The Paradox of Plenty: A Meta-Analysis*

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Abstract

Since Sachs and Warner's seminal article in 1995, numerous studies have addressed the link between natural resources and economic growth. Although the "resource curse" effect was commonly accepted at first, many articles have challenged its existence, and the results found in the literature are ambigious. In this paper, we aim to quantitatively review this literature in order to i) identify the sources of heterogeneity and ii) estimate the average impact of natural resources on economic development. To this end, we implement a meta-analysis based on 69 empirical studies of the latter nexus, totaling 1419 estimates. The results show i) that while there is a soft curse in developing countries, natural resources do not seem to harm growth in developed ones; ii) that the way natural resources are measured, as well as their appropriability, explain part of the heterogeneity of the results found in the literature; and finally, iii) that institutions are crucial in mitigating the resource curse.

Keywords: meta-analysis; resource curse; natural resources; appropriability; institutions

JEL Codes: C82; O11; O13.

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1 Introduction

Countries endowed with a rich bounty of natural resources have often failed to benefit from them and sometimes have performed worse than countries with fewer resources. This conventional wisdom of the paradox of plenty has spread through the academic literature since the mid-1990s (Gelb, 1988 ; Barro, 1991 ; DeLong and Summers, 1991 ; King and Levine, 1993 ; Auty, 1993). One recurring example is Nigeria's poor performance despite its substantial oil wealth compared to diamond-rich Botswana, which has managed to escape that pattern and improve economically. Since Sachs and Warner's famous paper in 1995, extensive literature, both theoretical and empirical, has emerged addressing the resource curse. The great heterogeneity of development paths followed by resource-rich countries demonstrates that the resource curse has not always been inevitable and that there exist ways to make the most of one's natural wealth (van der Ploeg, 2011).

The detrimental effects of natural resources on the economy have been highlighted through two perspectives: a market-based viewpoint focusing on macroeconomic mechanisms and a political economy approach stressing the role of institutions (Deacon, 2011 ; Deacon and Rode, 2015) that has gained importance in the last decade.[1]

The Dutch disease is surely among the oldest explanations of the resource curse: a revenue windfall leads to a contraction of the manufacturing sector because of an increase in labor costs appreciating the real exchange rate (see Corden and Neary (1982) for further explanations).[2] The subsequent loss in learning-by-doing in the non-resource traded sector may also add existing pressures on this sector. In the same vein, increasing world commodity prices has led countries to follow unsustainable policies, especially in Latin America in the

[1] We acknowledge the fact that both views are highly—if not completey—entangled, but this distinction is in accordance with the literature's evolution. van der Ploeg (2011) provides a variety of empirical evidence for each proposition mentioned in the text that follows, but we focus on the potential negative outcomes resulting from natural resource wealth without addressing the implicit factors that can alleviate the curse. Section 2 will provide a more in-depth review of the empirical findings.

[2] The Netherlands experienced a severe decline in the manufacturing sector after a large gas field was discovered, due to a high appreciation of the Dutch guilder.

1970s. Political scientists have focused on the inability of government actors to see further than "good times", which is reflected in over-expanding public sectors (Lane and Tornell, 1999 ; Auty, 2001) sometimes financed by excessive borrowing that causes "debt-overhangs" (Manzano and Rigobon, 2001). The problem arising from this behavior is that it becomes "impossible to finance once resource revenues dry up" (van der Ploeg, 2011: 392). These issues are all the more important because many resource-rich economies fail to transform their stock of natural wealth into more labor- and capital-intensive wealth and experience negative savings yet still strive to foster growth (Atkinson and Hamilton, 2003) while facing credit constraints (Beck, 2010). The risks inherent to resource-rich economies evoked above are also present in the high volatility of commodity prices because export revenues exhibit a low price elasticity, which "seems to be the quintessence of the resource curse" according to van der Ploeg and Poelhekke (2009). High volatility generates large real exchange rate fluctuations and less investment, especially in countries where financial development is lagging (Aghion et al. , 2009), consequently translating into lower productivity growth. All these factors may ultimately hamper growth, especially in developing countries where terms-of-trade fluctuations are twice as large as in developed countries (Baxter and Kouparitsas, 2006). Finally, together with the recurrence of blind governments that are overly optimistic about their relative natural richness, the neglect of investment in human capital and its effects on growth have been emphasized in Gylfason (2001).

The cornerstone of the political economy approach is that natural resources may be growth-deterring because they foster rent-seeking behavior. Institutions are at the heart of this relation, but thus far, the role they play is not clear-cut because it seems to be an issue of endogeneity. On the one hand, the main strand of the literature supports the theory that poor institutions are primarily the group fostering the rent-seeking behavior in a natural resource bonanza context. Lane and Tornell (1996) and Tornell and Lane (1999) pin down the voracity effect—a particular form of rent-seeking in which powerful groups have the ability to hijack and seize natural resources for their benefit—that occurs within a poor "legal-political institutional framework" (altered property rights and market imperfection) and in the presence of fractionalization. Torvik (2002), or Mehlum et al. (2006), put forward an entrepreneurship diversion effect in which institutions determine the behavior of an entrepreneur. When institutions are weak, profits retrieved from resource appropriation tend to be higher than from pure production. Hence, entrepreneurs are incentivized to become resource-grabbers rather than wealth-producers, hampering growth. On the other hand, some research takes the position that a low-quality institutional framework is instead considered a result of rent-seeking (Karl, 1997 ; Ross, 2001). When resource-rich countries are fractionalized, competition between groups for resource appropriation leads to damaged institutions, which in turn negatively affect growth through the lens of property-rights corrosion (Hodler, 2006). Issues other than property-rights may also be at work, such as corruption, as documented in Brazil by Caselli and Michaels (2013), or rigged elections in which both voters (Acemoglu and Robinson, 2006) and political challengers have been bribed (Acemoglu et al. , 2004). On the whole, democracy seems to be harmed, as highlighted by Ahmadov (2013), whose meta-analysis demonstrates a strong negative relationship between democracy and oil-wealth.

Thus far, traditional reviews of the literature put forward the ideas that i) the occurrence of the resource curse is not clear-cut because "empirical evidence suggests that either outcome [curse or blessing] is possible" (van der Ploeg, 2011) and ii) several factors, including resource measurement, institutions, policy, and financial development (among others), seem to play a central role.

We believe that although the traditional literature review is very useful because it illustrates the most advanced ideas, discusses the theoretical backgrounds, and provides some new guidelines for further research, it suffers from a major shortcoming when addressing the empirical consideration of quantification. Indeed, studies have been unable to determine how large the curse or the blessing can be or the relative importance of each factor in fueling or mitigating the curse (blessing). It has had even less success in addressing the existence of a publication bias.[3] Because of these structural weaknesses, conventional literature reviews may present incomplete and/or flawed conclusions. The aim of this paper is to address the shortcomings previously mentioned and to provide quantitative results regarding the magnitude of the link between natural resources and growth found in the literature as well as discuss the sources of heterogeneity across studies' findings on quantitative bases. As this quantitative review is specifically designed to integrate and evaluate econometric estimates, a meta-regression analysis (MRA) appears to be the best technique to fulfill this goal.

Moreover, such a synthesis may also prove interesting to policy-makers/advisors; since the early 2000s, international institutions have implemented programs to "beat the curse" and allow less developed countries plainly benefit from their resources. In particular, the World Bank has promoted the Extractive Industry Transparency Initiative (EITI) and signed specific bilateral agreements, such as that of the oil pipeline in Chad in 2005.[4] By statistically identifying the channels through which the curse or blessing operates and their extent, our MRA can be used as a preliminary tool for decision-making support.

First, an MRA is a systematic literature review in which all empirical studies have to be accounted for (unless there is a solid justification), rendering it more immune to selection bias than a conventional literature review. Another interesting characteristic lies in the quantitative assessment it offers. Thanks to econometric techniques, one can obtain an estimation of the studied effect (here the resource curse) that is revealed by the meta-average along with a discussion of each heterogeneity factor reflected in the magnitude and significance of the respective coefficients. An MRA benefits from increased statistical power due to the merger

[3] Simply put, *"publication bias is the term for what occurs whenever the research that appears in the published literature is systematically unrepresentative of the population of completed studies"* (Rothstein, et al. (2005). In the social sciences, there is a tendancy to prefer significant findings rather than unsignificant ones. In the medical sciences, some results may be more desirable than others regarding, for example, a drug's second-round effect. Both cases can lead to a publication bias in the existing literature.

[4] The World Bank engaged in funding part of the pipeline in return for a commitment from Chad to devote 72% of its oil royalties to poverty-reducing policies. The idea was to prevent rent-seeking by allocating windfalls from the oil to policies that benefit the entire population. In 2008, the World Bank finally cancelled the agreement after observing that windfalls "were used to consolidate President Idriss Deby's grip on power" (The Guardian - 12/09/08).

of the different samples of primary regressions. Finally, an MRA is also characterized by replicability, ensuring additional objectivity.

In short, reviewing literature with a meta-regression involves three main steps, starting with an exhaustive search of all empirical studies dealing with the topic of interest. A second stage uses this search to enable the coding of a dataset constituted by an explanatory variable (containing the effect-sizes) and a set of moderators (reflecting the potential heterogeneity between and within primary studies). This dataset is necessary to run regressions and provide quantitative assessments in a third step. Although meta-regression is a powerful tool, it also suffers from a few shortcomings that we have to keep in mind when interpreting the results. In particular, the second step is crucial because there is necessarily a loss of information when transforming characteristics from primary literature to quantitative or dummy variables (this problem is further developed in Section 3).

Although meta-analysis has been employed in the medical field for quite some time with the seminal work of Pearson (1904), it only spread into social sciences in the early eighties (Glass, 1981). Stanley and Jarrell (1989) first adapted and applied meta-analysis to economics, giving rise to meta-regression analysis. Since then, hundreds of papers have adopted this quantitative literature review to address topics as diverse as the growth-education nexus (Benos and Zotou, 2014), macroeconomic impacts of FDI (Iršová et al., 2013 ; Iwasaki and Tokunaga, 2014) or minimum wage effects (Doucouliagos and Stanley, 2009). Regarding the paradox of plenty literature, to the best of our knowledge, only Havranek et al. (2015) have implemented an MRA. In our work, we encompass a wider dataset (69 studies containing 1419 estimates vs. 33 studies containing 620 estimates) with alternative measures of resources, and we go further on the role of institutions by implementing a separate MRA to interaction results—studying the effects on growth of resources when conditioned by institutions.

