

Resource Rents, Democracy & The Eight Policy Lessons

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Abstract

We examine if resource revenues are likely to be managed more effectively with strong (or lack of) institutions and if so to contribute to economic development in resource abundant countries. We estimate a general model using evidence for the resource booms of the 1970-2012 period, resource rents, natural capital, socio-economic indicators and for institutions. Our results show 1) Countries with ample natural capital and subsoil wealth levels are associated to a healthier democracy which potentially mitigates the resource curse (RC); 2) High resource rents are negatively associated to weak institutional quality deepening the curse; 3) Long run economic growth is positively associated to natural capital but negatively associated for those countries that receive high resource rents. We recommend stronger transparency for revenue allocation, for sales of oil production, for the allocation of licences, and for revenue collection. One limitation is the lack of information: (energy) laws inducing economic growth. This paper contributes to explaining the long run impact of democratic change on managing resource revenue. Our three key conclusions are: 1) Resource abundance across the world produces a strong income effect; 2) Institution quality emerges as the key mechanism from which the RC effect emanates; and 3) The RC effect does not appear in all countries at all times as some researchers argue.

JEL Classification: Q33, Q38, Q43, Q35.

Keywords: Oil revenues, subsoil wealth, institutions, Mexico, China.

Renta de recursos, Democracia & las ocho lecciones de política

Resumen

Examinamos si las rentas de recursos naturales son probablemente mejor administradas bajo instituciones fuertes (o falta de estas), y de serlo así si eso contribuye al desarrollo económico de países con abundantes recursos naturales. Estimamos un modelo usando evidencia de booms (1970-2012) de recursos, rentas de recursos, capital natural, indicadores socio-económicos y de instituciones. Nuestros resultados son tres que 1) países con capital natural y riqueza del subsuelo están asociados a una sana democracia lo que mitiga la maldición de los recursos naturales (MRN); 2) altos niveles de renta están negativamente asociados a la baja calidad de instituciones lo que profundiza la maldición; 3) el crecimiento económico a largo plazo está asociado a el capital natural pero tal crecimiento esta negativamente asociado en países que registran altos percepciones de rentas. Recomendamos transparencia en: la distribución de rentas, las ventas de petróleo, distribución de licencias y la recaudación de rentas. Una limitación es la falta de información: leyes (sector energético) que produzcan el crecimiento. Explicamos el impacto de largo plazo del cambio democrático sobre la gestión de las rentas. Nuestras tres conclusiones claves son: 1) La abundancia de recursos naturales en todo el mundo produce un fuerte efecto sobre los ingresos; 2) La calidad institucional emerge como un mecanismo clave del que emana el efecto MRN; y 3) El efecto MRN no aparece en todos los países en todo momento como argumentan algunos investigadores.

Clasificación JEL: Q33, Q38, Q43, Q35.

Palabras clave: Ingresos petroleros, riqueza del subsuelo, instituciones, México, China.

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1. Introduction

The resource curse (RC) has been deepening in recent decades along with energy and commodity prices which peak in 2008 after more than 10 years of a global boom in those prices. The RC can be defined by two dimensions: 1) it can be seen as an association of natural resources to slow economic growth and 2) with armed civil conflict (Brunnschweiler and Bulte (2008a)). The RC can be measured by using a monetary value of resource endowment of annual rents and by subsoil wealth (resource abundance) of oil and minerals expressed in monetary values of GDP per capita (World Bank, 2015). The World Bank defines the GDP growth rate as the “annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2000 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.” (World Bank 2020).

Van der Ploeg (2011), Collier and Hoeffler (2004) examine the RC using various methods concluding that the jury is out on the direction of the impact of resources rents on economic growth. Collier and Godieris (2007) find conclusive evidence of the negative impact on growth of natural resource rents. This paper has two objectives. The first is to establish if institutional development occurs along with resource abundance; second, to establish if the RC is observed or not during the commodity boom of 1970-2012 using a model for cross country data. As well as using the established definition of resource dependence, or resource rents as a fraction of GDP, the paper also uses the less examined resource abundance measure. This paper uses two alternative definitions for 1) measuring the effect of natural resources on economic growth and for 2) institutional arrangements. Of all resources, oil and gas stand apart in terms of breath and depth of impact (Anderson, 2012) on the economy.

Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents (World Bank, 2013). Total natural resources rents are calculated as a percentage of GDP. The BRICS economies provide an example of resource based economies that display large dependence and of RC effects. Russia and South Africa are large exporters of natural resources (resources exports >10% of GDP in 2015, World Bank 2015) but these two nations have registered lower GDP growth than China and India. The latter two are large importers of these (Imports of resources account for 14% and 32 %, of GDP respectively, World Bank (2015), these are oil resources mainly). Brazil shows a >10% share of resource to GDP and is a strong exporter of oil and gas, biofuels, biomass and other commodities. The BRIC economies are heavily networked with each other as far as energy and natural resources.

The evidence for the resource dependence and slow economic growth exists but evidence pointing to the contrary abounds since natural resources do not necessarily spell doom for development (Brunnschweiler and Bulte, 2008a). As a rule a country is considered resource dependent if the ratio for resource revenues as a fraction of GDP exceeds 5% (Van Der ploeg, 2011). A country is considered an economic laggard if per capita income falls below 3%.

Four problems are associated to the RC. Besides producing declining economic growth the RC is closely linked to 1) currency overvaluation reflected in the terms of trade, 2) capital flight, 3) dampening growth of manufacturing exports; and 4) distortion in labour markets producing lower levels of entrepreneurship by raising wages in one sector relative to others. Resource abundance (RA, or subsoil wealth), but not dependence, can also lead to higher economic growth or lower growth, however, there is little consensus on the direction and the channel of the impacts in the applied literature. One possible

channel that RC supporters identify is the role and quality of current (and early) institutions, some of which are transitory and others permanent. An institution is defined as “a set of rules, compliance procedures, and moral and ethical and behavioural norms designed to constrain the behaviour of individuals in the interests of maximising wealth and utility of principals” (p. 201-202, in North, 1981).

To understand the resource dependency-economic growth (RC) nexus it is crucial to understand the institutions, politics and oil management of nations, since oil is the key resource (Anderson , 2013). Twelve nations hold 47% of the world’s oil reserves (BP Statistical Review of Energy, 2017). The countries examined in the paper vary in terms of resource wealth, the nature and depth of their internal differences and their democratic experience. Their growth rates also differ substantially but are positively correlated to resource revenues.

Our paper extends the empirical work of both Sachs and Warner (2001) (hereafter S-W) and Brunnschweiler and Bulte (2008b) (hereafter B-B) by analysing 1) the governance-resource nexus through various proxies of institutional quality (rule of law index); and of 2) data on resource dependence caused by recent oil booms and busts. Our models add to the literature cited here for three main reasons. First, the period of estimation of the three models includes the resource booms of 1973-1980, 2000-2009 and a boom in capital inflows into resource dependent economies. Secondly, the RC does not appear at all times in all countries as a few RC supporters argue. Therefore the RC is not a golden rule as we show in section 3-5. The models use stock (resources underground, subsoil wealth, natural capital) and flow variables (annual resource revenues) to represent the resource economy relationship. Thirdly, this procedure avoids two problems: 1) using endogenous variables for resources; and 2) introducing bias. The models also use an indirect transmission mechanism which measures the RC through institutional quality.

2. Background

In this section we describe the time path of resource booms mainly through price of oil and of commodities and discuss the empirical literature on the RC during 1990-2012. Fig 1 describes the time path of energy prices (oil) in 1968-2017.

