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The effects of institutions and natural resources in heterogeneous growth regimes with endogeneity

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Abstract

Since the seminal paper of Sachs and Warner (1995), several justifications have been advanced to explain the observed disparities in the performance between the oil resource dependent economies. The most important one deals with the quality of the institutions although no agreement has been made on the importance of their role, or the direction in which they affect economic growth. Some recent studies point to the interaction effect on growth of both “natural resources" and "institutions" factors. In this paper, we focus on these interaction effects to explain why countries rich in oil resources can be both winners and losers due to ions of their institutions. We use a specific econometric approach to e simultaneously analyse the interaction effects and the threshold from which the so-called ‘natural resource curse’ can be reversed. We examine the effect of the interaction between natural resources and the quality of institutions on corruption and economic growth, and the interaction between natural resources and the revenue level on corruption and economic growth. The estimation of our models is based on a sample of 24 countries for the period 2000-2015. While allowing g for endogeneity, we find that: i) large oil export leads to more corruption, whatsoever the quality of institutions and the revenue levels; ii) in the most democratic or developed countries, more democracy and development reduces corruption; iii) in countries with higher revenue levels, large oil exports and income per capita leads to lower levels of corruption; iv) industrialisation and democracy leads to a better political and civil liberties score, whatsoever the level of revenue and democracy v) the levels of democracy and oil dependence have a positive effect on growth, whatsoever the level of democracy, however the most democratic economies converge to the same long term growth rate; vi) oil dependence increases growth rate, whatsoever the corruption level, however democracy increases growth only in the less corrupted economies; vii) oil dependence and democracy increase growth in developed countries, however only developed countries converge to their long term steady rate of growth.

Keywords: Natural resources, quality of institutions, growth, threshold regression, endogeneity.

JEL Classification: O4, Q0, P16, C21

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1. Introduction

As was historically the case for some developed countries (England, United States, etc.), we can be tempted to believe that an abundance of natural resources will necessarily have a positive effect on economic growth. However, the "resource curse" hypothesis suggests that natural resource-rich economies tend to grow less rapidly than poorer ones. Our paper shows that these last assertions may not be so obvious.

Several contributions have examined the relationships between natural resources and growth. For Sachs and Warner (1995) and many others , the results support the curse thesis and natural resources are significantly correlated with weak rates of growth. However, in some more recent studies natural resources have positively contributed to growth, as in the cases of Australia, Botswana, Canada, and Norway. The important question to ask here is why are some natural resource rich economies successful, while others are not, despite their huge natural wealth?

The more famous classical explanations put forward "the Dutch disease" argument because of the apparent relationship between the development of the natural resource sector and the decline in other sectors (Corden and Neary, 1982 and 1984), the "curse" attributed to the volatility in natural resource prices (Hausmann and Rigobon, 2003) , and the procyclicality of fiscal policy in oil dependent economies (Kaminsky et al., 2005). Another well advocated idea is related to the important role of the quality of institutions in explaining the resource curse. Several studies have tested this explanation, but no consensus has been reached on the importance and the immediate effect of natural resources when the role of the institutions is controlled. Many economists agree on the proposal of the negative effect of natural resources on the quality of institutions which, in turn, impacts economic growth on their behalf.

Many different types of institutions are analysed; like corruption (Leite and Weidman, 1999; Arezki and Brückner, 2011), democracy (Ross, 1999, Smith, 2004), civil and armed conflicts (Collier and Hoeffler, 2004, Fearon and Latin, 2003). Ross (2001) has shown that natural resources, in the form of oil and mineral wealth, are negatively associated with democratic measures. Leite and Weidmann (2002) found that export of fuel and ore increases corruption. However, other studies have supported inconclusive results (e.g. Di Tella, 1999). They found a close relationship between natural resource exports and corruption in the 1980s, but no clear evidence for this in the 1990s. Serra (2006) could not find a reverse link between natural resource exports and corruption, while Sala-i-Martin and Subramanian (2013) found a negative impact of natural resource exports on corruption in the case of Nigeria.

Some studies, like those of Brunnschweiler, 2007, Brunnschweiler and Bulte, 2008 found a positive impact of natural resources on the quality of institutions and growth. Moreover, in some rich natural resource countries with strong institutions, such as Australia, Canada and Botswana, the large endowment of natural resources has fostered the expansion of their economic growth.