The remainder of the paper is as follows. In Section 2, we review the articles used in our

MRA. Some descriptive statistics are provided and we discuss the different parti-pris of authors. In Section 3, we introduce the dataset and the econometric issues. We explain the way in which we code variables, the different categories therein and principal features. We also propose solutions to the main econometric pitfalls and present the estimators. Section 4 is devoted to the results and their interpretation. We go deeper into the role of institutions in Section 5 by performing a specific meta-analysis. Finally, we compare our results to previous literature and draw conclusions in the last section.

2 Primary Studies

2.1 Data set description

A comprehensive search of the literature via the software Publish or Perish revealed a large number of articles responding to the following keywords: "resource curse", "economic growth", and "natural resources".[5] We choose 1995 (Sachs and Warner's seminal paper) as the starting year of the search for studies and end our search in 2016, totaling 21 years of academic research. Of these 184 studies, sixty-seven papers met our requirements, which consisted of i) an empirical assessment of the link between natural resources and economic growth; ii) an investigation into the existence of the resource curse with a natural resource variable that is continuous and the dependent variable defined in growth terms; and finally, iii) the use of an econometric framework that is linear in its parameters.

This leaves us with 69 studies that aim to assess whether the resource curse exists and if so, what its transmission channels are. The entire database is available upon request to the authors, and all the papers that are used here may be found in Section A.

In Figure 1, we report all the effect sizes found in our dataset with the studies depicted on the vertical axis and the corresponding estimated effect sizes therein on the horizontal

[5] Studies were retrieved from Google Scholar and EconLit.

axis. All estimates are not directly comparable, which is the reason we depicted the partial correlation coefficients (PCC). Roughly speaking, the dots that lie on the left of the vertical line in 0 (horizontal axis) tend to offer evidence of a resource curse, while it is the opposite on the right. In other words, the closer the dot is to -1 (or 1), the stronger the resource curse (or blessing). The visual insight we gain from this plot is that correlations are quite dispersed among the [-1; 1] interval; they range from -0.80 to 0.70 (Table 2). Moreover, dispersion is present not only between the 69 studies but also on a within-study basis.

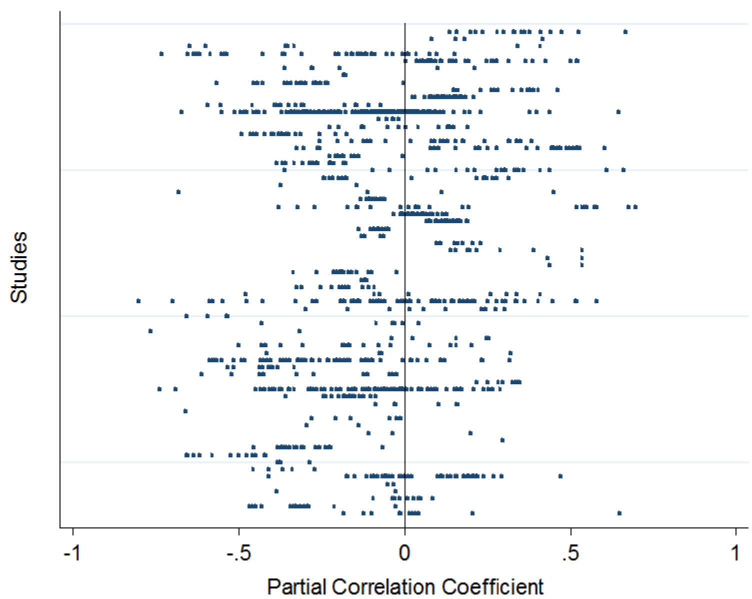

Figure 1: Heterogeneity of Results

Notes. The Figure reports Partial Correlation Coefficients (PCC). The latter are depicted instead of estimated coefficients with respect to the natural resource variable in growth regressions, as they are not directly comparable accross studies. PCC measure the direction and the strength of the association between natural resources and economic growth, *ceteris paribus* (Stanley and Doucouliagos, 2012). The closer to the boundaries [-1;1], the higher the correlation. PCC takes into account the Student statistic associated with the association and the regression's number of degrees of freedom. Each dot represents a PCC and when they are aligned, it means that they are retrieved from the same study. I.e. the more dots aligned, the more size effects are estimated in the study. **Sources.** Authors' calculation and database in Appendix A.

Figure 2 depicts a funnel plot—a scatter plot of the effect sizes estimated from individual studies (horizontal axis) against a measure of study size (vertical axis), which here is the standard error of the effect sizes (this is also known as the FAT-PEESE test).[6] The diagonal lines represent the "pseudo" 95

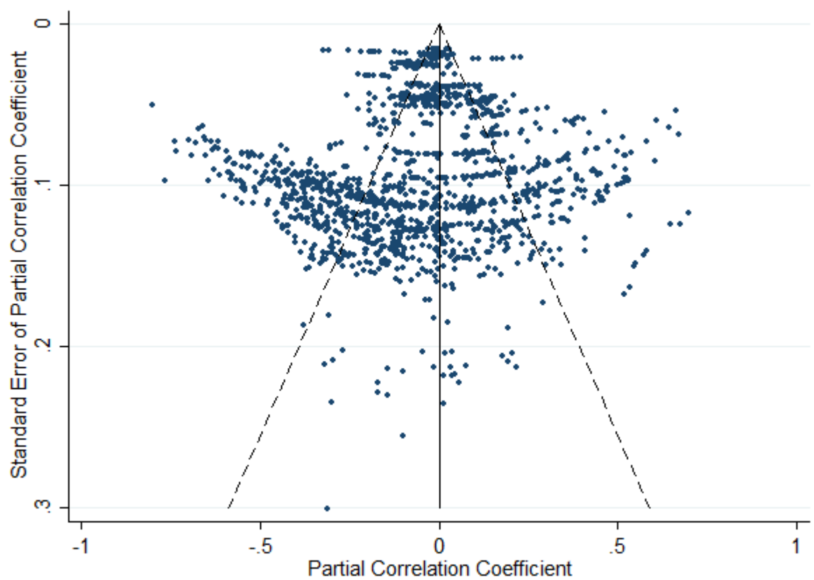

Figure 2: Funnel plot

Notes. Each dot represent the PCC estimated from a study against the standard error of the PCC, with a reversed scale that places the larger, most powerful studies towards the top. The outer dashed lines indicate the triangular region within which 95% of studies are expected to lie in the absence of both biases and heterogeneity. **Sources.** Authors' calculation and Database in Appendix A.

2.2 Heterogeneity in primary studies

Statistical heterogeneity refers to differences between study results beyond those attributable to chance. In the following, we discuss three sources of heterogeneity that we believe may explain the different outcomes found in the literature.

2.2.1 Abundance versus dependence

For almost a decade, economists have equated resource abundance and resource dependence,[7] or at the very least, the bias between the two did not raise much concern, as illustrated by

[6] The standard error of the PCC is often chosen as a measure of the study's size (Sterne and Egger, 2001)

[7] The preferred measure was actually the one allowing for the largest data set.

Sachs and Warner (2001 : 5): "*For most countries, however, changes in the definition of natural resources is not as quantitatively important as one may think". Moreover, the concept of resource abundance seems unclear, and as Lederman and Maloney note, "there is limited consensus on the appropriate empirical proxy for measuring resource abundance*" (2003: 4). One simple illustration is that studies tend to use all types of natural resource variables interchangeably to assess the robustness of their empirical strategy regardless of its economic significance. Not surprisingly, many papers followed Sachs and Warner's strategy of using the share of primary exports over GDP to assess the existence of the resource curse.

Let us now go back to the original concept of the resource curse: it states that countries highly endowed with natural resources have tended to experience more fragile economic performances than their resource-poor counterparts. Therefore, if one wishes to quantify the resource curse as previously defined, then one should first consider measures that are the closest proxies for wealth and not for intensity and specialization, which is the case of export or GDP-based variables. While resource abundance refers to a gift of nature, endowment, or wealth (i.e., stock), resource dependence reflects more the extent to which a country is reliant on the production and exportation of its natural resources to sustain its consumption and development (i.e., reliant on money flows). There are no reasons for abundance to lead to dependence in the first place. Indeed, there exist examples of resource-rich countries exhibiting low economic dependence on their resources as well as countries with less abundant resources that have an extreme specialization in the production of primary products (Brunnschweiler, 2008 ; Kropf, 2010).

Interpretation of the resource curse thus may differ substantially as "*changes in its definition sensitively [could] affect the outcome of empirical analyses*" (Kropf, 2010: 108). Our set depicts that resource abundance measures, which is measured by the share of natural capital (including geology, soil, air, water and livestock) and reserves, are associated with higher growth, while resource intensity, generally illustrated by the share of commodity exports over GDP or total exports, tends to impede growth. Sachs and Warner (1995, 1999, 2001) do not demonstrate that there is a resource curse per se, but they do show that a higher specialization in the natural resource sector generally goes in hand with poor development. While it is easy to sort the measures previously mentioned, there is no consensus on how production and rents of natural resources should be considered, as they are a mix of both stocks and flow concepts. For instance, Norman (2009) defines rents as "*the flow of income derived from the resource stock at some point in time*". If we divide natural resource measurements between i) all scaled variables that reflect intensity measures (DEPENDENCE) and ii) stocks that may include rents and production (ABUNDANCE), we obtain the picture in Table 1.

Table 1: Effect sizes

	ABUNDANCE	DEPENDENCE	TOTAL
TOTAL	482	937	1419
SIGNIFICANT	238	426	664
% Total	0.49	0.46	0.46
POSITIVE	171	86	257
% signif.	0.72	0.20	0.39
NEGATIVE	67	340	407
% signif.	0.28	0.80	0.61

Notes. Signif. means significance at the 5% confidence level.

