Natural Resource and Economic Growth: A Meta-Analysis

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Overview

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Motivation I

- Theoretically, an abundance of natural resources tends to stimulate economic growth and to move the economy to a steady state.

- In contrast, though, there are many empirical surveys which show and emphasize a negative relationship between natural resource abundance and economic growth (e.g., Sachs and Warner, 1995; Brunnschweiler and Bulte, 2008).

- Several studies have stressed the particularly deleterious effects of natural resource richness on institutional governance and economic growth (e.g., Sala-i-Martin and Subramanian, 2013).
- Natural resources richness cause the quality of institutions to decay and this, in turn, leads to poor economic performance in resource-rich countries.(Leite and Weidmann, 1999).
- While resource abundance can be a blessing for countries with good institutions and a curse for countries with bad institutions (Mehlum et. al., 2006)

Motivation II

- It might be shown that resource-rich countries grow slower than resource-poor ones, but not all of them: Botswana (Acemoglu et. al., 2001; Ilmi, 2007), Canada, Australia, Norway.
- Negative effect might be related to the type of natural resource and quality of governance in resource-rich countries.
- When natural resources are a blessing and when they are a curse?
- Motivated by the source of heterogeneity in effect-size or study-to study variation between controversial findings, this research analyze natural resource economics that examines the partial correlations between natural resource and economic growth.
- Clarify the controversial findings by using meta-analysis in natural resource economics.

Research Objects

This research extend literature with several ways:

- First, detect whether “publication bias” exists in natural resource literature
- Second, estimate true effect-size of natural resource richness on economic growth in the primary studies.
- Thirdly, to explore what determines the study-to-study variation or heterogeneity in effect-size.

Natural Resource - Economic Growth Nexus

- As econometrics approaches, studies tested the effect of natural resource on economic growth whether with using cross-sectional data or panel data estimation (Lederman and Maloney, 2003; Ades and Di Tella, 1999).
- The dependent variable as an economic growth measured as a growth (level) in GDP, or GDP per capita, or GNP
- The measurement of natural resource might change results, even it might give bias results in natural resource economics literature. Specially, if it measured as a fuel, metal and ores.
- Natural resource dependence or natural resource abundance?
- Do better institutions mean better economic growth?
- Interaction term as a product of institutional quality and natural resource, where natural resources have a negative impact on economic growth while institutional quality had a positive effect, and interactive term has positive and significant effect on economic growth (Boschini et. al., 2003, Horvath and Zeynalov, 2014).

Methodology and Data I

- This research conducted a search of the relevant literature in natural resource economics: RePec, JSTOR, SSRN, Wiley-Blackwell, ScienceDirect and numerous Google Scholar.
- Key words used in the search were: “natural resource+economic growth”, “natural resource+economic development” and “Dutch disease”.
- 34 econometric studies together reporting 398 regression of interest
- The selection criteria of natural resource richness was “share of primary export in GDP”, “natural capital share in GNP”, “mineral resource export share in GDP” and “fuel mineral export share in GDP”.

Methodology and Data II

- Following previous studies (Doucouliagos, 2005; Efendic et.al., 2011; Havranek et.al., 2013), the partial correlation coefficient derived as:

$$PCC_{is} = \frac{t_{is}}{\sqrt{t_{is}^2 + df_{is}}} \tag{1}$$

where $i = 1, \ldots 34$ indexes the 34 primary studies, $s = 1, \ldots, 52$ indexes the different reported result for each primary studies.

