The Double Curse of Innovations in Resource-Rich Autocracies

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Introduction

- The “resource curse” literature is blooming, and its very name is telling of the main conclusion: on average, abundance of natural resources negatively affects economic development (the term was coined by Auty, 1993).

- The widespread explanation is that large reserves of natural resources provide opportunities and incentives to economic and political actors for rent-seeking, hence for diverting limited budgets from productive activities.

- At the same time, one of the most productive activities today is **innovation**. Given that technological innovations are responsible for **as much as 80%** of economic growth (Solow, 1957) and that the world is at the dawn of the Fourth Industrial Revolution (Schwab, 2017), it is worth considering the interaction between resource abundance and innovation.

Literature

- The meta-analysis by Havranek et al. (2016) finds that 40% of recent papers on natural resources report **no effect**, and 20% find a **positive effect** of resources on different economic and social outcomes (with another 40% - reporting a **negative effect**).

- **The political Dutch Disease**, as named by Lam and Wantchekon (2003), posits that windfall gains from natural resources create rent-seeking opportunities, especially enriching those already in power and thereby **generating further inequality and fight for rents** (Acemoglu, 1995; Lane and Tornell, 1996; Deacon and Rode, 2015). Economic and political elites often choose to distribute resources to their subordinates rather than invest them into education, health, or public infrastructure.

- An important separate strand of literature argues that **political institutions are endogenous**: countries that are rich in natural resources tend to develop (and prolong) authoritarian institutions and are **more prone to civil wars** (Wantchekon, 2003; Aslaksen, 2010; Goldberg et al., 2008). Tornell and Lane (1999) and Collier and Hoeffler (1998) argue that the probability of **civil war** in countries endowed with large caches of natural resources is higher than in resource-poor countries.

Argument

- Our argument is consistent with the theoretical belief that **political institutions** as rules of the game **determine a payoff structure of the society creating (dis)incentives for entrepreneurs and thus are decisive for whether resources are a curse or a blessing**.

Argument

- Baumol (1990) shows that **the allocation of resources between productive and unproductive economic activities depends on the payoff structure in the society.** Ceteris paribus, economic agents rationally choose to engage in those activities that bode well in terms of profits. For example, neither Ancient Rome nor Medieval China rewarded entrepreneurial activity, giving preference to the military and government-related corruption, respectively. Baumol (1990, p.898) cuts to the heart of the argument by asking what determines this very payoff structure:

"…. it will be argued only that at least one of the prime determinants of entrepreneurial behavior at any particular time and place is the prevailing rules of the game that govern the payoff of one entrepreneurial activity relative to another".

We apply Baumol's (1990) theoretical proposition to the topic at hand and **combine it** with the resource curse theory.

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- **Hypothesis:** Natural resource rents have a pernicious effect upon technological innovations only under authoritarian settings

Research Design

- To explore the influence of natural resources on innovations mediated by the political regime, we employ a time-series cross-section (TSCS) data from 1980 to 2010 and run panel regressions (fixed effects specification).

$$Innovations_{i,t} = \beta_1 NR_{i,t} + \beta_2 NR^2_{i,t} + \beta_3 PR_{i,t} + \beta_4 PR^2{}_{i,t} + \beta_5 NR_{i,t} \times PR_{i,t} + \beta_6 NR^2_{i,t} \times PR_{i,t} + \beta_7 X_{i,t} + \delta_i + \lambda_t + \epsilon_{i,t} \quad (1)$$

- Where NR is natural resources rents, PR is political regime, NR*PR – an interaction between these two variables. An interaction term is used in order to assess whether natural resources affect technological innovations, differently, within democratic and autocratic contexts. X is a vector of control variables. Indexes *i* and *t* show that the variables vary across countries and over time. delta_i are country fixed effects, lambda_t are year dummies.

