The curse of natural resources: An empirical analysis on European regions

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Abstract

This paper investigates the existence of a natural resource curse at the level of European regions. While the literature has extensively analysed the course of natural resources at the country level, not much evidence exists for regions. The analysis concerns 232 regions and focuses in particular on the impact of the endowment of agriculture and mining and quarrying resources on regional economic growth. Results show that resource-abundant regions exhibit lower economic growth, even after controlling for region and time specific effects and other socio-economic variables. The effect is mostly in the long run, but it holds for both types of resources. However, the magnitude of the curse of natural resources is small, confirming that the differences across regions in terms of economic growth derive more from formal and informal institutional factors that have been decisive in shaping the permanent economic gaps in Europe.

1. Introduction

The phenomenon of resource-poor economies out-performing resource rich economies has been a recurrent pattern in the economic history. If we look to the empirical evidence many countries abundant in natural resources have not resulted in economic growth. Notwithstanding its important oil and gas reserve, Venezuela experienced a traumatic violence and upheaval due to the crowding out of non-resources related sectors, dependence on the import of commodities, and several declines in production volumes and prices due to corruption, underinvestment and the recent recession. Russian resources represent over 30% of word's natural resources with oil and gas exports accounting for 95.7% of national wealth (Advantour, 2016), 85% of Russian treasury revenues and 70% of Russia's annual exports (US Energy Information Administration, 2014). With such an important reliance on natural resources, Russia is strongly exposed to the sharp decrease in commodities prices. Since 2012, the Russian economy is experiencing a slower pace of economic growth and ranks now 13th in the World Bank ranking of per capita nominal GDP for countries (World Bank, 2015). In the African Continent, oil, gas and mining are important sectors and natural resources in general account for a major source of income (45% of total general revenues). For instance, in 2010 in Nigeria and Angola the combined size of oil rents was more than $169bn (The Guardian, 2012). Many resource-exporting countries have failed in diversifying their economies away from the extractive sectors, remaining heavily dependent on extraction revenues.

Although UK's and Germany's industrial development in the late nineteenth century was based on the steel industry and on iron and coal deposits, there are many instances of resource-poor economies – e.g. Netherlands, Switzerland, Japan and newly industrializing Asian tigers - surging ahead of resource-abundant economies such as Russia, Mexico, Nigeria or Venezuela (Sachs and Warner, 1997).

The negative relationship between natural resources and economic growth has been the motif of various studies that have confirmed the empirical evidence (World Bank, 1997; Gylfason, 2001). Moreover, even in the US, which seems to be the main counterexample of the natural resource curse, there is evidence that natural resource abundance has led to lower economic growth both at the state (Papyrakis and Gerlagh, 2007) and at the county level (James and Aadland, 2010).

They way natural resources affect economic growth is determined by several factors such as the learning process involved in the exploitation and the development of natural resources (human capital) as well as by some external factors such as government effectiveness, institutional quality or civil conflicts. For instance, comparing Indonesia and Nigeria, that started with similar oil dependence and per capita income, it is possible to notice that Indonesia stems from the victory of counter-revolutionary forces and the nature of its geopolitical context[1]. Similarly, Botswana's success (8.7% annual economic growth between 1980s and 2013) compared to Sierra Leone, similarly rich in diamonds, can be explained by the civil strife experienced by Sierra Leone (Stiglitz, 2004).

Furthermore, if we look to different types of natural resources, the final impact on economic growth generally tends to be significantly different. In fact, it is noticeable how agriculture and land seem to have a negative impact on many determinants of economic growth while minerals, coal, natural gas and oil may affect economic growth through positive or negative channels (Stijns, 2005).

The present paper aims at testing the existence of a natural resource curse in the context of European regions. Our dataset covers 232 European Regions. All data come from the European Statistic Database, following the NUTS 2 European regional classification. Our panel analysis takes as base year 2004 because of consistent available

[1]Course Hero. *Explanation of Indonesia Economy.* Available at https://www.coursehero.com/file/p3021q3/Explanation-of-indonesias-economic-success-I-argue-that-Indonesias-economic/. Accessed 10 October 2016.

data for all the regions and covers a ten-year period from 2004 to 2014. Our results show that resource-abundant regions exhibit lower economic growth, even after controlling for region and time specific effects and other socio-economic variables. However, the effect appears to be small and valid only in the long run, and it is mostly due to the type of natural resources considered and to historical formal and informal institutional factors that have been decisive in shaping the economic gap.

The rest of the paper is organized as follows. Section 2 discusses the theoretical foundations and empirical evidence on the natural resource curse. Section 3 presents the data and the methodology used for the analysis. Section 4 discusses our econometric results, while conclusions and suggestions for future research follow in Section 5.

