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DO THE RESOURCE-RICH AND RESOURCE-POOR COUNTRIES OF SUB-SAHARAN AFRICA GROW DIFFERENTLY?

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Abstract

Objective of this paper is to analyse the mechanisms of growth functioning in different sub-Saharan African countries that are landlocked compared to coastal countries, and resource-rich compared to resource-poor countries. This issue is addressed by first performing Barro-type reduced-form growth regressions, and then explaining in separate regressions the results of the initial growth regressions. The results of the robust regressions first show that reducing tax distortions promotes growth in resource-rich and resource-poor countries, and is necessary but insufficient in landlocked countries. Demographic growth is detrimental to growth in resource-rich and resource-poor coastal countries, and could be reduced by high levels of education. Institutional quality, enhanced by higher levels of education, promotes growth in coastal and resource-rich countries, while cultural fragmentation undermines growth as well as institutional quality in coastal, landlocked and resource-rich countries. For resource-poor countries, closure to trade is detrimental to growth.

Keywords: Growth, Geographical endowments, Resources, Sub-Saharan Africa

INTRODUCTION

Until the mid-2000s, growth in sub-Saharan Africa was weak or even negative. Average growth in GDP per capita (purchasing power) was -0.23% between 1970 and 2000 and -0.07% between 2001 and 2007 (Arbache et al., 2008). There are many reasons for this poor economic performance. Africa's poor economic performance is rooted in more fundamental factors, including poor policies, low labour productivity and low levels of human capital, poor institutional quality, the continent's geographical disadvantages, the natural resource 'curse' - growth in resource-rich countries is significantly slower than in other countries, other things being equal - among others (see for example Collier and Gunning, 1999; Bosker and Garretsen, 2010; Nunn and Puga, 2011).

After this long period of low growth, Africa has experienced a remarkable period of growth since the mid-2000s. From -0.07% in 1990-2010, Africa's growth increased substantially to reach 1.88% in 1995-2005. The main drivers of this growth trend include improved macroeconomic conditions, a favourable business environment, marked improvements in governance and foreign direct investment (FDI) flows (Bandara, 2015). It is also believed that most of this African growth is due to the export of natural resources, namely the rising prices of oil and natural resources (Collier, 2006). However, the improvement in the rate of economic growth has been unevenly distributed across African countries. For example, resource-rich countries have grown significantly faster than all other African economies. In particular, oil-exporting countries grew at more than twice the average rate for Africa. Africa's resource-poor economies have also seen an improvement in their growth performance, but this has been stronger for resource-rich economies than for resource-poor countries. Landlocked and non-landlocked economies grew at roughly the same rate, 1.2% and 1.3% per annum respectively (Arbache and Page, 2009).

However, after two decades of significant progress that began in the mid-1990s, recent trends indicate that the last few years have been difficult, with the region experiencing a sharp slowdown. For example, growth in Africa fell from 5% in 2014 to 3.5% in 2015, the lowest in some 15 years (Radelet, 2016). Once again, this general picture conceals striking variations from one country to another. Contrary to the commonly held view that African growth is largely driven by natural resources, resource-rich African countries have been hit hard, i.e. they have experienced the largest decline in growth, while resource-poor African economies have recorded significant gains in terms of economic growth. For example, some resource-poor African economies are expected to record robust growth in 2016, such as Kenya (6%), Senegal (6.5%) and Côte d'Ivoire (8.5%) (Sayeh, 2016).

Previous developments highlight considerable heterogeneity in economic growth between resource-rich and resource-poor African countries. In light of this heterogeneity, and in contrast to previous studies, the novelty of our contribution is that we address the question of the impact of natural resources on Africa's growth by examining whether the transmission channels of growth operate differently in resource-rich and resource-poor African countries. The paper attempts to answer the following two questions. What are the indirect contributions to growth of initial conditions in resource-rich and resource-poor economies? Are the effects on growth of certain explanatory variables the same in resource-rich and resource-poor economies?

Following the classification scheme developed by Diao et al (2006) and Collier and O'Connell (2008), we identify and compare the following groups of countries: (i) coastal versus landlocked countries, (ii) mineral-rich versus mineral-poor countries, and (iii) countries with more favourable versus less favourable agricultural conditions.

Using annual data from 1970 to 2015 and controlling for Nickel (1981) bias and cross-sectional dependence, we find that robust regression analysis suggests four main results. First, reducing tax distortions promotes growth in resource-rich and resource-poor countries, and is necessary but insufficient in landlocked countries. Second, population growth is detrimental to growth in coastal, resource-rich and resource-poor countries, and could be reduced by high levels of education. Third, institutional quality, which could be improved by higher levels of education, promotes growth in coastal and resource-rich countries, while cultural fragmentation undermines growth as well as institutional quality in coastal, landlocked and resource-rich countries. Fourth, and for resource-poor countries, closure to trade is detrimental to growth.

LITERATURE REVIEW

Several studies have examined the mechanisms of economic growth in resource-rich and resource-poor African countries. In the context of the African region, countries may be less productive than others because of factors that they cannot change (at least in the medium term) (Collier and Gunning, 1999; Easterly and Levine, 2003). These factors include geographical endowments (landlocked or with access to the sea), resource endowments, disease prevalence, past history (the nature of colonial government), ethnic diversity, etc. (Collier and Gunning, 1999). According to the geographical endowments hypothesis, the fact that a country is landlocked and therefore not open to trade will permanently limit its ability to access a large economic market, hamper its ability to exploit economies of scale and therefore reduce the efficiency of its production (Sachs and Warner, 2001). Collier (2006) argues that coastal countries will perform better than landlocked countries. Depending on the availability of natural resources, growth opportunities vary from one country to another (Collier and O'Connell, 2004). Resource endowments have a potentially beneficial impact on economic prosperity. For example, natural resources are a potential source of income, part of which can be saved and converted into capital to support future increases in production levels (Papyrakis and Gerlagh, 2004). Bloom and Sachs (1998) point out that unfavourable geography is a cause of slow development. For example, countries with unfavourable agricultural conditions should be poorer than countries with more favourable agricultural conditions.

