

The Effects of Institutions and Natural Resources in Heterogeneous Growth Regimes

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I. Motivation (1/4)

- Several papers have explored the relation between natural resources dependence and growth.
 - **Natural resources dependence is correlated with a weak rate of growth:** Sachs and Warner (1995) and Ross (2001). Robustness checked by Gylfason, Herbertson and Zoega (1999), Leite and Weidman (1999), Sachs and Warner (2001) and Sala-i-Martin and Subramanian (2013).
 - **But some exceptions exist where resources have contributed positively to growth** as is the case in Australia, Canada, Norway and most recently Malaysia, Botswana, Thailand and Indonesia.
 - **“the interesting question is why some resource rich economies [...] are successful while others [...] perform badly despite their immense natural wealth.”** Van der Ploeg (2011)
 - The answer lies on the different between institutions. (Mehlum et al., 2006)
 - If Institutions are *enough good*, the interaction between natural resources and institutions can have positive effects on growth. (Bochini et al., 2013)

Motivation (2/4)

Going from the interaction idea:

- The quality of the institutions can be penalized by natural resources abundance, because:
 - Undermine democracy (Ross, 1999), or pro-regime stability and helps autocracies and democracies to survive (Smith, 2004)
 - Drives civil and armed conflicts (Collier and Hoeffler, 2004, Fearon and Latin, 2003).
 - Oil rents increase corruption, deteriorate political rights, but improve civil liberties (Leite and Weidman, 1999, Arezki and Brückner, 2011).

Motivation (3/4)

□ However,

- It does not significantly foster authoritarianism (Haber and Menaldi, 2011).
- (i) resource dependence does not affect growth, and (ii) resource abundance positively affects growth and institutional quality. (Brunnschweiler, 2007 and Brunnschweiler and Bulte, 2008).
- The curse is a result of a wrong interpretation of data, and the natural resources abundance does not affect the quality of the institutions (Alexeev and Conrad, 2009 and James, 2014).

Motivation (4/4)

□ Interaction between natural resources and institutions

- Indirect effect of natural resources (through institutions), but weak for (Sachs and Warner, 1995).
- Indirect link between natural resources and wealth that operates through institutional quality (Bulte et al., 2005)
- Following the quality of institutions, natural resources can be curse or blessing (Mehlum, Moene and Torvik, 2006).
- Less harsh effects when the institutions are good (Arezki and Ploeg, 2011).
- Good institutions reduce the curse effect (Gylfason, 2011).
- Kan Ji et al. (2013) observe an provincial and nonlinear effect of oil abundance
- Significant and non linear with threshold effect (Belarbi, Sami and Souam, 2016)

Objectives of the paper

- Analyze the interaction effect and the threshold from which the curse effect can be reversed in a nonlinear methodological approach with threshold and endogeneity.
- We compare two aspects of institutional quality: following Anderson and Aslaken (2008) and Brunnschweiler and Bulte (2008)
 - Institutions as long term rules constraining behaviors or durable constraints (Polity II).
 - Institutions as outcomes reflecting actions and policy decisions (short term rules or changeable policy outcomes) (ICRG).

II. The model specification

Structural Threshold Regression

$\{y_i, x_i, q_i, z_i\}_{i=1}^n$ is the observed sample, we consider the following threshold regression model:

$$\begin{aligned} y_i &= \beta'_{x1} x_i + u_i, q_i \leq \gamma \\ y_i &= \beta'_{x2} x_i + u_i, q_i > \gamma \end{aligned} \quad (1)$$

Where :

- q_i is the threshold variable,
- and γ the sample split (threshold) value.
- The threshold variable is determined by the reduced form equation : $q_i = \pi'_q z_i + v_{q_i}$ where: $E(v_{q_i} | z_i) = 0$; $E(u_i | z_i) = 0$ and $v_{q_i} \sim N(0, 1)$.
- The threshold form equation is analogous to the selection equation in the limited dependent variable models.
- Here we treat q_i as observed and γ is a parameter to be estimated.

- $x_i = (x'_{1i}, x'_{2i})'$, where: x_{1i} is endogenous and x_{2i} is exogenous.
- $z_i = (z'_{1i}, z'_{2i})'$, where: $x_{1i} \in z_{21}$.
- We consider simultaneously endogeneity in x_i and q_i .

