

Do Resource-rich and Resource-poor Sub-Saharan Africa Countries Grow Differently?

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Summary:

The issue of whether growth mechanisms operate differently in Sub-Saharan Africa resource-rich and resource-poor economies is addressed in two ways. First, by testing the assumption that growth effects of particular explanatory variables are the same in resource-rich as in resource-poor countries. Second, by measuring indirect contributions to growth of initial conditions as they influence explanatory variables in a basic growth regression. Robust regression results show that for landlocked countries, being closed to trade harms growth; mineral-poor countries growth is more responsive to fiscal deficit reductions; population growth is of serious concern in less-favourable agricultural conditions countries, while institutional quality and openness are necessary for growth in less-favourable agricultural conditions countries, but are insufficient in more-favourable agricultural conditions countries. Across the subgroups of countries, ethnic and cultural fragmentation, schooling, and natural resource abundance are relevant determinants of institutional quality, and population growth determinants include initial life expectancy at birth and education attainment.

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1. Introduction

Depending on the availability of natural resource, opportunities for growth vary among Sub-Saharan Africa (SSA) countries (Collier and O'Connell, 2004). Several transmission channels of the effects of natural resource abundance on economic growth have been advanced in the literature. It has been suggested that the negative growth impact of natural resources stems from lower education spending and less schooling in the resource-rich countries (Gylfason, 2001 and Bravo-Ortega and De Gregorio, 2005). Some authors proposed that the root of the problem is political i.e. natural resource abundance increases the rent-seeking behavior and lowers income (Torvik, 2001), while others believe that the real problem for growth is the debt overhang in resource-rich countries (Manzano and Rigobon, 2001). Last but not the least, the trade structure also matters i.e. diversified economies in terms of export are less likely to suffer negative effects of natural resource wealth.

In this article we analyze the question of natural resource abundance on SSA growth by asking whether the channels of growth transmission function differently in resource-rich and resource-poor SSA countries. The paper's main objective is thus to identify the important initial conditions in both groups of countries and to explore their role in explaining growth and policy outcomes. In particular, we try to shed light on the following two questions. First, what are the indirect contributions to growth of initial conditions in resource-rich and resource-poor economies? Second, are the growth effects of particular explanatory variables the same in economies abundant in natural resources as in economies poor in natural resources? When considering the role of natural resources in SSA's growth, it is particularly important to account for the diversity of conditions facing SSA countries i.e. we distinguish countries according to a range of indicators reflecting natural resource potential. Drawing on the classificatory scheme developed by Diao et al. (2006), we identified and compared six groups of countries: (i) coastal versus landlocked countries, (ii) mineral-rich versus mineral-poor countries, and (iii) more-favorable agricultural conditions versus less-favorable agricultural conditions countries.¹

The results of initial growth regressions show that being closed to foreign trade harms growth in landlocked countries more than in coastal ones. Mineral-poor countries growth is more responsive to fiscal deficit reductions than is the case in mineral-rich countries. Population growth is of great concern for less-favorable agricultural conditions countries growth than for growth in more-favorable agricultural conditions countries; while institutional quality and openness to international trade are necessary for growth in less-favorable agricultural conditions countries, but may be insufficient for growth in more-favorable agricultural conditions countries. The relevant growth transmission variables include institutional quality and population growth. The estimation results of additional equations to explain the determinants of these variables reveal the following. Ethnolinguistic fragmentation, cultural fragmentation, stock of education, and abundance of raw materials are determinants of institutional quality, while population growth determinants include initial life expectancy at birth and initial total years of schooling of the over 25 population.

The next section presents the theoretical transmission mechanisms between economic growth and natural resource. Section 3 presents and compares the growth trend in the different subgroups of countries. Section 4 presents the analytical framework – methodology of an assessment of the magnitude of differences in the mechanisms of growth in SSA resource-rich

¹ Agricultural conditions are based on FAO Farming Systems potentials weighted by system's land coverage within each country.

and resource-poor economies. Section 5 presents the empirical results, and section 6 concludes with policy implications.

2. Theoretical Background

Natural resource endowments matter in shaping the economic development of nations. The geography endowment hypothesis holds that geographical circumstances i.e. whether a country is landlocked and therefore not open to trade will permanently limit the country's ability to access a large economic market, hinder its capacity to exploit economies of scale, and therefore lower its production efficiency (Sachs and Warner, 1997; 2001). Natural resource wealth has a potentially beneficial impact on economic prosperity i.e. natural resources are a potential source of income, some of which can be saved and converted into capital to support increases in future output levels. Resource endowments like agroecological conditions favoring cash crops may also influence economic growth (Easterly and Levine, 2003). Another line of argument believes that as wealth effects pull resources in and out of non-traded sectors, the existence of large natural resource sectors will affect the distribution of employment throughout the economy. These sectoral shifts can affect long term growth.²

However, it is equally widely accepted that the natural resources seem to have been more of a curse than a blessing for many countries i.e. natural-resource abundant economies tend to grow at a slower pace (see Lane and Tornell, 1996, Atkinson and Hamilton, 2003, and Papyrakis and Gerlagh, 2004). One hypothesis is that natural resource abundance leads to increased rent-seeking, corruption, and poorer overall government efficiency (Leite and Weidmann, 1999). Indeed, the presence of abundant natural resources (especially minerals) leads to rent-seeking behavior and corruption, thereby decreasing the quality of government, which in turn negatively affects economic development. Moreover, governments that control natural resource rents tend to waste the rents through profligate or inappropriate consumption (Ross, 2001, Auty, 2001, and Sala-i- Martin and Subramanian, 2003).

A second natural resource curse hypothesis is that high resource wealth has encouraged developing countries to pursue protectionist, state-led development strategies, as they try to combat the Dutch Disease effects of the resource abundance. This inward-looking development strategy may result in lower investment rates and/or low growth rates (Matsen and Torvik, 2005). The third hypothesis of the natural resource curse is that countries with higher natural resource abundance would have higher overall demand and higher relative price of non-traded goods. This might affect the relative prices of investment goods (which have a large traded component), with effects on investment rates and growth (Sachs and Warner, 1999).

