# NATURAL RESOURCE RENTS, GOVERNANCE QUALITY, PUBLIC DEBT AND ECONOMIC GROWTH IN RESOURCE-RICH COUNTRIES: A PANEL DATA ANALYSIS

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## ABSTRACT

This study investigates the dynamic relationship between natural resource rents, governance quality, GDP per capita, and public debt in resource-rich economies. Using panel data from 13 resource-rich countries, we employ cross-sectional dependence (Breusch-Pagan LM and Pesaran CD) tests to explore cross-sectional dependencies across variables, and apply the second-generation unit root tests. Unit root tests reveal a mix of stationary and non-stationary variables, validating the appropriateness of the panel ARDL model for cointegration analysis. Empirical findings highlight nuanced relationships: total natural resource rents exhibit a negative impact on public debt, moderated by governance indicators such as control of corruption and rule of law. Governance quality also significantly matters for public debt accumulation in the panel of selected countries. Moreover, GDP per capita demonstrates varying effects on debt reduction across different models. These insights underscore the importance of governance frameworks in managing fiscal outcomes amid resource wealth. The study contributes empirical evidence to inform policy discussions on sustainable economic management in resource-rich contexts.

**Keywords:** Public debt; total natural resource rents; resource-rich countries; governance quality; economic growth.

# INTRODUCTION

Managing public debt is crucial to fiscal stability and economic positioning in the context of a complex global integration (Greiner & Fincke, 2016). The fluctuating nature of public debt has shaped the trajectory of nations and the prosperity of their citizens from the ancient times, creating a narrative about fiscal and economic governance that is relevant throughout time and space.

Within financial crises and with economic downturns, public debt – which is commonly used to measure economic sustainability – has increasingly become focused on as an illustration of the ability of a country to sustain the difficulty (Spaventa, 1987). The processes of public debt management, which are based on the experience of the administration, political science, and economics, have become an object of policy debates and academic analysis as governments were concerned about budget deficits and debt repayment. The management of public debt becomes even more critical for resource-rich countries since it is directly related to the level, trends, and volatility of natural resource rents, and the quality of governance (Baglioni and Cherubini, 1993). In this context, it is still concluded that governments who operate in regions with a rich potential for minerals and oil fields have to actively manage resources, develop a non-oil economy, and keep fiscal discipline that all must be achieved while keeping in view the long-term and short-term objectives of fiscal consolidation and economic growth.

It is impossible to underestimate the role that natural resource rents have in determining the economic future of resource-rich countries. These rents provide a wonderful source of foreign exchange earnings to the government (Manzano and Rigobon, 2001). Nevertheless, many challenges affect the management of these rents for instance macroeconomic shocks, the impacts of Dutch disease, governance challenges, and environmental impacts among others as pointed out by (Gurbanov and Merkel 2012). In most developed, as well as developing countries, the blessings of natural resource endowment have been described as a 'resource curse' or the 'paradox of plenty'. Such hypothesis known as the Prebisch hypothesis dictates that countries with large amount of natural resources are likely to grow at a slower rate, have higher inequality and more political instability than their counterparts with limited resource wealth (Prebisch, 1950; Singer, 1950). This has several factors which include institutional capacity issues, issues of economic diversities, and issues with the efficiency of governance.

Developing countries, especially the ones endowed with natural resources, often get into the 'paradox of plenty', whereby even with the potential for development, they experience a boom-bust cycle due to excessive reliance on such resources (Cust and Mihalyi, 2017). Public sectors may also borrow more when business cycles are favorable owing to projected high revenues due to continuing resource endowment. However, when the reserves of resources deplete or the prices of these commodities drop, many countries are left with rising debts and fewer prospects for development.

Natural resource rents are both opportunities for revenues and threats to public debt formation in the same sense that they can be a potential source of receipts and at the same time a source of debts. Another area through which resource rent income could potentially assist governments of mineral-exporting nations in establishing sustainable strong future growth is providing financial freedom to invest in very critical lines such as infrastructure, health, and education. However, depending on unpredictable and structural revenue sources and volatile and unpredictable

commodities prices endangers nations with considerable fiscal risks, thereby worsening debt vulnerabilities and macroeconomic instability (Gonzalez-Redin et al., 2018).

Today, public debt is still a key issue for government institutions, both because of the amount of its revenues, which partly compensate for the possible shortfall in tax collection, and because it is an essential instrument of fiscal policy for the government (Cifuentes-Faura and Simionescu, 2024).