However, it is also widely accepted that natural resources appear to have been more of a curse than a blessing for many countries, i.e. resource-rich economies tend to grow more slowly (Lane and Tornell, 1996; Atkinson and Hamilton, 2003). Firstly, economists, such as Leite and Weidmann (1999), Ross (2001), Auty (2001) and Sala-i-Martin and Subramanian (2003), believe that natural resource abundance leads to increased rent-seeking, corruption, lower overall government efficiency and, consequently, poor economic growth. Secondly, it is widely acknowledged that natural resource wealth has encouraged developing countries to pursue protectionist and state-led development strategies, in an attempt to combat the effects of resource-abundance related Dutch Disease. This inward-looking development strategy can result in lower investment rates and/or lower growth rates (Matsen and Torvik, 2005). Third, for many economists (e.g. Sachs and Warner, 1999), countries with more abundant natural resources tend to have higher aggregate demand and higher relative prices for non-traded goods. This could affect the relative prices of investment goods (which have a large trade component), with effects on investment rates and growth. Fourth, an abundance of natural resources leads to an increase in aggregate demand that diverts labour away from learning-by-doing sectors, lowering growth in GDP per worker. In addition, resource-rich economies benefit less from the technological spillovers typical of manufacturing industries, as exports from these industries are affected by an appreciation of the local currency, for example through inflationary pressure resulting from increased domestic demand (Gylfason, 2001). Finally, there is also evidence that the abundance of natural resources greatly increases the potential for violent civil conflict, which is not conducive to growth (Collier and Hoeffler, 2005).

METHODOLOGY

To deal with the endogeneity of the repressors, the equations are estimated using the generalized method of moments (GMM). The model estimated in this study is the resource-rich country intercept, which is estimated using the random fixed effects approach.

Specification of the model

The resource-rich and resource-poor countries in Sub-Saharan Africa have different growth, the equations are estimated in two modalities: restricted and unrestricted, hence the writing of the unrestricted regression is as follows:

$$Y = \beta_{\grave{a}} + \gamma_{\grave{a}} d + \beta X + \gamma (dX) + \varepsilon \qquad (1)$$

With **d** a dummy variable, 1 equals the observation of resource-rich (coastal) countries and 0 equals the observation of resource-poor (landlocked) countries, similarly **1** for mineral-rich countries and **0** for poor countries. This study makes use of the semi-parametric technique of median regression, which is considered to be one of the solutions to the optimization problem, written as follows:

$$Min\ y_{\beta} \sum_{i=1}^{n} \left| -x\beta \right| \ Le\ LAD \qquad (2)$$

$$\Pr ob\left[y_i \leq x^{'} \beta \right] = q.Le \qquad (3)$$

LAD is the estimator of the median regression, it is also the quintile solution when q=0.5.

The data

We use the dataset covering the period: 1970-2015 and covering 45 African countries. Detailed descriptions of the variables and sources are presented in Table 1.

Table 1. Sources and definitions of variables

Variable	Definition	Source
Growth in real GDP per capita	Calculated as the first difference of the natural logarithm of the level series.	Penn World
Initial real GDP per capita	Logarithm of real GDP per capita measured at the beginning of each 5-year period.	Penn World
Demographic growth (η_i), plus technological progress (g) plus depreciation ( ) δ	Log of the sum of the rates of population growth, technological progress and depreciation. Like Mankiv et al (1992) and Ulasan (2015), we assume that the sum of the rates of depreciation.	World Bank's World Development Indicators (2015).
Secondary school enrolment rate	Average number of years of study in the total population aged over 25,	World Bank's Development Indicators

	measured at the beginning of each 5-year period.	(2015).
Size of government	Growth in the share of public spending in GDP.	Penn World
Terms of trade shock	Measured by the growth rate of the net terms of trade (2000=100). The net terms of trade are the ratio between the export price index for 2000 (base year) and the corresponding import price index.	World Bank's World Development Indicators (2015).
Investment share	Ratio of real gross investment to real GDP.	Penn World
Inflation	Inflation measured by the annual percentage growth in the GDP deflator (series in local currency).	World Bank's World Development Indicators (2015).
Institutional quality	Measured by the "constraint on the executive" variable...	Jaggers and Marshall's (2000) Policy IV Project.
WORK	The ratio of the economically active population to the total population, where the total economically active population includes those persons who meet the ILO definition of the economically active population.	World Bank's World Development Indicators (2015).
Ethnic fractionalization	Measures the probability that two individuals chosen at random in a given country belong to different ethnic groups.	Fearon (2003) and Alesia et al. (2003).
Cultural fractionalization	Measures the cultural distances between ethnic groups.	Fearon (2003) and Alesia et al. (2003).
Total arable land area	Area of arable land as a % of total land area. Raw materials endowment indices.	World Bank's World Development Indicators (2015).
Trade openness	(i) Part of the year of each 5-year period during which the country is "open" according to the definition of Sachs and Warner (1995); (ii) current openness.	Sachs and Warner (1995); Penn World

Geography Governance is measured using Freedom House's civil liberties and political rights indicators, which range from 1 (maximum rights) to 7 (minimum rights). The two indicators are combined into a composite governance indicator as follows: [14-(Civil liberties + Political rights)]/14.