2. The curse of natural resources: a review of the literature

The theory of natural resource curse suggests that, at the country and regional level, the abundance of natural resources (especially non-renewables such as minerals, gas and oil) is associated with bad economic outcomes and low economic growth. Therefore, countries and regions with fewer natural resources are expected to perform better. The most important explanation of this phenomenon is related to the so-called Dutch Disease, a concept originally used by "The Economist" in 1977 to describe the boom and poor management of natural resource sectors (specifically natural gas) in concomitance with the shrinkage of the manufacturing sector, which led to economic difficulty in the Netherlands. This concept was subsequently modelled by Colden and Neary (1982), who claimed that the boom in natural resource sectors of small countries induce a fall in the output share of non-resource tradable goods relative to non-tradable goods and a real exchange rate appreciation. For instance, the boom of energy in a small open economy with traded and non-traded goods causes an inflow of foreign currency, which in turn appreciates national currency increasing the cost of domestic goods and thus increasing the demand and the supply of tradable goods. This decreases their relative price causing exchange rate appreciation (Afandiyev, 2013).

This could happen through two different channels. The first channel consists in the increase of domestic income and therefore aggregate demand for non-tradable goods (non-manufacturing goods) leading to a rise in the price (including input costs and wages) and reduction in profits of non-tradable goods. The studies of Prebisch (1950) and Singer (1950) suggest that a decrease in primary good prices negatively affects the price of manufactured goods and how primary good share on total GDP will decline because of technical progress. In agreement with this theory, the specialization in resources and primary goods, without a parallel development of the manufacturing sector, leads to slower economic growth. The second channel reflects the potential crowding out effect with the attraction by resource sectors of capital and labour (which can translate in more education, innovation and entrepreneurial activity) from other economic sectors, especially traded manufacturing activities[2]. Relying on the basic assumption that learning-by-doing, technological innovations and knowledge accumulation occurr only in the manufacturing sector, the Dutch disease model perceives the specialization in natural resource sectors as detrimental for the overall economic development of a country.

The negative effects coming from the specialization in natural resources sectors has also been analysed by Matsuyama (1992) and successively generalized in the framework of the Dutch Disease model by Sachs and Warner (1995 and 1997). Both conclude that specializing in natural resource sectors and pushing the labour force away from manufacturing sectors toward low-skill agriculture sectors lowers the overall economic growth. The idea that if learning-by-doing or capital accumulation positive effects exist in tradable sectors and not in resources related sectors, then booms in natural resources can have a negative impact on economic growth in the long term has also been supported by Corden and Neary (1982), Krugman (1987) and Auty (2001). As reported by Auty (2001), a significant endowment in natural resources generates rents leading to factional and predatory contexts, which distribute rents without transparency and in favour of some

[2] Brahmbhatt, M., Canuto, O., and Vostroknutova, E., (2010). Dealing with Dutch Disease. *Economic Premise World Bank*.

favoured groups distorting economic policies and leading to protectionism and late diversification in competitive labour intensive manufacturing sectors. This in turn leads to a deceleration in the accumulation of human and social capital.

Sachs and Warner (1999) reconsider this thesis pointing out how for certain natural resources related sectors as the oil sector - which uses less labour without drawing away employment from manufacturing sectors - the negative impact on growth is somehow mitigated and the economy demonstrates overshooting effect. Torvik (2001) criticizes even further these results basing his models on the hypothesis of the existence of learning-by-doing processes also in non-manufacturing related sectors and finding that production and productivity in both natural resource and manufacturing sectors may increase or decrease.

A second explanation for the curse is related to the volatility of the revenues. Dutch Disease may translate in higher exports of commodities, which generally have greater volatility in their price compared to manufacturing products. This is due to the low short-term supply elasticity of natural resources output (Jacks et al., 2009). Greater volatility in commodity prices can lead to greater volatility in both government revenues and therefore in national spending and investments and real exchange rate affecting negatively the final economic outcomes.

A third explanation of natural resource curse relies on the concept of temporary boom of natural resources[3], which often translates in a temporary income boom. This temporary boom in per capita income leads to overconsumption lower savings and therefore lower investments. Nonetheless, when the boom ends, this overconsumption is no more sustainable especially for less developed countries. Besides, abundant natural resources

[3] The Economist (2015). *Commodity Dependency: A risky State.* Available at http://www.economist.com/blogs/graphicdetail/2015/08/commodity-dependency. Accessed 13 October 2016.

have often been used by governments as collateral to borrow and finance large investments and high public consumption, thus generating balance-of-payment crisis and unsustainable external debt during the 80s (Rigobon, 2007). Natural resource production typically generates high income rents, therefore, resource abundant countries can be exposed to rent seeking phenomenon on the side of producers (especially when commodities prices rise) which in turn incentivizes the government to concede various privileges such as tariff protections to domestic producers or even business and government corruption (Auty, 2001). In addition to rent seeking, natural resource abundance, high-commodity prices and temporary income booms could boost the general overconfidence generating a false sense of security. Therefore, in a context in which resource abundant economies can live off resource exports, governments tend to lose sight of the need for growth-supporting public goods such as infrastructures and good economic management (Gylfason, 2001). This exposes countries to lower openness to trade, bureaucratic inefficiency and bad institutions, missing-out on export–led growth and risking waste of rents in profligate or inappropriate consumption (Sachs and Warner, 1997).