By definition, natural resource variables scaled by the size of the economy (e.g., total exports, GDP) imply that they depend highly on "*economic policies, institutions that produced them*" (Brunnschweiler and Bulte, 2006 : 249). From a purely econometric viewpoint, the problems most likely to arise—particularly in cross-country regression analyses (two-thirds of our sample)—are those of endogeneity and omitted variable bias. However, reserves are not immune to endogeneity, but only affected by it to a lesser extent, as they depend on technological standards and on investments that are made (Norman, 2009). Aside from these endogeneity issues, the political economy literature contributed substantially to the understanding of the main differences between the concepts of abundance and dependence. In a nutshell, resource wealth may shape the institutional context such that it ends up hampering growth, while resource dependence is most likely to be detrimental to growth as a result of the poor institutions that are in place (Melhum et al., 2006 ; Norman, 2009). Finally, once resources are allowed to impact economic growth not only by themselves but also via crowding-out effects either through their impact on savings (Atkinson and Hamilton, 2003), investment (Gyflason and Zoega, 2006 ; Papyrakis and Gerlagh, 2006), human capital (Gyflason, 2001) or institutions (Brunnschweiler and Bulte, 2008), their existence per se does not appear as a burden anymore. It seems that abundance does not necessarily induce a lagging economic development; it is when abundance turns into too much dependence that it can be detrimental.

We identified approximately six main ways of taking natural resources into account: from exports to production, employment, through reserves, rents, and natural capital. These measures are generally expressed either as a share in national income or total exports, or in per capita terms.

2.2.2 A matter of appropriability

A theme that has been less controversial in the literature compared to the debate mentioned above revolves around the inherent nature of the resources considered. More precisely, the distinction lies between extracted and produced primary products, namely, "point-source" and "diffuse" resources, respectively. Point-source resources, characterized by the fact that they are clustered geographically and relatively easy to monitor and control, favor appropriative behavior either from producers or governments (Boschini et al., 2007)[8] Oil, minerals, precious metals, and crops such as coffee, cocoa fall under this category. The non-renewable feature of oil and mineral resources should not be ignored as it raises even more rent-seeking incentives, in part due to uncertainty about the amount of resources that are left to extract (Pindyck, 1993). Although renewable and diffuse in terms of production, coffee and cocoa are considered point-source resources because they are subject to concentration in ownership (Murshed, 2004). Produced resources such as rice, wheat or livestock (animals) are more

[8]Facilitated storing and transportation is also an important feature.

diffuse in that their production results among local farms and are less prone to lobbying over their control or special favors from those in power (Brunschweiler and Bulte, 2008).

If we go back to the notion of the resource curse as it was characterized earlier,[9] the natural resources considered and their definition is highly relevant. The World Trade Organization (WTO hereafter) defines natural resources as "*stocks of materials that exist in the natural environment that are both scarce and economically useful in production or consumption, either in their raw state or after a minimal amount of processing*" (WTO, 2010), meaning that there is a major difference between those that are extracted and those that are produced, such as agricultural products that fail to meet standard definition of natural resources.[10]

There is indisputable evidence that fuel and mineral wealth (in general, point-source resources) have a more detrimental impact on a country's development compared to other natural resources (Auty, 1997, 2001 ; Costantini et al., 2008 ; Norman, 2009 ; Williams, 2011). Additionally, oil and mineral resource measures are negatively associated with institutional quality, which is not the case for diffuse resources (Sala-i-Martin and Subramanian, 2003; Isham et al., 2005). The rationale behind this predictable behavior is strongly linked to political economic considerations (Robinson et al., 2006); the "rentier effect" is closely related to the notion of appropriability. The appropriability of a resource refers the extent to which its control allows "the realization of large economic gains within a relatively short period of time" (van der Ploeg, 2011: 384) and is critical in understanding why some resource-rich countries sharing the same natural resources follow different development paths.

Boschini et al. (2007) define two dimensions of appropriability. The first one is the legal and political context in which the resource is produced, which corresponds to "institutional" appropriability and states that resource dependence hampers growth only under poor insti-

[9] "Countries highly endowed in natural resources have tended to experience more fragile economic performance than their resource-poor counterparts."

[10] As they require water, land and fertilizers (natural resources) for their production, coffee and cocoa are produced and not extracted; however, they may still lead to appropriative behavior.

tutions. Physical and economic characteristics of the resources compose what is referred to as "technical appropriability" and allow the capture of rent-seeking incentives that point-source resources may generate. Indeed, it states the existence of a non-monotonic impact of resource dependence on economic growth via the quality of institutions (Melhum et al., 2006). More specifically, countries with poor institutions are expected to have the largest negative effects from their resources, while countries endowed with both these resources and good institutions are predicted to have large gains from them.

Finally, disentangling "diffuse" from "point-source" resources seems to be an indirect way of defining natural resources as the WTO would, that is, i) extracted resources and identified crops that may favor appropriative behavior that harms the economy as a whole in the long-run and ii) produced commodities that are negatively correlated with unfavorable outcomes that may be the result of too much dependence, highly volatile prices, etc.

2.2.3 The role of institutions

Institutions play a central part in the paradox of plenty literature. They are thought to explain why similarly endowed countries follow opposite development paths, as illustrated by the Nigeria-Botswana comparison. The profits that result from natural resources may become a blessing if there are well-established institutions that prevent economic distortions such as corruption or rent-seeking behaviors. Empirically, the institutional channel of the natural resources-economic growth nexus is taken into account with the interaction term (Institutions $\times$ Natural Resource). Given the multifaceted nature of institutions, a wide range of proxies may be found in the literature, encompassing political, economic, or legal and contracting aspects. However, despite these differences in institution measures, the interaction variable is most of the time positively associated with economic growth.

Political institution are important because they determine the distribution of the (*de jure*) political power inside a country as well as the constraints put on the governments (Acemoglu et al, 2005). Among the studies paying attention to political features, Bjorvatn et al. (2012), Boschini et al (2013), Bjorvatn and Farzanegan (2013) and Libman (2013) focus on the country's level of democracy.[11] The results indicate that a higher level of democracy allows the resource curse to be mitigated, though it is significant solely in Libman (2013)). The extent to which politicians may be restrained from abusing their office for political purposes appears in Brückner (2010). Sluggish checks and balances are found to deepen the negative effects arising from bad natural resources' management. Alkhater (2012) shows that a low or moderate rate of political repression leads to positive economic growth in natural abundant countries whereas a high level generates negative growth rates.

The legal and contracting structure of a country illustrates the quality of property rights (protection of citizens against expropriation), and the confidence citizens have in the rules of the society. Among the variables translating this feature, the rule of law is found to be significantly and positively correlated with economic development (Brunnchschweiler, 2008; Alexeev and Conrad, 2009; Kolstad, 2009); confidence in courts does not seem relevant (Ji et al, 2014); security of property rights is found to mitigate the curse (Farhadi et al, 2015).

Disentangling economic features among the bulk of institutional variables used is not straightforward because they cannot be considered as reflecting institutions per se. Indeed, they do not measure institutional quality but rather its outcomes, such as behaviors of the rulers and public servants and on a more general ground, policies.[12] Indicators of corruption control, government effectiveness[13], budget transparency and regulation of credit, labor and business indices may be considered as economic institutions as they affect the production, the allocation or the distribution process of goods and services. Farhadi et al. (2015), El Anshasy and Katsaiti (2013), Brückner (2010) and Iimi (2007) put forward a positive impact of natural

[11] Either with a dummy or with Polity IV/2 indices.

[12] One crucial issue in the resource curse literature and its close ties with the importance of institutions is that the bulk of the variables used may not necessarily purely reflect institutions such as "economic" ones (e.g., corruption) or suffer from being to broadly dfined. See Voigt (2013) for a criticism.

[13] The latter captures perceptions of the quality of public services, the quality of 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. These indicators are retrieved from the WGI database.

resources on growth as their level increases.

Finally many authors used combined aspect of institutions to get an overall picture of institutional quality that relates to government actions and their effectiveness in harnessing windfalls. Hence, rent-seeking incentives–permitted by poor governance–may cause institutions to deteriorate such that revenues are cornered and whether a country is more prone towards grabber-friendly rather than producer-friendly actions becomes a key point (Melhum et al., 2006). They include composite indices calculated as unweighted averages of 3 or more characteristics, such as the International Country Risk Guide index that stems from the Political Risk Services database (Boschini et al., 2013 ; Bjorvatn and Farzanegan, 2013). Examples of characteristics of those measures are bureaucratic quality, corruption in the government, risk of expropriation, government repudiation of contracts, etc. All institutions that beneïňĄt from rent-seeking activities tend to exacerbate the impact that natural resources might have on a country's economic performance. In an attempt to identify one of the channels they regard as the most important, Knack and Keefer (1995) proposed an indicator that reflects the ability to secure property and contractual rights. Boschini et al (2007) add support to their hypothesis, the more property and contractual rights are secured, the more growth-enhancing resources are.

3 Coding and econometric issues

3.1 The construction of variables

As mentioned in the introduction, the coding of variables is a crucial step. It allows the transformation of the different characters identified in the primary literature into testable features. However, this procedure is not without problems. The main issue raised is the loss of information. This necessarily happens when primary literature reports only limited material about key determinants (for example, data sources, samples under study, econometric techniques). In this sense, the quality of an MRA is conditioned by the quality of the primary studies. There is also a trade-off between the number of moderators coded (which accounts for intra- and inter-study heterogeneity) and saving degrees of freedom. As we further demonstrate, multi-collinearity may heavily hamper the scope of the results, and meta-analysts are forced to reduce information in order to obtain robust conclusions.

The dependent variable is crucial in an MRA because it has to measure the relationship we are interested in—in other words, the effect-size of natural resources on growth. Special care should be taken because the construction of the dependent variable cannot be reduced to simply retrieving and pooling the estimated coefficients found in the primary studies. Effect-sizes must gauge exactly the same purpose, which implies that they be expressed in a common metric. The main issue impeding the direct use of coefficient estimates is that functional forms used through the primary literature on resource curses are not homogeneous; while some rely on linear, others rely on log-linear or log-log functional forms. In order to overcome the problem, we transform these coefficients (semi-elasticities and elasticities) into partial correlation coefficients (hereafter PCC) as follows:

$$PCC_{ij} = \frac{t_{ij}}{\sqrt{t_{ij}^2 + \mathrm{df}_{ij}}} \tag{1}$$

where t denotes the reported effect size's t-statistic of the i-th regression in the j-th study and *df* the degrees of freedom associated with the former. PCC measures the direction and the strength of the association between natural resources and economic growth, ceteris paribus (Stanley and Doucouliagos, 2012). We also derive the standard-errors from PCC because they are needed as explanatory variables to control for publication bias:

$$PCC_{SE_{ij}} = \sqrt{\frac{(1 - PCC_{ij}^2)}{\mathrm{df}_{ij}}} \tag{2}$$

Note that PCC are statistically rather economically meaningful. This should be kept in mind when interpreting the results.

