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Article

# Do natural resources hinder or help? Exploring economic development in EU countries through human and institutional lenses

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**Abstract.** This study investigates the impact of natural resource dependence and abundance on economic development in 21 EU countries from 1996 to 2019, focusing on critical gaps in the literature on resource-driven development. Using the Generalized Method of Moments (GMM), we address issues of endogeneity, heterogeneity, and cross-sectional dependence issues to capture nuanced relationships. Findings indicate that natural resource dependence and abundance are negatively associated with development in the EU; economic growth, however, positively reinforces it. Additionally, the observed patterns consistent with the resource curse are associated with lower development outcomes. Considering the impact of natural resources alongside economic growth, human capital, and institutional quality factors, this study provides valuable insights for EU policymakers, highlighting the need for sustainable and inclusive resource management policies. In a broader sense, the findings are robust for resource-rich countries aimed at achieving sustainable development.

**Keywords:** Human Development Index; natural resources; economic growth; institutional quality; panel data; GMM
**JEL classification:** O15; O13; O47; O43 ; C23

## 1. Introduction

Since the United Nations Development Programme (UNDP, 1990) introduced the Human Development Index (HDI), there has been continuous debate regarding the link between natural resources and development outcomes. HDI is a widely recognized composite metric used to evaluate overall development, considering three fundamental dimensions: life expectancy, educational attainment, and standard of living. As a pivotal measure of human well-being, policymakers are increasingly attuned to their countries' HDI outcomes in pursuit of improving societal welfare beyond conventional indicators such as gross domestic product (GDP). The nexus between macroeconomic indicators and economic development is well-documented (Khan et al., 2023), yet it remains a complex and multifaceted topic of study. Historically, the HDI emerged as part of a growing recognition that economic growth alone does not guarantee improvements in human welfare (Haq, 1995, p. 24), in other words, as a response to the limitations of GDP in measuring the well-being of societies (Sen, 1999). Over the last three decades, development economists have emphasized the importance of people's choices and freedoms while improving their health and education levels. HDI gained worldwide recognition with periodically adjusted metrics and a methodology to measure it, yet the fundamentals have continued to center on the multidimensional features of human welfare (Fukuda-Parr, 2003).

A key strand of development economics focuses on natural resource dependence (NRD), defined as the degree to which an economy relies on revenues or exports related to natural resources. Dependence can heighten vulnerability to commodity price shocks, limit economic diversification (Matsen & Torvik, 2005), and weaken incentives for human capital accumulation (Gylfason, 2001; Petermann et al., 2007). These negative impacts of NRD align with the resource curse hypothesis (Auty, 1994; Sachs & Werner, 2001; Zhang et al., 2008). High NRD may also deepen inequality (Bardhan, 2005), concentrating benefits among elites while leaving broader society underdeveloped, contributing to social instability (Kim et al., 2020) and unrest (Dabla-Norris et al., 2015; Stiglitz, 2012). Weak institutional structures further amplify these risks by enabling corruption and misallocation of resource revenues (Cust & Mihalyi, 2017; Rodrik et al., 2004).

Another perspective emphasizes natural resource abundance (NRA) as typically measured as the size of a country's natural endowments or the share of resources in total output. When supported by strong institutions and effective governance, abundant resources can stimulate economic growth (Singh et al., 2024), reduce poverty, and finance investments in health and education, thereby enhancing human capital (Cust & Mihalyi, 2017; Li et al., 2023). However, NRA may also be associated with rent-seeking behavior, institutional fragility, and volatility in public revenues, all of which reinforce the mechanisms of the resource curse (Mehlum et al., 2006; Mousavi & Clark, 2021; Ross, 2012; Sachs & Warner, 2001; Timbe et al., 2024). In this view, the presence of resource abundance itself may create incentives for political capture and mismanagement, thereby constraining sustainable development. Contemporary empirical evidence shows mixed outcomes. The NRA has been found to hinder development for African countries (Debonheur et al., 2023), Salahojaev et al. (2024) presented a U-shaped relationship where HDI improves once resource rents exceed a threshold (42.8% of GDP) and are managed efficiently in Belt and Road Initiative (BRI) countries. These contradictory findings suggest that the NRA is not inherently detrimental, but instead its effects depend on governance, institutional quality, and the allocation of revenues towards human capital and economic diversification (van der Ploeg & Poelhekke, 2017).

Taken together, both NRD and NRA are linked to the resource curse, though through distinct mechanisms. Resource dependence reflects economic reliance and exposure to volatility, while abundance emphasizes structural endowments and potential for mismanagement. Understanding these dynamics is crucial for designing policies for channeling resource revenues toward sustainable development progress. In this context, the Sustainable Development Goals[1] (SDGs) provide a valuable framework to assess the broader developmental implications for natural resources (UNDP, 2015). The links between NRD, NRA, and specific SDGs are detailed in the literature review section, enabling policymakers to evaluate how resource endowments affect economic development across

[1] Sustainable Development Goals (SDGs) are a set of global objectives adopted by the UN for improving human development levels all by 2030 (UNDP, 2015).

multiple dimensions (Eurostat, 2022). This study examines the impact of NRD and NRA along with several other control variables on HDI using panel data for 21 highly developed EU countries from 1996 to 2019. The Generalized Method of Moments (GMM) estimator is employed to address endogeneity and unobserved heterogeneity (Farhadi et al., 2015). Our findings indicate a negative association between natural resource rents and human development in EU countries, suggesting that resource dependence and abundance may constrain progress when not supported by growth, human capital, and institutional quality. Specifically, the resource curse is linked with lower HDI levels. These results can inform EU policymakers on how to ensure that natural resource rents are utilized appropriately to support development.

This study reviews the literature on the relationship between the dependent variable, HDI, and proxy variables, NRA and NRD, with control variables in the next section. Section 3 outlines the data sources and methodology. Section 4 presents the GMM estimation results. The study is concluded in the final section.

## 2. Literature review

Despite the substantial progress in development in the EU, the impact of natural resources on HDI remains an ongoing inquiry (Radulescu et al., 2025). Some EU Countries have abundant resources, whereas others are resource-dependent and mostly rely on imports for raw materials and energy. This diversity presents an opportunity to examine the influence of resources, growth, human capital, and institutions on development.

## 2.1 Economic development and natural resource dependence

NRD is defined as an economy's overreliance on resource revenues for exports, government budgets, or GDP. Resource curse theory (Gelb, 1988; Sachs & Warner, 1995) suggests that heavy dependence on volatile natural resource rents often crowds out investment in human capital, increases rent-seeking behavior, and exposes public spending for social benefits to commodity price shocks (Arezki & Brückner, 2011), resulting in slower growth for countries. Furthermore, NRD harms development as resource inflows appreciate the real exchange rate, reduce competitiveness in other tradable sectors, and foster de-industrialization (Corden & Neary, 1982). The asymmetric growth in both resource allocation and income distribution is the primary reason for limiting investments in crucial areas such as education and healthcare, which hinders development (Stijns, 2005; Mohamed, 2020). This problem is illustrated by Nigeria's (Sala-i-Martin & Subramanian, 2013; Ross, 2012) and Venezuela's heavy reliance on oil export revenues (Karl, 1997; Corrales & Penfold, 2015), as decades of oil dependence have been accompanied by widespread poverty, fiscal mismanagement, and stagnant HDI levels despite substantial petroleum reserves.

