Why are natural resources a curse in Africa, but not elsewhere ?

Fabrizio Carmignani
School of Economics
The University of Queensland*

Abdur Chowdhury
Department of Economics
Marquette University

Abstract. We study the nexus between natural resources and growth in Sub-Saharan Africa (SSA) and find that SSA is indeed special: resources dependence retards growth in SSA, but not elsewhere. The natural resources curse is thus specific to SSA. We then show that this specificity does not depend on the type of primary commodities on which SSA specializes. Instead, the SSA specificity appears to arise from the interaction between institutions and natural resources.

JEL Classification O13, O40, Q00, F43,

Keywords: natural resources, growth, institutions

* Corresponding author: School of Economics, The University of Queensland, Brisbane, QLD 4072 Australia. E-mail address: f.carmignani@uq.edu.au.

Introduction

Between 1960 and 2008, Sub-Saharan Africa (SSA) has been characterized by a weak growth performance and a high and persistent dependence on natural resources. During this period, per-capita GDP in SSA has grown at an average annual rate of 0.74%.[1] Over the same period of time, the ratio of natural resource exports to total merchandise exports in SSA has only marginally declined from an initial 77% to the current 65.1%[2]. As of 2006, the ratio in SSA is about 16 percentage points higher than the average observed for the group of low income countries and 28 points higher than the average of the group of middle income countries. Is there any causality nexus between these two facts? In this paper we try to answer this question. More specifically, we study whether natural resources are the cause (or one of the causes) of underdevelopment of SSA.

Hints to answering this question may come from two separate strands of the literature. The first strand investigates the natural resource curse hypothesis. Sachs and Warner (1995 and 2001) empirically show that a higher dependence on natural resources reduces subsequent economic growth in a large cross section of countries.[3] However, recent contributions challenge the conventional wisdom on the resource curse. The findings reported by Stijns (2005), Brunnschweiler (2008), and Brunnschweiler and Bulte (2008) suggest that the negative effect of

[1] This compares with an average growth rate of 2.78% in South Asia, 1.83% in Latin America, 5.47% in East Asia, and 1.67% in the group of low income economies.

[2] The comparison with other developing regions is again quite striking: the ratio of resource exports to total exports has decreased from 88.1% to 42.8% in Latin America, from 57.9% to 23.7% in South Asia, and from 49.5% to 19.2% in East Asia.

[3] Theoretical rationalizations of this negative effect can be found in Gylfason and Zoega (2003) and Eliasson and Turnovsky (2004) while Leite and Weidmann (1999), Bravo-Ortega and De Gregorio (2005), Bulte et al. (2005) and Isham et al. (2005) provide further empirical support to the curse hypothesis. A related branch of the literature studies how the presence and exploitation of resources matters for the occurrence of conflict (which is in turn detrimental to growth), see for instance Humphreys (2005), Brunnschweiler and Bulte (2009), and Schollaert and Van de gaer (2009).

natural resources on growth is not robust to changes in the specification of the regression model and/or the empirical measurement of resources. Furthermore, Mehlum et al. (2006), Snyder (2006), and Boschini et al. (2007) provide evidence that natural resources are not a curse *per se*, but that their effect on growth is conditional on the quality of underlying institutions. Along similar lines, Hodler (2006) argues that natural resources lower incomes in ethnically fractionalized countries, but increase income in homogenous countries. Alexeev and Conrad (2009) emphasize the importance of "level effects" of natural resources and provide evidence that a large endowment of oil and other mineral resources has a positive effect on the level of per-capita GDP in the long-term. They also show that oil and minerals are largely neutral with respect to the quality of the countries' institutions. In a recent contribution, Norman (2009) finds that larger initial natural resource stocks reduce the levels of rule of law and do not affect growth directly, while raw resource exports do not significantly affect the role of law but do affect average growth rates. All in all, the jury is still out on the case of whether natural resources are bad for growth or not.

The second relevant strand of the literature is concerned directly with the explanation of Africa's growth tragedy. The general idea underlying this research is that Africa is deficient in most of the key determinants of growth, such as openness to international trade, human capital (education and health), and public infrastructures. Easterly and Levine (1997) suggest that this deficiency is due to the high degree of ethnic fragmentation that characterizes the continent. Collier and Gunning (1999) point to institutional weaknesses as the main reason why Africa lacks the key growth drivers. Following the argument originally advanced by Acemoglu et al. (2001), Nunn (2007) traces the cause of bad institutions back to colonial rule and slave trade. The high mortality due to high malaria incidence is also regarded as a major obstacle to growth and development in Africa (Bloom and Sachs, 1998) and Bhattacharyya, 2009). Sachs and Warner (1997) also emphasize the role of geography, which includes exposure to malaria and other diseases as well as the tendency to develop a high dependence on natural resources. Artadi and Sala-i-Martin (2003) take a number of robust determinants of growth and show that with respect to almost each of them African performs significantly worse than the other developing regions.

We bring these two strands of the literature together in an attempt to shed new light on the relevance of the curse hypothesis within the African context. Our methodological framework is a standard growth regression (see Section 2 below). We specify the r.h.s. of the regression to (i) allow the effect of natural resources to be different between SSA and the rest of the world (ROW) and to (ii) understand why natural resources are (eventually) a curse in SSA but not elsewhere. Our main findings can be summarized as follows. First, SSA does suffer from the resource curse while the rest of the world does not. This differential effect, which we refer to as the "SSA specificity", mostly arises from the negative growth-effect that fuels and base metals have in SSA. One can see in this result an extension of the hypothesis that natural resources are not a curse *per-se*, but rather that they are a curse depending upon some other initial conditions of the economy. Second, only few of the commodities that characterize the structure of production and export specialization of SSA seem to be intrinsically bad for growth in the sense that they significantly increase economy's exposure to growth-reducing terms of trade shocks. Third, institutional development affects the extent to which the relationship between natural resources and growth differs between SSA and the rest of the world. In fact, once the interaction between natural resources and institutions is explicitly modeled, the SSA specificity vanishes.

The rest of the paper is organized as follows. Section 2 presents the basic regression framework and the differential role of natural resources in SSA and in the rest of the world. Section 3 links the peculiar pattern of specialization of SSA to terms of trade effects. Section 4 looks at the interaction between natural resources and institutions. Section 5 provides some additional evidence on the robustness of the main results of the paper. The appendix contains the description of variables, a full list of data sources, and statistics on the relevance of the instruments used in the econometric analysis.

1. Searching for a curse

1.1 *Econometric model*

The econometric analysis in this paper makes use of a standard growth regression framework of the type:

$$(1) \quad g_{it} = \alpha_0 + \alpha_1 x_{1,it} + .. + \alpha_n x_{n,it} + \beta z_{it} + \varepsilon_{it}$$

where g is the growth rate of per-capita GDP period over period t in generic country i, x_k (with $k = 1, 2 \ldots n$) is a set of control variables, z is an indicator of resource dependence, ε is a random disturbance, and the αs and β are parameters to be estimated. To capture long-term effects, and coherently with much of the growth literature, data are averaged over sub-periods of five year each. The period of observation is 1975-2004. The full sample includes up to 109 countries (see Appendix for a list).

The methodological difficulties in estimating equation (1) are well-known. The first hurdle is the choice of control variables. In the voluminous literature on growth empirics, up to 70 variables have been used on the r.h.s. of equation (1). Given the impossibility of using all of them simultaneously, one is left with a close to infinite number of combinations of subsets. The feasible strategy is to select a number of controls on the basis of theoretical considerations and then test for the sensitivity of the results to changes in the basic specification of the model. In line with this approach, the following variables are used as controls: (i) the lagged value of per-capita GDP to account for the relative convergence hypothesis, (ii) average inflation rate and government consumption to GDP ratio to account for the macroeconomic policy stance, (iii) the enrollment rate in secondary schooling to proxy for the impact of human capital accumulation, (iv) an index of ethno-linguistic fractionalization and the absolute geographical latitude of countries to capture country-fixed effects that previous research has shown to be important determinants of growth in the least developed countries, (v) the ratio of exports and imports to GDP to measure the degree of country's trade integration with the rest of the world, and (vi) time dummies to account for time-specific effects.