A final hypothesis relative to the natural resource endowment curse is that high resource abundance leads to increased aggregate demand that shifts labor away from high learning-by-doing sectors and thus depresses growth in gross domestic product-GDP per worker, which is a better measure of labor productivity change. Moreover, natural resource abundant economies benefit less from the technology spillovers that are typical in manufacturing industries because the exports of these industries are harmed by an appreciation of the local currency, e.g., through the inflationary pressure resulting from increased domestic demand. As the natural resource sector expands relative to other sectors, the returns to human capital decrease and investments in education decline (Gylfason, 2001).

² See among others Rodriguez and Sachs (1999), Stijns (2000), and Brunnschweiler (2006) for further developments.

There is also evidence that natural resource abundance considerably increases the potential of violent civil conflict (Collier and Hoeffler, 2005).

3. Growth Trends: Resource-rich versus Resource-poor SSA Countries

It is widely agreed that economic growth within countries varies considerably across decades (Easterly et al., 1993 and Jones and Olken, 2005). Table 1 presents the growth performance by subgroup of countries and by decades as well as the mean comparison t-test for average growth performance. We also report the p-value from the t-test where the null hypothesis is that there is no difference in means growth rate for the two groups of countries.

If we look at the subgroup of countries growth experience during the entire period of analysis 1970-2005, some immediate differences are apparent. The average growth in per capita output for landlocked countries over this period was 1%, compared with an average growth rate of 0.14% in the coastal countries. The t-test reveals the significance of the relative weakness of growth in the coastal economies. The economic growth was about 0.7 percentage points higher in mineral-rich countries than in mineral-poor countries (0.86% versus 0.15%). The test shows that we reject the null hypothesis that the average growth of mineral-rich economies is the same as that experienced by the mineral-poor countries. The average per capita growth was 1.184% in less-favorable agricultural conditions economies. This is significantly above what was experienced in the more-favorable agricultural conditions countries (0.18% average growth rate of GDP per capita during 1970-2005).

Coming to the subgroups growth performance by decades, the figures in Table 1 indicate that from the 1970s through 1990s and during the recent period 2000-2005, landlocked countries grew more than coastal ones, and less-favorable agricultural conditions countries also grew more than more-favorable agricultural conditions countries. However, we fail to reject the null hypothesis of equal average growth in the different subgroups of countries. Except in the 1980s, average mineral-poor countries incomes grow more slowly than average mineral-rich countries incomes in the 1980s, 1990s and the recent period 2000-2005. But, this difference in average growth rate is statistically significant only during the period 2000-2005. To summarize, except in the case of the resource endowment like mineral, the figures in Table 1 seem consistent with the notion of a resource curse i.e. the widely accepted view that resource-poor countries (in terms of agroecological conditions and geography endowments) often outperform resource-rich countries in economic growth.

Table 1: Mean comparison t-test for average GDP per capita growth rate by decades, 1970-2005

Period	Mean		t-test	Probability
	Coastal	Landlocked		
1970-2005	0.137	0.9956	1.9724	0.0488
1970-1979	1.4348	2.0354	0.7036	0.4823
1980-1989	-0.6133	0.3659	1.42	0.1568
1990-1999	-1.0471	0.3097	1.3585	0.1753
2000-2005	1.198	1.4553	0.3237	0.7466
	Mineral-rich	Mineral-poor		
1970-2005	0.8548	0.152	1.6255	0.1043
1970-1979	2.1597	1.2619	1.049	0.2953
1980-1989	0.3477	-0.7135	1.5367	0.1255
1990-1999	-1.0938	-0.0509	1.0673	0.2869
2000-2005	2.773	0.0826	3.5948	0.0004
	More-favorable agriculture	Less-favorable agriculture		
1970-2005	0.1769	1.1843	2.0274	0.0431
1970-1979	1.3302	2.4915	1.0812	0.2818
1980-1989	-0.5063	0.4308	1.1875	0.2369
1990-1999	-0.7366	0.0029	0.7016	0.4837
2000-2005	0.9159	2.2307	1.5055	0.1356

Author's calculations using World Development Indicators (2008) data set.

We turn now to the cross-sectional variation in volatility of growth. Specifically, we examine the cross-country relationship between growth and volatility in each subgroup of countries. The results of regression of mean GDP per capita growth rates on the standard deviation of growth (σ_i) for the country sample in each subgroup from 1970 to 2005 are presented in Table 2. As the regressions show, in the coastal, mineral-poor, and more-favorable agricultural conditions samples, there is a negative and statistically significant relationship between growth and volatility. Thus, in the coastal-country sample, mineral-poor-country sample, and more-favorable agricultural conditions-country sample, there is evidence that countries with higher year-to-year volatility in GDP per capita growth rates tend to have systematically lower growth rates.

Table 2: Cross-sectional variation in growth volatility across subgroups of SSA countries, 1970-2005

Subgroup	Constant	Standard deviation (σ_i)	R ²	# observations
Coastal	0.9159** (1.78)	-0.1245** (1.95)	0.1249	19
Landlocked	0.3764 (0.24)	0.1016 (0.62)	0.089	12
Mineral-rich	-0.4439 (0.27)	0.21 (1.25)	0.033	14
Mineral-poor	1.1035* (3.11)	-0.1535* (3.34)	0.3462	17
More-favorable agriculture	1.0067** (2.29)	-0.1403* (2.97)	0.1206	22
Less-favorable agriculture	1.0884 (0.48)	0.014 (1.07)	0.02	9

Notes: t statistics are within parentheses. **, * imply significant at the 5% and 1% levels.