Fourth, there is an issue concerning the potential lack of investment in human resources as a partial consequence of the overconfidence in natural resources perceived as the primary national asset. Several studies have given empirical evidence of a negative relationship between resource abundance and education enrolment across countries (Gylfason et al., 1999). This can be explained by the fact that governments believe that resource – sectors do not require high level of human capital and high-skilled labour and therefore neglect the investment in human capital which has often been proved to be a critical factor for economic growth (Lucas, 1998 and Mankiw et at., 1992). Gylfason (2001) points out how more natural resources measured as the share of labour engaged in primary production leads to less school enrolment at all educational levels. The argumentation below this result is that resources rich countries can live well of their natural resources during long periods even without good economic policies or significant investments in education while countries with less natural resources generally have smaller margin of error. This analysis stands from the wide recognized evidence that human capital is one of the fundamental factors of economic growth in the long run (Mankiw et al. (1992), Lucas (1988) and Acemoglu (1996)). Mankiw et al. (1992) finds that human capital is positively correlated with savings and population growth, highlighting the consistency of Solow model with the importance of human and physical capital in the overall economic growth of a country. In addition to this, Acemoglu (1996) and Lucas (1988) confirm the contribution of human capital accumulation in the increase of rate of social returns deriving it from Market interactions (matching labour market imperfections and firms and workers' investment decisions) and aggregate technology respectively. More recently, Higgins et al. (2006) along their study on the speed of convergence across the United States find a positive and significant non-linear relation between education and economic growth. Interestingly, this relation is positive and significant for educational levels up to high school but insignificant for educational levels between high school and associate's degrees.

Finally, an important strand of the literature emphasizes government failure in managing natural resources and the decisive role played by institutional quality in natural resources' overall impact on economic growth. Revenues from natural resources can lead to grabber friendly institutions, which generally translate in weaker rule of law, dishonest competition, corruption and inefficient bureaucracy (Auty, 1997; Sachs and Warner, 1999; Mehlum et al., 2006). This in turn converts into government investment in unproductive activities taxing the primary sector and investing in rent seeking activities, primary industries and in short-term spending (Venables, 2016) hampering the overall economic growth. Low quality institutions seem to be the primary determinant of government failure in managing natural resource endowment (Gylfason (2001); Stijns (2005)). However, some types of natural resources such as minerals do not always necessarily incentivize rent seeking or corruption and their outcome can be determined by the way in which policy makers and business view minerals. In agreement with Wright and Czelusta (2004), minerals should not be conceived as fixed stocks, booms nor windfalls but as non-renewables that can be extended through exploration, technological progress and investment in minerals related knowledge. It is interesting to notice how institutional quality and natural resource dependence interact mutually (Ahmadov et, al. (2013)). In other words, natural resources rents can damage institutional quality threatening reforms and good policies but low quality institutions, as stated above, can lead to a bad management of natural resources and the missing out of economic development opportunities. Cabrales and Hank (2010) set a model where the income of the government comes only from natural resources. They conclude that better education should enhance both productive activities, enabling the government to extract more taxes, and the capacity of citizens to drive revolutions and fight for their interests threatening the political position. In this context, the government may prefer not to increase education.

Most studies have analysed the natural resource curse at the cross-country level, trying to find a direct or indirect relation between natural resources endowment and national economic growth. However, some authors have also been intrigued with the questioning of the existence of the natural resource curse at the regional and county level within a country. In the case of United States, there is evidence that the abundance of natural resources did not affect the overall economic growth of the country, which has based its industrial development on minerals and other natural resources and currently ranks first in the World Bank ranking by country GDP[4]. Nevertheless, Papyrakis and Gerlagh (2007) and James and Aadland (2010) find that the same processes responsible for economic underperformance among resource-abundant countries can also be found in the case of United States at the regional level for resource-rich regions and at the county level for resource–rich counties respectively. Even after controlling for variables such as county-

[4] World Bank (2015). *Gross Domestic Product 2015.* Available at http://databank.worldbank.org/data/download/GDP.pdf. Accessed 16 October 2016

level effects, state specific fixed factors, race, education, initial income and population density in different periods, the curse keeps being statistically significant.

Starting from here, we aim at testing the existence of the curse at the level of European regions over the period 2004 – 2014, controlling for variables related to education, quality of institutions, immigration and social cohesion, unemployment. Our research stems from the existence of an historical gap in terms of economic development between regions that have been characterized by earlier industrialization, openness to trade and better economic outcomes, and regions that have been historically specialized in the primary sector through protectionist policies and which experienced a relatively tardive industrialization and lower economic development.

3. Data collection and methodology

Our dataset covers 232 European Regions. Data were collected from the European Statistic Database website (http://ec.europa.eu/eurostat/data/database) according to the NUTS 2 European regional classification. Our panel analysis takes as base year 2004 because of consistent available data for all the regions and covers the ten-year period from 2004 to 2014.

