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Resource curse versus resource blessing: New evidence from resource capital data

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ABSTRACT

This study aims to investigate the association between natural capital and economic development using panel data comprising a large number of countries across the world for the period 1995–2018. The study accounts for several key drivers of economic development, such as the produced capital, human capital, trade and institutional quality indicators. Our findings demonstrate that the effect flowing from natural capital to economic performance is sizable and positive. The institutional indicators such as the control of corruption, rule of law and government effectiveness play an important role in driving economic growth positively. Overall, we reject the resource curse hypothesis and support the resource blessing hypothesis. The evidence also shows that the combined effect of institutions and resources is not a crucial factor in determining growth. These results are fairly consistent for both developing and developed economies. The study offers important policy implications and adds a new dimension to the empirical literature on the nexus between resource abundance and economic growth by using wealth and capital data.

1. Introduction

This study examines the role of natural resources wealth and institutions' role in economic performance across the world. Since the time-old belief of classical economists like Smith and Ricardo, it is of the opinion that the countries having more natural resources tend to have an advantage over a resource-shrunk country. However, after the pioneering contribution of Sachs and Warner (1995) in identifying the negative relationship between natural resource abundance and economic growth, a large assortment of literature has been put forward by researchers. The attempts to explore and establish distinguish channels of what has been famously called 'Natural Resource Curse'- an anomaly that resource-rich nations perform rather badly compared with resource-poor nations (e.g., Gylfason, 2001; Mehlum et al., 2006). The poor quality of institutions and governance as prime factors for the sluggish growth of resource abundant countries (Rodriguez and Sachs, 1999; Brunnschweilera and Bulte, 2008; Khan et al., 2020). It was also argued that the low quality of institutions and complex government policies cause a low level of saving and investment, which diminishes economic progress and prosperity (Atkinson and Hamilton, 2003). The core argument extended to explain the resource curse affirms that lopsided availability of natural resources crowds out production activities (so-called Dutch Disease), that results in under-investment in human capital and therefore stifles a country's economic growth (Gylfason et al., 1999; Gylfason, 2001).

Even after more than two decades of research, no consensus has been drawn on the proximate impact of resources on economic growth. Studies such as Atkinson and Hamilton (2003), Bakwena et al. (2009), Arezki and Ploeg (2010), Henry (2019), and Guan et al. (2020) produce evidence that resource-endowed countries tend to experience sluggish growth. Other studies such as Ross (2003, 2013), Bulte et al. (2005), Papyrakis and Gerlagh (2007), and Arezki and Brückner (2011) document that the sluggish growth is due to the low institutional quality of a nation's governing establishments and thereby increasing the incidence of corruption and social conflict of interest in resource rich countries. On the other hand, a contradictory view has been put forward by Sala-i-Martin and Subramanian (2013), Alexeev and Conrad (2009), Smith (2015), Yanıkkaya and Turan (2018), Haseeb et al. (2021) along with others, wherein natural resources exhibit a boosting effect on the economic growth of a country. These conflicting outcomes can be ascribed to the diverse selection of resource variables and application of different econometric techniques, which primarily fall flat in explaining cross-

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section dependence in panel analysis and robust association of resource dependence and economic growth. Careful scrutiny in this field of research is of utmost significance because of its potential implications in development policies.[1]

Literature supporting the natural resource curse is extensive; yet, most of it has been called into question and subjected to a litany of criticisms for various reasons. In that regard, previous studies, e.g., Sachs and Warner (1995, 1999, 2001), Gylfason (2001), Neumayer (2004) and many others, have mainly utilized the share of resource rent to GDP or share of primary exports to GDP or total export as measures of resource abundance endowments. However, these measures reflect the country's dependency on natural resources rather than resource abundance. According to Brunnschweilera and Bulte (2008) resource dependence has nothing to do with economic growth, while resource abundance can positively add to the growth of a country, given good quality of institutions and other constitutional factors. Kropf (2010) holds a similar view and strikes a dissimilarity between resource dependence and resource abundance, where the former measures the level of consumption in economies that depends on production and export of natural resources, whereas the latter is an indicator of a country's natural resource endowment that may be assessed by the per capita annual rent of resource production.

In light of these considerations and the conflicting results in the empirical literature, this study re-examines the relationship of a country's natural resource endowment and institutional quality on economic performance. Our study contributes to the related literature in several ways. First, previous studies largely provide evidence from a small sample of countries or an individual country's standpoint. Also, past studies that covered a group of countries mostly use a short time span. We use a large sample, 137 countries, over the period 1995–2018. Second, unlike previous studies, we focus on asset measures in our analysis. Specifically, previous studies have mainly used flow variables for measuring resource endowments, such as resource rent, oil rent, natural resource export and others. Some studies (e.g., Brunnschweilera and Bulte, 2008) argued that using these measures may lead to a false conclusion. Given that, we use the total natural resource wealth to understand the nexus between economic growth and resource endowment. Therefore, we use natural wealth[2] as a measure of resource endowment, that is an appropriate measure of resource richness. Third, as widely discussed in the literature, governance and institutions are critical factors in determining the effect of resources on growth; therefore, we test their individual and combined effect on growth. Fourth, previous studies also indicated that the findings are critically dependent on the choice of econometric methods used for the empirical investigation. The empirical models, including resource and growth, are subject to heterogeneity and endogeneity issues. Considering the importance of these aspects, we employ the methods such as the fixed effect and two-stage instrument variable method that takes care of these issues in the analyses.

Finally, we include human capital and produced capital as control factors in the growth model. The measure of human capital is not restricted to only years of schooling, instead, it is a complete index that also accounts for other relevant facets. Since the previous studies have highlighted the significance of the quality of institutions and governance, we have taken various measures of them in the estimation. In view of the demographic diversification across the selected sample countries, the study measures all the variables in per capita terms to capture a more realistic relationship.

Our efforts in this study are likely to offer some critical policy recommendations. The most notable is using wealth data in the analysis to measure natural resource abundance more authentically. Therefore, the policy response to the curse or blessing should be prepared more confidently. Moreover, using better proxies of the critical control variables related to institutional, human and physical capital indicators in the growth models and estimating their effects on income may help governments to formulate growth and development policies. More importantly, these policy recommendations can be charted separately for developed and developing economies as we are set to offer evidence for both types of economies.

The empirical results of our study show that natural capital has a significant positive relationship with economic performance. The study reveals a similar relationship between growth and institutional indicators such as corruption, rule of law and effectiveness of government agencies and trade. These results are fairly consistent for both developing and developed economies. Based on these evidences, we reject the resource curse hypothesis and support the resource blessing hypothesis.

The main implications of the study are as follows: natural capital plays a vital role in driving economic growth. However, the policy authorities should note that by having a natural capital or resource abundance will not simply help them to achieve their desired economic growth targets; so they must ensure that they have all the supporting players in place such as the produced capital (e.g., machinery and buildings), high-quality human capital and desired international trade policies. In addition to that, the concerned authorities should also pay attention to improving the institutional setup by controlling the level and degree of corruption and ensuring the rule of law and government effectiveness, as these factors have an indispensable role in driving economic growth and prosperity.

The rest of the paper is organized as follows: Section 2 presents an overview of the existing literature. Section 3 explains the data and methodology employed in the analysis. Section 4 discusses the results of our empirical findings and Section 5 concludes the study.

2. Review of literature

Evident from the older times and established by many growth theories, sufficiency in natural resources is centric to a country's growth and development. Improved sources of capital generation, advantages in international trade, sound financial position, and better infrastructure facilities are some of the manifold benefits of abundant natural resources. There is a voluminous literature that empirically examines the relationship between the presence of natural resources and rate of economic growth. However, not much consensus has been drawn thus far. Studies by Rodriguez and Sachs (1999), Gylfason (2000), Gylfason and Zoega (2006) and Sharma and Pal (2021) advocate the popular “natural resource curse”, famously argued by Sachs and Warner (1995, 1999, 2001), which examines the effect of the existence of natural resources on long-term economic growth and concludes that countries having vast reserves of natural resources tend to be sluggish than nations having scare allocation of natural resources. This argument traced a new path of empirical research and was followed extensively. In parallel, a positive relationship has been found between the economic growth and natural resource abundance by Brunnschweilera and Bulte (2008), Kropf (2010), Yang (2010), Sarmidi et al. (2014), Yanıkkaya and Turan (2018) and Haseeb et al. (2021).

There are several studies that investigated the justifications and sought marginal validation of the negative relationship between natural resources and economic growth. The foremost factor which affects this causation is the role of institutions and their quality. Bakwena et al. (2009) and Mehlum et al. (2006) support the view that irrespective of institutional design and components of performance, the presence of good quality institutions can help in abating the natural resource curse by diminishing rent-seeking activities, reducing corruption and bureaucracy and ensuring proper assignment of property and contractual rights. On the contrary, Tamat Sarmidi et al. (2014) have shown natural

[1] Refer to Havranek et al. (2016), and Badeeb et al. (2017) for further detailed discussion.