Turning to explanatory variables, we follow the advices provided by Stanley and Doucouliagos (2012) and focus on five classes to explain heterogeneity.

The data regroup all the variables (or families of variables) that account for data heterogeneity in the primary studies. They concern the sources, the time period under study (the number of years relative to 1990 precisely) and the type of countries (developing/developed) considered.

Econometrics aims at distinguishing the type of data (time-series, cross-section or panel) and the estimators employed (for example OLS or IV). It is particularly relevant for addressing the problems of endogeneity that arise from primary studies. The functional forms of the models (lin-lin, log-lin, log-log) are also listed.

Model specification is necessary to appraise the impact of modeling designs on the study outcomes. It encompasses the (control) variables included in the growth regressions, such as initial income, investment or openness; the dummy variables take into account specific features (time dummies, characteristic dummies)[14] or interaction variables. or interaction variables. The classification of all control variables found in the 69 studies may be found in the Appendix, in Table 9.

Resource measurements tackle the problems discussed in Section 2, which were raised by the way in which primary authors measure resources: abundance versus dependence, appropriability. We have identified six mains measures, which we listed in Section 2.[15] Abundance variables include any variable that measures natural wealth (in stock or value terms), while the ones that are scaled by the size of the economy are considered as dependence variables.

[14]See Table 10. The dummy classification is, of course, debatable; however, it allows for reduced multicollinearity risks.

[15]Export-based variables are divided between exports and "primary exports"—found in Sachs and Warner (1995, 1999, 2001).

Publication is made of three variables assessing the problems in line with publication: bias (with the standard errors of PCC), replication, and working papers. All the variables and their descriptive statistics are reported in Tables 2 and 3.

Table 2: Descriptive Statistics of covariates used in the MRA

Variable		Mean	Standard Error	Min	Max
Partial Correlation Coefficient (PCC)		-0.05	0.25	-0.80	0.70
Standard Error of PCC (PCC_SE)		0.1	0.04	0.01	0.31
Number of years relative to 1990		-2.16	8.15	-52	16
	Measures of Natural Resources (NR)		Frequency = 1		Frequency = 0
Abundance	Dummy = 0 if Dependence Measure, 1 if Abundance measure.		482		937
— **Dependence**					
Primary_ Exports	Dummy = 1 if NR is expressed as exports over total exports		104		1315
Employment	Dummy = 1 if NR is expressed in terms of Employment		64		1355
— **Abundance**					
Natural_ Capital	Dummy = 1 if NR is expressed in terms of Natural Capital		57		1362
Rents	Dummy = 1 if NR is expressed in terms of Rents		266		1153
Reserves	Dummy = 1 if NR is expressed in terms of Reserves		51		1368
Production**	Dummy = 1 if NR is expressed in terms of Production		225		1194
	Appropriability				
Point	Dummy = 1 if NR comprises point-source NRs		633		786
Diffuse	Dummy = 1 if NR comprises diffuse NRs		166		1253
— **Diffuse**					
Agri	Dummy = 1 if NR Variable includes agricultural NRs		94		1325
Food	Dummy = 1 if NR Variable includes food NRs		94		1325
Forestry	Dummy = 1 if NR Variable includes forestry		40		1379
— **Point-source**					
Fuel	Dummy = 1 if NR Variable includes fuel NRs		366		1053
Ore_ mineral	Dummy = 1 if NR Variable includes mineral NRs		353		1066
Subsoil	Dummy = 1 if NR Variable includes subsoil		28		1391
Precious_ met	Dummy = 1 if NR Variable includes precious metals		35		1384

Notes. **: The Production variable, once scaled by the size of the economy is considered as a Dependence measure. The same applies to the other variables.

3.2 Econometric features

Baseline specification A simple meta-regression model would consist of the following:

$$PCC_{ij} = \alpha_0 + PCC_{SE_{ij}}\alpha_1 + X_{ij}\beta + v_{ij} \tag{3}$$

with X an $L \times K$ matrix of moderator variables ($j = 1, ..., L$ regressions and $k = 1, ..., K$ variables), β a $K \times 1$ vector of MRA coefficients, and v_{ij} the sampling error of the ij-th regression. The standard error of the effect size is $PCC_{SE_{ij}}$, which is used to account for

Table 3: Descriptive Statistics of covariates used in the MRA (continued)

		Frequency = 1	Frequency = 0
	The data		
SW	Dummy = 1 if Data retrieved from Sachs and Warner (1995, 1997)	234	1185
Developed	Dummy = 1 if developed countries are considered	123	1296
Developing	Dummy = 1 if developing countries are considered	157	1262
	Econometrics		
—Functional Form			
Lin_ lin	Dummy = 1 if Functional form is Linear-linear	171	1248
Log_ log	Dummy = 1 if Functional form is Log-log	264	1155
—Structure			
Cross	Dummy = 1 if Structure of data is cross-sectional	984	435
Time_ series	Dummy = 1 if Structure of data is time series	8	1411
—Methods			
Endogeneity	Dummy = 1 if endogeneity is controlled for (IV or GMM)	384	1035
Meth_others	Dummy = 1 if estimation technique uses FLIML, CI and SUR	11	1408
	Model specification		
— Control Variables			
init_income	Dummy = 1 if Initial Income absent	283	1136
investment	Dummy = 1 if Investment absent	460	959
openness	Dummy = 1 if Openness absent	520	899
institutions	Dummy = 1 if Institutions absent	543	876
human_k	Dummy = 1 if Human Capital included	386	1033
physical_k	Dummy = 1 if Physical Capital included	117	1302
competitiveness	Dummy = 1 if Competitiveness included	258	1161
policy	Dummy = 1 if Economic Policy included	193	1226
geo	Dummy = 1 if Geography included	7	1412
— Dummies			
D_events	Dummy = 1 if Events dummy included, 0 otherwise	8	1411
D_geo	Dummy = 1 if Geographical dummy included	614	805
D_time	Dummy = 1 if Time dummy included	171	1248
D_instit	Dummy = 1 if Institutional dummy included	88	1331
D_political	Dummy = 1 if Political Regime dummy included	33	1386
D_charact	Dummy = 1 if Country Characteritics dummy included	59	1360
— Interaction			
interact_ instit	Dummy = 1 if (Natural Resource*Institution) Interaction variable included	491	928
interact_ others	Dummy = 1 if (Natural Resource*Others) Interaction variable included	155	1264
Replication	Dummy = 1 if Regression replicates SW	14	1405
WP	Dummy = 1 if the estimate comes from an unpublished study	186	1223

Notes. Details on how the control variables are classified may be found in the Appendix in Table 9.

potential publication bias as noted in the previous Section. If such an effect exists, then the reported estimate will be positively correlated with its standard error, *ceteris paribus.*

Weighted Least Squares Unlike conventional econometric models, an MRA cannot assume that errors are independently and identically distributed because standard errors of multiple effect sizes (comprising our database) are most likely to vary from one estimate to another. Moreover, dependence is likely to arise among reported estimates, especially when multiple estimates from a sole study are coded (Stanley, 2001 ; Doucouliagos and Stanley, 2012). If a paper has many observations, as is the case in Boschini et al. (2007) with 310 reported estimates (Table 2), its results might dominate the whole meta-analysis. Estimating an MRA with OLS procedures would thus lead to unbiased estimates, though they will not be consistent. This is why the baseline regression is usually estimated using weighted-least squares (WLS). Our model to be estimated (WLS-MRA) will be:

$$\frac{PCC_{ij}}{a_{ij}} = \frac{1}{a_{ij}}\alpha_0 + \frac{PCC_{SE_{ij}}}{a_{ij}}\alpha_1 + \frac{1}{a_{ij}}X_{ij}\beta + \frac{1}{a_{ij}}v_{ij} \tag{4}$$

Unlike least squares, each term in the WLS includes an additional weight a_{ij} that determines how much each observation in the dataset influences the final parameter estimates. While conventional econometricians would generally need the estimated squared residuals to correct for heteroskedasticity, we already have the required variance to compute analytical weights, which corresponds to the variance of the PCC as defined in (2).[16]

An important feature of this model is that the original constant term, which represents the "true" underlying empirical effect can now be recovered from α_1, while α_0 takes the precision of the effect in regression ij.[17] Re-writing Equation ((4)), we get:

$$\widetilde{PCC}_{ij} = \alpha_1 + \alpha_0 PREC_{ij} + \widetilde{X}_{ij}\beta + \widetilde{v}_{ij}, \tag{5}$$

with ~ indicating the transformed variables and $PREC_{ij}$ the inverse of the estimates' standard error (Equation (2)).

As stated by Stanley and Doucouliagos (2012), an MRA can be improved by considering (un)balanced panel data models. Indeed, these techniques are specially designed to address

[16] We could use the standard error of the PCC as analytical weights but most statistical software calculates the WLS version of (4) with each estimates' variance (Doucouliagos and Stanley, 2012).

[17] If each variable is weighted and regression (4) is estimated using OLS, then we need to be careful when interpreting the supposedly constant term. It will refer to precision. However, if we, for instance, estimate the regression on non-transformed variables simply adding an "[$aweight = PCC\_VAR\_PREC$]" in the computer program, then the intercept will correspond to the "true" underlying effect size.

the problem of dependence between observations (which is the case in meta-analysis when primary studies report more than one estimate). By adding a study-level component in the error-term structure, one can account for common influential unreported or unobserved factors. There are two ways to model these factors: the fixed effects model and the random effects model.

The fixed effects model includes an individual dummy for each study of the panel in order to account for those study specific characteristics that have been forgotten by the moderators or that are unobservable:

$$\widetilde{PCC}_{ij} = \alpha_1 + \alpha_0 PREC_{ij} + \widetilde{X}_{ij}\beta + \sum_{j=1}^{L} \delta_i \widetilde{D}_{ij} + \widetilde{\epsilon}_{ij}, \tag{6}$$

with L dummy variables (D_{ij}) assuming we omitted the intercept. This Least Square Dummy Variable approach allows us to use the inverse of the standard errors' effect sizes as analytic weights (Stanley and Doucouliagos, 2012). Equation (6) is hence usually labeled Fixed-effect WLS.