The dependent variable is the annual growth rate of the Gross Domestic Product (GDP) per capita between 2004 and 2014. In our model, we measure resource endowment with two variables. The first one is the number of agricultural units, the second one is the number of mining and quarrying units, both computed at the regional level. Across the 232 regions the average annual growth rate in GDP per capita is 1.7% while the average numbers of agriculture and mining and quarrying units are 32437 and 119 respectively (Table 1). From these numbers, we can already observe a predominance of the agriculture on natural reserve extractions, in average, across European regions.

Table 1 – Descriptive statistics on GDP growth and natural resources

Variables	*Observations (#)*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*
GDP per capita growth rate	2,320	1.7%	4.8%	-19.4%	-33.3%
Agriculture	1,013	32,437	46,074	0	27,4182
Mining and quarrying	2,188	119	146	0	1,093

There is a significant variation in resource endowment and resource specialization across European regions. For instance, in southern regions such as Apulia, Sicily and Andalucia agricultural units are generally above 200,000 (over the period 2004 – 2014) while manufacturing units are only around 300. This contrasts with northern regions such as Greater Manchester, Åland or Bremen for which the average of agricultural units is below 1,000 and manufacturing units are very few.

To test the existence of a curse of natural resources we develop a fixed effects model[5] from the traditional neoclassical models of income convergence across countries (Mankiw et al., 1992) that can be described as follow:

$$G_i = \beta_1 lnY_{t,i} + \beta_2 A_{t,i} + \beta_3 MQ_{t,i} + \gamma X_{t,i} + \alpha_i + \varepsilon_i$$

$$\text{with } i = 1, \dots, 232 \text{ } and \text{ } t = 2004, \dots, 2014$$

where $G_i = (\frac{1}{Y_{t,i}})(Y_{t,i} - Y_{t-1,i})$ is the annual growth rate between 2004 and 2014; $lnY_{t,i}$ is the natural log of GDP per capita at time t, $A_{t,i}$ and $MQ_{t,i}$ are respectively the number of Agriculture and Mining and Quarrying units at time t; $X_{t,i}$ is a set of socio-economic

[5] The Hausman test rejects the null hypothesis at a level of confidence of 1%, so that in our case, FE is the only consistent estimator. We also verify the presence of both heteroskedasticity and serial autocorrelation of errors rejecting in both case the null hypothesis of absence of heteroskedasticity and autocorrelation at a level of confidence of 1%. We therefore estimate our FE model controlling for both phenomena.

control variables measured at time t; α_i is a region-specific fixed effect for $i = 1, \ldots, 232$ and ε_i is the error term that includes all other controls that are constant over time.
We add a one-year lag of both agriculture units and mining and quarrying units, $A_{t-1,i}$ and $MQ_{t-1,i}$ respectively. This allows varying amounts of recent history to be considered into the forecast and will help us to predict what happens based on the knowledge in t-1. The model becomes:

$$G_i = \beta_1 lnY_{t,i} + \beta_2 A_{t,i} + \beta_3 MQ_{t,i} + \beta_4 A_{t-1,i} + \beta_5 MQ_{t-1,i} + \gamma X_{t,i} + \alpha_i + \varepsilon_i$$

$$\text{with } i = 1, \ldots, 232 \textit{ and } t = 2004, \ldots, 2014$$

To control for both heteroskedasticity and autocorrelation, we estimate our model using a Generalized Least Squares for Panel data, including $T - 1$ dummies (10) to control for time specific fixed effects and $N - 1$ dummies (231) to control for region specific fixed effects. In this way, we obtain a fixed effects model controlling for both error phenomena.

The model becomes the following:

$$G_i = \beta_1 lnY_{t,i} + \beta_2 A_{t,i} + \beta_3 MQ_{t,i} + \beta_4 A_{t-1,i} + \beta_5 MQ_{t-1,i} + \gamma X_{t,i} + +\gamma_2 D2_i + \cdots + \gamma_{21} D232_i + \delta_2 T_{2005} + \cdots + \delta_t T_{2014} + \varepsilon_i \quad (3.2.3)$$

$$\text{with } i = 1, \ldots, 232 \textit{ and } t = 2004, \ldots, 2014$$

To control for endogeneity of Agriculture and Mining and quarrying, we use as instrumental variables the interaction of these two regressors with the price index of agricultural products and resources extractions respectively. Testing for correlation among variables, we find that although price index affects and is highly correlated with the final production as well as with the number of economic units producing the specific related good, it is not correlated with the specific GDP growth rate of a country. Primary product and extraction prices are settled by the market and therefore may vary over time but are expected to be equal across regions. Therefore, interacting prices with the number of operational units we can approximate the market share of each region in both agriculture and mining and quarrying industries, which is correlated with the endowment in natural resources and the instrumented variables, controlling for possible endogeneity. To implement the econometric model with instrumental variables we use a two stage least square approach that includes the usual dummies for time and regions, to keep the fixed effects model, and, in addition to this, controls for heteroskedasticity and correlation of errors. To test the validity of these instruments we include the total Used Agriculture Area (SAU) as third instrument the Hansen-Sargan test for over-identifying restrictions. From the output of the test (p-value=0.44) we cannot reject the null hypothesis that all instruments are valid. After having confirmed the validity of our instruments we test for weak instruments looking at the Shea's statistics in the first stage. Having both Shea's Partial R-square and Shea's Adjusted Partial R-square are above 0.80 for all instrumented variables we can then reject the null hypothesis of weak instruments.