While considering the effects of interaction between natural resources and institutions, natural resource abundance only becomes a curse if the institutions are of "bad" quality or a blessing if the institutions are "good". Furthermore, several papers have drawn attention to the nonlinearity relationship in econometric specifications measuring the effect of natural resources and the quality of institutions on growth, and the introduction of heterogeneity through threshold effects (Mehrara and Sayed, 2011; and Belarbi et al., 2016).

In practice, the commonly used variables for measuring natural resource curse effects suffer from the endogeneity problem. Several measures of natural resources were proposed to replace the usual variables related to production and exports, in order to deal with the problem of endogeneity. Some authors, like Stijns (2005, 2006), Lederman and Maloney (2007), proposed using rent of natural resources and total natural capital (or total proved reserves) which seem to suffer less from the endogeneity problem and are more exogenous. Resource dependence (measured as production or exports) is considered by Stijns (2005) and Brunschweiler and Bulte (2008) as an endogenous outcome. Also endowments, measured by proven reserves, can be considered as endogenous (Wright and Czelusta, 2004). Torvik (2009) and Van der Ploeg and Poelhekke (2010) point out that measures of reserves are not necessarily exogenous, while Van der Ploeg and Poelhekke (2010) show that the value of subsoil assets are proportional to resource rents, and thus is endogenous. However, following Boschini et al. (2013), the measure of the share of primary exports on GDP and resource rents are more appropriate in studying the effects on growth and institutions. These last measures are arguably more exogenous than measures like reserves, or measures of geography or geology.

The same kind of problem appears when using institutions. Acemoglu and Johnson (2005) look at institutions as endogenous. So one can capture reverse causality or the effect of some omitted characteristics (geography, religion, or other variables). Also, institutions are measured with errors, so there may be a downward attenuation bias. Institutions are generally instrumentalised using variables like latitude, colonial origin, ethnic fragmentation and percentage of population speaking English or another European language.

In this paper, we analyse the interaction effects and show how these effects can reverse the resource curse. We use a new methodological approach by dealing simultaneously with endogeneity and non-linearity. Based on these observations, we propose using a nonlinear panel (panel transition models) with the introduction of endogeneity (Kourtellos et al., 2013). This specification deals with the problem of endogeneity of the used variables in different dynamics.

2. Panel Transition Regression model with endogeneity

Threshold models are econometric specifications used to analyse nonlinear economic phenomena. Among these models, depending on the transitional function from one regime to another, we can consider the Panel Threshold Regression model (PTR) developed by Hansen (1999), or the Panel Smooth Threshold Regression model (PSTR) developed by Gonzalez et al. (2005). More recently, Kourtellos et al. (2013) extended the Panel Smooth Threshold Regression model (PSTR) to tackle the endogeneity problem. In this paper, we consider a PTR model with endogeneity, to describe the heterogeneity in ' economic performance of rentier States.

Let $\{y_i, x_i, q_i, z_i\}_{i=1}^{n}$ be an observed sample. We consider the following threshold regression model:

$$y_i = \beta'_{x1} x_i + u_i,\ q_i \leq \gamma$$
$$y_i = \beta'_{x2} x_i + u_i,\ q_i > \gamma$$

where q_i is the threshold variable and γ the sample split (threshold) value. Where q_i is observed and γ is a parameter to be estimated.

The threshold variable is determined by the reduced form equation: $q_i = \pi'_q z_i + \nu_{q_i}$ where $E(\nu_{q_i}|z_i) = 0$; $E(u_i|z_i) = 0$ and $\nu_{q_i} \sim N(0, 1)$. The threshold reduced form equation is analogous to the selection equation in the limited dependent variable models

$x_i = (x'_{1i}, x'_{2i})'$, is a set where: x_{1i} is endogenous and x_{2i} is exogenous. We simultaneously consider endogeneity in x_i and q_i.

$I_{\{q_i \le \gamma\}}$ is defined as : $I_{\{q_i \le \gamma\}} = \begin{cases} 1 & \text{if } q_i \le \gamma \iff \upsilon_{q_i} \le \gamma - z'_i \pi_q \\ 0 & \text{if } q_i > \gamma \iff \upsilon_{q_i} > \gamma - z'_i \pi_q \end{cases}$

$x_i = \pi'_x z_i + \upsilon_{x_i}$, where: $E(\upsilon_{x_i}|z_i) = 0$, and $I_{\{q_i \le \gamma\}}$ and υ_{x_i} are independent.