The second major problem in the estimation of equation (1) concerns the choice of the estimator. In order to address the issues of endogeneity and correlated individual effects that make standard Ordinary Least Squares inappropriate, Caselli et al. (1996) propose to estimate the growth regression with a variant of the Generalised Method of Moment (GMM) of Arellano and Bond (1991). With this estimator, the growth regression is first transformed in a dynamic model of the level of per-capita GDP. The transformed model is then first-differenced to eliminate the bias arising from individual heterogeneity and estimated using all lagged values of the regressors as instruments. However, given that the basic specification chosen for model (1) also includes time-invariant country fixed effects, we opt for a standard two stage least squares (2SLS) estimator, which can in fact be regarded as a special case of GMM estimator for dynamic panels. The endogenous variables in model (1)[4] are instrumented using their one period-lagged value (as the data are five period averages, the observation in 1970-74 is used to instrument the observation in 1975-79: the observation in 1975-79 is used as instrument of the observation in 1980-1984, and so on). In order to strengthen the set of instruments and increase the number of overidentifying restrictions, legal origin dummies are added to the group of lagged variables (see La Porta et al., 1999) for the underlying rationale). This also allows controlling for some possible residual endogeneity of lagged income[5].

The final methodological issue concerns the measurement of resource dependence. Sachs and Warner (1995) suggest using the share of exports of natural resources in GDP while Sala-i-Martin and Subramanian (2003) extend this to include the share of the exports of four types of natural resources – fuels, ores and metals (base metals), agricultural raw materials and food. This is indeed a measure of resource dependence. Brunnschweiler and Bulte (2008) stress that resource dependence is different from resource abundance, defined as the log of total natural capital and mineral resource assets in dollars per-capita. Data on resource abundance are however

[4] Inflation, government consumption, school enrollment, trade openness.

[5] We use the Sargan test of over-identifying restrictions to assess the exogeneity of our instruments. This statistic is reported at the bottom of the table with the regression results. The null hypothesis that the over-identifying restrictions are valid can never be rejected at usual confidence levels. In the Appendix we also show some measures of the goodness of fit of the first stage regression in order to assess the relevance of the instruments.

available for two years only (1994 and 2000) and for a relatively small number of African countries (see World Bank 1997 and 2006). We therefore use a measure of resource dependence in our baseline estimates.

As some of these methodological choices are admittedly controversial, in Section 5 we will run a number of robustness checks using alternative instruments, different estimators, and a measure of resource abundance instead of one of resource dependence.

2.2 *Growth and dependence on primary commodities*

The basic findings concerning the curse of natural resources are reported in Table 1. Column I of the table shows the basic growth regression without the indicator of resource dependence. All of the control variables, with the only exception of the inflation rate, are statistically significant and display the expected sign. The rate of relative convergence is lower than that reported in Barro and Lee (1994), but still different from zero, thus implying that initially poorer economies grow faster. A larger government, represented by higher values of the government consumption to GDP ratio, reduces growth most likely because it implies greater nonproductive public expenditure and taxation. The positive coefficient on school enrollment reflects the positive direct impact of human capital formation on growth. The country fixed effects indicate that more ethnically fractionalized countries grow less, probably because of their intrinsically greater sociopolitical instability, and that geographical location does matter in the process of economic development. Greater openness to international trade appears to promote faster growth. Finally, a noteworthy feature of this basic specification in column I is that it is able to explain much of the difference in growth performance between SSA and rest of the world. Indeed, a regional dummy taking value 1 for SSA countries is included among the regressors, but its coefficient is statistically insignificant (coefficient is –0.009 with a p-value of 0.14).

INSERT TABLE 1 ABOUT HERE

The model in column II includes the measure of resource dependence. Its coefficient turns out to be negative but not different from zero at usual confidence levels. This means that after controlling for other determinants of growth, the growth-reducing effect of natural resources is negligible. That is, in the global sample there is no statistical evidence of a natural resource curse.

In order to test for a possible differential effect of primary commodities in SSA relative to the rest of the world, a slightly amended growth specification is estimated:

$$(2) \quad g_{it} = \alpha_0 + \alpha_1 x_{1,it} + .. + \alpha_n x_{n,it} + \beta_1 z_{it} dSSA + \beta_2 z_{it} (1 - dSSA) + \varepsilon_{it}$$

where *dSSA* is the dummy variable taking value if country *i* is in Sub-Saharan Africa. All the other variables and parameters are the same as in equation (1). In equation (2) the relationship between primary commodities and growth is allowed to have different slope in SSA relative to the rest of the world.

The estimates of equation (2) are displayed in column III of Table 1. Natural resources seem to reduce growth in Africa, but not in the rest of the world. In fact, both β_1 and β_2 are negative (-

0.010 and –0.004 respectively), but only β_1 is statistically different from zero at usual confidence levels. Thus, for the average SSA country, the marginal impact of natural resources on growth is negative. For the average country in the rest of the world, instead, the marginal impact of natural resources on growth is negligible. The remaining columns in the table show estimates of equation (2) for disaggregated categories of primary commodities. It turns out that fuels (Column VI) and ores and metals (Column VII) drive much of the negative growth-effect of resources in SSA. Conversely, none of the four categories of primary commodity has any significant effect of growth in the rest of the world.

The curse is therefore a SSA specificity. Why is then Sub-Saharan Africa afflicted by a curse while the rest of the world apparently is not? Our hypothesis is that SSA differs from the rest of the world with respect to some structural characteristics that are crucial in shaping the relationship between growth and resources. We identify two such characteristics. One is the pattern of specialization: within the broad category of primary commodities, SSA specializes in commodities that are not necessarily those in which the rest of the world specializes. The other is the level of institutional development: institutions in SSA are generally worse than in the rest of the world. The rest of the paper studies whether these differences in specialization patterns and institutional quality help explain the SSA specificity.

2. The effect of specialization patterns

The primary commodities in which SSA specializes are not necessarily the same in which the rest of the world specializes. Taking the year 2007 as a reference, out of the 10 primary commodities that were most exported worldwide, only three were among the 10 primary commodities most exported by SSA.[6] The different pattern of specialization (reflected in a different structure of exports of natural resources) might therefore explain why SSA is found vulnerable to resource dependence while the rest of the world is not. To put it mildly, the hypothesis is that natural resources are a curse in SSA just because, among the several possible primary commodities, SSA specializes on those that are *intrinsically* bad growth.

To see how relevant this hypothesis might be, we re-run the regression equation (1) using export shares of individual commodities instead of the aggregate index of resource dependence. To make sure that the estimated coefficients picks the effect of individual commodities on the growth process and not some other effect due to other structural features of SSA, the regression is estimated on the sample of non SSA countries. Column I of Table 2 reports estimated coefficients for the ten primary commodities most exported by SSA.[7] It turns out that only three commodities appear to be bad for growth: cotton, coffee, and iron ores. Oil, cocoa, silver and coal instead appear to generate a positive growth effect.

INSERT TABLE 2 ABOUT HERE

Why do different primary commodities have different effects on growth? We can think of two theoretical rationalizations. One draws on recent work on external economies of scale and

[6] The statistic is confirmed by data from previous years.