RESULTS

We first present the basic results, and then carry out some sensitivity tests. In order to reveal differences in a typology of sub-Saharan African countries based on geography (coastal and landlocked countries) and natural resource endowment (resource-rich and resource-poor countries), the empirical framework is implemented by first specifying an initial growth regression and comparing estimates from restricted and unrestricted specifications. Then, additional specifications examine the determinants of the relevant variables.

Basic results

(i) Landlocked versus coastal countries: The results of the system GMM and LAD are presented in Table 2. In the systematic GMM estimations, and for each model, the validity of the estimation approach is generally confirmed by the Sargan/Hansen and autocorrelation tests. Ramsey's RESET test fails to reject the null hypothesis of no model misspecification. Column (1) shows the restricted results. The coefficient estimated by the GMM system for the (log) initial GDP per capita is negative and highly significant, confirming the conditional convergence hypothesis. The coefficients on INST, OPEN and SCHO are positive and significant at the 1 and 5% levels, confirming the importance of institutions, openness to world trade and schooling for the coastal and landlocked countries of sub-Saharan Africa. When I control for outliers, and with the exception of school enrolment, which appears to be negatively (and significantly) correlated with growth, the LAD estimates are in line with the GMM system in terms of sign, but their statistical significance and magnitude differ. In addition, and as predicted by the Solow model, population growth now contributes negatively (and significantly) to economic growth. In addition, and contrary to expectations, cultural fractionation promotes growth. However, the main interest of the restricted specification lies in the intercept term specific to landlocked countries. The results in column (1) indicate that the model in which the slope coefficients of landlocked countries are constrained to be equal to those of coastal countries does not explain the lower growth of landlocked countries. With the controls as specified, landlocked countries grow 0.4 (system-GMM) and 1.3 (LAD) percentage points per year more slowly.

The results of the unrestricted specification reported in column (2) reveal that the slope terms for landlocked countries differ along two dimensions among the nine independent variables in the initial growth regression: growth in the public expenditure/GDP ratio and institutional quality. The results of the initial growth regression, whether using the GMM system or the LAD, suggest that growth in landlocked countries is less sensitive to changes in the size of public spending as a share of GDP than it is in coastal countries. A one percentage point reduction in the growth in the size of government, which increases economic growth by 0.22 (system-GMM) or 0.12 (LAD) percentage points in coastal countries, has no impact on growth in landlocked countries. This negative result does not rule out an effect on growth from reductions in tax distortions in the landlocked countries of sub-Saharan Africa.

This potentially implies that landlocked countries do not derive the same benefit in terms of growth from reductions in the size of public spending, which is of great concern given the central role of reductions in fiscal distortions in the structural adjustment programme (SAP) adopted by most sub-Saharan African countries. In fact, the difference in the landlocked (versus coastal) slope term is statistically highly significant (P=0.051). Furthermore, the F-test fails to reject (P=0.052) the null hypothesis that the net landlocked slope term is equal to zero. Therefore, it may be more reasonable to conclude that reductions in the growth rate of the public expenditure-to-GDP ratio are a necessary but insufficient driver of growth in landlocked countries. Institutional quality promotes growth in coastal countries, while landlocked countries do not. In the full sample, coastal countries have a significantly higher median institutional quality than landlocked countries (3 versus 2) and the difference between landlocked countries is bad for growth.

The LAD results of the initial growth regression also suggest that landlocked countries are more responsive to changes in population growth and school enrolment than coastal countries. For example, an increase in the annual population growth rate of one percentage point, ceteris paribus, reduces growth in annual real per capita income by 1.6% in coastal countries, but increases it by 1.2% in landlocked countries. The t-test confirms that the difference in average years of initial schooling between coastal and landlocked countries is statistically significant. In addition, the median initial human capital endowment in coastal countries is 3.3 compared with 2.7 in landlocked countries. However, the LAD results reveal that while human capital accumulation contributes negatively (-0.8%), but not significantly, to per capita income growth in coastal countries, it contributes to per capita growth in landlocked countries by 1.3% per annum. The landlocked countries' slope terms for population growth and years of schooling are jointly significantly different from the coastal countries' slopes. An F-test strongly rejects the null hypothesis that the landlocked countries' slope terms for both variables are jointly equal to the coastal countries' slope terms (F(4, 110)=2.5, P=0.046).

The magnitude of the differences between coastal and landlocked countries is further clarified by looking for quantitative significance in explaining the slower growth of landlocked countries. To do this, I re-estimate the unrestricted specification of the initial growth regression with the independent variables in standardised form (based on the standard deviation of each variable over the whole 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 example, the LAD results indicate that a one standard deviation increase in population growth reduces growth in coastal countries by 1.8 percentage points, but increases growth in landlocked countries by 1.4 percentage points per year.

Similarly, a one standard deviation increase in the quality of institutions, represented by the 'constraint on the executive' variable, increases growth in coastal countries by 7.5 percentage points, but has no effect on the growth process in landlocked countries.

Why do landlocked countries differ in their institutional and population levels? Growth?

This question is addressed by examining whether the determinants of institutional quality and demographic growth operate differently in landlocked countries.