Additionally, weaker institutional structures among resource-dependent countries are one of the main reasons for hindered development in individuals and society (SDGs[2] 10, 16). The reliance on natural resources may lead to volatility rather than stable development progress, under-investment in other industrial sectors, and governance issues (Saud et al., 2023) that negatively impact social outcomes at the education level and public health (SDGs 3, 4, 8, 9). Bulte et al. (2005) reveal that resource-dependent developing countries tend to invest less in public services or other non-resource-dependent industries that can adversely impact their HDI rankings (SDGs 1, 10). In more contemporary evidence, Cust and Mihalyi (2017) echo these findings, showing that resource-dependent countries experience challenges transforming resource wealth into economic development, especially without an effective governance system (SDG 16).

## 2.2 Economic development and natural resource abundance

On the contrary, NRA refers to the existence of substantial natural resource endowments that can have both beneficial as well as detrimental effects on development progress, depending on how authorities manage them (SDGs 1, 3, 4). While resource abundance can reduce poverty, expand healthcare spending, and improve education (SDGs 1, 3, 4, 16) to increase human capital if allocated effectively by the existence of strong institutions and strategic investments (Li et al., 2023), but it may also foster rent capture (SDGs 10, 16, 17) by elites and governance failures in contexts of weak institutions (Ross, 2001; Mehlum et al., 2006). Van der Ploeg and Poelhekke (2011) provide evidence that the main effect of resource abundance is to increase growth volatility, which in turn reduces the long-term average growth rate. Results from African economies indicate that resource abundance harms development outcomes (Debonheur et al., 2023), yet Salahojaev et al. (2024) demonstrate that a U-shaped relationship for 51 BRI countries increases HDI when a country's share of natural resources exceeds 42.8% of GDP. Their results imply that resource-rich countries, such as Norway's management of oil revenues (Mehlum et al., 2006) or Botswana's diamond revenues (Acemoglu et al., 2003), alongside greater financial development and efficient institutions, may channel their resource wealth, leading to higher HDI results. Thus, the developmental impact of NRA is not predetermined but rather depends on governance, distributional policies, and the ability to channel resources into human capital.

## 2.3 Economic development and control variables

The nexus between development and growth is well-established. Sen's (1999) capability approach offers a theoretical framework for understanding this relationship, asserting that economic growth is essential but insufficient for human development. To truly improve HDI, growth must be inclusive and directed toward improving vital social indicators, including education, health, and income

[2] The related SDGs to resource endowments and economic development are SDG1: No Poverty, SDG3: Good Health and Well-being, SDG4: Quality Education, SDG8: Decent Work and Economic Growth, SDG9: Industry, Innovation and Infrastructure, SDG10: Reduced Inequalities, SDG16: Peace, Justice and Strong Institutions, SDG17: Partnership for the Goals.

distribution. Empirical research by Ranis et al. (2000) confirms that countries experiencing sustained economic growth tend to improve their HDI, but only when the gains are channeled into public services. Abraham and Ahmed (2011) applied an error correction model, and their findings show that growth has sustained negative impact in the short run, while in the long run, this impact is reversed. Hashmat et al. (2023) presented the adverse outcome of HDI due to the GDP per capita income disparities in their multi-country dataset from 1996 to 2021, applying GMM analysis.

The increase in population within a country should not be considered a significant indicator of human capital growth on its own. Sustainable population growth, achieved in an environment where access to education and social health indicators are improving (Schultz, 1961; Becker, 1962), is essential for countries to increase their human capital (HC) and perform better in their HDI rankings. HC is directly linked to two critical components of the HDI: education and life expectancy. Countries prioritizing education and healthcare systems are better positioned to improve their HDI scores. Barro and Lee (2013) empirically found a strong positive correlation between educational attainment and improvements in HDI, particularly in life expectancy and income per capita. Hanushek and Woessmann (2021) also underscore the importance of human capital investments in achieving sustainable development in the long term. Their study emphasizes that even in advanced economies, where educational systems are well-established, continued investment in human capital is critical for maintaining high HDI scores, especially in the face of technological change and evolving labor market demands.

Institutions play a fundamental role in determining economic development outcomes. According to Acemoglu and Robinson (2012), inclusive institutions that enforce the law, ensure political stability and promote good governance are crucial for converting economic gains into improvements in development. Strong institutions help to manage resources efficiently, reduce corruption, and ensure that the benefits of economic growth are distributed equitably across society (Torvik, 2009). Countries with transparent and effective governance mechanisms may be better equipped to respond to crises (e.g., financial crises, global pandemics, etc.) and protect the economic development gains obtained in the past. Empirical evidence provided by Rodrik et al. (2004) supports this argument, showing that countries with more robust institutional frameworks experience higher levels of development. Hong (2017) analyzed data from 1972 to 2008 and confirmed that natural resource dependence, diminished bureaucratic incentives to invest in human capital through spending in markets characterized by low institutional quality. Radulović (2020) found a positive relationship between the quality of institutions and growth for EU Countries in the SEE region by applying the ARDL estimator only in the long run from 1996 to 2017.

## 2.4 Contemporary empirical framework

Panel data models are widely utilized in empirical research to investigate the dynamic relationships between natural resource endowment and development. These models offer several advantages, including the control for unobserved heterogeneity across countries and over time, leading to more robust and consistent estimations (Baltagi, 2021; Van der Ploeg & Poelhekke, 2011). Badeeb et al. (2017) suggest that panel frameworks provide a clear picture of the concept the resource curse.

Hsiao (2014) argues that panel data models mitigate potential biases arising from omitted variables and measurement errors, providing more accurate insights into the complex interactions among the variables. Therefore, this study employs a panel data model to examine the multifaceted impacts of natural resources and control variables on development outcomes.

Several studies employed alternative models to investigate the impact of natural resources on development. Sinha (2019) investigated the relationship between resource rents and development by applying co-integration and vector error correction models (VECM) to study Asia-Pacific countries, highlighting the moderating effect of globalization. Destek et al. (2022), utilizing continuously-updated and fully modified (CUP-FM) and continuously-updated and bias-corrected (CUP-BC), fully modified OLS (FMOLS), found that an inverted U-shaped relationship where resource dependence is not a barrier to growth but constitutes a curse for sustainable development by analyzing 28 countries from 1990 to 2017. Aljarallah (2020) analyzed the resource-rich Gulf countries and their economic activities by applying ARDL from 1984 to 2014, and the results showed that resource abundance increases GDP. Zhang et al. (2024) employed an autoregressive distributed lag (ARDL) model for eight South Asian countries from 1996 to 2022. They found that natural resource rents have a negative impact on economic performance in the short run.

The European experience provides additional insights into the relationship between natural resources and development. Studies on Norway, a resource-rich country, highlight how its strong institutional structure and sovereign wealth funds have allowed resource abundance to be channeled into higher HDI levels (Cappelen & Mjøset, 2009; Holden, 2013). In contrast, resource-rich Southern and Eastern European countries, as well as post-Soviet states with weaker governance, struggle to convert their resource dependence into sustainable human development reflecting rent-seeking behavior and a fragile institutional structure (Alexeev & Conrad, 2009; Esanov et al., 2001). Empirical research on EU countries indicates that resource rents tend to have a limited direct effect on HDI; however, they operate indirectly through growth and institutional channels (Boschini et al., 2013; Mavratos et al., 2001; Papyrakis & Gerlagh, 2007). More recently, Simionescu et al. (2024) found that the EU's green economy transition substantially affects development. Their study analyzes EU member countries from 2008 to 2022, while natural resource rents detriment development in the region.