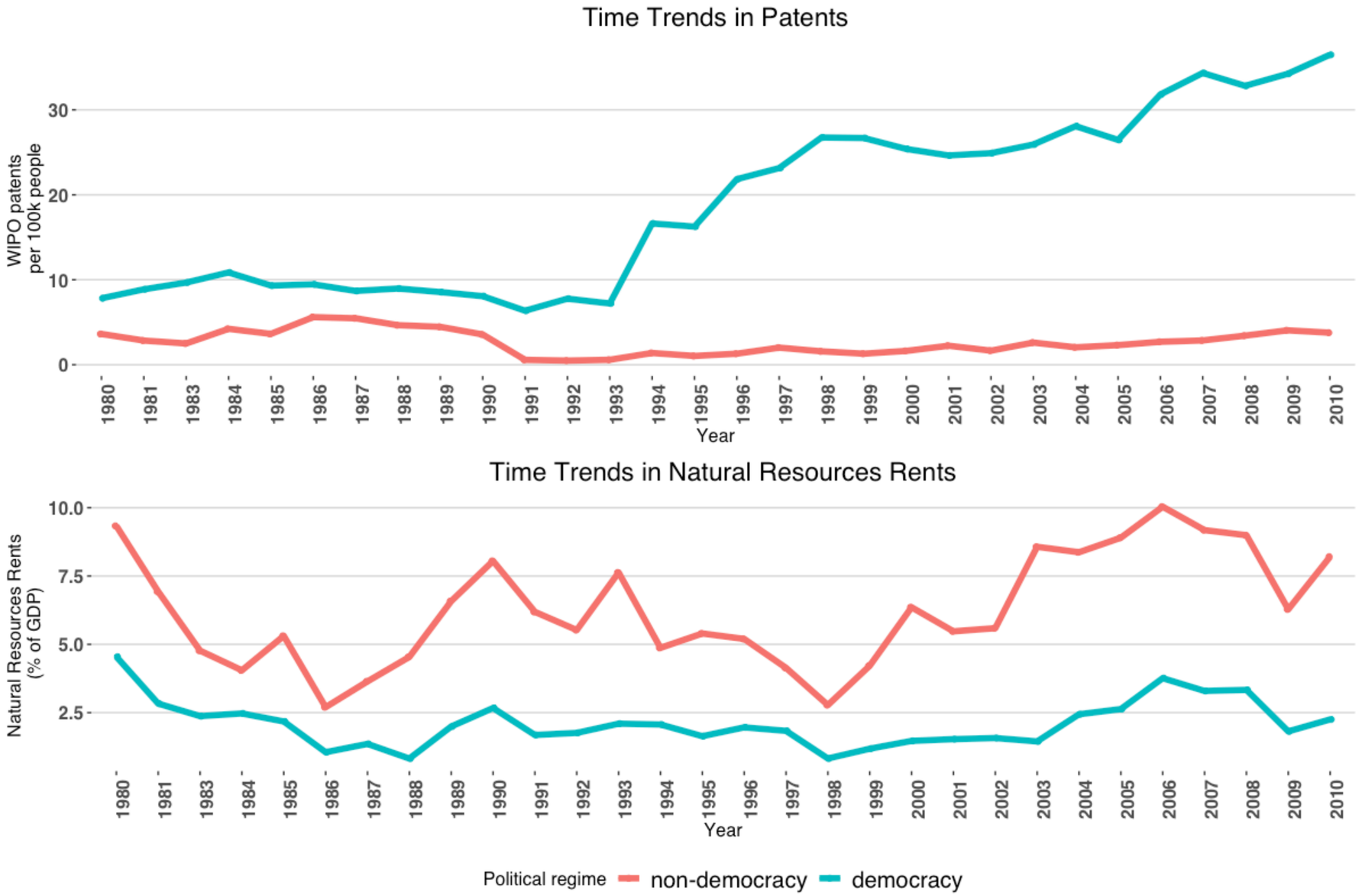
Research Design

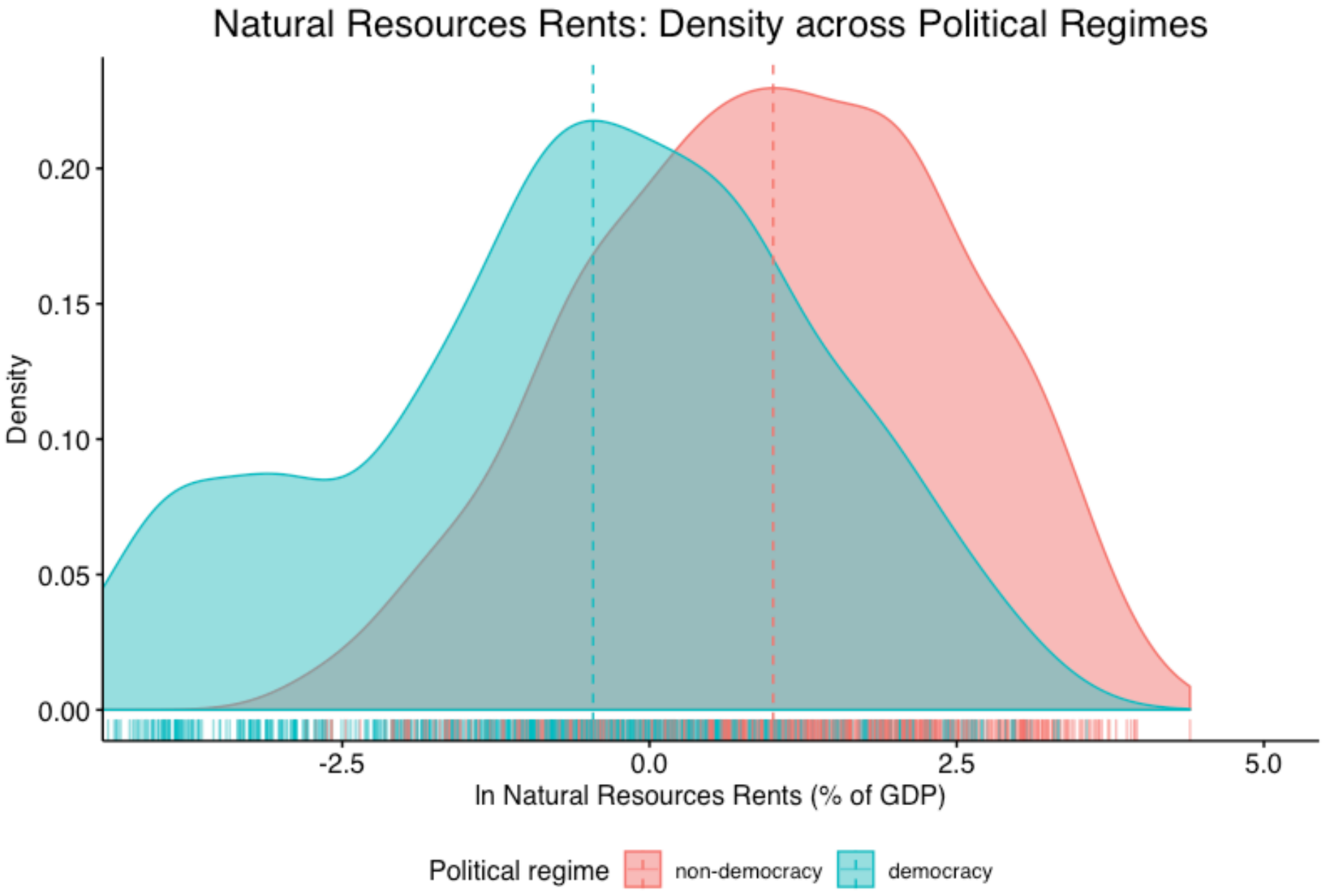
- **Dependent variable:** *Innovations*
  - How to operationalize?
  - In this study we measure technological innovations **via patents granted by the World Intellectual Property Organization (WIPO)**, weighted per 100,000 of population, which is the most widely spread indicator. Given our research question, patents as an indicator of technological innovations, possess several advantages in contrast to other measures (e.g., scientific publications, R&D expenses) (see, Taylor, 2007; Balalaeva, 2015)