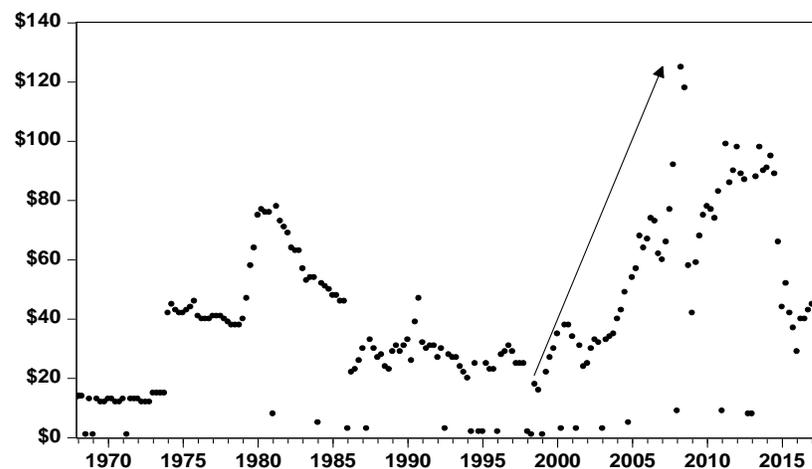


Figure 1. Oil Price annual average: \$/barrel (real 2010 US\$). Source; EIA, U.S. 2017.

The time path of global commodity prices including (Fig. 1) is a partial indicator of the effect of RC; there is an uptick in price in years 1973-74, 1978-80 and a price decrease in 1981-86, while the 1990s

price levels are stable and then grow dramatically in 2000s. The uptick in energy prices accelerates during 2003-2008, due to global demand for energy resources. That peak ends in 2013 after more than 10 years of a global boom in prices. Studies on the RC use oil price information to work out trends on oil rents. Studies on the RC can be subdivided into four schools of thought of the RC that we label: modern, institutional, time series, and historical.

2.1 The schools of thought of the RC.

The Modern School

Table 1. emphasises the important econometric studies of the RC, the dependent variable, and independent variables. There are two innovations of the S-W approach. The first is the breath of analysis: it includes evidence of a large number of developed and developing countries. The second is that S-W conclude that resources (% of total exports) fail to harness economic development. One criticism levelled at the S-W (2001) study is that cross-section data can not observe booms or collapses for decades as accurately as time series approaches do. The latter method allows observation of the effect of resource booms after 10 or 20 years. B-B (2008b) fails to find evidence for the RC and suggests that resource abundance, not rents, is conducive to economic growth via institutions.

In recent work on the RC both Van Der Ploeg and Poelhekke (2010) and Collier and Goderis (2007) use panel and cross country data. The former study corrects for endogeneity in the modes of the RC. Both studies report strong evidence for RC. The latter work tests for the RC using co-integration methods which allows for short and long run effects of resource dependence and economic growth. Those authors identify four channels through which the effect operates the most important are commodity prices with high volatility, among others. Collier and Goderis (2007) test the weight of each of these factors using cointegration techniques rather than a levels approach in their econometric specification. Other advanced techniques based on panel data find conclusive evidence against the RC, however, when using cross country data the evidence for the RC is strong (Manzano and Rigobon, 2001).

The theory of RC is partly based on the Salter Swan (SS) model which explains three features of the RC. First it describes the so-called ‘Dutch disease’ effect following a windfall in resource revenues. The effect occurs after the extra wealth generated by the sale of natural resources induces appreciation of the exchange rate and an ensuing contraction of the traded sector (Van Der Ploeg, 2011), this is discussed in section 5. Second the SS model explains the changes that both resource rents and exports have on relative prices of non traded goods (non manufacturing goods), and effects on employment when the economy relies on resource rents. Third, employment in non traded goods rises after an increase in exchange rate; while, a lower exchange rate is associated to higher demand for non traded goods and thus with more workers employed in the non traded sector. The SS model describes the increase in resource dependence so long as relative prices move positively, holding the other variables constant. We define the following variables of the SS model as:

Q is the world price of natural resources, E export volume of natural resources, C_t consumption of traded goods, C_n consumption of non traded goods, L_T Employment in the traded sector, P real exchange rate or relative prices between traded and non traded goods. F and G stand for coefficients of employment (traded and non traded sectors, respectively). ε is elasticity of substitution between traded and non traded goods.

In Van Der Ploeg (2011) the following identities explain the SS model:

H stands for productivity, $H \equiv \frac{H_T}{H_N}$, of the traded and resource sectors relative to that of the non traded sector; exports of resources equals net imports of traded goods is described by $H_T QE = ct - H_T F(L_T)$; and the output of the non traded sector described by $H_N \times GL_N$, and, output of traded sector in $H_T \times FLH_T$. National income is given in $Y \equiv PH_N G(L_N) + H_T \times FLH_T + H_T QE$. The variable $P^{\epsilon-1}$ is defined as the real exchange rate elasticity of non traded goods with respect to traded ones.

Using the SS framework, Van Der Ploeg (2011) describes the causal relationships for the equilibrium in the markets for non traded goods ('subscripts "T" denotes the traded sector, "N" the non-traded).

The equilibrium in the markets for non traded goods is achieved in,

$$H_N G(L_N) = C_N = \frac{Y}{(1 + P^{\epsilon-1})} \quad (1)$$

$$= \frac{[PH_N G(L_N) + H_T F(L_T) + H_T QE]}{P + P^{\epsilon}} \quad (2)$$

Recall ϵ stands for the substitution elasticity between traded and non traded goods and "P" for real exchange rate of traded versus non traded goods.

The ratio of national income to relative prices in eq. 2 yields,

$$P^{\epsilon} = H[F(1 - L_N) + QE]/G(L_N) \quad (3)$$

Solving for $QE/G(L_N)$ in Equation 3, allows to capture resource dependence (Equation 4),

$$\frac{QE}{G(L_N)} = P^t + H[F(1 - L_N)] \quad (4)$$

Equation (1) assumes the economy achieves equilibrium for the market for non tradable goods and equation (2) and equation (3) are written in their reduced form. In the short run, a boom in natural resource revenues QE increases national income, aggregate demand and leads to exchange rate appreciation. The same boom produces a decline in the traded sector and an expansion of the non traded sector.

A commonality of many studies (Table 1) is their use of the definition of governance used in S-W (2001) and in Collier and Goderis (2007). A gap in the literature is that the majority of studies of the RC do not distinguish between the effects of resource abundance and resource rents. The latter metric is narrow because it does not allow for wider effects of the resources-economy space over time that is captured in subsoil wealth differences among countries.

Papers that use methodological improvements [Sala I Martin & Subramanian (2003) for Nigeria; Caselli & Michaels (2009) and Medeiros Costa-Dos Santos 2013) for Brazil; Holden for Norway (2013); Alcott and Keniston (2018) for the USA] focus on a single nation breaking the long practice of bundling numerous countries for analysis of resource dependence. Previous papers of the RC include Frankel (2012) and Van Der Ploeg (2011). The papers included in those two reviews are largely technical ones, however, theoretical aspects are explored in Van Der Ploeg (2011).

Table 1. Literature on resource curse.