4. Methodology

The greatest practical concern in the present analysis are the following: (i) the potential problem of outliers driving the findings, (ii) the potential endogeneity of covariates in growth regressions, (iii) the parameter heterogeneity resulting from unobserved time-invariant characteristics of each country in the sample, and (iv) the model uncertainty. To address the potential endogeneity of regressors, the equations can be estimated by the Generalized Method of Moments-GMM using the ‘internal’ instruments of lagged values of the regressors. However, and concerning the use of instrumental variables, Temple (1999) notes that few useful and valid instruments present themselves. Also, the ‘tests of overidentifying restrictions in too many cases of both 2SLS and GMM led to rejection of the validity of the instruments’ (Block, 2001:449).

The fixed effects approach can be used to address the problem of parameter heterogeneity. But, the fixed effects models perform poorly when many of the explanatory variables in the models are relatively persistent over time, as in the present study. Moreover, a key parameter of the models estimated in this study is the resource-rich countries intercept term, which is time invariant and thus falls out of fixed effects estimation. It is possible to use the random effects approach. However, the maintained assumption of no correlation between the unobserved country effects and regressors is difficult to accept in the present application. Finally, the Ramsey’s RESET test is applied to test for omitted variables in the models.

To address the question of whether SSA resource-rich and resource-poor countries grow differently, each of the equations is estimated in two forms: (i) restricted and (ii) unrestricted. In the generic form, the unrestricted regression takes the following form,

$$(1) \quad Y = \beta_a + \gamma_a d + \beta X + \gamma(dX) + \varepsilon$$

Where \mathbf{d} is a vector of dummy variables equal to 1 for observations from coastal countries and 0 for observations from landlocked countries, 1 for mineral-rich countries and 0 for mineral-poor countries, and 1 for more-favorable agricultural conditions and 0 for less-favorable agricultural conditions countries. The columns of the \mathbf{X} matrix are particular explanatory variables.

The restricted regression frees only the subgroup of countries intercept, imposing the constrain $\gamma = 0$. For instance, a restricted specification indicates that the model fails to account for coastal countries differences. A finding that the coastal-specific intercept disappears in the unrestricted specification indicates that freeing the coastal countries slope coefficients provides a better description of the data. Chow tests permit testing of whether the resource-rich countries regression surface differs from the resource-poor countries regression surface. This approach allows the identification of policy-related variables having marginal impacts on growth that differ between the resource-rich and resource-poor observations.

To address the potential problem of outlier driving the findings, we use the semi-parametric technique of median regression i.e. the least absolute deviation-LAD estimation, which is the solution to the following optimization problem, $Min_{\beta} \sum_{i=1}^n |y_i - x_i' \beta|$. The LAD estimation is a special case of the following quantile regression, $Prob[y_i \leq x_i' \beta] = q$. The LAD estimator estimates the median regression-the LAD estimator is the solution to the quantile regression when $q=0.5$. Following Johnson and DiNardo (1997), the LAD approach consists of the five following steps: (i) run LAD on the entire sample to generate an initial estimate of β , (ii) use this estimate of β to drop observations for which the predicted value is negative, (iii) run LAD on this new sample to calculate a new estimate of β , (iv) repeat steps 2 and 3 using the $\hat{\beta}$ in step 3 as the new initial estimate, and (v) continue until the estimate stops changing.

The data set covers the period 1970-2005 and includes 30 SSA countries. The data set is structured as a panel with observations for each country consisting of 5-year averages. Each country thus has seven observations-the averages for 1970-74, 1975-79, 1980-84, 1985-89, 1990-94, 1995-99, and 2000-05. The detailed variable descriptions and sources are reported in Appendix B.

5. Results

To analyze the magnitude and relative importance of growth transmission channels we implement the empirical framework presented in the previous section by first specifying an initial growth regression and comparing estimates of the restricted and unrestricted specifications; then additional specifications examine the determinants of relevant variables e.g. institutional quality and population growth in order to reveal differences in a typology of SSA countries based on natural resources i.e. (i) coastal versus landlocked countries, (ii) mineral-rich versus mineral-poor countries, and (iii) more-favorable agricultural conditions versus less-favorable agricultural conditions countries.

(i) Coastal versus landlocked countries

The initial equation is estimated as in equation (1). The results are reported in Table 3. Column (1) presents the restricted results. With the exception of fiscal deficit, all coefficient estimates are of the expected sign and are statistically significant at the 1% and 5% levels, except the coefficients on initial life expectancy at birth and population growth which are insignificant. The Ramsey's RESET test fails to reject the null hypothesis of no misspecification of the model. The primary interest in the restricted specification lies in the landlocked countries-specific intercept term. The results in column (1) indicate that

landlocked countries grow more slowly by 3.6 percentage points per year than coastal countries.

The results of the unrestricted specification reported in column (2) reveal that the landlocked countries slope terms differ along one dimension among the eight independent variables in the initial growth regression i.e. openness. Indeed, the slope coefficient for openness differs between landlocked countries and the rest of the sample (coastal countries). The interpretation is that while openness increases per capita growth in the general sample by 0.14% annually, the increase for landlocked countries is 5.4% annually.³ Therefore, openness to world trade has an extraordinarily stronger effect on landlocked economies growth. Collier and Gunning (1999) find that the black market premium is half as damaging to growth in Africa as elsewhere. In a robustness check, we also investigate the effect of openness on landlocked countries growth by replacing the Sachs-Warner openness dummy by the residuals of a regression of the log of the ratio of exports and imports (in 2000 US\$) to GDP (in 2000 US\$), on the logs of area and population, as well as dummies for oil-producing and landlocked countries. The results (not reported here) show that the coefficient on openness is positive and statistically insignificant for the coastal countries, but positive and statistically significant for landlocked countries. Therefore, being closed to trade hurts landlocked countries more than coastal countries. In search of quantitative importance in explaining landlocked countries slower growth, we re-estimate the unrestricted specification of the initial growth regression with the independent variables in standardized form-the standard deviation of each variable across the full sample. In this form, the estimated coefficients reported in column (3) of Table 2 describe the impact on growth resulting from a one standard deviation change in each explanatory variable. For instance, a one standard deviation increase in openness increases growth in landlocked countries by 0.18 percentage points, but increases growth in coastal countries by 0.13 percentage points per year.