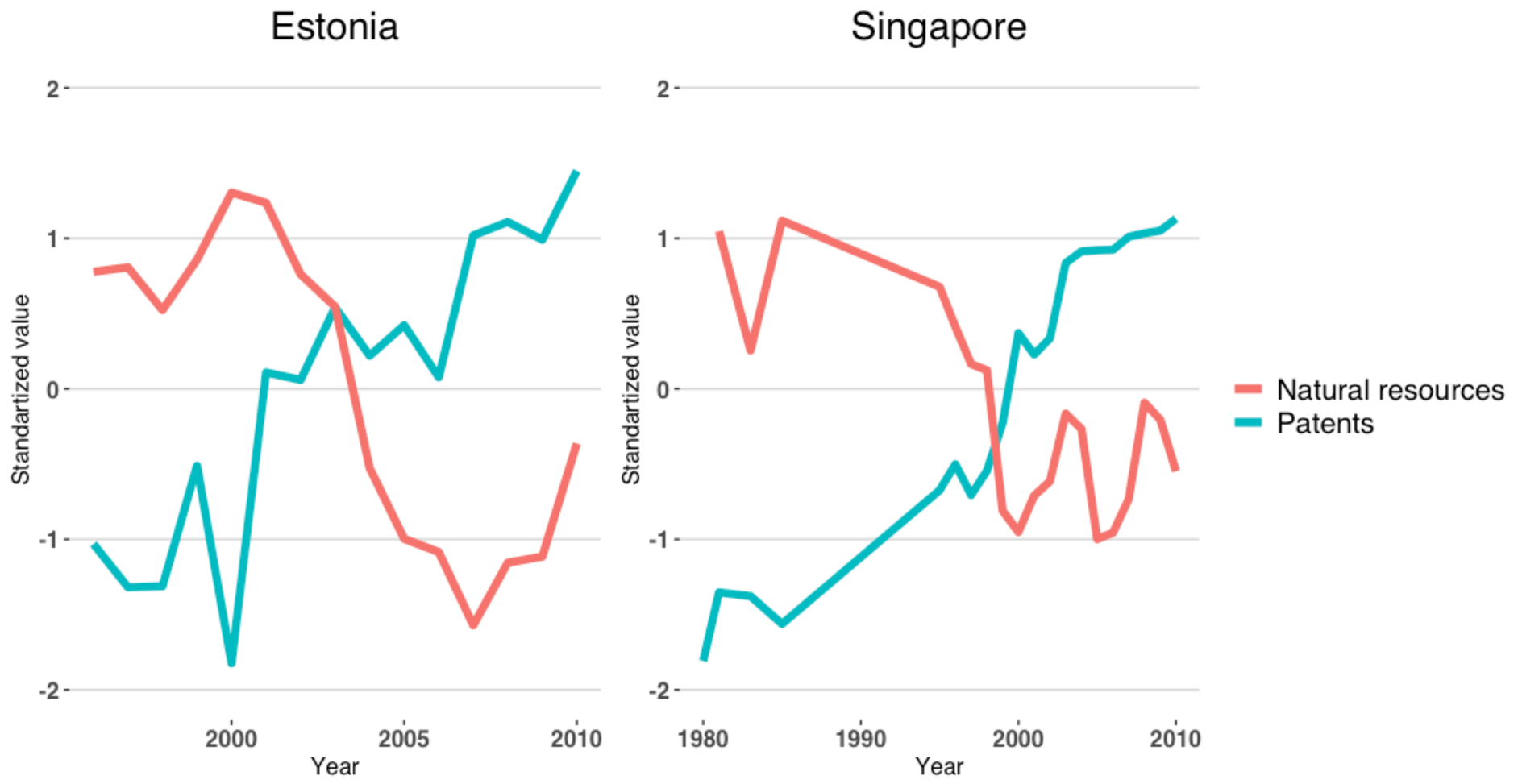
Research Design

- **Independent variables:**
  - To measure the role of *natural resources* in the national economy we use data on **total natural resources rents** as a share of GDP by the World Bank. Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents.