One advantage of looking for resource curse at the European regional level is that it reduces the need to control for various effects such as currency, trade restrictions or civil conflicts which may be confounding. In order to control for institutional differences, we rely on an Environment Quality Indicator, result of novel survey data on corruption and governance at the regional level within the EU based on World Bank data, conducted in 2013. The data focus on both perceptions and experiences with public sector corruption, along with the extent to which citizens believe various public sector services are impartially allocated and of good quality (Charron, Dijikstra and Lapuente, 2014).

We estimate our model controlling for various socio-economic variables, which could have an impact on our dependent variable leading to potential bias in the estimation of the coefficients related to Agriculture, Mining and Quarrying and their respective lagged values. We first control for the natural log of regional GDP per capita that is included in the formula of the GDP per capita annual growth rate and therefore has a direct impact on our dependent variable. Additionally, we include the regional economic activity rate intended as the percentage of the population both employed and unemployed that constitutes the labour force of a specific region. This variable is a fundamental input for production and therefore economic outcomes both at regional and national level. Considering the various contrasting theories on the positive (World Bank, 1996; Owusu, 2013) or negative (Acemoglu and Johnson, 2007; Bloom et al., 2009) effect of population density on the economic development of a country we also include this variable measured as the number of inhabitant per km^2.

As discussed before, during the literature review, education and human capital accumulation are determinant factors in the economic development of a population. We therefore include in our model two variables representing the share of the population having a less than primary, primary and lower secondary educational level (from level 0 to level 2) and the share of population with a secondary and upper secondary education (from level 3 to level 4). Considering the role of innovation in the process of economic growth of a region, as underlined by Romer (1990), Aghion and Howitt (1992) and Barro and Sala-i-Martin (2004) we include a variable representing the annual regional expenditure in R&D per inhabitant. The higher the investments in developing knowledge and innovations on a systematic basis the higher the economic development of a specific region.

In addition, to account for regional poverty, which derives from the economic conditions of a region and at the same time can lead to higher criminality and social instability, generating vicious cycles and lower economic growth, we include the regional rate of material deprivation. This variable refers to a state of durable economic strain in which an individual cannot afford unexpected expenses, expensive meats or some durable goods. Lately, immigration flows from countries involved in wars and conflicts (such as Syria and Libya) to European regions have had a significant effect on the number of incoming foreign people. In the absence of a strong social integration and a good management of immigration phenomenon, a rise in the number of immigrants may cause social fragmentation and higher criminality, which could generate social instability harming the overall economic growth. We therefore decided to control for the regional net migration representing the difference between immigration and emigration from a specific region. In case of missing data, this variable is estimated as the difference between the total regional population change and the natural increase during the year.

Finally, as already mentioned, to consider the cultural and institutional aspects of European regions, which have important consequences in terms of bureaucracy efficiency and institutional quality and therefore on economic growth (as analysed in the literature review), we include an ad hoc Environment Quality Index. The index is calculated for the year 2013 as a proxy of three main pillars: Quality, Impartiality and Corruption in fields such as education, health, law and political elections. Our assumption is that in a context of lower quality and impartiality and higher corruption perception and therefore of a lower Environment Quality Index the quality of the overall regional institutional system would be lower affecting the annual growth rate of GDP per capita at the regional level. In order to analyse this impact we consider the coefficient of the 9^{th} year dummy variable referring to 2013, which takes into account institutional and environmental differences across European regions.

Table 2 provides a detailed description of the variables included in the model, while Table 3 provides a correlation matrix.

Table 1 – Variables Description

Variable	*Description*	*Mean*	*Min*	*Max*
Agriculture	Single units, in both technical and economic terms, operating under a single management, which undertakes agricultural activities within the regional economic territory, either as its primary or secondary activity	32,437.48	0	274,182
Mining and Quarrying	Single units, in both technical and economic terms, operating under a single management, which undertakes mining and quarrying activities within the regional economic territory, either as its primary or secondary activity	119.57	0	1,093
Log GDP per Capita	Natural Log of the regional Gross Domestic product (in Euro) per inhabitant	10,2	8,68	11,38
Economic Activity Rate	Employed and unemployed persons as a percentage of the population living in private households	72,6	44,2	85,3
Population Density	Number of inhabitant per km^2 as at last 1^{st} January of the year	387,9	2,4	7,393.4
Levels02	Share of the regional population aged 25-64 having completed less than primary, primary and lower secondary education (levels 0-2 of the ISCED 2011)	29,4	3	82
Levels34	Share of the regional population aged 25-64 having completed upper secondary and post non-tertiary education (levels 3-4 of the ISCED 2011)	44,1	10,5	71,8
Material Deprivation	Share of regional population unable to afford some items considered by most people to be desirable or even necessary to lead an adequate life	5,92	0	35,9
Net Migration	Difference between the immigration and emigration from a region	8,505.6	-75,468	360,977
Dummy 2013	Time dummy related to the year 2013 in which Environment Quality Index data are available	0,1	0	1
R&D expenditure	Expenditure on research and development by business enterprises, higher education institutions, as well as government and private non-profit organisations (in Euro) per inhabitant	561,99	12	4,342
Agriculture Prices	Price index of food industry products as at 31th December of the year on the domestic market (Index, 2010=100)	102,87	82,8	120
Extraction Prices	Price index of natural rescources extraction as at 31th December of the year on the domestic market (Index, 2010=100)	102,58	57,8	157,3

