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The resource curse hypothesis: an empirical investigation

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Abstract

The relationship between natural resources and economic growth has been widely analyzed in the recent past. This thesis empirically examines the "resource curse hypothesis", i.e. countries with large natural resource endowments have tended to grow less rapidly than resource-scarce nations. In this paper, oil and gas production data are used as a measure for resource abundance. In addition, we will illustrate the importance of institutional quality to mitigate the negative effects of the resource curse. The panel includes data from 58 countries spanning from 1984 to 2014. The linkage between natural resources and GDP growth will be examined using an ARDL and a CS-ARDL model. The results contradict the curse hypothesis: natural resources have a positive impact on economic growth. Therefore, this thesis challenges the past literature regarding the impact of natural resources on GDP growth.

Keywords: Resource curse hypothesis, Natural resource abundance, Economic growth, Institutions, ARDL, CS-ARDL

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1. Introduction

The aim of this thesis is to analyze the relationship between natural resource abundance and economic growth. Since the 90s, several authors have tried to examine this linkage: the recurrent result was that natural resources had a negative impact on economic growth. The finding was labelled as the “recourse curse hypothesis”. However, the rise in data availability and the development of more advanced econometric techniques have undermined the consensus on the curse.

The curse has also an impact on the development of “good” institutions. In fact, natural resource revenues can negatively affect the political stability of a country: the discovery of mineral reserves can cause clashes between the ruling élites for the control over the extraction of natural resources. Thus, nations with large resource endowments might experience lower levels of democracy and widespread corruption. This, in turn, hampers economic growth and the well-being of the population.

The thesis is organized as follows. First, an extensive literature review is provided in order to delve into the topic and to illustrate the findings of the past research. Second, the empirical methodology will be presented and the econometrics issues examined. Then, the results will be discussed. The last section will provide the conclusion and further research suggestions.

2. Literature review

2.1. Resource curse hypothesis

The resource curse hypothesis is a widely-discussed topic. It was first introduced in the seminal work of Sachs and Warner (1995), where the authors found evidence of a negative relationship between economic growth and natural resource dependence. In the paper the authors used the share of primary exports over GDP as a proxy for resource dependence. The empirical analysis was performed on a cross-country panel which included several control variables[1]. The results showed that resource-rich countries tended to grow less compared to resource-scarce nations.

In more recent papers, a special attention has been drawn toward the role that institutions play in the resource curse. In fact, a higher degree of political freedom, wider political participation and lower levels of corruption can overcome the negative effects generated by the curse (Mehlum et al., 2005; Boschini et al., 2007). This is mostly true for oil and gas revenues, which are particularly at risk of being kept by a powerful political élite.
In the following pages, a deep analysis will be conducted on the different types of data that can be used to account for resource abundance. In addition, the role of institutions will be further analyzed.

The selection of the time period of the collected data can influence the sign of the regression's results. As highlighted by Alexeev and Conrad (2009, p.586): "there is a different pattern between economic growth and oil/gas commercial exploitation. In fact, most of the countries analyzed in this paper have started to exploit their reserves in the 50s and 60s, while the time period included in the analysis starts from 1984. Thus, the early exploitation of these resources might have caused an increase in the growth rates, while the declining in the rate of growth is due to the maturity of the deposit." In conclusion, the negative coefficients of oil and gas production illustrated in the early literature might have been caused by this gap between reserves' discovery and initial increase in the GDP levels.

[1] The dependent variable is annual GDP growth. The control variables are: initial GDP, trade policy, investment rates, terms of trade volatility, inequality and the effectiveness of bureaucracy. For a more comprehensive analysis, see J. Sachs and A. Warner (1995), Natural resource abundance and economic growth.

Table1 summarizes the previous findings on the resource curse hypothesis. As it can be seen, the studies show mixed results: there is a predominance of papers that found a negative impact of natural resources on growth, yet some authors have discovered a positive relationship. This variety of results depends on the type of variables used, the time span analyzed and also on the econometric technique employed.

Table 1: Summary of the literature

	Study	**Measure of natural resource**	**Methodology**	**Results**
Resource dependence	Sachs and Warner (1995)	Share of primary exports in GDP	OLS fixed effects	Negative
	F. Van der Ploeg and R Arezki (2010)[2]	Natural resources exports	OLS and IV	Negative
	Boschini et al. (2012)	share of primary exports in GDP	OLS (with time effects and lags)	Negative
	S. Dietz et al. (2007)	share of fossil fuel and mineral products in total exports	OLS fixed effects/GMM	Mixed (depends on the type of institutional quality measure included)
Resource abundance	Brunnschweiler (2006)	Total natural capital	OLS and 2SLS	Positive (especially for minerals)
	F. Van der Ploeg and R Arezki (2010)	Total natural capital	OLS and IV	Negative
	Apergis et al. (2014)	Share of oil rent in GDP	Time-varying cointegration	Negative
	Cavalcanti et al. (2011)	logarithm of the real value of oil production per capita	Common Correlated Effects type estimators (CCEMG)	Positive
	M. Alexeev and R. Conrad (2009)	Logarithm of oil deposits and oil production	OLS and 2SLS	Positive

[2] In order to proxy for economic growth, income per capita is used rather than GDP per capita growth

2.2 Resource abundance vs resource dependence

A key issue in the resource curse hypothesis is to identify a suitable indicator for resource abundance or dependence. The distinction between dependence and abundance is paramount: the former indicates the country's reliance on natural resources to sustain its economic growth. The indicator used by Sachs and Warner (1995), i.e. the share of primary exports in GDP, can be labelled as a proxy for resource dependence rather than abundance. However, as highlighted by Brunnschweiler (2006, p.4), "there are some countries, i.e. Germany and Australia, that have large resource endowments, but low primary exports. Thus, for these countries the indicator does not necessarily yield a truthful representation of reality. It also indicates an excessively specialized economy, i.e. the resource sector attracts inputs that can be directed to other sectors. The resulting lower economic growth derives from the dependence on the primary sector, rather than from the effect of the resource curse". Lastly, it can also suffer from endogeneity, since the dependent variable (GDP growth per capita) is used to scale the volume of exports (Brunnschweiler 2006).

The features of this measure of resource dependence are also criticized by Alexeev and Conrad (2009, p.589): "We are even more skeptical about using the share of natural resource exports in GDP or in total exports. The use of export-related measures of oil dependence has a bias similar in nature to measures expressed in shares of GDP. In fact, the bias in the export-related measures is probably larger numerically, because a more developed country may consume much of its natural resources domestically and export a smaller share of its endowment, holding initial total reserves constant. Therefore, an oil-producing country that has a relatively small GDP for reasons unrelated to oil would have a large ratio of oil exports to GDP, thus biasing the results toward the negative effect of oil on both GDP and growth. The same argument holds for other mineral resources". In sum, the indicator used by Sachs and Warner (1995) has some major issues.

Resource abundance indicates the presence of large natural resource reserves in a country. There are two main indicators that belong to this category: resource rents and production data. According to the World Bank website: "The estimates of natural resources rents are calculated as the difference between the price of a commodity and the average cost of producing it. This is done by estimating the price of units of specific commodities and subtracting estimates of average unit costs of extraction or harvesting costs (including a normal return on capital). These unit rents are then multiplied by the physical quantities countries extract or harvest to determine the rents for each commodity as a share of gross domestic product (GDP).”[3] Hence, this indicator yields a more economic related view on the extraction and use of natural resources. Still, as the one discussed above, it depends on the level of GDP (since it is expressed as a percentage of GDP) which can lead to endogeneity issues. According to Brunnschweiler (2006), “resource rent data have revealed both positive and negative growth effects (Stijns, 2001; Atkinson and Hamilton, 2003 cited in Brunnschweiler 2006, p.5)”.