Table 2. Initial growth regression results - landlocked versus coastal countries

Dependent variable: GR[a]

Variable	(1)		(2)		(3)[b]	
	System GMM	LAD	System GMM	LAD	System GMM	LAD
Constant	-0.102	-0.207*	0.250	-0.011	0.026**	-0.024
	(0.173)	(0.065)	(0.270)	(0.022)	(0.013)	(0.023)
$\ln GDP_0$	-0.022*	-0.021**	-0.018*	-0.006*	-0.015	-0.006*
	(0.009)	(0.011)	(0.008)	(0.002)	(0.012)	(0.001)
$\ln LEX_0$	0.062	0.062*	-0.032	-0.001	-0.005	-0.004
	(0.042)	(0.020)	(0.057)	(0.062)	(0.008)	(0.013)
GSGS	-0.040	-0.043	-0.219**	-0.123**	0.006	-0.009
	(0.062)	(0.031)	(0.0110)	(0.066)	(0.007)	(0.007)
GPOP	0.273	-1.117*	-0.047	-1.567*	-0.001	-0.018*
	(0.286)	(0.241)	(0.066)	(0.627)	(0.008)	(0.007)
OPEN	0.023**	0.005**	0.034**	0.015	0.016**	0.007
	(0.013)	(0.003)	(0.018)	(0.016)	(0.009)	(0.008)
INST	0.001*	0.004*	0.002*	0.005	0.027*	0.075***
	(0.0003)	(0.002)	(0.0006)	(0.004)	(0.009)	(0.045)

SCHO	0.008***	-0.004*	0.010	-0.007	0.014	-0.011
	(0.005)	(0.002)	(0.010)	(0.005)	(0.014)	(0.007)
CUFR	-0.010	0.016***	-0.059	0.010	-0.013	0.002
	(0.025)	(0.009)	(0.048)	(0.031)	(0.010)	(0.007)
D_{geo}	-0.004*	-0.013*	-0.553**	-0.113	-0.004	0.019
	(0.002)	(0.004)	(0.310)	(0.315)	(0.012)	(0.031)
lnGDP			-0.007	-0.007	-0.006	-0.006
$*D_{0geo}$			(0.018)	(0.016)	(0.015)	(0.013)
lnLEX $*D_{0geo}$			0.146**	0.020	0.021**	0.003
			(0.074)	(0.095)	(0.011)	(0.014)
GPOP$*D_{geo}$			0.400	2.808*	0.005	0.032*
			(0.716)	(1.025)	(0.008)	(0.012)
OPEN$*D_{geo}$			-0.014	0.090*	-0.006	-0.004
			(0.020)	(0.034)	(0.009)	(0.010)
SCHO$*D_{geo}$			-0.003	0.013**	-0.005	0.019**
			(0.010)	(0.008)	(0.015)	(0.011)
CUFR$*D_{geo}$			0.070	-0.011	0.015	-0.024
			(0.054)	(0.022)	(0.012)	(0.023)
Pseudo-R^2		0.102		0.130		0.130
RESET[c]	0.489					
Sargan test	19.900		15.970		17.990	
(p-value)	(0.567)		(0.587)		(0.481)	
2nd order	-0.610		-0.940		-0.940	
correlation	(0.541)		(0.348)		(0.348)	
(p-value)						
# comments						
	210	128	210	128	210	128
Chow test[d] H_0 : $\gamma_0 = \gamma = 0$			0.006	0.076		
Chow test H_0 : $\gamma = 0$			0.001	0.072		

a: The coefficients are estimated for the period 1985/1989-2005/2007. The GMM coefficients of the system on the time variables are not reported .

b: Independent variables in standardised form. The coefficients indicate the effect of a variation of one standard deviation on the dependent

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

d: p-value of the stated null hypothesis.

* Standard errors in brackets = significance level of 0.01.

** Standard errors in brackets = 0.05 level of significance.

*** Standard errors in brackets = significance level 0.10.

The analysis examines whether the determinants of institutional quality operate differently in landlocked countries. The determinants of institutional quality taken into account are initial cultural fragmentation, the total number of years of schooling of the population over the age of 25 and the endowment of raw materials, represented by arable land as a fraction of the country's total surface area. Cultural diversity is a potential indicator of a country's social cohesion.

It is widely accepted that ethnic and cultural fragmentation is the fundamental reason for the difficulties of SSA, for example the lack of national political unity, the fragile nature of states, etc. (Kyumkowski and Hall, 1990). These difficulties can be seen as institutional failures. A more educated society, i.e. one with greater human capital, is better equipped to put in place a solid set of social institutions. The endowment of raw materials potentially reinforces rent-seeking behaviour. The latter is conducive to corruption and should therefore be detrimental to the quality of institutions.

The system-GMM results for the restricted specification presented in column (1) of Table 3 indicate that higher initial levels of total years of schooling and raw material endowment have positive, but insignificant, effects on institutional quality. Greater initial cultural fragmentation is detrimental to institutional quality, and the effect is also insignificant. It should be noted that the restricted specification fails to eliminate the intercept of landlocked countries (P=0.044). In terms of sign, the results of the LAD estimation of the restricted specification (column (1), Table 3) are consistent with the results of the GMM system, but differ in terms of statistical significance and magnitude. Indeed, higher educational attainment and greater cultural fragmentation have the expected statistically significant effects on institutional quality.

By focusing the analysis on the LAD estimate, the results of the unrestricted specification in column (2) of Table 3 fail to eliminate the intercept for landlocked countries. The results of the unrestricted specification further reveal that the marginal impacts of the variables of schooling, commodity abundance and cultural fragmentation differ significantly in the observations of landlocked countries compared to those of coastal countries.

The total number of years of education contributes to institutional quality in coastal countries. The slope term for landlocked countries is statistically different from the slope for coastal countries, and their sum (the net slope for landlocked countries) is not significantly different from zero. Counter-intuitively, the abundance of raw materials favours the quality of institutions in coastal countries and, as expected, weakens institutions in landlocked countries.

