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Abstract

This paper analyzes the behavior of cross-country growth rates with respect to resource abundance and dependence. We reject the linear model that is commonly-used in growth regressions in favor of a multiple-regime alternative. Using a formal sample-splitting method, we find that countries exhibit different behaviors with respect to natural resources depending on their initial level of development. In high-income countries, natural resources play only a minor role in explaining the differences in national growth rates. On the contrary, in low-income countries abundance seems to be a blessing but dependence restricts growth.

Keywords: Natural Resources; Growth; Resource Curse; Threshold Regressions.

JEL Codes: O11; O13; Q33.

1 Introduction

Following the seminal work of Sachs and Warner (1995), a huge literature has developed on the so-called resource curse. The latter refers to the paradox that resource-abundant countries experience lower long-run economic growth than do resource-poor countries. A number of transmission channels have been put forward in the literature to explain this curse. These channels can be split up into two categories: *economic* mechanisms and *political* explanations.

Among the economic transmission channels, the most popular is the "Dutch disease", which has been widely documented in the literature (see for example Corden, 1984; Krugman, 1987; Bruno and Sachs, 1982; Torvik, 2001; Matsen and Torvik, 2005). This refers to the over-evaluation of the local currency following the discovery and exploitation of a significant new

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resource deposit. This currency appreciation causes a loss of competitiveness in the secondary and tertiary sectors that are the engines of growth (increasing returns to scale and positive externalities are more likely to be found in the secondary and tertiary sectors than in the primary sector). Alongside the Dutch disease, we can note that mining is largely an enclave industry. As such, the extraction of mineral resources *per se* will produce relatively few positive spillovers for the rest of the economy (Davis and Tilton, 2005; Humphreys *et al.*, 2007). Abundant natural resources may also crowd out human-capital investment, increasing agents' opportunity costs of investing in human capital (Gylfason, 2001; Sachs and Warner, 1999). In addition, natural resource discoveries shift investment from the secondary and tertiary sectors to the extractive industry, which is less likely to generate productivity gains (Sachs and Warner, 1995). The other main economic channels include resource-price volatility. The main source of revenues in resource-rich countries is often the extractive sector. However, resource prices can vary substantially, affecting the ability of governments to successfully manage their rent. The macroeconomic instability that results from resource price volatility can also discourage investment (van der Ploeg and Poelhekke, 2009, 2010; Daniel, 1992).

There also exist various political transmission channels. Natural resources first generate rents, which may be misused. Resource rents allow governments to avoid or postpone unpopular but necessary structural reforms, and may also be devoted to unproductive welfare expenditures (Bomsel, 1992). Ross (1999) also notes that nationalized mining companies may soften the budget constraint of resource-exporting governments, *"producing fiscal laxity and a tendency to over-borrow"*. In addition, natural resources may encourage weak institutions: resource-rich countries are often characterized by centralized power and collusion between public authorities and the mining industry. Moreover, resource revenues may be used in order to mollify dissent, repress opposition and avoid accountability pressure (Karl, 1999). With weak institutions, natural resources incite rent-seeking behaviors by political interest groups. Those groups often ask for transfers that do not reflect economic contributions or social value. Corruption is also a major concern in resource-rich economies: politicians are often suspected of embezzling rents for their own personal gain or accepting bribes from third parties who wish to obtain or conserve access to the rent. Last, natural resources can generate conflicts for greed or grievance motives. Under the greed theory, rebels begin armed conflict in order to obtain access to or secure resource revenues. The grievance theory on the contrary suggests that rebels are motivated by the rising inequality that follow a resource boom (caused by rent-seeking, corruption and so on). In this latter case, social justice is the main source of conflict. There are obviously many causes of war, among which appear natural resources. These have been shown to often cause longer conflicts by providing the belligerents with revenues.

Alongside this transmission-channel literature, there has been great debate over the evidence for the existence of the resource curse. Lederman and Maloney (2006, 2008) discuss carefully the evidences in the literature and explain that it is difficult to talk about a curse. They review the literature on each channel and argue that for some channels the curse is not convincingly present. For other channels, they claim that the curse is not very specific to resources. Indeed, there exist evidences that there is no curse in the strictest sense of the word because the underlying mechanisms also apply for non-resource goods. For example, the negative effects that natural resources may have on institutional quality described earlier (through rent seeking, conflicts, etc.) are not specific to natural resources but concern any sources of rents. When the channel is not convincingly demonstrated, this is often because the results found by Sachs and Warner (1995) and other authors using the share of resource exports in GDP as a proxy for resource abundance are not robust to the use of other resource-abundance indicators and different econometric methodologies. In this spirit, Stijns (2006) shows that the crowding-out effect of resource abundance on human capital disappears when measuring resource wealth with more appropriate metrics.[1] This ambivalence in the literature is driven by the empirical observation that resource-rich countries have diverse experiences. First of all, natural resources have been historically the engine of growth of developed countries. Indeed, the use of mineral resources was the very source of the two first industrial revolutions, and the success story of the United-States since independence represents one of the best illustrations. However, it seems that this positive relationship between resource endowments and economic development has reversed since the 1960s. For example, as Nigeria's oil revenues rose sharply between 1966 and 2010, its real GDP per capita in constant PPP was multiplied by a factor of 2.2.[2] Equally, Botswana was one of the poorest countries in the world when it gained independence in 1966, but has enjoyed one of the highest growth rates over the past four decades thanks to its diamond deposits. Its GDP per capita in constant PPP rose by a factor of 14.8 over this period:[3] it is now one of the richest African countries and left the least-developed economies group in 1994.[4] Indonesia, Malaysia, and Thailand have also often been cited (together with Botswana) as developing resource-rich economies that have achieved a long-term investment ratio of over one quarter of GDP. While some suggest that these countries have escaped the resource curse, they still appear to have performed less well than their neighbors who have fewer raw materials: Hong Kong, Singapore and South Korea (van der Ploeg, 2011).[5] The World Bank estimates in Table 1 show that subsoil-asset and natural-capital shares are higher in low- and middle-income economies than in developed countries. Symmetrically, the intangible-capital share rises with the level of development.

Growth regressions are often used to investigate the resource curse. The growth regressions in the seminal paper by Sachs and Warner (1995) show that the natural-resource share of exports is negatively correlated with economic development. They then extend their work to show that there is little evidence that the curse is explained by omitted geographical variables (Sachs and Warner, 2001). Atkinson and Hamilton (2003) use growth regressions to suggest that the resource curse reflects the inability of governments to manage large resource revenues in a sustainable way. Papyrakis and Gerlagh (2004) also use growth regressions to analyze resource-curse transmission channels. Alongside these positive analyses, some normative work also relies on growth regressions. Among others, Sala-i-Martin and Subramanian (2008) suggest that resource-rich economies (and, more precisely, Nigeria) should directly distribute their oil revenues to the population.

The empirical evidences for a curse that use growth regressions are a source of controversy. The most skeptic paper on those findings is perhaps the one by Brunnschweiler and Bulte (2008) who argue that the use of growth regressions in this literature is often accompanied by two sizeable problems: *i)* natural-resource exports over GDP capture resource dependence rather than resource abundance, and their use as a proxy for abundance may lead to the misinterpretation of the regression results; and *ii)* introducing resource dependence and institutional

[1] The interested reader could refer to Lederman and Maloney (2006, 2008) for more details about the robustness of each channels we have previously exposed.

[2] Nigeria's GDP per capita in constant PPP was 2240$ in 1966 and 5030$ in 2010 (source: Penn World Tables 9.0).

[3] Botswana's GDP per capita in constant PPP was 872$ in 1966 and 12871$ in 2010 (source: PWT9.0).

[4] Since its creation in 1971, five countries have left the least-developed economies group: Botswana (1994), Capo Verde (2007), the Maldives (2011), Mauritania and Samoa (2014). The group currently still includes 48 countries.

[5] Of course, these differences may be explained by other factors. Notably, James (2015) highlights the importance of industry in the economy and shows that there is little evidence that resource abundance hampers non-resource growth.

variables in growth regressions may lead to endogeneity bias, as resource-dependence is related to economic choices that may simultaneously affect growth. Natural resources can also reduce institutional quality, which in turn affects resource dependence through the economic policies that depend on institutions. The authors address this endogeneity problem via Three-Stage Least Squares (3SLS) regressions using historical openness and having a Presidential regime in the 1970s as instruments for resource dependence, while institutional quality is instrumented by latitude.[6] They conclude that resource abundance has a positive effect on economic growth, while resource dependence has no effect: the resource curse may then be a red herring.