We note: $g_{xi} = g_x(z_i; \pi_x)$

We assume that $\begin{pmatrix} u_i \\ \nu_{q_i} \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_u^2 & \kappa \\ \kappa & 1 \end{pmatrix}\right)$, where $\kappa = \frac{cov(u_i, \nu_{q_i})}{var(\nu_{q_i})}$).

In each of the two linear models, y is a dependent variable and a vector of regressors.

u_i is the error term where:

- $E(u_i|z_i) = 0$,
- $E(u_i|z_i, \nu_{qi} \le \gamma - z'_i \pi_q) = \kappa \lambda_{1i}(\gamma) = -\frac{\phi(\gamma - z'_i \pi_q)}{\Phi(\gamma - z'_i \pi_q)}$ for $q_i \le \gamma$,
- $E(u_i|z_i, \nu_{qi} \le \gamma - z'_i \pi_q) = \kappa \lambda_{2i}(\gamma) = \frac{\phi(\gamma - z'_i \pi_q)}{1 - \Phi(\gamma - z'_i \pi_q)}$ for $q_i > \gamma$,
- λ_{1i} *and* λ_{2i} are the inverse Mills ratio terms,
- $\phi(.)$ and $\Phi(.)$ are the normal pdf and cdf.

Also,

- $E(y_i|z_i, \nu_{q_i} \le \gamma - z'_i \pi_q) = \beta'_{x1} g_{xi} + E(u_i|z_i; \nu_{qi} \le \gamma - z_i \pi_q) = \beta'_{x1} g_{xi} + \kappa \lambda_{1i}(\gamma)$ for $q_i \le \gamma$,
- $E(y_i|z_i, \nu_{q_i} > \gamma - z'_i \pi_q) = \beta'_{x1} g_{xi} + E(u_i|z_i; \nu_{qi} > \gamma - z_i \pi_q) = \beta'_{x2} g_{xi} + \kappa \lambda_{2i}(\gamma)$ for $q_i > \gamma$.

The equation (1) can be re-written in the following structural form:

$y_i = \beta'_{x1(qi \le \gamma)} + \beta'_{x2} g_{xi} I_{(qi > \gamma)} + \kappa \Lambda_i(\gamma) + e_i$

where: $\Lambda(\gamma) = \lambda_{1i} I_{(q\_i \le \gamma)} + \lambda_{2i} I_{(qi > \gamma)}$.

Estimation steps

First step:

1. $\hat{\pi}_q$ and $\hat{\pi}_x$
2. $\hat{q}_i = \hat{\pi}'_q z_i$ and $\hat{x}_i = \hat{g}_{x_i} = \hat{\pi}'_x z_i$
3. $\hat{v}_{q_i} = q_i - \hat{q}_i$ and $\hat{v}_{x_i} = x_i - \hat{x}_i$

For a given $\gamma=\gamma_0$, we have:

$\hat{\lambda}_{1i}(\gamma_0) = \lambda_1(\gamma_0 - z'_i\hat{\pi}_q)$

3. $\boldsymbol{\hat{\lambda}_{2i}(\gamma_0) = \lambda_2(\gamma_0 - z'_i\hat{\pi}_q)}$

$$\hat{\Lambda}_i(\gamma_0) = \hat{\lambda}_{1i}(\gamma_0)I_{(q_i \le \gamma_0)} + \hat{\lambda}_{2i}(\gamma_0)I_{(q_i \le \gamma_0)}$$

Second step: Estimate in an iterative procedure

- $\hat{\theta}(\gamma_0) = (\hat{\beta}'_{x1}(\gamma_0), \hat{\beta}'_{x1}(\gamma_0), \hat{\kappa}(\gamma_0))$ by 2SLS and GMM
- $\hat{\gamma} = \text{argmin}_\gamma S_n(\gamma)$

where:

$$S_n(\gamma) = \sum_{i=1}^{n} (y_i - \hat{\beta}'_{x1}\hat{g}_{xi}I_{(q_i \le \gamma)} - \hat{\beta}'_{x2}\hat{g}_{x_i}I_{(q_i > \gamma)} - \kappa\hat{\Lambda}_i(\gamma))^2$$

-Re-estimate $\hat{\theta}(\gamma)$ with $\hat{\gamma}$.