Resource production data has been widely used as an indicator for resource abundance. The production of natural resources is influenced by several economic factors. For example, the rate of extraction depends on the state of the economy, commodity prices and on the level of technology. In fact, the volatility of oil/gas prices can widely determine their rate of extraction. For example, as reported by Kleinberg et al. (2017, p.70), “Many analysts suggested that the oil price needed to maintain the economic viability of the preponderance of U.S. tight oil projects - the breakeven point - was in the range of $60/bbl to $90/bbl”. The presence of breakeven points[4] can affect the rate of extraction of some minerals.

The extractive industry is one of the most capital intensive sectors. Large investments and extractive technologies are needed to allow an efficient and steady rate of production. Therefore, the technological level of a country can determine whether or not that nation is resource abundant. Also, one could argue that investment in technology depends on the level of GDP and on the human capital available to develop and use the adequate technologies. Yet, thanks to the presence of international resource-extracting firms, gaps between countries can be partially reduced by the adoption of imported technologies and skilled foreign workers. In conclusion, the mineral production data will be used as the indicator for resource abundance.

The expression “natural resource curse” encompasses a variety of minerals and other resources, from oil and gas to agriculture and forestry. The main distinction can be made between point and non-point resources. The former generally includes all the minerals that are extracted from a circumscribed area, like a mine, a quarry or and oil/gas field. The latter includes those resources that can be extracted from areas that do not have a specific demarcation, such as

[3] The World Band estimates are based on "The Changing Wealth of Nations 2018: Building a Sustainable Future" (Lange et al 2018)
[4] According to (Kleinberg et al., p.71), breakeven points are the combination of project costs and market prices for which the net present value of a project is zero

timber and agricultural products. Furthermore, the former has only to be extracted, while the latter, especially in the case of agriculture, also involves a production process. Most papers on this topic only include point-resources in the analysis (see Mehlum et al, 2005; Isham et al., 2005 and Boschini et al., 2007). The same approach will be adopted in this thesis.

2.3 Dutch disease

There are several possible explanations for the resource curse. One of these is the "Dutch disease" hypothesis. The term describes the effects of the discovery of large gas reserves in the Netherlands in the 1960s and 1970s. A direct consequence of this was a change from manufacturing to the export of the primary good. There was also a large currency appreciation that led to a reduction in the exports of other goods. This happened for two reasons: non-tradable goods prices rose due to the increased domestic demand generated by the increased resources revenues and secondly, rising exports led to increased export revenues. (Gala et al., 2017).

These changes had repercussions in the manufacturing sector: less products were exported so that unemployment increased and growth rates decreased. In conclusion, the discovery of natural resources reserves led to a shift away from manufacturing which, in turn, negatively affected the economic growth of the country. As Gala et al. (2017) summarize, "More generally, the Dutch disease paradoxically connects with the negative effects of the economic rents generated by great discoveries or the abundance of natural resources such as gold, oil, and gas" (Gala et al., p.118).

The main outcome of the Dutch disease is the crowding out effect. The natural resource sector draws resources that were originally destined for the agricultural and manufacturing sectors. In other words, capital and labor inputs are shifted from one sector of mass employment to a tiny one (Gala 2017). Unemployment rises also as a consequence of the deindustrialization of the economy.

In conclusion, the "Dutch disease" can be defined as a loss of economic diversification. The overspecialization of the country's economy will, in the long run, hamper economic growth. As well-summarized by Frankel (2010, p.19), "the phenomenon has some common features: large appreciation of the currency, increase in government spending, non-traded goods' price rise, shift of labor to more profitable sectors and an account deficit". A limitation of the Dutch disease theory is that it only focuses on economic events to explain the natural resources curse. However, in the recent past, in the resource curse literature, an increasing attention has been drawn towards other non-economic factors, such as the quality of institutions or human capital.

2.4 Institution curse

There is a broad consensus on the relation between institutions and natural resource abundance. The words of a World Bank publication reflect this view:

"[Natural resource exports] can damage institutions (including governance and the legal system) indirectly—by removing incentives to reform, improve infrastructure, or even establish a well-functioning tax bureaucracy—as well as directly—by provoking a fight to control resource rents. ... There is growing evidence that [this] effect is the most problematic". (Brunnschweiler 2006, p.2)

High levels of institutional quality, i.e. representative democracy and low levels of corruption are fundamental to guarantee an equal and efficient distribution of the resource revenues. It is therefore not surprising that (good) institutions can mitigate the negative effects caused by the resource curse. The importance of high levels of institutional quality is substantial in the long run, since government's policies do not take effect in the short term.

The abrupt discovery of new oil or gas reserves, particularly in the case of a country with low level of political participation, can have detrimental effects on long run economic growth. Countries with large point-source resource endowments are the most vulnerable to the resource curse, which might be exacerbated by an autocratic government. In fact, since oil and gas extractions are subject to stricter regulations compared to other resources such as crops or forests, it can be tempting for political élites to retain the revenues and not invest into long-term economic growth projects. This short-sighted policy is often called "rent-seeking behavior" and it is particularly common in less democratic governments. The role of institutions in the resource curse literature is becoming more important, as highlighted by Wick and Bulte (2009, p.144): "it appears as if a consensus is now growing that points to institutional quality - or the lack thereof - as a driver or the curse".

A simple explanation on the extent to which mineral-endowed countries are more corrupt involves the effect that large and "difficult to absorb" sums of oil and gas money have on governments (Shaxson, 2007). In fact, these can create internal divisions which damage the social fabric of a country, especially if characterized by a high level of ethnic fractionalization. Moreover, non-homogeneous countries perform poorly in terms of economic growth compared to the ones with lower social divisions. Therefore, this will lead to a sort of "tragedy of the commons": the ruling élites compete to accumulate the revenues generated by the extraction of natural resources, without considering a long-term growth planning.

In conclusion, democratic institutions can mitigate the negative effects brought by the discovery of natural resources. Countries such as Norway and Canada, with their high level of institutional quality, are usually described as positive examples of natural resources management. The resource curse may occur for low and middle-income countries; however, it is not necessarily true that resource-rich countries with poor institutional quality will fall prey to the curse.

2.5 Volatility and Human capital

Other factors, such as the volatility of mineral revenues and low levels of human capital, can explain the presence of a resource curse. In fact, oil prices volatility might hamper the planning of economic development and thus undermine economic performance in the long term. For example, as highlighted by Mohaddes et al. (2017, p.6): "there seems to be growing support for the view that it is the volatility in commodity prices and revenues in particular, rather than oil (natural resource) abundance per se, that drives the resource curse paradox". Furthermore, the volatility is especially harmful for those countries that specialize in the export of commodities with high price volatility: the fluctuations in revenues and terms of trade do not allow for a proper governmental spending plan which will then hamper growth (van der Ploeg and Poelhekke, 2009). The negative impact of volatility on growth is worsen by the lack of a well-functioning financial system, a common feature in resource-rich countries (Aghion, et al., 2006; Rose and Spiegel, 2007).

Point-source natural resources can have a negative impact on the development of human capital through the channel of the Dutch disease. The crowding-out effect of the latter tends to increase the demand for capital to the detriment of labor. In fact, natural resources have a negative impact on education: the primary sector necessitates less skilled workers which, in turn, decreases the demand for higher education (Gylfason 2001). Hence, natural resources are responsible for a crowding-out effect on human capital, which can hamper growth in the long term.

