Natural Resource and Economic Growth: A Meta-Analysis

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Abstract

There is no consensus on the impact of natural resource richness on economic growth in the natural resource literature. This research conducts the first meta-analysis to the empirical literature in the relationship, between natural resources richness and economic growth. Including 34 studies with different 398 estimates, the heterogeneity across primary studies is driven by both model design and real factors, in particular, publication characteristics (publication year, the impact factor of journal and citations), model specification and time-horizon play important role to explain the heterogeneity on natural resource-economic growth nexus. The research suggests evidence that publication bias exist in this literature, it indicates that negative reported results are preferable for publication.

Keywords. Meta-Analysis, natural resource, economic growth, institutions
JEL Classification: Q30; O13; C51

Introduction

There is no consensus on the impact of natural resource richness and institutional quality on economic growth. These impact is related to various empirical analyses that with the different type of natural abundance and institutional quality, as well as various impacts whether directly or indirect, positive or negative, cursed or blessed effects of resource on economic performance in the resource-rich countries. The purpose of this research aimed to clarify the controversial findings by using meta-analysis in natural resource economics.

Main discussion across studies is whether natural resource richness has positive or negative effect, as well as direct or indirect impact on economic growth. Some research argues that natural resource is not correlated with institutional quality, and it has direct

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effect on economic growth (Sachs and Warner, 1995; Arezki and van der Ploeg, 2007). Other research claims that natural resources richness cause the quality of institutions to decay and this, in turn, leads to poor economic performance in resource-rich countries. These studies claim that effect of natural resource and corruption have negative, direct and significant effect on economic growth, and it related to the type of natural resource itself, where fuel, metal and ores export might have negative effect on control of corruption, however agriculture and food resource increases control on corruption (Leite and Weidmann, 1999); negative effect of natural resource richness can be alter adding control variables, and natural resource might be obstacle on investment and trade openness, where they are determinant of economic growth (Papyrakis and Gerlagh, 2004).

It might be shown that resource-rich countries grow slower than resource-poor ones, but not all of them. Botswana experienced remarkable economic growth with using its natural resource richness, such as diamond (Acemoglu et. al., 2001; Ilmi, 2007). Negative effect might be related to the type of natural resource and quality of governance in resource-rich countries. Therefore, it seems that the negative effect of natural resource richness on economic growth cannot be generalized for all countries and all types of natural resources.

This study applies meta-regression analysis in natural resource economics that examines the partial correlations between natural resource and economic growth. This meta-regression addresses issues of data heterogeneity, heteroskedasticity, and non-independent or correlated observations. The research refers to heterogeneity of effect-size estimates from primary studies, whether heterogeneity occurs by real differences in effects of natural resource richness on economic growth across primary studies or different approaches of study designs and methodologies. Motivated by the source of heterogeneity in effect-size or study-to study variation between controversial findings in natural resource economics, this research examines model design and methodologies or techniques of primary studies, and detect publication bias, and test of fundamental hypothesises, such as "natural resource curse", "reverse casualty" etc.

This research extend literature with several ways. Firstly, estimated effect-size such as a regression coefficient for the natural resource abundance/dependence and institutional qualities in the primary studies. Second, to explore what determines the study-to-study variation or heterogeneity in effect-size. Third, present a study of "publication bias".

The paper is organized as follows. Section 2 discusses different primary studies which employed in this topic: concept of primary studies such as cross-sectional, panel data, choice of dependent variable, and measurement of explanatory variable. Section 3 describes the approach of meta-regression analysis in this topic. Section 4 contains findings on publication bias and heterogeneity due to research design and data characteristics. Section 5 contains concluding remarks and focus on implications of discovered heterogeneities across primary studies in natural resource literature. The studies of meta-analysis listed in Appendix.