The parameters of interest, which are assumed to be unknown, are:

- The scalar threshold parameter or sample split value, γ,
- The slope (or regression) coefficients $\beta_x = (\beta'_{x1}, \beta'_{x2})'$,

We use an STR model with two regimes. (Here, we only test the presence of nonlinearity in our data. We do not test the maximum number of regimes).

4. Methodology, data and descriptive statistics

We do consider the existence of a nonlinear effect of the institutions that vary with their goodness. We use a nonlinear regression to analyse these interactions by introducing threshold effects in the variable used to introduce this nonlinearity.

In our estimation strategy, we compare two aspects of institutional quality: Institutions as long term rules constraining behaviours or durable constraints (Polity II), and

Institutions as outcomes reflecting actions and decisions (short term rules policy or changeable policy outcomes) (ICRG). Note, that this distinction is also made by Anderson and Aslaken (2008) and Brunnschweiler and Bulte (2008). Persson (2005) uses the term ”structural policies” to separate regulation institutions from more fundamental political arrangements, such as constitutions (extensively studied in Persson and Tabellini, 2003).

As in Boshini et al. (2013), we introduce the fixed effects to capture the not enough variation in institutions. More precisely, we consider a panel of 24 countries exporting mineral fuels for the period 2000-2015

Institutional variables are instrumented by latitude cross temperature or by themselves lagging in time. The variable of natural resources (oil rents and fuel oil exports) are instrumented by oil reserves.

Tables 1 and 2 provide respectively a precise description of the used variables in our empirical study and some descriptive statistics.

Table 1. Description of the used variables

Variable	Description	Source
Oil rents	Oil and Gas rent flows as % of GDP (resource dependence)	World Bank
Oil Exports	Resource dependence (Fuel exports as a % of merchandise exports)	World Bank
Manuf	Manufacturing value added (as % of GDP)	World Bank
Corruption	The corruption score ranges from 1 to 6, with higher values indicating less corruption.	Political Risk Services,
Gdp	In constant Millions LCU	World Bank
Oil reserves	Crude Oil Proved Reserves (Billion Barrels)	World Bank
Polity II	Ranges from -10 to +10, with higher values indicating stronger democratic institutions. Used as rules	Polity IV database
Civil liberties	Ranges from 1 to 7, with higher values indicating less civil liberties	Freedom house
Political rights	Ranges from 1 to 7, with higher values indicating less civil liberties	Freedom house

Table 2. Descriptive statistics

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Ggdp growth (%)	408	-13,13	33,73	3,65	4,42
GDP per capita	408	494,24	69094,75	9585,22	16198,20
Oil export	408	1,55	99,65	61,43	26,73
Oil rent	408	1,39	78,85	18,36	14,77
GDP constant	408	4397	8568115600	449199493	1394783367
Oil reserves	408	0,10	297,74	36,97	74,86
corruption	408	0,00	6,00	2,61	1,21
Manuf	408	0,65	29,05	13,87	6,01

Source: Constructed using data sets.

5. The results

Hereafter, we present the results of the estimation using a panel transition model, taking into account the problem of endogeneity. Tables 3, 4 and 5 provide the endogenous response of different variables to corruption (while allowing for democracy and level of income):

Table 3. The endogenous response of oil export to corruption (allowing for democracy and level of income)

Independent variable	Corruption					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp/capita		*Instrument*	Threshold Variable: Polity II	
Threshold Variable:	*Gdp/capita*	q(t)<=5053	q(t)>5053	*Latitude*temperature*	q(t)<=2	q(t))>2
Oil export	*Oil reserves*	-0.0091 (0.0170)	-0.0146 (0.0519)	*Oil reserves*	-0.0092 (0.0638)	-0.0107 (0.0031)
Polity II		-0.0315 (0.0124)	0.0505 (0.0003)	*lag(Polity II, 5)*	-0.0141 (0.5980)	0.0718 (0.0143)
Manufacture VA		0.0362 (0.0321)	-0.0038 (0.7690)	-	0.0608 (0.0054)	0.0163 (0.2490)

Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations		408	408		408	408
Gamma pvalue		0.0	0.0		0.0	0.0

Student statistics t between brackets.