The random effects model includes a random term because unexplained heterogeneity is supposed to come from a population effect (underlying population differences). The model can be written as :

$$\widetilde{PCC}_{ij} = \alpha_1 + \alpha_0 PREC_{ij} + \widetilde{X}_{ij}\beta + \widetilde{u}_j + \widetilde{u}_{ij} \tag{7}$$

where $\widetilde{u}_j$ is the random term. Equation 7 is usually labeled mixed-effect WLS because it contains moderators and is weighted by standard errors of effect-sizes. Note that mixed-effect WLS assumes that moderators $\widetilde{X}_{ij}$ are independent from $\widetilde{v}_j$. This is rarely the case in an MRA, leading to biased results. Hence, mixed-effect WLS have to be used with caution (see Stanley and Doucouliagos (2012) for further explanations of bias and the use of mixed-effects WLS). Moreover, as additional insurance we follow Stanley and Doucouliagos (2012), by clustering standard errors at the study level in all specifications, in order to make them robust to intra-study dependence. This does not affect the estimated coefficients, only their significativity in a more conservative way.

Finally, we pay a special attention to multicollinearity in our regressions. To our knowledge, little attention has been provided to this topic in the MRA literature despite being a major caveat. The effects of multicollinearity are well-known in "traditional" econometrics: i) the parameters (both coefficients and standard errors) are unstable and sensitive to small changes in observations or to the inclusion (exclusion) of a new variable, ii) the impact of explanatories on the dependent variables are impossible to disentangle, and iii) the non-significance of the explanatories do not impact the coefficients of determination, which are high. In other words, estimates are far from robust. An MRA is even more subject to multicollinearity than "traditional" econometrics because almost all the explanatories are dummy variables. In order to avoid this problem, we rely on variance inflation factors (VIF) and apply a simple rule of thumb: all variables have to present a VIF near or above 10, and the mean VIF must be approximately 5.

4 Results and interpretation

The results of the MRA are reported in Tables 4 and 5.[18] In Table 4, we investigate whether the way in which natural resources are measured changes the outcome of the commonly-observed resource curse, i.e., whether using abundant-based resource variables have an impact or not. We first differentiate resources that translate wealth from those that embed dependence or intensity (Columns (2)-(4)) and then introduce dummies that account for the six measures most used in the literature, namely, employment, primary exports, natural capital, rents, reserves and production. The omitted variable regroups measures that incorporate all types of resources, such as a primary exports-to-GDP ratio. Our aim is also to assess the validity of the appropriability hypothesis through two regressions, the results of

[18]As a robustness check, we performed the same MRA but included disaggregated institutional variables and dropped the variable "institution". The results remain the same, illustrating the robustness of our findings, and are available upon request to the authors.

which may be found in Table 5. The first one includes a point dummy for studies whose natural resources variable accounts for either fuel, ore and minerals or precious metals and a diffuse dummy when food or agricultural commodities are considered. The latter specification includes disaggregated dummies of natural resources measures. The natural component is divided in seven groups that are: agricultural, food, fuel, ores and mineral, forestry, subsoil and precious metals.

Before turning to specific interpretations, there are findings that are noteworthy and systematic, regardless of the table we consider.[19] First, what may be drawn from the empirical literature is that the average effect of natural resources on economic growth favors the existence of the resource curse. Indeed, the meta-average (constant term) varies from -0.09 to -0.167 and is significant most of the time at the 1% confidence level. According to Doucouliagos' guidelines on the size of PCC (2011), one can argue that the effect is small to medium, indicating a type of "soft" curse. One should note that all the other parameters require an interpretation with respect to this constant term. In addition, there is no sign of publication bias because PCC_SE never enters significantly into the regressions.

Among the common sources (Section 2.2) that may explain heterogeneity in the literature, the research design is an important feature. Time series datasets result in lower negative resource-growth effects than the use of panel data. Studies that estimated the growth regression through cointegration or SUR methods tend to find a higher negative effects of natural resources on growth. Estimating a growth regression in either a log-log or a lin-lin framework strongly helps to reverse the resource curse, *ceteris paribus*, compared to a log-lin specification (the omitted variable). The coefficient associated with developed countries is positive and statistically significant. Hence, studies that only consider developed countries in their sample are more likely to experience a resource blessing (Table 4) or a mitigated

[19] The fixed effects (FE) model—Columns (2)-(5)—is the preferred model, as it accounts for unobserved heterogeneity, whereas the weighted least squares (WLS) do not. In addition, it takes care of potential dependence among estimates from a given study. Finally, FE estimators are close to the RE ones, i.e., heterogeneity is due to the research design rather than random factors; the FE model is preferred (Hunter and Schmidt, 2004) insomuch as RE may provide biased results (recall previous sections).

curse (Table 5), compared to those who consider all types of countries. This is an interesting result because it tends to support the idea that the level of development plays a role in the intensity of the curse/blessing. This idea has already been developed in the literature through the lens of institutional quality (North et al., 2007).

Table 4: Results — Resources measurement

VARIABLES	Abundance vs. dependence WLS Eq. 1	W-FE Eq. 2	W-RE Eq. 3	Detailed resources WLS Eq. 1a	W-FE Eq. 2a	W-RE Eq. 3a
PCC_SE	-0.199 (0.43)	-0.774 (0.54)	-0.774 (0.52)	-0.176 (0.41)	-0.797 (0.55)	-0.797 (0.53)
Years relative to 1990	-0.002 (0.001)	-0.001 (0.002)	-0.001 (0.002)	-0.003^{c} (0.002)	-0.001 (0.002)	-0.001 (0.002)
WP	0.045 (0.09)	0.196^{a} (0.02)	0.195^{a} (0.02)	0.062 (0.09)	0.182^{a} (0.02)	0.182^{a} (0.02)
Endogeneity	0.023 (0.02)	0.009 (0.01)	0.009 (0.01)	0.031^{c} (0.01)	0.008 (0.01)	0.008 (0.01)
Meth_others	-0.156 0.11)	-0.078^{a} (0.01)	-0.078^{a} (0.01)	-0.247^{b} (0.12)	-0.078^{a} (0.01)	-0.078^{a} (0.01)
Init_income	0.020 (0.03)	0.059 (0.03)	0.059^{c} (0.03)	0.077^{b} (0.03)	0.061 (0.04)	0.061^{c} (0.03)
Investment	0.015 (0.03)	0.028 (0.02)	0.028 (0.02)	-0.021 (0.03)	0.029 (0.02)	0.029 (0.02)
Openness	0.082^{b} (0.03)	-0.012 (0.01)	-0.012 (0.01)	0.057 (0.03)	-0.013 (0.01)	-0.013 (0.01)
Institutions	-0.0001 (0.04)	-0.021 (0.02)	-0.021 (0.02)	0.024 (0.04)	-0.021 (0.02)	-0.021 (0.02)
Human_k	-0.011 (0.02)	0.020^{c} (0.01)	0.020^{b} (0.01)	-0.0005 (0.02)	0.019^{c} (0.01)	0.02^{c} (0.01)
Physical_k	-0.024 (0.04)	0.008 (0.02)	0.008 (0.02)	-0.015 (0.04)	0.008 (0.02)	0.008 (0.02)
Competitiveness	-0.021 (0.04)	-0.022 (0.04)	-0.022 (0.04)	-0.034 (0.04)	-0.021 (0.04)	-0.021 (0.04)
Policy	-0.017 (0.03)	0.034^{b} (0.01)	0.034^{b} (0.01)	0.001 (0.03)	0.035^{b} (0.01)	0.035^{b} (0.01)
Geo	-0.005 (0.07)	0.177^{a} (0.04)	0.176^{a} (0.04)	0.013 (0.08)	0.166^{a} (0.05)	0.166^{a} (0.05)
Time_series	0.020 (0.02)	0.024^{a} (0.0098	0.024^{a} (0.008)	0.0356 (0.02)	0.022^{b} (0.01)	0.022^{b} (0.01)
Cross	-0.057 (0.03)	-0.031 (0.06)	-0.031 (0.05)	-0.065 (0.03)	-0.030 (0.06)	-0.030 (0.05)
SW	0.022 (0.07)	-0.128 (0.08)	-0.128 (0.07)	0.047 (0.07)	-0.112 (0.10)	-0.112 (0.09)
Lin_lin	-0.007 (0.06)	0.186^{a} (0.05)	0.186^{a} (0.04)	0.022 (0.05)	0.187^{a} (0.05)	0.187^{a} (0.04)
Log_log	0.232^{a} (0.04)	0.368^{a} (0.09)	0.368^{a} (0.09)	0.177^{a} (0.04)	0.179^{a} (0.05)	0.179^{a} (0.05)
D_events	-0.110 (0.10)	0.067^{a} (0.009)	0.067^{a} (0.008)	-0.144 (0.10)	0.063^{a} (0.01)	0.063^{a} (0.01)
D_geo	0.037 (0.03)	0.004 (0.02)	0.004 (0.02)	0.051^{b} (0.02)	0.003 (0.02)	0.003 (0.02)
D_time	-0.061^{c} (0.03)	0.018 (0.02)	0.018 (0.02)	-0.046 (0.03)	0.019 (0.02)	0.019 (0.02)
D_instit	-0.039 (0.06)	0.004 (0.02)	0.0024 (0.02)	-0.039 (0.05)	0.013 (0.03)	0.013 (0.03)
D_political	-0.112 (0.08)	-0.032^{c} (0.02)	-0.032^{c} (0.02)	-0.085 (0.10)	-0.033^{c} (0.02)	-0.033^{c} (0.02)
D_charact	-0.035 (0.04)	0.028^{c} (0.01)	0.028^{b} (0.01)	0.004 (0.03)	0.028^{c} (0.01)	0.028^{b} (0.01)
Developed	-0.092 (0.06)	0.141^{a} (0.04)	0.140^{a} (0.04)	-0.188^{b} (0.08)	0.145^{a} (0.04)	0.144^{a} (0.04)
Developing	0.021 (0.04)	0.007 (0.02)	0.007 (0.02)	-0.002 (0.04)	0.008 (0.02)	0.008 (0.02)
Interact_instit	0.015 (0.02)	-0.012 (0.01)	-0.012 (0.01)	0.019 (0.02)	-0.012 (0.01)	-0.012 (0.01)
Interact_others	-0.002 (0.05)	0.096^{a} (0.03)	0.096^{b} (0.03)	0.01 (0.04)	0.098^{a} (0.03)	0.098^{a} (0.03)
Replication	-0.025 (0.16)	-0.077 (0.05	-0.077 (0.05)	-0.022 (0.16)	-0.078 (0.05)	-0.078 (0.05)
Abundance	0.018 (0.02)	-0.006 (0.01)	-0.006 (0.01)			
Employment				0.146^{a} (0.06)	- -	-0.09 (0.11)
Primary_Exports				-0.102^{b} (0.05)	-0.099^{c} (0.05)	-0.099^{c} (0.05)
Natural_Capital				0.279^{a} (0.07)	0.238^{a} (0.05)	0.238^{a} (0.05)
Rents				-0.004 (0.01)	-0.004 (0.003)	-0.004 (0.003)
Reserves				0.108 (0.08)	0.005 (0.08)	0.005 (0.08)
Production				0.033 (0.04)	0.012 (0.03)	0.012 (0.03)
Constant	-0.09^{b} (0.03)	-0.136^{a} (0.03)	-0.119^{b} (0.04)	-0.107^{a} (0.04)	-0.103^{a} (0.03)	-0.092^{b} (0.05)
Observations	1,419	1,419	1,419	1,419	1,419	1,419
R-squared	0.41	0.68	-	0.44	0.69	-
Number of id_paper	69	69	69	69	69	69

Notes. Robust standard errors in parentheses. ^{a} p<0.01, ^{b} p<0.05, and ^{c} p<0.1. Since multilevel models are used for random-effects, R-squared are not available.