According to Hanushek and Wößmann (2007) the quality of education, i.e. higher levels of human capital, is connected to the quality of institutions. As a matter of fact, a country characterized by rent-seeking institutions will grow less compared to a nation where education is aimed at fostering productive and entrepreneurial activities. In sum, both institutional quality and education are deemed to have a positive effect to economic growth, while natural resources can undermine this virtuous process.

In conclusion, the importance of controlling for other channels is well-summarized by Papyrakis and Gerlagh (2004, p.190): “A natural resource economy that suffers from corruption, low investment, protectionist measures, a deteriorating terms of trade, and low educational standards will probably not benefit from its natural wealth due to adverse indirect effects”.

3. Data Description

The GDP per capita data (constant 2010 US dollar) is retrieved from the World Development Indicators (WDI) database. Most of the previous studies use the growth of GDP per capita and therefore so do we.
As discussed before, in order to account for natural resource abundance, oil and gas production data have been used instead of primary exports over GDP. The data are obtained from the Ross and Mahdavi database,[5] which includes data from different sources, such as the US Geological Survey Minerals Yearbook, World Bank’s Wealth of Nations database and US Energy Information Administration. The data have then been transformed in natural logarithms, specifically $\ln(oil_t + 1)$ and $\ln(gas_t + 1)$.[6]
The measure for institutional quality has been obtained from the Quality of Government (QOG) Institute dataset, namely the International Country Risk Guide (ICRG) from the PRS group.

[5]The database is available at https://doi.org/10.7910/DVN/ZTPW0Y
[6] As done, for example, by Alexeev and Conrad in “the elusive curse of oil”, the review of economics and statistics (2009)

The ICRG is a composite index that includes a variable for Corruption, Law and order and Bureaucracy quality and it is scaled 0-1 (where 1 indicates a high quality of government).

A trade variable is included to account for trade openness, which is a known engine of growth. The data is retrieved from the WDI and it includes the sum of exports and imports of goods and services measured as a share of gross domestic product[7].

A measure for volatility (VToT) is included in the panel, since it can have a negative effect on growth. The variable describes the volatility of the CToT (Commodity Terms of Trade) which is based on weighted averages of the prices of 45 primary commodities. These two variables, CToT and VToT have been obtained from the dataset provided by Mohaddes (2017).[8] VToT is included in the regression since countries that are heavily dependent on exports might suffer from commodity volatility, which will cause an economic slowdown. Thus, the inclusion of this measure is reasonable given its potential effect on economic growth.

The Human Capital Index is obtained from the PennWorld 9.0[9] tables and it is based on average years of schooling (following the procedure of Barro and Lee[10], 2013) and on an assumed rate of return for primary, secondary, and tertiary education (as in Caselli 2005)[11]. The variable (ln_growth_hci) is expressed in growth rates by the formula $\ln\left(\frac{HCI_{t+1}}{HCI_t}+1\right)$. A variable for the level of investments in the country, namely unna_gfcf, is included. In detail, the variable includes "the gross fixed capital formation which is measured by the total value of a producer's acquisitions, less disposals, of fixed assets during the accounting period plus certain additions to the value of non-produced assets (such as subsoil assets or major improvements in the quantity, quality or productivity of land) realized by the productive activity of institutional units." (UN statistics)[12]

Table2 illustrates the descriptive statistics of the sample.

[7] For a more detailed description see https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS

[8] For further reference read the paper "Do sovereign wealth funds dampen the negative effects of commodity price volatility?" at http://www.econ.cam.ac.uk/people-files/faculty/km418/research.html

[9] Feenstra, Robert C., Robert Inklaar and Marcel P. Timmer (2015), "The Next Generation of the Penn World Table" American Economic Review, 105(10), 3150-3182

[10] This measure accounts for education attainments, however it does not include the set of skills acquired and the differences in schooling. For a more detailed analysis, see Barro, Robert J. and Jong-Wha Lee (2013), "A new data set of educational attainment in the world, 1950-2010" Journal of Development Economics 104: 184–198.

[11] Caselli, Francesco. 2005. "Accounting for Cross-Country Income Differences." In Phillipe Aghion and Steven N. Durlauf, editors, Handbook of Economic Growth, Volume 1A, 679-741. Amsterdam: Elsevier

[12] For a more complete definition see http://data.un.org/Glossary.aspx?q=National+accounts+-+Gross+fixed+capital+formation

Table2: descriptive statistics

Variable	Observations	Mean	Std. deviation	Min	Max
ln_gdpc2010	1798	.0173351	.0456961	-.3447926	.8112276
ln_oil_prod	1798	15.04088	3.5278	0	20.23713
ln_gas_prod	1798	3.512762	2.351734	0	8.631614
vtot	1798	1.5058	2.516532	0	20.0341
icrg_qog	1798	.580094	.2253014	.0555556	1
ln_growth_hci	1798	.6904388	.0660912	0	1.071157
wdi_trade	1798	64.23408	34.91543	0	220.4074
unna_gfcf	1798	22.16534	6.243	2.1	58.59839

The econometric analysis will be conducted on a panel data which includes 58 countries (N=58) and goes from 1984 to 2014 (T=31). The use of panel data in econometrics has spread widely in the last decades. As highlighted by Sarafidis and Wansbeek (2010, p.2), “One major issue that inherently arises in every panel data study with potential implications on parameter estimation and inference is the possibility that the individual units are interdependent”. This issue is known as cross-sectional dependence and it can undermine the validity of the model used in the regression. In particular, failing to consider this can lead to a biased and not consistent estimation or low efficiency (V. Sarafidis and T. Wansbeek 2010, p.4). Thus, a specific model to account for cross-sectional dependence will be employed.

In the cross-country econometrics analysis, the presence of cross-sectional dependence is a common issue. The Pesaran cross-section dependence test can be applied to a wide variety of balanced and unbalanced panels with large T and N, with unit-root and heterogeneous panels. As T and N go to infinity, the test statistics has mean zero and variance one, moreover, even though this is not the case, it also has good small sample properties, i.e. small N and T. (Pesaran 2004).

Table 3: Cross sectional dependence test on y-variable (ln_gdpc2010)

Variable	CD-Test	p-value	Corr	Abs(corr)
ln_gdpc2010	23.83	0.000	0.105	0.207

Under the H_0 of cross-section independence CD ~ N(0,1)

The Pesaran CD test on the Y variable (ln_gdpc2010) confirms the presence of cross-sectional dependence in the dependent variable, since the test rejects the H_0 of cross-section independence (at the 1% level).

Table4 shows the correlation coefficients for the variables included in the panel. As it can be seen, even though it provides a rough overview of the linkages between the variables, both oil and gas production are positively correlated to GDP growth. Furthermore, all the other variables follow the sign predicted by the literature. Vtot, a measure for volatility of commodity prices, is negatively correlated to GDP growth. For instance, institutional quality (icrg_qog), human capital (in growth rates), trade openness and investments (unna_gfcf) are positively correlated to GDP growth.

Table 4: Correlation table

	ln_gdpc2010	ln_oil_prod	ln_gas_prod	vtot	icrg_qog	ln_growth_hci	wdi_trade	Unna_gfcf
ln_gdpc2010	1.0000							
ln_oil_prod	0.0778	1.0000						
ln_gas_prod	0.1239	0.7181	1.0000					
vtot	-0.0689	0.1808	0.0230	1.0000				
icrg_qog	0.0236	-0.0230	0.2017	-0.3478	1.0000			
ln_growth_hci	0.0339	0.1272	-0.0669	0.2059	-0.3529	1.0000		
wdi_trade	0.0571	-0.1771	-0.1224	0.3056	0.0485	-0.0383	1.0000	
unna_gfcf	0.2530	0.1279	0.1499	0.0541	0.2062	0.0018	0.1173	1.0000

4. Empirical approach

4.1 Autoregressive Distributed Lag model

The resource curse hypothesis investigates the relationship between economic growth, expressed as GDP growth per capita, and natural resource abundance, in this case, oil and natural gas.