Table 3. Determinants of institutional quality - results for coastal and landlocked countries[a]

Variable	(1)		(2)		(3)[b]	
	System GMM	LAD	System GMM	LAD	System GMM	LAD
Constant	2.836	2.032*	1.484	1.002*	2.911**	3.116*
	(4.749)	(0.466)	(1.963)	(0.363)	(1.377)	(0.103)
SCHO	0.650	0.498*	0.931	0.736*	1.354	1.070*
	(0.812)	(0.085)	(0.834)	(0.069)	(1.213)	(0.100)
ARAB	0.351	0.688	0.089	0.384*	1.503	0.807*
	(0.924)	(0.908)	(0.060)	(0.045)	(1.015)	(0.094)
CUFR	-0.347	-1.766*	-0.587	-0.511*	-0.657	-0.548*
	(0.510)	(0.557)	(0.544)	(0.109)	(0.534)	(0.117)
Dgeo	-0.092**	-0.654*	0.804	0.767*	-0.557	-0.977*
	(0.052)	(0.239)	(0.638)	(0.207)	(0.426)	(0.168)
SCHO*D_{geo}			-1.650	-0.747*	-0.401	-1.087*
			(2.399)	(0.130)	(0.489)	(0.190)
ARAB*D_{geo}			-0.629	-0.825*	-0.872	-1.495*
			(0.593)	(0.105)	(0.766)	(0.191)
CUFR*D_{geo}			-0.425	0.354	-0.185	0.077
			(0.335)	(0.901)	(0.138)	(0.197)
Pseudo-R^2		0.084		0.095		0.095
RESET[c]	0.964					
Sargan test	16.680		28.440		29.210	
(p-value)	(0.274)		(0.288)		(0.255)	
2nd order correlation	-0.430		-0.420		-0.410	
(p-value)	(0.666)		(0.674)		(0.684)	
# comments	210	210	210	210	210	210
Chow test[d] $H_0 : \gamma_0 = \gamma = 0$			0.007	0.000		
Chow test $H_0 : \gamma = 0$			0.003	0.000		

a: The coefficients are estimated for the period 1985/1989-2005/2007. The GMM coefficients of the system on the time variables are not reported.

b: Independent variables in standardised form. The coefficients indicate the effect of a variation of one standard deviation on the dependent

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

* Standard errors in brackets = 0.01 level of significance.

** Standard errors in brackets = 0.05 level of significance.

*** Standard errors in brackets = significance level 0.10.

Table 4 presents the results of System-GMM and LAD regressions of restricted versions of a quadratic specification of population growth. Both the restricted System-GMM and LAD specifications in column (1) account for differences between landlocked countries, as reflected in the intercept term. For example, the results of the GMM system indicate that ceteris paribus the population of landlocked countries is growing at a slower rate of 1 percentage point per year. For life expectancy at birth, the first and second order terms have the expected sign, i.e. they produce a U-shaped function, which is only significant at the 13% level. But the LAD estimate produces a statistically significant U-shaped function for life expectancy at birth.

Table 4, column (2), presents the results of the unrestricted version of the population growth specification, both by system-GMM and by LAD. In terms of initial life expectancy at birth, the landlocked countries' terms are both significantly different from the coastal countries' terms (P=0.000 and P=0.000 for the first-order and second-order terms, respectively). The F-test rejects the null hypothesis that the first-order and second-order net slope terms for landlocked countries are equal to zero (P=0.000 and P=0.000 for the first-order and second-order terms, respectively).

Table 4. Determinants of population growth - results for coastal and landlocked countries[a]

Variable	(1)		(2)		(3)[b]	
	System GMM	LAD	System GMM	LAD	System GMM	LAD
Constant	1.159***	-1.865*	-2.258*	-2.240*	0.026*	0.026*
	(0.709)	(0.294)	(0.494)	(0.524)	(0.001)	(0.001)
$lnGDP_0$	-0.003	-0.002***	-0.002	-0.001	-0.003**	-0.003**
	(0.006)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
$lnLEX_0$	-0.530	-0.954*	-1.168*	-1.144*	-0.001	-0.001
	(0.346)	(0.149)	(0.246)	(0.265)	(0.001)	(0.001)
SCHO	-0.003**	-0.002*	-0.002*	-0.003*	-0.003*	-0.004*
	(0.002)	(0.0005)	(0.0008)	(0.0007)	(0.001)	(0.001)
WORK	-0.240	-0.046	-0.118	-0.006	-0.001	-0.001
	(0.269)	(0.073)	(0.077)	(0.101)	(0.001)	(0.001)
$(lnLEX)_0^2$	0.068	0.120*	0.146*	0.144*	0.005*	0.002**
	(0.044)	(0.019)	(0.031)	(0.033)	(0.001)	(0.0008)
$(WORK)^2$	0.168	0.037	0.123***	0.015	0.001	0.001
	(0.298)	(0.079)	(0.073)	(0.106)	(0.002)	(0.001)
Dgeo	-0.010	-0.001	5.996*	3.305*	-0.003	-0.0005
	(0.009)	(0.001)	(1.056)	(0.676)	(0.002)	(0.002)

lnGDP $*Dgeo_0$			-0.008**	-0.006*	-0.006	-0.003
			(0.004)	(0.002)	(0.004)	(0.002)
lnLEX $*Dgeo_0$			-3.075*	-1.686*	-0.011**	-0.006*
			(0.543)	(0.345)	(0.005)	(0.002)
SCHO*Dgeo			0.002	0.002**	0.002	0.003**
			(0.002)	(0.001)	(0.003)	(0.002)
WORK*Dgeo			-0.087	-0.114	0.003	-0.003**
			(0.328)	(0.184)	(0.003)	(0.002)
(lnLEX)			0.398*	0.219*	0.028**	0.091*
$*Dgeo_0^2$			(0.073)	(0.044)	(0.013)	(0.007)
(WORK)			0.140	0.160	-0.024	0.009
$*Dgeo^2$			(0.404)	(0.212)	(0.084)	(0.011)
Pseudo-R^2		0.212		0.248		0.248
RESET[c]	0.749					
2nd order	0.780		0.570		0.560	
correlation	(0.435)		(0.567)		(0.574)	
(p-value)						
# comments						
	210		210	210	210	210
Chow test[d] $H_0: \gamma_0 = \gamma = 0$			0.000	0.000		
Chow test $H_0: \gamma = 0$			0.000	0.000		

a: The coefficients are estimated for the period 1985/1989-2005/2007. The GMM coefficients of the system on the time variables are not reported.

b: Independent variables in standardised form. The coefficients indicate the effect of a variation of one standard deviation on the dependent

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

* Standard errors in brackets = 0.01 level of significance.