Table 4. The endogenous response of oil rent to corruption (allowing for democracy and level of income)

Independent variable	Corruption					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp/capita		*Instrument*	Threshold Variable: Polity II	
Threshold Variable :	*Gdp/capita*	q(t)<=6510	q(t)>6510	*Latitude*temperature*	q(t)<=2	q(t))>2
Oil rent	*Oil reserves*	0.0035 (0.5103)	0.0014 (0.4195)	*Oil reserves*	0.0072 (0.1949)	0.0042 (0.3964)
Polity II	-	-0.0146 (0.2345)	0.0107 (0.4103)	*lag(Polity II, 5)*	-0.0161 (0.5596)	0.0887 (0.0007)
Manufacture VA	-	0.0764 (0.0000)	-0.0301 (0.0390)	-	0.0985 (0.0000)	0.0451 (0.0000)
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations		408	408		408	408
Gamma pvalue		0.0	0.0		0.0	0.0

Student statistics t between brackets.

Table 5. The endogenous response of oil export and oil rent to corruption (allowing for level of income)

Independent variable	Corruption					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp/capita		*Instrument*	Threshold Variable: Gdp/capita	
Threshold Variable :	*Gdp per apita*	q(t)<=6283	q(t)>6283	*Gdp/capita*	q(t)<=5836	q(t))>5836
Oil rent	*Oil reserves*	0.0085 (0.1844)	0.0042 (0.4195)	-	-	-
Oil export	-	-	-	*Oil reserves*	-0.0109 (0.0010)	-0.0120 (0.0722)
Manufacture VA		0.0700 (0.0000)	-0.0134 (0.3847)		0.4157 (0.4157)	0.2069 (0.2403)
Log (gdpper capita)	*Log (gdp/capita)*	0.5093 (0.0221)	0.2368 (0.1695)		0.0260 (0.0947)	-0.0309 (0.0656)
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations		408	408		408	408
Gamma pvalue		0.0	0.0		0.0	0.0

Student statistics t between brackets.

We can summarise the results of the combined effects, as follows:

- The effect of the variable "oil rent" is not significant. The effect of oil exports is more important than the effect of rents on corruption.
- The effect of oil exports is negative and significant, regardless of the level of democracy. Larger oil exports lead to more corruption (as in Busse and Groning, 2011). The same kind of results are found when introducing the heterogeneity according to the level of income per capita (level of development). Therefore, larger oil exports lead to more corruption.
- For the less democratic countries (less than 2), the effect of democracy on corruption is negative and significant. Contrarily, it appears that for the most democratic countries the effect is positive and significant. This means that more democracy reduces corruption. When we introduce the heterogeneity according to the level of income per capita (level of development), we find that the results are opposed between the two groups of countries (low-income countries and high-income

countries). For low-income countries, the effect of the "Polity II" variable is negative and significant on "corruption". More democracy leads to more corruption, while for low-income countries, the effect of the variable "Polity II" is positive and significant on "corruption". Thus, democracy reduces corruption in this case.

- A higher income per capita leads to a lower level of corruption.
- Higher levels of industrialisation induce less corruption. For democratic countries, this effect is not significant when using oil exports to control the effect of natural resources.

The models of the response of different variables on oil rents and oil exports (allowing for democracy and level of income) are linear. Thus, it is statistically unfair to introduce different regimes depending on the level of oil dependence, whereas the introduction of different regimes according to the institutional levels (democracy) is statistically valid. The relation is then only valid in one direction: it is oil dependence that influences corruption and not the other way round. However, the sign of the relationship between the variables specified in the model remains the same.

Tables 6, 7, 8 and 9 provide the endogenous response of different variables to political rights and civil liberties (while allowing for democracy and level of income).

Table 6. The endogenous response oil export to political rights (allowing for democracy and level of income)

Independent variable	Political rights					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp/capita		*Instrument*	Threshold Variable: Polity II	
Threshold Variable :	*Gdp per apita*	q(t)<=4312	q(t)>4312	*Latitude*temperature*	q(t)<=2	q(t))>2
Oil export	*Oil reserves*	-0.0006 (0.9264)	-0.0158 (0.1057)	*Oil reserves*	0.0069 (0.3691)	-0.0087 (0.1663)
Polity II	*lag(Polity II, 5)*	0.0045 (0.8766)	-0.0879 (0.0001)	*lag(Polity II, 5)*	-0.0947 (0.0665)	-0.1334 (0.0088)
Manufacture VA		-0.1209 (0.0001)	-0.0503 (0.0064)	-	-0.1884 (0.0000)	-0.0825 (0.0014)
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations		408	408		408	408
Gamma pvalue		0.0	0.0		0.0	0.0

Student statistics t between brackets.