Natural Resource - Economic Growth Nexus

Natural resource richness might have indirect effect through change on terms of trade, appreciation of real exchange rate or quality of institutional to economic growth (Sala-i-Martin and Subramanian, 2003); natural resource decreases quality of institutions in resource-rich countries and hereby institutions cause poor economic performance (Isham et al., 2005); resource abundance positively effect to institutional quality, however, resource dependence has not; resource dependence positively affected by resource abundance, trade openness, and it is negatively by institutional quality; resource abundance stimulate economic growth, however resource dependence influence only through institutional quality (Brunnschweiler and Bulte, 2006), natural resource dependence has negative impact on economic growth through savings and investment (Gyfason and Zoega, 2006); natural resource richness is increased the level of corruption and it is neglected the level of education in transition economies in eastern Europe and central Asia (Beck and Laeven, 2006). Using several panel regression models that address the endogeneity issues, natural resources have a negative effect on growth performance unless the quality of domestic institutions is sufficiently high in homogenous group of countries such as post-Soviet countries (Roman and Ayaz, 2014).

Natural resource richness might weaken the political system and governance, leads to corruption and, in some cases, civil conflict, and damages the quality of institutions, as well as decreases the level of democracy in general or at least frustrate their developments (Ades and Di Tella, 1999; Barro, 1999; Ross, 2001; Jensen and Wantchekon, 2004; Collier and Hoeffler, 1998).

The impact of natural resource on economic growth changes by choice of the measurement of natural resource, the econometric approaches: cross-sectional and panel, type of natural resource and institutional quality as well. As econometrics approaches, studies tested the effect of natural resource on economic growth whether with using cross-sectional data (Sachs and Warner, 1995; 2001; Leite and Weidmann, 1999; Ades and Di Tella, 1999; Lederman and Maloney, 2003; Boschini and others, 2003; Sala-i-Martin and Subramanian, 2003; Ding and Field, 2005; Mehlum and others, 2006; Brunnschweiler and Bulte, 2006; Arezki and van der Ploeg, 2007), or panel data estimation (Lederman and Maloney, 2003; Jensen and Wantchekon, 2004; Beck and Laeven, 2006; Ilmi, 2007; Roman and Ayaz, 2014). Lederman and Maloney (2003) used both and they found that the results of cross-sectional are different than panel data estimation, where although panel data estimation gave significant positive effect of natural resource on economic growth, using cross sectional data gave negative but insignificant results. Ades and Di Tella (1999) also used both cross-sectional and panel data, where impact of natural resource on economic growth became insignificant with using panel data.

The dependent variable as an economic growth measured as a growth in per-capita GDP with starting Sachs and Warner (1995), where many studies followed their approaches. The mismeasurement of independent variables plays pivot role to explain reliability of natural resource impact on economic growth. The measurement of natural resource might change results, even it might give bias results in natural resource economics literature.

Sachs and Warner (1995) measured natural resource as a sum of export of agriculture, fuels and mineral to GDP, where many research followed their measurement in their analysis. The natural resource measured as an export of primary resource as a percentage of GDP (Lederman and Maloney, 2003; Isham and others, 2005; Brunnschweiler and Bulte, 2006; Beck and Laeven, 2006); value of exports of metal, ores and fuels, value of mineral production as well (Boschini and other, 2003); as share of exports of primary products in GNP (Leite and Weidmann, 1999; Mehlum and others, 2006); as a percentage of fuel, mineral and metal exports on merchandise exports (Sala-i-Martin and Subramanian, 2003; Jensen and Wantchekon, 2004); as the sum of resource rents as a percentage of GDP (Collier and Hoeffler, 2005);share of mineral production in GDP (Papyrakis and Gerlagh, 2004); share of natural resource capital as a percentage of total capital (Gyfason and Zoega, 2006).

Some research tested a model with an 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, Roman and Ayaz, 2014); natural resource is a blessing for those with good institutions (Mehlum and others, 2006); institutional quality has not significant effect, however interaction term has positive and significant effect on economic growth (Arezki and van der Ploeg, 2007). A common econometrical problem in natural resource economics is the measurement of natural resource richness. Different measurements perform different association between natural resource and economic growth.