A common feature of panel data with growth regressions and large N and T is the presence of a high degree of cross-sectional heterogeneity (Blackburne 2007). This means that panel data techniques such as fixed and random effects estimators and also GMM cannot be used, since all these assume a large degree of homogeneity (Mohaddes and Raissi, 2017).

In this paper, an Autoregressive Distributed Lag (ARDL) model will be used[13]. The ARDL is a dynamic model that yields a short and a long run estimate of the process. The short-run estimate includes an error correction (EC) value, which indicates how much the model adjusts itself from the previous period to the new period.

It is characterized by the inclusion of lags of the regressors and of the dependent variable in the regression function. The choice of the number of lags to be included in the model is important to obtain consistent estimates. As stated by Chen and Vujic (2016, p.13): "using too much lags will lose much degrees of freedom in estimation, which would deteriorate the small sample performance". Furthermore, a satisfactory performance depends also on the size of T (Chudik et al., 2016). As mentioned before, the panel is characterized by a T=31, so the lag length for the models has been capped at one, due to the time-series requirements[14] (Mohaddes and Raissi, 2017).

[13] In the following analysis, the STATA command *xtpmg* will be used, as described in Blackburne and Frank (2007)

[14] The same lag length is applied to both the ARDL and CS-ARDL model. As a robustness check, the results of an ARDL and CS-ARDL model with two lags will be discussed in the appendix. The inclusion of three or more lags is not possible due to the large number of regressors. (the maximum likelihood procedure run in Stata does not converge with more regressors).

The particular ARDL model is derived by Blackburne (2007):

$$y_{it} = \alpha + \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=0}^{q} \delta'_{ij} X_{i,t-j} + \mu_i + \epsilon_{it} \qquad (1)$$

Where y_{it} represents the dependent variable (GDP growth per capita), i= 1, 2…, N indicates the number of countries; t= 1,2…, T indicates the number of periods; p and q indicate the lags included in the regression (in this case, since only one lag has been included, p=1 and q=1); X is a k x 1 vector of explanatory variables (in detail: oil and gas production, institutional quality index, trade openness, commodity volatility, human capital and level of investments); δ_i are the k x 1 coefficient vectors; λ_i are the scalars; μ_i are the country specific effects, α is a constant and ϵ_{it} are the errors.

As already mentioned, a large T, specifically T ≥ 30, is required for the PMG estimator to work properly. In the short run estimation yielded by the model, particular attention must be given to the error correction parameter, which represents the responsiveness to any deviations from the long run equilibrium (Blackburne 2007). In order to illustrate this, note how (1) can be reparametrized into the Error Correction Model as:

$$\Delta y_{it} = \phi_i \left(y_{i,t-1} - \theta'_i X_{it} \right) + \alpha + \sum_{j=1}^{p-1} \lambda^*_{ij} \Delta y_{i,t-1} + \sum_{j=0}^{q-1} \delta'^*_{ij} \Delta X_{i,t-j} + \mu_i + \epsilon_{it} \qquad (2)$$

Where $\phi_i = -(1 - \sum_{j=1}^{p} \lambda_{ij})$ indicates the error-correcting speed of adjustment[15]. In order to allow the variables to return to the equilibrium, the error correction term must be negative and between -1 and 0, although if 0 it would imply the lack of any long run cointegration between the variables (Basu and Getachew 2017, p.10). θ'_i represents the long run relationship between the variables ($\theta'_i = \theta'$ for all i, since the long run coefficients are constrained to be equal across groups, Blackburne 2007).

There are different estimating procedures, yet the pooled mean-group estimator (PMG) is the most suitable in this case, since it allows for some degree of heterogeneity. In fact, according to Mohaddes (2017, p. 20): "[the PMG estimator] restricts the long-run coefficients to be homogenous over the cross-sections, but allows for heterogeneity in intercepts, short-run

[15]Furthermore, the reparametrization leads to $\lambda^*_{ij} = -\sum_{m=j+1}^{p} \lambda_{im}$ and $\delta'^*_{ij} = -\sum_{m=j+1}^{q} \delta_{im}$

coefficients (including the speed of adjustment) and error variances. It also generates consistent estimates of the mean of short-run coefficients across countries by taking the simple average of individual country coefficients”. Finally, the maximum likelihood method is used to estimate the parameters.

This is important because, as highlighted by Blackburne and Frank (2007, p.197): “One of the central findings from the literature, however, is that the assumption of homogeneity of slope parameters is often inappropriate”. In addition, as stated by Di Casola and Sichlimiris (2015, p.10): “The ARDL methodology has been shown to be valid regardless of whether the regressors are exogenous or endogenous and irrespective of whether the variables are integrated of order zero or one, but they cannot be integrated of order two”.

In conclusion, as briefly summarized by Chen and Vujic (2016, p.13): “the panel ARDL approach accounts for slope heterogeneity across provinces, different order of integration in variables, and the potential endogeneity caused by potential feedback effects from growth to regressors”. Moreover, the ARDL can consistently estimate the long run parameters even with the presence of endogeneity, which is relevant since the aim is to analyze the long run relationship (Fadiran 2015, p.12).

The illustration of the ARDL model is necessary to provide a baseline of the features of the model. The next paragraph will introduce a variation of the Autoregressive Distributed Lag model, i.e. the CS-ARDL. This is obtained by adding the cross-sectional means of the regressors and the dependent variable to the basic ARDL in order to account for the presence of cross-sectional dependence (Mohaddes and Raissi, 2017).

4.1 Cross-sectionally augmented ARDL model

As stated by Westerlund and Edgerton (2008, p.666), “when studying macroeconomic and financial data for example, cross-sectional dependencies are likely to be the rule rather than the exception, because of strong inter-economy linkages”. In fact, factors such as oil shocks, financial crises and trade integration can lead to potential cross-sectional dependencies and thus undermine the consistency of the ARDL model. Hence, a new model specification is adopted. Following the works of Pesaran (2006) and Chudik and Pesaran (2013), the regression is augmented with the cross-sectional averages of the dependent variable, the regressors and their lags (the number of lags of the CS averages is equal to the number of lags of the regressors, which in this case is set equal to one). This method should increase the fitting of the model, since it accounts for some form of cross-sectional dependence in the panel; moreover, it is robust to omitted variables. The aim of the new model is to include in the error correction term those common factors, i.e. the correlated errors across countries, that otherwise will enter in the error terms ϵ_{it} and yield biased estimates. The same assumptions work for this model, i.e. large N and T.

$$y_{it} = \alpha + \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=0}^{q} \delta'_{ij} X_{i,t-j} + \sum_{j=0}^{n} \varphi'_{i,j} \bar{Z}_{t-j} + \mu_{it} \qquad (3)$$

$$\bar{Z}_t = (\bar{y}_t, \overline{X'}_t) \qquad (4)$$

$$\mu_{it} = \gamma'_i f_t + \varepsilon_{it} \qquad (5)$$

Where $\bar{Z}_t$ is a vector with the averages of the dependent variable ($\bar{y}_t$) and the regressors ($\overline{X'}_t$). Moreover, *n* indicates the lag length of the cross-sectional averages, ε_{it} are idiosyncratic errors, f_t is a vector of unobserved common factors, which are the source of the cross-sectional dependence across countries. The aim of the CS augmented ARDL model is to account for these common factors through the de-trended cross section averages and their lags (represented by $\bar{Z}_t$) [16]. Equation (3) will be estimated through PMG. In sum, the addition of the CS averages in the model is necessary to improve the estimation output, while accounting for the cross-sectional dependence and potential endogeneity problems (Mohaddes and Raissi, 2017).

