of export and/or import. This is because it is easy for such measure to capture terms of trade effect rather than openness. For example, a country exporting a specific amount of barrels of oil per year (due to quota or technical constraints) would have varying export values corresponding to the behavior of the price of crude rather than an element of openness. Furthermore, increased technical capacity to export crude cannot be regarded as increased openness as witnessed in many

of the sampled countries. In fact (binary) proxies constructed by Sach and Warner (1995) show that Angola, Chad, Congo, Equatorial Guinea, Gabon, Nigeria, (with no data for Sudan) are all regarded as closed economies with all having value zeros in their binary coding. Furthermore, time series on the quality of institution, corruptions, bureaucracy, etc., are generally lacking in these countries. Hence we could not incorporate any meaningful measure of institution.

Data

This paper uses a balanced panel of major oil producing countries of sub Saharan African countries namely; Angola, Chad, Congo Brazzaville, Equatorial Guinea, Gabon, Nigeria and Sudan. Annual observations covering the period 1987 to 2005 are utilized. The study is aware of the fact that there are differential oil prices based on the quality of the crude from each country, with Nigeria having the highest price for her crude. To prevent complexities that could arose from such price variation we use, as the standard crude price, an average nominal crude oil price in the US in dollars per barrel[iii]. The prices were recorded for Chad and Sudan from the year they started exporting crude. Similarly, oil price volatility was computed for both countries from the year they started exporting crude. Except for the crude oil price, values for other series are obtained from the World Bank World Development Indicators (WDI Online).

In this study, we simply estimate the real exchange rate misalignment – defined as the deviation of the actual real exchange rate from some "equilibrium" value – as the residual from a first order autoregressive (AR(1)) process of the natural log of real exchange rate[iv]. This is the longest significant lag length sufficient to generate a white noise error process. The AR(1) process is given as $lnr = 0.822 + 0.824lnr_{-1}$ where r is real exchange rate . The t-statistics, respectively, are 4.60 and 29.99. Also, volatility (of terms of trade and crude oil price) is estimated as centered three-period moving standard deviation of the variables.

5. Estimation and Interpretation of Result

The study adopts a balanced panel data approach which is commonly used in the analysis of the neoclassical convergence hypothesis, the determinants of growth and the impact of policies on growth performance. This study is very much aware of the various contending issues in the literature on modeling growth such as data reliability, model specification, estimation procedures, treatment of country specific effects, endogeneity, variable stability (particularly of the growth rates), etc. Some of these issues, such as data reliability, can be compelling in this circumstance. However, the study has little option but to rely on secondary data. The issues of estimation procedure and endogeneity are usually addressed by resorting to the use of the generalized method of moments (GMM) estimator and choice of appropriate instruments – usually lags of the right hand side variables. It is worth stating that the structure of the panel is also important in the choice of estimation technique. For example, in this study, we have a relatively small cross section, 7, as compared to the time period of 19. Hence, we report estimates from three different techniques. The first is the panel least squares (PLS) estimation technique (which is equivalent to the pooled mean squares technique), the second is a generalized

least squares (GLS) estimation of the first model specification accounting for both cross sectional heteroscedasticity and period autocorrelation. The third estimation is a GMM estimation of the first model, also accounting for hereroscedasticity and autocorrelation. All estimations are done with the cross section fixed effect option. The results are presented in the following section

Table 3 presents the results from the basic neoclassical Solow growth model. The PLS results indicates that initial level of gdp, initial literacy rates and investment are strong determinants of real per capita growth in the oil producing countries of SSA. Except for average year of schooling, though insignificant, was expected to be positive, all other variables have the expected signs. However, this estimates show signs of autocorrelation and hence we report the GLS estimates in column 3. The GLS estimates confirm the results from the PLS technique. Here we observed the significance of all the variables including average schooling years completed, though this variable still remains negative. To reduce inconsistencies that can arise from omitted variable and/or endogeniety bias we report estimates from GMM method in column 4. Here, the population growth rate assumes a positive sign in contrast to expectation. Also, we observed that only initial gdp level and investment rate significantly affect real per capita gdp in the sampled countries. A tentative conclusion from this is that all methods indicate the importance of initial level of gdp and investment in the growth process of major oil producing countries of SSA.