³ In column (2) of Table 3, the net slope term for landlocked countries is the sum of the slope for coastal countries and the slope of landlocked countries interaction term.

Table 3: Initial growth regression-LAD estimation results. Dependent variable: $GGDP^a$

Variable	(1)	(2)	(3) ^b
Constant	0.0408 (0.2169)	0.2105 (0.5893)	0.0306* (0.0109)
LnGDPo	-0.0197** (0.0091)	-0.0178 (0.0276)	-0.0175 (0.0145)
LnLEXo	0.0404 (0.0603)	-0.0055 (0.1616)	-0.0128 (0.1031)
INST	0.0406* (0.0141)	0.0576** (0.0251)	0.0571* (0.0257)
OPEN	0.0321** (0.0175)	0.0014 (0.0009)	0.0013 (0.0209)
OBDEF	-0.0307 (0.1697)	-0.0158 (0.5129)	-0.0049 (0.2956)
GPOP	-0.4021 (0.755)	-0.2975 (0.6314)	-0.259 (1.1488)
DumGeo	-0.0358* (0.0135)	0.3493 (0.9377)	-0.0258 (0.024)
LnGDPo*DumGeo		0.006 (0.068)	0.0111 (0.0498)
LnLEXo*DumGeo		-0.0984 (0.7997)	0.1266 (0.3936)
INST*DumGeo		-0.0147 (0.129)	-0.067 (0.0752)
OPEN*DumGeo		0.0527* (0.0147)	0.0018 (0.0581)
OBDEF*DumGeo		0.0088 (0.0384)	0.1077** (0.0439)
GPOP*DumGeo		-0.6944 (0.6348)	-0.267 (0.681)
Pseudo-R ²	0.3903	0.4291	0.4124
# observations	54	54	54
RESET ^c	0.7016		

Notes:

^a: Coefficients are estimated for the period 1970/1974-2000/2005.

^b: Independent variables in standardized form. Coefficients indicate effect of a one standard deviation change on the dependent variable.

^c: Ramsey RESET test, P-value for Ho: no omitted variables (based on OLS estimation).

* Standard errors in parentheses = 0.01-level of significance.

** Standard errors in parentheses = 0.05-level of significance.

We extend the analysis by examining whether the determinants of institutional quality operate differently in landlocked countries. The determinants of institutional quality are the initial ethnic fractionalization, initial cultural fractionalization, initial total years of schooling of the over 25 population, total arable land (the proxy for raw materials endowment), terms of trade shock, and openness. The results of LAD estimation reported in Table 4 (column (1)) indicate that cultural distances between ethnic groups and raw materials endowment negatively (and significantly) affect institutional quality, while openness has a positive and statistically significant effect on institutional quality. It is equally important to note that the restricted specification eliminates the landlocked countries intercept.

The results for the unrestricted specification in column (2) of Table 4 fail to eliminate the landlocked countries intercept. The unrestricted specification results further reveal that ethnolinguistic fragmentation and raw materials endowment hurt the institutional quality in coastal countries and do not undermine the institutional quality in landlocked countries. Block (2001) finding also corroborate the fact that ethnolinguistic fragmentation does not undermine the institutional quality in Africa. Cultural fragmentation, total year of education, terms of trade shock, and openness help and undermine the institutional quality in coastal and landlocked countries, respectively. Table 4 column (3) shows that in coastal countries ethnic fragmentation and raw materials endowment are negatively associated with institutional quality, while cultural fragmentation and openness are positively associated with institutional quality. In the landlocked countries the results in column (3) show that raw materials abundance is positively correlated with institutional quality.

Table 4: Determinants of institutional quality-LAD estimation results^a

Variable	(1)	(2)	(3) ^b
Constant	-0.7106* (0.1472)	-0.3929* (0.0222)	0.0015 (0.0046)
ETF	0.2845 (0.2445)	-0.608* (0.0389)	-0.0831* (0.029)
CUF	-0.62* (0.2445)	0.1224* (0.0064)	0.0526** (0.0287)
SCHOOL	0.0005 (0.0385)	0.0215* (0.0064)	0.0054 (0.0048)
ARABLE	-0.0126** (0.0061)	-0.0383* (0.002)	-0.0023*** (0.0014)
TOTS	0.2248 (0.5105)	0.6926* (0.0877)	0.0573 (0.0662)
OPEN	0.3104* (0.0739)	0.611* (0.0118)	0.0239* (0.0087)
DumGeo	0.0731 (0.0755)	-0.2571* (0.0348)	0.0027 (0.006)
ETF*DumGeo		1.334* (0.0529)	0.0497 (0.039)
CUF*DumGeo		-1.6644* (0.0555)	-0.0243 (0.041)
SCHOOL*DumGeo		-0.0248* (0.0083)	-0.007 (0.0062)
ARABLE*DumGeo		0.0412* (0.0021)	0.0026*** (0.0015)
TOTS* DumGeo		-0.6868* (0.109)	0.0065 (0.0838)
OPEN* DumGeo		-0.5913* (0.0166)	-0.0287* (0.0122)
Pseudo-R ²	0.1325	0.2238	0.0769
# observations	110	110	110
RESET ^c	0.531		

Notes:

^a: Coefficients are estimated for the period 1970/1974-2000/2005.

^b: Independent variables in standardized form. Coefficients indicate effect of a one standard deviation change on the dependent variable.

^c: Ramsey RESET test, P-value for Ho: no omitted variables (based on OLS estimation).

* Standard errors in parentheses = 0.01-level of significance.

** Standard errors in parentheses = 0.05-level of significance.

*** Standard errors in parentheses = 0.1-level of significance.

(ii) Mineral-rich versus mineral-poor countries

The results of the estimation of initial growth equation are reported in Table 5. With the exception of fiscal deficit, all coefficient estimates in the restricted specification in column (1) are of the expected sign and are statistically significant at the 1% and 10% levels. With the control as specified, mineral-poor countries grow more faster by 2.6 percentage points per year than mineral-rich countries.