Brunnschweiler and Bulte (2008) introduce regional dummies to pick up the differences in average economic growth across regions, conditional on the other explanatory variables. However, this choice of regions needs to be discussed and justified, as countries in the same region do exhibit considerable heterogeneity in terms of climate, geology, culture, politics and economics. Using the same dataset, Clootens and Kirat (2017) show that the impact of resource dependence on growth becomes strongly negative and significant when the regional dummies are omitted. Moreover, the way in which Brunnschweiler and Bulte (2008) take regional heterogeneity into account constrains the model parameters (apart from the constant) to be identical across regions. Durlauf and Johnson (1995) show that the linear model that is commonly used to analyze growth behavior may be misspecified, and argue for a multiple-regime alternative.

Clootens and Kirat (2017) relax this linearity assumption and allow all estimated parameters to vary by region. They split the sample into two distinct regions: the Northern and Southern countries.[7] As this split is subjective, they also look at OECD versus non-OECD countries. They find that Southern (non-OECD) and Northern (OECD) economies have different relations to resource dependence: resource dependence reduces growth in low-income economies.

The sample split in Clootens and Kirat (2017) is subjective, and could be improved by the use of formal sample-splitting methods. Konte (2013) argues that the impact of natural resources on growth may depend on the growth regime to which the country belongs. Using regression-mixture methods, she shows that natural resources increase growth in some countries but reduce it in others.

We here use the sample-splitting approach in Hansen (2000) to test for a threshold effect, and estimate the threshold endogenously rather than arbitrarily select the value. This approach is motivated by the fact that the relationships between growth and its determinants are non-linear. Indeed, it is well-known from the literature on growth that countries experience various growth regimes. This idea was first developed by Durlauf and Johnson (1995), who suggest that cross-section growth may be determined by initial conditions. Hansen (2000) extends the works by Durlauf and Johnson (1995) and uses initial GDP and literacy as threshold variables in growth regression to distinguish multiple equilibria. This is why we go further and extend this latter idea to assess whether the impacts of resource abundance and resource dependence on growth are regime-dependant. We believe that this approach has notable advantages, as it allows to correct for potential endogeneity bias provided that our splitting variable is exogenous. Indeed, Caner and Hansen (1982) show that this method allows the use of instrumental variables instead of ordinary least squares to address the potential endogeneity of right-hand-side variables. This method requires the exogeneity of the threshold variable. In our application, initial GDP seems exogenous because initial period characteristics suffer less from reverse

[6] Other popular instruments appear in their robustness checks: the results remain unchanged.

[7] This split is effected using the areas in Brunnschweiler and Bulte (2008). The Northern countries include the North-American, European and Central-Asian countries. They do not consider African and Middle-Eastern countries against the rest of the world separately, as there are too few observations in the sub-sample of African and Middle Eastern countries.

causality concerns. We estimate the threshold value of initial GDP that allows the sample to be split in two. Then we run regressions on our sub-samples. We find that resource dependence reduces growth in low-income economies, while resource abundance is on the contrary a blessing. Growth in high-income countries is not significantly affected by either abundance or dependence.

The remainder of the paper is organized as follows. Section 2 describes the data and Section 3 sets out the estimation strategy. Section 4 then presents the results and their interpretation. Last, Section 5 concludes.

2 Data

One of the main purposes of this paper is to explain the differences in long-run growth between countries. To this end, our econometric analysis below is carried out on a cross-sectional data set of 83 countries covering the period 1980-2014. This section describes all of the variables used in our analysis and clarifies the differences among the most commonly used indicators in the literature to measure resource-abundance and resource-dependence. Section 2.1 introduces our dependent variable while Section 2.2 discusses in detail the explanatory variables. Section 2.3 deals with the instrumental variables.

2.1 The dependent variable

The variable *Growth* is the dependent variable. This variable refers to the average log-growth of real (PPP in constant $) GDP per capita between 1980 and 2014. The Penn World Tables 9.0 provide five GDP estimates: we here use real GDP calculated using national-accounts growth rates, as recommended for growth regressions by Feenstra *et al.* (2015).[8]

2.2 The explanatory variables

This paper tries to disentangle resource-abundance effects from resource-dependence ones, in a way that follows Brunnschweiler and Bulte (2008). In all our regressions, we consequently include a resource-abundance variable together with a resource-dependence variable as regressors. In addition, we include different variables capturing the institutional quality, the level of investment, human capital, population growth, as well as the initial GDP. All of these explanatory variable are described hereafter.

We use alternatively two indicators of resource abundance (*RA*). RA_1 is the log of the World Bank subsoil asset natural capital per capita indicator averaged over the period. Natural capital includes the valuation of numerous minerals and fuels. This includes exhaustively bauxite, copper, hard coal, iron, lead, lignite, natural gas, nickel, oil, phosphate, silver, tin and zinc, and is measured as the discounted sum of the value of rents generated over the lifetime of the resource stock. Values are measured at market exchange rates in constant 2014 US dollars, using a country-specific GDP deflator.[9] RA_2 is the natural resources rents as a share of GDP estimated by the World Bank. Rents are calculated as the difference between the market price of a commodity and its cost of production. We averaged rents over the period to obtain an index of revenues generated by natural resources exploitation in a country during the observation period.

[8]PWT 9.0 also includes GDP in constant PPP and current PPP, estimated from both the demand and supply sides.

[9]The interested reader could refer to Lange *et al.* (2018) for more details about this variable.

While RA_1 may be seen as a measure of the stock value in the ground, RA_2 is an estimation of the revenues generated by such stocks along the period.

Concerning resource dependence, we use three alternative proxies. RD_1, is the average GDP share of mineral exports (the sum of mineral fuels, ores and metal exports).[10] The famous work of Sachs and Warner (1995, 1999, 2001) uses this proxy as a resource abundance variable. Numerous authors criticize this choice and suggest that this is more a proxy for resource dependence (Stijns, 2006; Brunnschweiler and Bulte, 2008; Lederman and Maloney, 2008). They also argue that evidences for a resource curse strongly lie on this poor choice. In the present paper, RD_1 is our favorite proxy for resource dependence. RD_2 is the average share of mineral exports in total exports. It shares a lot of characteristics with RD_1 but often lead to somewhat more robust results (Sachs and Warner, 1995). Those variables are calculated by the World Bank using the Comtrade database (United Nations Statistics Division). RD_3 represents the net exports of mineral resources per worker, averaged over the period. Leamer (1984) and Lederman and Maloney (2008) recommend the use of this variable to proxy resource dependence. They argue that it is the more appropriate measure of resource dependence according to the Heckscher-Ohlin model of international trade. Moreover, taking the net value of resource exports obviate that countries appear as resource-abundant economies due simply to large imports of raw materials immediately re-exported. Singapore is the typical example of such a country (Lederman and Maloney, 2008). This variable can be thought of as the resource-dependence variable that is best suited to capture abundance of resources when we do not have resource-abundance variables as such. Fortunately, in the present work, resource abundance is already captured by our *RA* variables. We thus introduce RD_3 as a resource dependence variable mainly to verify the consistency of our results.

We measure institutional quality using two alternative proxies. Our preferred one, *Rule* is the well-known "Rule of law" indicator popularized by Kaufmann *et al.* (2011) which captures the effectiveness of contract enforcement, police and the courts, and the likelihood of crime and violence. We averaged it over the period to better represent "average" institutional quality over the period considered. As an alternative proxy, we use $GovEffect$, the popular Kaufmann *et al.* (2011)'s Government Effectiveness indicator. It captures how the people perceive "the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies". We use this indicator for robustness check purposes. Both institutional quality measures are obtained through large surveys and take values between -2.5 and 2.5.[11]

Inv is a variable that represents the gross formation of fixed capital, *i.e.* investments, as a share of GDP. We use the average share of investment over the period. $human_{t=0}$ is a measure of human capital. We use the Barro and Lee (2013) average years of total schooling for people over 25 years old in 1980. *popgrowth* is the annual population growth rate. Finally, initial GDP is introduced following the recommendation in Feenstra *et al.* (2015). We thus take log of real GDP in current PPP in 1980. This choice limits the bias that may be introduced by the "constant PPP correction" and is the best measure of initial GDP.

[10]Fuels are the commodities in Standard International Trade Classification (SITC) 3, while ores and metal are those in SITC 27, 28 and 68.