Table 3 Regression Estimates of the Base Model (1986-2005).

Dependent variable: Δy_{it} (y is real GDP per capita).

	Panel Least Squares (PLS)	**Panel GLS**	**GMM Estimation**
Variables	Coefficients (*t*-Statistics)		
Constant	0.210520 (0.5195)	0.027179 (0.3266)	-0.195808 (-2.4029)**
Ln(initial GDP)	-0.089378 (-3.9728)**	-0.071328 (-14.6947)**	-0.079449 (-2.7350)**
Initial Life expectancy	-0.113079 (-1.9620)*	-0.050932 (-2.8440)**	-0.024811 (-0.1959)
Initial literacy rate	0.241327 (6.4985)**	0.154782 (7.5293)**	0.145466 (0.9308)
Ln(Population growth rate)	-0.263382 (-0.9905)	-0.104053 (-2.3934)**	0.039004 (1.1523)
Investment to GDP ratio	0.083057 (3.6712)**	0.051396 (3.7709)**	0.071023 (2.2239)**
Ln(average school year completed)	-0.173776 (-1.0333)	-0.064741 (-1.8254)*	-0.048529 (-0.7991)
R^2	0.06	0.37	0.47
Num. of Obs.	133	133	133

Notes: **(*)Significance at 5(10) percent. White heteroscedastic t-Statistics are reported in parenthesis.

Table 4: Regression Estimates of the Augmented Model (1986-2005).

Dependent variable: Δy_{it} (y is real GDP per capita).

		Panel Least Squares (PLS)		Panel GLS		Panel GMM Estimation	
	Variables	Coefficients (t-Statistics)					
	Constant	0.2470 (0.640)	0.1748 (0.537)	0.0030 (0.030)	-0.1051 (-0.994)	-0.5409 (-2.573)***	-0.2813 (-1.834)*
Core Neoclassical Variables	*Ln*(initial GDP)	-0.0850 (-2.756)**	-0.0902 (-2.802)***	-0.0875 (-7.095)***	-0.0987 (-7.116)***	-0.2020 -(1.560)	-0.0909 (-1.252)
	Initial Life expectancy	-0.0630 (-1.311)	-0.0579 (-1.129)	-0.0959 (-2.993)***	-0.0531 (-1.569)	0.1195 (0.562)	0.1131 (0.430)
	Initial literacy rate	0.1900 (2.257)**	0.1957 (2.186)**	0.2248 (5.885)***	0.2069 (4.847)***	0.2205 (1.059)	0.0135 (0.036)
	Ln(Population growth rate)	-0.2821 (-0.950)	-0.3095 (-0.927)	-0.0670 (-1.396)	-0.0599 (-1.157)	0.0673 (0.646)	0.0539 (0.571)
	Investment to GDP ratio	0.0867 (3.669)***	0.090 (3.697)***	0.0582 (3.913)***	0.0783 (4.866)***	0.1312 (2.047)***	0.1183 (2.159)***
	Ln(average school year completed)	-0.1859 -1.302	-0.0677 (-0.758)	-0.0772 (-1.631)	-0.0269 (-0.589)	-0.0121 (-0.063)	-0.0303 (-0.185)
Macroeconomic (control) Variables	Ratio of debt service to export	-0.1516 (-0.948)	-0.1206 (-0.783)	-0.0670 (-1.144)	-0.0747 (-1.063)	-0.0440 (-0.178)	0.0877 (0.289)
	Ratio of debt to export	-0.0007 (-0.329)	-0.0022 (-0.613)	0.0003 (0.288)	0.0004 (0.428)	-0.0014 (-0.121)	0.0001 (0.043)
	Ratio of debt to GDP	0.0476 (0.496)	0.0473 (0.534)	-0.0148 (-0.763)	-0.0137 (-0.611)	0.0609 (0.228)	-0.0181 (-0.301)
	Inflation (ΔlnCPI)	-0.0417 (-0.849)	-0.0644 (-1.081)	0.0061 (0.382)	-0.0163 (-0.843)	-0.0682 (-0.377)	-0.0488 (-1.137)
	Real exchange rate misalignment	0.0521 (0.928)	0.0505 (0.956)	-0.0018 (-0.091)	0.0110 (0.450)		
	Ratio of government consumption to GDP	-0.3179 (-1.033)	-0.2155 (-0.837)	-0.0546 (-0.673)	-0.0202 (-0.223)	0.5122 (0.616)	-0.1285 (-0.423)
	Average growth rate of G7	0.6341 (0.832)	0.7597 (0.758)	0.3308 (1.068)	0.3888 (1.032)	-1.3233 (-0.395)	0.6762 (0.471)
Oil Variables	Terms of trade growth rate		0.1660 (1.308)		0.0691 (2.614)***		0.2684 (0.859)
	Volatility in terms of trade growth		-0.0601 (-0.498)		-0.0115 (-0.212)		-0.2649 (-1.191)
	Volatility in average crude oil price		-0.0133 (-0.898)		-0.0054 (-2.214)***		-0.0082 (-0.598)
	R^2 Num. of Obs.	0.076 133	0.097 133	0.35 133	0.31 133	0.32 133	0.25 133