[2] The significance of this indicator is that it measures the resource abundance by using the valuation of fossil fuel energy, minerals and agricultural indicators (land, forests and protected areas). Therefore, it is a comprehensive measure of resource abundance.

resources can positively add to the economic growth of a country only after a certain threshold level of institutional quality. It is only the quality of institutions that can aid in neutralizing the impact of natural resource curse. Any country's institutional quality falling less of this specific level is considered as a low-quality institution and the ones exceeding this level are considered as a high-quality institution. Resource policy with good quality governance can insulate the economy.

A strong emphasis has also been put on the fact that the countries with efficient institutions are comparatively less reliant on natural resources as a path to economic growth. Yang (2010) has put forward that there exists no outstanding share of institutions to get away from the resource curse, especially in developing nations where the curse is generally perceived to be more dominant. In the short run, for countries with low quality institutions, government policy tends to be more pertinent in neutralizing the effects of the curse by various transmission channels. Though institutions might prove to be centric in effectively mitigating the dismissive effects of resource abundance in the long period, government policy for the efficient usage of resources is the ultimate escape for the brief period. More recently, Bonet-Morón et al. (2020) have shown that the oil boom in Colombia has boosted local public investment. In addition, they have demonstrated that the effects were fuelled by institutional reform, highlighting the significance of the reform in avoiding a resource curse. Another facet of the resource curse was argued by Brunnschweilera and Bulte (2008), authors argue that the inappropriate use of resource dependence as a measure of natural resource availability and draw a distinction between resource abundance, which represents a stock measure of resource wealth, resource rents that capture the income stream procured from the stock of resources at some point in time and resource dependence which relates to the point to which a country does or does not has the option of income from other sources except extraction of natural resources. Contrasting with other studies, they observe resource dependence as endogenous and trace its insignificance in the growth and quality of institutions. Their findings stand opposite to the resource curse hypothesis, with resource abundance majorly associated with economic growth and institutional quality, implying vast reserves of natural resources lead to improved institutions and speedy economic growth. A similar conclusion was drawn by Kropf (2010). The author measures resource abundance by resource rent per capita produced annually, whereas resource dependence can be estimated by measuring the share of natural resources in total exports or in GDP. Also, selecting the appropriate method to estimate resource abundance is crucial in shaping the association between resource reserves and growth as mentioned by Brunnschweilera and Bulte (2008). Perhaps lesser importance can be accorded to the share of the export of natural resources over GDP because it encapsulates resource dependence instead of resource abundance.

Another line of argument stretches to the state of development in an economy as an explanatory variable of the pessimistic approach to the resource curse. Kronenberg (2004) shows that transition economies of the Eastern Bloc follow the path of developing countries; the higher the endowment of natural resources, the lower the growth rate. Even after accounting for various alternative factors, a significant negative correlation exists between natural resource sufficiency and economic growth. Amid the transition economies, the major causes of the curse were rigid corruption, higher bureaucracy and disregarding primary education. Investment of resource rents in preserving natural resources and upgrading human capital is the way out of the resource curse. Yanıkkaya and Turan (2018) examine the resource curse hypothesis and find significant evidence in favor of the view that resource abundance rather turns out to be a blessing for both advanced and emerging economies. Smith (2015) finds a positive correlation between natural resources and GDP per capita for developing countries in the long run but no outcome for developed nations. Haseeb et al. (2021) observe the validation of the resource curse in the top five Asian economies except for India. The study revealed a strong negative relationship between natural resource reserves and economic growth in the context of India.

Likewise, Gylfason and Zoega (2006) examine a distinct channel. They reveal that too much dependency on natural resources perhaps unfavourably impacts saving and investment and thereby growth in a country over a longer period. Accumulating too much of natural resources may crowd out physical capital, human capital and social capital, which would ultimately translate into lower rates of economic progress. Papyrakis and Gerlagh (2004) put forward the positive association of resource sufficiency and economic growth only if they are accounted for in isolation, without considering the other variables in the model like education, corruption, low investment and sinking terms of trade. If adverse indirect effects accruing to all such factors are taken into account, the overall impact of the natural resource curse stands valid. Also, according to Ross (2003), and Collier and Hoeffler (2005), the richness in natural resources might lead to hindrances in the political system, promote corruption and impede the functioning of institutions.[3]

Given the varying empirical pieces of evidence and arguments in the literature, this study is designed to investigate the impact of natural resource capital on economic growth by accounting for a number of key drivers of growth such as physical capital, human capital, institutional factors and trade using a comprehensive data set of 137 countries from 1995 to 2018. The study undertakes panel estimation techniques for the empirical investigation. The study is expected to significantly contribute to the literature on the nexus between natural resource capital and economic growth.

3. Data and methodology

3.1. Data measurement

The motive behind studying an extensive set of countries was to affirm the validity of the resource curse and identify the suitability of different control variables. Following Khanna (2017), Sharma and Pal (2021) and others, we measure the economic growth by the level of GDP per capita (YCAP) instead of calculating growth in GDP for each year as the former is a better indicator of point-source welfare, which captures the consumption welfare in true (Rodrik et al., 2004, Alexeev and Conrad (2009, 2011).[4] GDP per capita has been extracted from the World Development Indicators (WDI) of the World Bank.

Our variable of primary interest is natural capital (NC) per capita, which incorporates the valuation of fossil fuel energy, minerals and agricultural indicators (land, forests and protected areas). This series is obtained from the Wealth Accounts (WA thereafter) of the World Bank. This indicator is rather untapped and has not been widely explored in past studies. Previous studies have mainly used measures such as primary exports over GDP, rents from natural resources over GDP, share of mineral exports in total exports and others as indicators of resources endowments. However, these are mainly resource dependency measures; thus, they are possible to be endogenous factors (e.g., Wright and Czelusta, 2004). Our indicator instead measures natural wealth and assets, which are likely to work better in empirical analysis. Our analysis

[3] Considering the space constraint, a limited number of studies and issue have been discussed in our review section. A summary of recent studies is also presented in **Appendix – 1**.

[4] We utilize per-capita GDP as it is a better measure of development and prosperity. Growth might be more appropriate for measuring short-run effects. Since our model is mainly focusing on the development and natural wealth relationship and that is indeed a long-run issue, therefore, per-capita income is a more suitable measure. We do accept that in standard literature, both, GDP growth as well as per-capita GDP, are used as dependent variables. However, meta-analysis results show that the selection of one over the other makes no significant difference in results (see Havranek et al. (2016), pp.141 and Table 4).

covers a panel of 137 countries from 1995 to 2018. The study undertakes five-yearly data because of the data available at this frequency from resource wealth data of the World Bank.[5]

Our study also accounts for other potential determinists of economic growth, such as the produced capital (PC) and human capital (HC), which are measured in per capita terms. The produced capital is measured using the value of machinery and buildings, whereas the human capital is computed using the present value of future earnings for the working population over their lifetimes. These measures are also drawn from the WA. Both these forms of capital, along with natural capital, are centric to the production process. Another factor that may have a critical role in development of an economy is openness. This is proxied by trade a percentage of GDP (XM). Furthermore, acknowledging the importance that institutions play in the process of economic development, this study also makes use of number of institutional quality indicators in the model. Specifically, study considers government effectiveness (GE), regulatory quality (RQ), political stability and absence of violence (PS), rule of law (RL), and control of corruption (COC). The data on these indicators are obtained from the World Governance Index (WGI). The complete list of variables and their sources are provided in Appendix – 2, while sample countries are presented in Appendix – 3:

3.2. Stylized facts

To understand the data and their inter-relationship, we present the list of the top 20 resource-rich and resource-poor countries in Table 1. The indicative barometer is taken to be resource abundance measured by natural capital (per capita), which is averaged for the entire study period. Average total natural resources rents, which depict the resource dependence and average per capita income of the observed nations, have also been reported. On careful scrutiny of these statistics, we can identify the oil-enriched OPEC countries to be the most resource-abundant, wherein Kuwait tops the list with $468.21 thousand of per capita natural resource followed by Qatar, the UAE and Saudi Arabia. On reviewing the least resource abundant nations, Singapore turns out to be the most resource-poor country, with merely $50 natural capital. According to Cale et al. (2017), one plausible explanation for the same can be the lack of raw material and lesser geographic land area that the country possesses. The other group of resource-shrunk nations consists South Asian countries like Bangladesh, India, Nepal, Pakistan and Sri Lanka, among others. When considering the measure of resource dependency, Iraq and Uganda emerge as the topmost nations among the resource-enriched and resource-impoverished categories of nations, respectively. These statistics show resource abundance and economic performance are complicated and perhaps conditional, i.e., depending on several other factors.