Another source of heterogeneity may arise from the control variables that are included or excluded in the growth equations. Including competitiveness measures does not lead to different results. This result is interesting because over 251 times, we find *competitiveness* is taken into account in our sample; the volatility of terms of trade appears 139 times (expressed as its standard deviation). It has been suggested that the latter partly explained bad economic performance in resource-rich countries (van der Ploeg and Poelhekke, 2009). In this respect, we should expect that including a competitiveness measure would decrease the resource curse, as all of it effects should have been captured by that volatility. This is not the case, and we must therefore qualify the negative impact of terms of trade's volatility on growth. Finally, accounting for geographical features seems to reduce the negative association between natural resources and economic growth most strongly, while policy and human capital variables' inclusion in growth equations only allows for a small diminution of the resource curse and is significant mostly at the 10% confidence level. While the literature acknowledges the importance of institutional quality in mitigating the resource curse, the detrimental effect of natural resources on growth remains the same, regardless of whether one considers Institutions or Natural Resources × Institutions. Hence, including a proxy for the institutional framework does not seem to directly impact the results. We will deepen the question in Section 5.

Turning to the source of heterogeneity evoked in Section 2.2, considering a variable expressing resource wealth and one that translates the intensity of dependence on such wealth cannot lead to the same implications in terms of the resource curse. Abundance measures do not seem to significantly mitigate the resource curse (Equation (1)-(3)). Although coefficients are low, they are not significant. This means that distinguishing between abundance and dependence measures alone may not be sufficient to explain the differences in the effect sizes found in the literature. In order to verify whether a more in-depth disaggregation between resource measurements helps to better understand heterogeneity, we focus on the 6 natural resource measures with Exports_GDP being the reference (the omitted variable). Overall, using exports of resources over total exports gives rise to a deeper resource curse than if the exports-to-GDP were considered. The more countries depend on resource exports, the more likely they are to experience a decline in growth. Considering employment-based or reserves-based measures leads to the same outcome; the negative association is mitigated and to some extent reversed into a positive one, though only in Equation (1a). Natural capital is the most significant variable out of the ones generally used in the literature. This variable reflects the most abundance and tends to be associated with a resource blessing as it is usually found in the literature (Gylfason, 2001 ; Gylfason and Zoega, 2006 ; Brunnschweiler, 2008 ; Brunnschweiler and Bulte, 2008 ; Cruzten and Holton, 2011). The effect switches from -0.103 when exports-to-GDP is accounted for to 0.135 once natural capital is considered (Equation (2a)), *ceteris paribus.*

Another source of heterogeneity that was previously mentioned is the differentiation of the appropriability aspects of resources. Recall that there are two types of appropriability: i) the "institutional" one that states that under poor institutions, natural resources are most likely to dampen growth prospects and ii) the "technical", which may give rise to a non-linear effect on growth the more prone to rent-seeking activities the resources are. The more appropriable the resources, the more difficult it seems to be to make the most of it as it is advocated in the literature (Boschini et al., 2007). In the first three columns of Table 5, diffuse dummies are significant in all specifications regardless of the estimator. The results indicate that considering diffuse resources gives rise to a lower curse, though it is negligible (the mean effect starts at -0.142 and becomes -0.110). Studies that account for agricultural or food resources measures find on average a smaller effect size compared to the ones that use an aggregated measure or a point source-based variable. However, there is poor evidence of this particular pattern in terms of appropriability. To some extent, this may be due to the fact that the omitted variable that considers all resource types does not allow the share of both point-source and diffuse resources included in it to be differentiated. The last three columns depict the results with the disaggregated resource-type measures. Food resources are not found to play a significantly different role than that of an all resource-type measure. In addition, the consideration of agricultural and forestry resources reduces the link between natural resources and growth only on a small basis (up to 0.059 and 0.029, respectively). Surprisingly, the same result is found for fuel minerals, although their extraction may give high incentives for rent-grabber friendly behaviorsand the economic consequences thereof. Ores and minerals are significantly related to the resource curse and tend to deepen the effect. Focusing on precious metals does not imply a higher negative genuine effect, while one would expect the contrary. Subsoil measures are associated significantly and positively to the effect size; they are even associated with a small blessing because the final effect is positive (-0.167+0.212 = 0.45, cf. Eq. (2a)). These results are somewhat counterintuitive because the subsoil measure incorporates resources that are most likely to be extracted and prone to rent-seeking incentives.[20]

Finally, the results do not seem to reveal a particular pattern with respect to both appropriability hypotheses. We previously demonstrated that the literature emphasized the close ties between resources and the quality of institutions, especially by using interaction variables in growth equations. If the direct effect is not large, there might be answers in the study of the indirect effect size.

[20] Indeed, as calculated by the World Bank, this includes oil, gas, coal, lignite, bauxite, copper, iron, lead, nickel, phosphate, timber and zinc (sometimes precious metals as well).

Table 5: Results — Appropriability

	Point vs. Diffuse			Detailed resources		
VARIABLES	WLS Eq. 1	W-FE Eq. 2	W-RE Eq. 3	WLS Eq. 1a	W-FE Eq. 2a	W-RE Eq. 3a
PCC_SE	-0.295 (0.39)	-0.801 (0.55)	-0.801 (0.50)	-0.495 (0.37)	-0.828 (0.53)	-0.828 (0.51)
Years relative to 1990	-0.002 (0.001)	-0.001 (0.002)	-0.001 (0.002)	-0.002 (0.001)	-0.001 (0.002)	-0.001 (0.002)
WP	0.047 (0.09)	0.200^{a} (0.02)	0.199^{a} (0.02)	0.033 (0.08)	0.200^{a} (0.02)	0.199^{a} (0.02)
Endogeneity	0.027 (0.01)	0.011 (0.01)	0.011 (0.01)	0.026 (0.02)	0.012 (0.01)	0.012 (0.01)
Meth_others	-0.135 (0.11)	-0.078^{a} (0.01)	-0.078^{a} (0.01)	-0.130 (0.11)	-0.077^{a} (0.01)	-0.077^{a} (0.01)
Init_income	0.031 (0.03)	0.059 (0.04)	0.059 (0.04)	0.038 (0.03)	0.059 (0.04)	0.059 (0.04)
Investment	0.010 (0.03)	0.027 (0.02)	0.027 (0.02)	0.004 (0.03)	0.027 (0.02)	0.027 (0.02)
Openness	0.087^{a} (0.03)	-0.013 (0.01)	-0.013 (0.01)	0.066^{b} (0.03)	-0.013 (0.01)	0.013 (0.01)
Institutions	0.011 (0.04)	-0.020 (0.02)	-0.020 (0.02)	0.025 (0.04)	-0.017 (0.02)	-0.017 (0.02)
Human_k	-0.002 (0.02)	0.020^{c} (0.01)	0.020^{c} (0.01)	-0.001 (0.02)	0.020^{c} (0.01)	0.019^{c} (0.01)
Physical_k	-0.021 (0.05)	0.007 (0.02)	0.007 (0.02)	-0.004 (0.05)	0.008 (0.02)	0.008 (0.02)
Competitiveness	-0.025 (0.04)	-0.022 (0.03)	-0.022 (0.03)	-0.021 (0.04)	-0.024 (0.03)	-0.024 (0.03)
Policy	-0.009 (0.03)	0.034^{b} (0.01)	0.034^{b} (0.01)	-0.017 (0.03)	0.034^{b} (0.01)	0.034^{b} (0.01)
Geo	0.014 (0.06)	0.175^{a} (0.04)	0.175^{a} (0.04)	-0.021 (0.06)	0.174^{a} (0.05)	0.173^{a} (0.04)
Time_series	0.016 (0.02)	0.018^{b} (0.008)	0.018^{b} (0.007)	0.023 (0.02)	0.024^{b} (0.009)	0.024^{a} (0.008)
Cross	-0.045 (0.03)	-0.03 (0.06)	-0.03 (0.06)	-0.035 (0.03)	-0.027 (0.06)	-0.027 (0.06)
SW	0.033 (0.07)	-0.122 (0.08)	-0.122 (0.08)	0.031 (0.07)	-0.133 (0.08)	-0.132^{c} (0.08)
Lin_lin	-0.010 (0.06)	0.186^{a} (0.05)	0.186^{a} (0.04)	-0.003 (0.06)	0.184^{a} (0.05)	0.183^{a} (0.04)
Log_log	0.236^{a} (0.04)	0.362^{a} (0.09)	0.362^{a} (0.09)	0.234^{a} (0.03)	0.229^{b} (0.09)	0.229^{b} (0.09)
D_events	-0.093 (0.10)	0.065^{a} (0.01)	0.065^{a} (0.009)	-0.090 (0.10)	0.066^{a} (0.01)	0.067^{a} (0.01)
D_geo	0.040 (0.02)	0.004 (0.02)	0.004 (0.02)	0.045^{c} (0.02)	0.003 (0.02)	0.003 (0.02)
D_time	-0.067^{b} (0.03)	0.018 (0.02)	0.018 (0.02)	-0.067^{c} (0.03)	0.018 (0.02)	0.018 (0.02)
D_instit	-0.037 (0.06)	-0.002 (0.03)	-0.002 (0.03)	-0.026 (0.07)	-0.025 (0.03)	-0.025 (0.03)
D_political	-0.103 (0.08)	-0.032^{c} (0.02)	-0.032^{c} (0.02)	-0.105 (0.08)	-0.033^{c} (0.02)	-0.033^{c} (0.02)
D_charact	-0.028 (0.04)	0.028^{c} (0.015)	0.028^{b} (0.014)	-0.041 (0.04)	0.028^{c} (0.014)	0.028^{b} (0.013)
Developed	-0.103^{c} (0.05)	0.142^{a} (0.04)	0.141^{a} (0.04)	-0.092^{c} (0.05)	0.141^{a} (0.04)	0.141^{a} (0.04)
Developing	0.004 (0.04)	0.008 (0.02)	0.008 (0.02)	0.025 (0.04)	0.009 (0.02)	0.009 (0.02)
Interact_instit	0.008 (0.02)	-0.006 (0.02)	-0.006 (0.01)	0.014 (0.02)	0.003 (0.02)	0.003 (0.02)
Interact_others	0.007 (0.04)	0.098^{a} (0.03)	0.098^{a} (0.03)	0.006 (0.04)	0.101^{a} (0.03)	0.101^{a} (0.03)
Replication	-0.0006 (0.16)	-0.076 (0.06)	-0.076 (0.05)	0.0006 (0.16)	-0.075 (0.06)	-0.075 (0.05)
Point	0.04^{c} (0.02)	0.012 (0.01)	0.012 (0.01)			
Diffuse	0.063^{b} (0.02)	0.032^{a} (0.01)	0.032^{a} (0.009)			
Agri				0.083^{a} (0.02)	0.056^{a} (0.008)	0.056^{a} (0.008)
Food				0.028 (0.02)	0.0006 (0.008)	0.0006 (0.008)
Fuel				0.060^{b} (0.02)	0.025^{a} (0.008)	0.025^{a} (0.007)
Ore_mineral				0.002 (0.01)	-0.014^{c} (0.01)	-0.014^{c} (0.01)
Forestry				0.054^{a} (0.01)	0.029^{a} (0.004)	0.029^{a} (0.004)
Subsoil				0.109^{a} (0.06)	0.212^{a} (0.02)	0.212^{a} (0.02)
Precious_met				-0.022 (0.09)	-0.065 (0.05)	-0.065 (0.05)
Constant	-0.140^{a} (0.03)	-0.142^{a} (0.03)	-0.116^{b} (0.06)	-0.144^{a} (0.04)	-0.167^{a} (0.04)	-0.144^{b} (0.09)
Observations	1,419	1,419	1,419	1,419	1,419	1,419
R-squared		0.43	0.69	0.45	0.70	
Number of groups	69	69	69	69	69	69