- The simple meta-regression model examines the effect of standard error of PCC_{is} $\left(SEpcc_{is}\right)$ on standardized effect size of effect size - PCC_{is} itself:

$$PCC_{is} = \beta_0 + \beta_1 * SEpcc_{is} + \epsilon_{is} \tag{2}$$

- To reduce heteroskedasticity and obtain more efficient estimates (Stanley, 2008):

$$TSTAT_{is} = \beta_0 \frac{1}{SEpcc_{is}} + \beta_1 + \epsilon_{is} \frac{1}{SEpcc_{is}} \tag{3}$$

Methodology and Data III

- The moderator variables added with weighted least squared values:

$$TSTAT_{is} = \beta_0 \frac{1}{SEpcc_{is}} + \beta_1 + \sum_{k=1}^{N} \lambda_k * \frac{1}{SEpcc_{is}} X_{kis} + u_{is} \frac{1}{SEpcc_{is}} \qquad (4)$$

- k represents number of moderator variables with weighted by $\left(1/SEpcc_{is}\right)$,
- λ_k are the coefficient of moderator variables, which each of them measure the impact of corresponding moderator variable on the underlying effect of natural resource on economic growth,
- u_{is} is the error term with standard assumption.

Meta-Independent Variables for Natural Resource - Original

Variable	Explanation	Mean	Stan.Dev	Min	Max
ID	Number of paper	16.89	10.58	1	34
OUTPUT	Number of regression	10.71	10.19	1	52
SXP	Natural resource effect size	-3.21	5.44	-35.26	8.25
SXPSE	Standard error of effect size	1.56	1.94	0	10.82
NO.EXP	Number of explanatory variable included	6.52	2.71	1	16
NO.OBS	Number of observation	171.54	298.99	20	2189
NO.COUNTRY	Number of country	66.45	29.10	1	153
NO.TIME	Number of time period	5.32	8.88	1	44
YEAR	Publication year	2006.88	4.69	1995	2013
INDEX	Recursive impact factor of journal	0.14	0.22	0	0.86
GOOGLECIT	Google citation	372.14	764.39	0	3258
REPECCIT	RePec citation	71.35	109.80	0	433

Source: Author

Meta-Independent Variables for Natural Resource - Transformed

Variable	Explanation	Mean	Stan.Dev	Min	Max
TSTAT	The estimated t-statistics of effect size	-1.01	2.83	-10.14	7.33
PCC	The partial correlation coefficient	-0.12	0.30	-0.78	0.72
INVSEpcc	The inverse standard error of the PCC	11.16	7.04	3.46	46.81
LNEXPLANATORYSE	Number of explanatory variable included	4.06	0.73	1.60	5.66
LNDFSE	Number of degree of freedom, log. transformation	6.75	1.39	3.64	11.54
LNOBSSE	Number of observation, logarithmic transformation	6.84	1.34	4.24	11.54
LNCOUNTRYSE	Number of country, logarithmic transformation	6.21	1.29	1.61	8.40
LNTIMESE	Number of time period, logarithmic transformation	2.95	1.57	1.24	7.07
LNYEARSE	Publication year, logarithmic transformation	4 .71	0.91	1.82	6.74
LNINDEXSE	Recursive impact factor of journal, log.transformation	0.68	0.64	0	2.68
LNGOOGLECITSE	Google citation, logarithmic transformation	5.92	2.89	0	10.49
LNREPECCITSE	RePec citation, logarithmic transformation	4.40	2.84	0	8.48
ENDOGENETYSE	Dummy,1 if endogeneity controlled, 0 otherwise	4.74	8.35		
INSTITUTIONSE	Dummy,1 if institutional variable included,0 otherwise	7.99	7.92		
INTERACTIONSE	Dummy,1 if interaction term included, 0 otherwise	3.67	7.89		
TOTSE	Dummy,1 if terms of trade included, 0 otherwise	1.72	3.93		
OPENSE	Dummy,1 if trade openness included, 0 otherwise	6.95	7.35		
initial GDPSE	Dummy,1 if initial GDP included, 0 otherwise	8.87	7.59		
DUMMY60SE	Dummy,1 if time period in 1960s, 0 otherwise	0.44	2.74		
DUMMY70SE	Dummy,1 if time period in 1970s, 0 otherwise	3.92	4.52		
DUMMY80SE	Dummy,1 if time period in 1980s, 0 otherwise	2.84	6.99		
DUMMY90SE	Dummy,1 if time period in 1990s, 0 otherwise	3.34	6.37		
DUMMY00SE	Dummy,1 if time period in 2000s, 0 otherwise	0.62	4.68		

Source: Authors, Notes: The year an article is transformed (1995=1, 1996=2,..., 2013=19).