The heterogeneity across primary studies might caused by authentic and/or methodological choices. A sample selection of empirical research addresses real difference across studies which called authentic heterogeneity. The different estimation technique, method and sample addresses methodological heterogeneity. Therefore, main analysis of meta-analysis method of natural resource are data heterogeneity, heteroskedasticity and non-independence.

Meta-Analysis

Following the methodology applied by Stanley(2001), the research conducted a search of the relevant literature in natural resource economics such as 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". These approaches identified more than 300 articles and papers, including 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". Authors preferred their specification to different measurement of natural resource, different methods, different sample (within sample and between sample), different time periods, different control variables and different endogeneity assumption. Following Doucouliagos and Stanley, (2009), these dummies and publication year, the impact factor of journal, citation number took into account as an independent variables to identify the

implication of heterogeneities of selected primary variables.

The number of reported results per studies ranges from one (Papyrakis and Gerlagh, 2006) to fifty two (Brunnschweiller, 2008) with an average of 10.73. The full list is reported in Appendix. Since natural resource economics stated quite recently, first study published in 1995 (Sachs and Warner, 1995), while last study is from 2013 (Obafemi et. al., 2013; El Anshasy and Katsaiti, 2013). Most cited top five papers by Google Scholar are: Sachs and Warner, 1995 (3258); Sachs and Warner, 2001 (2009); Leite and Weidmann. 1999 (975) Gylfason, 2001 (962) and Sala-i-Martin and Subramanian, 2003 (719), by IdeasRePec Sachs and Warner, 1995 (433); Mehlum et. al., 2006 (259); Sachs and Warner, 2001 (232); Gylfason, 2001 (183) and Sala-i-Martin and Subramanian, 2003 (183).

In meta-analysis sample, all reported results of the effects of natural resource on economic growth and level of economic output were included, other type of dependent variables such as, human capital, physical capital, democracy, institutions were excluded.

The selected studies used different types of natural resource that include different units, scales and components. The partial correlation coefficient were estimated between natural resource and dependent variable for each reported results to standardized measure of the estimated effect of natural resource on economic growth (Green 2008, p.31; Doucouliagos and Laroche, 2009; Valickova et.al., 2013). This standardize allows to analyze different studies with direct comparison.

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

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

where $i = 1, ...34$ indexes the 34 primary studies, $s = 1, ..., 52$ indexes the different reported result for each primary studies. t_{is} is the associated t-statistics; and df_{is} is the corresponding number of degree of freedom. PCC_{is} represents partial correlation coefficient between natural resource and economic growth.

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

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

where $SEpcc(SEpcc_{is} = \frac{PCC_{is}}{TSTAT_{is}})$ is the conventional measure of precision, which estimated as a standard error of partial correlation coefficient, ϵ is the regression error term.

To reduce heteroskedasticity and obtain more efficient estimates, Stanley (2008) purpose that Eq.(1) can weight with the standard error of the PCC_{is}. Therefore, weighted least squared (WLS) version of Eq.(1) is obtained with divided each variable to $SEpcc_{is}$:

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

where $TSTAT_{is} = \frac{PCC_{is}}{SEpcc_{is}}$ measures the significance of partial correlation coefficient of interest. The β_0 provide true effect size of natural resource on economic growth in terms

of partial correlation coefficient: as a coefficient of the inverse of the standard error of the partial correlation coefficient, it measures the underlying effect of natural resource on economic growth. β_1 measures publication bias. Therefore, in Eq.(3), β_0

The bivariate regression may provide bias estimate results if important moderator variables were omitted (Doucouliagos and Stanley, 2008). Adding moderator variable to Eq.(3), will develop the detection of the source of heterogeneity across primary studies (Doucouliagos and Laroche, 2009). The moderator variables added with weighted least squared values:

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

where k represents number of moderator variables with weighted by $(1/SEpcc_{is})$, 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., and u_{is} is the error term with standard assumption.