** Standard errors in brackets = 0.05 level of significance.

*** Standard errors in brackets = significance level 0.10.

(ii) Resource-rich and resource-poor countries: The results of the estimation of the initial growth equation are presented in Table 5. The Ramsey RESET test does not reject the null hypothesis of no omitted variables. Initial life expectancy, population growth, institutions and openness all have the expected sign and are statistically significant at conventional levels. In addition, the LAD results show that financial development promotes growth. With the controls as specified, the GMM and LAD results show that resource-poor countries grow more slowly than their resource-rich counterparts. When all slope terms are freed to differ for resource-poor countries, the unrestricted GMM and DAL results in column (2) of Table 5 do not eliminate the intercept term for resource-poor countries.

Among the twelve exogenous variables in the initial growth regression, the results in column (2) reveal that the marginal effects of resource-poor countries differ along five dimensions, namely growth in public spending as a percentage of GDP, population growth, openness, institutions and cultural diversity. The quality of institutions both promotes and hinders growth in resource-rich and resource-poor countries. The slope term for resource-rich countries is statistically different from the slope for resource-poor countries (P=0.012), and their sum (the net slope for resource-poor countries) is also significantly different from zero (P=0.028). Cultural diversity is detrimental to growth in resource-rich countries, but has no impact in resource-poor economies. An F-test strongly rejects the null hypothesis that the resource-rich countries' slope term for cultural fragmentation is equal to the resource-poor countries' slope term (F (1,147) =1.21, P=0.031). The slope term for cultural fragmentation is not significantly different from zero in resource-poor countries (P=0.152). Indeed, resource-rich countries in Sub-Saharan Africa have a high degree of cultural fragmentation, i.e. a median score of 0.51 compared with 0.4 in resource-poor countries. Any increase in the annual growth rate of the public expenditure/GDP ratio as well as in the annual growth rate of the population reduces growth in both resource-rich and resource-poor sub-Saharan African countries. For example, the GMM results in column (3) of Table 5 show that a one standard deviation increase in public expenditure growth reduces growth by 0.3 and 2.3 percentage points in resource-rich and resource-poor countries, respectively. Similarly, a one standard deviation increase in population growth reduces growth by 1 (resource-rich countries) and 5.5 (resource-poor countries) percentage points.

Finally, with regard to the difference in the slope coefficient of openness between resource-poor countries and the rest of the sample (resource-rich countries), the interpretation of the GMM system results is that while openness increases growth in the general sample by 4.8% per year, the increase for resource-poor countries is 8.3% per year. Consequently, openness to world trade has a greater effect on growth in resource-poor countries. Another approach to studying the effect of openness on growth is to replace the Sachs-Warner dummy variable with the residuals from a regression of the logarithm of the share of trade in GDP on the logarithms of area and population, as well as on indicator variables for oil-producing and landlocked countries. The results (not reported here) show that the coefficient of openness is positive and statistically insignificant for resource-rich countries, but positive and significant for resource-poor countries. As a result, closure to trade is more detrimental to growth in resource-poor countries than in resource-rich countries.

Table 5. Initial growth regression results - resource-poor versus resource-rich countries. Dependent variable : GR [a]

Variable	(1)		(2)		(3)[b]	
	System GMM	LAD	System GMM	LAD	System GMM	LAD
Constant	-0.161	0.048	0.199	0.185*	0.036*	0.003
	(0.136)	(0.058)	(0.188)	(0.044)	(0.014)	(0.005)
$lnGDP_0$	-0.029*	-0.022**	-0.045*	-0.012*	-0.038*	-0.010*
	(0.010)	(0.012)	(0.015)	(0.002)	(0.012)	(0.002)
$lnLEX_0$	0.097**	0.054***	0.032	-0.020***	0.005	-0.003***
	(0.041)	(0.032)	(0.043)	(0.012)	(0.006)	(0.002)
GSGS	-0.048	-0.023	-0.045*	-0.007**	-.003*	-0.001**
	(0.067)	(0.027)	(0.018)	(0.004)	(0.001)	(0.0003)
GPOP	-0.204**	-0.787*	-0.084**	-0.345**	-0.010**	-0.004**
	(0.117)	(0.220)	(0.046)	(0.182)	(0.005)	(0.002)
OPEN	0.029**	0.006**	0.048***	0.024*	0.023***	0.011*
	(0.014)	(0.003)	(0.029)	(0.003)	(0.014)	(0.002)
INST	0.001*	0.003*	0.002*	0.004*	0.026*	0.057*
	(0.0003)	(0.001)	(0.0006)	(0.0007)	(0.009)	(0.011)
SCHO	0.006	-0.002	0.010	-0.002	0.014	-0.002
	(0.004)	(0.002)	(0.007)	(0.001)	(0.010)	(0.002)
INFL	-0.0005	-0.008	-0.001	0.001	-0.006	0.004
	(0.0005)	(0.007)	(0.001)	(0.004)	(0.005)	(0.028)
FDEP	-0.0004	0.010**	-0.0001	0.018*	-0.0001	0.041*
	(0.0003)	(0.006)	(0.0005)	(0.004)	(0.001)	(0.009)
CUFR	-0.030	-0.011	-0.066**	-0.040*	-0.014	-0.009*
	(0.025)	(0.010)	(0.032)	(0.008)	(0.009)	(0.002)
D_{geo}	-0.032**	-0.046**	-0.627*	-0.015*	-0.033**	-0.117*
	(0.016)	(0.024)	(0.268)	(0.007)	(0.016)	(0.007)
lnGDP			0.035	0.019*	0.006	0.016*
$*D_{0geo}$			(0.021)	(0.004)	(0.013)	(0.003)
$lnLEX *D_{0geo}$			0.095	-0.024	-0.012	-0.004
			(0.077)	(0.019)	(0.014)	(0.003)
$GSGS*D_{geo}$			-0.020**	-0.080*	-0.001**	-0.006*
			(0.009)	(0.026)	(0.0005)	(0.002)
$GPOP*D_{geo}$			-0.045**	-1.113*	-0.005*	-0.013*
			(0.023)	(0.238)	(0.002)	(0.003)