[7] Export shares of individual commodities are instrumented by their own lagged values. All controls and instruments are the same as in column II of Table 1. Estimated coefficients on the controls are not reported as they do not significantly differ from those reported in Table 1.

comparative advantage (see for instance Ethier and Ruffin, 2009). If the production of a commodity is characterized by negative external economies of scale (due to, say, land overcrowding), the exporting country would suffer from a comparative cost disadvantage. Therefore, exporting that commodity would make the country worse off. In fact, to complete this explanation one would need to formalize why external diseconomies of scale occur, across countries, for some commodities and not others. This is potentially an interesting topic of future research.

The second explanation is probably more appealing at this stage and involves the link between dynamics of the terms of trade and patterns of specialization. As broadly documented in the literature, international prices of several commodities exhibit large swings and secular declining trends. This in turn affects the terms of trade of countries that export those commodities, thus opening up a channel of transmission from commodity specialization to growth (see Dehn, 2000 and Blattman *et al*. 2007). The inclusion of the annual change in terms of trade as an explanatory variable in equation (1) confirms the empirical relevance of the terms of trade channel. Estimated coefficients are as follows (p-values in parenthesis; coefficient of time dummies are not reported):[8]

$$\text{(3)}\quad \text{Growth} = \underset{(0.00)}{0.051} - \underset{(0.00)}{0.004}\text{*lagged GDP p.c.} - \underset{(0.03)}{0.016}\text{*inflation} - \underset{(0.62)}{0.014}\text{*gov consumpt} +$$

$$+0.001\text{*school enroll.} +0.025\text{*latitude} -0.012\text{*ethnic frag.} + 0.001\text{*trade} +$$

[8] The data on terms of trade growth are available for a shorter time series, this explains the smaller number of observations and some changes in the estimated coefficient on the other regressors. Interestingly, it seems that when changes in the terms of trade are accounted for, the residual impact of trade openness is negligible.

(0.92)	(0.05)	(0.04)	(0.42)

+0.050*terms of trade growth
(0.000)

Number of observations =159, Sargan test statistic = 1.13

To check whether the selected primary commodities listed in Table 2 affect growth through terms of trade effects, the relationship between each commodity share of exports and average annual changes in terms of trade is estimated using the following regression:

$$(4) \quad tot_{it} = \gamma_0 + \gamma_1 w_{1,it} + ...\gamma_m w_{m,it} + \delta q_{it} + \upsilon_{it}$$

where *tot* is the growth of terms of trade in country *i* over time *t*, w_j (j = 1….*m*) is a set of controls, *q* is the specific commodity share of total exports, υ is a random error and γs and δ are the parameters to be estimated. The choice of controls include: (i) secondary school enrollment and the capital formation ratio to GDP to account for factor accumulation and hence for the potential expansion of the country, (ii) per-capita GDP in percent of US per-capita GDP to account for the stage of economic development and hence the degree of product variety and quality, (iii) world GDP per-capita growth to reflect the dynamics of potential international demand[9]. Estimation is again by instrumental variables, using lagged variables of all regressors as instruments. Data are averaged over five year periods.

[9] This choice of regressors draws on the work of Debaere and Lee (2003).

The last column of Table 2 reports the estimated δ for all the selected primary commodities that constitute the core of SSA specialization[10]. Cotton and coffee effectively appear not to be conducive to growth through their negative effect on terms of trade. Iron ores instead do not seem to worsen the terms of trade, therefore their negative effect in the growth regression must be due to some other channel (i.e. possible negative spillovers stemming from their extraction/production). Interestingly, specialization in sugar also exposes the country to negative terms of trade shocks, but this is probably compensated by other possible positive spillovers associated with sugar production, since the overall effect on growth is not negative. Oil and cocoa specialization increase the likelihood for the country to experience positive shocks to the terms of trade, which is in line with their aggregate positive growth-yield.

To sum-up the evidence in this section, some of the primary commodities on which SSA most strongly relies (Cotton and Coffee) are not conducive for growth. This negative effect is likely to work through their greater exposure to adverse shocks to terms of trade. Iron ores also do not appear to be conducive to growth, but not because of terms of trade effects. To what extent this findings help explain the specificity of the SSA curse detected in Section 2 is however dubious. As noted in the previous section, the SSA specificity seems to emerge mostly from fuels and base metals. But, with the exception of iron ores, none of the other fuels and metals on which SSA heavily specializes appears to be intrinsically bad for growth. On the contrary, oil (but also coal and silver) positively affects growth outside SSA. Hence, the pattern of specialization of SSA

[10] Again, readers interested in the estimated coefficients on the controls can obtain them from the authors upon request.

relative to the rest of the world can account for some of the SSA specificity, but the roots of this specificity probably lie elsewhere.

3. The interaction between institutions and natural resource in SSA

If institutions are effectively important in determining how natural resources affect the growth process, then the explanation of the SSA specify might rest with the institutional underdevelopment of SSA relative to the rest of the world.

To substantiate the argument that SSA lags behind the rest of the world in terms of institutional development, some quantitative indicator of institutional quality is needed. While many such indicators are available, the institutional dimension that is most relevant in the context of the resource curse literature is the quality of the legal arrangements disciplining the activities of the private sector and its interactions with the public sector. Based on this interpretation, our proxy of institutional development will be the index of quality of the legal system and enforcement of property rights available from the Fraser Institute (Fraser Institute, 2006).[11]

We start investigating the role of institutions by simply adding institutional quality to regression equation (2). Institutional quality is instrumented by its lagged values. Results are reported in column I of Table 3. As expected, the coefficient of the institutional variable is positive and

[11] The index ranges from 1(lowest institutional quality) to 10 (highest institutional quality). Its full sample average is 5.52, with a standard deviation of 1.94. In the sample of SSA observations, however, the average of the index drops to 4.15. This compares against an average of 6.11 in the sample of non SSA observations. Interestingly, there appear to be no structural breaks in the institutional quality series for SSA. The index averages 4.07 in the '70s, 4.12 in the '80s, 4.21 in the '90s and 4.14 in the 2000s. Furthermore, a simple OLS regression of the index of institutional quality on the SSA dummy yields a negative estimated coefficient of -1.445 (significant at the 1% level). The coefficient of the dummy stays significant even after adding the log of per-capita GDP to the regression.

significant, meaning that better institutions promote growth. However, even after controlling for institutional differences, SSA remains characterized by the resource curse while the rest of the world does not.

The growing body of research on the political economy of natural resources indicates that the effect of resource dependence on growth is conditional on the level of institutional quality. In terms of regression analysis, this conditionality requires an extension of the model specification to allow for an explicit interaction between institutions and resource dependence. The model with interactive terms is therefore written as follows:

$$
\begin{aligned}
(5)\quad g_{it} = {} & \alpha_0 + \alpha_1 x_{1,it} + .. + \alpha_s q_{it} + .. + \alpha_n x_{n,it} + \beta_1 z_{it} dSSA + \beta_2 z_{it}(1 - dSSA) + \beta_3 z_{it} q_{it} dSSA + \\
& + \beta_4 z_{it} q_{it}(1 - dSSA) + \varepsilon_{it}
\end{aligned}
$$

where *x*s are controls, q is an index of institutional quality, and everything else is as in equation (2). Note that with specification (5), the marginal effect of natural resources on growth is equal to $\beta_1 + \beta_3 q$ in SSA and to $\beta_2 + \beta_4 q$ in the rest of the world. So, if β_3 is positive, then: (i) institutional development (e.g. higher values of q) reduces the extent to which resources are a curse in SSA and eventually transforms them into a blessing (resources positively contribute to growth for $-\beta_1 < \beta_3 q$) and (ii) the difference between SSA and rest of the world vanishes at sufficiently high level of institutional quality as long as $\beta_3 > \beta_4$.