The potential explanatory variables used in this meta-regression analysis are listed and explained in Table 1. These variables represent potential source of heterogeneity between primary studies. These variables are expected main potential sources of heterogeneity in the natural resource economics.

Table 1: **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
ENDOGENETY	Dummy,1 if endogeneity controlled, 0 otherwise	0.33	0.47		
INSTITUTION	Dummy,1 if institutional variable included,0 otherwise	0.69	0.46		
INTERACTION	Dummy,1 if interaction term included, 0 otherwise	0.25	0.43		
TOT	Dummy,1 if terms of trade included, 0 otherwise	0.19	0.39		
OPENNESS	Dummy,1 if trade openness included, 0 otherwise	0.61	0.49		
initial GDP	Dummy,1 if initial GDP included, 0 otherwise	0.80	0.40		
DUMMY60	Dummy,1 if time period in 1960s, 0 otherwise	0.04	0.18		
DUMMY70	Dummy,1 if time period in 1970s, 0 otherwise	0.44	0.50		
DUMMY80	Dummy,1 if time period in 1980s, 0 otherwise	0.19	0.39		
DUMMY90	Dummy,1 if time period in 1990s, 0 otherwise	0.32	0.47		
DUMMY00	Dummy,1 if time period in 2000s, 0 otherwise	0.02	0.14		

Source:Author

The weighing procedure - divide each variable to the standard error, plays pivot role in meta-regression analysis, it gives greater weight to the more precise estimates. The

potential explanatory variables are listed in Table 2. The unconditional mean - partial correlation coefficient between natural resource and economic growth is -0.12 (see Table 2).

Table 2: **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: Author Notes: The year an article is transformed (1995=1, 1996=2,..., 2013=19).

These moderator variables represent the potential source of heterogeneity in the natural resource economics.

Publication bias

Publication bias occurs when researcher(s), referee(s), and editor prefer to report positive (statistically significant) results rather than negative one (Stanley, 2005). It is expected that statistically results has more chance to publish rather than insignificant results. It leads positive results bias. Addressing funnel plot (Stanley and Doucouliagos 2010), horizontal axis displays effect size of natural resource on economic growth, more precisely, partial correlation coefficient, and vertical axis displays inverse standard errors derived from each study. The funnel plot for the natural resource literature is depicted in Figure (1).

The absence of publication bias occurs if figure looks like as symmetric inverted funnel. The left-hand side of the funnel appears to be heavier than right-hand side (Figure (1), left). This finding suggests that negative estimates may be preferable for publication, those inspired by Sachs and Warner's (1995) findings. The solid line (Figure (1), right)is the