This study intends to contribute to a better understanding of the nexuses that exist between public debt, natural resource rents, economic growth, and governance quality, as well as their independent relationships. The analyses suggest that natural resource rents have a complex, non-linear impact on public debt, with governance quality moderating this relationship. Strong governance institutions, particularly in controlling corruption and ensuring the rule of law, can mitigate fiscal vulnerabilities, while weak governance exacerbates debt accumulation. Additionally, economic growth significantly reduces fiscal burdens, emphasizing the importance of fostering both growth and governance for debt sustainability.

*Research questions*

Our research attempts to clarify the complex linkages that exist in resource-rich countries between public debt, natural resource rents, economic growth, and governance quality. We aim to reveal subtle insights into how these factors interact and influence one another over time by analyzing these interactions using a panel data analytic approach like that of (Ampofo et al., 2021). Unlike their study, we will also explore the effects of additional variables beyond natural resource rents. Our study aims to add to the body of literature by providing a thorough understanding of the processes underlying public debt buildup in resource-rich situations, using rigorous empirical analysis and a strong methodology. In our research, we have tried to answer the following questions:

*Q1: Do higher levels of natural resource rents incentivize resource-backed borrowings in resource-rich countries?*

*Q2: How does the quality of governance influence the level of debt in resource-rich countries?*

*Q3: Does the higher quality of governance mitigate the negative consequences of natural resource rents on economic growth in resource-rich countries?*

*Q4: How do total natural resource rents and governance quality interact to affect public debt in resource-rich countries?*

## 1. LITERATURE REVIEW

The story of resource-rich countries is filled with both difficulties and opportunities. This story in most cases summed up in the term "resource curse" is dedicated to the paradoxical connection between resource wealth and economic development. Based on the publications from the 1950s, including the Prebisch hypothesis scholars have been trying to explain the complex association between natural resource rents, governance capabilities, public debt, and economic advancement. This pursuit has led to the emergence of diverse perspectives and approaches, that include novel financial strategies like "resource-backed financing" to critical examinations of governance structures and debt management practices. Given the challenges associated with the use of natural resources by resource-rich countries for development, there is a need to explore the intricate connections between these factors.

## 2.1. Natural resource rents and the public debt

Based on the views of Prebisch and Singer in 1950, the "Prebisch hypothesis" presents an early theory regarding the complex challenges of the 'resource curse'. Prebisch (1950) and Singer (1950) stated that the declining price of natural resources in the international market is a challenge to economic growth especially to economies that heavily depend on natural resources. The early 21st-century resource boom gave rise to a new financial approach known as "resource-backed financing". (Mihalyi and Scurfield, 2020) define this approach as a new means of raising funding where countries borrow money based on secured future natural resource-related income. This idea is further developed by (Manzano and Rigobon, 2001), who stated that resource-rich countries usually employ their expected windfalls as security for loans simply because the amount of credit that is available to them is strictly limited. They further pointed out that this method enables these countries to address their debt liabilities, especially during price fluctuations. On the other hand, the problems of mismanagement are also widespread, thus countries like Indonesia, Norway, Nigeria, and Mexico become the victims of external debt, and thus, concepts like "debt overhang" and "boom-induced borrowing capacity" are developed (Gurbanov and Merkel, 2012).

Further, the studies by (Lederman and Maloney, 2006) emphasize the shortcomings of lending in the 1970s due to the false expectations of a rising oil price which then resulted in debt crises in the 1980s. Likewise, Mozambique's case of the over-borrowed but little to be booked upon discovery of vast offshore gas reserves is an example of the risk associated with over-dependence on future resource revenues (Cust and Mihalyi, 2017).

Ag'enor (2013) claims that the abundance of resources could be used to finance public investments and hence, can be the source of economic growth but borrowing against future revenues without observing fiscal responsibility could expose economies even to debt unsustainability (Melina et al., 2016). Sadik-Zada et al. (2019) using an empirical analysis revealed that oil wealth, mineral rent as a percent of total revenue, and economic growth rates cause the public debt to grow. Ampofo et al. (2021) explored the interaction between total natural resource rents and public debt in resource-rich countries, discovering a positive long-run relationship between countries' resource earnings and public debt. The study also shows a causal relationship between resource abundance and public debt.

## 1.2. Natural resource rents and governance quality

Promoting management of natural resource wealth remains one of the robust safeguard mechanisms against the threats of what has been termed as the 'resource curse'. This dilemma emerges when the availability of resources raises the intensity of inequality (Smith, 1882; Keynes, 1936; Seccareccia and Lavoie, 2016), increases the level of conflict (Bannon and Collier, 2003; Fearon and Laitin, 2003; Humphreys, 2005), and weakens the government's accountability (Karl, 1997; Moore, 2004).