Estimates of equation (5) are reported in column II of Table 3

INSERT TABLE 3 ABOUT HERE

The interactive terms between primary commodities and institutions (β_3 and β_4) are positive and statistically significant, meaning that better institutions make resources more conducive to growth. Moreover, the coefficient of the interactive term is higher for SSA than for the rest of the world. This implies that institutional development eventually makes the SSA specificity vanish.

Figure 1 can be helpful in understanding what the estimated coefficients in column 2 imply. The figure plots $\partial g/\partial z$ for the two groups SSA and ROW based on the estimated coefficients reported in column 2. As it can be seen, at low levels of institutional quality, the marginal effect of resources on growth is negative in both groups, but sharply more so in SSA. As institutions improve, the effect turns from negative to positive. For the average ROW country, the marginal effect of resources on growth is already positive for a level of institutional quality of 3.7. In SSA, instead, for resources to become a blessing a higher level of institutional quality (4.55 and above) is required. However, when institutions are of a very good quality, resources are more of a blessing in SSA than elsewhere. This is an interesting result that, to some extent, might depend on the fact that we are estimating a linear coefficient on the interactive term. Nevertheless, the possibility that SSA benefits more than other countries from institutional development is an intriguing finding that deserves consideration in future analysis.

INSERT FIGURE 1 ABOUT HERE

The two remaining columns of Table 3 re-estimate equation (5) using dependence on fuels (column III) and dependence on ores and metals (column IV) instead of the overall index of dependence on primary commodities. As it will be recalled from section 2, much of the negative growth-effect of resources in SSA is driven by these two categories of commodities. The estimates confirm the findings from column II: both fuels and ores and metals are a curse at low levels of institutional quality in SSA much more than in the rest of the world. However, the improvement in institutions turns resources from a curse into a blessing.

4. Sensitivity analysis

In this section we study how robust previous results are to different methodological choices.[12]

4.1 *Choice of instruments*

Perhaps, the most critical methodological choice we have made concerns the identification strategy; that is, the use of lagged values as instruments for potential endogenous regressors in the growth equation. This strategy has been largely used in the growth empirical literature and, in the specific context of our paper, it is to some extent validated by the statistics of the Sargan test reported at the bottom of tables 1 and 3 as well as the first stage diagnostics discussed in the appendix . Nevertheless, one would also like to see whether results change when lagged variables

[12] To save space, we do not report all of the robustness results in detail. All of them can be obtained from the authors upon request.

are replaced by other instruments. To this purpose we re-estimate equations (2) and (5) using the following instruments:

- The rate of inflation is instrumented by the type of exchange rate regime and the degree of independence of the Central Bank. Carmignani et al. (2008) show that these economic institutions effectively determine monetary outcomes, while the evidence of reverse causality is more ambiguous.
- Government consumption is instrumented by a dummy variable for non-proportional electoral rules and a dummy variable for presidential regimes. Persson and Tabellini (2003) show that constitutional arrangements of this type are indeed important determinants of fiscal policy outcomes. At the same time, constitutional arrangements are rather stable over time and therefore unlikely to be determined by changes in fiscal policy.
- School enrolment is instrumented by the incidence of natural disasters. Toya et al. (2010) present a model where the rate of accumulation of human (as well as physical capital) is determined by natural disasters. Their econometric evidence effectively suggests that natural disasters perform well as an instrument for a variety of measures of schooling.
- Trade openness is instrumented by the log-area of a country, a dummy for landlocked countries, and the number of free trade agreements in which each country participates. The use of geographical variables as instruments of trade goes back to Frankel and Romer (1999). We add the number of free trade agreements as a rather crude proxy of the attempt of a country to undertake liberalization policies that should promote international trade.
- Institutions are instrumented by the settler's mortality rate, following a well known argument of Acemoglu et al (2001). The legal origin dummies that are already included as

instruments in the regressions of tables 2 and 4 also work well as instruments for institutional quality (on this point, see La Porta et al., 1999)

- Resource dependence is instrumented by the proportion of country land at the tropics and country distance from the sea or a major river. Brunnschweiler and Bulte (2008 and 2009) use these two variables as instruments for resource dependence together with a dummy for presidential regimes, which however we already use as instrument for government consumption. Their results also indicate that natural capital (see subsection 5.3) might also be an instrument of resource dependence, even though we cannot exclude that it is correlated with growth over and above any effect it might have on resource dependence.
- Finally, we also include as instruments a few interactive terms: (i) proportion of land at the tropics and settler's mortality, (ii) country distance from sea/river and settler's mortality, (iii) proportion of land at the tropics and dummy for SSA, and (iv) proportion of land at the tropics and dummy for non SSA. These additional instruments are meant to be used in associated with the inclusion of interactive terms in the growth regression.

Results are reported in columns I and II of Table 4. The last row of the table reports the statistic of the Sargan test (the null hypothesis can never be rejected at usual confidence levels). First stage diagnostics are reported in the Appendix. As it can be seen, results are very much in line with those discussed in the previous sections. In other words, the evidence concerning the role of primary commodities and its interaction with institutional development is robust to changes in the identification strategy.

4.2 *Level effects and GMM estimator*

Recent empirical work on the determinants of long-term development uses the level of per-capita GDP (rather than its growth rate) as the dependent variable (see for instance, Acemoglu et al. 2001, Nunn 2008, Bhattacharyya, 2009 and Alexeev and Conrad, 2009). In fact, a growth regression can be easily transformed into a regression of current per-capita income on its lagged values and a set of controls. This transformed regression can then be estimated using a dynamic panel GMM estimator (see Arellano and Bond, 1991 and Caselli et al. 1996) that involves (i) first-differencing the transformed growth regression to eliminate individual effects and (ii) instrumenting first-differences by all the lagged values of the regressors. This estimator therefore offers another possible way to address the inconsistency arising from the endogeneity of the explanatory variables.

GMM estimates of equation (2) and (5) are reported in columns III and IV of Table 4. Because the first-step of the procedure involves taking first-differences, latitude and ethnic fractionalisation have to be removed as they are fixed effects over time. Nevertheless, the GMM estimates are again very similar to those reported in tables 1 and 3, thus providing further evidence of the robustness of our results.

We also estimate a very parsimonious, non-dynamic, specification of the regression in level including only latitude, ethnic fractionalisation, and institutional quality as controls (see Alexeev and Conrad, 2009 for a discussion of this parsimonious specification). We use 2SLS and instrumented institutional quality by the settler's mortality rate and the legal origin dummies. Resource dependence are instrumented by the proportion of land within the tropics and distance from sea/river. Results (not reported in the table, but available upon request) are highly consistent with those discussed so far. Latitude and institutional quality are positive and significant, while ethnic fractionalisation is negative and significant. The coefficient on resource dependence is negative and significant in SSA and non-significant in the rest of the world. The interactive term between resource dependence and institutions is positive and significant in both groups. The estimated coefficients imply that resources become a blessing in SSA for a level of institutional quality above 4.82.

4.3 *Specification of the set of control variables*

We expand the set of control variables to include an index of capital account liberalization, budget deficit, and domestic credit to the private sector in percent of GDP. None of these additional controls turns out to be statistically significant while the results concerning the role of primary commodities are practically unchanged. We also add fixed capital formation in percent of GDP as a proxy for the investment in physical capital. Again, the estimated coefficient on this variable is largely insignificant, thus suggesting that the other variables of the model already fully explain how investment influences growth.

Perhaps, a more interesting robustness test is suggested by the findings recently reported by Bhattacharyya (2009). He shows that malaria incidence is the main determinant of income and growth in Africa. We therefore re-estimate our equations (2) and (5) including this variable. Results are shown in column V and VI of Table 4. The instruments are the same as in columns I and II of the table. Malaria is instrumented using an index of malaria ecology plus three climatic variables: rain, humidity, and frost.