Table 1
List of countries having the most and the least natural resource abundance.

Most resource abundant countries			
	Natural Capital per capita	Natural resources rents	GDP per capita
Australia	134.12	5.51	48.96
Brazil	29.37	3.53	10.08
Canada	42.86	2.82	44.37
Chile	34.92	12.12	11.75
Gabon	90.96	30.01	9.82
Guyana	36.29	18.64	2.89
Iraq	39.40	47.87	4.33
Kazakhstan	47.65	19.80	7.55
Kuwait	468.21	45.71	40.07
Mongolia	39.82	21.73	2.53
Norway	88.48	8.20	85.51
Oman	95.93	37.10	17.75
Papua New Guinea	33.98	28.29	1.90
Qatar	383.99	32.62	64.48
Russian Federation	39.30	14.26	9.10
Saudi Arabia	173.37	1.38	19.43
Suriname	76.62	17.08	7.18
Turkmenistan	53.31	42.46	4.01
United Arab Emirates	268.30	20.57	49.75
Venezuela	33.93	7.50	12.53
Least resource abundant countries			
	Natural capital per capita	Natural resources rent	GDP per capita
Bangladesh	1.60	0.91	0.72
Belgium	5.31	0.02	42.08
Cambodia	4.54	3.38	0.69
Dominican Republic	5.24	1.17	5.05
Hungary	5.97	0.48	12.56
India	3.36	3.17	1.21
Japan	3.45	0.02	44.21
Lebanon	6.03	0.21	6.24
Maldives	0.47	0.01	6.54
Mauritius	3.65	0.01	7.21
Moldova, Republic Of	6.05	0.26	1.77
Nepal	5.72	1.15	0.56
Pakistan	5.66	1.74	0.95
Philippines	4.46	1.75	2.02
Senegal	3.52	0.12	1.23
Singapore	0.05	0.02	42.32
Sri Lanka	3.40	0.02	2.52
Tajikistan	5.52	1.33	0.66
Thailand	5.26	2.04	4.60
Uganda	5.39	14.51	0.54

Source: Authors calculations, World Bank 2018.Notes: (1) Natural capita per capita and income per capita are measured in $US thousands while natural resource rents are expressed as a percentage of GDP. (2) Values reported are averaged over the time period of study. (3) The least resources abundant countries are opted by author's discretion (Ignoring the diminutive countries).

3.3. The model setting and estimation techniques

By making use of underlying theoretical models and empirical literature, we frame the following empirical model to determine the influence of natural resources on per-capita income:

$$YCAP = f\ (PC, HC, XM, IF, NC) \tag{1}$$

where YCAP, PC, HC, XM, IF and NC stand for per-capita income, physical capital (produced capital), human capital, trade, institutional factors and natural resource capital, respectively.

$$ln\ (YCAP)_{it} = \beta_0 + \beta_1 ln(PC)_{it} + \beta_2 ln(HC)_{it} + \beta_3 ln(XM)_{it} + \beta_4 ln(IF)_{it} + \beta_5 ln(NC)_{it} + \delta_i + u_{it} \tag{2}$$

where ln, i and t stand for natural logarithms, cross-section (country) and time period (year), respectively. β_s are parameter to be estimated. It is noteworthy to mention that we specifically interested to know the sign of β_5 as its positive (negative) sign indicates for resource blessing (resource curse) phenomenon. Likewise, δ and u *account for* country fixed effect and error term in the model, respectively.

As discussed previously, the quality of institutions and resource endowment interplay is critical in determining the resource effect on income (e.g., see Bonet-Morón et al. (2020)). The estimated results reported by Mehlum et al. (2006) and Boschini et al. (2007) show that the effects of resources are negative and institutions are positive. However,

[5] The World Bank's (2021) wealth data encompasses 146 countries and spans >20 years (from 1995 to 2018). The data is available at five-yearly frequency. We limit our analysis to 137 countries as some countries are not listed in ICRG database which we use for institutional indicators.

their inter-play is positive. Thus, the obvious question arises – is the joint effect of quality of institutions and resource endowment good enough to negate the inverse effect of resource endowment sufficiently? To know this, we also examine the joint effect of institutions and natural wealth in an alternative setup.

Therefore, we include institutions and resource endowment in the alternative setup. Specifically, we estimate the following model:

$$ln\ (YCAP)_{it} = \beta_0 + \beta_1 ln(PC)_{it} + \beta_2 ln(HC)_{it} + \beta_3 ln(XM)_{it} + \beta_4 ln(IF)_{it} + \beta_5 ln(NC)_{it} + \beta_6 \left(ln(NC)_{it} \times ln(IF)_{it}\right) + \delta_i + u_{it} \quad (3)$$

In this equation β_6 discloses the combined role of institution and resource endowment on per capita income. This equation also reveals the marginal effect of other drivers of economic performance.

To estimate the above models, we choose two alternative methods. First, following Collier and Goderis (2007) and Cockx and Francken (2016), we use ordinary least square fixed effect (FE) method. The fixed estimator eliminates the effect of time-invariant attributes, allowing us to evaluate the determinants' net effect on the outcome variable. Another critical assumption of the FE method is that such time-invariant traits are unique to the individual and must not be associated with other features of the individual. Because each entity is unique, its error term and constant (which capture its unique properties) should be uncorrelated. Our procedure incorporates country-specific heterogeneity by allowing cross-section fixed effect. Precisely, this procedure takes care of unobservable time-invariant country-specific heterogeneity in the estimation.

However, if the error terms are likely to correlate with explanatory variables, then FE method is not a suitable one to draw inferences and estimated coefficients may be biased. The previous studies, such as Boschini et al. (2013) and Apergis and Payne (2014) pointed out that endogeneity and correlated individual effects pose a serious challenge in the estimation when examining the growth, institution and resource equation. The obvious solution to these problems is adopting an instrument variable method. The first choice of estimator is obviously System GMM proposed by Arellano and Bover (1995) and Blundell and Bond (1998). However, the GMM estimator takes lag of the dependent variable, which leads to loss of data point. Considering the limited data points, we employ two stage instrument variable method designed for panel data estimation technique for models with endogenous variables. This is one of the most effective and convenient approaches for addressing endogeneity caused by omitted variables, measurement error, simultaneity, and common procedure bias (Kennedy, 2003; Cameron and Trivedi, 2010; Greene, 2005). The model is as follows:

$$Y_{it} = X_{it}\beta + \delta_i + u_{it} \quad (4)$$

where Y_{it} is the dependent variable. X_{it} is a 1 × g vector of observations on g endogenous variables incorporated as covariates, and these variables are allowed to be associated with the u_{it}. β is a gx1 vector of coefficients and δ is firm-specific fixed effect. The order condition is satisfied if $k \geq g$. Specifically, we estimated the first stage as follows:

$$Z_{it} = X_{it-1}\beta + \Delta Y_{it-1} + \delta_i + e_{it} \quad (5)$$

In the equation, first lag of X and first difference lag of Y is used as explanatory variables in the model. Finally, in the second stage, we estimate following equation:

$$Y_{it} = \widehat{Z}_{it}\gamma + \delta_i + \acute{u}_{it} \quad (6)$$

where $\widehat{Z}$ is predicated value obtained from the first stage (Eq. (5)) and γ is K x1 vector of coefficients.

Consequently, we employ the second estimation technique in the paper i.e., panel two-stage least square method with country fixed effect. In absence of finding suitable instruments, we use lags of variables as instruments which perform suitably.

4. Empirical results

The main objective of this study is to investigate the role of natural resources in economic performance of selected sample countries using the latest data and reliable panel estimation techniques. More specifically, to account for the country-specific effects, we estimate the model with fixed effect method and its results are presented in Table 2. We present results on five different models to account for various measures of institutional quality indicators.

Columns 1 to 5 show the results that allow cross-section fixed effects. Our findings establish a significant positive relationship between natural resources per capita and per capita income, indicating the encouraging role of natural resources in economic development. However, the measure of resource abundance stands positive but statistically significant only when we consider institutional factors such as the control of corruption and effective governance. The coefficient estimates range from 0.038 to 0.045, meaning if natural resource per capita is increased by 1%, then per capita income would increase by 0.038% to 0.045%. It is worth taking note of relatively smaller point estimates than earlier studies. A plausible explanation for the same could be that the fixed effect estimator is robust to capture the homogeneous attributes that each panel sample carries. The indicators of institutional quality, namely, control of corruption, political stability and absence of violence, rule of law and regulatory quality, are statistically significant; however, government effectiveness is found to be insignificant. Further, keeping aside the regulatory quality, the rest of above stated measures of institutional quality produce a dampening effect on per capita income.