[11]The interested reader could refer to Kaufmann *et al.* (2011) for more details.

2.3 Instrumental variables

As it will be discussed later and given the specification of the model we estimate, some of the explanatory variables presented above are potentially endogenous and may result in a biased estimates of model parameters. We hereafter describe the instrumental variables we use to tackle this issue. More details on the estimation procedure will be provided in section 3.2.

$pres_{t=0}$ is a dummy variable for the regime being Presidential (1) or Parliamentary (0). The first entry in 1980s is retained. *open* is a historical trade-openness variable calculated as the average real (current PPP) GDP share of imports and exports over the 1970s. We do not consider previous periods in order to maximize the number of observations in the database. Finally, *latitude* is the country capital's latitude in absolute value, divided by 90 to produce a figure between 0 and 1.

The summary statistics of our dataset are displayed in Table 2.

3 Estimation strategy

3.1 The threshold regression model

We extend the linear model in Brunnschweiler and Bulte (2008) by introducing non-linearity. We also introduce additional regressors, namely human capital, investment, and population growth, to be consistent with the literature on growth. The main equation in the linear model of Brunnschweiler and Bulte (2008) is very similar to the following:[12]

$$Growth_i = \beta_0 + \beta_1 RD_i + \beta_2 RA_i + \beta_3 Rule_i + \beta_4 gdp_{t=0,i} + \beta_5 Inv_i + \beta_6 human_{t=0,i} + \beta_7 popgrowth_i + \varepsilon_i \quad (1)$$

This regression can also be written as follows:

$$Growth_i = \Psi X_i + \varepsilon_i$$

where

$$\Psi = (\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7)$$

and

$$X_i = (1, RD, RA, Rule, lngdp_{t=0}, Inv, human_{t=0}, popgrowth)'$$

We look for a possible nonlinear effect of initial GDP per capita (*i.e.* in the starting period). The choice of the transition variable among the explanatory variables for threshold models is key. In many papers, this choice comes from economic theory. We here appeal to the literature on convergence clubs to identify initial real GDP per capita as the threshold variable. The idea is to show that there are different growth trajectories, depending on initial GDP. We believe that these differences can be measured by the asymmetry of long-run GDP growth relative to initial GDP.[13] Hansen (2000) uses initial GDP as the threshold variable in growth regression to distinguish multiple equilibria. This idea was inspired by Durlauf and Johnson (1995), who suggest

[12]Following the referee's suggestion to consider further control variables, we improve accordingly the model and include investment, population growth an human capital as explanatory variables in equation (1). We also omit the regional dummies.

[13]Another way to identify the threshold variable is to run a test procedure that applies linearity tests to each of the explanatory variables. The threshold variable is then selected as that with the lowest risk of error when linearity is rejected. This statistical approach has no theoretical economic foundation, and thus presents the disadvantage of potentially selecting a threshold variable that differs from the theoretically-based variable of interest. For this reason many authors (Hansen, 2000; Ahamada and Kirat, 2018), opt for the approach we take here.

that cross-section growth may be determined by initial conditions. Clootens and Kirat (2017) uncover some evidence that countries do react differently to an increase in resource dependence or abundance by their initial level of GDP. We thus consider the following threshold-regression model:

$$Growth_i = \begin{cases} \Psi^1 X_i + \varepsilon_i & if \quad gdp_{t=0,i} \leq q \\ \Psi^2 X_i + \varepsilon_i & if \quad gdp_{t=0,i} > q \end{cases} \tag{2}$$

where $\Psi^1 = (\beta_0^1, \beta_1^1, \beta_2^1, \beta_3^1, \beta_4^1, \beta_5^1, \beta_6^1, \beta_7^1)$ and $\Psi^2 = (\beta_0^2, \beta_1^2, \beta_2^2, \beta_3^2, \beta_4^2, \beta_5^2, \beta_6^2, \beta_7^2)$. The threshold parameter q is considered as unknown. It is convenient to rewrite (2) as follows:

$$Growth_i = \Psi^2 X_i + \lambda X_i \mathbb{1}_{gdp_{t=0,i} \leq q} + \varepsilon_i \tag{3}$$

where $\lambda = \Psi^1 - \Psi^2$. We want to estimate Ψ^1, Ψ^2 and q if the null hypothesis of linearity is rejected, i.e. $H_0 : \lambda = 0$ in equation (3).

We first examine this null hypothesis of linearity in equation (3), $H_0 : \lambda = 0$. Without an *a priori* fixed value of q in regression (3), it is not easy to carry out statistical inference regarding λ. In this case q is a nuisance parameter that is not identified under the null hypothesis. Hansen (1996) avoids this problem via a simulation technique producing a p-value statistic for the inference of λ. His approach does not require fixing an *a priori* value of q and allows for possible heteroskedasticity in (3). The calculation of the threshold estimate $\widehat{q}$ uses the concentrated sum of squared errors function from (3):

$$S(q) = \sum_{i=1}^{N} \left(Growth_i - \widehat{\Psi^2}(q) X_i - \widehat{\lambda}(q) X_i(q) \right)^2$$

and the threshold estimate $\widehat{q}$ is the value that minimizes $S(q)$:

$$\widehat{q} = \arg\min_{q \epsilon \Gamma} S(q)$$

where Γ is a bounded set of elements of $\{gdp_{t=0,i}, i = 1, ..., N\}$ and can be approximated by a grid (see Hansen, 2000). Finally, the slope estimates in the threshold model (2) can be calculated using $\widehat{\Psi^2}(\widehat{q})$ and $\widehat{\lambda}(\widehat{q})$. Hansen (2000) and Caner and Hansen (1982) have also developed asymptotic-distribution theory for the threshold estimate $\widehat{q}$, and propose asymptotic confidence intervals by inverting the likelihood-ratio statistic. This approach also allows for possible heteroskedasticity in (3).

3.2 Dealing with endogeneity

Endogeneity is a central issue in threshold models. Threshold regression requires the exogeneity of regressors in equation (1), otherwise the estimates will be biased. In their paper Brunnschweiler and Bulte (2008) identify a number of sources of endogeneity.[14] For instance, taking institutional quality and resource dependence as exogenous variables may lead to biased outcomes. Institutional quality might be linked to variables such as culture or other omitted variables that also determine growth. Moreover, resource dependence is not a proper explana-

[14]Haber and Menaldo (2011) concur with this point and argue that cross-country growth regressions for the resource curse may suffer from omitted variables and reverse-causality bias. Instrumentation should correct for these biases. Moreover, our sample-splitting may reduce the omitted-variable bias as we group countries according to their initial level of income. We nevertheless acknowledge that our results should not necessarily be read as being set in stone.

tory variable in growth regressions. Resource dependence is to a large extent determined by the comparative advantage of the resource sector which in turn is determined by government choices. It makes few doubt that those choices also determine growth.

Another concern is the exogeneity of the resource-abundance variables. We believe that RA_1 may be reasonably though as exogenous. Obviously, the exploration and evaluation of resource stocks is a technologically-intensive process that is not independent of countries' technological levels. Nevertheless, thanks to their economic potential, mineral deposits have been explored and estimated by large multinational firms regardless of the local conditions. While RA_1 is not free from criticism,[15] we believe that it constitutes a significant improvement with respect to the standard measure popularized by Sachs and Warner (1995). Our second resource abundance variable RA_2 is the natural resources rents as a share of GDP. It thus captures the actual rent that has been realized during the period. Broadly speaking, it is calculated as the difference between the resource price and the extraction cost, multiplied by extracted quantities. Finally, the scaling exercise suppose that the rent is divided by the GDP. To some extent, resource prices are determined on world markets and can be seen as exogenous.[16] The extraction costs are determined by the deposit quality. Sure, it can also be affected by the level of technology. However, mining deposits are often operated by large multinational firms that have access to the same technology. We thus believe that the unitary rent may reasonably be considered as exogenous. More suspicions can be put on the quantity extracted, and the scaling exercise, which are affected by government decisions. Still, while we acknowledge that this second resource-abundance variable is more prone to generate endogeneity issues, we consider it exogenous, and we use it mainly for robustness check purposes.