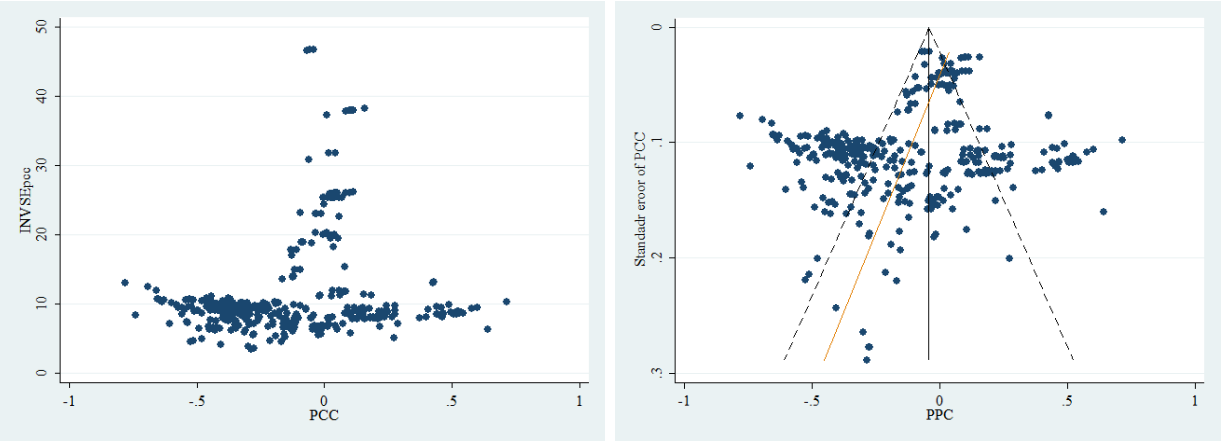

Figure 1: A Funnel Plot of the Effect of Natural Resource and Funnel plot with pseudo 95% confidence limits

summary estimate of the effect size of natural resource on economic growth derived using fixed-effect meta-analysis. It suggests that association between natural resource richness and economic growth is negative. However, visual method might be subjective, therefore it is better to follow formal detection and correction of publication bias.

Using Eq.(3), if constant term is statistically significant, then we can conclude that formal evidence for publication bias; the direction of biasness detects from sign of constant term. Negative and statistically significant results represent that, negative results are preferable in natural resource economics. It is mostly accepted that the effect of natural resource richness on economic growth is negative due to the Dutch disease, rent seeking and conflicts, corruption, low level of institutions, macroeconomic instability and debt overhang. It can conclude that resource rich countries perform slower economic growth rather than resource poor ones.

Bivariate meta-regression results suggests that publication bias exists and does not provide strong evidence of true empirical effect of natural resource on economic growth. Using both OLS with clustered at the study level and Mixed effect ML regression, direction of publication bias is negative, those consistent with visual finding. The mean value of natural resource on economic growth is estimated 0.073 for Clustered OLS, and -0.006 for Mixed effect ML regression. However none of them is statistically significant (see Table (3)). The Funnel Asymmetry Test (FAT) helps to detect publication bias: significant negative constant term suggests that effect size is subject to an downward bias across primary studies. The Precision-Effect Test (PET) tests the significance of slope coefficient, where null hypothesis ($H_0 : \beta_0 = 0$) cannot reject, it suggests that there is only publication bias on natural resource literature. However, the bivariate regression might provide bias results if any important explanatory variable are omitted (Doucouliagos and Stanley, 2009). Moderator variables involve differences due to the research design or due to real factors. The difference due to research design might related to data characteristics, measurement of

Table 3: **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. 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.

natural resource, estimation strategies, various conditional variables or publication characteristics. The difference due to real factors might be caused by different sample countries or different time periods.

Using Eq.(4), where k=1,..,17 represents meta-independent variables. The results are reported in Table (4). The model F-statistics provides that Clustered OLS results are jointly significant, and overall fit of regression is high ($R^2 = 62$). Although results by Clustered OLS suggests that publication bias may not exist, it provides statistically significant heterogeneity between natural resource and economic growth (see Table (4)). Ramsey RESET test confirms that model might suffer from misspecification. Mixed effect model might be true specification (Valickova et.al., 2013), which contains both fixed and random effects both.

The constant term and the coefficient of inverse standard error are statistically significant with Mixed-effects ML regression. Firstly, it suggests publication bias in natural resource literature. Secondly, the underlying effect of natural resource on economic growth is negative and it is corrected result for publication selection: it suggests that study characteristics decreases the association between natural resource and economic growth. The results purposes that heterogeneity between primary studies arises from both research design and real factors.