To incorporate the possible macroeconomic and technological shocks, we also include time fixed effects (TFE). The inclusion of time-effects reduces the possibility of omitted variable bias caused by not incorporating unobserved factors that move over time. Thus, we repeat the analysis but with TFE, columns 6 to 10 of Table 2 present these results. The estimated coefficients of natural resource have gone up in all cases and all models demonstrate a positive and statistically significant relationship. However, the inclusion of unobserved time-effects made all governance-related indicators insignificant; perhaps governance and regulatory related reforms are well captured by time-dummies.[6]

In the next stage, following Rodrik et al. (2004) and Arezki and Ploeg (2010), we employ two-stage instrumental variables method that may address the potential endogeneity problem in the models. Since finding suitable instruments is very difficult; hence, we choose to use first difference lags as instruments in the model. The results are reported in Table 3. The findings show that the natural resource capital is statistically significant and positive in all cases (columns 1 to 5). Although the estimated coefficients vary to some degree across the models, when different institutional variables are used in the models yet, the effect is sizable across the models. Specifically, the effect on income varies from 0.17% to 0.26% in response to a 1% increase in natural capital. Focusing on the results of institutional indicators, which suggest that all other indicators are statistically significant except political stability. Specifically, control on corruption, rule of law and government effectiveness have a significant positive relationship with growth, while regulatory quality negatively influences. The possible argument is that a higher regulatory structure may become an obstacle to economic growth and development due to the extreme interference of government officials.

Comparing these results with those of FE-OLS suggests that after controlling endogeneity issues at least to some extent in the models, the natural capital coefficients become statistically significant in all the models and the degree and nature of the role of institutional quality

[6] Carter and Signorino (2010) argue that due to high multicollinearity, time-dummies may not be appropriate, polynomial terms of time-dummies may work better. With these consideration, we also tried polynomial terms; however, the results are broadly unchanged. These results are not reported due to space constraints.

Table 2
Fixed effect regression- natural resources and GDP per capita.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	ln(YCAP)	ln(YCAP)	ln(YCAP)	ln(YCAP)	ln(YCAP)	ln(YCAP)	ln(YCAP)	ln(YCAP)	ln(YCAP)	ln(YCAP)
ln(NC)	**0.0446***	**0.0391**	**0.0382**	**0.0397**	**0.0420***	**0.0527****	**0.0467****	**0.0492****	**0.0479****	**0.0514****
	(0.0246)	**(0.0243)**	**(0.0241)**	**(0.0241)**	**(0.0251)**	**(0.0228)**	**(0.0229)**	**(0.0227)**	**(0.0226)**	**(0.0229)**
ln(PC)	0.105**	0.0997**	0.0980**	0.113**	0.135**	0.0743**	0.0838**	0.0833**	0.0828**	0.0938**
	(0.0284)	(0.0286)	(0.0283)	(0.0279)	(0.0302)	(0.0254)	(0.0254)	(0.0253)	(0.0251)	(0.0267)
ln(HC)	0.602**	0.607**	0.604**	0.591**	0.621**	0.484**	0.487**	0.487**	0.481**	0.493**
	(0.0306)	(0.0305)	(0.0303)	(0.0312)	(0.0308)	(0.0306)	(0.0305)	(0.0306)	(0.0311)	(0.0307)
ln (XM)	0.205**	0.200**	0.206**	0.199**	0.203**	0.0525	0.0532	0.0496	0.0511	0.0341
	(0.0368)	(0.0374)	(0.0366)	(0.0368)	(0.0396)	(0.0367)	(0.0367)	(0.0369)	(0.0366)	(0.0387)
ln (COC)	−0.0594**					0.000659				
	(0.0244)					(0.0234)				
ln (PS)		−0.128*					0.0502			
		(0.0712)					(0.0684)			
ln (RL)			−0.101**					0.0270		
			(0.0405)					(0.0411)		
ln (RQ)				0.0637**					0.0261	
				(0.0228)					(0.0219)	
ln(GE)					−0.0637					0.0262
					(0.0513)					(0.0457)
Constant	−0.200	−0.114	−0.0949	−0.0114	−0.625*	−0.200	−0.114	−0.0949	−0.0114	−0.625*
	(0.307)	(0.318)	(0.312)	(0.318)	(0.328)	(0.307)	(0.318)	(0.312)	(0.318)	(0.328)
N	438	439	439	439	415	438	439	439	439	415
adj. R^2	0.644	0.644	0.648	0.649	0.662	0.644	0.644	0.648	0.649	0.662
Cross-section fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effect	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$.

Table 3
2SLS-IV regression- natural resources and GDP per capita.

	(1)	(2)	(3)	(4)	(5)
	ln(YCAP)	ln(YCAP)	ln(YCAP)	ln(YCAP)	ln(YCAP)
ln(NC)	**0.257****	**0.176****	**0.214****	**0.172****	**0.190****
	(0.0772)	**(0.0690)**	**(0.0625)**	**(0.0745)**	**(0.0626)**
ln(PC)	0.236**	0.192**	0.247**	0.300**	0.219**
	(0.0695)	(0.0550)	(0.0585)	(0.0770)	(0.0668)
ln(HC)	0.339**	0.394**	0.387**	0.378**	0.467**
	(0.0718)	(0.0564)	(0.0589)	(0.0611)	(0.0610)
ln (XM)	0.149**	0.140**	0.172**	0.102	0.108
	(0.0697)	(0.0644)	(0.0637)	(0.0730)	(0.0679)
ln (COC)	0.156**				
	(0.0724)				
ln (PS)		−0.405			
		(0.257)			
ln (RL)			0.179*		
			(0.107)		
ln (RQ)				−0.188*	
				(0.106)	
ln(GE)					0.814**
					(0.396)
Constant	−0.211	0.152	−0.580	−0.498	−0.199
	(0.515)	(0.594)	(0.459)	(0.478)	(0.534)
N	324	326	326	326	304
R^2	0.92	0.9360	0.9369	0.9410	0.9361
Sargan-Hansen statistic	9.372	7.599	10.934	6.033	4.094
F-Stat	(0.0022)	(0.0058)	(0.0009)	(0.0140)	(0.0430)

Standard errors in parentheses.
* p < 0.10, ** p < 0.05.
Note: all models are estimated using panel TSLS with FE estimator. First difference of explanatory variables and first lag of dependent variable is used as instruments. All variables are treated endogenous variables. Sargan-Hansen statistic is a test of an instrumental variables estimation, with H0 that the excluded instruments are valid instruments, i.e., uncorrelated with the error term and correctly excluded from the estimated equation.

indicators have substantially reversed. These changes perhaps indicate that FE-OLS estimated coefficients might be biased due to the presence of endogeneity in the models. Specifically, it seems that wealth or resource and institutional indicators suffer from dynamic endogeneity due to simultaneity problems (Wooldridge, 2002). Resources and institutional factors with economic growth are likely to have a two-way relationship. This perhaps led to a correlation between the error terms and these variables, which might have caused for inconsistent and biased coefficients yielded by the FE regression. The results of IV regression seem to be more reliable and consistent as biasness has been, at least to some extent corrected.

In the next step, we estimate the combined effects of natural wealth and institutional factors on economic performance. For the estimation, we again use panel-IV estimator with country fixed effect. Estimated results are displayed in Table 4. Results show that the individual effect of natural wealth is statistically significant only for models 1 to 3. Particularly, the natural capital coefficients range from 0.215 and 0.287, which means that a 1% increase in natural capital raises per capita income by 0.22% to 0.29%, ceteris paribus. Important to note that the estimated size of coefficients of natural capital is not significantly different from previously reported results (Table 3).

Moreover, in these cases, the individual association between the institution as well as the interaction effect is not turned out to be statistically significant. The only exception is government effectiveness which is positive and significant. Also, the interaction term with NC is statistically significant and negative. However, the interpretation of these results is complicated as NC is individually statistically not significant. Nevertheless, it indicates some combined adverse effects of active government or bureaucracy and availability of resource endowment.

Overall, the coefficient estimates of the joint association between institutional measures and resource endowment give us an inconclusive output. The centric role attributed to the quality of institutions in determining the resource curse by Mehlum et al. (2006), Bakwena et al. (2009), and Yang (2010), among others, can be almost denied in our analysis. Nevertheless, we do find the individual role of institutional factors such as regulation, control of corruption, and effective government. Yet, our analysis mostly shows that institutions are obstacles to

Table 4
2SLS-IV regression- Joint effect of natural resources and institutions on GDP per capita.