The literature has typically used three alternative instruments to control for the endogeneity bias introduced by institutions: latitude, the fraction of population speaking a Western-European language (Hall and Jones, 1999) and the logarithm of settler mortality (Acemoglu *et al.*, 2001). Latitude and the fraction of population speaking a Western language are measures of the extent to which the economy has been influenced by Western Europe, as this was the first area to introduce institutions supporting production. Nevertheless, these variables are not affected by current economic performance.[17]

According to Acemoglu *et al.* (2001), settler mortality is also a good instrument for institutions, as there were various types of colonization ranked from "extractive states" to "neo-Europes" (Crosby, 2004). The feasibility of settlements affected the colonization strategies such that "neo-Europes" appeared where settler mortality was low. As past institutions are a major determinant of current institutional quality, settler mortality seems to be a good instrument for institutions. We here use latitude to instrument institutions, as it is likely that mineral abundance promoted the establishment of extractive states.

We distinguish two institutional perspectives, following Brunnschweiler and Bulte (2008). First, institutions can be seen as persistent constitutional variables (Presidential vs. Parliamentary regimes, electoral rules etc.) and refer to the "deep and durable" characteristics of a society (Glaeser *et al.*, 2004). On the other hand, institutions can also refer to the policy outcomes in

[15] Notably, Bohn and Deacon (2000) remark that economic policies may affect the present value of rents. van der Ploeg and Poelhekke (2010) are also suspicious of the exogeneity of the abundance variable. Since the results obtained by Brunnschweiler and Bulte (2008) are robust to the use of different abundance variables (some of which were proposed in the critical paper by van der Ploeg and Poelhekke, 2010) we do not enter into this debate here.

[16] We acknowledge that some countries may have market power on a given resource price. OPEC and especially Saudi Arabia are good examples. But our data doesn't include numerous countries in such a situation.

[17] This is especially true for latitude, while economic development may affect the current English-speaking percentage. Fortunately, this difficulty can be avoided using the proportion of English-speaking people in 1970.

property-rights enforcement, the fight against corruption and so on (Rodrik *et al.*, 2004). Our variables *Rule* and $GovEffect$ are of the second type, and may be endogenous when used in the second-step estimation. We therefore need to instrument them in a first step.

Brunnschweiler and Bulte (2008) show that deep and durable institutions can be used to instrument resource dependence. They use a dummy variable (for the country having a Presidential regime in the 1970s) as a proxy for institutions. Presidential regimes are often associated with public expenditures that are biased in favor of private interests (including the primary sector), as the decision-maker does not have to rely on a stable majority. They also show that past trade openness is a good instrument for *RD*.[18]

To avoid endogeneity issues in threshold estimation, we here use the predicted values of the *RD* and *Rule* variables from instrumental equations (or first-step instrumental-variable estimations) instead of their observed values. The instrumentation procedure that we use here follows that in Brunnschweiler and Bulte (2008).

4 Results

We first check that there is evidence of a threshold effect associated with the initial level of GDP. We do so by carrying out the threshold test proposed by Hansen (2000) on an instrumented version of equation (1):

$$growth_i = \beta_0 + \beta_1\widehat{RD}_i + \beta_2 RA_i + \beta_3\widehat{Rule}_i + \beta_4 gdp_{t=0,i} + \beta_5 Inv_i + \beta_6 human_{t=0,i} + \beta_7 popgrowth_i + \varepsilon_i \quad (4)$$

where

$$\widehat{RD}_i = \widehat{\psi_0} + \widehat{\psi_1}RA + \widehat{\psi_2}gdp_{t=0,i} + \widehat{\psi_3}latitude_i + \widehat{\psi_4}open_i + \widehat{\psi_5}pres_{t=0,i} + \widehat{\psi_6}Inv_i + \widehat{\psi_7}human_{t=0,i} + \widehat{\psi_8}popgrowth_i \quad (5)$$

and

$$\widehat{Rule}_i = \widehat{\phi_0} + \widehat{\phi_1}RA + \widehat{\phi_2}gdp_{t=0,i} + \widehat{\phi_3}latitude_i + \widehat{\phi_4}open_i + \widehat{\phi_5}pres_{t=0,i} + \widehat{\phi_6}Inv_i + \widehat{\phi_7}human_{t=0,i} + \widehat{\phi_8}popgrowth_i \quad (6)$$

In equation (4), $\widehat{RD}$ and $\widehat{Rule}$ are the predicted values from the instrumental regressions (5) and (6).

The non-linearity test strongly rejects the null hypothesis of linearity in favor of the alternative of a threshold effect at the 95% confidence level in all six specifications reflecting various combinations of proxies for resource abundance and resource dependence. The bootstrapped p-values with 5000 replications are reported in the bottom of table 3. There is then a threshold value of initial GDP that splits our sample into two subsamples, consistent with Clootens and Kirat (2017). Sample-splitting estimations should then be carried out for all specifications.

Table 3 presents the estimation results for the threshold growth models. It reports the estimation results of six different specifications reflecting various combinations of proxies for resource abundance and resource dependence. This table also contains the estimation results from the corresponding linear models, and underlines the non-relevancy of estimates when non-linearity is not taken into account. For each specification in table 3, the first column reports the IV estimates of the linear model while the second and the third columns report respectively those of the low regime and the high regime of the corresponding threshold model. The estimated initial GDP per capita thresholds are robust to change in the resource-dependence and resource-abundance proxies and equals 1928.48$ (current PPP in 1980) in all specifications.

[18] The use of the predicted trade shares developed by Frankel and Romer (1999) as an instrument for potentially endogenous trade openness does not affect their results.

The instruments are exogenous according to the Hansen J overidentification test statistic, which is robust to heteroskedasticity. The Hansen J stat is below the χ^2 critical value of 3.84 for all six specifications. Although the instruments are not perfect, the Kleibergen-Paap F statistics for weak identification test are much more favorable in specifications (I) and (IV). The instruments predict the average GDP share of mineral exports or RD_1, much better than the other metrics of resource-dependence RD_2 and RD_3. The Shea's partial R^2 reported in 5 confirm the conclusions of these diagnostic statistics. The excluded instruments explain a significant part of the endogenous variables *Rule* and *RD* in most cases, with the exception of RD_3 for which instruments are likely to be weak.

The results in table 3 support the insights in Clootens and Kirat (2017) regarding the need for sample splitting: poor and rich countries (defined using the method in Hansen, 2000) do not react in the same way with respect to natural resources.[19] In low-income economies, resource dependence is a curse that reduces growth possibilities, while resource abundance remains a blessing. In our favorite specification (I) with regard to the relevance of instruments, it appears that a one percentage point rise in the GDP share of mineral exports leads to a fall of 0.187 percentage points in growth, all things being equal. However, an increase of one unit in the logarithm of subsoil assets is associated with higher growth of about 0.4 percentage points, all things being equal. The negative sign of the estimated parameter associated to initial GDP per capita reflects catch-up. Finally, human capital and investments affect growth positively. Indeed, an increase of one percentage point in the share of GDP devoted to investment increases growth by 0.228 percentage points while an increase of one year of total schooling for people over 25 in 1980 increases growth by 0.4 percentage points, all things being equal.

In high-income economies, growth is neither determined by dependence nor abundance. The GDP share of investment seems to increase growth while we also find a catch up effect.

These results seems robust when we change the resource dependence variable for the total export share of mineral exports (RD_2). However, when we use the third mineral dependence indicator RD_3 (the net exports of minerals per worker), we find no significant impact of either abundance or dependence on growth. Still, the signs of the estimates are consistent with previous estimations. The non-significance of parameters is probably due here to the weakness of instruments. The corresponding Shea's partial R squared are very low and reported to be around 0.10 (see 5). According to van der Ploeg and Poelhekke (2010), this implies noisy 2SLS first-stage estimates, leading to inflation of the second-stage standard errors by $0.1^{-0.5} \approx 3.16$. This may mean that the estimated coefficients associated with the net exports of minerals per worker variable is much more significant than suggested.

The results remain consistent when we introduce changes in variables proxying for resource-abundance. Considering the natural resource rent as a share of GDP instead of the logarithm of subsoil-asset natural capital per capita doesn't change significantly the estimation results. Our results are also robust to the use of an alternative institutional quality variable, namely the government effectiveness (see Appendix A.4). Finally, we also propose the OLS estimates in Appendix A.3. Using OLS in place of 2SLS doesn't change strongly the results except for specifications (III) and (VI) that suggest some room for a dependence curse also when we use RD_3 as the resource-dependence indicator.