Results I

Publication bias

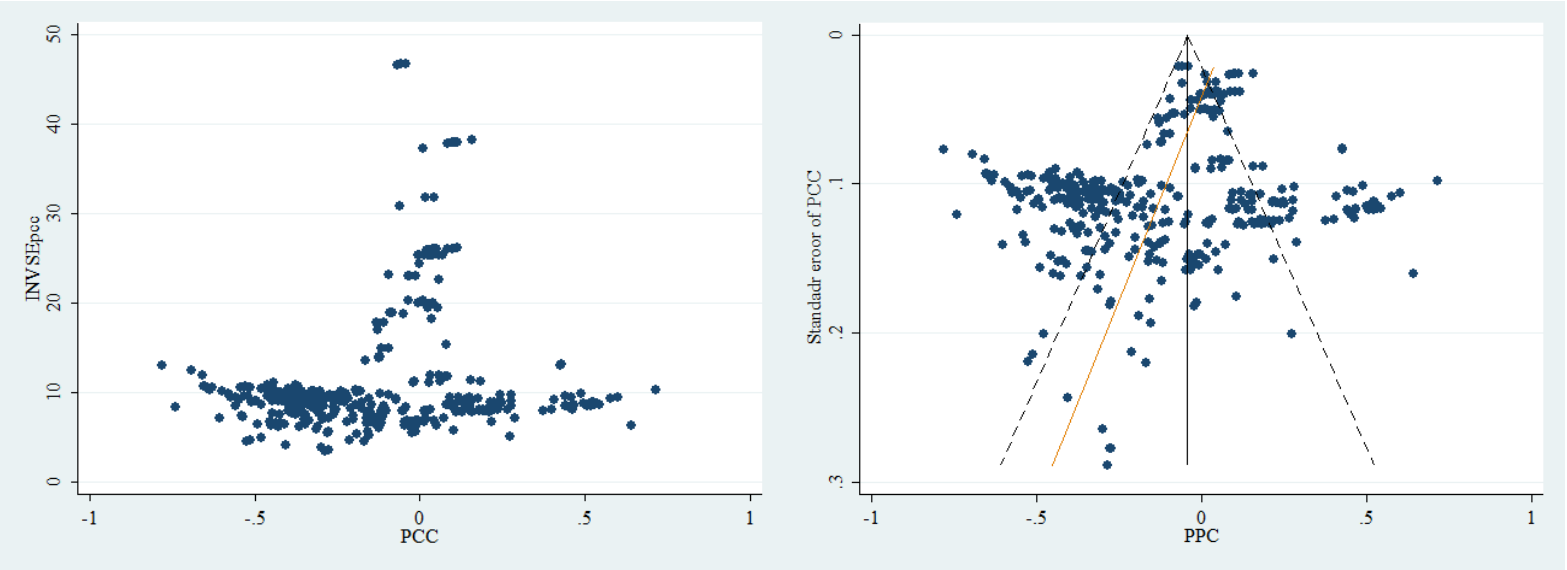

Figure: A funnel plot of the effect of natural resource and funnel plot with pseudo 95% confidence limits

- The left-hand side of the funnel appears to be heavier than right-hand side [Figure (1), left]: Negative estimates may be preferable for publication.
- The solid line [Figure (1), right] is the summary estimate of the effect size of natural resource on economic growth derived using fixed-effect meta-analysis.