Authors	Method and dependent variable in brackets	Variables	Period	Countries covered
Alcott and Keniston (2018)	OLS (wages, employment, manufacturing employment)	Oil and gas endowment,	1960-2011	U.S regions/counties
Van der Ploeg (2010)	Cross country data (economic growth)	Rule of law, trade openness; inv./ GDP; Education	1970-2000	World
Brunnschweiler and Bulte (2008b)	Cross country data (economic growth, stock of natural capital, subsoil wealth (oil & minerals in natural logarithms)	Index of rule of law, index of parliamentary system, presidential system	1970-2000	World
Andersen and Asleken (2007)	Cross sectional data (economic growth)	Presidential, Parliamentary & dictatorship	1970-2005	80 countries
Collier and Goderis (2007)	Time series Data (Cointegration: Changes in GDP per capita, values in log.)	Investment, energy prices, raw material prices		World
Collier and Hoeffler (2004)	Cross country data, panel data/logit regression: (risk of conflict)	Exports of natural resources as a % of per capital income, schooling, peace duration; geographic dispersion, population	1965-69; 1994-99	World
Neumayer (2004)	Per capita SERAFI Method(GDP growth, genuine income growth)	Investment, rule law, Resource Rents in GDP, trade openness, terms of trade	1970-98	86 Countries
Sachs and Warner (2001)	Cross sectional data (resource rents % PIB); exports of natural resources % personal income; Exports % national income	Rule of law, index of Malaria, investment, % de economically active population, changes in GDP, GDP of manufacturing sector.	1970-1998	World
Sala-I-Martin – Subramanian (2003)	Per capita GDP growth; Rule of Law	Rule of law, currency volatility, natural resource share 1970, 1980, investment price level, fuel & minerals share,	1970,1980	World regions
Manzano (2001)	Panel data (economic growth, GDP excludes GDP of resource)	Prim exports. Primary export /GDP; Investment/GDP, trade openness	1970-1990	
Gylfason (1999)	Economic growth, primary education, investment, civil liberties.	Natural Capital, initial income population, terms of trade	1980-1995	World
Davies (2012)	Cross country data (Economic growth)	Same variables in Sachs and Warner (2001) different period		world
Prebisch (1950)	Historical data	Terms of trade, Price of raw materials and manufactures		Latin America

2.2 The Institutions School

The institutional school focuses on the quality effect of political institutions on economic growth and some argue that parliamentary governments are better suited to mitigate the negative effects on economic growth of resource rents more effectively than presidential ones do, claiming “long run ability to deal with natural resources depends largely on country specific constitutional arrangements” Andersen and Aslaksen, (2006). Gylfason (1999) extends the institutional analysis to that of the strength of civil liberties and finds supportive evidence for the RC by using natural capital instead of resource rents. Le Billon (2010) argues that there are four channels through which the RC effects (in the case of conflict) operate:

- 1) how the RC influences institutional quality and economic performance and resource conflicts,
- 2) access to resources,
- 3) distribution of resource revenues; and
- 4) how resource conflict relates to the environmental and social impacts of resource exploitation.

2.3 The Time-series School

These studies are based on time-series data. Harvey et al. (2010) find evidence of long run decline in commodity prices (includes oil and coal) which explains long run declining economic growth or the Prebisch thesis (explained below). The studies on the effects of commodity prices use a different methodology (Deaton and Miller, 2006) and rely on the vector auto regression system (VAR). That system relies on data for a single variable that is observed over time. The latter have, however, arrived to conclusions close to those of S-W regarding the direction of impact of the resource dependence on GDP. The VAR approach, however, differs from the S-W methods because the former does not use structural relationships of the economy.

2.4 The Historical School

This fourth wave of studies of the literature on RC emerges in 1950s through the 70s including Frank, (1967), Prebisch (1952), and Lewis (1952). The same wave includes Bulmer Thomas (1994, 2013). The Prebisch hypothesis holds that a secular decline in the terms of trade in Latin America affects economic growth. A long term decline in the commodity NBTT (net barter terms of trade) means that countries should develop their own industries (infant industry argument) in order to avoid poor economic performance (Prebisch, 1952). Bulmer -Thomas (2013) finds evidence that the NBTT and the ITT (income terms of trade) indicators point to strong dependence on natural resources for the Latin American region.

2.5 Summary

There are six weaknesses in the studies of the *modern school* approach, 1) Missing data and measurement error; 2) the literature is dominated by the use of dummy variables; 3) the use of natural resource variables which are endogenous to growth and to war (Le Billon, 2010) biasing the quantitative results. 4) Studies also suffer from reverse causality issues, spurious correlation and robustness (B-B, 2008b). Besides this, 5) the literature relies on a narrow definition of the resource curse and it has assumed that natural resources are correctly priced producing miscalculated indicators of resource dependence. 6) Further problems includes scant or no analysis of how access to international credit markets influences how severe the RC is. Nations of abundant natural resource, however, are likely to be given access to global credit markets.

The resource literature offers six explanations for the RC effect: Dutch disease, governance, conflict, excessive borrowing in global credit markets, inequality and volatility of commodity prices. Many of the above papers reflect incremental improvements for modelling the effect of resources abundance on the economy.

3. Methodology

The section describes the sample of data and the theoretical model of the resource curse and lays out the causal relationships that make up the RC. It also introduces the econometric analysis that tests two dimensions: a) the resource dependence following the SS (Salter-Swan) framework and b) the resource abundance effect on institutional strength.

3.1 Description of the data used

Data for Explanatory variables are sourced from various publicly available data banks. Table 2 gives definitions of and sources of variables and Table 3 reports standard deviation and observation samples and mean variable values. Table 3 shows the description of data for empirical analysis.

Table 2. Variable definitions and data sources.

Variable	Definition	Source
Rents	GDP share of resources exports (oil, gas, forests, biomass) in % of GDP for 2011). Average share 1970-2011.	World Bank (2014)
GDPpop	Annual growth of GDP per capita 1970-2011	World Bank (2014)
Population	Population (millions).	World Bank (2014)
GDP70	Annual growth of GDP per capita 1970	Sachs and Warner (2001)
TT	Change in the Terms of trade index (100=2000) % increase 2000-12	World Bank (2014)
Law	Governance: Rule of law (index: 100=; 2000-2011)	As above
LAT	Latitude	Glaeser <i>et al.</i> , (2004)
GovEff	Governance: Government Effectiveness (index: 100=2000, 2011)	World Bank (2014)
Democ	Democracy 500 years: index of change between 1500-2000	Acemoglu <i>et al.</i> ,(2008) and 2000(2005)
NATK	Natural capital, sum of crop, pasture land, timber, non-timber forest, protected areas, oil, natural gas, coal, and minerals.	World Bank (2005)
SubAssets	Subsoil assets in USD per capita; (Resource Abundance indicator)	World Bank (2005)
Natural logarithm		
MinXp	Mineral exports as % GDP, average share 1970-2012. The World Bank (2014) defines Mineral rents as the difference between the value of production for a stock of minerals at world prices and their total costs of production. Minerals included in the calculation are tin, gold, lead, zinc, iron, copper, nickel, silver," bauxite, and phosphate.	Word Bank, (2014)

In

Natural Logarithm

Table 3. Description of data. (For sources: Table 2)

	N	Median	Minimum	Maximum	Standard Deviation
Rents	162	9.61	.00	53.82	13.04
GDP-pop	163	5.54	.000	17.100	2.82
GDP70	102	8.27	6	10.0	0.93
TT	163	17.22	-100.00	164.52	47.08
Law	163	-0.11	-1.94	1.96	0.98
GovEff	163	-0.08	-2.24	2.24	0.99
Democ	116	0.68	.00	1.00	0.32
NATK	96	6209.10	514	54828.0	8836.08
SubAssets	158	3817.19	.00	139436.0	14099.25
MinXp	159	1.11	.00	18.19	2.74