	(1)	(2)	(3)	(4)	(5)
	ln(YCAP)	ln(YCAP)	ln(YCAP)	ln(YCAP)	ln(YCAP)
ln(**NC**)	**0.216****	**0.215****	**0.287****	**0.0641**	**−0.00315**
	(0.0938)	**(0.100)**	**(0.0899)**	**(0.143)**	**(0.105)**
ln(PC)	0.225**	0.195**	0.261**	0.306**	0.196**
	(0.0696)	(0.0519)	(0.0592)	(0.0778)	(0.0611)
ln(HC)	0.336**	0.395**	0.391**	0.396**	0.453**
	(0.0721)	(0.0559)	(0.0591)	(0.0654)	(0.0573)
ln(XM)	0.152**	0.125*	0.150**	0.110	0.0898
	(0.0694)	(0.0706)	(0.0665)	(0.0748)	(0.0629)
ln(COC)	0.576				
	(0.530)				
ln(NC) × ln (COC)	−0.0458				
	(0.0572)				
ln (PS)		−1.600			
		(2.269)			
ln(NC) × ln (PS)		0.127			
		(0.235)			
ln (RL)			−0.950		
			(0.875)		
ln(NC) × ln (RL)			0.129		
			(0.0989)		
ln (RQ)				1.796	
				(2.228)	
ln(NC) × ln (RQ)				−0.219	
				(0.246)	
ln(GE)					3.208**
					(1.081)
ln(NC) × ln (GE)					−0.297**
					(0.136)
Constant	0.280	−0.194	−1.312*	0.208	1.811*
	(0.810)	(0.805)	(0.727)	(0.927)	(0.970)
N	324	326	326	326	304
R^2	0.9234	0.9331	0.9280	0.9487	0.9528
Sargan-Hansen statistic	9.303	7.616	10.039	5.019	2.985
	(0.0023)	(0.0058)	(0.0015)	(0.0251)	0.0840

Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$.
Note: all models are estimated using panel TSLS with FE estimator. First difference of explanatory variables and first lag of dependent variable is used as instruments. All variables are treated endogenous variables. Sargan-Hansen statistic is a test of an instrumental variables estimation, with H0 that the excluded instruments are valid instruments, i.e., uncorrelated with the error term and correctly excluded from the estimated equation.

the economies that are growing faster. The other important driver of economic performance is trade, which role is consistent with the expected lines, both theoretically and empirically. Specifically, it turns out to be statistically significant under different models and demonstrates the central role in determining income per capita in the selected sample countries.

By keeping various aspects of analysis into consideration, our estimates are in line with Kropf (2010), Yang (2010), Sarmidi et al. (2014), Smith (2015), Yanıkkaya and Turan (2018), Haseeb et al. (2021), and Shahbaz et al. (2018), we reject the natural resource curse hypothesis and conclude that resource abundance plays an important role in driving the economic development of the nations. The extent of correspondence between the two is further influenced by various control variables, some of which this study has accounted for.

Table 5
2SLS IV regression- natural resources and GDP per capita for lower and lower-middle income economies.

	(1)	(2)	(3)	(4)	(5)
	ln(YCAP)	ln(YCAP)	ln(YCAP)	ln(YCAP)	ln(YCAP)
ln(NC)	**0.303****	**0.176****	**0.208****	**0.100**	**0.188****
	(0.101)	**(0.0730)**	**(0.0678)**	**(0.108)**	**(0.0817)**
ln(PC)	0.186**	0.182**	0.213**	0.383**	0.147*
	(0.0941)	(0.0667)	(0.0623)	(0.134)	(0.0805)
ln(HC)	0.377**	0.447**	0.460**	0.497**	0.529**
	(0.0815)	(0.0591)	(0.0557)	(0.0704)	(0.0696)
ln(XM)	−0.0179	0.0300	0.0322	0.00440	0.0922
	(0.0997)	(0.0801)	(0.0800)	(0.0981)	(0.0985)
ln(COC)	0.190**				
	(0.0870)				
ln(PS)		−0.330			
		(0.402)			
ln(RL)			0.0863		
			(0.126)		
ln(RQ)				−0.286*	
				(0.173)	
ln(GE)					0.723**
					(0.302)
Constant	−0.269	−0.292	−0.764	−1.683*	−0.301
	(0.805)	(0.807)	(0.572)	(0.883)	(0.791)
N	118	120	120	120	100
R^2	0.7396	0.7752	0.7775	0.7886	0.7826
Sargan-Hansen statistic	3.214	4.929	6.895	0.528	0.566
	(0.0730)	(0.0264)	(0.0086)	(0.4674)	(0.4518)

Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$.
Note: all models are estimated using panel TSLS with FE estimator. First difference of explanatory variables and first lag of dependent variable is used as instruments. All variables are treated endogenous variables. Sargan-Hansen statistic is a test of an instrumental variables estimation, with H0 that the excluded instruments are valid instruments, i.e., uncorrelated with the error term and correctly excluded from the estimated equation.

4.1. Sub-sample analysis

We further undertake our analysis by dividing the sample countries into two groups: the lower and lower-middle income and upper-middle and high-income economies. It is also crucial to understand role of different economic categories. In this context, Larsen (2005) posed a crucial question: are resource-rich economies resistant to the resource curse? In the case of Norway, the author was unable to give any conclusive evidence. It is likely that high-income countries make better use of natural resources and do it more efficiently. This is due to the fact that such economies have far superior resource extraction and utilization technologies. We look at the issue for two groups: poorer and lower-middle income economies, and higher and upper-middle income economies. We utilize the World Bank's income classification for this purpose.

Similar to prior findings, the interaction associations are equivocal here as well, thus we exclude them in our analysis. Table 5 shows the findings for economies with lower and lower-middle incomes. In all cases, natural capital (NC) is positive, and the estimated coefficients are slightly larger than the overall values (comparing with the results of Table 3). Controlling corruption and improving government performance have been demonstrated to have favorable inter-relationship, similar to prior findings, whereas regulation quality has a negative influence.

When looking at the results of upper-middle and high-income economies (Table 6), the picture is a little different. In contrast to corruption, regulation, and government efficiency, the coefficients of

Table 6
2SLS IV regression- natural resources and GDP per capita for higher and upper-middle income economies.

	(1)	(2)	(3)	(4)	(5)
	ln(YCAP)	ln(YCAP)	ln(YCAP)	ln(YCAP)	ln(YCAP)
ln(NC)	**0.246****	**0.171**	**0.216***	**0.279****	**0.151**
	(0.116)	**(0.120)**	**(0.120)**	**(0.122)**	**(0.125)**
ln(PC)	0.243	0.195	0.303**	0.182	0.511**
	(0.160)	(0.134)	(0.150)	(0.141)	(0.196)
ln(HC)	0.319**	0.366**	0.318**	0.346**	0.248*
	(0.149)	(0.124)	(0.138)	(0.127)	(0.127)
ln (XM)	0.374**	0.293**	0.368**	0.393**	−0.0525
	(0.133)	(0.129)	(0.130)	(0.152)	(0.138)
ln (COC)	0.0765				
	(0.143)				
ln (PS)		−0.479*			
		(0.283)			
ln (RL)			0.290*		
			(0.174)		
ln (RQ)				0.136	
				(0.169)	
ln(GE)					0.417
					(2.074)
Constant	−0.758	0.0983	−1.007	−0.831	0.116
	(0.843)	(0.892)	(0.818)	(0.836)	(1.384)
N	206	206	206	206	204
R^2	0.8132	0.8582	0.8533	0.7635	0.9215
Sargan-Hansen statistic	3.592	2.370	2.765	7.538	1.182
	(0.0581)	(0.1237)	(0.0964)	(0.0060)	(0.2770)

Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$.
Note: all models are estimated using panel TSLS with FE estimator. First difference of explanatory variables and first lag of dependent variable is used as instruments. All variables are treated endogenous variables. Sargan-Hansen statistic is a test of an instrumental variables estimation, with H0 that the excluded instruments are valid instruments, i.e., uncorrelated with the error term and correctly excluded from the estimated equation.

natural, physical, and human capital assets are not always substantial. Overall, our results confirm that natural capital has a positive effect for all income categories, high income and low income, economies. The institutional factors do vary as per income-level that is understandable.[7]

5. Conclusion

Numerous empirical attempts have been made in the literature to examine whether natural resources are proven to be a blessing or curse for economic development, and yet to achieve conclusive evidence on this aspect. For instance, the findings from Sachs and Warner (1995, 1999, 2001), Rodriguez and Sachs (1999), Gylfason (2000), Gylfason and Zoega (2006), among others, are in favor of the natural resource curse. In contrast, the studies of Brunnschweilera and Bulte (2008), Kropf (2010), Sarmidi et al. (2014), Yanıkkaya and Turan (2018), Haseeb et al. (2021) are of the opinion that natural resources pave the path for economic development. There exist voluminous literature concerning the imperative factors and transmission mechanisms as to how resource rich economies grow poorly. Specifically, they argue that the quality of institutions, fixed capital formation, investment in human capital, the structure of trade policies and governing efficiency, among others, play an indispensable role in the nature and degree of nexus between natural resources and economic growth in any given country. Further, the divergent and indecisive outcomes of distinctive studies can be attributed to the choice of variables together with econometric techniques to estimate the models that capture the dynamic linkage between resource abundance and economic growth.