OPEN*D_{geo}			0.035**	0.017*	0.016	0.008*
			(0.016)	(0.005)	(0.015)	(0.002)
INST*D_{geo}			-0.045**	-0.0004**	-0.019**	0.007
			(0.023)	(0.0002)	(0.010)	(0.018)
SCHO*D_{geo}			-0.014	-0.0004	-0.020	-0.001
			(0.010)	(0.002)	(0.014)	(0.003)
INFL*D_{geo}			0.001	-0.109*	0.009	-0.836*
			(0.0007)	(0.005)	(0.006)	(0.039)
FDEP*D_{geo}			0.004	-0.027*	0.010	-0.061*
			(0.044)	(0.009)	(0.102)	(0.021)
Pseudo-R^2		0.068		0.127		0.127
RESET[c]	0.429					
Sargan test	16.540		19.950		19.950	
(p-value)	(0.672)		(0.288)		(0.288)	
2nd order	-0.530		-0.450		-0.450	
correlation	(0.599)		(0.649)		(0.649)	
(p-value)						
# comments						
	210	144	210	144	210	144
Chow test[d] H_0 : $\gamma_0 = \gamma = 0$			0.002	0.000		
Chow test H_0 : $\gamma = 0$			0.001	0.000		

a: The coefficients are estimated for the period 1985/1989-2005/2007. The GMM coefficients of the system on the time variables are not reported.

b: Independent variables in standardised form. The coefficients indicate the effect of a variation of one standard deviation on the dependent

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

d: p-value of the stated null hypothesis.

* Standard errors in brackets = significance level of 0.01.

Regarding the question of whether the determinants of institutional quality operate differently in resource-poor countries, the results of the System-GMM and LAD estimation of the restricted specification in column (1) of Table 6 show that cultural fragmentation and education have the expected sign and that both effects are statistically significant. It should be noted that the restricted specification fails to eliminate the intercept for resource-poor countries. The results in column (2) indicate that the marginal impact of cultural fragmentation, total years of education and commodity abundance differs in resource-poor countries compared to observations from resource-rich countries. The initial number of years of education does not contribute to institutional quality in resource-poor countries, despite its very significant effect in resource-rich countries. The slope term for resource-poor countries is statistically different from the slope term for resource-rich countries (P=0.004), but the net slope term for resource-poor countries (their sum) is not significantly different from zero (P=0.346). Cultural fragmentation undermines institutional quality in resource-rich countries and has no effect in resource-poor countries. The slope term of resource-poor countries for cultural diversity is significantly different from the slope of resource-rich countries (P=0.008), but not significantly different from zero (P=0.921). A counterintuitive result is that commodity abundance is positively associated with institutional quality in resource-rich countries, despite the usual claim of increased potential for rent-seeking behaviour, which can be conducive to corruption in resource-rich economies. This result is statistically different from resource-poor countries (P=0.000) and zero (P=0.002).

Table 6. Determinants of institutional quality - performance of resource-poor versus resource-rich countries[a]

Variable	(1)		(2)		(3)[b]	
	System GMM	LAD	System GMM	LAD	System GMM	LAD
Constant	-1.240	1.267*	-3.196	1.299*	2.328	2.669*
	(0.984)	(0.432)	(2.251)	(0.332)	(2.172)	(0.120)
SCHO	0.062**	0.053*	0.043*	0.056*	0.085**	0.813*
	(0.034)	(0.008)	(0.019)	(0.006)	(0.040)	(0.086)
ARAB	0.079	-1.079	0.096	0.065*	0.029**	0.461*
	(0.074)	(0.893)	(0.116)	(0.020)	(0.016)	(0.145)
CUFR	-0.011**	-1.500*	-0.026**	-0.086*	-0.015**	-0.456*
	(0.005)	(0.525)	(0.015)	(0.018)	(0.009)	(0.095)
Dres	0.069**	0.941*	1.402**	1.245*	1.304**	0.499*
	(0.034)	(0.240)	(0.783)	(0.425)	(0.639)	(0.142)
SCHO*D_{res}			-0.003	-0.092	-0.015*	-0.134
			(0.002)	(0.079)	(0.006)	(0.114)
ARAB*D_{res}			-0.028**	-0.118*	-0.035***	-0.773*
			(0.015)	(0.024)	(0.021)	(0.158)
CUFR*D_{res}			0.019**	0.029***	0.040**	0.198***
			(0.009)	(0.018)	(0.019)	(0.122)
Pseudo-R^2		0.069		0.093		0.093
RESET[c]	0.418					
Sargan test	11.100		22.590		22.590	
(p-value)	(0.678)		(0.601)		(0.601)	

2nd order correlation (p-value)	-0.410 (0.679)		-0.410 (0.685)		-0.410 (0.685)	
# comments	210	210	210	210	210	210
Chow test[d] H_0 : $\gamma_0 = \gamma = 0$			0.067	0.000		
Chow test H_0 : $\gamma = 0$			0.056	0.000		

a: The coefficients are estimated for the period 1985/1989-2005/2007. The GMM coefficients of the system on the time variables are not reported.

b: Independent variables in standardised form. The coefficients indicate the effect of a variation of one standard deviation on the dependent

Finally, I investigate whether the determinants of population growth act differently in resource-poor countries. Table 7 presents the results of system-GMM and LAD regressions of restricted specifications for population growth. The total number of years of education is, as expected, negatively and significantly associated with population growth.