Country list: Afghanistan, Albania, Algeria, Angola, Armenia, Australia, Austria, Azerbaijan, The Bahamas, Bahrain, Bangladesh, Belarus, Belgium, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Cape Verde, Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo, Dem. Rep., Congo Rep., Costa Rica, Cote d'Ivoire, Croatia, Cyprus, Czech Republic, Denmark, Dominica, Dominican Republic, Ecuador, Egypt, Arab Rep., El Salvador, Equatorial Guinea, Eritrea, Estonia, Ethiopia, Fiji, Finland, France, The Gambia, Georgia, Germany, Ghana, Greece, Guatemala, Guinea, Guinea-Bissau, Haiti, Honduras, Hong Kong SAR, China, Hungary, Iceland, India, Indonesia, Iraq, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Kenya, Kiribati, Korea, Rep., Kosovo, Kuwait, Kyrgyz Republic, Lao PDR, Latvia, Lebanon, Lesotho, Liberia, Lithuania, Luxembourg, Macedonia, FYR, Madagascar, Malawi, Malaysia, Maldives, Mali, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Montenegro, Morocco, Mozambique, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russian Federation, Rwanda, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Sierra Leone, Slovak Republic, Slovenia, Solomon Islands, Spain, Sri Lanka, Sudan, Suriname, Swaziland, Sweden, Switzerland, Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Uzbekistan, Vanuatu, Venezuela, RB, Vietnam, Yemen, Zambia, Zimbabwe.

The values for the variables have been calculated for the countries are listed in Table 3; we make some observations. Resource rents (*Rents*) average 9.6% of GDP in our sample of countries between 1970-2011 with Uzbekistan and Iceland having the largest and lowest shares at 49% and much below 1%, respectively. In the same period, GDP growth rates per capita (*GDPpop*) average 5.5% per year; *GDPpop* growth for Bhutan shows the highest growth rates (17.1% per yr.) and Liberia (Africa) records the lowest average growth (1.6% per yr.). Lebanon records the lowest annual growth rate in resource rent (0.0168% of GDP) in the same period; and Uzbekistan the highest (53.8% of GDP). Between 2000-2011 the terms of trade (*TT*), on average, expanded by 17%, (base year, 2000 =100) supported by strong growth in natural resource prices. The index for institutions (*Democ*) averages 0.67, -0.10 for rule of law (*Law*), -0.08 for government effectiveness (*GovEff*). Saudi Arabia and Bhutan records the lowest *Democ* index and Norway the highest. The highest value of the *Law* index is 2 (Sweden) and the lowest -2. (Afghanistan). Somalia

registers the lowest index (-2.24) of government effectiveness and Finland and Singapore the highest with 2.23 and 2.24 respectively.

Subsoil wealth per capita (*SubAssets* in US\$, 2006) averages US\$3817 in our sample; Kuwait shows the largest level of subsoil assets and Bangladesh the lowest. The share of mineral exports (*MinXp*) averages 1.1% of GDP with Papua New Guinea and Hong Kong (China) having the largest and the smallest shares at 18% and much below 1% (1970-2012), respectively. The most volatile variables are *TT*, *Law*, and *MinXp*.

Next we inspect correlation data (Appendix 1 and 2). Resource rents and GDP per capita are negatively correlated (Figure 2), while mineral rents and GDP per capita (not graphed) show negative correlations. Subsoil wealth (*SubAssets*) and GDP per capita show weak correlations (Figure 5A). A negative association between the *Law* and *Subsoil wealth* can be seen (Figure 6A). *Law* and *subsoil wealth* shows points positive correlations but the correlation is not so strong (Figure 6A, Appendix 1). *Law* and *Rents* (Figure 7A, App. 2) variables also show negative associations, particularly if rents lie around 10% of GDP. As we approach the origin of the graph, increasingly larger gains in “*Law*” are needed to cut the ratio of *Rents*. The most notable correlation is the link between the rule of law (*Law*) and *GDPpop* which is positive (Figure 8A).

3.2 The resource curse models

Our econometric models extend the SS model and we validate empirically the SS framework as follows. The variable *Rents*_{*i*} for the *i*th country enters both the economic growth and the institutions model (equations 4 and 5). We assume that the GDP share of resources is $\geq QE/G(Ln)$ of eq. 3. We build two models to establish the strength of the RC: 1) resource dependence and institutions; 2) resource abundance and economic growth. The expected direction of impact of resource rents (our main hypothesis) is shown in parenthesis below equations 4 and 5, and follows from the theory discussion above.

To test for the transmission mechanism of the RC a model of institutions is introduced, the model uses institutional quality and abundance. It uses proxies for resource dependence (GDP as a share of resource rents) and resource abundance (subsoil asset wealth). For democracy we include three metrics: an index of the rule of law (*Law*), effective Government (*GovEff*) and for the change in democracy in 500 years (*Democ*), “ln” stands for natural logarithms of all variables. For examining the relationship between institution quality and abundance we use,

$$\ln(I) = \alpha + \beta_1 \ln(LAT)_i + \beta_2 \ln(NATK)_i + \beta_3 \ln(SubAssets)_i + \beta_4 \ln(Rents)_i + \beta_5 \ln(MinXp)_i \quad (4)$$

[+]
[+]
[+]
[-]
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and for economic growth we use,

$$\ln(GDPpop) = \alpha + \beta_1 \ln(Rents)_i + \beta_2 \ln(SubAssets)_i + \beta_3 \ln(Law)_i + \beta_4 \ln(GovEff)_i$$

[-]
[+]
[+]
[-]

$$+ \beta_5 \ln(GDP)_i + \beta_6 \ln(TT) + \beta_7 \ln(MinXp) \quad (5)$$

[+]
[-]
[-]

Of particular interest are two parameters in equation 5, namely $\beta_1 \ln(Rents)$ which will be less than zero if the RC occurs; and β_2 will be > 0 if the resources foster economic growth. Estimation results of equations 4 and 5, using ordinary least squares technique are reported in Tables 4-5.

4. Results and Discussion

We discuss results for the two relationships tested separately, then consider the historical changes in oil rents with respect to both GDP per capita and manufacturing export activity (traded sector). For the resource–economic growth debate we use two definitions: GDP share of resource rents, and per capita subsoil wealth (resource abundance). Finally, we make some remarks about the implications for energy policy.

The hypothesis described in section 3 can be confirmed by eq. 4. We test for a) the RC using the institutions model (Table 4), and b) the transmission channel of the RC using two innovations: institutional strength and the change in democracy. We then test for economic growth. The estimated model (eq. 5, Table 5) gives coefficients with the expected sign following both the SS framework and the S-W (2001) results. One key weaknesses in the S-W methods is the latter's use of endogenous variables when measuring resource rents in relation to GDP effects. To avoid endogeneity we use an indirect transmission mechanism to test for the RC such as institutional quality.

4.1 Resources and institutional quality: the transmission channel

We derive five key results using the institutions model (eq. 4) which are shown in Table 4. Natural capital, subsoil wealth, and mineral rents are positively associated to high quality institutions confirming that these sort of institutions can manage more effectively natural resource rents than weak institutions do. (Table 4, columns 2 and 5). Except for mineral rents (*MinXp*), these are long term effects.