5. Econometric issues

5.1 Unit roots

In the recent past, a large variety of models has been used to empirically test the resource curse hypothesis. Several authors, for example Sachs and Warner (1995), Van der Ploeg and Arezki (2010), Boschini et al. (2012) have used panel data OLS estimation techniques with fixed

[16] For further details refer to Chudik, A., Pesaran, M.H., 2015. Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors. J. Econ. 188 (2), 393–420.

effects, instrumental variables or time effects and lags; however, these methods do not allow for a combination of variables that are I(0) and I(1). On the other hand, the ARDL model is applicable for both non-stationary variables or variables with a combination of order of integration, specifically I(0) and I(1), but not I(2) or higher (Nkoro and Uko, 2016).

Several panel unit root tests have been developed throughout the years; however, given the features of the data, a specific test has to be implemented, due to the presence of heterogeneity in the dynamic panel. According to the “economics of growth” literature there might be some cross-sectional dependence in the errors, which will undermine the significance of the results of the unit root tests. External shocks, such as oil price shocks or financial crises can have a broad repercussion on deeply interconnected countries. Such shocks, in turn, may affect growth rates of some countries, and these are not accounted for in the classic unit roots tests.

One solution to the problem would be to subtract the cross-sectional means when applying the unit root tests. However, as stated by Pesaran (2003, p.1): “it was thought that cross-sectionally de-meaning the series before application of the panel unit root test could partly deal with the problem. (see Im, Pesaran and Shin (1995)). However, it was clear that cross-section de-meaning could not work in general where pair-wise cross-section covariances of the error terms differed across the individual series”.

An alternative method is to use the Pesaran (2007) Augmented Dickey-Fuller test (CADF from further on). The test accounts for cross-sectional dependence in the panel and it is thus more reliable than many other tests. It accounts for residual serial correlations and heterogeneity in the panel. The test has a satisfactory size and power even with small N and T. The inclusion of time trends in the model requires larger T and N, yet the performance is satisfactory even if $T \geq 30$.

The variables have been tested with 0 lags (and trend) and 1 lag (and trend). As table5 illustrates, the variables have a mixed order of integration. However, no variable is I(2) or higher. Therefore, the presence of mixed orders of integration allows for the use of the ARDL model.

Table 5: CADF Unit root test

Variable	0 lag	0 lag and trend	1 lag	1 lag and trend
ln_gdp	.000***	.000	.000	.000
ln_oil	0.15	0.31	.000***	.000
ln_gas	.003***	0.102	0.096	0.3
icrg	0.51	0.016**	0.274	.000***
ln_hci	.002***	0.000	0.41	0.99
vtot	.000***	.000	.000	.000
trade	0.029**	0.995	.005***	.96
unna_gfgc	.242	0.733	.038**	0.104

Pvalues of the test are reported, *** p<0.01, ** p<0.05, * p<0.10
H_O: the process has a unit root

5.2 Cointegration test

According to the time series theory, the presence of unit roots in the data can yield spurious estimates. However, this can be avoided if the variables are cointegrated. Since in the panel data, oil production and the investments variables have a unit root, a cointegration test is necessary in order to show a long-run relationship between these variables.
The test adopted is the one proposed by Westerlund (2007), which accounts for heterogeneity in the long and short run and also for cross-sectional dependence.
Westerlund (2007) proposes four tests. However, the G_t and P_t tests appear to be relatively more robust to the cross-sectional correlation. They will therefore be used to test for cointegration.

Table 6: Westerlund cointegration test

Statistic	Test values (0 lag)	Test values (1 lag)
Gt	-0.284	-4.601***
Ga	2.506	-0.970
Pt	-5.699***	-25.493***
Pa	-5.390***	-18.595***

H_0: no cointegration, xtwest has been used with a constant and 0/1 lag options
*** p<0.01, ** p<0.05, * p<0.10

The G statistics indicate that at least one series is cointegrated, while the P statistics implies that the panel is cointegrated as a whole. Moreover, the Pt and Pa have a higher power over Gt and Ga according to the Monte Carlo simulation (Westerlund 2007). As it can be seen, the Pt rejects the null hypothesis of no cointegration at the 1% level, therefore the variables are cointegrated.

6. Estimation results

In the resource curse literature, a panel data regression analysis is frequently conducted. The dependent variable is GDP growth per capita, while the regressors are usually some variables that proxy for resource abundance or dependence. The regression includes some extra variables that are related to economic growth. According to the economic theory, trade openness, human capital, institutional quality and level of investments have a positive and significant impact on growth. Furthermore, several authors such as Mohaddes (2017), Mehlum (2006), Béland and Tiagi (2009) have showed that, the resource curse hypothesis can be mitigated through the development of "good institutions". In fact, countries with a higher level of political participation, or lower level of corruption, usually experience a positive economic return from the resource rents.

As we have discussed above, the presence of cross-sectional dependence can undermine the results of the ARDL model. Hence, the findings of the restricted model will be included in the Appendix. Table7 illustrates the results of the CS-ARDL model with one lag.

Table 7: CS-ARDL results for GDP per capita growth

Variables	SR (short run)	LR (long run)
D.ln_oil_prod	.0461402** (.0220354)	.0021606*** (.0006091)
D.ln_gas_prod	.0162704** (.0072228)	.0070473*** (.0008673)
D.icrg_qog	.0157028 (.050359)	.0142997** (.0066923)
D.ln_hci_growth	.1741143 (.6440913)	.8448201*** (.2300079)
D.wdi_trade	-.000074 (.0002647)	-.0001398*** (.0000395)
D.vtot	-.001229 (.0069255)	-.0005102 (.0006559)
D.unna_gfcf	.0064058*** (.0007633)	.0000217 (.0001819)
Constant	-.4472736*** (.0279659)	
EC	-.7117502*** (.044971)	

d.ln_gdp_growth is the dependent variable, *** p<0.01, ** p<0.05, * p<0.10, SE in parenthesis
D. indicates first difference, EC is the error correction coefficient

Given the different nature of the data, one should focus on the signs rather than on the coefficients of the regression. The SR column illustrates the short run dynamic relationship between the variables. Both the oil and the gas variable are positive and significant (at the 5%

level). The institutional quality, human capital, trade openness and volatility coefficients are not significant. The gross fixed capital formation variable is positive and significant, which means that higher levels of investments foster economic growth (a similar result, concerning the short-term impact of investments, is obtained by Esu, 2017).

The long-run natural resources coefficients are significant and positive. This means that, even after cross-sectional dependence is accounted for, the resource curse does not hold. On the contrary, point-source natural resources have a positive impact on economic growth.

These findings accord with some of the recent literature. For example, the signs of the control variables, namely institutional quality, trade openness, human capital and investments are concordant with those from the work by Papyrakis and Gerlagh (2004). The same authors have, however, found a negative impact of natural resources on growth. Nonetheless, they used the share of mineral production in GDP, which is a measure of resource dependence, rather than resource abundance. This supports the notion that results vary depending on the type of data used to proxy for natural resources endowments. The discrepancy in results is also highlighted by Ding and Field (2005): the authors, when distinguishing between natural resource abundance and dependence, found that the variable for resource abundance has a positive impact on economic growth.