Bivariate Meta-Regression Analysis

Variable	coefficient	t-stat	p-value	coefficient	z-stat	p-value
		Clustered OLS			Mixed-effects ML regression	
INVSE	0.073	1.40	0.169	-0.006	-0.23	0.820
CONS	-1.828	-1.80	0.081	-1.731	-3.23	0.001
Model Diagnostic						
	Number of observation=398			Number of observation=398		
	R-squared=0.03			Number of groups = 34		
	F-test: F(1,33)=1.97			Wald test: $\chi^2(1) = 0.05$		
	Ho: INVSE=0, $Prob > F = 0.169$			$Prob > \chi^2 = 0.819$		
	Ramsey RESET test: F(3,393)=9.38			LR test vs. linear regression: $\chi^2(1) = 418.67$		
	Ho: No omitted variables, $Prob > F = 0.000$			$Prob > \chi^2 = 0.000$		

Dependent variable is *TSTAT*. The coefficient of INVSE measures the magnitude of the effect of natural resource on economic growth, corrected for publication selection. Column (2)-(4) represent OLS with cluster-robust standard errors at the study level, observation weighted to give each study equal weight. Column (5)-(7) represent Mixed-effects ML regression. Reported t-statistics are based on heteroskdasticity cluster-robust standard errors.

Multivariate Meta-Regression Analysis

Variable	coefficient	t-stat	p-value	coefficient	z-stat	p-value
	Clustered OLS			Mixed-effects ML regression		
INVSE	-0.552	-2.30	0.028	-1.339	-7.05	0.000
LNDFSE	0.742	1.28	0.210	-0.000	-0.18	0.856
COUNTRYSE	0.001	0.02	0.988	0.001	1.97	0.049
LNTIMESE	-0.631	-1.45	0.156	-0.641	-1.67	0.095
YEARSE	0.019	2.70	0.011	0.052	4.80	0.000
INDEXSE	-0.151	-1.91	0.065	-0.347	-2.01	0.045
RCITSE	0.001	2.05	0.048	0.002	3.69	0.000
ENDOSE	0.038	1.05	0.303	-0.000	-0.02	0.982
INSSE	0.049	1.45	0.157	-0.074	-3.38	0.001
INTERSE	0.045	1.47	0.150	0.027	1.69	0.091
TOTSE	0.084	1.47	0.151	0.024	0.60	0.552
OPENSE	-0.063	-1.66	0.106	0.017	0.57	0.569
iGDPSE	-0.229	-3.95	0.000	-0.025	-0.70	0.482
DUMMY60SE	0.238	2.64	0.013	0.256	2.52	0.012
DUMMY80SE	0.357	5.37	0.000	0.379	6.90	0.000
DUMMY90SE	0.271	3.08	0.004	0.497	9.74	0.000
DUMMY00SE	0.250	2.10	0.043	0.581	6.33	0.000
CONS	-1.738	-0.75	0.461	-3.347	-3.32	0.001

Dependent variable is TSTAT. The coefficient of variables measures the magnitude of the effect of natural resource on economic growth, corrected for publication. Column (2)-(4) represent OLS with cluster-robust standard errors at the study level. Column (5)-(7) represents Mixed-effects ML regression. Reported t-statistics are based on heteroskdasticity cluster-robust standard errors.

Concluding Remarks

- The obtained results from graphical analysis, bivariate and multivariate mixed effect suggest evidence of publication bias in natural resource literature.
- Bivariate results suggest evidence of publication bias, and do not suggest statistically significant authentic empirical effect of natural resource on economic growth.
- Multivariate mixed ML results suggest both publication bias and statistically significant negative authentic effect of natural resource on economic growth.

Heterogeneity across primary studies:

- Differences due to research design - data characteristics (no. of countries, no. of time period); publication characteristics (publication year, journal impact factor and citation)
- Conditioning variables could not able to explain difference, exception: institutional quality and interaction term
- Difference due to real actors - Differences between time periods (1970s)

Thank you! Any Questions?