Table 7. The endogenous response oil rent to political rights (allowing for democracy and level of income)

Independent variable	Political rights					
Estimation method	GMM					
	Instrument	*Threshold Variable: Gdp/capita*		*Instrument*	*Threshold Variable: Polity II*	
Threshold Variable :	*Gdp per capita*	q(t)<=5434	q(t)>5434	*Latitude*tem perature*	q(t)<=2	q(t))>2
Oil rent	*Oil reserves*	0.0106 (0.4963)	-0.0031 (0.6944)	*Oil reserves*	0.0149 (0.2131)	-0.0147 (0.1366)
Polity II	*Lag(Polity II, 5)*	0.0014 (0.9588)	-0.0712 (0.0006)	*Lag(Polity II, 5)*	-0.0966 (0.0526)	-0.1444 (0.0014)
Manufacture VA		-0.1026 (0.0001)	-0.0354 (0.0304)		-0.1783 (0.0000)	-0.0738 (0.0004)
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations		408	408		408	408
Gamma pvalue		0.0	0.0	0.0	0.0	0.0

Student statistics t between brackets.

Table 8. The endogenous response oil rent to civil liberties (allowing for democracy and level of income)

Independent variable	Civil liberties					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp/capita		instrument	Threshold Variable: Polity II	
Threshold Variable :	Gdp per apita	q(t)<= 4312	q(t))> 4312	Latitude*tem perature	q(t)<=2	q(t))>2
Oil rent	Oil reserves	-0.0035 (0.6699)	-0.0219 (0.0000)	Oil reserves	-0.0018 (0.8143)	-0.0242 (0.0000)
Polity II	lag(Polity II, 5)	0.0008 (0.9603)	-0.0392 (0.0058)	lag(Polity II, 5)	-0.0976 (0.0096)	-0.0155 (0.6527)
Manufactur e VA		-0.0598 (0.0000)	-0.1042 (0.0000)		-0.1017 (0.0000)	-0.0698 (0.0000)
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observation s		408	408		408	408
Gamma pvalue		0.0	0.0		0.0	0.0

Student statistics t between brackets.

Table 9. The endogenous response of oil exports to civil liberties (allowing for democracy and level of income)

Independent variable	Civil liberties					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp/capita		*Instrument*	Threshold Variable: Polity II	
Threshold Variable :	*Gdp per apita*	q(t)<= 4312	q(t))> 4312	*Latitude*te mperature*	q(t)<=2	q(t))>2
Oil export	*Oil reserves*	-0.0011 (0.7552)	-0.0241 (0.0004)	*Oil reserves*	0.0021 (0.6586)	-0.0076 (0.0298)

Polity II	*lag(Polity II, 5)*	0.0008 (0.9621)	-0.0507 (0.0002)	*lag(Polity II, 5)*	-0.0950 (0.0140)	-0.0104 (0.7769)
Manufacture VA		-0.0607 (0.0003)	-0.1123 (0.0000)		-0.1018 (0.0000)	-0.0694 (0.0000)
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations		408	408		408	408
Gamma pvalue		0.0	0.0		0.0	0.0

Student statistics t between brackets.

The effect of oil exports and oil rents on political rights and civil liberties are not significant while introducing the heterogeneity by differentiating the democracy measure level between countries. The effect of industrialisation on both political rights and civil liberties is negative and significant, regardless of the level of democracy and whatever the level of income. It means that more industrialisation leads to better political and civil liberty scores. The effect of democracy on both political rights and civil liberties is negative and significant. It means that, regardless the level of democracy, higher democracy leads to better political rights and civil liberty scores. We find the same results when we introduce the heterogeneity according to the level of GDP per capita, but only for rich countries.

Tables 10, 11 and 12 provide the endogenous response of oil dependence on growth (while allowing for democracy and level of income).