The positive and significant sign of the institutional quality variable confirms what discussed before. Widespread democracy and low levels of corruption can enhance economic growth (Nawaz et al., 2014). The opposite is true when a country is characterized by grabber-friendly institutions: in this case, resource abundance can be detrimental to GDP growth (Mehlum et al. 2006).

The volatility coefficient is negative, yet not significant; while, the investment one is positive but not significant. The negative sign of the trade openness variable does not support the predominant literature. However, a possible explanation is the one reported by Esu (2017, p.189): "an economy that is completely open without a strong manufacturing sector may not benefit much from international trade interactions, rather it may run a persistent balance of trade deficit". In fact, natural resources can crowd-out the manufacturing sector, which leads to the adoption of protectionist policies to safeguard the domestic producers from international competition and to a reduction in trade openness (Papyrakis and Gerlagh, 2004).

6.1 Resource abundance and institutions

Following the paper of Alexeev and Conrad (2009)[17], an additional regression analysis was carried out to test the extent to which economic growth and natural resource abundance affect institutional quality. According to the literature, nations with lower levels of corruption experience better economic performances (Acemoglu et al., 2002 and Rodrik et al. 2002). The interaction between economic development and institutional quality can yield a vicious or virtuous circle, depending on the country's institutions. In addition, several authors have argued that natural resources have an indirect impact on economic performance through their (negative) impact on institutions (Leite and Weidmann, 1999; Sala-i Martin and Subramanian, 2003).

A widespread political participation allows citizens to hold the government accountable for how the oil and gas rents are managed by the ruling parties. Meanwhile, point-source resources can have a detrimental effect on the democratization of a country, produce political instability and foster corruption (Tella and Ades, 1999; Barro, 1999; Ross, 2001; Jensen & Wantchekon, 2004; Collier and Hoeffler, 2005). This will have then negative repercussions on the long run economic growth of that nation.

The interconnection between these effects is briefly summarized by Shaxson (2007, p.1123): "Oil booms, such as we are seeing today, promote bursts of temporary headline economic growth, followed by hangovers so deep that growth in the very long term is often lower than it would have been without the resource. Mineral dependence turns out to be a curse not just in terms of economic growth, but also in terms of risks of violent conflict, greater inequality, less democracy and more corruption".

Institutional quality is also positively related to human capital. In fact, a highly educated population demands greater level of political participation (Alesina and Perotti, 1996). Likewise, international trade is a factor that encourages the development of "good" institutions. The increased openness to trade demands higher efficiency and creates a more competitive environment, which is not suitable for rent-seeking institutions (Alonso and Garcimartìn 2013).

[17] The authors investigate the transmission mechanism between institutions and natural resource abundance. They use the "rule of law" index as the dependent variable. Resource abundance (expressed as hydrocarbon deposits per capita), GDP per capita and a set of control variables (specifically, absolute latitude, number of English speakers and ethnic fractionalization) are included as regressors. They conclude that oil wealth negatively affects the institutional quality, while GDP has a positive coefficient.

The model is the same used in the main regression: a CS-ARDL with 1 lag. The variables included, however, are different. The dependent variable is the institutional quality index. The regressors are: oil and gas production (in logarithm), GDP growth per capita, human capital index (expressed in growth) and a measure of trade openness.

Table 8: CS-ARDL results for institutional quality

Variables	SR (short run)	LR (long run)
D.ln_gdpc_2010	-.0222003 (.0485752)	.0494491 (.0740249)
D.ln_oil_prod	-.0075149 (.0176599)	-.016739*** (.0019976)
D.ln_gas_prod	-.009082 (.011031)	-.0166828*** (.0041796)
D.ln_growth_hci	-.738375 (1.10123)	4.984521*** (1.023715)
D.wdi_trade	-.000464 (.0003323)	.0005422*** (.0001691)
Constant	-.4104533*** (.070499)	
EC	-0.1526142*** (.0253867)	

Icrg_qog is the dependent variable, *** p<0.01, ** p<0.05, * p<0.10, SE in parenthesis
D. indicates first difference, EC is the error correction coefficient

The results confirm the predominant literature: both the oil and gas variables have a negative and significant coefficient (in the long run). The GDP growth per capita coefficient is positive, although not significant. Human capital has a positive and significant impact on institutional quality; this result is concordant with the finding of Alesina and Perotti (1996) and Alonso and Garcimartìn (2013). The trade openness coefficient is positive and significant. In fact, as mentioned before, countries that trade more experience an improvement in the quality of institutions.

A special attention should be focused on the relation between institutions and natural resources. These findings do not necessary imply that the abundance of natural resources always deteriorates the quality of institutions. As a matter of fact, the literature assumes the presence of a threshold effect between the level of democracy (or corruption) and the resource curse. For example, in their paper, Horiuchi and Waglé (2008) claim that countries did not become less democratic due to the effect of oil wealth. Hence, it appears that countries characterized by an already stable and well-defined democracy and with low levels of corruption do not experience a worsening in their institutional quality.

The opposite is true for countries with autocracies and corrupted élites. These nations might be worse off if relevant oil and gas reserves are discovered, as highlighted by Shaxson (2007, p.1123): "The poorer and weaker a country is before the oil discovery, the more likely it is to be harmed by it". Therefore, the impact of oil revenues varies according to the level of institutional quality of the country involved.

In conclusion, one could argue that there is a resource curse, but it affects the development of more democratic institutions rather than the GDP growth. Thus, a drawback generated from natural resource abundance is the excessive focus on resource-based growth, which hampers the institutional quality improvement over time.

7. Discussion

The resource curse hypothesis is a widely-discussed topic, yet in the recent years, the consensus on the phenomenon has faded. In fact, several authors have found a positive relationship between natural resource abundance and economic growth. There are numerous reasons that can explain such findings. First, results vary depending on the type of variable used to account for natural resource abundance or dependence. Then, as it has been showed before, institutions play a major role in mitigating the negative effects generated from oil and gas revenues. Furthermore, the period chosen to carry out the econometric analysis can influence the results: it is likely that the oil crises that have taken place in the 70s may have contributed to generate the negative impact on economic growth through the volatility channel.

Many authors have also highlighted the importance of adopting the most suitable econometric techniques to study this linkage. The seminal work by Sachs and Warner (1995) used a fixed effect panel regression to examine the curse. With the advancement in panel data techniques, the recent literature has showed a positive impact of resources on growth.

The findings of this thesis do follow the path outlined by the recent discoveries: oil and gas production are beneficial for the economic growth of a country. The relevance of institutional quality, as it has been highlighted by the regressions' results, is important in mitigating the negative effects of the curse. The importance of good institutions has also some policy implications. Promoting democracy can limit the possible damages caused by large resources endowments. Lower levels of corruption allow for a fair and equal redistribution of resources revenues and long-term economic growth. Still, a more comprehensive analysis on the features of corruption is necessary to better understand its effects on long-term economic growth.

As a matter of fact, even though several papers include some type of institutional quality indices, the phenomenon of cross-border corruption is never examined. Corruption is always considered a discrete component, while, in reality it affects countries transnationally: huge sums of money move from resource-rich and autocratic countries to tax heavens through the financial system (Shaxson, 2007). This worsens the economic growth of the former, while the latter are classified as good performing countries according to the ordinary institutional quality indices.