Notes. See notes in Table 4

5 On the specific role of institutions

As we emphasized in the previous section, the results are not clear-cut and somewhat counter-intuitive relative to "appropriability". This may be due to the way institutions are accounted for. Indeed, the "appropriability" hypothesis is entangled with the nature and particularly the quality of institutions. One way to shed some light on the topic and obtain more reliable results is by paying interest on the effects of natural resources on growth when the former are conditioned by institutions. This is possible with our panel studies through a specific MRA on the coefficients of interaction terms (Natural Resources $\times$ Institutions). Despite the restrictions it imposes, we dispose of 185 estimates[21] distributed among 19 studies.

5.1 Methodology and variables

When focusing on interaction terms, the dependent variable is not straightforward; the marginal effect under study is not reflected by the coefficient of the interacted variables, but by the coefficient multiplied by the conditioning variable (Stanley and Doucouliagos, 2012). If Equation (8) is the growth model of a primary study containing an interaction term between Natural Resources and Institutions:

$$Y = \beta_0 + \beta_1 NR \times I + \sum_{i=2}^{k} \beta_k X_k + \epsilon \tag{8}$$

where Y is growth, NR the conditioned variable (natural resource) and I the conditioning variable (institutions). When considering the marginal effect, we get:

$$\frac{\partial Y}{\partial \mathrm{NR}} = \beta_1 I \tag{9}$$

As a result, when studies do not directly report marginal effects (as in our case), it is impossible to implement a meta-regression unless the conditioning variable is bounded. One can then fix an arbitrary value inside the bounds and interpret results relative to the chosen value.

[21] Initially, there were 430 estimates among which 290 were retrieved from Boschini et al. (2013). This raised the problem of over-representation of this specific study and the bias it could thus introduce. We decided to only keep the results that the authors considered their best (36 overall).

It is precisely the methodology we adopt because all measures of institutions are bounded. We first rescale them in order to establish the lower bound at 0 (lowest institutional quality) and the upper bound at 1 (best institutional quality) and choose to fix institutional quality at 1 so that the marginal effect is equivalent to the estimated coefficient of the interacted variables. The ways in which institutional variables were classified can be found in Table 6. As in Section 4, we transform the estimated coefficients into PCC because of functional form problems and also to derive the standard errors.

Table 6: Institutional variables classification

POLITICAL
checks and balances, democracy, democratic institutions, government size, political repression, civil repression, voice and accountability, political stability.
LEGAL AND CONTRACTING
rule of law, confidence in courts, legal structure and security of property rights index.
ECONOMIC
corruption, policy inflation, access to sound money index, freedom to trade internationally index, regulation of credit, labor, and business index, government effectiveness.
AGGREGATED
ICRG, Knack and Keefer (1995) index, economic freedom index, Polity IV.

Because the sample at our disposal for interaction terms is highly restricted relative to that of Section 4, the degrees of freedom problem raised in Section 3.2 is even more pertinent. It forces us to focus on limited sources of heterogeneity (here we are mainly interested in "appropriability" and institution measures), which leads us to build a new set of explanatory variables. Compared to Section 4, there is no change regarding the *data* group, nor the *publication* group other than replication, which is dropped because there are no replicated results. The category *econometrics* is redesigned because family variables are recoded into dummy variables. Hence, we are only able to account for the control of endogeneity, panel frameworks and double-log functional forms. *Resource measurements* now only handle the "appropriability" feature, and we decide to relinquish the category model specification (because it may be partially handled by fixed-effects) in favor of a family variable allowing us to distinguish the institution variables of the primary literature. The descriptive statistics are reported in Table 7.[22]

Table 7: Variables

Variable		Mean	Standard Error	Min	Max
Partial Correlation Coefficient (PCC)		0.106	0.202	-0.446	0.635
Standard Error of PCC (PCC_SE)		0.102	0.035	0.037	0.225
Number of years relative to 1990		-2.58	8.36	-12.5	16
	INSTITUTIONS		Frequency = 1		Frequency = 0
Political Institutions	Dummy = 1 if Political Measure.		22		165
Legal and Contracting Intitutions	Dummy = 1 if Legal and Contracting Measure		25		160
Economic Institutions	Dummy = 1 if Economic Measure		16		169
Aggregated Institutions	Dummy = 1 if Aggregated Measure		122		63

5.2 Results

The results are reported in Table 8. "Technical appropriability" is accounted for in two ways: i) a general specification is adopted thanks to the point and diffuse dummies in first three columns and ii) a disaggregated specification at the sectoral level. As previously, three different estimators are used: WLS, WLS-FE and WLS-RE. Again, our preferred outcome is from WLS-FE first because compared to WLS, its errors structure allows us to account for a greater part of heterogeneity, and unlike WLS-RE, it does not suffer from bias.

The first outcome we may note is that there is no sign of publication bias (because PCC_SE is not significant). Once corrected from fixed-effects, the meta-average is significant and approximately 0.21, which reflects a medium effect according to the guidelines of Doucouliagos (2011). It indicates that when institutional quality is at its best,[23] natural resources do foster growth. In other words, and tacking stock from the literature, institutional quality appears to be a key factor in mitigating the curse found in Section 4.

General sources of heterogeneity are made up by the usual suspects. Model specification, econometric characteristics and the data used play a part through i) the absence of an

[22] The studies that were used in this investigation are denoted with a "◇" in Section A in the Appendix.

[23] One must recall that PCCs were calculated on the basis that Institutional Quality takes the value of 1. It corresponds to the upper bound of the variable.

initial income variable in the model, ii) the endogeneity, and finally iii) the use of Sachs and Warner's data, respectively.

Table 8: Results — Appropriability and Institutions

	Point vs. Diffuse			Detailed resources		
VARIABLES	WLS Eq. 1	W-FE Eq. 2	W-RE Eq. 3	WLS Eq. 1a	W-FE Eq. 2a	W-RE Eq. 3a
PCC_SE	0.842	0.049	0.044	0.558	0.051	0.046
	(0.66)	(0.58)	(0.53)	(0.54)	(0.58)	(0.52)
Years relative to 1990	-0.003	-0.016	-0.015	-0.006	-0.011	-0.010
	(0.006)	(0.01)	(0.01)	(0.006)	(0.01)	(0.01)
WP	-0.212[b]	dropped	0.119	-0.150[c]	dropped	-0.081
	(0.07)		(0.09)	(0.07)		(-0.09)
Init_income	0.001	-0.258[a]	-0.257[a]	-0.045	-0.258[a]	-0.257[a]
	(0.06)	(0.03)	(0.03)	(0.06)	(0.03)	(0.03)
Investment	-0.168	dropped	0.040	-0.030	dropped	0.019
	(0.17)		(0.25)	(0.18)		(0.24)
Competitiveness	0.152	-0.008	-0.008	0.133	-0.008	-0.008
	(0.10)	(0.007)	(0.006)	(0.09)	(0.007)	(0.006)
Human_k	0.071	0.010	0.011	0.137[b]	0.019[b]	0.019[a]
	(0.06)	(0.01)	(0.009)	(0.06)	(0.008)	(0.007)
Endogeneity	0.146	-0.130[b]	-0.130[a]	0.020	-0.131[b]	-0.130[a]
	(0.13)	(0.05)	(0.04)	(0.13)	(0.05)	(0.04)
SW	-0.010	-0.345[a]	-0.345[a]	0.031	-0.296[a]	-0.295[a]
	(0.11)	(0.01)	(0.01)	(0.09)	(0.007)	(0.006)
Developing	0.119	0.024[b]	0.024[b]	0.12	0.024[b]	0.024[b]
	(0.07)	(0.01)	(0.01)	(0.08)	(0.01)	(0.01)
Developed	0.017	-0.072	-0.072	-0.047	-0.072	-0.072
	(0.11)	(0.11)	(0.10)	(0.08)	(0.11)	(0.10)
Political Institutions	0.047	-0.006	-0.006	0.060	-0.005	-0.005
	(0.04)	(0.02)	(0.02)	(0.04)	(0.02)	(0.02)
Legal and Contracting Institutions	-0.077	-0.010	-0.010	-0.045	-0.009	-0.009
	(0.05)	(0.008)	(0.007)	(0.04)	(0.008)	(0.007)
Economic Institutions	0.002	-0.026	-0.026	0.0114	-0.025	-0.025
	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)
Panel	-0.058[c]	-0.069[a]	-0.069[a]	-0.036	-0.060[a]	-0.060[a]
	(0.02)	(0.006)	(0.005)	(0.02)	(0.007)	(0.006)
Point	0.091[b]	0.044[a]	0.0403[a]			
	(0.04)	(0.01)	(0.01)			
Diffuse	-0.006	-0.001	-0.001			
	(0.02)	(0.02)	(0.02)			
Agri				0.009	-0.013[a]	-0.013[a]
				(0.02)	(0.003)	(0.003)
Food				0.033[c]	0.011[a]	0.011[a]
				(0.02)	(0.004)	(0.003)
Fuel				0.019	-0.023[a]	-0.023[a]
				(0.03)	(0.003)	(0.003)
Ore_mineral				0.123[a]	0.083[a]	0.083[a]
				(0.02)	(0.01)	(0.009)
Forestry				-0.038[b]	-0.048[a]	-0.048[a]
				(0.02)	(0.005)	(0.004)
Subsoil				-0.338	0.081[a]	0.081[a]
				(0.24)	(0.01)	(0.01)
Precious_met				0.136[b]	0.115[a]	0.115[a]
				(0.06)	(0.01)	(0.01)
Constant	-0.025	0.213[a]	0.300[b]	-0.048	0.207[b]	0.288[c]
	(0.05)	(0.06)	(0.14)	(0.05)	(0.07)	(0.12)
Observations	185	185	185	185	185	185
R-squared	0.34	0.72	-	0.471	0.75	-
Number of groups	19	19	19	19	19	19