Column (2) of Table 7 shows the unrestricted specification for population growth. Freeing the slope terms for resource-poor countries does not eliminate the intercept for resource-poor countries. For total schooling, the slope term for resource-poor countries is significantly different from the slope for resource-rich countries. Thus, a more educated population reduces demographic growth in both resource-rich and resource-poor countries. The LAD results in column (3) of Table 8, for example, reveal that each additional year of schooling reduces the population by 0.4 (resource-rich countries) and 0.7 (resource-poor countries) percentage points.

Table 7. Determinants of population growth - results for resource-poor versus resource-rich countries[a]

Variable	(1)		(2)		(3)[b]	
	System GMM	LAD	System GMM	LAD	System GMM	LAD
Constant	0.042	0.055	-0.051**	-0.016	0.025*	0.026*
	(0.050)	(0.048)	(0.029)	(0.032)	(0.002)	(0.001)
$\ln LEX_0$	-0.002	0.009**	0.023*	0.012	0.003*	0.002
	(0.014)	(0.005)	(0.008)	(0.008)	(0.001)	(0.001)
SCHO	-0.003*	-0.003*	-0.003*	-0.003*	-0.004*	-0.004*
	(0.0008)	(0.0005)	(0.0008)	(0.0006)	(0.001)	(0.0009)
WORK	-0.0001	-0.0004	-0.0001	0.0001	-0.001	0.0004
	(0.0001)	(0.001)	(0.0002)	(0.0001)	(0.001)	(0.0009)

Dres	-0.0005	-0.001	0.133	0.062	-0.0003	-0.0006
	(0.004)	(0.001)	(0.082)	(0.041)	(0.002)	(0.001)
lnLEX *$Dres_0$			-0.036	-0.014	-0.005	-0.002
			(0.022)	(0.010)	(0.003)	(0.001)
SCHO*Dres			-0.001**	-0.002**	-0.0001**	-0.003**
			(0.0006)	(0.001)	(0.00005)	(0.001)
Pseudo-R^2		0.122		0.142		0.142
RESET[c]	0.487					
Sargan test	21.140		26.930		26.930	
(p-value)	(0.132)		(0.468)		(0.468)	
2^{nd} order	0.780		0.800		0.800	
correlation	(0.438)		(0.424)		(0.424)	
(p-value)						
# comments						
	210	210	210	210	210	210
Chow test[d] H_0 : $\gamma_0 = \gamma = 0$			0.016	0.020		
Chow test H_0 : $\gamma = 0$			0.012	0.009		

a: The coefficients are estimated for the period 1985/1989-2005/2007. The GMM coefficients of the system on the time variables are not reported.

b: Independent variables in standardised form. The coefficients indicate the effect of a variation of one standard deviation on the dependent

Robustness tests

One of the main econometric problems is related to outliers, i.e. high growth rates in certain countries, such as Botswana and Mauritius. To ensure that the results are not unduly influenced by a small group of outliers, I use the semi-parametric technique of median regression (a special case of quantile regression). Rather than minimising the squared deviation from the mean, median regression minimises the absolute deviation around the median of the distribution of the dependent variable, by solving (Block, 2001). The resulting estimator is also known as the least absolute deviation (LAD) estimator. LAD estimation is a special case of quantile regression. The LAD estimator estimates the median regression, i.e. it is the solution of the quantile regression when q=0.5.

CONCLUSION

The main objective of this paper was to investigate whether growth mechanisms work differently in landlocked versus coastal countries, and in resource-rich versus resource-poor countries in sub-Saharan Africa (SSA). The study used panel data for the period 1985/89-

2005/07. The determinants of growth were identified in the initial growth regression using both system-GMM and least absolute deviation (LAD) estimation approaches. In addition, and in contrast to previous studies, I extended the analysis in two respects. First, in order to find differences in the impact of variables on growth in landlocked and resource-poor countries, I tested the hypothesis of equal parameter estimates first in coastal and landlocked countries and then in resource-rich and resource-poor countries. Then, by specifying additional equations, I estimated the indirect contributions to growth of various initial conditions and exogenous factors to the extent that they influence the explanatory variables in the initial growth regression. Whatever the sub-group of countries considered, the empirical results reveal that most of the differences in growth mechanisms do not appear in the initial regression, but rather in the indirect effects on growth that operate through these direct determinants. The robust regression analysis suggests four main results. First, reducing tax distortions promotes growth in both resource-rich and resource-poor countries, and is necessary but insufficient in landlocked countries. Second, population growth is detrimental to growth in coastal, resource-rich and resource-poor countries, and could be reduced through high levels of education. Third, institutional quality, enhanced by higher levels of education, promotes growth in coastal and resource-rich countries, while cultural fragmentation undermines growth as well as institutional quality in coastal, landlocked and resource-rich countries. Fourth, and for resource-poor countries, closure to trade is detrimental to growth. So, as a future research perspective, the question is: why do the landlocked countries of sub-Saharan Africa have very low levels of institutions and population?

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