  - The main measure of the *political regime* in our study is the **Liberal Democracy Index (LDI)** from the Varieties of Democracy Project (V-Dem).

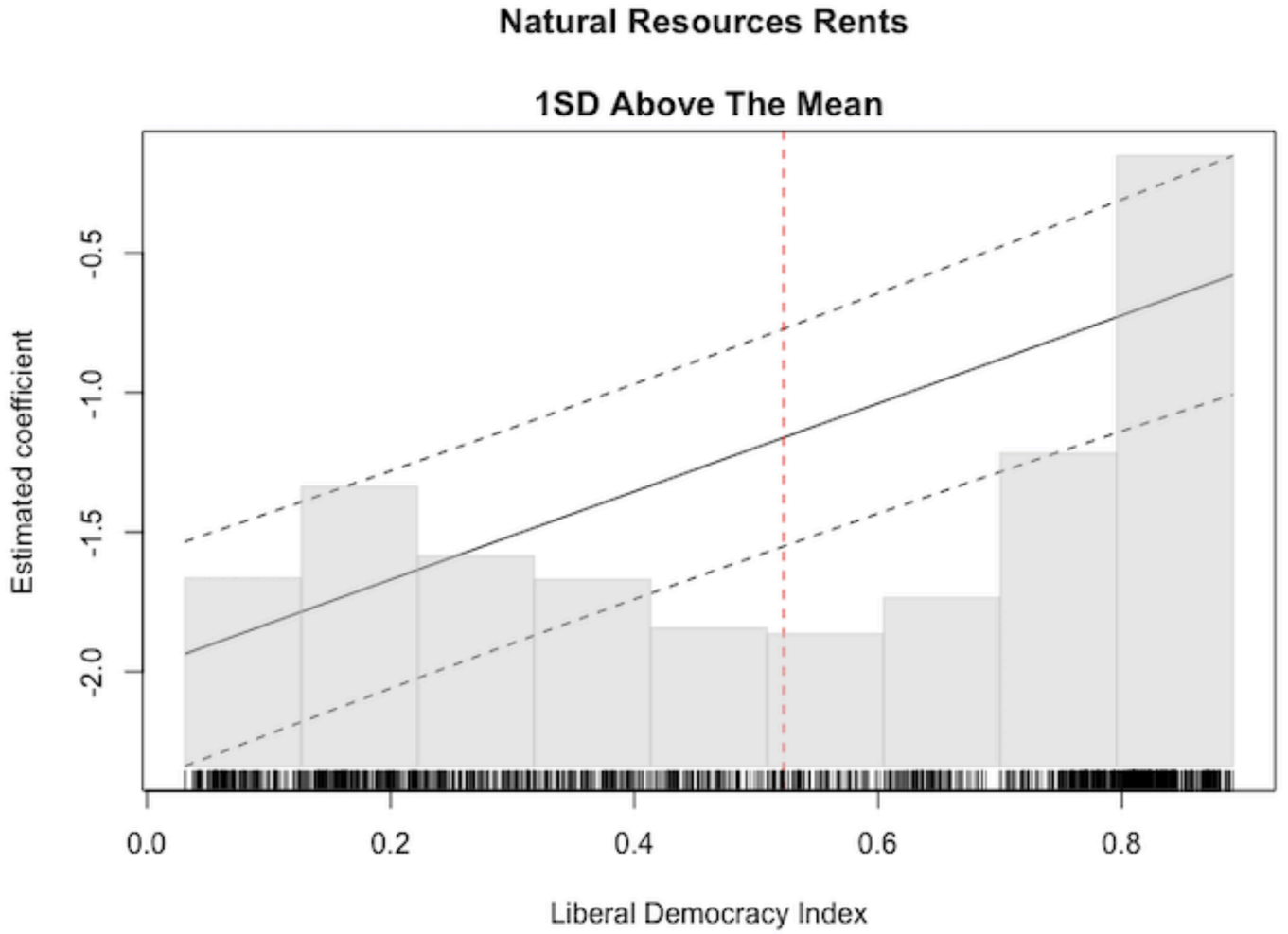
- In different specifications we **control** for the quality of government, globalization, military expenditure, GDP per capita, tertiary schooling, property rights protection and population