The addition of the malaria variable makes latitude statistically insignificant. This is probably to be expected given that malaria tends to be more endemic in areas that are closer to the equator. There is therefore a strong collinearity between malaria incidence and latitude. However, all of the other results are, once again, confirmed.

4.4 *Resource dependence vs. resource abundance*

As noted in Section 2, the recent literature on the economics of natural resources distinguish between resource dependence and resource abundance. The measure of natural resources that we have adopted so far (total exports of primary commodities in percent of total merchandise exports) is a measure of dependence. Our last robustness check is therefore to use a measure of resource abundance in our growth regressions.

Following Brunnschweiler and Bulte (2008) we take the world bank data on natural capital as a proxy for resource abundance. These data are available for a smaller sample of countries and for the reference year 1994. Estimation is therefore based on a cross-section of 81 countries, of which 31 are SSA economies. Inflation, government consumption, school enrolment, trade openness, and institutional quality are all measured as averages over the entire sample period (1975-2004) and instrumented with the alternative instruments introduced in subsection 5.1. Lagged per-capita GDP is measured as the level of per-capita GDP in 1975. Brunnschweiler and

Bulte (2008) argue that natural capital, even if measured in 1994, is exogenous to the growth process and it can be instrumented by itself. In fact, we tried two alternatives: one with natural capital treated as exogenous and the other with natural capital instrumented by share of country land at the tropics and distance from river/sea. Results are virtually the same. We therefore report only those where natural capital is exogenous.

Results are shown in columns VII and VIII of table 4. The use of natural capital seems to make the difference between SSA and rest of the world even sharper. In column VII resource abundance is found to increase growth in the rest of the world while decreasing growth in SSA. Similarly, in column VIII, resource abundance is not significantly negative for growth in the rest of the world even at very low level of institutional quality. On the contrary, in SSA resources remain a curse as long as institutions are of a sufficiently low quality. All in all, our basic story on the SSA specificity relative to the rest of the world is confirmed.

INSERT TABLE 4 ABOUT HERE

5. Conclusions

The econometric analysis in this paper has uncovered some interesting results. While there is no evidence of a generalized curse at the global level, it appears that primary commodities negatively affect economic growth in SSA. One might think that this specificity arises from the fact that SSA specializes on commodities that are not conducive for growth. In fact, only few of the primary commodities that characterize the production structure of the SSA are intrinsically bad for growth. This finding generalizes the argument of Deaton (1999): while adverse price dynamics of some commodities (like cotton and coffee) do not help, the root cause of slow African development resides elsewhere. The key to understanding the SSA specificity seems to lie in the interaction between institutions and natural resources. When we extend our model to account for this interaction we find that (i) the African specificity exists only at low levels of institutional development and (ii) as institutions improve, resources turn from a curse into a blessing, especially in SSA.

A number of avenues for future research can be pointed out. One interesting area to pursue is the extension of the analysis to other measures of economic development and/or macroeconomic performance. For instance, output growth volatility is an important factor influencing people's welfare and long-term growth prospects. The question is then to see how resources dependence affects volatility and growth simultaneously. A second possible direction of research should focus on sub-regional effects. SSA is a broad continent covering several sub-regions at different state of economic and institutional development. These sub-regions are also different in terms of their degree of integration and policy coordination. The issue is then to model the primary commodity-growth relationship allowing for differences across sub-regions in SSA. This will of course require some considerable efforts in data collection, since at the present stage, the number of observations available for most sub-regions would not be enough to allow the estimation of a growth model of the type used in this paper.

Appendix A: Relevance of instruments

Valid instruments need to be (i) significantly correlated with the exogenous regressor (relevance of the instrument) and (ii) exogenous to the error term (validity of the instrument).

When the number of instruments exceeds the number of endogenous regressor (e.g. when the model is over-identified), then validity can be tested using the test of overidentfying restrictions, whose statistics is reported at the bottom of tables 1, 3, and 4.

Relevance is instead assessed from the goodness of fit of the first stage regression. However, the standard R^2 and F-test of the joint significance of all instruments are not particularly useful in this context: high values of the R^2 and F-statistic in the first stage regression do not necessarily imply that instruments are relevant (see Nelson and Startz, 1990). Two more informative statistics are the standard partial R^2 (Bound et al. 1995) and Shea's partial R^2 (Shea, 1997), which are computed by partialling-out the "included" instruments (that is, the instruments that are also included as exogenous explanatory variables in the original regression). The interpretation of these two statistics is however limited by two factors: (i) the standard partial R^2 is reliable if there is only one endogenous variable per equation (and this is the case only in equation (3)); (ii) Shea's partial R^2 is designed to account for multiple endogenous regressors, but its distribution has not been derived, and hence no formal test of significance can be conducted. Baum et al. (2003), however, propose a helpful rule of thumb: if the standard partial R^2 is high and the Shea's partial R^2 is low, then instruments probably lack sufficient relevance.

Table 5 reports the three statistics computed from the first stage regression of the estimates presented in column II of Table 3 and in column II of table 4. The statistics are: the standard partial R^2, the F-statistic of the test of joint significance of the excluded instruments (and the associated p-value in bracket), and the Shea's partial R^2. The F-test suggest that the standard partial R^2 are high enough, while the Shea partial R^2 are not too smaller than the standard partial R^2. We take this as evidence in support of our identification strategies.

INSERT TABLE 5 ABOUT HERE

Appendix B: Variables description and data sources

Variable name[a]	Description	Source[b]
Growth per-capita GDP	Annual percent change in constant prices per-capita GDP	WDI
Lagged per-capita GDP	One period lagged value of log per-capita GDP (constant prices)	WDI
Inflation	Average annual rate of change of consumer price index	WDI
Government consumption	Final government consumption expenditure in percent of GDP	WDI
School enrollment	Net secondary schooling enrollment rate	WDI
Latitude	Absolute latitude	La Porta et al (1999)
Ethnic fragmentation	Index of ethnolinguistic fractionalisation	La Porta et al (1999)
Trade openness	Total exports plus total imports in percent of GDP	WDI
Primary commodities	Exports of primary commodities in percent of total exports. Primary commodities include food and live animals, beverages and tobacco, animal and vegetable oils and waxes, excluding manufactured goods; crude materials, mineral fuels, lubricants and related materials; non ferrous metals, metalliferous ores and scrap, crude fertilizers	WDI
Agricultural materials	Exports of agricultural raw materials in percent of total exports. Agricultural raw materials include SITC section 2 excluding divisions 22, 27 and 28	WDI
Food	Exports of food and bevarges in percent of total exports. Food and beverages include SITC 0, 1, 4, and 22	WDI
Fuels	Exports of mineral fuels in percent of total exports. Fuels	WDI

	include SITC 3	
Ores and metals	Exports of ores and metals in percent of total exports. Ores and metals include SITC 27, 28, 68.	WDI
Oil	Exports of oil in percent of total exports. Oil is SITC 333	UNCTAD
Cocoa	Exports of cocoa in percent of total exports. Oil is SITC 072	UNCTAD
Cotton	Exports of cotton in percent of total exports. Oil is SITC 263	UNCTAD
Coffee	Exports of coffee in percent of total exports. Coffee is SITC 071	UNCTAD
Fruits and nuts	Exports of fruits and nuts in percent of total exports. Fruits and nuts are SITC 057	UNCTAD
Sugar	Exports of sugar in percent of total exports. Sugar is SITC 061	UNCTAD
Silver	Exports of silver in % of total exports. Silver is SITC 681	UNCTAD
Iron ores	Exports of iron ores in percent of total exports. Iron ores is SITC 281	UNCTAD
Coal	Exports of coal in percent of total exports. Coal is SITC 322	UNCTAD
Copper	Exports of copper in percent of total exports. Copper is SITC 682	UNCTAD
Aluminum	Exports of aluminum in percent of total exports. Aluminum is SITC 684	UNCTAD
Institutional quality	Index of legal structure and property rights (Area 2 of the Economic Freedom Index)	Fraser Institute
Terms of trade growth	Annual percent change in net barter terms of trade	WDI
Capital formation	Gross capital formation (addition to fixed assets plus net changes in inventory) in percent of GDP	WDI
World growth	Annual percent change of constant prices per-capita GDP	WDI