Given the above background, we explored the nexus between resource abundance and economic growth in this study and provided some robust evidence regarding the resource curse hypothesis. We use a relatively less explored wealth database and analysis covers a large number of countries around the world. We employed the estimation methods that capture cross-country heterogeneity and take care of the issue of endogeneity to some extent. Our results established that the resource wealth of nations matter for their economic growth. Further, our findings strongly reject the 'resource curse' hypothesis. The evidence is consistent across the estimators and income groups of countries. Our findings are in consonance with Kropf (2010), Smith (2015), Yanıkkaya and Turan (2018), Shahbaz et al. (2018), and Haseeb et al. (2021). On considering various institutional quality indicators, we found that quality of institutions is a critical factor in governing the growth and development in a country. However, contrary to the evidence of Mehlum et al. (2006) and others that the quality of institutions plays a critical role in the resource-growth linkage. We find that such linkage or dependency is widely missing for developed as well as developing countries. The possible reason for such divergence could be that those studies rely primarily on resource dependency indicators of natural resources. Nonetheless, we can deduce that tighter governance and policies in a nation hampers the effective allocation and functioning of the resources, which finally lead to some unfavorable consequences for economic growth. Finally, we also disclosed some evidence for the trade-led growth phenomenon, yet, for developing countries groups, this phenomenon is widely missing.

Based on these findings, this research has substantial policy implications and adds to the empirical literature on the relationship between resource abundance and economic growth. In particular, our research revealed that natural capital played a significant positive role in economic performance of the countries. Given this, the policymakers must realize that while natural capital or resource abundance is important, they should also ensure that the countries should have appropriate international trade policies. On a similar note, policymakers should also pay special attention to improving the quality of institutional factors such as corruption control, rule of law, and government effectiveness. Each of them share a substantial positive inter-relationship with economic growth. Finally, this research contributes to the empirical literature by providing fresh information on the measurement of natural, manufactured, and human capital. As a result, the findings of this research are crucial in understanding the importance of resource abundance and its interplay with institutions on determining economic development and growth.

Like any other research attempt, this study is also not without limitations. We have considered natural wealth to analyze the effects of resource abundance on economic performance. However, effects of sectoral wealth data, such as oil, gas, coal, bauxite, copper, gold, iron ore, lead, nickel, phosphate, silver, tin, agricultural land and forests, might be examined separately on economic performance. These resources may have a varying effect on economic performance. Thus, future studies may extend our models by examining these sectoral effects, which will have more implementable policy relevance.

Credit author statement

Chandan Sharma: Conceptualization, Data curation, Methodology, Formal analysis, Writing – original draft.

Sudharshan Reddy Paramati: Writing – original draft, writing –

[7] The first stage worked well in almost all cases. Due to space constraint, we have not presented full first stage results. Nevertheless, we report F stat of first stage, please see Appendix-4. In majority of cases F statistics is above 10. Instruments for our prime focus variables related natural capital and institutions worked well in almost all occasions. Furthermore, we also conduct sys-GMM analysis on our model; however, in most of the cases models are not identified. Therefore, these results are not presented in study as they are not reliable.

review and editing.

Appendix 1. A brief literature review

Author	Data period	Sample	Model	Key findings
Sachs and Warner (1995)	1970 to 1989	Data for 18 countries	Cross-country regression	Statistically significant, inverse and robust relationship between natural resources and growth
Sachs and Warner (1999)	1965 to 1990	11 Latin American Countries	Cross-country regression	In line with the resource curse. Natural resource abundant countries tended to have slower growth in exports of manufactures
Rodriguez and Sachs (1999)	1972 to 1993	Venezuela	OLS	Supports negative convergence of growth rate in presence of resource abundance
Gylfason et al. (1999)	1960 to 1992	Total 125 countries, accounted for in various groups	Cross-country regression, RE panel analysis	Statistically significant relationship between the size of the primary sector and the average rate of growth of output across countries
Sachs and Warner (2001)	1965 to 1990	7 Latin American Countries	Cross-country regression	Geographical or climate variables marginally justify the curse. Also, resource-abundant countries tended to miss out on export-led growth
Gylfason (2001)	1980 to 1997	85 countries	SUR model	Natural capital appears to crowd out human capital, thereby slowing down the pace of economic development.
Ross (2003)	1990 to 2002	17 countries	Summary of important findings	It suggests that resource dependence hampers the economic development and weakens structure of government.
Atkinson and Hamilton (2003)	1980 to 1995	Panel of 100 countries categorized on various parameters	Cross-country regression	Confirms the resource curse and provide evidence that inefficient macroeconomic policies and governance leads to low investment and genuine saving
Sala-i-Martin and Subramanian (2013)	1960 to 2000	Nigeria	Cross-country regression, 2SLS	Confirms the resource curse. However, natural resources such as oil and minerals mayor may not be a curse on balance. Poor institutional quality play major role.
Papyrakis and Gerlagh (2004)	1975 to 1996	47 countries	Cross-country regression	Acceptance of resource curse hypothesis if considered in isolation; inclusion of corruption, investment, openness, terms of trade and schooling rejects the hypothesis.
Tobias Kronenberg (2004)	1989 to 1999	26 countries	Pooled OLS	Resource curse (Corruption and neglect of education) is prime reason for slower growth rates among transition economies
Gylfason and Zoega (2006)	1965 to 1998	85 countries	Cross-country regression	Accumulation of physical capital, human capital and social capital inversely related to the share of natural capital in national wealth
Mehlum et al. (2006)	1965 to 1990	87 countries	Cross-country regression	Quality of institutions plays the centric role in avoiding the resource curse
Brunnschweilera and Bulte (2008)	1970 to 2000	60 countries	Pooled OLS	Traced the difference between resource dependence and abundance and find significant association with growth and institutional quality for the latter only.
Bakwena et al. (2009)	1984 to 2003	53 countries	OLS, 2SLS, GMM	Affirms the important role of institutional quality in turning natural resources into an economic boon
Van der Ploeg and Poelhekke (2009)	1970 to 2003	91 countries	Cross-country regression	Policy variability in inflation and government spending exerts a strong and negative impact on growth
Kropf (2010)	1973 to 2004	111 countries	OLS, 2SLS	Points out the traditional 'curse' measure as a proxy of resource dependence and not abundance; positive correlation between resource abundance and growth
Yang (2010)	1965 to 1990	87 countries	Cross-country regression	Government policies play a significant role in neutralizing the negative impact of resource abundance
Arezki and Ploeg (2010)	1965 to 2000	95 countries	OLS, IV	Resource curse is less severe in countries with less restrictive trade policies and good institutions
Sarmidi et al. (2014)	1984 to 2005	90 countries	Cross-country regression	Impact of natural resources is meaningful to economic growth only after a certain threshold point of institutional quality has been attained.
Smith (2015)	1950 to 2007	72 countries	Pooled OLS	Positive effects of natural resources on GDP per capita in the long term for developing countries while no effect for developed countries.
Cockx and Francken (2016)	1995 to 2005	140 countries	Fixed Effects Estimation	Inverse relationship between resource dependence and education spending that is robust to controlling for a range of additional covariates
Yanıkkaya and Turan (2018)	1970 to 2014	125 countries	GMM	Resource rents appear to be a blessing rather than a curse except for forest rents
Shahbaz et al. (2018)	1960 to 2016	United States of America	ARDL, VECM	Natural resource abundance contributes to financial development which promotes economic growth with positive effect of education and negative effect of capitalization
Damette and Seghir (2018)	1996 to 2011	26 developing oil exporting countries	PSTR	Detrimental effect of oil resources on the quality of government spending and economic development.
Henry (2019)	1980 to 2014	21 Sub-Saharan countries	CCEMG and DOLS	Confirms the resource curse universally. Countries with weak institutions are more vulnerable to the negative growth.
Haseeb et al. (2021)	1970 to 2018	5 Asian economies	QQ technique	Natural resources have a positive and significant impact on economic growth, except India.
Jianqiang et al. (2020)	1990 to 2017	G7 Countries	CCEMG, CS-ARDL, AMG	Resource abundance coupled with R&D leads to financial expansion but rising energy prices have the adverse effect
Guan et al. (2020)	1971 to 2017	China	ARDL, FMOLS, DOLS, CCR	Confirm China's resources curse hypothesis and shows the effect of natural resources on financial development is negative
Bonet-Morón et al. (2020)	2008–2016	Colombia	Difference-in–differences	A lower likelihood of a resource curse
Zakharov (2020)	2003 to 2013	74 Russian regions	IV estimation	An asymmetric relationship between oil rents and institutions, i.e., positive oil windfalls adversely affect institutional quality and negative oil windfalls have no impact

(*continued on next page*)

(*continued*)

Author	Data period	Sample	Model	Key findings
Mignamissi and Kuete (2021)	1990 to 2015	149 countries	OLS	Resource rents tend to reduce happiness, particularly in developing nations, subject to the political system, level of development, the types and the measures of natural resources and the scale of happiness
Sharma and Pal (2021)	1995 to 2015	111 countries	CS-ARDL, CS-DL	Support for the resource curse hypothesis, suggesting that resource-rich economies tend to grow at a slower rate in comparison to the resource-deprived ones.
Sharma and Mishra (2022)	1995 to 2018	141 countries	Panel quantile	Fuel export and oil–gas results support the resource curse. Corruption is key in determining the marginal impact of natural resources.