Some of the resource-related institutions including legal frameworks and other provoking bodies become crucial assets for avoiding the resource curse and for practicing sustainable development (Mehlum et al., 2006; Frankel, 2010). Knack and Keefer (1995) and Stevens and Dietsche (2008) have also stated that the effect of natural resources on the growth and development of a country depends greatly on the institutional quality of the country's institutions. Literature reveals that in many resource-rich countries, poor governmental control and organizations usually act as

precursors to the identification of large depletable resources (Vahabi, 2018). Many scholars have ascertained that abundant natural resources breed resource dependency which precipitates a decline in governance and institutional improvement, creating a negative cycle. (Ross, 2001; Jensen and Watchekon, 2004; Rosser, 2006).

Rent-seeking models further suggest that since rents can be easily appropriated, they give rise to corruption, bribes, and perverse policy inclinations, thereby shifting public funds towards favor-seeking activities (Torvik, 2002; Papyrakis & Gerlagh, 2004; Vicente, 2010). In particular, when managing relatively large amounts of rent, rent seeking might be more appealing to governments than development policies. As such, the "resource curse" in nations with a large stock of depletable resources is often linked with the development of the "extractive" political states by Ross (2001) and Moore (2004).

Despite their unique characteristics, all resource institutions grapple with two closely intertwined spheres: the emergence and distribution of resource wealth (Webb, 2010). The genesis involves the formulation of laws, rules, and institutions that create property rights to encourage the proper utilization of resources and prevent waste. On the other hand, allocation addresses the matter of dividing the wealth created between stakeholders, which include governmental bodies, local communities, and developmental institutions. The complex interactions between local historical trajectories and political dynamics are reflected in these institutional formations. (Barma et al., 2012).

Thus, uncertainty, especially in assessing wealth and governmental performance, arises as a crucial challenge in defining appropriate allocations. Integrity, resilience, regulatory capability, and legal compliance form the foundation of a competent government without which effective allocation of the public sector cannot take place. In conclusion, the search for the most efficient allocation strategy proves to be a complex process that depends on governmental honesty and is filled with risks. Effective governance systems and accountable institutional structures assume centrality in mapping development pathways for countries endowed with natural resources.

### 1.3. Public debt and governance quality

Analyzing the association between governance quality and public debt is crucial for interpreting the general economic processes of countries with an abundance of natural resources. The analysis of this connection necessitates a detailed examination of multiple aspects of governance and their effects on fiscal strategies and debts.

According to Tarek and Ahmed (2017), poor governance reduces the GDP growth rate in MENA countries and, therefore, is a major determinant of higher public debt. Their research reveals that only three indicators of governance provide strong support to this relationship. They noted that poor governance leads to an increase in the public debt-to-GDP ratio due to five governance index indicators: government effectiveness, voice and accountability, political stability and absence of violence, regulatory quality, and rule of law, which are statistically negatively related to the public debt ratio.

In a related argument, Nguyen and Luong (2021) reveal that institutional quality, especially the control of corruption, has a direct effect on public debt. According to their evidence, they validate the concept that with weak governance not only public debt grow, but they also confirm that attempts to improve institutional quality regarding government effectiveness, regulatory quality, and rule of law for the transition countries may lead to the increase in public debt. This is

a clear indication of the dynamic relationship between institutional changes and fiscal effects particularly after shifts in political régimes.

Mehmood et al. (2022) provided additional macroeconomic evidence that clearly supports the two governance indicators namely, the political stability and the control of corruption negatively influence the public debt while government effectiveness and the rule of law push public indebtedness upward. Authors affirm that the long-run estimate of the impact of governance are similar across countries, but the short-run estimates and the rates of adjustments to the long-run equilibrium differ greatly. Imaginário and Guedes (2020) support these findings using a large sample of 164 countries from 2002 to 2015. These results illustrate that the quality of governance is negatively related to government debt, especially in low-income countries. The analysis highlights that improving governance environments helps in decreasing public debts across these countries, but the impact is relatively weaker for high-income countries.

These studies, taken together, suggest that governance quality is a determinant of public debt and that distinct indicators of governance are related to public debt levels in various geographical locales and income classes. There is, therefore, a call for analyzing the ways in which specific governance reforms can be managed better in order to address the problems of public debt and the variance of effects according to the socio-economic status of the respective nations.

## 2. DATA

The study employs a balanced panel dataset covering the period from 1996 to 2021 for 13 resource-rich countries. Raw data was obtained from the International Monetary Fund (IMF), World Development Indicators (WDI) and World Bank (Table 1).