	for the world aggregate	
Financial intermediation	Monetary aggregate M2 (money and quasi-money) in percent of GDP	WDI
Financial openness	Index of capital account liberalization	Fraser Institute
Time dummies	Dummy 80 = 1 for years in the '80s and 0 otherwise Dummy 90 = 1 for years in the '90s and 0 otherwise	
Legal dummies	Dummy UK = 1 if legal origins are Anglo-Saxon Dummy FR = 1 if legal origins are French Dummy SC = 1 if legal origins are Scandinavian Dummy GE = 1 if legal origins are German	La Porta et al. (1999)
SSA	Dummy variable taking value 1 for African countries	
Natural capital	Alternaitve measure of resource abundance defined as the the (log) of total natural capital and mineral resource assets in dollars per capita	World Bank
Malaria incidence	Proprotion of total population living in endemic malaria zones	CID
	Other instruments for the regressions in table 4	
Exchange rate regime	Categorical variable taking value from 1 to 5, where 1 indicates an extreme peg and 5 a freely falling regime.	Rehinart et al.
Central bank independence	Average turnover of the central banker	Ghosh et al.
Electoral rule	Dummy variable taking value in countries that adopt a plurality rule	DPI
Presidential regime	Dummy variable taking value 1 if the country is a presidential regime	DPI
Natural disasters	Total number of significant disasters normalized by land size	CRED
Area	Log of land area (in kmq)	WDI
Landlocked	Dummy variable taking value 1 if the country has no direct access to the sea	CIA

FTA participation	Number of free trade agreements and other trade facilitation agreements in which a country participates	WTO
Distance from sea/river	Log of distance (in Km) of capital city from the nearest coast or river	CIA and Nunn
Proportion of land in tropics	Proportion of total country land included within the two tropics	Author's calculation from CIA
Settlers mortality	Log of European settlers' mortality rate	Acemoglu
Malaria Ecology	Ecologically based spatial index defined from climatic factors and biological properties of each regionally dominant malaria vectors (see original reference for further details)	Kiszewski
Rain	Minimum of monthly average rainfall	Nunn
Humidity	Minimum of monthly average humidity (in percent)	Nunn
Frost	Seasonal frost: number of days with below-freezing ground temperatures in a winter season that follows a frost-free summer	Masters

[a] Variable name as it appears in the tables and/or in the text
[b]Detailed references for the sources are as follows:

WDI:	World Bank (various issues) *World Development Indicators*, Washington D.C.
UNCTAD	United Nations Conferences on Trade and Development (various issues) *Handbook of Statistics*, Geneva.
Fraser Inst.	Fraser Institute *Economic Freedom of the World Annual Report 2006*; Edited by: J. Gwartney and R. Lawson with W. Easterly, Vancouver.
La Porta et al	La Porta R., Lopez-de-Silanes F., Shleifer A., and Vishny R. (1999). The Quality of Government. Journal of Law, Economics, and Organizations, 15, 222-279.
Reinhart et al.	Reinhart, C, Rogoff, K. (2004) The Modern history of Exchange Rate Arrangements: A reinterpretation. Quarterly Journal of Economics, 119, 1-48. Ilzetski, E. Rehinart, C., Rogoff, K., Exchange rate arrangements entering the 21st century: which anchor will hold? http://terpconnect.umd.edu/~creinhar/Papers.html
Ghosh et al.	Ghosh, A., Gulde, A., Wolf, H. (2002) Exchange rate regimes, choices and consequences, MIT Press
DPI	Beck, T., Clarke, G., Groff, A., Keefer, P., Walsh, P. (2001) "New tools in comparative political economy: the database of politica institutions", World Bank Economic REview 15, 165-176 http://go.worldbank.org/2EAGGLRZ40
CRED	Center for Research on the Epidemiology of Disasters http://www.cred.be/
CIA	Central Intelligence Agency, World Factbook, https://www.cia.gov/library/publications/the-world-factbook/
WTO	World Trade Organization http://www.wto.org/english/res_e/statis_e/Statis_e.htm

Acemoglou	Acemoglu, D, Johnson, S., Robinson, J. (2001) "The Colonial Origins of Comparative Development : An Empirical Investigation" American Economic Review, 91, 1369-401.
World Bank	World Bank (1997) Expanding the measure of wealth: indicators of environmentally sustainable development. Environmentally Sustainable Development Studies and Monographs Series No. 17, 1997. And World Bank (2006) *Where is the Wealth of Nations? Measuring capital for the XXI century*. Washington D.C.
Kiszewski	Kiszewski, A., A.Mellinger, A. Spielman, P. Malaney, S. Sachs and J Sachs (2004) 'A Global Index Representing the Stability of Malaria Transmission', American Journal of Tropical Medicine and Hygiene, 70, 486–98.
Masters	Masters, W. and M. McMillan (2001) 'Climate and Scale in Economic Growth', Journal of Economic Growth, 6 (3): 167–186.
Nunn	Nunn, N. (2008) 'The Long-Term Effects of Africa's Slave Trades', Quarterly Journal of Economics, 123 (1): 139–176.
CID	Centre for International Development at Harvard University http://www.cid.harvard.edu/ciddata/ciddata.html

Table 1: Growth and dependence on primary commodities

	I	II	III	IV	V	VI	VI
Lagged income per-capita	-0.010***	-0.011***	-0.010***	-0.010***	-0.010***	-0.010***	-0.010***
Inflation	0.003	0.003	0.003	0.003	0.003	0.002	0.002
Government consumption	-0.072***	-0.070***	-0.064***	-0.077***	-0.075***	-0.087***	-0.110***
School enrollment	0.041***	0.041***	0.039***	0.047***	0.044***	0.044***	0.049***
Latitude	0.049***	0.049***	0.046***	0.046***	0.044***	0.048***	0.043***
Ethnic fragmentation	-0.010***	-0.010***	-0.007**	-0.009**	-0.005**	-0.005**	-0.003**
Trade openness	0.012***	0.012***	0.012***	0.013***	0.012***	0.012***	0.012***
Primary commodities		-0.004					
Prim commodities * SSA			-0.007**				
Prim commodities*(1-SSA)			-0.003				
Agricultural mat. * SSA				0.005			
Agricultural mat				-0.004			
Food * SSA					-0.010		
Food					0.000		
Fuels * SSA						-0.037***	
Fuels						0.005	
Ores and metals * SSA							-0.065***
Ores and metals							0.004
Number of observation	283	256	256	258	258	256	258
Sargan Test	2.92	5.96	5.81	4.04	5.04	4.09	2.89

Notes: SSA denotes the dummy variable taking value 1 for Sub-Saharan Countries. For full description of variables see Appendix. Time dummies and constant not reported. Column I also include the SSA dummy separately: its estimated coefficient is –0.009 with a p-value of 0.14. The raw Sargan test reports the J-statistic for the test of overidentifying restrictions. *, **, *** respectively denote significance of coefficients at the 10%, 5%, and 1% level of confidence.