Stronger institutions are seen to be associated to bigger resource abundance (*SubAssets*); and Weaker institutions are associated to bigger resource rents – this provides indirect evidence of RC effects, but only in the short run (Table 4, columns 2, 3, and 5). Amongst other characteristics, the institution quality (*Law*) measures contract enforcement which is particularly prominent in the petroleum and minerals sectors. Resource rents (*Rents*) are negatively associated to our three proxies of institutional quality which in turn are associated to lower GDP growth (Table 4, columns 2, 5, and 7). Resources are associated to two opposing effects on GDP growth via institutions (*Law*): these are positively correlated to GDP growth (1970-2011) but this is not the case every year.⁴ Below a ratio of 10% of *Rents* in GDP a much larger gain in democracy is needed to cut that ratio for the entire 1970-2012 period).

⁴ The correlation coefficient of 2012 returns a negative coefficient between GDP per capita growth and both *law* and *Democ*.

Table 4. Regression results for assessing institutional quality and natural resources (t-values in brackets). Estimated from equation 4 by Ordinary Least Squares using the SPSS software.

	Dependent variable: Institution quality							
	(1) <i>Law</i>	(2) <i>Law</i>	(3) <i>Law</i>	(4) <i>Law</i>	(5) <i>Democ</i>			(7) <i>GovEff</i>
Latitude	0.73** (9.20)	0.63** (7.09)	0.51** (5.72)	0.82** (11.1)	0.20 (1.55)	-0.16 (1.17)	0.03 (0.22)	0.54** (5.86)
NATK	0.13* (1.73)		0.29** (3.59)		0.22 (1.75)	0.46** (3.71)		
SubAssets		0.15 (1.9)*		-0.01 (0.18)			0.24 (1.8)	0.22 (2.68)
Rents		-0.29** (-3.18)	-0.35** (4.12)			-0.58** (4.3)	-0.57** (3.72)	-0.38** (3.93)
MinXp				0.07 (0.98)			0.04 (0.35)	0.01
# Countries	67	68	67	65	64	64	63	65
F-Stat	56.2	52.9	52.5	43.2	4.2			37.8
Adjusted R ²	0.62	0.69	0.70	0.65	0.09	0.29	0.25	0.69
**statistical significance at .05 % probability levels; * statistical significance at 10% level.								

The change in democracy (*Democ*) is boosted by subsoil wealth and natural capital (Table 4, column 5) but the negative effect of *Rents* on *Democ* is larger than its effect on the rule of law (contemporary index). This is because the 500 year democracy variable includes early institutions and current institutions and this is associated to decreasing rents which gives evidence of RC effects. The negative effect of *Rents* on *Democ* reflects over reliance of governments on resource revenue that is volatile, alternatively a gain in *Democ* is associated to lower *Rents*. The impact chain of institutions is the following: falling rents to better institutional quality (or *Democ*) and to higher economic growth.

4.2 Resource abundance and economic growth

The estimated growth model (Equation 5) shows both high economic and statistical significance (Table 5) with five main outcomes emerging. These results are complemented by cross-country evidence of the non-linearity of resource dependence and economic growth.

Economic growth is associated to resource abundance and *Law* which explains a larger part of the story on economic growth. The magnitude of both coefficients is high, particularly that of *Sub-Assets* (Table 5, columns 5 and 6).

Economic growth is retarded by resource rents in the short run (Table 5, columns 4, 5, and 6). This is the case even after controlling for subsoil assets, institutional quality and productivity growth in the initial year (1970). But the effect is exactly the opposite following a boost to resource abundance. Two reasons stand out for the latter. First, regions with abundant resources attract capital inflows from abroad which in turn stimulates economic growth via an income effect (Table 5, columns 2, 3, 5, and 6). Secondly, countries with resources and good institutions attract drilling activities for hydrocarbon production which stimulate economic growth. The puzzle is that the two resource metrics are correlated positively using cross-country data on 32 nations: higher abundance is associated to resource rents.

Table 5. Regression analysis for resource abundance and economic growth (t-values in brackets).
 Estimated from equation. 5 by Ordinary Least Squares using SPSS software, controlling for initial productivity.

Dependent variable: GDP per capita 1970-11.								
	(1)	(2)	(3)	(4)	(5)	(5a)	(6)	(7)
Rents				-0.08 (0.77)	-0.51** (3.16)	-0.45	-0.44** (2.71)	-0.43 (1.70)
SubAssets		0.38** (3.30)	0.39** (3.44)		0.66** (4.76)	1.02** (5.02)	0.62** (4.54)	0.95** (4.59)
Law		0.48** (3.06)			0.30* (1.91)	0.12 (0.70)		
GovEff			-0.57** (3.62)				0.41** (4.54)	
Democ								0.14 (1.02)
GDP70	0.28* (2.5)	-0.23 (1.38)	-0.29 (1.77)	0.32** (2.95)	0.38 (2.31)	-0.40 (1.79)	-0.42* (2.61)	-0.22 (1.10)
TT						-0.22 (0.82)		0.01 (0.096)
MinXp	-0.11 (1.04)	-0.18 (1.59)	-0.13 (1.16)					
No. obs.	82	66	66	93	69	37	69	69
F-Stat	5.11	7.28	8.47	6.98	10.23	8.19	11.32	8.8
Adjusted R ²	0.11	0.27	0.31	0.11	0.35	0.50	0.37	54
**statistical significance at .05 % probability levels; * statistical significance at 10% level.								

Economic growth can be predicted by current and past institutions (Table 5, column 2, 7). The variable *Democ* includes a period that predates the recent GDP growth and it shows the expected sign: higher *Democ* is associated to higher GDP growth, but is not statistically significant. The positive change in *Law* supports economic growth but the *Law* variable captures a contemporaneous effect.

Figure 2 shows that resources (*Rents*) do both harness economic growth (1970-2011) and depress economic growth depending on the country.

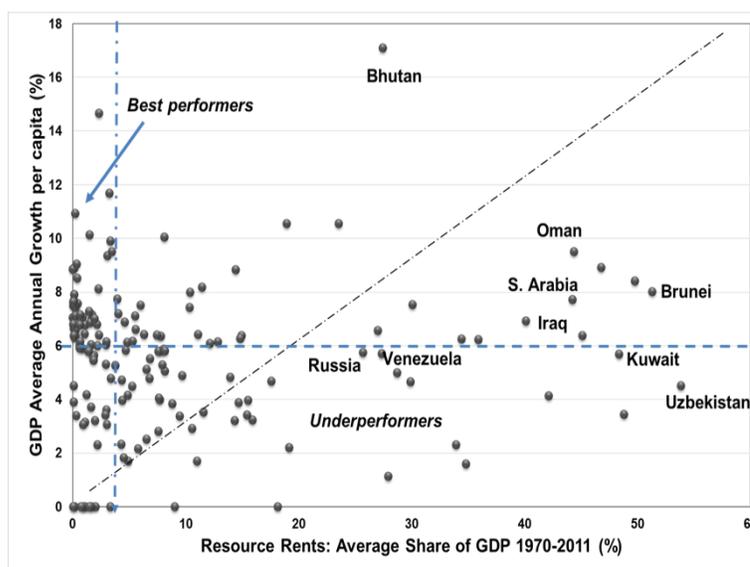


Figure 2. GDP growth (1970-2012) and resource rents (1970-2011).
Source: the authors, based on data of World bank (2015).

The checked lines represent the median value (*GDPpop*: 5.5% pa. and *Rents*: 9.64 %, 5% for meeting the definition of resource dependence) and countries lying below the median are deemed underperformers. Russian and Venezuela are underperformers (Lower GDP growth). The best performers include mainly the EU-28 or the OECD nations.