There are some limitations in the analysis carried out in this paper. First, the measure for resource abundance only accounts for point-source resources, while agriculture and other minerals are excluded from the analysis. Second, the regressions only include data from 1984 to 2014, which is a small sample considering that several countries have started extracting natural resources in the 1950s. Therefore, the inclusion of a broader time period is desirable. Data availability is another issue, for example institutional quality is not easy to measure, while data might be missing for some countries. It is desirable to extend the analysis to a larger time period and also increase the number of countries examined.

The lack of a general consensus on the resource curse hypothesis should foster the research on this topic. The adoption of more advanced models and econometrics techniques is necessary to disentangle this relationship. Great focus should be addressed toward the creation of a more reliable measure for natural resource abundance.

The econometric analysis might still have some issues of endogeneity, since for instance, natural resources production, institutional quality and trade are somehow related to GDP. The presence of endogeneity, then, cannot be completely excluded. Yet, the CS-ARDL model is still consistent, since lags of the dependent variable are included in the regression.

8. Conclusion

This study has analyzed the resource curse hypothesis. The analysis was conducted on a sample of 58 countries with data ranging from 1984 to 2014. The adoption of a CS-ARDL model was necessary to account for the presence of heterogeneity in the panel, combination of different orders of integration and cross-sectional dependence.

The major finding produced by the panel regression contradicts the resource curse hypothesis: natural resource abundance, measured in oil and gas production, is found to have a positive impact on economic growth. Following the recent literature methodology, this thesis also focuses on the role of institutions. Democratic governments and low levels of corruption can mitigate the negative effects brought by natural resource abundance. Political participation is important to foster economic growth, since it guarantees an equal and productive use of resource rents. The negative effect of commodity goods volatility on GDP growth has been illustrated and is concordant with the literature. In addition, the human capital and investment coefficients' signs are positive, which means that higher education and investments increase economic output.

The relation between institutions, economic growth and natural resources has been examined in order to determine the mechanism through which natural resources affect GDP growth. The findings are concordant with the literature: natural resource abundance negatively affects the quality of institutions. Countries with large natural resource endowments are more vulnerable to the presence of widespread corruption or lack of political participation. These findings imply that the resource curse affects economic performance indirectly through the institutional quality channel. Therefore, it is crucial to further analyze the implications that resource abundance has on the long-run economic growth of a country.

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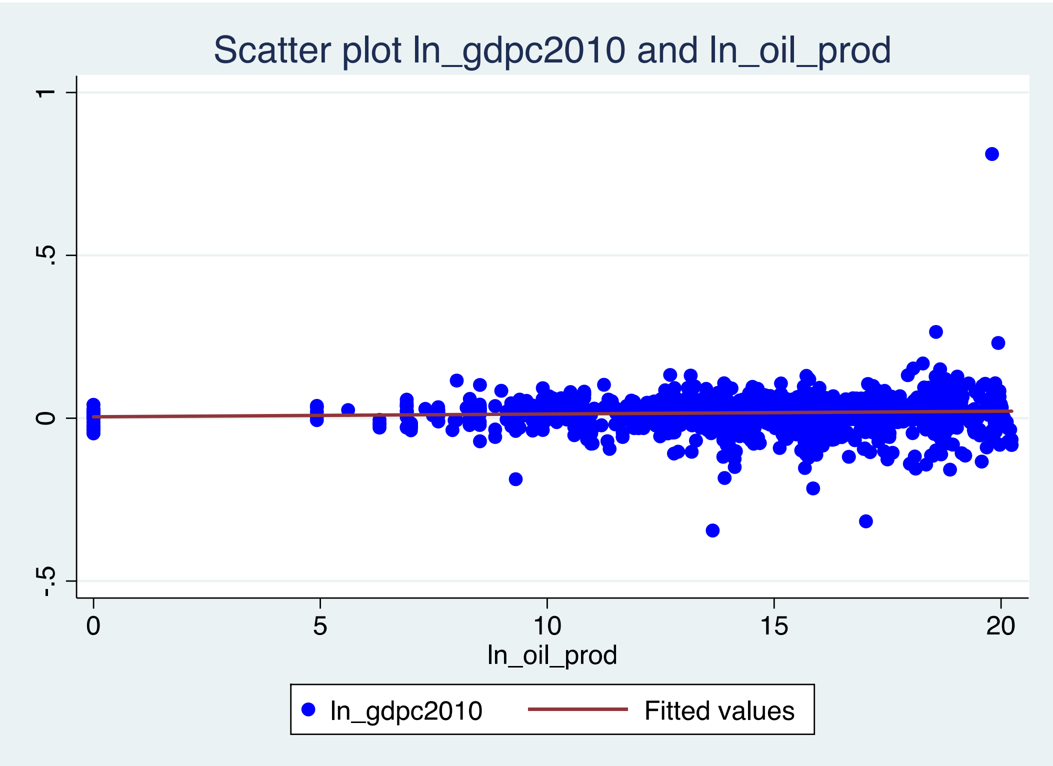
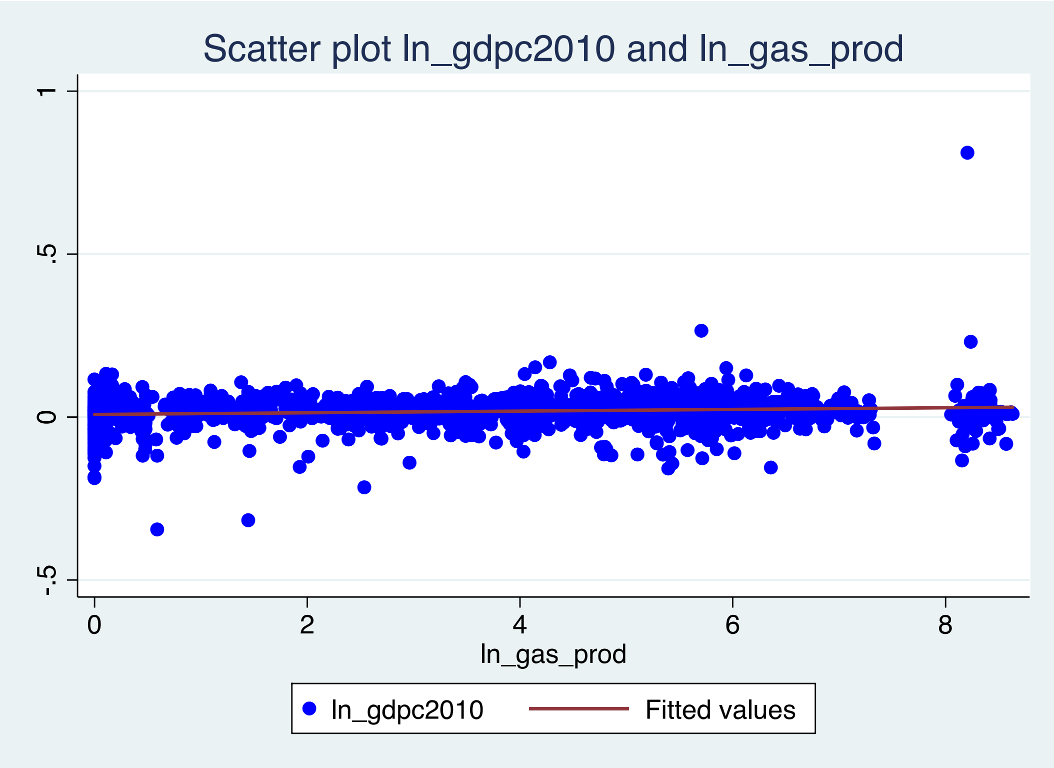
APPENDIX

List of countries (58)

Albania	Ecuador	Nigeria
Algeria	Egypt	Norway
Angola	France	Pakistan
Argentina	Gabon	Peru
Australia	Germany	Philippines
Austria	Ghana	Russian federation
Bahrain	Greece	Saudi Arabia
Bangladesh	Guatemala	Senegal
Bolivia	India	South Africa
Brazil	Indonesia	Spain
Bulgaria	Iran	Thailand
Cameroon	Israel	Trinidad and Tobago
Canada	Italy	Tunisia
Chile	Japan	Turkey
China	Jordan	United Kingdom
Colombia	Malaysia	United States
Congo, Dem. Rep.	Mexico	Venezuela
Congo, Rep.	Morocco	Vietnam
Cote d'Ivoire	Netherlands	
Denmark	New Zealand	





Both graphs show a small positive relationship (represented by the red line) between ln_gdpc2010 and logs of oil and gas production.