Several studies have applied GMM regression (Blundell & Bond, 1998) with various macroeconomic indicators. Farhadi et al. (2015) examined the relationship between the impact of resource rents on growth in 99 countries from 1970 to 2010 on their path of economic development. The study revealed that the countries with higher freedom of choice levels turn the adverse growth effects of natural resources into positive ones for development. Awoa et al. (2024) analyzed how economic complexity moderates the negative impact on income inequality across 111 countries, finding that economic complexity reduces income inequality linked to resource dependence. Additionally, countries with less income inequality problems have smoother development paths. The empirical results of Debonheur et al. (2023) show that resource abundance has a negative influence on development outcomes for 41 African countries covering from the period from 1996 to 2019. Farooq et al. (2025) examined 48 Asian countries from 1996 to 2019 and found that while natural resources negatively affect growth, strong governance moderates this effect, transforming the resource curse into a resource blessing and enhancing growth.

## 3. Data and methodology

### 3.1 Data description

This study examines the relationship between NRD, NRA, and development for 21 EU member countries[3] between 1996 and 2019. The choice of variables is based on both theoretical reasoning and established empirical practice. HDI is the dependent variable as a composite measure encompassing life expectancy, educational attainment, and standard of living. Both NRD (total natural resource rents, as a percentage of GDP) and NRA (natural capital per capita, nonrenewable assets, constant 2018 US$) are the proxy variables that their data are derived from the World Bank's The Changing Wealth of Nation dataset (CWN). NRD captures the extent to which an economy relies on resource revenues relative to its overall output, which is central to the "resource curse" hypothesis and NRA reflects the stock dimension of natural wealth available to a country, thereby operationalizing the abundance concept. Economic growth (EG) from the World Bank's World Development Indicators (WDI), human capital (HC) from the Penn World Table (PWT), and institutional quality (IQ) from Transparency International (TI) are included as control variables. In the GMM estimation, internal instruments are generated from the lagged values of endogenous regressors (e.g., lagged HDI and NRD/NRA), rather than using EG, HC, or IQ as external instruments. Definitions and sources of the variables are given in Table 1 below.

**Table 1.** Definitions and resources of variables.

| Variables | | Definition | Source |
|---|---|---|---|
| ***Dependent Variable*** | | | |
| Economic Development | HDI | Human development index | UNDP |
| ***Proxy Variables*** | | | |
| Natural Resource Dependence | NRD | Total natural resources rents (%GDP) | World Bank (CWN) |
| Natural Resource Abundance | NRA | Natural capital per capita, nonrenewable assets (Constant 2018 US$) | World Bank (CWN) |
| ***Control Variables*** | | | |
| Economic Growth | EG | GDP growth (annual %) | World Bank (WDI) |
| Human Capital | HC | Human capital index | PWT |
| Institutional Quality | IQ | Corruption perceptions index | TI |

*Source*: UNDP (2024), World Bank (2021, 2024), PWT (Feenstra et al., 2015), TI (Transparency International, 2023).

### 3.2 Preliminary investigation

Tables 2 and 3 present statistics and the correlation matrix of the variables. According to descriptive statistics, the highest HDI among the sample is 0.951, the lowest is 0.711, and the mean is 0.865. The highest NRD is 5.714, the lowest is 0.008, and the mean is 0.702. Therefore, there is a significant

[3] Austria, Belgium, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden.

difference between the NRD of the countries in the sample. The same goes for the NRA. While the highest NRA value is 7270.7, some countries in the analysis have no natural resources for at least one year, while the mean value of NRA is 1384.133.

Development is adversely affected by the NRD and EG factors, as seen by the correlation results in Table 3. On the other hand, NRA, HC, and IQ positively affect economic development. The variable with the highest interaction with HDI is NRA, with a coefficient of 0.3858, while the variable with the least interaction is HC, with 0.1860.

**Table 2.** Descriptive statistics,

| Variable | Observation | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| HDI | 504 | 0.8654544 | 0.0489737 | 0.711 | 0.951 |
| NRD | 504 | 0.5325826 | 0.7025445 | 0.0088736 | 5.714163 |
| NRA | 483 | 870.2907 | 1384.133 | 0 | 7270.7 |
| EG | 504 | 2.431929 | 3.141529 | -14.83861 | 13.05001 |
| HC | 504 | 2.98 | 7.70 | 2.92 | 3.82 |
| IQ | 504 | 6.413512 | 1.942724 | 3 | 10 |

*Source:* Authors' own calculations

**Table 3.** Correlation matrix.

| | HDI | NRD | NRA | EG | HC | IQ |
|---|---|---|---|---|---|---|
| **HDI** | 1.0000 | | | | | |
| **NRD** | -0.2105 | 1.0000 | | | | |
| **NRA** | 0.3858 | 0.3781 | 1.0000 | | | |
| **EG** | -0.2706 | 0.2051 | -0.1398 | 1.0000 | | |
| **HC** | 0.1860 | 0.1205 | 0.1569 | 0.0202 | 1.0000 | |
| **IQ** | 0.7322 | -0.1731 | 0.3734 | -0.1128 | 0.1366 | 1.0000 |

*Source:* Authors' own calculations

When performing panel data analysis, it is essential to first test for cross-sectional dependence. If there is no cross-sectional dependence, first-generation panel data tests can be employed. Conversely, if cross-sectional dependence exists, second-generation panel data tests should be utilized. There are various tests to detect cross-sectional dependence. Since T (24) > N (21) in our model, the Breusch-Pagan LM test should be applied. $H_0$ of the test states that there is no cross-sectional dependence, whereas $H_1$ states that there is. The results presented in Table 4 below indicate the existence of cross-sectional dependence. Due to cross-sectional dependence, unit root tests to be applied in the later stages of the analysis should be selected among techniques that account for cross-sectional dependence.

**Table 4.** Cross-sectional dependence tests.

| | Model 1: NRD | | Model 2: NRA | |
|---|---|---|---|---|
| **Test** | **Stats.** | **Prob.** | **Stats.** | **Prob.** |
| **LM** | 802.2 | 0.0000 | 880.5 | 0.0000 |
| **LM adj*** | 46.33 | 0.0000 | 50.46 | 0.0000 |
| **LM CD*** | 21.52 | 0.0000 | 23.09 | 0.0000 |

*Source:* Authors' own calculations.

In this study, we apply three variants of the Breusch-Pagan Lagrange Multiplier (LM) test for cross-sectional dependence. The standard Breusch-Pagan LM test (Breusch & Pagan, 1980) evaluates the null hypothesis of no cross-sectional correlation in the residuals. However, when the panel dimensions differ (e.g., moderate T relative to N), the test can be biased. Pesaran et al. (2008) proposed adjusted versions to improve finite-sample properties. The LM adj corrects the mean and variance of the LM statistic under finite samples, while the LM CD (cross-section dependence test) standardizes the statistic for panels where N and T are both large. Reporting all three ensures robustness: in our case, all versions reject the null, confirming cross-sectional dependence. It is also important to perform the endogeneity test to ensure the robustness of the estimates. The Durbin (1954) score and Wu-Hausman (Wu, 1973; Hausman, 1978) tests were applied to test endogeneity. The $H_0$ of the test is “variables are exogenous”. The test results are shown in Table 5 below.