The boost to *GDPpop* of resource abundance runs counter to the RC hypothesis. The models also show that poor rates of growth in *GDPpop* lead to exports of natural resources and thus to greater resource dependence (Table 5).

Many resource poor countries match the growth rates of those with high resource dependence (share of, mainly oil, resources as a percentage of total exports). The RC hypothesis can be confirmed in its soft form. However, a broader metric of resource dependence shows exactly the opposite impact i.e. economic growth is supported by natural resource abundance. This is explained by financial speculation and currency appreciation as foreign investors take notice of abundant underground resources which leads to economic growth. A rise in the *TT* index results from an increase in the price of mainly energy exports since the countries experience a resource boom (prices and volume). The increase in *TT* lowers economic growth confirming the SS theory: The price of non-oil tradable goods should increase at the expense of non-tradable goods which allocates more capital and labour to the non-tradable goods sector. As S-W (2001) show, a bigger *TT* is associated to resource dependence. The *TT* effect boosts the RC, however, the transmission mechanism between the variable *TT* and resource dependence is the change in the exchange rate.

Mineral resource rents are associated to poor economic growth. The effect reflects the impact of high resource rents and the sign is consistently negative although not statistically significant. Such rents are geographically dispersed, unlike for oil and gas, and so the effect on growth is not strong.

To demonstrate resource dependence we use data for oil revenues. Oil revenue is the largest component for total resource revenues. Figure 3-4 emphasises the role of manufacturing exports as a function of oil rents for 1966 to 2013 for several geographical regions. Manufacturing exports represent the traded goods sector. Figure 3-4 also demonstrate that manufacturing exports can be crowded out by oil rents

in many countries, following currency appreciation. This in turn reacts to capital inflows from abroad creating the so-called 'Dutch disease'. The overall relationship between energy/fuel exports and manufacturing exports is negative in most of the period considered. However, some developing countries temporarily escape the RC; for example Mexico (Figure 3a), China and Malaysia (Figure 4a). China shows a stronger decline in oil dependence (reduction in RC effects) and higher manufacturing export growth. This is a consistent trend since 1984. By contrast Indonesia and many other countries show strong RC effects (4a). Exceptions to the RC include Japan, China and the Korea Republic (Figure 4a). India shows RC effects in the 2000s when fuel exports rose dramatically. Throughout the 1970s India's energy dependence is too insignificant to curtail exports of manufacturing. The evidence suggests that China is escaping the RC effects more quickly than India or Indonesia (figure 4a). Figure 4b reveals that countries with low resource dependence (below 5 % Share of GDP) are either resource poor or technology advanced. European countries stand out, but some also suffer from RC effects e.g. Canada, Norway and U.S. (2012). In short potential GDP may have been much higher in the absence of resource exports (4b).

Latin America's energy dependence (Figure 3a) has grown at the expense of manufacturing exports and the misallocation of capital and labour; Asia's dependence shows some parallels: it reduced energy dependence while improving export performance of manufacturing goods (Figure 4a). Africa's dependence (Figure 3b) reveals that most countries remain locked in and path-dependent on an export-led growth model based on oil and other resources, harming GDP growth. The Middle East region continues to have low levels of manufacturing and high rents (Figure 4c).

Considering the institutions model and the growth together, our results show RC effects are not as strong as previously thought. The resource abundance (*SubAssets*) effect is much more important for growth. Despite the fact the resource abundance is not exogenous enough (Equation 5) we can argue that in some cases underground resources will be associated to development and economic growth. In terms of coefficient size, the resource rent effect will be the biggest effect in the institutions models and for the economic growth models (Table 4 and Table 5) the resource abundance effect is the dominant one.

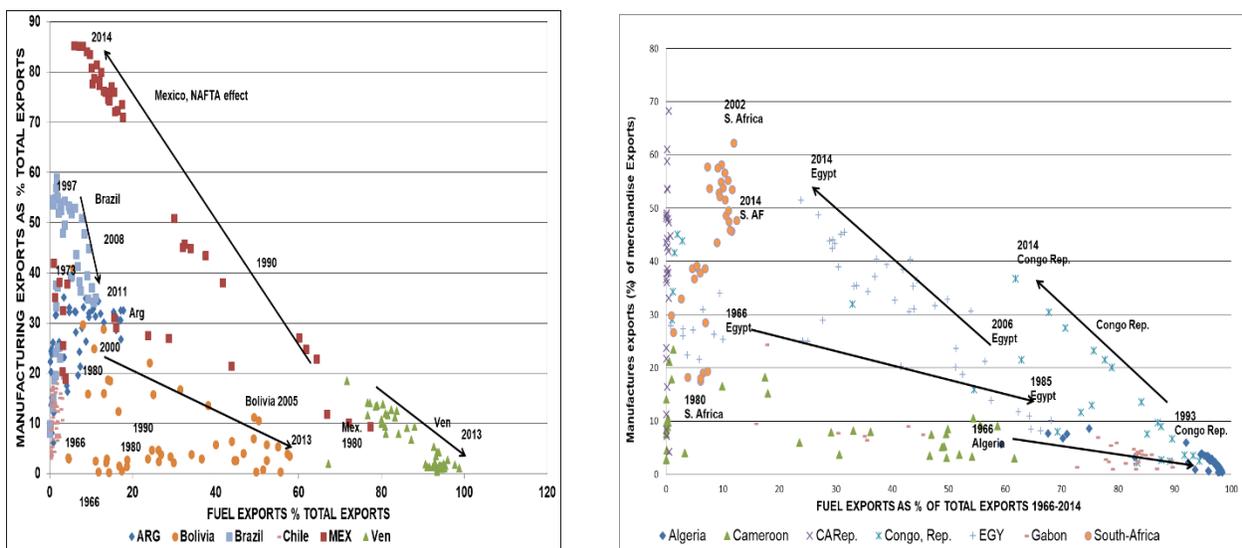


Figure 3. Manufacturing exports (traded goods) and fuel exports (rents) for 1966-2014. The arrows indicate from older to newer data. Arrows pointing to the upper left indicate countries escaping from the RC effect, whilst arrows: down or to the bottom right indicate that the RC deepens: a) Latin America, b) Africa

Source: authors, based on data in World Bank (2015).