Table 3 – Correlation matrix

Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*
(1)	1										
(2)	0.45***	1									
(3)	-0.39***	0.02	1								
(4)	-0.53***	-0.08***	0.50***	1							
(5)	-0.18***	-0.14***	0.21***	-0.06***	1						
(6)	0.47***	0.13***	-0.59***	-0.62***	0.01	1					
(7)	-0.26***	-0.13***	0.37***	0.39***	-0.14***	-0.82***	1				
(8)	0.48***	-0.02	-0.50***	-0.66***	0.25***	0.38***	-0.15***	1			
(9)	0.18***	0.20***	0.17***	0.07***	0.05**	-0.04**	0.02	-0.0944**	1		
(10)	-0.23***	0.04*	0.66***	0.35***	0.07***	-0.50***	0.26***	-0.33***	0.15***	1	
(11)	-0.07***	-0.01	0.03	0.04**	0.01	-0.07***	0.01	0.09**	0.19***	0.05**	1

Notes: All regressions include year and region fixed effects. Robust standard errors in parentheses. *** Significant at the 1% level (p-value<0.001), **Significant at the 5% level (p-value<0.05). *Significant at the 10% level (p-value<0.01). Variables are summarized as follows:
(1)= Agriculture (2)=Mining and Quarrying (3)=Log GDP per capita (4)=Economic Activity Rate (5)=Population Density (6)=Levels02 (7)=Levels34 (8)=Material Deprivation (9)=Net Migration (10)=R&D (11)=Dummy 2013

4. Results and discussion

The main results of our fixed effects GLS model using Agriculture Mining and Quarrying and their respective one-year lag as main covariates are displayed in Table 4. The coefficients for the two resource variables for our sample period 2004-2014 are of different sign.

Table 4 – The determinants of regional growth - Fixed effects model

	Model 1	***Model 2***	***Model 3***	***Model 4***
Variable	***Coeff. (HAC s.e.)***	***Coeff. (HAC s.e.)***	***Coeff. (HAC s.e.)***	***Coeff. (HAC s.e.)***
Agriculture	1.07e-08 (1.61e-07)	-5.22e-08 (1.56e-07)	-1.51e-07 (1.36e-07)	-1.34e-07 (1.18e-07)
L1 Agriculture	-8.65e-09 (1.59e-07)	4.67e-08 (1.55e-07)	-9.55e-08 (1.35e-07)	-9.51e-08 (1.22e-09)
Mining and quarrying	0.0002*** (0.00003)	0.0002*** (0.00004)	0.0001*** (0.00003)	0.0001*** (0.00003)
L1 Mining and quarrying	-0.0001** (0.00004)	-0.00001*** (0.00004)	-0.0001*** (0.00004)	-0.0001*** (0.00003)
ln(GDP per capita)		0.099*** (0.02)	0.36*** (0.032)	0.68*** (0.05)
Economic Activity Rate			0.0006 (0.001)	0.003** (0.001)
Population Density			-0.00004*** (5.01e-06)	-0.0001 (0.0005)
Education Levels 0-2			0.009*** (0.001)	0.007*** (0.0015)
Education Levels 3-4			0.007*** (0.0007)	0.0003 (0.0017)
Material Deprivation				0.0007 (0.0004)
Net Migration				7.72e-08 (5.18e-08)
R&D				-0.00005 (0.00003)
Year 2013	-0.0009 (0.006)	-0.006 (0.006)	0.029*** (0.0065)	0.03*** (0.008)
Wald chi2	907.9	983.3	1454	1058,4
Log Likelihood	1127,3	1139,3	1179,4	591,6

*All regressions include year and region fixed effects. Robust standard errors in parentheses. *** Significant at the 1% level (p-value<0.001), **Significant at the 5% level (p-value<0.05). *Significant at the 10% level (p-value<0.01).*