The unrestricted specification results in column (2) of Table 5 indicate that freeing the mineral-poor countries slope terms does not eliminate the mineral-poor countries intercept. Among the eight exogenous variables in the initial growth regression, the results in column (2) reveal that mineral-poor countries slope terms differ along one dimension e.g. fiscal deficit. Mineral-rich countries growth is less responsive to changes in fiscal deficit than is the case in the mineral-poor countries. A 1 percentage point reduction in deficits, which increases economic growth by 28.4 percentage points in mineral-poor countries, has no impact on growth in mineral-rich countries. In quantitative term, the results in column (3) of Table 5 indicate that a one standard deviation reduction in the fiscal deficit increases growth in mineral-poor countries by 12.3 percentage points per year, but has essentially no effect on growth in mineral-rich countries.

Table 5: Initial growth regression-LAD estimation results. Dependent variable: $GGDP^a$

Variable	(1)	(2)	(3) ^b
Constant	-0.1893 (0.1212)	-0.0969 (0.1316)	0.0028 (0.0039)
LnGDPo	-0.0354* (0.0056)	-0.0273* (0.0113)	-0.0273* (0.0113)
LnLEXo	0.1244* (0.0353)	0.0926** (0.0427)	0.0926** (0.0427)
INST	0.0194* (0.0071)	0.0118 (0.0157)	0.0118 (0.0157)
OPEN	0.0228* (0.0093)	0.0108 (0.0112)	0.0108 (0.0112)
OBDEF	-0.0319 (0.0689)	-0.199*** (0.1166)	-0.1478** (0.0866)
GPOP	-0.7992*** (0.4899)	-1.1042** (0.548)	-0.1042** (0.0548)
DumMin	0.021* (0.0063)	0.2654 (0.1658)	0.2654 (0.1658)
LnGDPo*DumMin		-0.0096 (0.0122)	-0.0096 (0.0122)
LnLEXo*DumMin		-0.0457 (0.0513)	-0.0257 (0.0513)
INST*DumMin		0.025 (0.0172)	0.025 (0.0172)
OPEN*DumMin		0.0179 (0.0151)	0.0179 (0.0151)
OBDEF*DumMin		0.2838** (0.1334)	0.1233** (0.0533)
GPOP*DumMin		0.117 (0.7033)	0.115 (0.6044)
Pseudo-R ²	0.2902	0.3183	
# observations	62	62	
RESET ^c	0.423		

Notes:

^a: Coefficients are estimated for the period 1970/1974-2000/2005.

^b: Independent variables in standardized form. Coefficients indicate effect of a one standard deviation change on the dependent variable.

^c: Ramsey RESET test, P-value for Ho: no omitted variables (based on OLS estimation).

* Standard errors in parentheses = 0.01-level of significance.

** Standard errors in parentheses = 0.05-level of significance.

*** Standard errors in parentheses = 0.1-level of significance.

Coming to the question of whether the determinants of institutional quality operate differently in mineral-poor countries, the results of LAD estimation of the restricted specification in column (1) of Table 6 show that ethnic fragmentation and openness have positive and statistically significant effects on institutional quality. It is equally important to note that the restricted specification fails to eliminate the mineral-poor countries intercept. The marginal impact of ethnic fragmentation, cultural fragmentation, total years of education, and raw materials abundance, differ at the 1% level in mineral-poor countries relative to mineral-rich observations. While ethnolinguistic fragmentation and raw materials abundance help institutional quality in mineral-rich countries, they rather hurt institutional quality in mineral-poor countries. Also, cultural fragmentation and total years of education hurt and help institutional quality in mineral-rich and mineral-poor countries, respectively. A counter-intuitive result is that raw materials are conducive to institutional quality in mineral-rich countries despite the usual alleged enhanced potential for rent-seeking behavior, which may be conducive to corruption in resource-abundant economies

Table 6: Determinants of institutional quality-LAD estimation results^a

Variable	(1)	(2)	(3) ^b
Constant	-0.6395* (0.0088)	-0.9203* (0.0056)	-0.6023* (0.0028)
ETF	0.3276* (0.0136)	0.6395* (0.0092)	0.6395* (0.0092)
CUF	-0.867* (0.0148)	-0.7892* (0.0099)	-0.3211* (0.0099)
SCHOOL	0.0001 (0.0023)	-0.0368* (0.0017)	-0.0358* (0.0017)
ARABLE	-0.004* (0.0004)	0.0641* (0.0012)	0.0441* (0.0012)
OPEN	0.06869* (0.0083)	0.0493* (0.0056)	0.0493* (0.0056)
DumMin	0.0662* (0.0042)	1.025* (0.0089)	0.8256* (0.0089)
ETF*DumMin		1.7842* (0.0137)	1.7842* (0.0137)
CUF*DumMin		0.0687* (0.014)	0.0687* (0.014)
SCHOOL*DumMin		0.0361* (0.0012)	0.0361* (0.0012)
ARABLE*DumMin		-0.0538* (0.0012)	-0.0538* (0.0012)
OPEN* DumMin		0.0568* (0.0083)	0.0568* (0.0083)
Pseudo-R ²	0.1643	0.3242	0.3242
# observations	195	195	195
RESET ^c	0.7428		

Notes:

^a: Coefficients are estimated for the period 1970/1974-2000/2005.

^b: Independent variables in standardized form. Coefficients indicate effect of a one standard deviation change on the dependent variable.

^c: Ramsey RESET test, P-value for Ho: no omitted variables (based on OLS estimation).

* Standard errors in parentheses = 0.01-level of significance.

** Standard errors in parentheses = 0.05-level of significance.

We also investigate whether the determinants of population growth operate differently in mineral-poor countries. Table 7 presents the results of LAD regression of the (un)restricted specifications for population growth. The intercept dummy in column (1) indicate that ceteris paribus mineral-poor countries population grows lower than mineral-rich countries' by 0.3 percentage points per year. Initial life expectancy at birth has the unexpected positive impact. Total years of education is as expected negatively and significantly associated with population growth. This implies that greater educational attainment increases the opportunity cost of time spent on child rearing.