- We define $I_{\{q_i \leq \gamma\}}$ as :

$$I_{\{q_i \leq \gamma\}} = \begin{cases} 1 & \text{if } q_i \leq \gamma \Leftrightarrow v_{q_i} \leq \gamma - z'_i \pi_q \\ 0 & \text{if } q_i > \gamma \Leftrightarrow v_{q_i} > \gamma - z'_i \pi_q \end{cases}$$

- $x_i = \pi'_x z_i + v_{x_i}$, where: $E(v_{x_i} | z_i) = 0$, and $I_{\{q_i \leq \gamma\}}$ and v_{x_i} are independent.
- Note: $g_{x_i} = g_x(z_i; \pi_x)$ so that $E(x_i | z_i) = \pi'_x z_i$.

$$\text{Assuming : } \begin{pmatrix} u_i \\ v_{q_i} \end{pmatrix} \sim N \left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_u^2 & \kappa \\ \kappa & 1 \end{pmatrix} \right) \quad (\kappa = \frac{\text{cov}(u_i, v_{q_i})}{\text{var}(v_{q_i})}).$$

In each of the two linear models, y_i is a dependent variable, x_i a vector of regressors.

u_i : error with :

- $E(u_i|z_i) = 0$

- $E(u_i|z_i, v_{qi} \leq \gamma - z'_i \pi_q) = \kappa \lambda_{1i}(\gamma) = -\frac{\phi(\gamma - z'_i \pi_q)}{\Phi(\gamma - z'_i \pi_q)}$ for $q_i \leq \gamma$

- $E(u_i|z_i, v_{qi} \leq \gamma - z'_i \pi_q) = \kappa \lambda_{2i}(\gamma) = \frac{\phi(\gamma - z'_i \pi_q)}{1 - \Phi(\gamma - z'_i \pi_q)}$ for $q_i > \gamma$

- λ_{1i} and λ_{2i} are the inverse Mills ratio terms ;

- $\phi(\cdot)$ and $\Phi(\cdot)$ are the normal pdf and cdf.

Also,

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

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

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

$$y_i = \beta'_{x_1} g_{x_i} I_{(q_i \leq \gamma)} + \beta'_{x_2} g_{x_i} I_{(q_i > \gamma)} + \kappa \Lambda_i(\gamma) + e_i$$

Where:

$$\Lambda_i(\gamma) = \lambda_{1i} I_{(q_i \leq \gamma)} + \lambda_{2i} I_{(q_i > \gamma)}$$

Estimation steps

– First step: Estimate the reduced form parameters

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

- For a given $\gamma = \gamma_0$:

- $\hat{\lambda}_{1i}(\gamma_0) = \lambda_1(\gamma_0 - z'_i \hat{\pi}_q)$
- $\hat{\lambda}_{2i}(\gamma_0) = \lambda_2(\gamma_0 - z'_i \hat{\pi}_q)$
- $\hat{\Lambda}_i(\gamma_0) = \hat{\lambda}_{1i}(\gamma_0)I_{(q_i \leq \gamma_0)} + \hat{\lambda}_{2i}(\gamma_0)I_{(q_i > \gamma_0)}$

– Second step: Estimate in an iterative procedure

- $\hat{\theta}(\gamma_0) = (\hat{\beta}'_{x_1}(\gamma_0), \hat{\beta}'_{x_2}(\gamma_0), \hat{\kappa}(\gamma_0))$ by 2SLS and GMM
- $\hat{\gamma} = \operatorname{argmin}_{\gamma} S_n(\gamma)$
 - Where $S_n(\gamma) = \sum_{i=1}^n (y_i - \hat{\beta}'_{x_1} \hat{g}_{xi} I_{(q_i \leq \gamma)} - \hat{\beta}'_{x_2} \hat{g}_{xi} I_{(q_i > \gamma)} - \kappa \hat{\Lambda}_i(\gamma))^2$
- 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. This will be extended to three or more thresholds.
 - Here, we only test the presence of nonlinearity in our data!!, we do not test the maximum number of regimes