Notes: **(*)Significance at 5(10) percent. White heteroscedastic t-Statistics are reported in parenthesis.

Table 4 reports the augmented neoclassical model in which some control variables and crude oil export related variables are introduced. Again, the PLS, GLS, and GMM estimates are reported. It is worth nothing that in these estimates, the GMM method was quite very sensitive to the choice of instruments used and the results were not quite robust. The PLS results indicate the significance of initial level of gdp, initial literacy rate and investment as a proportion of gdp as the major determinants of growth in the sampled countries. The crude oil variables were not particularly significant, though they had the expected signs. The PLS results still shows sum significant sign of autocorrelation. Hence, we report the GLS approach which accounted for autocorrelation and heteroscedasticity. The GLS estimates support the proposition that terms of trade growth in the oil producing countries of SSA positively impact on growth and that volatility in crude oil prices negatively and significantly impact on growth. Like in the PLS estimates, none of the other control variables were significant. The GMM estimation indicates that only investment rate significantly affect growth. As mentioned earlier, the GMM estimation was observed to be very sensitive to choice of instrument and we considered this estimate as not too reliable.

Generally, the results could be described as indicative of some relationship between the international oil market and the growth pattern of the sampled countries. Particularly, growth in terms of trade was observed to be positively related to growth and volatility in crude oil price was negatively related to growth. These are in accordance with a priori expectations. However, of importance is the fact that all the techniques point to the positive impact of investment in the growth process of the sampled countries. Also, the PLS and GLS estimates indicate the significance of literacy rate in the growth process of the sampled countries. It is interesting to note that the improvement in fit of the augmented as against the neoclassical model is marginal. This tentatively suggests that the basic neoclassical model could significantly explain cross country growth difference amongst the sampled countries.

5. Concluding Remarks

This study sets out to examine the impact of crude oil exportation on the growth process of major oil exporting countries of SSA. The results indicate some significant impact of oil on growth. Particularly, it was observed that the growth in terms of trade is positively related to growth in real per capital output in these countries while volatility in oil price negatively affect growth in these countries. Currently, the results could not be described as robust. Furthermore, the current sample consists of oil exporting countries of SSA. It will be worthwhile to compare this growth process with the non oil exporting countries of SSA and also to compare the growth process of the oil exporting countries of SSA with those of Latin America, North Africa and the Middle East and even Asian countries. From this, a more definitive pattern may be discerned.