The coefficients of Agriculture and its one year lag are negative and statistically insignificant while the coefficient of Mining and quarrying is positive statistically significant at the 1% level, supporting the idea that the magnitude of the resource curse can depend on the type of natural resource we consider (empirical evidence suggest a higher negative impact of land compared to resources such as coal on the overall economic growth). Furthermore, it is surprising how the one-year lag of Mining and quarrying has a negative coefficient statistically significant at the 1% level. This could be due to some dynamic confusion, in other words as FE model usually better estimates short term relations, or to a smaller impact of the variables in the long run (here one year after) compared to its short and immediate impact. We estimate four different models that control for the natural log of the regional GDP per capita, economic activity rate, population density, education, poverty and institutional quality. All four regressions include region and time specific effects. The coefficient of Mining and quarrying is consistently around 0.0001, implying that one percentage point increase in mining and quarrying operational units increases the annual rate of regional GDP per capita by 0.01%, all else equal. Furthermore, our results suggest that in the long run mining and quarrying units have a negative impact on the overall regional growth in terms of GDP per capita growth: one percentage point increase in the mining and quarrying units after one year decreases the annual rate of regional GDP per capita by 0.01%, all else equal. As concerns the variable Agriculture and its one-year lag, their coefficients are both negative suggesting a negative short and long term effect which is not statistically significant.

The estimates in Table 4 are not consistent with the theory of conditional income convergence at the regional level (Baumol (1986); Barro and Sala-i- Martin, (1992)). The coefficient on the log of the annual GDP per capita income is consistently positive and statistically significant. This would imply that two regions similar in all features with different GDP per capita levels would not converge over time leading to a possible expansion of the historical economic gap between northern and southern European regions. In addition to this, the variable Economic activity rate has a positive and statistically significant coefficient 0.003, suggesting that an increase in the share of the total labour force of a region of 1% increases regional GDP per capita annual growth rate by 0.3%.

As regards education, it impacts the regional GDP only if considered in terms of primary and lower secondary educational levels, considering that an increase in the share of population aged between 25 and 64 can increase the regional GDP by 0.7%. Higher levels of educations do not have a statistically significant coefficient and this might suggest that basic educational levels could be enough in helping a region to growth. Contrasting with our expectations, neither immigration, population density nor R&D expenditure have statistically significant coefficients, implying that for the considered sample period these variables do not impact the annual growth rate of regional GDP per capita. What is actually very interesting for us is the positive and statistically significant impact of the Dummy 2013, year in which we control for EQI regional levels, on the annual regional growth rate. This confirms our conviction that institutional quality (here measured in different fields such as education, health, law and politics) might have a decisive role in shaping economic development of European regions.

In Table 5 we present the results from our regression models instrumenting Agriculture with the interaction between agricultural units and the index price of the agriculture industry products and Mining and quarrying with the interaction between mining and quarrying units and the index price of extractions. The coefficients on Mining and quarrying and its one year lag keep being of opposite sign and statistically significant and having both almost the same magnitude than before. Contrarily to what we previously found, through instrumented variables the coefficient on the one-year lag of Agriculture become statistically significant meaning that in the long term the number of agricultural unit may have a negative impact on growth. Nevertheless, in the short term the impact of agricultural resources on GDP per capita growth keeps being statistically insignificant.

Table 5 – The determinants of regional growth – IV Fixed Effects Model

	Model 1	Model 2
Variable	Coeff. (HAC s.e.)	Coeff. (HAC s.e.)
Agriculture	-4.33e-08 (1.28e-07)	-5.52e-08 (1.26e-07)
L1 Agriculture	-2.74e-07** (1.38e-07)	-2.96e-07** (1.36e-07)
Mining and quarrying	0.0001*** (0.00003)	0.0001*** (0.00003)
L1 Mining and quarrying	-0.0001*** (0.00003)	-0.0001*** (0.00003)
ln(GDP per capita)	0.66*** (0.053)	0.68*** (0.053)
Economic Activity Rate	0.003** (0.0015)	0.0033** (0.0015)
Population Density	-0.00001 (0.0005)	-0.0001 (0.0005)
Education Levels 0-2	0.007*** (0.001)	0.007*** (0.0015)
Education Levels 3-4	0.0006 (0.0005)	0.0003 (0.0017)
Material Deprivation	0.0009* (0.0005)	0.004** (0.0005)
Net Migration		7.17e-08 (5.24e-08)
R&D		-0.00006 (0.0004)
Year 2013	0.27*** (0.008)	0.023*** (0.008)
Root MSE	0,013	0,013

*All regressions include year and region fixed effects. Robust standard errors in parentheses. *** Significant at the 1% level (p-value<0.001), **Significant at the 5% level (p-value<0.05). *Significant at the 10% level (p-value<0.01).*

As regard the natural log of annual GDP per capita and the Economic activity rate, their coefficients are still positive and statistically significant, while Material deprivation has now a positive and statistically significant coefficient (at the 5% level) equals to 0.004. This may suggests that poorest regions in terms of material deprivation could grow faster and therefore that income convergence across regions could be possible. In terms of human capital, basic education (less than primary, primary and secondary level) keeps having a positive impact on regional growth. A 1% increase in the share of the population aged 25-64 having achieved only the lowest levels of education increases the annual growth rate of regional GDP per capita by 0.7%. This could mean that in order for education to have an overall positive impact on the regional economic growth, educational levels achieved by the population do not necessarily need to be higher (including upper secondary, tertiary and higher education levels). Having elementary education seems to be enough to develop knowledge and basic skills helping the overall economic development of a region.