Column (2) of Table 7 presents the unrestricted specification for population growth. Freeing the mineral-poor countries slope terms does not eliminate the mineral-poor countries intercept. With respect to initial life expectancy at birth, mineral-poor countries term is significantly different from the mineral-rich countries term. Thus, having and initial higher life expectancy at birth decreases population growth in mineral-poor countries, but has no impact within the mineral-rich countries. The results in column (3) of Table 7 reveal that a 1 percentage point increase in initial life expectancy at birth, decreases population growth by 2.2 percentage points in mineral-poor countries, but has no impact on population growth in mineral-rich countries.

Table 7: Determinants population growth-LAD estimation results^a

Variable	(1)	(2)	(3) ^b
Constant	0.039* (0.0163)	-0.0007 (0.0254)	0.0797* (0.0009)
LnGDPo	-0.0009 (0.0009)	-0.0008 (0.0016)	-0.0008 (0.0016)
LnLEXo	0.0137* (0.0048)	0.0237* (0.0074)	0.0237* (0.0074)
SCHOOL	-0.0024* (0.0008)	-0.0022** (0.0012)	-0.0022** (0.0012)
DumMin	-0.0025* (0.0011)	0.086** (0.0379)	0.086** (0.0379)
LnGDPo*DumMin		-0.0003 (0.0021)	-0.0003 (0.0021)
LnLEXo*DumMin		-0.0215** (0.0111)	-0.0215** (0.0111)
SCHOOL*DumMin		-0.0015 (0.0018)	-0.0015 (0.0018)
Pseudo-R ²	0.0777	0.1115	0.1115
# observations	185	185	185
RESET ^c	0.946		

Notes:

^a: Coefficients are estimated for the period 1970/1974-2000/2005.

^b: Independent variables in standardized form. Coefficients indicate effect of a one standard deviation change on the dependent variable.

^c: Ramsey RESET test, P-value for Ho: no omitted variables (based on OLS estimation).

* Standard errors in parentheses = 0.01-level of significance.

** Standard errors in parentheses = 0.05-level of significance.

(iii) More-favorable agricultural conditions versus less-favorable agricultural conditions countries

Table 8 reports the results of the estimation of initial growth specifications. The results in column (1) indicate that the Ramsey's RESET test fails to reject the null hypothesis of no omitted variables. With the exception of population growth and initial life expectancy at birth, all coefficient estimates are of the expected sign. The intercept dummy reveals that less-favorable agricultural conditions countries grow more slowly by 1.4 percentage points per year than more-favorable agricultural conditions countries.

The column (2) of Table 8 presents the results for the unrestricted specification. Note, first, that freeing the less-favorable agricultural conditions countries slope terms does not eliminate their intercept. Second, less-favorable agricultural conditions countries slope terms differ along four dimensions e.g. institutional quality, openness, investment, and population growth. More-favorable agricultural conditions countries growth is more responsive to changes in institutional quality and openness than is the case in less-favorable agricultural conditions countries. A one percentage point increase in institutional quality and openness increase economic growth by respectively 2.7 and 1.8 percentage points in more-favorable agricultural conditions countries, but has no effect within less-favorable agricultural conditions countries. However, less-favorable agricultural conditions countries growth is more responsive to changes in population growth. A one percentage point increase in population growth decreases economic growth by 6.1 points in less-favorable agricultural conditions countries, but has no effect in the more-favorable agricultural conditions countries.

The results in column (3) further reveal that a one standard deviation increase in the institutional quality and openness increases growth in more-favorable agricultural conditions countries by 2 and 2.8 percentage points per year, but has no impact on growth in less-favorable agricultural conditions countries. A one standard deviation increase in the population growth reduces growth by 5.8 percentage points per year in the less-favorable agricultural conditions countries.

Table 8: Initial growth regression-LAD estimation results. Dependent variable: $GGDP^a$

Variable	(1)	(2)	(3) ^b
Constant	0.1377* (0.145)	0.3943* (0.0809)	0.0205* (0.0027)
LnGDPo	-0.0048 (0.0063)	-0.0148* (0.0037)	-0.0163* (0.0183)
LnLEXo	-0.0469 (0.0352)	-0.109* (0.016)	-0.1007* (0.0183)
INST	0.0311* (0.0114)	0.0274* (0.0089)	0.0201** (0.0089)
OPEN	0.0001 (0.0131)	0.0177 (0.013)	0.0279** (0.0133)
OBDEF	0.2662* (0.1)	-0.0827 (0.1038)	-0.2694* (0.1058)
GPOP	1.0218** (0.4639)	0.2529* (0.0177)	0.2182* (0.0179)
INVEST	0.1546* (0.0352)	0.0263** (0.0139)	0.2961* (0.0372)
DumAgri	-0.0141*** (0.0087)	-0.4297* (0.1444)	-0.3975* (0.1496)
LnGDPo*DumAgri		0.0219* (0.0063)	0.0234* (0.0062)
LnLEXo*DumAgri		0.1147* (0.0348)	0.1064* (0.0359)
INST*DumAgri		-0.0353* (0.0123)	-0.028** (0.0123)
OPEN*DumAgri		-0.0462* (0.0167)	-0.0564* (0.0169)
OBDEF*DumAgri		-0.0459 (0.1409)	0.1408 (0.1424)
GPOP*DumAgri		-0.0612* (0.0045)	-0.0577* (0.0045)
INVEST*DumAgri		0.0299 (0.055)	-0.0272 (0.0538)
Pseudo-R ²	0.2604	0.3915	0.3866
# observations	57	57	57
RESET ^c	0.6		

Notes:

^a: Coefficients are estimated for the period 1970/1974-2000/2005.

^b: Independent variables in standardized form. Coefficients indicate effect of a one standard deviation change on the dependent variable.

^c: Ramsey RESET test, P-value for H_0 : no omitted variables (based on OLS estimation).