References

Azam, Jean-Paul; Fosu, Augustin; and Ndung'u, Njuguna S. 2002. "Explaining Slow Growth in Africa" *African Development Review*, Volume 14, Number 2, Pp. 177-220.

Broadman, G. and Y. Xiaoqing, 2007. *Africa's Silk Road: China and India's New Economic Frontier.* The World Bank, Washington, D.C.

Barro R. J., 1997. *Determinants of Economic Growth: A Cross-Country Empirical Study*. Cambridge, MA: MIT Press.

Barro, R. and J.-W. Lee .1994. Data Set for a Panel of138 Countries, National Bureau of Economic Research.

Basu A. and K Srinivasan. 2002. Foreign Direct Investment in Africa - Some case Studies. IMF Working paper WP/02/61.

Caselli, F. Esquivel G. and F. Lefort .1996. "Reopening the Convergence Debate: A New Look at Cross-Country Growth Empirics" *Journal of Economic Growth*, Volume 1, Number 3: Pp. 363-389.

Chung, Kim-Sau .1998. "A Lousy Survey on Growth Empirics" http://faculty-web.at.northwestern.edu/economics/chung/growth/index.htm. Accessed 09/07/2007

Devarajan Shanta, David Dollar, and Torgny Holmgren .2001. "Aid and Reform in Africa. Lessons from Ten Case Studies." Washington, DC: IBRD, World Bank.

Elizabeth Asiedu. 2006. Foreign Direct Investment in Africa: The Role of Natural Resources, Market Size, Government Policy, Institutions and Political Instability. *The World Economy* 29:1, 63–77.

Hahn Chin Hee and Jong-il Kim. 2000. "Sources of East Asian Growth: Some Evidence from Cross-country Studies" http://www.gdnet.org/pdf/300_Hahn-kim.pdf. Accessed 09/07/2007.

Hoeffler, A. A. (1999) "Econometric Studies of Growth, Convergence and Conflicts." D. Phil. Thesis, Oxford University.

Jadresic, Esteban and Roberto Zahler .2000, "Chile's Rapid Growth in the 1990s: Good Policies, Good Luck, or Political Change?", *IMF Working Paper* 153.

Jeffrey A. Edwards. 2007. "Dynamics of the Cross-Country Growth/Volatility Relationship," *Global Economy Journal*: Vol. 7: Issue. 2, Article 4.

Judson, R., 2002, Measuring Human Capital Like Physical Capital: What Does It Tell Us? *Bulletin of Economic Research*, 54, pp. 209-31.

Kourtellos, Andros. 2002. "Modeling Parameter Heterogeneity in Cross Country Growth Regression Models" http://www.econ.ucy.ac.cy/papers/0212.pdf; Accessed 09/07/2007.

Lawrence Bouton, Jones Christine and Kiguel Miguel .1994. "Macroeconomic reform and growth in Africa : adjustment in Africa revisited" World Bank Policy Research Working Paper 1394.

Levine, R. and D. Renelt. 1992. "A Sensitivity Analysis of Cross-Country Growth Regressions" *The American Economic Review*, Vol. 82, No. 4. , pp. 942-963.

Ley, Eduardo and Steel, Mark F.J., 1999. "We Just Averaged over Two Trillion Cross-Country Growth Regressions". IMF Working Paper No. 99/101.

Lin, Tin-Chun, 2006 "Alternative measure for education variable in an empirical economic growth model: Is primary education less important?" *Economics Bulletin*, Vol. 15, No. 15 pp. 1-6.

Maria-Angels, Oliva, Luis A Rivera-Batiz .2002. "Political Institutions, Capital Flows, and Developing Country Growth: An Empirical Investigation" *Review of Development Economics* 6 (2), 248–262.

McCartney, Matthew .2006. Can a Heterodox Economist Use Cross-country Growth Regressions? *Post-Autistic Economics Review*, Issue no. 37, 28 April 2006 article 4.

McDonald Scott and Jennifer Roberts .1996. "Misspecification and cross-country growth regressions" *Journal Applied Economics Letters*, Volume 3, Issue 6 J, Pp 413 – 416.