**Table 5.** Endogeneity tests.

| | **Model 1: NRD** | | **Model 2: NRA** | |
|---|---|---|---|---|
| **Test** | **Statistic** | **Probability** | **Statistic** | **Probability** |
| **Durbin (score)** | 202.472 | 0.0000 | 151.81 | 0.0000 |
| **Wu-Hausman** | 345.721 | 0.0000 | 219.562 | 0.0000 |

*Source:* Authors’ own calculations.

Based on the test results, $H_0$ is rejected, and endogeneity is present. When the independent variables and the error term are correlated, panel data analysis encounters the endogeneity issue. This correlation causes bias and inconsistency in the estimates that undermine the reliability of the analysis. The endogeneity issue is a common problem in panel data analysis, and GMM is widely used in dynamic panel models to resolve it by deriving instrumental variables for endogenous variables. Regression assumptions must be tested to apply regression analysis effectively. In this context, heteroskedasticity (Breusch-Pagan, 1979) and autocorrelation tests (Arellano & Bond, 1991) were conducted. The null hypotheses of the tests are established as "there is no heteroscedasticity" and "there is no autocorrelation", respectively. According to the test results, the model has heteroscedasticity but no autocorrelation. The tests’ results are given in Table 6 below.

**Table 6.** Preliminary tests.

| | **Model 1: NRD** | | **Model 2: NRA** | |
|---|---|---|---|---|
| **Test** | **Statistic** | **Probability** | **Statistic** | **Probability** |
| Breusch-Pagan (1979) | 228.78 | 0.0000*** | 208.12 | 0.0000*** |
| Arellano-Bond (1991) | -1.70 | 0.089* | -1.71 | 0.087* |

*Source:* Authors’ own calculations

Note: ***, * represent the significance levels at %1 and %10.

## 3.3 Model specification

The study focuses on the relationship between development, NRD, and NRA. Growth, human capital, and institutional quality are included as instrumental variables. We use two different models for comparison:

$$HDI_{it} = \beta_0 + \beta_{1it}NRD + \beta_{2it}EG + \beta_{3it}HC + \beta_{4it}IQ + \varepsilon_{it} \quad [1]$$
$$HDI_{it} = \beta_0 + \beta_{1it}NRA + \beta_{2it}EG + \beta_{3it}HC + \beta_{4it}IQ + \varepsilon_{it} \quad [2]$$

The GMM approach used in this study was chosen to consider both the dynamic structure of the model and the potential endogeneity problem among the variables. HDI is a variable affected by past values and can exhibit bidirectional relationships between institutional quality, human capital, and natural resource indicators. Therefore, fixed effects or classical panel estimators cannot provide reliable results due to endogeneity. The GMM method mitigates endogeneity by using lagged values of the variables as internal instruments; EG, HC, and IQ are included as control variables rather than external instruments. Furthermore, the 21 EU countries covered in the study exhibit heterogeneous structures: GMM controls for country fixed effects, limiting the distorting effects of these differences on the estimates.

In practice, the differential GMM estimator suggested by Arellano and Bond (1991) was preferred. The primary reason for this was the moderate size of our data set (N=21, T=24) and the possibility that the system GMM could lead to over-instrumentation in small samples. The validity of the model was tested using the Sargan test, which assesses the adequacy of the instruments employed, and the Arellano-Bond AR(2) test, which verifies the absence of second-order autocorrelation. The results confirmed the robustness of the method used. Therefore, the GMM method was considered the most appropriate method for revealing the effects of natural resource dependence and abundance on development.

### 3.3.1 Panel unit root analysis

The panel unit root tests are reported separately from the preliminary diagnostics because they address a different econometric property. While the Breusch-Pagan LM tests focus on cross-sectional dependence in the residuals of the regression model, the Cross-sectionally Augmented IPS (CIPS) test (Pesaran, 2007) is specifically designed to assess stationarity of the variables under cross-sectional dependence. For clarity, we therefore present the cross-sectional dependence results first (Table 4), and the unit root test results in a dedicated section (Table 7). This separation avoids conflating the diagnostics of error dependence with the time-series properties of the variables.

In order to perform regression analysis, the stationarity of the variables must first be tested. The series' stationarity is crucial for the reliability of analysis results. Since there is a correlation between units in the series, second-generation panel unit root tests must be performed (Breitung & Das, 2005). Therefore, the cross-sectionally augmented Im-Pesaran-Shin (CIPS) test will be used (Im et al., 2003). Since the CIPS test is an extension of the ADF regression with lagged cross-sectional means (Pesaran, 2007), cross-sectional dependence is eliminated.

$$Y_{it} = (1 - f_i)m_i + f_i Y_{i,t-1} + u_i \quad [3]$$

$u_{it}$ can be stated as follows:

$$U_{it} = g_i f_t + e_{it} \quad [4]$$

$$\Delta Y_{it} = \alpha_i + r_i Y_{it-1} + g_i f_t + e_{it} \quad [5]$$

The CIPS statistic, as the cross-sectional extended type of the IPS test, is the average of the CADF statistic:

$$CIPS = N^{-1} \sum_{i=1}^{N} CADF_i \quad [6]$$

The $H_0$ of the CIPS test is "the series is not stationary".

## 3.3.2 Panel regression analysis

Economic actors are under the influence of past behaviors in their decision-making processes. Therefore, when an economic model is established, the explanatory power of the model is increased by adding the lagged values of the variables to the model. Dynamic panel data models account for the lagged values of the variables. The dynamic model equation is established as follows:

$$Y_{it} = \alpha Y_{i,t-1} + \acute{\beta}_{it X} + \mu_{it} \qquad i = 1,\ldots,N; \quad t = 1,\ldots,T \quad [7]$$

In Equation 1, the scalar term $a$ stands for the matrices in dimensions. It is assumed that $\mu_{it}$ follows the one-way error component model (Baltagi, 2021).

$$\mu_{it} = u_i + v_{it} \quad [8]$$

$u_i$ and $v_i$ in Equation 2 are independent error terms. In Equation 1, the dependent variable's lagged value ($Y_{i,t-1}$) is correlated with the error term ($\mu_{i,t-1}$). Since $Y_{it}$ is a function of $\mu_i$, $Y_{i,t-1}$ is also a function of $\mu_i$. Hence, $Y_{i,t-1}$ is also correlated with $\mu_i$ (Baltagi, 2021). The existence of such a correlation may lead to a deviation from the exogeneity assumption. Balestra and Nerlove (1966) suggested using instrumental variables to solve this problem. According to Tatoglu (2012), instrumental variables are highly correlated with the variable they replace and have no correlation with the error term.