The consistency of our results requires the exogeneity of the threshold variable. This point is crucial. Indeed, Caner and Hansen (1982) suggested the use of 2SLS estimator to correct the endogeneity of the explanatory variables when the threshold variable is necessarily exogenous as is the case in our model. Yu (2013) however shows that even in the case where the threshold variable is exogenous the 2SLS estimator of Caner and Hansen (1982) may be inconsistent.

[19] In order to verify the consistency of our results, the OLS estimates are given in Appendix A.3

Yu (2013) and Yu and Phillips (2018) give examples where the true relationship between the endogenous right-hand-variables and their instrumental variables are non-linear but mistakenly considered as linear to support this result. To overcome this issue, Yu and Phillips (2018) suggest a non-parametric estimator of the threshold which is unfortunately data consuming. For these reasons, a special attention should be paid to the instrumental equations to ensure that they are well specified. Fortunately, the estimated results in 5 show that the instrumental equations are well specified and have good statistical properties including high explanatory power (High R-squared and partial R squared of Shea) and high significance levels of the estimated parameters, which move us away from the particular case that invalidates the 2SLS estimator.

The results for mineral dependence contradict one of the principal results in Brunnschweiler and Bulte (2008):[20] we find that with sample splitting, resource dependence matters for the growth of developing economies. Initial GDP per capita is typically introduced in growth regressions to reflect catch-up. Here, this variable also acts as the sample-splitting variable to take into account the heterogeneity of countries with respect to their stage of development. Implicitly, by choosing this variable to split the sample, we suppose that countries on each side of the threshold share common properties in a way that is determined by their initial level of development. Notably, we believe that a country with high income per capita in 1980 is probably a country with a market-friendly environment in 1980: a more-educated population, developed financial markets, sufficient trade openness, good institutional quality, a high level of investment, and so on. These shared characteristics help high-income economies compensate for the negative impact that natural resource dependence may have on economic performance. For example, the probability of civil conflict falls with education. Moreover, the potential cost that will be incurred by the failure of rebellion is higher in high-income economies. Developed markets may also reduce rebellion for grievance reasons, and help to absorb shocks to resource prices. Greater (unobserved) institutional quality implies less corruption and misappropriation of public revenue. The Dutch disease or other crowding-out mechanisms associated with natural resources are easier to counter with appropriate economic policy when markets are developed.

As we may think that resource abundance generates dependence, we would like to calculate the net effect of natural-resource abundance on economic growth. We can do so using our first-stage IV estimates (see Appendix A.2). We conclude that the net effect of resource abundance is such that a one unit rise in the logarithm of subsoil assets generates an average increase in growth of about 0.026 and 0.015 percentage points in low-income economies when one considers specification (I) and (II) respectively. We should nevertheless be cautious regarding these figures, and believe that there is some potential for a resource-dependence curse. However, if resource abundance does improve growth there is no universal resource curse: resource abundance does not necessarily reduce growth, even if greater resource dependence does hamper growth in low-income economies.

[20] We believe that our results help to understand those in Brunnschweiler and Bulte (2008). They introduce regional dummies in their regression, but the only significant coefficient is for Africa and the Middle East. These dummies are introduced to control for geographical (cultural, climatic, natural, geological etc.) unobserved characteristics. Our results suggest they capture something quite different. The regional dummies proposed cover a very large area with very different countries: South Africa, Jordan, Tunisia and Togo (for example) seem to be sufficiently distant to not have common geographical characteristics. As Africa is the poorest continent, we believe that the dummies capture unobserved differences that are strongly linked to initial development.

5 Conclusion

This paper has added the work of Brunnschweiler and Bulte (2008) by improving the treatment of heterogeneity between countries. We notably use the sample-splitting method in Hansen (2000) on an updated data set. One of their main results is affected by the sample split: resource dependence negatively affects development in low-income countries (but has no effect in high-income countries). We acknowledge that this result is not independent of the choice of the threshold variable. While our method allows us to test for and estimate the value of the threshold without any subjective considerations, we still have to choose the threshold variable.

The natural resource effect on growth is dependant of the growth regime a country belongs which is in turn determined by the level of initial GDP. Initial GDP is highly correlated with initial levels of institutional quality, trade-openness, human capital, market development etc. We believe that high-income economies share a number of common properties that allow them to limit the negative effects of natural resources on growth. We thus argue that developing education, financial markets and institutions may restrict the negative influence of resource dependence on growth. Moreover, since resource dependence results from economic choices, it can be avoided by an appropriate diversification policy.

To summarize, we highlight that it is difficult to promulgate universal laws, such as natural-resource abundance is a blessing or a curse. We argue that while, on average, resource abundance favors growth in low-income economies, there does also exist some evidence for a resource-dependence curse.

Appendix A.1 List of countries

Table 4 reports the list of countries included in our regressions. The unique criteria of country selection was data availability. We keep all the countries for which we had a complete set of data.

Appendix A.2 First-stage regressions

Table 5 reports first stages estimations of our main IV regression.

Appendix A.3 The OLS regression

If there are no endogeneity problems in the data, a simple OLS regression is more efficient than a 2SLS regression. We believe that there are good reasons to suspect endogeneity and use 2SLS. Nevertheless, robustness checks using OLS are of interest. The threshold test concludes for the rejection of the null hypothesis of linearity in all specifications. Table 6 presents the results of the threshold OLS estimations by regime.

The results confirm those above: *RD* has a negative impact on growth while *RA* is a blessing for low-income economies. There is still a catch-up effect in this group, while *Inst* becomes significant, which is as expected as OLS implies an efficiency gain with respect to IV in the absence of endogeneity. Neither natural-resource abundance nor dependence affect growth in developed economies.

Appendix A.4 Alternative Institutional Quality Measure

In Table 7, we use an alternative proxy for institutional quality, namely the government effectiveness (see Kaufmann *et al.*, 2009).

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Table 1: Total wealth and subcomponents in 2005

Income group	Subsoil-asset share	Natural-capital share	Produced-capital share	Intangible-capital share
Low-income	6.02%	35.50%	11.31%	53.18%
Middle-income	7.80%	20.57%	19.09%	60.32%
High-income	1.09%	2.50%	17.03%	80.47%
World	2.41%	6.16%	17.32%	72.18%

These are per capita figures. Source: Own calculations based on Lange *et al.* (2010).

Table 2: Descriptive statistics

Variables	Mean	S.D	Min.	Max.	Source
$Growth$	0.016	0.015	-0.021	0.063	Penn World Table 9.0
RD_1	0.067	0.100	0.001	0.51	World Development Indicators, The World Bank
RD_2	0.228	0.234	0.006	0.909	World Development Indicators, The World Bank
RD_3	690.093	4019.233	-3755.635	21704.562	World Development Indicators, The World Bank
RA_1	6.114	2.998	0.000	13.053	Wealth Accounts, The World Bank
RA_2	0.037	0.073	0.000	0.433	World Development Indicators, The World Bank
$Rule$	0.196	1.004	-1.571	1.965	World Governance Indicators, The World Bank
$GovEffect$	0.269	0.968	-1.468	2.139	World Governance Indicators, The World Bank
$lngdp_{t=0}$	8.637	1.112	6.273	11.116	Penn World Table 9.0
Inv	0.220	0.044	0.108	0.352	World Development Indicators, The World Bank
$human_{t=0}$	4.921	2.660	0.460	11.940	Education Statistics, The World Bank
$popgrowth(\%)$	1.614	1.071	-0.572	4.134	World Development Indicators, The World Bank
$pres_{t=0}$	0.639	0.483	0.000	1.000	Persson and Tabellini (2004)
$latitude$	0.296	0.197	0.011	0.722	La Porta*et al.* (1999)
$open$	0.382	0.362	0.020	2.204	Penn World Table 9.0

Notes: We here provide the sources where we actually obtain the data. RD_1 refers to the average GDP share of mineral exports. RD_2 is the average share of mineral exports in total export. RD_3 represents the net exports of mineral resources per worker. RA_1 is the log of subsoil asset per capita. RA_2 is the natural resources rents as a share of GDP. *Rule* is the "Rule-of-law" indicator while $GovEffect$ represents the government effectiveness. $lngdp_{t=0}$ is the log of real GDP in current PPP in 1980. Inv is the investment to GDP ratio. $Human_t = 0$ is the average years of total schooling for people over 25 years old in 1980. $popgrowth$ represents the annual population growth rate. $pres$ is a dummy variable for the regime being Presidential (1) or Parliamentary (0). $open$ is a historical trade-openness variable. $Cons$ is the constant of regression.