**Table 1.** Data, abbreviation, measurement, source and time

| Data | Abbreviation | Measurement | Source | Time |
|---|---|---|---|---|
| Public Debt | **DEBT** | Central government debt as a percent of GDP | **IMF** | 1996-2021 |
| Total natural resource rents expressed as a proportion of GDP | **TNRR** | Rents of Oil + natural gas + coal + mineral + forest (Share of GDP) | **WDI** | 1996-2021 |
| Worldwide Governance Indicators | **WGI** | Composite scores for six governance dimensions from over 30 data sources, using the Unobserved Components Model (UCM). | **World Bank** | 1996-2021 |
| *Voice & Accountability* | *VA* | | | |
| *Political Stability* | *PS* | | | |
| *Government Effectiveness* | *GE* | | | |
| *Regulatory Quality* | *RQ* | | | |
| *Rule of Law* | *RL* | | | |
| *Control of Corruption* | *CC* | | | |
| GDP Per Capita | **GDPPC** | Average economic output per person in a given Population | **WDI** | 1996-2021 |

The participant countries were selected based on their weighted share of natural resource rents in GDP (%) during 1996-2021 period. To obtain more effective results, we chose countries with a weighted share of more than 20%. Selected countries are Saudi Arabia, Qatar, Oman, Mongolia, Kuwait, Iran, Gabon, Congo Republic, Chad, Burundi, Azerbaijan, Algeria, and Angola.

Table 2 presents an overview of these economic and governance indicators, highlighting substantial variability in public debt, natural resources rents, GDP per capita, and various aspects of governance. To enhance the effectiveness of our analysis, all data were transformed into their natural logarithmic forms. This strategy enables a less biased comparison and analysis of the data given that issues of skewness and heteroscedasticity may come up.

Analysis shows that, log of public debt ranges from 2.54 in Kuwait to 4.56 in the Congo Republic, indicating fiscal disparities. Natural resources rents span from 2.58 (Mongolia) to 3.76 (Kuwait), reflecting the significance of natural resources in some economies. GDP per capita varies greatly, from 5.22 in Burundi to 10.79 in Qatar, illustrating economic inequalities.

Governance indicators show stark contrasts. Voice and Accountability scores range from 1.57 (Saudi Arabia) to 4.37 (Burundi), while Political Stability scores are lowest in Burundi (1.50) and highest in Qatar (4.38). Government Effectiveness spans from 1.95 (Burundi) to 4.28 (Qatar), and Regulatory Quality from 1.83 (Iran) to 4.18 (Qatar). Rule of Law scores range from 1.90 (Chad) to 4.23 (Qatar), and Control of Corruption from 1.19 (Chad) to 4.32 (Qatar)

**Table 2.** Descriptive Statistics

| Country | lnPUBLIC DEBT | lnTNRR | lnGDPPC | Governance Quality | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Voice and Accountability (lnVA) | Political Stability (lnPS) | Government Effectiveness (lnGE) | Regulatory Quality (lnRQ) | Rule of Law (lnRL) | Control of Corruption (lnCC) |
| *Disaggregated level* | | | | | | | | | |
| **Saudi Arabia** | 3.11 | 3.54 | 9.6 | 1.57 | 3.52 | 3.96 | 3.96 | 4.02 | 4.02 |
| **Qatar** | 3.63 | 3.45 | 10.79 | 3.06 | 4.38 | 4.28 | 4.18 | 4.23 | 4.32 |
| **Oman** | 2.66 | 3.49 | 9.55 | 3.02 | 4.28 | 4.13 | 4.17 | 4.17 | 4.21 |
| **Mongolia** | 4.03 | 2.58 | 7.41 | 4.05 | 4.25 | 3.7 | 3.8 | 3.88 | 3.67 |
| **Kuwait** | 2.54 | 3.76 | 10.29 | 3.5 | 4.01 | 3.99 | 4.03 | 4.15 | 4.12 |
| **Iran** | 3.21 | 3.16 | 8.19 | 2.39 | 2.72 | 3.51 | 1.83 | 3.07 | 3.36 |
| **Gabon** | 3.9 | 3.29 | 8.77 | 3.26 | 3.97 | 3.24 | 3.58 | 3.55 | 3.08 |
| **Congo Republic** | 4.56 | 3.64 | 7.5 | 2.74 | 3.07 | 2.26 | 2.28 | 2.28 | 2.36 |
| **Chad** | 3.7 | 2.88 | 6.25 | 2.52 | 2.31 | 2.1 | 2.53 | 1.9 | 1.19 |
| **Burundi** | 4.37 | 3.05 | 5.22 | 4.37 | 1.5 | 1.95 | 2.52 | 2.14 | 2.37 |
| **Azerbaijan** | 2.46 | 3.19 | 7.79 | 2.48 | 3.11 | 3.33 | 3.41 | 3.07 | 2.29 |
| **Algeria** | 3.28 | 3.11 | 8.06 | 2.96 | 2.37 | 3.41 | 2.8 | 3.04 | 3.38 |
| **Angola** | 4.1 | 3.49 | 7.44 | 2.62 | 2.71 | 2.53 | 2.57 | 2 | 1.9 |
| *Aggregated/panel level* | | | | | | | | | |
| **Mean** | 3.5 | 3.28 | 8.22 | 2.83 | 3.25 | 3.26 | 3.2 | 3.19 | 3.1 |
| **Min** | 2.46 | 2.58 | 5.22 | 1.57 | 1.5 | 1.95 | 1.83 | 1.9 | 1.19 |
| **Max** | 4.56 | 3.76 | 10.79 | 4.05 | 4.38 | 4.28 | 4.18 | 4.23 | 4.32 |
| **Std Dev.** | 0.66 | 0.32 | 1.51 | 0.58 | 0.87 | 0.77 | 0.78 | 0.85 | 0.96 |