Abbreviations: OLS (Ordinary Least Square Estimator), 2SLS (Two-stage Least Square Estimator), GMM (Generalized Method of Moments), IV (Instrumental Variables Estimator), AMG (Augmented Mean Group Estimator), ARDL (Autoregressive Distributed Lag Model), CS-ARDL (Cross-Sectionally Augmented Autoregressive Distributed Lag Model), VECM (Vector Error Correction Model), PSTR (Panel Smooth Transition Regression Model), CCEMG (Common Correlated Effects Mean Group Estimator), DOLS (Dynamic Ordinary Least Square Estimator), FMOLS (Fully Modified Ordinary Least Square Model), QQ (Quantile-on-Quantile Regression), CCR (Canonical Cointegrating Regression).

Appendix 2. Measurement of variables and their sources

Variable	Definition	Source
ln(YCAP)	Log of GDP per capita (Constant 2010 U.S. dollars)	WDI (2018)
ln(PC)	Log of produced capital per capita (Constant 2014 US$)	Wealth Accounts (2018)
ln(HC)	Log of human capital per capita (Constant 2014 US$)	Wealth Accounts (2018)
ln(NC)	Log of natural capital per capita (Constant 2014 US$)	Wealth Accounts (2018)
ln(XM)	Log of trade (% of GDP)	ICRG (2019)
ln(COC)	Log of control of corruption (Score of countries ranging between 0 and 1)	ICRG (2019)
ln(PS)	Log of political stability and absence of violence (Score of countries ranging between 0 and 1)	ICRG (2019)
ln(RL)	Log of rule of law (Score of countries ranging between 0 and 1)	ICRG (2019)
ln(RQ)	Log of regulatory quality (Score of countries ranging between 0 and 1)	ICRG (2019)

Appendix 3. List of sample countries

Albania	Chile	Gabon	Jamaica	Moldova	Portugal	Thailand
Algeria	China	Gambia	Japan	Mongolia	Qatar	Togo
Angola	Colombia	Ghana	Jordan	Morocco	Romania	Trinidad And Tobago
Argentina	Congo	Greece	Kazakhstan	Mozambique	Russian Federation	Tunisia
Armenia	Congo	Guatemala	Kenya	Myanmar	Saudi Arabia	Turkey
Australia	Costa Rica	Guinea	N. Korea	Namibia	Senegal	Uganda
Austria	Cote d'Ivoire	Guinea-Bissau	S. Korea	Netherlands	Serbia	Ukraine
Azerbaijan	Croatia	Guyana	Kuwait	New Zealand	Sierra Leone	United Arab Emirates
Bahamas	Cuba	Haiti	Latvia	Nicaragua	Singapore	United Kingdom
Bahrain	Cyprus	Honduras	Lebanon	Niger	Slovenia	United States Of America
Bangladesh	Czech	Hong Kong, China	Liberia	Nigeria	Somalia	Uruguay
Belarus	Denmark	Hungary	Libya	Norway	South Africa	Venezuela
Belgium	Dominican	Iceland	Lithuania	Oman	Spain	Viet Nam
Botswana	Ecuador	India	Luxembourg	Pakistan	Sri Lanka	Yemen
Brazil	Egypt	Indonesia	Madagascar	Panama	Sudan	Zambia
Brunei Darussalam	El Salvador	Iran	Malawi	Papua New Guinea	Suriname	Zimbabwe
Bulgaria	Estonia	Iraq	Malaysia	Paraguay	Sweden	
Burkina Faso	Ethiopia	Ireland	Mali	Peru	Switzerland	
Cameroon	Fiji	Israel	Malta	Philippines	Syrian	
Canada	France	Italy	Mexico	Poland	Tanzania	

Appendix 4. First stage regression results: F statistics

Eq. no.	ln(PC)	ln(HC)	ln(NC)	ln (XM)	ln (COC)	ln (PS)	ln (RL)	ln (RQ)	ln(GE)
Table 3									
1	54.07 (0.00)	182.98 (0.00)	37.91 (0.00)	41.8 (0.00)	22.3 (0.00)				
2	64.65 (0.00)	186.81 (0.00)	36.02 (0.00)	41.91 (0.00)		21.27 (0.00)			
3	61.04 (0.00)	186.15 (0.00)	36.43 (0.00)	41.92 (0.00)			23.33 (0.00)		
4	61.33 (0.00)	187 (0.00)	36.03 (0.00)	45.98 (0.00)				17.52 (0.00)	
5	81.76 (0.00)	190.79 (0.00)	37.76 (0.00)	32.34 (0.00)					3.46 (0.00)
Table 4									
1	46.74 (0.00)	156.93 (0.00)	32.34 (0.00)	37.02 (0.00)	19.04 (0.00)				
2	62.70 (0.00)	162.54 (0.00)	30.77 (0.00)	35.98 (0.00)		25.85 (0.00)			
3	35.89 (0.00)	159.66 (0.00)	31.74 (0.00)	35.89 (0.00)			19.97 (0.00)		
4	56.31 (0.00)	160.09 (0.00)	31.31 (0.00)	39.22 (0.00)				16.44 (0.00)	
5	71.73 (0.00)	163.59 (0.00)	32.33 (0.00)	28.00 (0.00)					3.09 (0.00)

(*continued on next page*)

(*continued*)

Eq. no.	ln(PC)	ln(HC)	ln(NC)	ln (XM)	ln (COC)	ln (PS)	ln (RL)	ln (RQ)	ln(GE)
Table 5									
1	17.72 (0.00)	64.28 (0.00)	22.80 (0.00)	23.17 (0.00)	11.60 (0.00)				
2	26.38 (0.00)	71.91 (0.00)	25.67 (0.00)	23.61 (0.00)		5.26 (0.00)			
3	25.36 (0.00)	72.97 (0.00)	22.95 (0.00)	23.60 (0.00)			16.07 (0.00)		
4	28.18 (0.00)	72.34 (0.00)	22.07 (0.00)	22.07 (0.00)				8.77 (0.00)	
5	25.99 (0.00)	64.62 (0.00)	15.97 (0.00)	15.92 (0.00)					3.47 (0.00)
Table 6									
1	36.35 (0.00)	126.51 (0.00)	24.88 (0.00)	17.01 (0.00)	10.20 (0.00)				
2	40.59 (0.00)	137.97 (0.00)	25.75 (0.00)	16.73 (0.00)		20.79 (0.00)			
3	36.72 (0.00)	124.04 (0.00)	24.47 (0.00)	16.73 (0.00)			10.79 (0.00)		
4	36.66 (0.00)	123.55 (0.00)	24.15 (0.00)	21.99 (0.00)				12.60 (0.00)	
5	58.44 (0.00)	154.76 (0.00)	26.39 (0.00)	15.01 (0.00)					0.49 (0.00)

Notes: Reported statistics is F-statistics of first stage regressions. *P*-value is in parenthesis.

Appendix 5. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.eneco.2022.106350.