Table 2: Growth-yield and terms of trade effects of selected commodities

	I Estimated coefficient in growth regression	II Estimated coefficient in terms of trade regression
Oil	0.009**	0.099***
Cocoa	1.626***	0.104***
Cotton	-0.276***	-0.038***
Coffee	-0.108***	-0.107***
Fruits and nuts	-0.008	0.034
Sugar	-0.032	-0.128*
Silver	1.160***	0.019
Iron ores	-0.041**	0.086**
Coal	0.085***	-0.002
Copper	0.005	-0.111***

Notes:. Column I reports the estimated coefficient of the share of exports of each individual commodity in a growth regression estimated on the sample of non-African countries. Column II reports the estimated coefficient of the share of exports of each individual commodity in a terms of trade regression. *, **, *** respectively denote significance of coefficients at the 10%, 5%, and 1% level of confidence.

Table 3: The interactive effect of institutional quality and primary commodities on growth

	I	II	III	IV
Lagged income per-capita	-0.012***	-0.008***	-0.012***	-0.012***
Inflation	0.003	0.002	0.003	0.001
Government consumption	-0.078***	-0.062***	-0.102***	-0.107***
School enrollment	0.058***	0.055***	0.065***	0.059***
Latitude	0.021***	0.017***	0.021***	0.027***
Ethnic fragmentation	-0.007*	-0.019**	-0.014**	0.003
Trade openness	0.010***	0.011***	0.011***	0.011***
Institutional quality	0.003**	0.004**	0.002*	0.003**
Prim commodities*SSA (β_1)	-0.006**	-0.116***		
Prim commodities*(1-SSA) (β_2)	0.000	-0.037*		
Prim commodities * SSA*inst quality (β_3)		0.025***		
Prim commodities*(1-SSA)*inst quality (β_4)		0.010**		
Fuels* SSA			-0.149***	
Fuels* (1-SSA)			-0.006	
Fuels* SSA*inst quality			0.039**	
Fuels * (1-SSA)*inst quality			0.002	
Ores and metals * SSA				-0.117***
Ores and metals *(1-SSA)				-0.043
Ores and metals * SSA*inst quality				0.011*
Ores and metals*(1-SSA)*inst quality				0.008
Number of observations	223	223	223	223
Sargan test	1.50	2.36	3.19	2.92

Notes: SSA denotes the dummy variable taking value 1 for Sub-Saharan Countries. For full description of variables see Appendix. Time dummies and constant not reported. The raw Sargan test reports the J-statistic for the test of overidentifying restrictions. *, **, *** respectively denote significance of coefficients at the 10%, 5%, and 1% level of confidence.

Table 4: Robustness analysis

	I (2SLS)	II (2SLS)	III (GMM)	IV (GMM)	V (2SLS)	VI (2SLS)	VII (IV)	VIII (IV)
Lagged income p.c.	-0.008***	-0.019***	0.603***	0.757***	-0.015***	-0.017***	-0.002**	-0.004**
Inflation	-0.005	-0.004	-0.003	-0.001	-0.003	0.001	-0.002**	-0.005*
Government cons.	-0.067***	-0.78***	-0.257	-0.305**	-0.064**	-0.116**	-0.066**	-0.071***
School enrolment	0.049**	0.072***	0.237**	0.264*	0.028**	0.067**	0.052**	0.055***
Latitude	0.033***	0.031***	..	..	0.001	0.002	0.038**	0.035***
Ethnic fragmentation	-0.005**	-0.007**	..	..	-0.007**	-0.002**	0.001**	-0.006**
Trade openness	0.022***	0.025***	0.352***	0.254***	0.023***	0.028**	0.021**	0.028***
Malaria incidence	..	..	..	..	-0.095**	-0.104***		
Institutional quality	..	0.004**	..	0.102**	..	0.007**		0.011***
Prim_comm*SSA	-0.022**	-0.132***	-1.612***	-5.287***	-0.032***	-0.118***	-0.014**	-0.129**
Prim_comm*(1-SSA)	-0.002	-0.022*	-0.257	-1.049*	-0.001	-0.021*	0.019**	-0.033
Prim_comm * SSA*inst. quality	..	0.027***	..	0.251**	..	0.030***	..	-0.032***
Prim_comm*(1-SSA)*inst quality	..	0.007**	..	0.059**	..	0.008**	..	0.004*
N. obs	252	231	174	172	238	219	81	81
Test of overidentfying restrictions	6.49	6.82	12.35	11.46	5.32	7.01	3.78	2.91

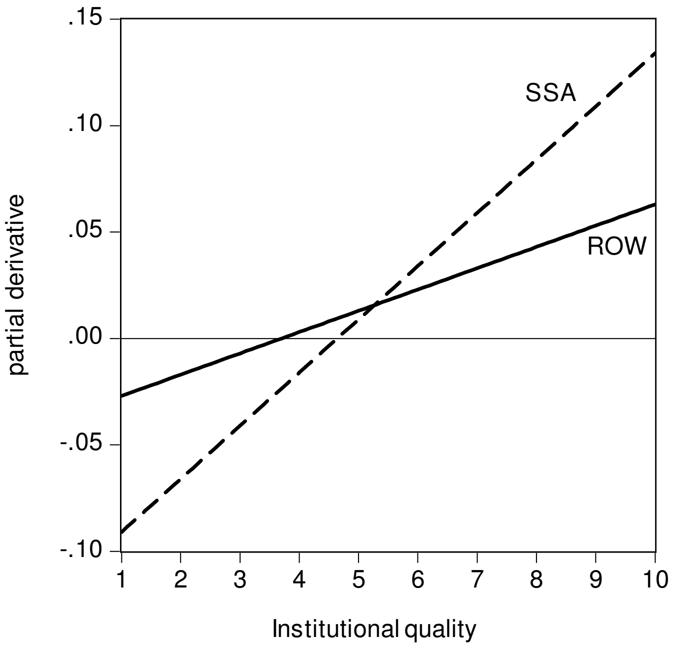
Notes: Estimators are as follows. Columns I and II:2SLS with alternative instruments. Columns III and IV: regression in levels estimated by Arellano and Bond (1991) GMM estimator. Columns V and VI: 2SLS with alternative instruments and malaria incidence as regressor (instrumented by malaria ecology from Kiszewski et al. 2004 and rain, humidity and frost indicators from Masters and McMillan (2001) and Nunn (2008). Columns VII and VIII: 2SLS estimated with alternative instruments and resource abundance.

Table 5. First stage statistics

	Partial R2	F-stat	Shea partial R2
Instrumented by lagged values			
Inflation	0.25	15.87 (0.001)	0.15
Government consumption	0.75	136.48 (0.000)	0.47
School enrolment	0.59	102.39 (0.000)	0.39
Trade openness	0.71	125.23 (0.000)	0.53
Institutional quality	0.78	142.74 (0.000)	0.58
Primary commodities*SSA	0.76	138.98 (0.000)	0.55
Primary commodities*(1-SSA)	0.75	137.83 (0.000)	0.54
Prim commodities*SSA*inst quality	0.77	140.22 (0.000)	0.51
Prim commodities*(1-SSA)*inst quality	0.77	139.41 (0.000)	0.52
Instrumented by other instruments			
Inflation	0.23	7.87 (0.000)	0.18
Government consumption	0.28	8.95 (0.000)	0.22
School enrolment	0.21	7.71 (0.000)	0.17
Trade openness	0.19	5.99 (0.001)	0.16
Institutional quality	0.34	9.94 (0.000)	0.29
Primary commodities*SSA	0.27	8.87 (0.000)	0.24
Primary commodities*(1-SSA)	0.29	9.02 (0.000)	0.25
Prim commodities*SSA*inst quality	0.30	9.17 (0.000)	0.25
Prim commodities*(1-SSA)*inst quality	0.31	9.46 (0.000)	0.26

Tests for lagged variables refer to the estimates of model II of table 3. Tests for the other instruments refer to model II of table 4. First stage statistics for all other models are available upon request.