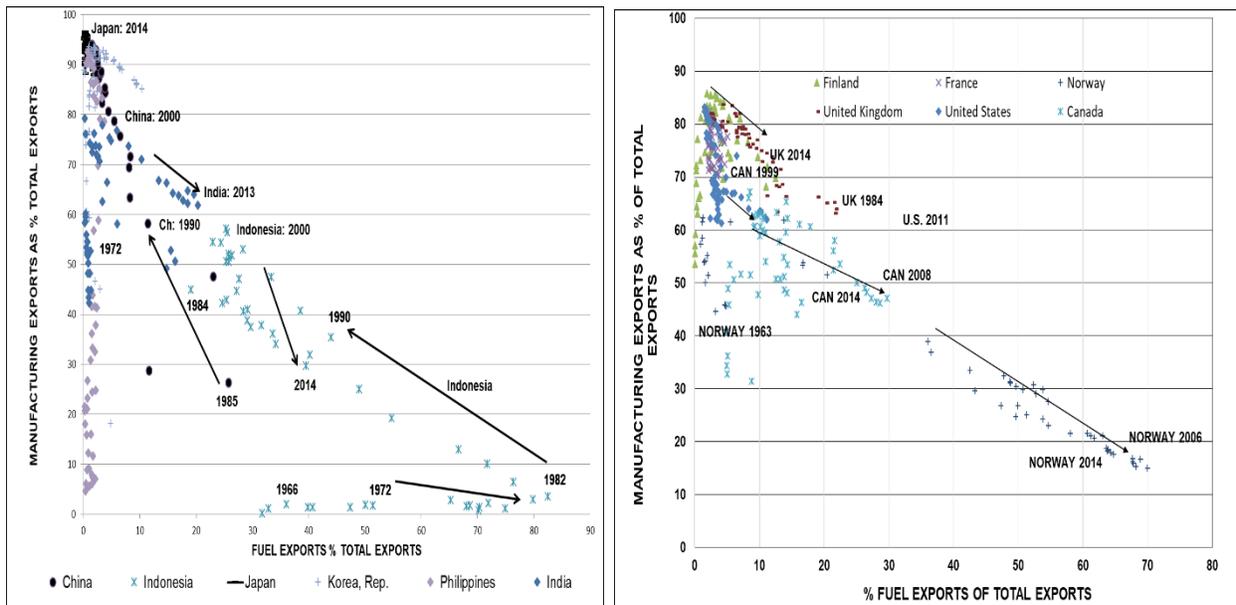


Figure 4. Manufacturing exports (traded goods) and fuel exports (rents) for 1966-2014. The arrows indicate from older to newer data. Arrows pointing to the upper left indicate countries escaping from the RC effect, whilst arrows: down or to the bottom right indicate that the RC deepens: a) Asia, b) selected OECD economies. Source: authors, based on data in World Bank (2015).

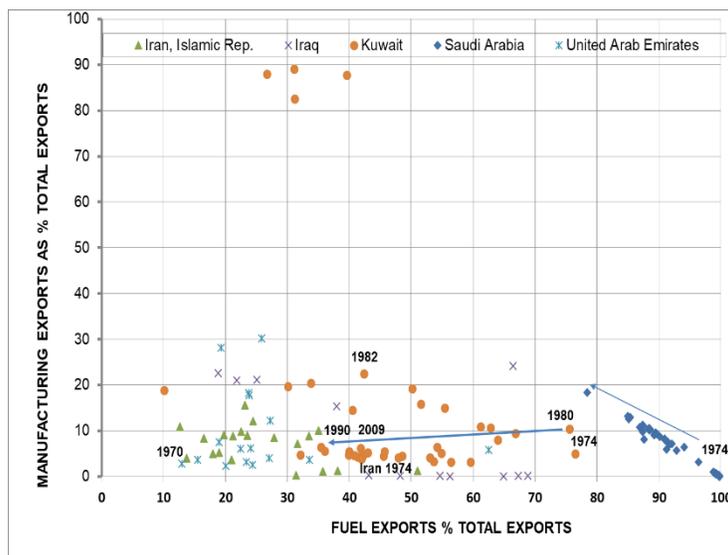


Figure 5. Manufacturing exports (traded goods) and fuel exports (rents) for 1966-2014. Region: Middle East, selected countries

4.3. Policy implications of the estimated models

The policy measures proposed in this section stem from 1) the econometric analysis and 2) from overall analysis of the evidence reviewed in the current work. In uncovering the key characteristics of the nexus among resource rents, subsoil wealth, institutional quality and economic growth over time, we are able to suggest some impacts of potential risks arising from institutional activity (or lack of), assess the impact, and recommend responses (Table 6). To be considered as a low risk for international development the political and socio-legal systems (or institution quality) need to be incorruptible and stable: this is borne out by the econometric results which show the importance of institutions and democracy for economic growth (section 4.1 and tables 4-6). We consider the role of institutions and other factors in the light of Collier (2008), who proposes a chain of five key decision points aimed at harnessing economic growth through: 1) changes in how the resource extraction contract is negotiated, 2) improving design features of the contract, 3) improving both transparency in revenues and 4) maximising the aggregate savings decision, and 5) opening up the process on how the public investment decision is taken.

Table 6. Summary of potential risks and their impacts on policy associated with institutions.

Risk	Impact	Response
Lack of rule of law on resource negotiation	Negotiation of contracts for resource extraction Lax rule of law affects how contracts are negotiated.	Create an independent judiciary.
	Corruption at the level of individuals, firms, and Government	An independent policing service applying the law without fear or favour.
Lack of democracy On resource revenue	Disputed land rights or resource ownership	Unambiguous legislation, or open and fair competitions
	Information of revenues generated by private firms and taxation rates	Implementation of open data systems
	Lower public investment	Improve GDP growth
Effect of weak rule of law on economic activity	Weak law distorts the aggregate saving decision	Improve rule of law to harness savings rates.
Effect of weak government effectiveness on economic activity	Poor Government effectiveness impacts on investment	Strengthen the public investment decision
Negative effect of resource revenues on institutions and on the economy.	Lax Transparency impacts on revenue reported	Strengthen transparency in revenues by open data systems and citizen involvement.

An area of concern are the rules regarding exploration and production (extraction). Our models show that production (*Rent*) are associated to both weaker rule of law (*Law*) and the democratic experience (*Democ*). To mitigate this association the legal system should be fair and overseen by an independent judiciary. Furthermore, a lack of rule of law leads to multi-level corruption. An impartial judiciary relies on a policing service free from corruption. For companies to invest in resource extraction, they need to be certain that any contract signed with another company, the Government, or Government agency will be upheld and disputes resolved fairly in the court system. Alongside this requirement is the need for internationally acceptable ethical standards of behaviour (employment, legal, fiscal, etc.) in public life.

The legislature ('Government effectiveness') sets the policy environment and the regulatory framework, which should be enforced equally for all actors. Two measures can be adopted. First, improvement in the transparency of the rules governing how exploration and production rights or ownership are granted. Secondly, open data systems (EITI, 2017) should be implemented. Together these will allow the citizenry to monitor the quality of the management of the nation's resources.

The taxation system is an important arm of the Government and should be predictable and transparent. Transparency means total disclosure of company payments and extraction rents (EITI, 2017), monitoring the sale of (oil) resource concessions, infrastructure provision and barter arrangements. One way to improve transparency is 'The publish what you pay' campaign which forces companies to reveal financial information with governments (Collier, 2011).

The final impact of the lack of effective government relates to the economy. The implications for economic growth are clear: countries with a stronger rule of law, more effective government, and better democratic experience are more likely to register GDP growth. How oil revenues are allocated for expenditure on public infrastructure requires open data practices allowing civil society to understand how revenues are recorded in the national budget including revenue management and expenditure. Adherence to the system of national accounts (United Nations et al., 2008) is one such step.

5. Conclusions

Our results advance on previous studies for three main reasons: first, we consider a period of estimation of the two models which includes a resource busts and booms (2000-2012) and second, a period of rapid growth of capital inflows into resource sectors: Resource abundance across the world produces a strong income effect. Third we consider institution quality as the mechanism from which the RC effect emanates. The RC effect does not appear in all countries at all times as some researchers argue.

There are various policy mistakes that continue to be repeated: weak (or lack of) political institutions and overreliance of public sector revenue on natural resource revenues all of which contribute to short lived economic growth in some countries. The evidence shows rents hold a negative effect on GDP as countries attempt to maintain the high resource extraction rates required to obtain resource rents. In contrast to rent effects the resource abundance effect is a blessing for institutional quality and for economic development.

The resource-economic growth debate can not be settled by econometric analysis alone, nonetheless our models confirm the findings of Brunnschweiler and Bulte (2008b) for a different period. Our two models confirm that countries with substantial subsoil wealth benefit from GDP growth relatively more than from resource rents. Causality effects run from ample (scarce) subsoil resource assets, to strong (poor) institutions, to positive GDP growth.