When using lagged values of independent variables as instrumental variables, the estimates will be biased if a unit effect is not considered. Therefore, instead of a random effects model in dynamic models, it is more appropriate to use fixed effects and first difference estimators that allow unit effects and explanatory variables to be correlated. The Arellano and Bond (1991) GMM uses the first difference model. The Generalized Least Squares estimates this method by transforming the first difference model with the instrumental variable matrix. The first difference model is expressed with matrices as in Equation 3:

$$Z'\Delta Y = Z'\Delta Y_{-1Y}\gamma + Z'\Delta X\beta + Z'\Delta u \quad [9]$$

The GMM estimator is given in Equation 4 below:

$$\hat{\delta}_{GMM} = (\Delta X'Z\left(Z'\widehat{\Omega}Z\right)^{-1}Z'\Delta X)^{-1} \quad [10]$$

Here, $\Omega$ is the error term's covariance matrix. The Sargan test is proposed by Arellano and Bond (1991) to test the validity of the instrumental variables used in GMM. The exogeneity of the instrumental variables used in the model is investigated. If exogeneity exists, the model residuals are not correlated with the independent variables. The Sargan Test is tested against the $H_0$ of "Over-identification restrictions are valid."

$$s = \Delta\hat{u}Z(\sum_{i=1}^{N} z_i'\Delta\hat{u}_i\, \hat{u}_i'Z_i)^{-1}Z'\Delta\hat{u} \sim \chi^2_{p-K-1} \quad [11]$$

In Equation 5, $\Delta\hat{u}$ represents the residuals obtained from the two-stage estimation, and p represents the number of columns of Z. The test statistics are distributed as $\chi^2$ in p-K-1 degrees of freedom (Tatoglu, 2012).
The GMM estimator should be effective without second-difference autocorrelation. Arellano and Bond (1991) use the residuals from a first-difference model to test for autocorrelation. The null hypothesis is "there is no autocorrelation."

$$s_{ab} = \frac{\hat{u}-2^{\hat{u}}}{\hat{u}^{\frac{1}{2}}} \sim N(0,1) \quad [12]$$

### 3.3.3 Panel causality analysis

The causality test reveals whether there is a unidirectional or bidirectional causality relationship between variables and the direction of these relationships. The Dumitrescu-Hurlin (D-H) (2012) causality test was used to determine the causality relationship. The D-H (2012) test has several advantages. First, it considers the cross-sectional dependence among the countries in the dataset. Second, it is not sensitive to the difference in magnitude between the time and the cross-sectional dimensions. The test can be explained with the help of the following equation:

$$Y_{i,t} = \alpha_i + \sum_{k=1}^{K}\gamma_{i,t}^{(k)}\gamma_{i,t-k} + \sum_{k=1}^{K}\beta_i^{(k)}\chi_{i,t-k} + \varepsilon_{i,t} \quad [13]$$

K represents the lag length for all cross-sections. To test $H_0$ and $H_1$ in the D-H test, individual Wald statistics are calculated for the cross-sections, and the Wald statistics of the panel are obtained by taking the average of these statistics.

## 4. Empirical findings

**Table 7.** Panel unit root test results.

| Variable | t-bar | cv10 | cv5 | cv1 | Z[t-bar] | Prob. |
|---|---|---|---|---|---|---|
| **HDI** | -1.668 | -2.070 | -2.150 | -2.300 | 0.381 | 0.649 |
| **ΔHDI** | -3.221 | -2.070 | -2.150 | -2.300 | -6.881 | 0.000 |
| **NRD** | -2.060 | -2.070 | -2.150 | -2.300 | -1.449 | 0.074 |
| **ΔNRD** | -4.196 | -2.070 | -2.150 | -2.300 | -11.438 | 0.000 |
| **NRA** | -1.759 | -2.070 | -2.150 | -2.300 | -0.043 | 0.483 |
| **ΔNRA** | -2.231 | -2.070 | -2.150 | -2.300 | -2.247 | 0.012 |
| **EG** | -2.962 | -2.070 | -2.150 | -2.300 | -5.668 | 0.000 |
| **ΔEG** | -3.791 | -2.070 | -2.150 | -2.300 | -9.546 | 0.000 |
| **HC** | -2.542 | -2.070 | -2.150 | -2.300 | -3.705 | 0.000 |
| **ΔHC** | -3.639 | -2.070 | -2.150 | -2.300 | -8.834 | 0.000 |
| **IQ** | -2.053 | -2.070 | -2.150 | -2.300 | -1.416 | 0.078 |
| **ΔIQ** | -2.927 | -2.070 | -2.150 | -2.300 | -5.505 | 0.000 |

Note: The lag length was selected as 1 based on the AIC.
*Source:* Authors' own calculations

Table 7 above shows the CIPS test results. Upon investigating the CIPS unit root test results, it becomes clear that the EG and HC variables are stationary at the level. The HDI, NRD, NRA, and IQ variables become stationary at their first differences are taken.

Table 8 shows the GMM test results for EU member countries. According to Wald test results, both models are significant. The Sargan test indicates that the over-identifying restrictions implied by the internal lag instruments are valid, supporting the exogeneity of the instrument set. When examining the results in Table 8, a negative relationship is observed between NRD and development in EU member countries. A one-unit increase in NRD results in a 0.016-unit decrease in economic development. Economies overly dependent on natural resources often suffer from resource price volatility, low investment diversity, and delays in the development of innovative sectors. Many European countries, which mainly depend on resources such as oil and natural gas, may experience difficulties in achieving industrial diversification for sustainable economic growth. This relationship is the same for NRA in the second model. A one-unit increase in NRA decreases development by 0.0000578 units. High natural resource revenue can make other export sectors uncompetitive by appreciating the domestic currency. This can lead to shrinkage in the industrial and agricultural sectors, as well as slow economic growth, particularly for the developed economies in the EU. EG has a significant positive effect on HDI for both models. Since economic growth is a key pillar of the HDI, higher growth rates will lead to an increase in the HDI. The effect of HC and IQ variables on HDI is positive but insignificant.

GMM results show that natural resource dependence (NRD) and abundance (NRA) reduce HDI in the short term in the EU sample, whereas growth increases HDI (Table 8). The negative and significant NRD coefficient indicates that price volatility, loss of competitiveness due to exchange rate appreciation, and the overshadowing of resource revenues by other sectors suppress welfare indicators in the short term. Similarly, the negative relationship between increases in NRA and HDI suggests that how resource revenues are channeled into public investment and sectoral diversification is a determining factor. High environmental standards and transformation costs may strengthen this effect in the EU.

**Table 8.** GMM test results.

| Dependent variable: HDI | Model 1: NRD | Model 2: NRA |
|---|---|---|
| HDI (L1) | 0.0566897 | 0.3653504* |
| | (0.448) | (0.056) |
| NRD | -0.0162052*** | --- |
| | (0.005) | |
| NRA | --- | -0.0000578** |
| | | (0.025) |
| EG | 0.0006828*** | 0.0005171** |
| | (0.000) | (0.025) |
| HC | 3.81 | 3.64 |
| | (0.362) | (0.440) |
| IQ | 0.0004783 | 0.0027557 |
| | (0.483) | (0.246) |
| Constant | 0.0012061 | 0.0009407 |
| | (0.332) | (0.478) |
| Wald test | 40.05*** | 27.45*** |
| | (0.000) | (0000) |
| Sargan test | 0.30 | 0.06 |
| | (0.587) | (0.814) |
| Arellano-Bond test | -1.70* | -1.71* |
| | (0.089) | (0.087) |
| Observations | 462 | 441 |

Note: The lag length was selected as 2; probability values are shown in parentheses. *, ** and *** represent the significance levels of %10, %5 and %1, respectively.
*Source:* Authors' own calculations

It is worth noting an apparent contradiction here. While simple correlations show a positive relationship between NRA and HDI (0.386) in Table 3, dynamic GMM estimations find adverse short-run effects (-0.0000578) in Table 8. This difference stems from the conceptual difference between cross-level correlations and the GMM difference estimation, which focuses on annual within-country changes. Developed countries may have historically had both higher HDI and more natural capital; however, annual resource shocks and exchange rate effects can slow the progression of HDI in the short term. Thus, the long-run level correlation and the short-run marginal effect may not be in the same direction.