Heterogeneity due to research design involves degree of freedom, sample size (number of countries) and time-horizon of the natural resource richness. Number of countries and time-horizon play pivot role to explain heterogeneity across primary studies. The increases of the number of countries and expanding time-horizon matter for reported result: more countries in the sample yields larger, more time-horizon yields smaller effect. Publication characteristics as a research design (publication year, index impact factor of journal and citation) have significant influence on reported results of primary studies in natural resource literature. The impact factor of journal has negative association with partial correlation coefficient. These suggest that journal, those has higher impact factor, prefers publishing

Table 4: **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

	Random-effects Parameter	Estimate	Standard Error
	SD(CONS)	2.597	0.429
	SD(RESIDUAL)	1.156	0.044

Number of observation=398	Number of observation=398
R-squared=0.62	R-squared=0.46
F-test: F(1,33)=32.71	Wald test:$\chi^2(1)$= 184.85
Ho: INVSE=0,$Prob > F = 0.000$	$Prob > \chi^2 = 0.000$
Ramsey RESET test: F(3,376)= 4.47	LR test vs. linear regression: $\chi^2(1) = 192.79$
Ho: No omitted variables, $Prob > F = 0.004$	$Prob > \chi^2 = 0.000$

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.

the negative reported results of natural resource - economic growth nexus.

The methodology to deal with endogeneity did not perform particularly significant effect on partial correlation between natural resource and economic growth. Although potential endogeneity problem exists in natural resource literature, meta-regression analysis could not able to suggest ignoring this methodological specification may under/overestimate the relationship between natural resource richness and economic growth. Addressing for the institutional effect on association between natural resource and economic growth, as well as interaction term between institutional quality and natural resource define whether natural resource is blessing or curse for resource-rich countries. The studies tested a model with an institutional quality have larger negative effect, while the studies tested interaction term reduced negative effect of partial correlation between natural resource and economic growth.

Due to real factor heterogeneity across primary studies, the impact of natural resource on economic growth is different with time periods. The dummy variables reflecting different decades, with 1970s is the base time periods. This was chosen to test dues o many

research follow Sachs and Warner (1995)'s empirical methodology and measurements. The results suggest that those selected sample from 1970s, highly reported negative association between natural resource and economic growth.

Therefore, from the discussing above, it can argue that publication bias exists in natural resource literature, additionally, the source of heterogeneity across primary studies is related to both research design and real factors.

Conclusion

This research used meta-regression analysis to investigate the effect of natural resource richness on economic growth. The obtained results from graphical analysis, bivariate and multivariate mixed effect suggest evidence of publication bias, and possible presence of an authentic difference across primary studies 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 Clustered OLS results suggest that publication bias may not exists and provide evidence of research design and real factor heterogeneity across selected studies. Multivariate mixed ML results suggest both publication bias and statistically significant negative authentic effect of natural resource on economic growth.

Including 34 studies with different 398 estimates of natural resource on economic growth, the heterogeneity across primary studies is driven by both model design and real factors. The natural resource - economic growth nexus varies across time periods. The negative impact of natural resource on economic growth inspired by Sachs and Warner (1995), where the authors measured natural resource richness from 1970s decade. Many research followed this specification, therefore, the reported results of natural resource - economic growth nexus from this time-horizon perform negative rather than other decades.

Publication characteristics play important role to explain negative reported results of natural resource - economic growth nexus. Publication year, citation and the impact factor of journal matter for negative results. Theoretically, it might expected that natural resource richness should promote economic growth, however, empirically, it is expect that the association between natural resource richness and economic growth performs negative. Therefore, the authors have a preference to publish negative results that support previous empirical findings.

Institutional quality, and interaction term between institutions and natural resource might be one of important empirical effect beyond publication bias in selected literature. The quality of institutions highly correlate with natural resource richness, studies those addressing institutional quality, reports higher negative effect of natural resource on economic growth. Concerning future research, it is interested take consider interaction term between natural resource and institutional quality. Empirical researches showed that, natural resource has negative effect on economic growth due to lower institutional quality; if country has sufficiently high institutional quality such as - control on corruption, political stability, government effectiveness and sufficient law of rules or property rights, then negative effect of natural resource turn bless for resource-rich countries. Additionally, larger

sample size might provide more significant results.

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Appendix

Meta-Analysis - The List of Selected Studies (sorted by publication year)

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