Table 3: Estimation results of the effect of natural resources on growth

Economic Growth									
	(I)			(II)			(III)		
	All	Low	High	All	Low	High	All	Low	High
RD_1	-0.002	-0.187***	0.015						
	(0.026)	(0.025)	(0.028)						
RD_2				-0.003	-0.037***	0.011			
				(0.017)	(0.008)	(0.022)			
RD_3							-2e-6	-9e-5	-1e-6
							(2e-6)	(6e-5)	(2e-6)
RA_1	-1e-4	0.004***	-0.001	-1e-4	0.003***	-0.001	0.001	0.004	2e-4
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)
RA_2									
Rule	0.004	0.004	0.005	0.004	0.002	0.006	0.006	0.011*	0.005
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.006)	(0.004)
$lngdp_{t=0}$	-0.008***	-0.045***	-0.010***	-0.008***	-0.037***	-0.011***	-0.006*	-0.042***	-0.006
	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.004)	(0.004)	(0.010)	(0.006)
Inv	0.181***	0.228***	0.117***	0.181***	0.273***	0.115***	0.168***	0.211**	0.121***
	(0.032)	(0.033)	(0.039)	(0.031)	(0.033)	(0.043)	(0.035)	(0.104)	(0.036)
$human_{t=0}$	0.001	0.004***	0.001	0.001	-0.002	4e-4	1e-4	0.005	1e-4
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.005)	(0.001)
popgrowth	-0.004*	0.000	-0.003	-0.003	-0.003	-0.003	-0.001	0.006	3e-4
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.008)	(0.004)
Cons	0.052**	0.274***	0.086**	0.051**	0.231***	0.091**	0.030	0.235***	0.044
	(0.023)	(0.014)	(0.033)	(0.021)	(0.020)	(0.041)	(0.034)	(0.049)	(0.057)
N	83	16	67	83	16	67	83	16	67
R^2	0.597	0.985	0.608	0.607	0.975	0.601	0.491	0.835	0.491
Threshold Test	0.004			0.002			0.007		
KP F	9.04			4.29			1.451		
Hansen J	2.198			2.181			1.106		

Economic Growth									
	(IV)			(V)			(VI)		
	All	Low	High	All	Low	High	All	Low	High
RD_1	-0.001	-0.166***	0.018						
	(0.031)	(0.043)	(0.033)						
RD_2				-0.010	-0.037***	0.006			
				(0.022)	(0.009)	(0.025)			
RD_3							-3e-6	-1e-4	-2e-6
							(3e-6)	(7e-5)	(2e-6)
RA_1									
RA_2	0.018	0.120**	-0.003	0.042	0.144***	-1e-4	0.156	0.295	0.130
	(0.038)	(0.051)	(0.046)	(0.060)	(0.044)	(0.072)	(0.139)	(0.195)	(0.124)
Rule	0.005	0.004	0.006	0.006*	0.001	0.007*	0.012*	0.010	0.015*
	(0.003)	(0.004)	(0.005)	(0.003)	(0.004)	(0.004)	(0.007)	(0.007)	(0.009)
$lngdp_{t=0}$	-0.010***	-0.041***	-0.012***	-0.010***	-0.036***	-0.012***	-0.012***	-0.042***	-0.016***
	(0.002)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.007)	(0.006)
Inv	0.173***	0.344***	0.116***	0.171***	0.355***	0.120***	0.126**	0.324***	0.077
	(0.032)	(0.033)	(0.039)	(0.032)	(0.021)	(0.039)	(0.058)	(0.047)	(0.057)
$human_{t=0}$	0.001	0.001	5e-4	0.001	-0.004***	3e-4	2e-4	0.001	-2e-5
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
popgrowth	-0.004**	8e-5	-0.003*	-0.004**	-0.003**	-0.003*	-0.002	0.010	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.009)	(0.002)
Cons	0.065***	0.240***	0.097***	0.070***	0.215***	0.095**	0.084**	0.218***	0.136**
	(0.023)	(0.025)	(0.038)	(0.025)	(0.015)	(0.039)	(0.033)	(0.031)	(0.058)
N	83	16	67	83	16	67	83	16	67
R^2	0.602	0.964	0.596	0.640	0.975	0.601	0.429	0.816	0.500
Threshold Test	0.026			0.031			0.031		
KP F stat	7.98			2.24			0.853		
Hansen J	2.689			2.594			1.237		

Robust standard errors in parentheses. *,** and *** refer respectively to the 10%, 5% and 1% significance levels. Models I and IV, II and V, III and VI use respectively RD_1, RD_2 and RD_3 as proxies for resource dependence. Models I, II and III use RA_1 to proxy for resource abundance, while models IV, V and VI use RA_2. RD_1 refers to the average GDP share of mineral exports. RD_2 is the average share of mineral exports in total export. RD_3 represents the net exports of mineral resources per worker. RA_1 is the log of subsoil asset per capita. RA_2 is the natural resources rents as a share of GDP. *Rule* is the "Rule-of-law" indicator. $lngdp_{t=0}$ is the log of real GDP in current PPP in 1980. *Inv* is the investment to GDP ratio. $Human_t = 0$ is the average years of total schooling for people over 25 years old in 1980. *popgrowth* represents the annual population growth rate. *pres* is a dummy variable for the regime being Presidential (1) or Parliamentary (0). *open* is a historical trade-openness variable. *Cons* is the constant of regression. The first-step results for the main regressions appear in Appendix A.2. The threshold test line reports p-values against the null of no threshold. We report the Kleibergen-Paap rk Wald F statistic (test of weak identification) and the Hansen J statistic (test of overidentifying restrictions).

Table 4: List of countries

Albania	Dominican Republic	Kenya	Paraguay
Argentina	Ecuador	Korea	Romania
Australia	Egypt	Kuwait	Saudi Arabia
Austria	Spain	Sri Lanka	Senegal
Bangladesh	Finland	Morocco	Singapore
Bulgaria	France	Mexico	El Salvador
Bahrain	Gabon	Malta	Sweden
Belize	United Kingdom	Mozambique	Togo
Bolivia	Ghana	Mauritius	Thailand
Brazil	Greece	Malawi	Tunisia
Central African Republic	Guatemala	Malaysia	Turkey
Canada	Honduras	Niger	Tanzania
Switzerland	Hungary	Nicaragua	Uganda
Chile	Indonesia	Netherlands	Uruguay
China	India	Norway	United States
Cote d'Ivoire	Ireland	Pakistan	Venezuela
Cameroon	Iceland	Panama	Vietnam
Colombia	Italy	Peru	South Africa
Costa Rica	Jamaica	Philippines	Zambia
Germany	Jordan	Poland	Zimbabwe
Denmark	Japan	Portugal	