The positive and significant finding of EG in the GMM results (Table 8) is an expected outcome, despite the negative appearance of the EG-HDI relationship (-0.271) in the correlation matrix (Table 3). Because the correlation captures both the sharp growth contractions during crisis periods and the slow-moving HDI dynamics, it can create confusion in signs. However, GMM isolates the causal short-term effect of growth on HDI by controlling for lagged HDI and contemporaneous endogeneity. This difference highlights the distinction between correlation and causality.

The coefficients for HC and IQ are positive but statistically insignificant (Table 8). HC and IQ are slow-moving indicators. Since the difference between GMM removes a country's fixed effects and utilizes annual changes, these variables remain limited in terms of within-time variance.

**Table 9.** Causality test results.

| Causality | Statistic | Probability |
|---|---|---|
| NRD→HDI | 1.4431 | 0.1490 |
| HDI→NRD | 1.2477 | 0.2121 |
| NRA→HDI | -0.9719 | 0.3311 |
| HDI→NRA | 3.8160 | 0.0001*** |
| EG→HDI | 8.8059 | 0.0000*** |
| HDI→EG | -1.4455 | 0.1483 |
| IQ→HDI | 2.3463 | 0.0190*** |
| HDI→IQ | 5.3121 | 0.0000*** |
| HC→HDI | 0.5157 | 0.0061*** |
| HDI→HC | 5.2638 | 0.0000*** |

Note: The lag length was selected as 2 based on the AIC. *** represents the significance level at 5%.
*Source:* Authors' own calculations

According to the causality test results (see in Table 9), there is a unidirectional causality from HDI to NRA and from EG to HDI. A unidirectional causality from HDI to NRA implies that the development level of countries impacts the discovery or development of natural resources. During development, progress in industry and technology enables natural resources to be discovered, extracted, and processed more effectively. The development increases elements such as infrastructure, capital and knowledge, allowing countries to utilize their natural resource reserves more efficiently. Unidirectional causality from growth to development arises from the fact that higher growth rates enable countries to provide the necessary conditions for achieving development. Causality tests do not indicate a direct causal effect of NRD/NRA on HDI; thus, the negative coefficients should be interpreted as associations rather than causal effects.

There are also bidirectional causalities between HDI and IQ, HDI and HC. The bidirectional causality between development and institutional quality creates a sustainable development cycle. While strong institutions support development, increasing development also ensures the development of institutions. This cycle creates a significant advantage, especially for developing countries, because both economic growth and institutional structure are strengthened during the development process. The bidirectional causality between development and human capital creates a cycle that supports sustainable development. As human capital develops, economic growth accelerates; as growth increases, more investment is made in human capital. This cycle increases the competitiveness of countries and ensures long-term development.

Finally, the unidirectional directionality of EG→HDI and HDI→NRA in the causality analysis clarifies policy channels. While inclusive growth pushes the HDI upward in the short term, the efficient use of resources increases as the level of development rises. These findings support the thesis that resource revenues should be converted into HDI through human capital and institutional quality (Table 9).

## 5. Conclusion

The path of development is one of the most critical issues for all countries. In literature, numerous studies have been conducted on attaining development. A crucial factor in determining a country's development is the availability of its natural resources. For this reason, the connection between development and natural resources has become more attractive lately. This study aims to reveal the effects of natural resource dependence and natural resource abundance on development. In this context, 21 EU countries were examined from 1996 to 2019 using GMM and panel causality estimations.

Our results indicate that natural resource abundance can negatively impact HDI, provided it is coupled with weak institutions and low levels of human capital (Corrocher & Deshaires, 2020). In contrast, excessive dependence on natural resources without adequate investment in education and institutional quality is associated with weaker development outcomes (Sachs & Warner, 1995). Economic growth, particularly when inclusive and sustained, plays a vital role in improving HDI, but the quality of growth and its distribution across society ultimately determine human progress. Our findings underscore the importance of institutional frameworks that prioritize human capital development and transparent governance, particularly in resource-rich EU countries (Boubaker & Sghaier, 2020). Although policy effects were not directly tested, our results may serve as an input for European policymakers concerned with sustainable and inclusive resource management. In this context, EU policymakers should manage natural resources more transparently and accountably, encourage the participation of local communities, and channel resource revenues to areas that support development, such as education, health, and infrastructure. In addition, investing in innovative sectors and green technologies will increase economic diversification, prevent the over-exploitation of natural resources, enhance social welfare and promote sustainable development.

Future studies could use mixed methods to further investigate the relationship between natural resource dependency and development by applying time-varying methodologies. In particular, case studies that analyze the social, economic, and environmental impacts of natural resources on local communities would help us better understand this relationship better in longer-dated periods. Furthermore, comparative analyses across European countries could provide an important basis for evaluating the impacts and successes of various policies in different regions. Such studies would contribute to tailoring sustainable development strategies and support better decision-making processes in natural resource management.

## References

Abraham, T. W., & Ahmed, U. A. (2011). Economic growth and human development index in Nigeria: An error correction model approach. *International Journal of Administration and Development Studies, 2*(1), 239–254.

Acemoglu, D., & Robinson, J. A. (2012). *Why nations fail: The origins of power, prosperity, and poverty.* Crown Publishers.

Acemoglu, D., Johnson, S., & Robinson, J. A. (2003). An African success story: Botswana. In D. Rodrik (Ed.), *In search of prosperity: Analytic narratives on economic growth* (pp. 80–119). Princeton University Press. https://doi.org/10.1515/9781400845897-006

Alexeev, M., & Conrad, R. (2009). The elusive curse of oil. *The Review of Economics and Statistics, 91*(3), 586–598. https://doi.org/10.1162/rest.91.3.586

Aljarallah, R. A. (2020). The economic impacts of natural resource dependency in Gulf countries. *International Journal of Energy Economics and Policy, 10*(6), 36–52. https://doi.org/10.32479/ijeep.9836

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies, 58*(2), 277–297. https://doi.org/10.2307/2297968

Arezki, R., & Brückner, M. (2011). Food prices and political instability. *IMF Working Paper, 11*(62). International Monetary Fund. https://doi.org/10.5089/9781455221066.001

Awoa, P. A., Ondoa, H. A., & Tabi, H. N. (2024). Natural resources and income inequality: Economic complexity is the key. *Environment and Development Economics, 29*, 127–153. https://doi.org/10.1017/S1355770X2300013X

Badeeb, R. A., Lean, H. H., & Clark, J. (2017). The evolution of the natural resource curse hypothesis: A critical literature survey. *Resources Policy, 51*, 123–134. https://doi.org/10.1016/j.resourpol.2016.10.015

Balestra, P., & Nerlove, M. (1966). Pooling cross-section and time-series data in the estimation of a dynamic model: The demand for natural gas. *Econometrica, 34*(3), 585–612. https://doi.org/10.2307/1909771

Baltagi, B. H. (2021). *Econometric analysis of panel data* (6th ed.). Springer. https://doi.org/10.1007/978-3-030-53953-5

Bardhan, P. K. (2005). *Scarcity, conflicts, and cooperation: Essays in the political and institutional economics of development.* MIT Press.