Table 10. The endogenous response oil exports on growth (allowing for democracy and level of income)

Independent variable	Gdp growth (%)					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp per capita		Instrument	Threshold Variable: Polity II	
Threshold Variable :	Gdp per capita	q(t)<= 4312	q(t)<=4312	Latitude*temperature	q(t)<=7.0	q(t)>7.0
Oil export	Oil reserves	0.0254 (0.1372)	0.0507 (0.2697)	Oil reserves	0.0555 (0.0029)	-0.0029 (0.8848)

Polity II	lag(Polity II, 5)	0.0041 (0.9382)	0.0770 (0.2423)	lag(Polity II, 5)	0.1274 (0.0340)	1.3854 (0.0153)
Lag (log gdp (-1))		0.1022 (0.1472)	-0.5698 (0.0455)		0.0003 (0.9968)	-0.3464 (0.0283)
Country fixed effect		Yes	Yes	Yes	Yes	Yes
Observations		408	408		408	408
Gamma pvalue		0.4	0.4		0.0	0.0

Student statistics t between brackets.

Table 11. The endogenous response oil export on growth (allowing for corruption and level of income)

Independent variable	Gdp growth (%)					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp per capita		Instrument	Threshold Variable: Corruption	
Threshold Variable	Gdp per capita	q(t)<= 4312	q(t)<=4312	Latitude*temperature	q(t)<=2.5800	q(t)>2.5800
Oil export	Oil reserves	0.0254 (0.1372)	0.0507 (0.2697)		0.0639 (0.0029)	0.0145 (0.4374)
Polity II	lag(Polity II, 5)	0.0041 (0.9382)	0.0770 (0.2423)	lag(Polity II, 5)	0.0472 (0.5276)	0.0738 (0.0356)
Lag (log gdp (-1))	-	0.1022 (0.1472)	-0.5698 (0.0455)		0.0041 (0.9604)	0.0276 (0.7481)
Country fixed effect		Yes	Yes	Yes	Yes	Yes
Observations		408	408		408	408
Gamma pvalue		0.4	0.4		0.0	0.0

Student statistics t between brackets.

Table 12. The endogenous response oil export to growth (allowing for democracy and level of income)

Independent variable	Gdp growth (%)					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp per capita		Instrument	Threshold Variable: Polity II	
Threshold Variable :	Gdppercapita	q(t)<= 2646	q(t)>2646	Latitude*temperature	q(t)<=2.5800	q(t)>2.5800
Oil rent	Oil reserves	0.0712 (0.0792)	0.1999 (0.0000)		0.1769 (0.0000)	0.1204 (0.0007)
Polity II	lag(Polity II, 5)	0.0640 (0.2792)	0.1180 (0.0325)	lag(Polity II, 5)	0.1892 (0.0015)	1.1993 (0.0238)
Lag (log gdp (-1))	-	0.1143 (0.0944)	-0.3891 (0.0274)		0.0622 (0.3466)	-0.2975 (0.0373)
Country fixed effect		Yes	Yes	Yes	Yes	Yes
Observations		408	408		408	408
Gamma pvalue		0.4	0.4		0.0	0.0

Student statistics t between brackets.

6. Conclusion

This research has shown the existence of an interaction effect between natural resource dependence and the quality of institutions. The introduction of a regime change differentiates the effects of the explanatory variables according to the threshold levels reached by the transition function. Indeed, when introducing the heterogeneity by differentiating the democracy measure level between countries, we find some important empirical results:

The effect of oil exports is negative and significant, regardless of the level of democracy. Higher levels of oil dependence lead to more corruption (Leite and Weidmann, 2002). Larger oil exports lead to more corruption (Busse and Groning, 2011). For the most democratic countries, more democracy reduces corruption. A higher income per capita leads to a lower level of corruption.

Introducing heterogeneity according to the level of income per capita (level of development), makes the results of the effect of democracy opposed between the two groups of countries (low-income countries and high-income countries). For low-income countries, democracy reduces corruption. Higher levels of industrialisation induce less corruption. The introduction of different regimes according to the institutional levels of (democracy) and level of oil dependence have shown that it is oil dependence that influences corruption and not the opposite. More industrialisation leads to better political and civil liberty scores. Higher democracy leads to better scores for political rights and civil liberties. We find the same results when we introduce the heterogeneity according to the level of GDP per capita, but only for rich countries.

The level of democracy and oil dependence have a positive effect on growth, whatsoever the level of democracy. However, the most democratic economies converge to the same long term growth rate and only developed countries converge to their long term steady rate of growth. Oil dependence increases growth rate, whatsoever the level of corruption, however democracy only increases growth in the less corrupted economies; oil dependence and democracy increase growth in the developed countries.

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