References

Alexeev, M., Conrad, R., 2009. The elusive curse of oil. Rev. Econ. Stat. 91 (3), 586–598.
Alexeev, M., Conrad, R., 2011. The natural resource curse and economic transition. Econ. Syst. 35 (4), 445–461.
Apergis, N., Payne, J.E., 2014. The oil curse, institutional quality, and growth in MENA countries: evidence from time-varying cointegration. Energy Econ. 46, 1–9.
Arellano, M., Bover, O., 1995. Another look at the instrumental variable estimation of error-components models. J. Econ. 68 (1), 29–51.
Arezki, R., Brückner, M., 2011. Oil rents, corruption, and state stability: evidence from panel data regressions. Eur. Econ. Rev. 55 (7), 955–963.
Arezki, R., Ploeg, F.V., 2010. Trade policies, institutions and the natural resource curse. Appl. Econ. Lett. 17 (15), 1443–1451.
Atkinson, G., Hamilton, K., 2003. Savings, growth and the resource curse hypothesis. World Dev. 31 (11), 1793–1807.
Badeeb, R.A., Lean, H.H., Clark, J., 2017. The evolution of the natural resource curse thesis: a critical literature survey. Res. Policy 51, 123–134.
Bakwena, M., Bodman, P., Le, T., Tang, K.K., 2009. Avoiding the Resource Curse: The Role of Institutions, vol. 3209. Macroeconomic Research Group.
Blundell, R., Bond, S., 1998. Initial conditions and moment restrictions in dynamic panel data models. J. Econ. 87 (1), 115–143.
Bonet-Morón, J., Pérez-Valbuena, G.J., Marín-Llanes, L., 2020. Oil shocks and subnational public investment: the role of institutions in regional resource curse. Energy Econ. 92, 105002.
Boschini, A.D., Pettersson, J., Roine, J., 2007. Resource curse or not: a question of appropriability. Scand. J. Econ. 109 (3), 593–617.
Boschini, A., Pettersson, J., Roine, J., 2013. The resource curse and its potential reversal. World Dev. 43, 19–41.
Brunnschweilera, C.N., Bulte, E.H., 2008. The resource curse revisited and revised: a tale of paradoxes. J. Environ. Econ. Manag. 55, 248–264.
Bulte, E.H., Damania, R., Deacon, R.T., 2005. Resource intensity, institutions, and development. World Dev. 33 (7), 1029–1044.
Cale, I.J.V.C., Camaro, P.J.C., Melendres, K.P., MDE, M.A.L.R., 2017. The Lucas paradox and the human capital resource curse in Philippines, Indonesia, Malaysia, Thailand and Singapore. Rev. Integr. Bus. Econ. Res. 6 (1), 276.
Cameron, A.C., Trivedi, P.K., 2010. Microeconometrics Using Stata, vol. 2. Stata press, College Station, TX.
Carter, D.B., Signorino, C.S., 2010. Back to the future: modeling time dependence in binary data. Polit. Anal. 18 (3), 271–292.
Cockx, L., Francken, N., 2016. Natural resources: a curse on education spending? Energy Policy 92, 394–408.
Collier, P., Goderis, B., 2007. Commodity prices, growth, and the natural resource curse: Reconciling a conundrum. In: Paper 274, The Centre for the Study of African Economies Working Paper Series. Oxford University.
Collier, P., Hoeffler, A., 2005. Resource rents, governance, and conflict. J. Confl. Resolut. 49 (4), 625–633.
Damette, O., Seghir, M., 2018. Natural resource curse in oil exporting countries: a nonlinear approach. Int. Econ. 156, 231–246.
Greene, W., 2005. Reconsidering heterogeneity in panel data estimators of the stochastic frontier model. J. Econ. 126 (2), 269–303.
Guan, J., Kirikkaleli, D., Bibi, A., Zhang, W., 2020. Natural resources rents nexus with financial development in the presence of globalization: is the "resource curse" exist or myth? Res. Policy 66, 101641.
Gylfason, T., 2000. Resources, agriculture and economic growth in economies in transition. In: Agriculture and Economic Growth in Economies in Transition (July 2000).
Gylfason, T., 2001. Natural resources, education, and economic development. Eur. Econ. Rev. 45 (4–6), 847–859.
Gylfason, T., Zoega, G., 2006. Natural resources and economic growth: the role of investmen. World Econ. 29 (8), 1091–1115.
Gylfason, T., Herbertsson, T., Zoega, G., 1999. A mixed blessing: natural resources and economic growth. Macroecon. Dyn. 3 (2), 204–225.
Haseeb, M., Kot, S., Hussain, H.I., Kamarudin, F., 2021. The natural resources curse-economic growth hypotheses: quantile–on–quantile evidence from top Asian economies. J. Clean. Prod. 279, 123596.
Havranek, T., Horvath, R., Zeynalov, A., 2016. Natural resources and economic growth: a meta-analysis. World Dev. 88, 134–151.
Henry, A., 2019. Transmission channels of the resource curse in Africa: a time perspective. Econ. Model. 82, 13–20.
Jianqiang, G.U., Umar, M., Soran, S., Yue, X.G., 2020. Exacerbating effect of energy prices on resource curse: can research and development be a mitigating factor? Resour. Policy 67, 101689.
Kennedy, P., 2003. A Guide to Econometrics. MIT Press, Cambridge MA.
Khan, M.A., Gu, L., Khan, M.A., Oláh, J., 2020. Natural resources and financial development: the role of institutional quality. J. Multinatl. Financ. Manag. 56, 100641.
Khanna, A.A., 2017. Revisiting the oil curse: does ownership matter? World Dev. 99, 214–229.
Kronenberg, T., 2004. The curse of natural resources in the transition economies. Econ. Transit. 12 (3), 399–426.
Kropf, A., 2010. Resource abundance vs. resource dependence in cross-country growth regressions. OPEC Energy Rev. 34 (2), 107–130.
Larsen, E.R., 2005. Are rich countries immune to the resource curse? Evidence from Norway's management of its oil riches. Res. Policy 30 (2), 75–86.
Mehlum, H., Moene, K., Torvik, R., 2006. Instituations and the resource curse. Econ. J. 116 (508), 1–20.
Mignamissi, D., Kuete, Y.F.M., 2021. Resource rents and happiness on a global perspective: The resource curse revisited. Resour. Policy 71, 101994.
Neumayer, E., 2004. Does the "resource curse" hold for growth in genuine income as well? World Dev. 32 (10), 1627–1640.
Papyrakis, E., Gerlagh, R., 2004. The resource curse hypothesis and its transmission channels. J. Comp. Econ. 32 (1), 181–193.
Papyrakis, E., Gerlagh, R., 2007. Resource abundance and economic growth in the United States. Eur. Econ. Rev. 51 (4), 1011–1039.
Ploeg, F.V., Poelhekke, S., 2009. Volatility and the natural resource curse. Oxf. Econ. Pap. 61 (4), 727–760.
Rodriguez, F., Sachs, J.D., 1999. Why do resource-abundant economies grow more slowly? J. Econ. Growth 4, 277–303.
Rodrik, D., Subramanian, A., Trebbi, F., 2004. Institutions rule: the primacy of institutions over geography and integration in economic development. J. Econ. Growth 9 (2), 131–165.
Ross, M., 2003. The natural resource curse: How wealth can make you poor. In: Natural Resources and Violent Conflict: Options and Actions, pp. 17–42.
Ross, M.L., 2013. The politics of the resource curse: A review. In: Lancaster, C., van de Walle, N. (Eds.), Handbook on the Politics of Development. Oxford University Press.
Sachs, J.D., Warner, A.M., 1995. Natural Resource Abundance and Economic Growth. National Bureau of Economic Research, Working Paper 5398.
Sachs, J.D., Warner, A.M., 1999. The big push, natural resource booms and growth. J. Dev. Econ. 59 (1), 43–76.
Sachs, J.D., Warner, A.M., 2001. The curse of natural resources. Eur. Econ. Rev. 45 (4–6), 827–838.
Sala-i-Martin, X., Subramanian, A., 2013. Addressing the natural resource curse: an illustration from Nigeria. J. Afr. Econ. 22 (4), 570–615.
Sarmidi, T., Law, S.H., Jafari, Y., 2014. Resource curse: new evidence on the role of institutions. Int. Econ. J. 28 (1), 191–206.
Shahbaz, M., Ahmed, K., Tiwari, A.K., Jiao, Z., 2018. Resource curse hypothesis and role of oil prices in USA. Res. Policy 64, 101514.
Sharma, C., Mishra, R.K., 2022. On the good and bad of natural resource, corruption, and economic growth nexus. Environ. Resour. Econ. https://doi.org/10.1007/s10640-022-00694-x.

Sharma, C., Pal, D., 2021. Revisiting resource curse puzzle: new evidence from heterogeneous panel analysis. Appl. Econ. 53 (8), 987-912.
Smith, B., 2015. The resource curse exorcised: evidence from a panel of countries. J. Dev. Econ. 116, 57–73.
Wooldridge, J.M., 2002. Econometric analysis of cross section and panel data MIT press. Cambridge, MA 108 (2), 245–254.
Wright, G., Czelusta, J., 2004. Why economies slow: the myth of the resource curse. Challenge 47 (2), 6–38.
Yang, B., 2010. Resource curse: the role of institutions versus policies. Appl. Econ. Lett. 17 (1), 61–66.
Yanıkkaya, H., Turan, T., 2018. Curse or blessing? An empirical re-examination of natural resource-growth nexus. J. Int. Dev. 30 (8), 1455–1473.
Zakharov, N., 2020. Asymmetric oil price shocks, tax revenues, and the resource curse. Econ. Lett. 186, 108515.