* Standard errors in parentheses = 0.01-level of significance.

** Standard errors in parentheses = 0.05-level of significance.

We also addressed the issue of whether the factors determining the institutional quality operate differently in both subgroups of countries. The LAD estimation results reported in column (1) of Table 9 indicate that the restricted specification fails to eliminate the less-favorable agricultural conditions countries intercept. Ethnolinguistic fractionalization and openness are positively and significantly associated with institutional quality, while cultural fragmentation is negatively and significantly associated with institutional quality. Among the eight explanatory variables under investigation, the results in column (2) of Table 9 show that less-favorable and more-favorable agricultural conditions countries slope terms differ along three dimensions, e.g. ethnic fragmentation, raw materials abundance, and openness. In the more-favorable agricultural conditions countries, ethnic fractionalization, raw materials abundance, and openness are conducive to institutional quality. However, in the less-favorable agricultural conditions countries, raw materials abundance helps, while ethnic fragmentation and openness hurt institutional quality.

Table 9: Determinants of institutional quality-LAD estimation results^a

Variable	(1)	(2)	(3) ^b
Constant	-0.8037* (0.0106)	-0.9722* (0.0123)	-0.6533* (0.0034)
ETF	0.5711* (0.0169)	0.8112* (0.0189)	0.8112* (0.0189)
CUF	-0.811* (0.0178)	-0.8387* (0.0206)	-0.8387* (0.0206)
SCHOOL	-0.0003 (0.0028)	-0.0036 (0.0038)	-0.0036 (0.0038)
ARABLE	0.0003 (0.0004)	0.0036* (0.0011)	0.0036* (0.0011)
TOTS	0.0011 (0.035)	0.0128 (0.0464)	0.0128 (0.0464)
OPEN	0.7457* (0.0099)	1.4806* (0.0113)	1.4806* (0.0113)
DumAgri	-0.1268* (0.0051)	0.5197* (0.016)	0.5197* (0.016)
ETF*DumAgri		-1.1426* (0.0264)	-1.1426* (0.0264)
CUF*DumAgri		0.0143 (0.0284)	0.0143 (0.0284)
SCHOOL*DumAgri		0.0008 (0.0045)	0.0008 (0.0045)
ARABLE*DumAgri		0.006* (0.0012)	0.006* (0.0012)
TOTS*DumAgri		0.0082 (0.0558)	0.0082 (0.0558)
OPEN* DumAgri		-0.7597* (0.0149)	-0.7597* (0.0149)
Pseudo-R ²	0.1799	0.2848	0.2848
# observations	165	165	165
RESET ^c	0.5432		

Notes:

^a: Coefficients are estimated for the period 1970/1974-2000/2005.

^b: Independent variables in standardized form. Coefficients indicate effect of a one standard deviation change on the dependent variable.

^c: Ramsey RESET test, P-value for Ho: no omitted variables (based on OLS estimation).

* Standard errors in parentheses = 0.01-level of significance.

** Standard errors in parentheses = 0.05-level of significance.

Table 10 presents the results of LAD regression for the determinants of a quadratic specification for population growth.⁴ The results in column (1) indicate that total years of education is negatively (and significantly) correlated with population growth. The results in Column (2) indicate that greater educational attainment decreases population growth in less-favorable agricultural conditions countries, but has no impact in more-favorable agricultural conditions countries. The results in column (3) show that a one percentage point increase in total years of schooling in the over 25 population, decreases population growth by 0.32 percentage points in less-favorable agricultural conditions countries, but has no effect on population growth within more-favorable agricultural conditions countries.

⁴ The Ramsey's RESET test rejects the null hypothesis of no omitted variables from the basic specification (P=0.0246). When the quadratic term of initial life expectancy at birth was included to resolve this problem, the RESET test failed to reject the null hypothesis (P=0.1822).

Table 10: Determinants population growth-LAD estimation results^a

Variable	(1)	(2)	(3) ^b
Constant	-0.3672 (0.3993)	0.2444 (0.4865)	0.0793* (0.001)
LnGDPo	-0.0018** (0.001)	0.0004 (0.0015)	0.0004 (0.0015)
LnLEXo	0.2256 (0.2076)	-0.0927 (0.2537)	-0.0927 (0.2537)
SCHOOL	-0.0019* (0.0009)	0.0008 (0.0014)	0.0008 (0.0014)
LnLEXo ²	-0.0274 (0.0271)	0.0126 (0.0333)	0.0126 (0.0333)
DumAgri	-0.0013 (0.0014)	-0.1241 (0.7365)	-0.1241 (0.7365)
LnGDPo*DumAgri		-0.0032*** (0.0019)	-0.0032*** (0.0019)
LnLEXo*DumAgri		0.0655 (0.3834)	0.0655 (0.3834)
SCHOOL*DumAgri		-0.0032** (0.0017)	-0.0032** (0.0017)
(LnLEXo*DumAgri) ²		-0.0067 (0.05)	-0.0067 (0.05)
Pseudo-R ²	0.0504	0.0904	0.0904
# observations	200	200	200
RESET ^c	0.1822		

Notes:

^a: Coefficients are estimated for the period 1970/1974-2000/2005.

^b: Independent variables in standardized form. Coefficients indicate effect of a one standard deviation change on the dependent variable.

^c: Ramsey RESET test, P-value for Ho: no omitted variables (based on OLS estimation).

* Standard errors in parentheses = 0.01-level of significance.

** Standard errors in parentheses = 0.05-level of significance.

6. Conclusion and Policy Implications

The main objective of this paper was to investigate whether the mechanisms of growth operate just the same in Sub-Saharan Africa-SSA resource-rich as in resource-poor countries. The study used a panel data over the period 1970/1974-2000/2005 and covered the following sub-samples of countries, (i) coastal versus landlocked countries, (ii) mineral-rich versus mineral-poor countries, and (iii) more-favorable agricultural conditions versus less-favorable agricultural conditions countries. The determinants of growth were identified in the initial growth regression using the least absolute deviation-LAD estimation approach. Moreover, and contrary to previous studies, we extended the analysis in two respects. First, in order to find differences in variables' impact on resource-poor countries growth we tested the assumption of equal estimated parameters in resource-rich and resource-poor countries. The, by specifying additional equations, we estimated the indirect contributions to growth of various initial conditions and exogenous factors as they influence explanatory variables in the initial growth regression.