Table 5: First Stages Estimations

Dep:	*Rule*			RD_1			RD_2			RD_3		
latitude	1.853***	3.649*	1.518***	-0.084	-0.037	-0.112*	-0.175	-0.217	-0.305*	2359.986	367.471	1626.264
	(0.356)	(1.818)	(0.414)	(0.059)	(0.231)	(0.063)	(0.170)	(0.760)	(0.161)	(3061.797)	(745.896)	(3483.566)
$pres_{t=0}$	-0.349**	-1.144***	-0.298**	0.043***	0.009	0.044**	0.087**	0.118	0.092**	1020.177	-60.739	977.735
	(0.162)	(0.265)	(0.147)	(0.015)	(0.036)	(0.018)	(0.033)	(0.136)	(0.040)	(644.209)	(147.776)	(720.418)
open	0.317**	0.278	0.301**	0.126***	0.114	0.113***	0.173***	0.538**	0.120	1769.599	212.817	1344.971
	(0.136)	(0.441)	(0.132)	(0.025)	(0.070)	(0.028)	(0.065)	(0.223)	(0.073)	(2079.171)	(298.566)	(2326.017)
RA_1	-0.051**	-0.065	-0.042*	0.012***	0.020**	0.012***	0.042***	0.077**	0.040***	488.109***	39.542*	544.345***
	(0.023)	(0.046)	(0.023)	(0.002)	(0.007)	(0.003)	(0.009)	(0.022)	(0.010)	(167.967)	(18.566)	(199.627)
$lngdp_{t=0}$	0.234***	-0.241	0.370***	0.034***	-0.055	0.052***	0.020	-0.050	0.074*	1513.405**	-103.732	2186.085**
	(0.075)	(0.178)	(0.098)	(0.012)	(0.034)	(0.014)	(0.033)	(0.110)	(0.038)	(737.636)	(104.653)	(880.910)
Inv	3.210**	-0.741	4.103**	0.164	-0.356	0.229	-0.219	-0.718	0.107	-5799.440	-1164.694	-2698.711
	(1.230)	(4.134)	(1.593)	(0.159)	(0.511)	(0.213)	(0.429)	(1.671)	(0.506)	(7652.057)	(1257.738)	(8891.316)
$human_{t=0}$	0.095**	0.376	0.093***	-0.008*	0.020	-0.008*	-0.005	-0.068	-0.003	-230.218	88.459	-216.169
	(0.037)	(0.199)	(0.034)	(0.004)	(0.029)	(0.004)	(0.012)	(0.102)	(0.012)	(189.166)	(106.000)	(203.849)
popgrowth	0.050	0.616**	-0.031	0.018	0.029	0.017	0.045	0.038	0.033	1454.551**	186.160	1588.956**
	(0.081)	(0.218)	(0.094)	(0.012)	(0.036)	(0.013)	(0.031)	(0.126)	(0.029)	(677.510)	(152.818)	(763.240)
Cons	-3.215***	-0.251	-4.521***	-0.382***	0.282	-0.546***	-0.273	0.263	-0.762**	-17329.422***	114.697	-24464.187***
	(0.630)	(1.253)	(0.783)	(0.109)	(0.236)	(0.134)	(0.271)	(0.775)	(0.351)	(6420.166)	(703.804)	(6877.382)
R^2	0.807	0.725	0.819	0.719	0.700	0.756	0.575	0.787	0.630	0.554	0.576	0.819
F stat	15.63	8.90	9.57	9.97	1.90	7.06	4.93	3.37	3.42	1.46	0.30	0.91
Shea's R^2	0.330	0.631	0.286	0.346	0.300	0.333	0.123	0.480	0.108	0.050	0.092	0.037

Dep:	*Rule*			RD_1			RD_2			RD_3		
latitude	1.663***	3.726	1.236***	-0.030	-0.060	-0.034	-0.004	-0.535	-0.073	4800.540*	103.860	5656.449*
	(0.330)	(2.020)	(0.361)	(0.039)	(0.271)	(0.036)	(0.137)	(0.896)	(0.135)	(2546.791)	(787.802)	(2826.126)
$pres_{t=0}$	-0.342**	-1.151***	-0.255*	0.031*	0.011	0.033*	0.064**	0.134	0.070*	189.202	-49.258	240.688
	(0.165)	(0.289)	(0.144)	(0.017)	(0.042)	(0.019)	(0.030)	(0.133)	(0.036)	(481.660)	(129.449)	(529.678)
open	0.365**	0.227	0.263*	0.122***	0.129	0.122***	0.145**	0.563**	0.137*	1806.697	210.790	2012.687
	(0.152)	(0.444)	(0.151)	(0.029)	(0.089)	(0.032)	(0.069)	(0.237)	(0.079)	(1798.984)	(272.660)	(2126.774)
RA_2	-2.324**	-2.278	-3.050***	0.819***	0.678	0.839***	2.372***	3.848*	2.428***	41291.133***	2498.371	44378.387***
	(1.007)	(4.115)	(1.140)	(0.156)	(0.692)	(0.173)	(0.484)	(1.692)	(0.500)	(5568.604)	(1811.435)	(6780.210)
$lngdp_{t=0}$	0.280***	-0.305	0.523***	0.009	-0.036	0.011	-0.042	0.009	-0.037	76.649	-80.583	-134.198
	(0.091)	(0.189)	(0.124)	(0.010)	(0.055)	(0.012)	(0.031)	(0.136)	(0.038)	(524.400)	(99.816)	(717.193)
Inv	3.132**	-2.889	4.335***	0.132	0.285	0.164	-0.242	1.767	-0.097	-8715.938*	103.175	-5896.406
	(1.212)	(3.804)	(1.417)	(0.127)	(0.539)	(0.160)	(0.420)	(1.675)	(0.463)	(4493.043)	(992.067)	(5919.013)
$human_{t=0}$	0.078**	0.440*	0.071**	-0.002	0.001	-0.002	0.012	-0.160	0.014	55.395	33.410	89.316
	(0.036)	(0.205)	(0.032)	(0.003)	(0.036)	(0.002)	(0.010)	(0.112)	(0.010)	(134.954)	(94.751)	(142.956)
popgrowth	0.069	0.616**	0.025	0.006	0.030	0.002	0.016	0.016	-0.006	720.232*	165.057	718.648
	(0.082)	(0.235)	(0.088)	(0.010)	(0.041)	(0.011)	(0.029)	(0.129)	(0.029)	(372.850)	(140.300)	(512.683)
cons	-3.736***	0.283	-5.976***	-0.131	0.122	-0.151	0.373	-0.147	0.334	-3257.178	-2.669	-2710.062
	(0.816)	(1.310)	(1.026)	(0.110)	(0.357)	(0.138)	(0.268)	(0.902)	(0.371)	(4388.088)	(676.154)	(6181.866)
R^2	0.805	0.693	0.831	0.808	0.582	0.831	0.649	0.777	0.712	0.750	0.626	0.831
F stat	14.13	7.36	6.98	6.99	0.87	5.78	2.40	2.79	1.86	1.33	0.29	1.54
Shea's R^2	0.274	0.643	0.191	0.372	0.305	0.381	0.093	0.524	0.114	0.043	0.108	0.057

Robust standard errors in parentheses. *,** and *** refer respectively to the 10%, 5% and 1% significance levels. F-stat robust to heteroskedasticity. RD_1 refers to the average GDP share of mineral exports. RD_2 is the average share of mineral exports in total export. RD_3 represents the net exports of mineral resources per worker. RA_1 is the log of subsoil asset per capita. RA_2 is the natural resources rents as a share of GDP. *Rule* is the "Rule-of-law" indicator. $lngdp_{t=0}$ is the log of real GDP in current PPP in 1980. *Inv* is the investment to GDP ratio. $Human_t = 0$ is the average years of total schooling for people over 25 years old in 1980. *popgrowth* represents the annual population growth rate. *pres* is a dummy variable for the regime being Presidential (1) or Parliamentary (0). *open* is a historical trade-openness variable. *Cons* is the constant of regression.

Table 6: OLS regressions by subgroups

Economic Growth	(I)			(II)			(III)		
	All	Low	High	All	Low	High	All	Low	High
RD_1	-0.016	-0.181***	0.002						
	(0.017)	(0.015)	(0.017)						
RD_2				-0.015**	-0.044***	-3e-4			
				(0.007)	(0.007)	(0.006)			
RD_3							2e-7	-4e-5***	3e-7
							(4e-7)	(1e-5)	(3e-7)
RA_1	7e-5	0.004***	-4e-4	5e-4	0.004**	-4e-4	-1e-4	0.001	-0.001
	(4e-4)	(0.001)	(4e-4)	(5e-4)	(0.001)	(4e-4)	(4e-4)	(0.001)	(3e-4)
RA_2									
Rule	0.005***	0.001	0.007***	0.004**	0.004	0.007***	0.005***	0.003	0.008***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.005)	(0.002)	(0.002)	(0.006)	(0.002)
$lngdp_{t=0}$	-0.008***	-0.046***	-0.011***	-0.008***	-0.038***	-0.011***	-0.009***	-0.038***	-0.012***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)	(0.007)	(0.002)
Inv	0.183***	0.246***	0.113***	0.179***	0.242***	0.114***	0.178***	0.319***	0.114***
	(0.033)	(0.030)	(0.035)	(0.030)	(0.048)	(0.034)	(0.033)	(0.071)	(0.034)
$human_{t=0}$	4e-4	0.004**	2e-4	5e-4	-0.002	2e-4	0.001	3e-4	2e-4
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.003)	(0.001)
popgrowth	-0.003	4e-4	-0.002	-0.002	-0.003	-0.002	-0.004**	-0.001	-0.002
	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.004)	(0.002)
Cons	0.048**	0.272***	0.093***	0.049***	0.239***	0.091***	0.060***	0.212***	0.100***
	(0.019)	(0.010)	(0.020)	(0.017)	(0.023)	(0.019)	(0.016)	(0.038)	(0.018)
N	83	16	67	83	16	67	83	16	67
R^2	0.602	0.987	0.627	0.623	0.979	0.627	0.598	0.948	0.632
Threshold Test	0.001			0.001			0.001		