III. Data (1/2)

Variable	Description	Source
Oil rents	Oil and Gaz rent flows as % of GDP. (resource dependence)	World Bank data
Oil Exports	Resource dependence	World Bank data
Corruption	The corruption score ranges from 1 to 6, with higher values indicating less corruption. In the model, the variable is multiplied by -1	Political Risk Services,
PolityII	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, we rescale the score so that higher value indicate more civil liberties	Freedom house
Political rights	Ranges from 1 to 7, we rescale the score so that higher value indicate more civil liberties	Freedom house

Data (2/2)

Variable	Description	Source
Manufacture value added on GDP		World Bank data
Oil Proved Reserves	or resource endowment	EIA
Gdp	In constant LCU	World Bank data
Add gdp/capita and gdp growth		

- Sample of 10 countries for the period 1980-2014.
- As in Boshini et al. (2013), we introduce fixed effects to capture the no enough variation in institutions and to reduce endogeneity effects.

The endogenous response
Of Natural Resource to
quality of institutions

The endogenous response of oil export and oil rent to corruption (controlling democracy and level of income)

Independent variable	corruption					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp per capita		instrument	Threshold Variable : Polity II	
Threshold Variable		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	Latitude* temperature	-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		350	350		350	350
Gamma pvalue		0,0	0,0		0,0	0,0

Independent variable	Corruption					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp per capita		instrument	Threshold Variable : Polity II	
Threshold Variable :		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	Latitude* temperature	-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		350	350		350	350
Gamma pvalue		0,0	0,0		0,0	0,0

Independent variable	corruption					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp per apita		instrument	Threshold Variable : Gdp per capita	
Threshold Variable :		q(t) <= 6283	q(t) > 6283		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 (gdp per 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		350	350		350	350
Gamma pvalue		0,0	0,0		0,0	0,0

Interpretation

These tables provide the results of the endogenous response of corruption to oil export and oil rent (controlling for the level of democracy and level of income).

The natural resource and institutions are instrumentalized respectively by oil reserves (which is relatively exogenous or we can say less endogenous than others measures of natural resources) and its lag taken 5 periods back or by latitude cross temperature.

We find that:

- The effect of the variable “oil rent” is not significant. The effect of oil export is negative and significant regardless of the level of democracy. We find the same results when we introduce the heterogeneity according to level of income per capita. Which means large oil export leads to more corruption whatsoever the quality of institutions and the revenue level .
- For the most democratic countries the effect of democracy on corruption is positive and significant. While for the less democratic countries the effect is negative and not significant, we find the same results with significance for the two groups.
- For high-income countries, the effect of the "polityII" variable is negative and significant on « corruption ».

-When we change the control variables in our regression we find that :
The effect of oil export is negative and significant whatsoever the level of the revenue level but the effect of income per capita is negative and significant only for countries with higher revenue level.
It means that in countries with higher revenue level, large oil export and income per capita leads to lower levels of corruption;

The endogenous response oil export to political rights (controlling democracy and level of income)

Independent variable	Political rights					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp per apita		instrument	Threshold Variable : Polity II	
Threshold Variable :		q(t) <= 4312	q(t) > 4312	Lattitude*temperatu re	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		350	350		350	350
Gamma pvalue		0,0	0,0		0,0	0,0

Independent variable	Political rights					
Estimation method	GMM					
-	Instrument	Threshold Variable: Gdp per apita		instrument	Threshold Variable : Polity II	
Threshold Variable :		q(t) <= 5434	q(t) > 5434	Lattitude*temperatu re	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		350	350		350	350
Gamma pvalue		0,0	0,0		0,0	0,0

The endogenous response oil export to political rights (controlling democracy and level of income)

Independent variable	Civil liberties					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp per apita		instrument	Threshold Variable : Polity II	
Threshold Variable :	Gdp per apita	q(t)<= 4312.5507	q(t) >> 4312.5507	Lattitude*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)
Manufacture 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
Observations		350	350		350	350
Gamma pvalue		0,0	0,0		0,0	0,0