Notes. Robust standard errors in parentheses. [a] p<0.01, [b] p<0.05, and [c] p<0.1. Since multilevel models are used for random-effects, R-squared are not available. WP and Investment are dropped in WLS-FE because of perfect multicolinearity with fixed-effects.

If we focus on the sources of heterogeneity specific to "appropriability", very interesting patterns emerge. First, hard-to-appropriate resources (agriculture and forestry in Equation 2a) enter negatively into our regressions, while easy-to-appropriate resources (except fuel in Equation 2a) enter positively. These results are apparently opposed to those found in Section 4 as well as by the literature that states that point-source resources tend to generate a resource curse, while diffuse resources tend to mitigate it. To fully understand the scope of these results, one has to remember that those addressing diffuse resources have to be interpreted with respect i) to the omitted variable, which captures all natural resources,[24] and ii) to the fact that institutional quality is fixed at its best by design in our regressions[25]. It then happens that when the institutional framework is "perfect", "technical appropriability" is no longer a problem, as high quality institutions counteract the problems of rent-seeking, entrepreneurship diversion or corruption and ensure better allocation. Appropriable resources do enhance growth, supporting the results of Boschini and al. (2007, 2013) in studying precious metal and extending them to other types of point resources (fuel excluded). If we pause to analyze the results with the most appropriative resources, i.e., precious metals and diamonds, we indeed find that they constitute the best resources when institution quality is set at its highest level. Why? In general, they share an extremely high average price, and their small size makes transportation practical; additionally, most of the mining is "alluvial",[26] which implies a low investment in costs, making them highly profitable.

The importance of institutional quality also appears to be confirmed by the variables that take into account the development of the countries under study. Unlike the results found in Section 4, Table 8 shows that, when institutions are set to their best, there is no systematic difference between developed and developing countries. This may suggest that the reason why developing countries experience a resource curse (cf. direct effects in Section 4) stems from institutional quality.

On the whole, our results confirm that the issue of "resource appropriability" together with the shape of institutions are crucial when determining the existence of a curse or a blessing.

[24] It is an undifferenciated mix of both point and diffuse resources.

[25] Note that when institutional quality is poor (fixed at 0.1 instead of 1), the meta-average is significant and positive but around zero, leading one to possibly think that the curse found in Section 4 is not mitigated by the quality of institutions. Result are available upon request to the authors.

[26] Most precious metals and diamonds are found in African regions where the collection consists in the sieving of river silt.

6 Conclusion

In this paper, we review a large body of literature that is devoted to the paradox of plenty. Thus far, the results on the topic are highly controversial and the impact of natural resources on growth seems to depend on a few identified factors, namely, the way resources are measured, the type of resources considered, and the institutional framework of resource-rich countries. To address the problem, we implemented two distinct meta-regressions: one on the direct effects of natural resources on growth and another on the indirect effects, namely, the impact of natural resources on growth when controlling for the quality of institutions. Relying on 69 primary studies, our aim is twofold: both quantifying the magnitude of the curse/blessing and identifying the sources of heterogeneity; we also challenge the previous literature with our results.

We suggested that there seems to be a "soft" resource curse in the literature, though only for developing countries, as there is poor evidence of a resource curse in the case of developed economies. Indeed, the statistical link (partial correlation coefficient) between resources and growth lies between -0.11 and -0.17, which is quite small according to the guidelines of Doucouliagos (2011). Moreover, these results are immune to publication bias, as we find no evidence of it. A few sources of heterogeneity may be noted, such as the control variables included in the primary models, the econometric methods, and the sample under study. Contrary to conventional wisdom, institutions play no significant role. Furthermore, the most important feature is certainly the measure of resources that is able to reverse a "soft" curse into a "soft" blessing, particularly when considering measures that translate abundance rather dependence such as natural capital. When considering the type of resources, there is no clear pattern indicating that hard-to-grab resources impact growth differently from easy ones. However, we do not immediately interpret this finding as a rejection of the "appropriability" hypothesis and instead prefer to explore the links that appropriability may nourish with institutional quality.

We show that the interaction between the type of resources and the quality of institutions is crucial for growth. We find evidence that when institutional quality is at its best, there is a positive and statistically significant link between resources and growth that lies at approximately 0.21, which can be considered quite important. We also find that in this high-quality institutional framework, point-source resources are more beneficial for growth than diffuse resources, supporting the "appropriability" hypothesis.

However, one may be cautious with the outcome of the second meta-regression. Indeed, it only reflects a partial and indirect effect of natural resources on growth (that with the higher institutional quality), and it cannot directly be merged with the results of the first meta-regression. In other words, we are only able to infer that the quality of institutions may mitigate the resource curse, not that it can reverse it into a blessing.

On the whole, our results support the view that the resource curse exists only for developing countries, but it is moderate and dependent on study characteristics, such as the type of country (developing/developed) and the measure of the natural resource (abundance/dependence) considered. We also validate the fact that "appropriability" is a real concern regarding the paradox of plenty and that institutions are definitely a mitigating factor of the resource curse.

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B Classification

Table 9: Classification of control variables

	CONTROL VARIABLES		
INITIAL INCOME	INVESTMENT	OPENNESS	INSTITUTIONS
Initial income	Investment	Openness	Average Gastil Index
	Deviation of investment price	Distance to nearest port	Black market premium
	Capital used per capita	Foreign investment proportion	Budget Transparency
HUMAN CAPITAL	Spending on invesment	Foreign stock of knowledge	Bureaucratic quality
Education	Gross capital formation	Migration	Business Regulation
Enrollment rate	Initial investment	Tariff restriction	Caucasian population
Initial human capital	Industrial machinery	Trade liberalization	Checks and balances
Literacy rate	R & D expenditure		Civil liberties
		COMPETITIVENESS	Civil repression
		Balassa-Samuelson effect	Confidence in court
ECONOMIC POLICY	PHYSICAL CAPITAL	Exchange rate (level, deviation)	Corruption control
Access to sound money	Arable land per capita	Terms-of-trade (change, volatility)	Corruption fiscal channel
Credit Constraint	Land area	Export growth	Democracy indices
Domestic credit to private sector	Resource stock		Economic freedom index
Gov. consumption			Ethnic fractionalization/ polarization
Inflation (level, distortion)		INSTITUTIONS (CONTINUED)	European language
Liabilities financial intermediaries	FINANCIAL DEVELOPMENT	Executive constraints	Expropriation risk
Public sector wages	Financial development	Freedom (to trade) internationally	Governance
	Mean liabilities	Government effectiveness	Gov. size index
		Government savings	ICRG
DEMOGRAPHY		Institutional quality	Inequality
Active population	GEOGRAPHY	Judicial independence	Language fractionalization
Fertility	Access to sea	Latitude	Legal structure and security of property rights
Median age	Distance (Moscow, Paris)	Life expectancy (level, squared, square root)	Malaria ecology
Population (old, young, female)	Temperate climate	Muslims (percentage)	Number revolutions
Population (level, density)	Distance to equator	Number assassination	Number civil conflicts
		Political repression	Political stability
		Polity Score	Poverty population
		Presidential regime	Property rights
		Regulatory quality	Rule of Law
		Transparency	Voice and Accountability

Table 10: Classification of dummy variables

DUMMIES					
GEOGRAPHIC	TIME	INSTITUTIONAL	POLITICAL REGIMES & ELECTORAL RULES	EVENTS	CHARACTERISTICS
11 South American countries	D0304	Bad Governance	Democratic Presidential	External War	EITI Intention
access to sea	Dummy75	Civil Liberties	Democratic Majority	Gulf War 1991	Former USSR
African	Dummy80	Colony Others	Non-Parliamentary	oil 08	Lower-middle income
Americas	Dummy85	Colony Spain	Parliamentary Proportional	Oil 1973 and 1979	Low-income
Asian	Dummy95	Colony U.K.	Presidential Majority		PD China
Coastal	Dummy95	Corruption: low quality institution	Presidential Proportional		special cities
Coastal Cities	Time dummies	Democracy	Presidential Regime		Transition from Social to Market
Country dummies		Governance: low quality institution			Upper-Middle income
East Asia and Pacific		High Corruption			Young Population (under 5 years old)
Europe		Loot			
Land-locked		Non Democratic			
Latin American and Caribbean		Non Transparent Budget			
Metropolitan Statistical Area		Open Budget: low quality institution			
Norway					
South Asia					
Sub-Saharan Africa					
Tropical Climate					
West Provinces China					