Whatever the subgroup of countries considered, the empirical results reveal that most of the differences in growth mechanisms arise not in the initial regression, but rather in the indirect effects on growth that operate through those direct determinants. Concerning the costal versus landlocked countries, the evidence suggests that being closed to international trade is more costly in terms of growth forgone in landlocked countries than in coastal countries. This implies that trade reform is particularly crucial for landlocked economies. In the case of mineral-rich versus mineral-poor countries, we find that in contrast to mineral-rich economies, fiscal deficit reduction is conducive for accelerated mineral-poor countries growth. The evidence finally suggests that population growth is a serious concern in less-favorable agricultural conditions countries growth than in more-favorable agricultural conditions countries, while institutional quality and openness to international trade may be necessary for accelerated less-favorable agricultural conditions countries growth, but the

results presented here suggest that, in contrast they may be insufficient in more-favorable agricultural conditions countries.

The consideration of various channels of growth transmission i.e. the consideration of the determinants of variables from the initial growth regression for which the marginal effects in resource-poor countries are not different (institutional quality and population growth in the present case) suggests the following. Concerning the institutional quality, three evidences emerged. First, ethnic fragmentation and abundance of raw materials improve and impede institutional quality respectively in landlocked and coastal countries; cultural fragmentation hurts and helps institutional quality in landlocked and coastal countries; while increased stock of education improves institutional quality in coastal countries, but has no effect in landlocked countries. Second, ethnic fragmentation and raw materials abundance reduce and increase institutional quality in mineral-rich and mineral-poor countries, respectively; cultural fragmentation helps and undermines institutional quality in mineral-poor and mineral-rich countries, respectively; while additional schooling has no effect in mineral-rich countries, but improves institutional quality in mineral-poor countries. Finally, ethnic fragmentation reduces and increases institutional quality, respectively in less-favorable and more-favorable agricultural conditions countries; while the abundance of raw materials improves the institutional quality in both more- and less-favorable agricultural conditions countries.

Concerning the population growth, the evidence suggests that higher initial life expectancy at birth reduces population growth in mineral-poor countries, but has no impact within mineral-rich countries, while greater educational attainment reduces population growth in less-favorable agricultural conditions countries, but has no effect within more-favorable agricultural conditions countries.

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Appendix A

List of the different subgroups of Sub-Saharan Africa (SSA) countries

Coastal countries	Landlocked countries	Mineral-rich countries	Mineral-poor countries	Less-favoured agriculture countries	More-favoured agriculture countries
Benin	Botswana	Botswana	Benin	Botswana	Benin
Cameroon	Burkina Faso	Cameroon	Burkina Faso.	Burkina Faso	Cameroon
Congo Rep.	Burundi	CAR	Burundi	Burundi	CAR
Ivory Coast	CAR	Chad	Ivory Coast	Chad	Congo Rep.
DRC	Chad	Congo, Rep.	The Gambia	Gabon	Ivory Coast
Gabon	Lesotho	DRC	Ghana	Madagascar	DRC
The Gambia	Malawi	Gabon	Guinea Bissau	Mali	The Gambia
Ghana	Mali	Lesotho	Kenya	Niger	Ghana
Guinea Bissau	Niger	Niger	Madagascar	Rwanda	Guinea Bissau
Kenya	Rwanda	Nigeria	Malawi		Kenya
Madagascar	Uganda	Sierra Leone	Mali		Lesotho
Nigeria	Zambia	Sudan	Rwanda		Malawi
Senegal	Zimbabwe	South Africa	Senegal		Nigeria
Sierra Leone		Zambia	Swaziland		Senegal
Sudan			Togo		Sierra Leone
Swaziland			Zimbabwe		Sudan
Togo					South Africa
					Swaziland
					Togo
					Zambia
					Zimbabwe

Appendix B

Sources and Definitions of variables

Variable	Definition	Source
GGDP	Annual growth rate of real GDP per capita, calculated as the first difference of the natural logarithm of the natural logarithm of the level series.	World Development Indicators (2008).
LnGDPo	Log of real per capita GDP measured at the start of each 5-year period.	Penn World Tables 6.2.
LnLEXo	Log of life expectancy at birth measured in the initial year of each 5-year period. Life expectancy at birth indicates the number of years a new born infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.	World Development Indicators (2008).
GPOP	Growth rate of population	World Development Indicators (2008).
SCHOOL	Average schooling years in the total population over age 25, measured at the start of each 5-year period.	Barro and Lee (2001).
ETF	Ethnic fractionalization. Measures probability that two individuals selected at random from a given country will be from different ethnic group.	Fearon (2003) and Alesia et al. (2003).
CUF	Cultural fractionalization. Measures cultural distances between ethnic groups.	Fearon (2003) and Alesia et al. (2003).
INST	Institutional quality measured by the government effectiveness. Measures the average score of the quality of the bureaucracy and of public services between 1996-2007 within a range from -2.5 (worst) to 2.5 (best).	Kaufman et al. (2008).
OBDEF	Overall budget deficit, including grants (% of GDP)	World Development Indicators (2008).
TOTS	Terms of trade shock, measured as the first difference of the natural logarithm of terms of trade (2000=100). Terms of trade are the ratio of the 2000 (base year) export price index to the corresponding import price index.	World Development Indicators (2008).
INVEST	Gross domestic investment (% of GDP).	World Development Indicators (2008)
ARABLE	Total arable land area. Proxies raw materials endowments.	World Development Indicators (2008).
OPEN	Portion of year in each 5-year period during which the country is 'open' as defined by Sachs and Warner (1995).	Sachs and Warner (1995).