Table A: Description of the variables

Variable	Description
ln_gdpc2010	GDP per capita growth (constant 2010 US dollar)
ln_oil_prod	Logarithm of oil production data obtained through the formula $\ln(Oil_t + 1)$
ln_gas_prod	Logarithm of gas production data obtained through the formula $\ln(gas_t + 1)$
vtot	Volatility of the commodity terms of trade. It is based on the weighted averages of the prices of 45 primary commodities
icrg_qog	Measure of institutional quality. It is a composite index including a variable for corruption, law and order and quality of bureaucracy (scaled 0-1)
ln_growth_hci	Growth rates of human capital index obtained through the formula $\ln\left(\frac{HCI_{t+1}}{HCI_t} + 1\right)$
wdi_trade	Measure for trade openness. It includes the sum of exports and imports of goods and services as a share of GDP
unna_gfcf	Measure for level of investments obtained through the gross fixed capital formation index (calculated by the UN statistics)

Table B: ARDL results for GDP growth per capita

Variables	SR (short run)	LR (long run)
D.ln_oil_prod	.0419024** (.0202116)	.0013216*** (.0003869)
D.ln_gas_prod	.0098984 (.0086851)	.0053168*** (.0008101)
D.icrg_qog	.0243138 (.0252115)	.0233444*** (.0062282)
D.ln_hci_growth	-.2302605*** (.0836079)	.3972498 (.2736031)
D.wdi_trade	.000416** (.0002078)	-.000125*** (.0000394)
D.vtot	-.0000447 (.0016967)	-.0014839** (.0007018)
D.unna_gfcf	.0063625*** (.00074)	.0006342*** (.0001801)
Constant	-.2431412*** (.0125058)	
EC	-.7724151*** (.0396705)	

d.ln_gdp_growth is the dependent variable, *** p<0.01, ** p<0.05, * p<0.10, SE in parenthesis
D. indicates first difference, EC is the error correction coefficient

Table B reports the results of the ARDL model. The long run oil and gas coefficients are positive and significant. The institutional quality variable (icrg_qog) has a positive and significant impact on growth, which is concordant with the majority of the literature. Better institutions and lower level of corruption can counteract the negative effect of the resource curse and also foster economic growth. In fact, democracies are usually better at effectively investing the revenues generated by the production of oil and gas. The trade openness variable has negative and significant coefficient, while the human capital one is positive but not significant. On the other hand, the volatility measure (as expected) shows a negative and significant (at the 10% level) sign. Finally, the gross fixed capital formation coefficient is positive and significant, which means that investments enhance economic growth (Menegaki, 2013). The error correction coefficient falls within the dynamically stable range and it is significant.

Table C: ARDL results for GDP growth per capita (with two lags)

Variables	SR (short run)	LR (long run)
D.ln_oil_prod	.056345*** (.0211213)	.0013789*** (.0002894)
D.ln_gas_prod	.0202538** (.0095034)	.0052051*** (.0008638)
D.icrg_qog	.113405** (.0455726)	.010633* (.0062237)
D.ln_hci_growth	1.963577 (1.95267)	1.090707*** (.2544404)
D.wdi_trade	.0003994 (.000288)	-.0000863** (.000039)
D.vtot	.0020868 (.0036227)	-.0099415*** (.001532)
D.unna_gfcf	.0060859*** (.0007528)	.0002279 (.0002028)
Constant	-.5219269*** (.042604)	
EC	-.6754753*** (.0538939)	

d.ln_gdp_growth is the dependent variable, *** p<0.01, ** p<0.05, * p<0.10, SE in parenthesis
D. indicates first difference, EC is the error correction coefficient

There are small differences between the ARDL model with one lag and the one illustrated above with two lags. All the variables' signs are still the same, however some coefficients are not significant anymore, i.e. the level of investments. The opposite is true for the human capital variable, it has become significant at the 1% level. In sum, these results are concordant with the main finding of this thesis: there is no evidence of a resource curse in the panel analyzed.

Table D: CS-ARDL results for GDP per capita growth (with two lags)

Variables	SR (short run)	LR (long run)
D.ln_oil_prod	.0677261 * (.0349956)	.0005962** (.0003144)
D.ln_gas_prod	.0302732 ** (.0149128)	.0069844*** (.0005323)
D.icrg_qog	.0210584 (.1073766)	-.0196302*** (.0064335)
D.ln_hci_growth	-2.039684 (2.243424)	-3.033347*** (.2727519)
D.wdi_trade	-.0000552 (.0005075)	-0.0000036 (.000038)
D.vtot	-.005013 (.0103549)	-.01341*** (.0011275)
D.unna_gfcf	.0064338*** (.0012578)	-.0002171 (.0001442)
Constant	1.344861*** (.1385227)	
EC	-.6271135*** (.0647128)	

d.ln_gdp_growth is the dependent variable, *** p<0.01, ** p<0.05, * p<0.10, SE in parenthesis
D. indicates first difference, EC is the error correction coefficient

The inclusion of two lags in the CS-ARDL model yields some different results. Nonetheless, the oil and gas variables are still positive and significant, both the long and short run (the oil coefficient loses some degree of significance). The trade and volatility variables have kept the same sign. The institutional quality and the human capital coefficients have changed signs: both have now a negative and significant sign. Therefore, according to this model, “good” institutions do not have a positive impact on economic growth. A similar result is obtained by Fadiran (2015) and Brunnschweiler and Bulte (2007) when using oil reserves as a proxy for resource abundance. However, the focus of this thesis is to illustrate the relationship between natural resource abundance and GDP growth. The extension of the model to two lags does not undermine the initial results: oil and gas enhance economic growth.

Table E: CS-ARDL results for institutional quality (with two lags)

Variables	SR	LR
D.ln_gdpc_2010	.0099276 (.0622472)	-.0391918 (.0535653)
D.ln_oil_prod	.0024643 (.0220736)	-.0186877*** (.0016181)
D.ln_gas_prod	-.0004745 (.0151168)	.0021218 (.0041241)
D.ln_growth_hci	-1.189329 (2.748665)	2.695453*** (.9785773)
D.wdi_trade	-.0007527* (.0004088)	.0003634*** (.0001011)
Constant	-.1453364*** (.0372692)	
EC	-.1293467 *** (.0310769)	

Icrg_qog is the dependent variable, *** p<0.01, ** p<0.05, * p<0.10, SE in parenthesis
D. indicates first difference, EC is the error correction coefficient

The extension of the model to two lags has caused some changes. The GDP per capita growth coefficient is now negative, yet not significant. The oil coefficient is the same as in the one lag model, while the gas one has now a positive sign, but it is not significant. Trade openness and human capital did not change, they have kept a positive and significant sign.

In conclusion, the two lags CS-ARDL model still partially confirms the main finding: point-source resources (in this case, only oil) have a negative impact on economic growth.