Barro, R. J., & Lee, J. W. (2013). A new data set of educational attainment in the world, 1950–2010. *Journal of Development Economics, 104*, 184–198. https://doi.org/10.1016/j.jdeveco.2012.10.001

Becker, G. S. (1962). Investment in human capital: A theoretical analysis. *Journal of Political Economy, 70*(5), 9–49. https://doi.org/10.1086/258724

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics, 87*(1), 115–143. https://doi.org/10.1016/S0304-4076(98)00009-8

Boschini, A. D., Pettersson, J., & Roine, J. (2013). The resource curse and its potential reversal. *World Development, 43*, 19–41. https://doi.org/10.1016/j.worlddev.2012.10.007

Boubaker, S., & Sghaier, A. (2020). Institutional quality and economic growth: Evidence from European countries. *International Journal of Economics and Finance, 12*(2), 64–76.

Breitung, J., & Das, S. (2005). Panel unit root tests under cross-sectional dependence. *Statistica Neerlandica, 59*(4), 414–433. https://doi.org/10.1111/j.1467-9574.2005.00299.x

Breusch, T. S., & Pagan, A. (1979). A simple test for heteroscedasticity and random coefficient variation. *Econometrica, 47*(5), 1287–1294. https://doi.org/10.2307/1911963

Breusch, T. S., & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *The Review of Economic Studies, 47*(1), 239–253. https://doi.org/10.2307/2297111

Bulte, E. H., Damania, R., & Deacon, R. T. (2005). Resource intensity, institutions, and development. *World Development, 33*(7), 1029–1044. https://doi.org/10.1016/j.worlddev.2005.04.004

Cappelen, A., & Mjøset, L. (2009). Can Norway be a role model for natural resource abundance? *WIDER Working Paper, 2009*(23). UNU-WIDER.

Corden, W. M., & Neary, J. P. (1982). Booming sector and de-industrialization in a small open economy. *The Economic Journal, 92*(368), 825–848. https://doi.org/10.2307/2232670

Corrales, J., & Penfold, M. (2015). *Dragon in the tropics: Venezuela and the legacy of Hugo Chávez* (2nd ed.). Brookings Institution Press. https://doi.org/10.5040/9780815750956

Cust, J., & Mihalyi, D. (2017). Evidence for a presource curse? Oil discoveries, elevated expectations, and growth disappointments. *OxCarre Working Paper, 193.* Oxford Centre for the Analysis of Resource Rich Countries.

Dabla-Norris, E., Ji, Y., Townsend, R. M., & Filiz Unsal, D. (2015). *Distinguishing constraints of financial inclusion and their impact on GDP and inequality* (NBER Working Paper No. 20821). National Bureau of Economic Research. https://doi.org/10.3386/w20821

Debonheur, K. D., Desire, A., & Ouedraogo, I. (2023). The effect of natural resources rents on human development in selected African countries. *Natural Resources Forum, 48*(3), 803–837. https://doi.org/10.1111/1477-8947.12341

Destek, M. A., Aydın, S., & Destek, G. (2022). Investigating an optimal resource dependency to prevent natural resource curse: Evidence from countries with the curse risk. *Resources Policy, 79*, 102981. https://doi.org/10.1016/j.resourpol.2022.102981

Dumitrescu, E.-I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling, 29*(4), 1450–1460. https://doi.org/10.1016/j.econmod.2012.02.014

Durbin, J. (1954). Errors in variables. *Review of the International Statistical Institute, 22*(1–3), 23–32. https://doi.org/10.2307/1401917

Esanov, A., Raiser, M., & Buiter, W. (2001). *Nature's blessing or nature's curse: The political economy of transition in resource-based economies* (ZEF Discussion Paper No. 81). University of Bonn, Center for Development Research (ZEF).

Eurostat. (2022). *Human development index across EU countries.* European Union.

Farhadi, M., Islam, M. R., & Moslehi, S. (2015). Economic freedom and productivity growth in resource-rich economies. *World Development, 72*, 109–126. https://doi.org/10.1016/j.worlddev.2015.02.014

Farooq, U., Tabash, M. I., & Al-Faryan, M. A. S. (2025). Natural resources and economic growth in Asia: The moderating role of governance. *Transnational Corporations Review.* Advance online publication. https://doi.org/10.1016/j.tncr.2025.200143

Feenstra, R. C., Inklaar, R., & Timmer, M. P. (2015). The next generation of the Penn World Table. *American Economic Review, 105*(10), 3150–3182. https://doi.org/10.1257/aer.20130954

Fukuda-Parr, S. (2003). The human development paradigm: Operationalizing Sen's ideas on capabilities. *Feminist Economics, 9*(2–3), 301–317. https://doi.org/10.1080/1354570022000077980

Gelb, A. (1988). *Oil windfalls: Blessing or curse?* Oxford University Press.

Gylfason, T. (2001). Natural resources, education, and economic development. *European Economic Review, 45*(4–6), 847–859. https://doi.org/10.1016/S0014-2921(01)00127-1

Hanushek, E. A., & Woessmann, L. (2021). Education and economic growth. *Oxford Research Encyclopedia of Economics and Finance.* https://doi.org/10.1093/acrefore/9780190625979.013.651

Haq, M. ul. (1995). *Reflections on human development.* Oxford University Press. https://doi.org/10.1093/oso/9780195101911.001.0001

Hashmat, A., Ghouse, G., & Ahmad, N. (2023). Impact of economic and environmental dynamics on human development: An analysis of HDI classifications. *Bulletin of Business and Economics, 12*(3), 738–751. https://doi.org/10.61506/01.00112

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica, 46*(6), 1251–1271. https://doi.org/10.2307/1913827

Holden, S. (2013). Avoiding the resource curse: The case of Norway. *Energy Policy, 63*, 870–876. https://doi.org/10.1016/j.enpol.2013.09.010

Hong, J. Y. (2017). Does oil hinder social spending? Evidence from dictatorships, 1972–2008. *Studies in Comparative International Development, 52*(4), 457–482. https://doi.org/10.1007/s12116-017-9237-y

Hsiao, C. (2014). *Analysis of panel data* (3rd ed.). Cambridge University Press. https://doi.org/10.1017/CBO9781139839327

Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics, 115*(1), 53–74. https://doi.org/10.1016/S0304-4076(03)00092-7

Karl, T. L. (1997). *The paradox of plenty: Oil booms and petro-states.* University of California Press. https://doi.org/10.1525/9780520918696

Khan, Y., Liu, F., & Hassan, T. (2023). Natural resources and sustainable development: Evaluating the role of remittances and energy resources efficiency. *Resources Policy, 80*, 103214. https://doi.org/10.1016/j.resourpol.2022.103214

Kim, D.-H., Chen, T.-C., & Lin, S.-C. (2020). Does oil drive income inequality? New panel evidence. *Structural Change and Economic Dynamics, 55*, 137–152. https://doi.org/10.1016/j.strueco.2020.08.002

Li, Y., Pang, D., & Cifuentes-Faura, J. (2023). Time-varying linkages among financial development, natural resources utility, and globalization for economic recovery in China. *Resources Policy, 82*, 103498. https://doi.org/10.1016/j.resourpol.2023.103498

Matsen, E., & Torvik, R. (2005). Optimal Dutch disease. *Journal of Development Economics, 78*(2), 494–515. https://doi.org/10.1016/j.jdeveco.2004.09.003