McQuinn, Kieran and Karl Whelany .2006. "Solow (1956) as a Model of Cross-Country Growth Dynamics" www.karlwhelan.com/Papers/mcquinn_whelan_oxrep.pdf: Accessed 09/07/2007.

Naudé, W. A. 2004. "The Effects of Policy, Institutions and Geography on Economic Growth in Africa: An Econometric Study Based on Cross-Section and Panel Data" *Journal of International Development*, Volume 16, Issue 6 , Pp. 821 – 849.

Nehru, V. and A. Dhareshwar. 1993. "A New Database on Physical Capital Stock: Sources, Methodology and Results," Revista de Analisisis Economico 8(1): 37- 59.

Nkurunziza, Janvier D. and Robert H. Bates. 2003. "Political Institutions and Economic Growth in Africa" Harvard University CSAE WPS/2003-03.

O'Connell, Stephen A. 2004. "Explaining African Economic Growth: Emerging Lessons from the Growth Project" www.gdnet.org/pdf2/special_features/connell_draft.pdf. Accesssed 09/07/2007

O'Connell, Stephen A. and Benno J. Ndulu. 2000. "Africa's Growth Experience: A Focus on Sources of Growth" www.swarthmore.edu/SocSci/soconne1/documents/revision2.pdf. Accessed 09/07/2007

Ojo, Oladeji and Temitope Oshikoya 1995. "Determinants of Long-Term Growth: Some African Results" *Journal of African Economies*, Volume 4, Number 2, 163-191.

Özlale Ümit and Erinç Yeldan 2002. "Measuring Exchange Rate Misalignment in Turkey" www.bilkent.edu.tr/~yeldane/ozlale&yeldan2002.pdf Accessed 10/08/2007

Pantelis Kalaitzidakis, Theofanis P Mamuneas and Thanasis Stengos .2000. A Non-Linear Sensitivity Analysis of Cross-Country Growth Regressions, *Canadian Journal of Economics/Revue canadienne d'économique* 33 (3), 604–617.

Robert Lensink and Oliver Morrissey. 2006. Foreign Direct Investment: Flows, Volatility, and the Impact on Growth. *Review of International Economics* 14:3, 478–493.

Sachs, J. D. and A. Warner. 1995. "Economic Reform and the Process of Global Integration." Brookings Papers on Economic Activity 1995(1): 1-118.

Sala-i-Martin, X., Doppelhofer, G. and R. Miller. 2004. "Determinants of Long-Term Growth: A Bayesian Averaging of Classical Estimates (BACE) Approach" *American Economic Review*, 94(4): 813-835.

Solow, Robert. 1957. "Technical Change and the Aggregate Production Function." *Review of Economics and Statistics*, 39:312-320

Tsangarides, G. C. 2001. "On Cross-country Growth and Convergence: Evidence from African and OECD Countries" *Journal of African Economies*, Volume 10, Number 4 Pp. 355-389.

Yanikkaya Halit. 2003. "Trade Openness and Economic Growth: A Cross-Country Empirical Investigation" Journal of Development Economics 72 Pp. 57– 89.

Endnotes

[i] The literature on growth is now very enormous and the authors will not be dwelling on them. Interested readers are referred to studies like Levine and Renelt (1992); Ojo and Oshikoya (1995); Caselli *et al* (1996); Barro (1997); Hahn and Kim (2000); Nkurunzizi and Bates (2003); Naude (2004); O' Connell (2004) amongst several excellent materials.

[ii] Data used in this section are largely from the World Bank Online WDI.

[iii] http://inflationdata.com/inflation/Inflation_Rate/Historical_Oil_Prices_Table.asp

[iv] The measurement of the theoretical concept of "equilibrium" real exchange rate is not straightforward; however it involves the use of some filtering to separate the permanent and the transitory components and modelling real exchange rate in terms of some fundamentals and the permanent components (see Özlale and Yeldan 2002 for some details).