Economic Growth	(IV)			(V)			(VI)		
	All	Low	High	All	Low	High	All	Low	High
RD_1	-0.035*	-0.140***	-0.018						
	(0.019)	(0.024)	(0.016)						
RD_2				-0.025***	-0.044***	-0.013**			
				(0.007)	(0.008)	(0.006)			
RD_3							-2e-7	-5e-5***	-3e-7
							(3e-7)	(1e-5)	(3e-7)
RA_1									
RA_2	0.045*	0.097***	0.036	0.075***	0.175***	0.053**	0.029	0.116	0.036
	(0.026)	(0.022)	(0.025)	(0.024)	(0.043)	(0.026)	(0.023)	(0.066)	(0.023)
Rule	0.006***	0.001	0.009***	0.006***	0.002	0.009***	0.006***	0.001	0.009***
	(0.002)	(0.004)	(0.002)	(0.002)	(0.005)	(0.002)	(0.002)	(0.004)	(0.002)
$lngdp_{t=0}$	-0.009***	-0.040***	-0.013***	-0.011***	-0.036***	-0.014***	-0.010***	-0.038***	-0.014***
	(0.002)	(0.004)	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)	(0.005)	(0.002)
Inv	0.182***	0.356***	0.120***	0.171***	0.350***	0.116***	0.169***	0.361***	0.109***
	(0.032)	(0.035)	(0.034)	(0.029)	(0.031)	(0.032)	(0.032)	(0.046)	(0.034)
$human_{t=0}$	5e-4	9e-5	1e-4	0.001	-0.005**	4e-4	0.001	-0.001	2e-4
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.003)	(0.001)
popgrowth	-0.003*	-0.001	-0.002	-0.003**	-0.002	-0.002	-0.004**	0.001	-0.002
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.004)	(0.002)
Cons	0.058***	0.235***	0.106***	0.072***	0.218***	0.112***	0.067***	0.209***	0.112***
	(0.019)	(0.027)	(0.019)	(0.018)	(0.023)	(0.019)	(0.017)	(0.025)	(0.019)
N	83	16	67	83	16	67	83	16	67
R^2	0.619	0.969	0.635	0.660	0.977	0.648	0.603	0.955	0.632
Threshold Test	0.006			0.002			0.011		

Robust standard errors in parentheses. *,** and *** refer respectively to the 10%, 5% and 1% significance levels. The threshold test line reports p-values against the null of no threshold. RD_1 refers to the average GDP share of mineral exports. RD_2 is the average share of mineral exports in total export. RD_3 represents the net exports of mineral resources per worker. RA_1 is the log of subsoil asset per capita. RA_2 is the natural resources rents as a share of GDP. *Rule* is the "Rule-of-law" indicator. $lngdp_{t=0}$ is the log of real GDP in current PPP in 1980. *Inv* is the investment to GDP ratio. $Human_t = 0$ is the average years of total schooling for people over 25 years old in 1980. *popgrowth* represents the annual population growth rate. *pres* is a dummy variable for the regime being Presidential (1) or Parliamentary (0). *open* is a historical trade-openness variable. *Cons* is the constant of regression.

Table 7: IV regressions by subgroups, alternative index for institutional quality

Economic Growth									
	(I)			(II)			(III)		
	All	Low	High	All	Low	High	All	Low	High
RD_1	-0.005	-0.208***	0.015						
	(0.024)	(0.035)	(0.026)						
RD_2				-0.004	-0.039***	0.014			
				(0.015)	(0.007)	(0.019)			
RD_3							-2e-6	-1e-4	-1e-6
							(2e-6)	(1e-4)	(2e-6)
RA_1	-5e-5	0.005***	-0.001	4e-5	0.003***	-0.001	0.001	0.008	3e-5
	(-5e-4)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.006)	(0.001)
RA_2									
$GovEffect$	0.006*	0.009	0.006*	0.005*	0.005	0.007*	0.007*	0.031	0.006
	(0.003)	(0.006)	(0.003)	(0.003)	(0.006)	(0.004)	(0.004)	(0.025)	(0.004)
$lngdp_{t=0}$	-0.009***	-0.045***	-0.011***	-0.009***	-0.036***	-0.011***	-0.007*	-0.040**	-0.007
	(0.002)	(0.003)	(0.003)	(0.002)	(0.004)	(0.004)	(0.004)	(0.019)	(0.006)
Inv	0.175***	0.165***	0.111***	0.174***	0.241***	0.106**	0.162***	-0.008	0.116***
	(0.031)	(0.062)	(0.038)	(0.030)	(0.054)	(0.042)	(0.034)	(0.252)	(0.036)
$human_{t=0}$	0.001	0.005***	0.001	0.001	-0.002	0.000	9e-4	0.009	1e-4
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.009)	(0.001)
$popgrowth$	-0.003	0.002**	-0.003	-0.003	-0.002	-0.003	-0.001	0.016	-8e-5
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.016)	(0.003)
$Cons$	0.056**	0.275***	0.088***	0.056***	0.230***	0.096**	0.035	0.226***	0.052
	(0.022)	(0.020)	(0.030)	(0.021)	(0.019)	(0.037)	(0.034)	(0.084)	(0.054)
N	83	16	67	83	16	67	83	16	67
R^2	0.618	0.977	0.615	0.626	0.981	0.596	0.501	0.443	0.512
Threshold Test	0.003			0.002			0.004		

Economic Growth									
	(IV)			(V)			(VI)		
	All	Low	High	All	Low	High	All	Low	High
RD_1	-0.007	-0.181***	0.015						
	(0.029)	(0.058)	(0.029)						
RD_2				-0.013	-0.038***	0.008			
				(0.021)	(0.007)	(0.023)			
RD_3							-3e-6	-1e-4	-2e-6
							(3e-6)	(1e-4)	(2e-6)
RA_1									
RA_2	0.036	0.155*	0.021	0.061	0.157***	0.017	0.164	0.429	0.125
	(0.038)	(0.084)	(0.046)	(0.056)	(0.039)	(0.067)	(0.131)	(0.362)	(0.109)
$GovEffect$	0.008**	0.008	0.010*	0.008**	0.003	0.010**	0.015*	0.023	0.016*
	(0.004)	(0.008)	(0.005)	(0.004)	(0.008)	(0.005)	(0.008)	(0.026)	(0.008)
$lngdp_{t=0}$	-0.011***	-0.039***	-0.014***	-0.012***	-0.035***	-0.014***	-0.013***	-0.038***	-0.017***
	(0.002)	(0.006)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.014)	(0.006)
Inv	0.163***	0.314***	0.102***	0.159***	0.343***	0.104***	0.114**	0.242*	0.075
	(0.031)	(0.060)	(0.039)	(0.030)	(0.039)	(0.040)	(0.055)	(0.129)	(0.053)
$human_{t=0}$	0.001	0.001	0.000	0.001	-0.004***	0.000	3e-4	0.002	2e-4
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)
$popgrowth$	-0.004**	0.002	-0.003**	-0.003**	-0.002	-0.003*	-0.002	0.017	-0.001
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.016)	(0.002)
$Cons$	0.077***	0.234***	0.118***	0.083***	0.212***	0.117***	0.097***	0.195***	0.141**
	(0.024)	(0.032)	(0.041)	(0.025)	(0.019)	(0.042)	(0.036)	(0.061)	(0.056)
N	83	16	67	83	16	67	83	16	67
R^2	0.637	0.951	0.608	0.675	0.978	0.589	0.476	0.572	0.507
Threshold Test	0.026			0.027			0.033		

Robust standard errors in parentheses. *,** and *** refer respectively to the 10%, 5% and 1% significance levels. The threshold test line reports p-values against the null of no threshold.RD_1 refers to the average GDP share of mineral exports. RD_2 is the average share of mineral exports in total export. RD_3 represents the net exports of mineral resources per worker. RA_1 is the log of subsoil asset per capita. RA_2 is the natural resources rents as a share of GDP. $GovEffect$ represents the government effectiveness. $lngdp_{t=0}$ is the log of real GDP in current PPP in 1980. Inv is the investment to GDP ratio. $Human_t = 0$ is the average years of total schooling for people over 25 years old in 1980. $popgrowth$ represents the annual population growth rate. $pres$ is a dummy variable for the regime being Presidential (1) or Parliamentary (0). $open$ is a historical trade-openness variable. $Cons$ is the constant of regression.