Mavratos, G., Murshed, S. M., & Torres, S. (2011). Natural resource dependence and economic performance in the 1970–2000 period. *Review of Development Economics, 15*(1), 124–138. https://doi.org/10.1111/j.1467-9361.2010.00597.x

Mehlum, H., Moene, K., & Torvik, R. (2006). Institutions and the resource curse. *The Economic Journal, 116*(508), 1–20. https://doi.org/10.1111/j.1468-0297.2006.01045.x

Mohamed, E. S. E. (2020). Resource rents, human development and economic growth in Sudan. *Economies, 8*(4), Article 99. https://doi.org/10.3390/economies8040099

Mousavi, A., & Clark, J. (2021). The effects of natural resources on human capital accumulation: A literature survey. *Journal of Economic Surveys, 35*(4), 1073–1117. https://doi.org/10.1111/joes.12441

Papyrakis, E., & Gerlagh, R. (2007). Resource abundance and economic growth in the United States. *European Economic Review, 51*(4), 1011–1039. https://doi.org/10.1016/j.euroecorev.2006.04.001

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics, 22*(2), 265–312. https://doi.org/10.1002/jae.951

Pesaran, M. H., Ullah, A., & Yamagata, T. (2008). A bias-adjusted LM test of error cross-section independence. *The Econometrics Journal, 11*(1), 105–127. https://doi.org/10.1111/j.1368-423X.2007.00227.x

Petermann, A., Guzmán, J. I., & Tilton, J. E. (2007). Mining and corruption. *Resources Policy, 32*(2), 91–103. https://doi.org/10.1016/j.resourpol.2007.08.003

Rădulescu, M., Simionescu, M., Kartal, M. T., Mohammed, K. S., & Balsalobre-Lorente, D. (2025). The impact of human capital, natural resources, and renewable energy on achieving sustainable cities and communities in European Union countries. *Sustainability, 17*(5), 2237. https://doi.org/10.3390/su17052237

Radulović, M. (2020). The impact of institutional quality on economic growth: A comparative analysis of the EU and non-EU countries of Southeast Europe. *Economic Annals, 65*(225), 163–182. https://doi.org/10.2298/EKA2025163R

Ranis, G., Stewart, F., & Ramirez, A. (2000). Economic growth and human development. *World Development, 28*(2), 197–219. https://doi.org/10.1016/S0305-750X(99)00131-X

Rodrik, D., Subramanian, A., & Trebbi, F. (2004). Institutions rule: The primacy of institutions over geography and integration in economic development. *Journal of Economic Growth, 9*(2), 131–165. https://doi.org/10.1023/B:JOEG.0000031425.72248.85

Ross, M. L. (2012). *The oil curse: How petroleum wealth shapes the development of nations.* Princeton University Press. https://doi.org/10.1515/9781400841929

Sachs, J. D., & Warner, A. M. (1995). Natural resource abundance and economic growth. *NBER Working Paper, 5398.* https://doi.org/10.3386/w5398

Sachs, J. D., & Warner, A. M. (2001). The curse of natural resources. *European Economic Review, 45*(4–6), 827–838. https://doi.org/10.1016/S0014-2921(01)00125-8

Salahojaev, R., Djalilov, B., Bakieva, I., & Kobiljonov, I. (2024). The relationship between natural resource abundance and human development in Belt and Road Initiative countries: The role of financial development. *International Journal of Energy Economics and Policy, 14*(1), 45–52. https://doi.org/10.32479/ijeep.14494

Sala-i-Martin, X., & Subramanian, A. (2013). Addressing the natural resource curse: An illustration from Nigeria. *Journal of African Economies, 22*(4), 570–615. https://doi.org/10.1093/jae/ejs033

Saud, S., Haseeb, A., Zafar, M. W., & Li, H. (2023). Articulating natural resource abundance, economic complexity, education and environmental sustainability in MENA countries: Evidence from advanced panel estimation. *Resources Policy, 80*, 103261. https://doi.org/10.1016/j.resourpol.2022.103261

Schultz, T. W. (1961). Investment in human capital. *The American Economic Review, 51*(1), 1–17.

Sen, A. (1999). *Development as freedom.* Oxford University Press.

Simionescu, M., Rădulescu, M., & Cifuentes-Faura, J. (2024). The role of natural resources rents and e-government in achieving sustainable development in the European Union. *Resources Policy, 97*, 105278. https://doi.org/10.1016/j.resourpol.2024.105278

Singh, S., Sharma, G. D., Rădulescu, M., Balsalobre-Lorente, D., & Bansal, P. (2024). Do natural resources impact economic growth? An investigation of P5+1 countries under sustainable management. *Geoscience Frontiers, 15*(3), 101595. https://doi.org/10.1016/j.gsf.2023.101595

Stiglitz, J. E. (2012). *The price of inequality: How today's divided society endangers our future.* W. W. Norton.

Stijns, J.-P. C. (2005). Natural resource abundance and economic growth revisited. *Resources Policy, 30*(2), 107–130. https://doi.org/10.1016/j.resourpol.2005.05.001

Tatoglu, F. Y. (2012). *İleri panel veri analizi: Stata uygulamalı.* Beta Yayınları.

Timbe, G., Flavio, L. P., Bam, W., Hartmann, D., & De Bruyne, K. (2024). Is natural resource abundance a curse or an opportunity? Economic complexity, FDI, and industrial policies in Mozambique. *Resources Policy, 98*, 105326. https://doi.org/10.1016/j.resourpol.2024.105326

Torvik, R. (2009). Why do some resource-abundant countries succeed while other do not? *Oxford Review of Economic Policy, 25*(2), 241–256. https://doi.org/10.1093/oxrep/grp015

Transparency International. (2023). *Corruption perceptions index 2022.*

United Nations Development Programme (UNDP). (1990). *Human development report 1990.* Oxford University Press.

United Nations Development Programme (UNDP). (2015). *Transforming our world: The 2030 agenda for sustainable development.* United Nations.

United Nations Development Programme (UNDP). (2024). *Human development report 2023–2024.*

van der Ploeg, F., & Poelhekke, S. (2011). Volatility and the natural resource curse. *Oxford Economic Papers, 61*(4), 727–760. https://doi.org/10.1093/oep/gpp027

Van der Ploeg, F., & Poelhekke, S. (2017). The impact of natural resources: Survey of recent quantitative evidence. *The Journal of Development Studies, 53*(2), 205–216. https://doi.org/10.1080/00220388.2016.1160069

World Bank. (2021). *The changing wealth of nations 2021: Managing assets for the future.* https://www.worldbank.org/en/publication/changing-wealth-of-nations/data

World Bank. (2024). *World development indicators.* https://databank.worldbank.org/source/world-development-indicators

Wu, D. M. (1973). Alternative tests of independence between stochastic regressors and disturbances. *Econometrica, 41*(4), 733–750. https://doi.org/10.2307/1914093

Zhang, J., Muhammad, T., Dai, W., Khan, Q. R., & Ahmad, M. (2024). How does the resource curse influence economic performance? Exploring the role of natural resource rents and renewable energy consumption in South Asia. *Sustainability, 16*(11), 11138. https://doi.org/10.3390/su162411138

Zhang, X., Xing, L., & Fan, S. (2008). Resource abundance and regional development in China. *Economics of Transition, 16*(1), 7–29. https://doi.org/10.1111/j.1468-0351.2007.00318.x