Time Trends in Patents
WIPO patents per 100k people
30
20
10
0
1980
1981
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Year
Time Trends in Natural Resources Rents
Natural Resources Rents (% of GDP)
10.0
7.5
5.0
2.5
Year
Political regime
non-democracy
democracy


Natural Resources Rents: Density across Political Regimes
Density
0.20
0.15
0.10
0.05
0.00
-2.5
0.0
2.5
5.0
ln Natural Resources Rents (% of GDP)
Political regime
non-democracy
democracy


Estonia
Singapore
Standartized value
2
1
0
-1
-2
2000
2005
2010
1980
1990
2000
2010
Year
Natural resources
Patents

Dependent Variable: *Patents per 100,000 people (Models 2-6), Patents' Residuals (Model 7)*	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
	Full Sample	**Full Sample (Polity)**	**LDI > 0.5**	**LDI < 0.5**	**Polity > 0**	**Polity < 0**	**Full sample**
Resources (ln)	0.567***	0.489***	-0,027	0,164	0,159	-0,014	-0.019**
Resources (ln, squared)	-0.463**	-0.548**	-0,044	-0.474***	-0.309*	-0.309***	
LDI	-1.475						
LDI (squared)	0,213						
QoG	-1.408***						
Polity		-0,042					
Polity (squared)		-0,02					
GDP pc (ln)	1.285***	1.755***	1.961*	1.153	1.734*	1.652	1.829***
Population (ln)	0,629	-1.216***	-0,603	-0,009	-1.883*	-0,026	-1.676***
Tertiary schooling (ln)	0.715***	0.761***	-0,002	1.121***	0.466**	1.399**	0.800***
Military expenditure (ln)	-0,100	-0.125*	-0,240	-0,035	-0,068	-0,054	-0.108***
Globalization	-0.022***	-0.020***	-0.035**	0,014	-0.031**	-0,014	-0.019***
Military expenditure (ln)		-0,056	0,053	0,063	-0,053	0,003	0.091***
LDI x Resources (ln)	-0.847***						
LDI x Resources (ln, squared)	0.360*						
Polity x Resources (ln)		-0.025***					
Polity x Resources (ln, squared)		0.013**					
Countries	98	114	54	80	87	60	114
Observations	1532	1800	989	811	1412	388	1800
R-squared	0.13	0.14	0.08	0.18	0.08	0.19	0.90
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes


Natural Resources Rents
1SD Above The Mean
Estimated coefficient
-0.5
-1.0
-1.5
-2.0
0.0
0.2
0.4
0.6
0.8
Liberal Democracy Index

Results

- The results confirm our main hypothesis that natural resource rents have a pernicious effect upon technological innovations.

- The effect is nonlinear, however: natural resources rents affect innovations positively only up to a point, after which the effect becomes and remains negative.

- The effect is most profound in the authoritarian settings.

- Substantially, these findings suggest, commissioning big gas or oil fields (as it was in Equatorial Guinea after 1996) or extreme growth in prices for energy carriers, can **probably undermine the innovative activity**. For instance, if Belarus – a full-fledged autocracy - discovered and commissioned a big energy field like the one in Slochteren (the Netherlands), in 1959, so that its resources rents jumped from 0.34% to 2.13% of GDP, the model predicts that the number of patents granted would drop dramatically by 72.8% (from 20.8 to 5.6 patents per 100,000 people).