As for institutional quality, the models explain resource dependence via long-run effects which emanate from the quality of democracy. Overtime the positive changes in democracy indicator is boosted by subsoil wealth and natural capital but the negative effect of rents on democracy is larger than that on the rule of law (index of current institutions). Therefore, the institution model (using the democracy index) confirms the RC. Our models show that a stronger rule of law is associated to resource abundance. Effective management of resources underground is likely in countries with a stronger rule of law.

The economic growth model reveals two outcomes. First, resource rents are not always as important for the economic growth regressions: Abundance is more significant for growth, but a correlation cannot be assumed between resources and growth. This relationship varies by period and country. Second, further

evidence confirms the growth-reducing effect of resource dependence on manufacturing exports. The latter sector is a key engine for economic growth. The growth reducing effect of resource dependence is invariant of the country from the U.S. to China, Mexico and Malaysia, Indonesia and others. Some of the BRICS economies and less developed nations show a deepening of the RC problem.

Five policy responses are needed to minimise the effects of resource booms: 1) uphold the rule of law on resource negotiation, 2) strengthen government effectiveness on resource revenues, 3) strengthen the rule of law and of government effectiveness to achieve economic activity, 4) mitigate the negative effect of resource revenues on institutions and on the economy through adopting open data practices and 5) improve citizen participation as this is an key mechanisms for improving transparency of revenues. A further response is that a below threshold of 10% of rents of GDP, a much larger gain in democracy is needed to cut resource dependency.

Further work should examine incentives for the RC: how specific legal frameworks have worsened the RC and how a negative debt position in international debt markets accelerates resource exports and the depth of the RC.

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Appendix 1. Correlations of Key Variables

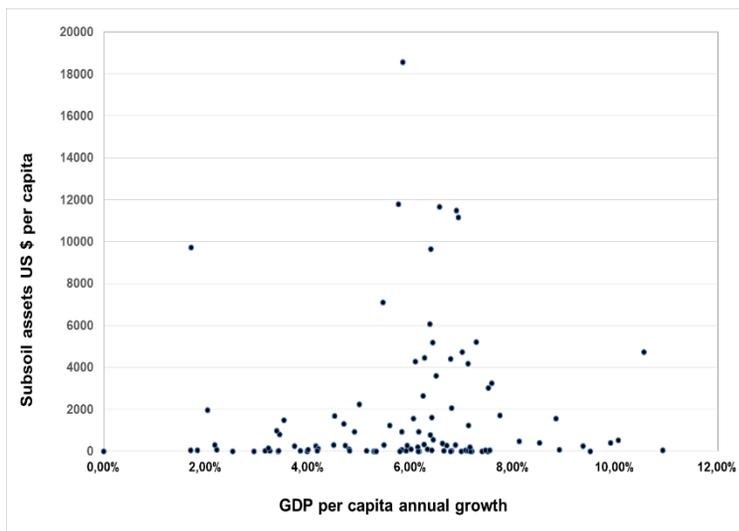


Figure 5A.

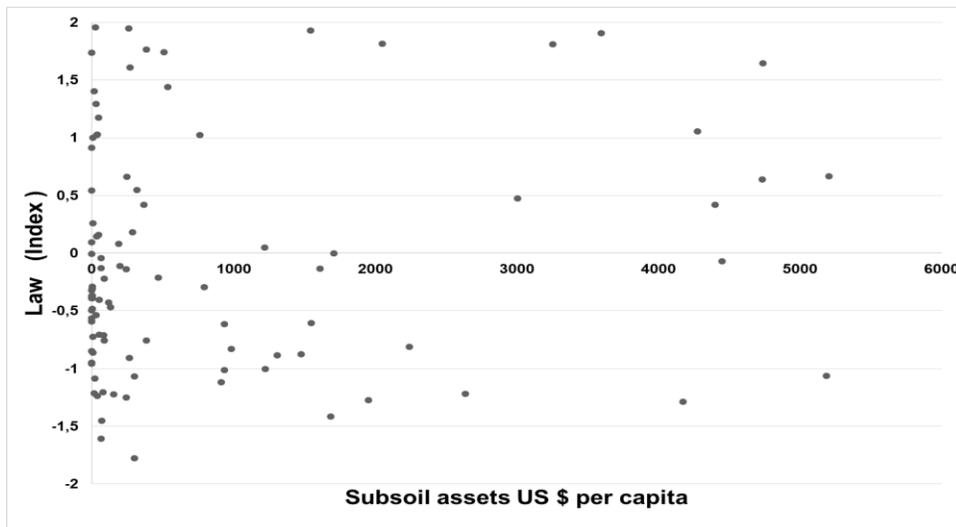


Figure 6A.

Appendix 2: key variables

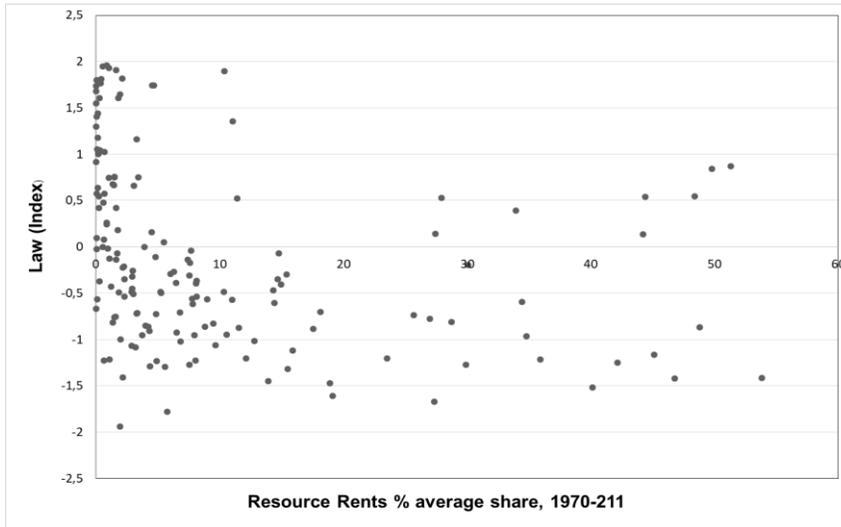


Figure 7A.

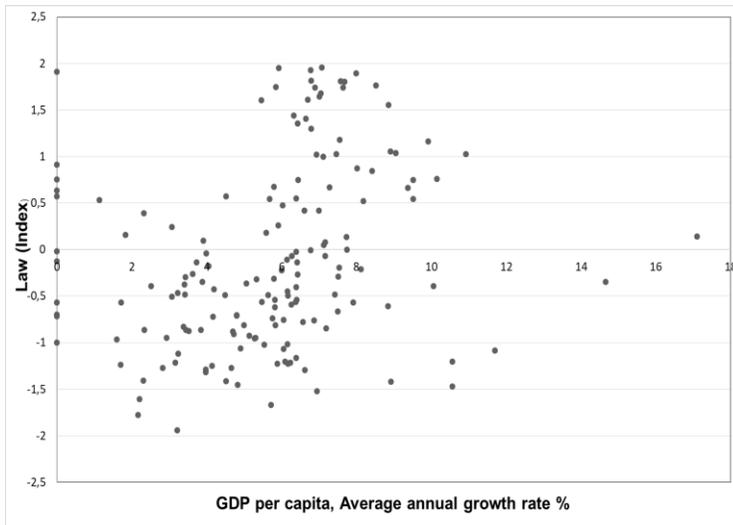


Figure 8A