Figure 1



.15
.10
.05
.00
-.05
-.10
1
2
3
4
5
6
7
8
9
10
SSA
ROW
partial derivative
Institutional quality

References

Acemoglu D, Johnson S, Robinson J (2001) The Colonial Origins of Comparative Development; An Empirical Investigation. American Economic Review 91: 1369-1401.

Alexeev M, Conrad R (2009) The Elusive Curse of Oil. The Review of Economics and Statistics 91: 586-598.

Arellano M, Bond S (1991) Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. Review of Economic Studies 58: 277-297.

Artadi E, Sala-i-Martin, X (2003) The Economic Tragedy of the XXth Century: Growth in Africa. NBER Working Papers 9865

Barro RJ, Lee JW (1994) Losers and Winners in Economic Growth. Proceedings of the World Bank Annual Conference on Development Economics, The World Bank, 267-297.

Baum C, Schaffer M, Stillman S (2003) Instrumental variables and GMM: estimation and testing. Stata Journal, StataCorp LP 3: 1-31.

Bhattacharyya S (2009) Root Causes of African Underdevelopment. Journal of African Economies 18: 745-780.

Blattman C, Hwang J, Williamson J (2007) Winners and Losers in the Commodity Lottery: The Impact of Terms of Trade Growth and Volatility in the Periphery 1870-1939. Journal of Development Economics 82: 156-179.

Bloom D, Sachs J (1998) Geography, Demography, and Economic Growth in Africa. Brookings Papers on Economic Activity 29: 207-296

Boschini A, Pettersson J, Roine J (2007) Resource Curse or Not: A Question of Appropriability. Scandinavian Journal of Economics 109: 593-617.

Bound J, Jaeger D, Baker R (1995) Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak. Journal of the American Statistical Association 90: 443-450.

Bravo-Ortega C, De Gregorio J (2005) The relative richness of the poor? Natural resources, human capital, and economic growth. World Bank Policy Research Working Paper Series 3484.

Brunnschweiler C (2008) Cursing the Blessings ? Natural Resource Abundance, Institutions, and Economic Growth. World Development 36: 399-419.

Brunnschweiler C, Bulte E (2008) The resource curse revisited and revised: A tale of paradoxes and red herrings. Journal of Environmental Economics and Management 55: 248-264.

Brunnschweiler C, Bulte E (2009) Natural resources and violent conflict: resource abundance, dependence, and the onset of civil wars. Oxford Economic Papers, online: doi10.1093/oep/gpp024

Bulte E, Damania R, Deacon R (2005) Resource intensity, institutions and development. World Development, 33: 1029-1044.

Carmignani F, Colombo E, Tirelli P (2008) Economic and Socio-Political Determinants of de Facto Monetary Institutions and Inflationary Outcomes. The B.E. Journal of Macroeconomics 8: Article 29.

Caselli F, Esquivel G, Lefort F (1996) Reopening the convergence debate: a new look at cross-country growth empirics. Journal of Economic Growth 1: 363-389.

Collier P, Gunning JW (1999) Why Has Africa Grown so Slowly. Journal of Economics Perspectives 13: 324-376.

Deaton A (1999) Commodity Prices and Growth in Africa. Journal of Economic Perspectives 13: 23-40.

Debaere P, Lee H (2003) The Real-Side Determinants of Countries' Terms of Trade. Mimeo, University of Texas-Austin.

Dehn J, (2000) The Effects on Growth of Commodity Price Uncertainty and Shocks. World Bank Policy Research Working Paper 2455.

Easterly W, Levine R (1997) Africa's Growth Tragedy: policies and Ethnic Divisions. The Quarterly Journal of Economics CXII: 1203-1249.

Ethier W, Ruffin R (2009) External economies of scale and comparative advantage, in T. Kamihigashi and L. Zaho (eds.) International Trade ad Economic Dynamics – Essays in Memory of Koji Shimomura, Springer-Verlag.

Eliasson L, Turnovsky S (2004) Renewable resources in an endogenously growing economy: balanced growth and transitional dynamics. Journal of Environmental Economics and Management 48: 1018-1049.

Frankel J, Romer D (1999) Does Trade Cause Growth? American Economic Review 89: 379-99

Fraser Institute (2006) Economic Freedom of the World Annual Report 2006; Edited by: J. Gwartney and R. Lawson with W. Easterly, Vancouver

Gylfason T, Zoega G (2003) Inequality and Economic Growth: Do Natural Resources Matter ? in T. Eicher and S. Turnovsky (eds.) Inequality and Growth: Theory and Policy Implications. CesIFO Semina Series, MIT.

Hodler R (2006) The curse of natural resources in fractionalized countries. European Economic Review 50: 1367-1386.

Humprheys M (2005) Natural Resources, Conflict and Conflict Resolution: Uncovering the Mechanism. Journal of Conflict Resolution 49: 508-537

Isham J, Woolcock M, Pritchett L, Busby G (2005) The Variety of Resource Experience: Natural Resource Export Structure and The Political Economy of Economic Growth. The World Bank Economic Review: 19, 141-174.

La Porta R., Lopez-de-Silanes F, Shleifer A, Vishny R (1999) The Quality of Government. Journal of Law, Economics, and Organizations 15: 222-279.

Leite C, Weidmann J (1999) Does Mother Nature Corrupt ? Natural Resources, Corruption and Economic Growth. IMF Working Paper 99/85

Mehlum H, Moene K, Torvik R (2006) Institutions and the Resource Curse. Economic Journal 116: 1-20.

Nelson C, Startz R (1990) The distribution of the instrumental variable estimator and its t-ratio when the instrument is a poor one. Journal of Business 58: S125-S140.

Norman C, (2009) Rule of law and the resource curse: abundance versus intensity. Environmental and Resource Economics 43: 183-207

Nunn N, (2007) Historical legacies: A model linking Africa's past to its current underdevelopment. Journal of Development Economics: 1, 157-175.

Nunn N, (2008) Long-term effects of Africa's slave trades. Quarterly Journal of Economics 123: 139-176.

Perrson T, Tabellini G (2003) The Economic Effects of Constitutions. MIT press.

Sachs J, Warner A (1995) Natural Resource Abundance and Economic Growth, in G. Meier and J. Rauch (eds.) Leading Issues in Economic Development, Oxford University Press.

Sachs J, Warner A (1997) Sources of Slow Growth in African Economies. Journal of African Economies 6: 335-76.

Sachs, J. and D. Warner (2001) The curse of natural resources. European Economic Review, 45, 827-838.

Sala-i-Martin X, Subramanian A (2003) Addressing the Natural Resource Curse: An Illustration from Nigeria, IMF Working Paper 03/139.

Schollaert A, Van de gaer D (2009) Natural resources and internal conflict. Environmental and Resource Economics 44: 145-165.

Shea J (1997) Instrument relevance in multivariate linear models: a simple measure. The Review of Economics and Statistics 79: 348-352.

Snyder R (2006) Does Lootable Wealth Bread Disorder ? Comparative Political Studies 39: 943-968

Stijns J P (2005) Natural Resource Abundance and Economic Growth Revisited. Resources Policy: 30, 107-130

Toya H, Skidmore M, Robertson R (2010) A re-evaluation of the effect of human capital accumulation on economic growth using natural disasters as an instrument" Eastern Economic Journal 36: 120-137.

World Bank (1997) Expanding the measure of wealth: indicators of environmentally sustainable development. Environmentally Sustainable Development Studies and Monographs Series No. 17, 1997.

World Bank (2006) Where is the Wealth of Nations? Measuring capital for the XXI centry. Washington D.C.