Finally, our results suggest that a 1% rise in the institutional quality in a region increases the GDP per capita annual growth rate by 2.3% implying that a higher perception of institutional and political quality and efficiency can be benefit the overall regional economic growth. From this results we can assume, that in regions dominated by corruption, institutional inefficiency, low rule of law and no impartiality in the institutional system, where the perception of political and institutional quality is relatively low, the Environment Quality index might be significantly lower possibly harming the economic development of the region.

The results suggest that we can reject our null hypothesis of strictly positive coefficients on all natural resources variables. In fact, although we find a positive and sufficiently different from zero short-term impact of the number of mining and quarrying units on the regional economic growth the same does not hold for the number of agricultural units neither in the first model nor in the instrumental variables model. This result is consistent with the idea that the magnitude of natural resources negative impact on economic growth may depend on which kind of natural resources we are considering. While land is generally negatively associated with determinants of economic growth, the same is not always true for minerals, coal, oil, or natural gas (Stijns, 2005). Furthermore, despite this short-term positive impact, the negative and statistically significant at the 1% level coefficient on the one-year lag of Mining and quarrying and Agriculture suggests a negative long-term impact of extractives and agricultural production on the overall economic growth. All these results are consistent with the idea of the existence of both positive and negative channels through which natural resources may affect economic growth even at the regional level. Moreover, reverse causality problems often complicate the analysis requiring the use of instrumental variables to control for endogeneity, which do not always lead to unbiased estimators, especially in finite samples.

Nevertheless, looking at our findings, although the null hypothesis can be rejected implying a possible natural resource curse at the European regional level and we did control for various socio-economic variables which could affect our independent variable, coefficients on natural resources variables tend to be generally low. From these results, we can presuppose that the differences in the economic growth of European regions stem from some more historical institutional factors. In the literature, there has been a wide recognition of the impact of early informal and formal institutions on current institutions and therefore on the current economic conditions of countries and regions (Tabellini (2010), Guiso et al (2008), Acemoglu et al (2001) and (2002)).
All these evidences suggest that the economic gap between regions primarily comes from historical institutional differences that have impacted the ability of each region in developing economically their own territory. Bad earlier formal and informal institutions in the South have been translated both in a current lower institutional quality and a lower capacity of southern regions (such as the Italian ones) in managing their natural resources to support their economic development and their protection from potential variations in commodities prices (especially oil). Therefore, these evidences seem to be consistent with the theory that institutions play a fundamental role in determining the final impact of natural resources on national and regional economic outcomes, in other words that the "*institutional quality is decisive in determining whether natural resources are a blessing*" (Cabrales and Hauk, 2010).

5. Conclusions

Some studies suggest that a higher natural resource endowment implies higher natural capital and therefore promotes economic growth while others (Sachs and Warner 1995, 1999 and 2001) found a negative impact of abundance and dependence on natural resources on the overall economic growth. This negative relationship can occur through different possible channels (education, institution, conflicts, Dutch disease etc.). James and Aadland (2010) and Papyrakis and Gerlagh (2007) argue that developed counties were also unable to escape the curse showing that the natural resource curse exists both among U.S. counties and states. Our analysis adds to this literature by showing the presence of a mitigated resources curse at the European regional level. Regions, which have been historically specializing their economies in the primary sector, did experience a tardive industrialization and a smaller economic development. Furthermore, we do find evidence that natural resources different from land (which has an almost null impact) as extractives may have a positive impact on the overall economic growth of a region in the short run. Despite the small and positive short-term impact, in the long run the relationship between mining and quarrying activities and GDP per capita growth becomes negative. This long term negative impact exists also if we think of natural resources in terms of land and agricultural production. However, the coefficients are generally low with a low capacity in explaining regional economic differences and this may be due to the specialization of some European regions in second category minerals and metals (with a poor exploitation of regional reserves in oil and gas) and to the presence of historical formal and informal institutional differences. These differences mainly explain the persistent economic gap, especially between Northern regions (Sweden, Finland, UK or Germany) and South (Italy, Greece, Spain, Portugal). Italy seems to be a special case of analysis in which history has a decisive role in explaining current economic differences among European regions and their different capacity in exploiting their natural resources in order to transform resource curse into a blessing. Analysing all the previous different possible explanations of the resource curse theory the strong correlation between institutional quality and policies and the final impact of natural resources on economic growth becomes evident. The failure of authorities in managing the exogenous endowment in natural resources can affect the country both socially through conflicts and inequalities and economically leading to inefficiency and slower economic growth. On the contrary through good institutions and policies promoting an efficient allocation of rents, corruption fight, openness to trade and sound investments in human capital, socially profitable projects and innovation even in the primary sector (e.g. United States) the negative effects of natural resources endowment on national economic and social outcomes can be mitigated.

Future research should further examine the relationship between natural resource abundance and economic growth in Europe using data available prior to 2004 or 2000, allowing the examination of the resource curse from a historical perspective, or alternatively considering resource endowments at the province or at the municipal level. This could help having a bigger sample size and lower bias in the final estimates.

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