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Robustness checks

- Additional measures of resource abundance. In our case, it is **oil production per capita** (Ross and Mahdavi, 2005)

- Arellano-Bond estimation

- We also follow Brunnschweiler and Bulte (2008) and check the robustness of our causal mechanism by introducing latitude (distance from the equator) as an instrumental variable for political institutions

- Bayesian model averaging

- **Results remain robust**

Dependent variable: *WIPO patents per 100,000 people*	**Model 8**	**Model 9**	**Model 10**	**Model 11**	**Model 12**	**Model 13**
	Full Sample (LDI)	**Full Sample (Polity)**	**LDI > 0.5**	**LDI < 0.5**	**Polity > 0**	**Polity < 0**
Oil production pc (ln)	3.280***	3.655***	2.210**	1.141**	2.020**	2.224**
Oil production pc (ln, squared)	-0.081**	-0.117**	-0,071	-0.065***	-0,058	-0.109**
LDI	15.700					
LDI (squared)	37.380**					
Polity		-786				
Polity (squared)		0.071***				
Oil (ln) x LDI	-2.743*					
Oil (ln, squared) x LDI	0.054*					
Oil (ln) x Polity		-0.112**				
Oil (ln, squared) x Polity		0.004*				
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Countries	113	113	54	79	89	61
Observations	2,163	2,163	1075	1,088	1590	573
R^2	88	76	76	78	44	157
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes

Dependent Variable:	Patents	LDI	Patents		
	Model 14	Model 15	Model 16	Model 17	Model 2
	Arellano-Bond	First-stage G2SLS	Second-stage	Bayesian Model	Full Sample
Patents (ln, lag)	0.499***				
LDI	-0,472		16.68*		
Polity				-0,123	-0,042
Latitude		0.003**			
Latitude x Resources		-0.000**	0,005		
Resources (ln)	0,137	-0.077***	1.535**	0,372	0.489***
LDI x Resources (ln)	0,120	0.157***	-3.102**		
Polity x Resources (ln)				-0,016	-0.025***
Resources (ln, squared)	59			-0,680	-0.548**
LDI (squared)	5.508**				
Polity (squared)				-0,001	-0,002
LDI x Resources (ln,	-1.547***			25	
GDP pc (ln)	0.784***	-0,004	0.832**	1.643	1.755***
Polity x Resources (ln,				-0,016	0.013**
Population (ln)	1.005***			-1.326	-1.216***
Tertiary schooling (ln)	0.413***			0,672	0.761***
Military expenditure (ln)	37			-0,011	-0.125*
Globalization				-0,025	-0.020***
Property rights				-0,003	
Year		0.005***	-0.0398		
Constant		0,199			
Observations	1277	1730	1730	1800	1800
Countries	84	109	109	114	114
Country dummies	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes
Sagan Chi sq	940.171				
R-squared					0.14
Mean N Regressors				147.216	
Model Prior				random / 146	
g-Prior				UIP	
Shrinkage-Stats				Av = 0.999	
Draws				3000	
Burnins				1000	

Conclusion

- In this paper we focus on an important, yet largely overlooked in the literature, question about the impact of natural resources on technological innovations.

- Theoretically, we argue that abundance in natural resources does undermine technological progress, but only under authoritarian settings. This is because **both conditions – windfall gains from natural resources and authoritarian institutions – reinforce each other in providing political and economic actors with the incentives for rent-seeking, or destructive activity, rather than engaging in innovative, or productive, activity.**

- Empirically, we demonstrate that **resource curse is indeed not inevitable**, and whether natural resources are a blessing or a curse for technological innovations depends heavily on the political rules of the game. The results are robust to different measures of political institutions, rents of natural resources, and various model specifications.