Independent variable	civil liberties					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp per apita		instrument	Threshold Variable : Polity II	
Threshold Variable :	Gdp per apita	q(t)<= 4312.5507	q(t) >> 4312.5507	Lattitude*tem perature	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		350	350		350	350
Gamma pvalue		0,0	0,0		0,0	0,0

Interpretation

- The effect of both the variables “oil export” and “oil rent” on “political rights and civil liberties” are not significant when introducing the heterogeneity in the level of democracy measure between countries.
- 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 scores of political rights and civil liberties. This effect is also found for countries with higher level of gdp per capita.
- The effect of industrialization on both « political rights » and « civil liberties » is negative and significant whatever the level of democracy or this of the of GDP/Capita. These results mean that more industrialization leads to better the political and civil liberties scores.

The endogenous response
Of Natural Resource to
quality of institutions

The endogenous response oil rent and oil export on growth (controlling democracy, corruption and level of income)

Independent variable	Gdp growth (%)					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp percapita		Instrument	Threshold Variable: Polity II	
Threshold Variable :		q(t) <= 4312	q(t) <= 4312	Latitude*tempera ture	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		350	350		350	350
Gamma pvalue		0.0	0.0		0,0	0,0

Independent variable	Gdp growth (%)					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp percapita		Instrument	Threshold Variable: Corruption	
Threshold Variable :		q(t) <= 4312	q(t) <= 4312	Latitude*temperatur e	q(t) <= 2.58	q(t) > 2.58
Oil export	Oil reserves	0.0254 (0.1372)	0.0507 (0.2697)	Oil reserves	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		350	350		350	350
Gamma pvalue		0.0	0.0		0,0	0,0

Independent variable	Gdp growth (%)					
Estimation method	GMM					
	Instrument	Threshold Variable: Gdp percapita		Instrument	Threshold Variable: Polity II	
Threshold Variable :		q(t) <= 2646	q(t) > 2646	Latitude*temperature	q(t) <= 2.58	q(t) > 2.58
Oil rent	Oil reserves	0.0712 (0.0792)	0.1999 (0.0000)	Oil reserves	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		350	350		350	350
Gamma pvalue		0.0	0.0		0,0	0,0

interpretation

- When we test the combined effects of institutional quality and natural resource on growth we find:
- -the effect of oil export and oil rent is positive and significant whatsoever the level of democracy and level of income per capita.
- The effect of the variable “polity” is positive and significant on growth but we have more of significativity in the less democratic countries.
- Concerning the convergence we find that the most democratic economies and developed countries converge to the same long run growth rate

Conclusion

- i) large oil export leads to more corruption whatsoever the quality of institutions and the revenue level;
- ii) In the most democratic or developed countries, more democracy and development reduce corruption;
- iii) In countries with higher revenue level, large oil export and income per capita leads to lower levels of corruption;
- iv) industrialization and democracy leads to better political and civil liberties score, whatsoever of revenue and democracy.

converge to the same long run growth rate.

vi) Oil dependence increase growth rate whatsoever the corruption level, however democracy increase growth only in the less corrupted economies.

vii) oil dependence and democracy increase growth in the developed countries, however only developed countries converge to their long run steady state rate of growth.

Thank you
for
your attention!

Endogeneity versus exogeneity

- Resource “endowments” (e.g., measured by proven reserves) and resource “dependency” (e.g., measured as production or exports). Distinction made by Stijns (2005) and Brunschweiler and Bulte (2008).
- The latter is an endogenous outcome (e.g., Wright & Czelusta, 2004) but also the former can be considered as endogeneous.
 - Torvik (2009) and van der Ploeg and Poelhekke (2010) point out that measures of reserves are not necessarily exogenous either.
 - van der Ploeg and Poelhekke (2010) show that the value of subsoil assets are proportional to resource rents, and thus is also endogenous
- BUT, Measure of the share of primary exports in GDP and resource rents are more appropriate to study the effects on growth and institutions than measures of reserves (which are arguably more exogenous) or measures of geography or geology (Boschini et al., 2013).

- In many papers, the relationship between institutions and economic development has been considered in the sense of the causal effect from the former on the latter.
- There are a number of reasons (omitted variables, errors-in-variables, and, in particular, a potential simultaneous causality between institutional quality and economic growth) to believe that institutional measures are correlated with the error term.