# 3. EMPIRICAL METHODOLOGY

## 3.1. Cross-Sectional Dependence

Working with panel data requires testing for cross-section dependence, followed by applying appropriate unit root tests. Here, we employ the Breusch-Pagan LM test (Breusch & Pagan, 1980), the Pesaran scaled LM test, and the Pesaran CD test (Pesaran, 2004) for cross-section dependence. These tests have been used in recent panel studies (e.g., Sadik-Zada et al., 2019; Ampofo et al., 2021).

**Table 3.** Cross-section dependence test results

| Variable | BP LM | Pesaran LM | Pesaran CD |
|---|---|---|---|
| LnDEBT | 2238.59*** | 93.40*** | 37.52*** |
| LnTNRR | 2226.78*** | 92.85*** | 42.37*** |
| LnGDPPC | 4637.56*** | 205.01*** | 67.56*** |
| VA | 2157.8*** | 89.64*** | 4.569*** |
| GE | 1569.0*** | 62.25*** | 0.605 |
| CC | 1618.9*** | 64.13*** | -1.792* |
| PS | 1061.3*** | 38.63*** | 1.628 |
| RL | 1182.5*** | 44.27*** | -0.948 |
| RQ | 1370.4*** | 53.01*** | 0.350 |

**\*Note:** Number of cross-sections – 22. ***, **, and * denote the rejection of null hypothesis at 1%,
5% and 10% significance levels.
Source: **Author's computation using EViews 13 software**

Table 3 summarizes the cross-section dependence test results. All the employed tests yield similar outcomes, rejecting the null hypothesis of 'no cross-section dependence.' The Breusch-Pagan LM and Pesaran LM tests indicate cross-section dependence in all variables, while the Pesaran CD test fails to reject the null hypothesis for governance quality indicators at the 5% level, except for VA. Therefore, we should account for cross-section dependence and also apply second-generation unit root tests.

## 3.2. Unit Root Tests

Because the test results reveal cross-section dependence in the model variables, we apply both second and first-generation unit root tests simultaneously. To address the issue of cross-section dependence, we use the commonly employed Pesaran's (2007) CIPS test (hereafter CIPS) as the second-generation unit root test. Additionally, the results from the first-generation unit root tests, namely Im-Pesaran-Shin (Im et al., 2003, hereafter IPS) and Levin-Lin-Chu (Levin et al., 2002, hereafter LLC), allow us to examine individual (IPS) and common (LLC) unit root processes. Table 4 reports the results of all the unit root tests.

**Table 4.** Unit root test results

| Variable | Level | | First-difference | | Order |
|---|---|---|---|---|---|
| | *Intercept* | *Intercept and trend* | *Intercept* | *Intercept and trend* | |
| *Pesaran – CIPS / 2nd generation* | | | | | |
| LnDEBT | -2.15* | -1.94 | -2.56*** | - | I(1) |
| LnTNRR | -2.19* | -2.37 | -2.74*** | - | I(1) |
| LnGDPPC | -2.73*** | - | - | - | I(0) |
| VA | -2.27** | - | - | - | I(0) |
| GE | -2.09* | -2.68* | -3.95*** | - | I(1) |
| CC | -1.85 | -2.39 | -3.96*** | - | I(1) |
| PS | -2.05 | -3.06*** | -4.39*** | - | I(1) |
| RL | -1.81 | -2.57 | -4.53*** | - | I(1) |
| RQ | -1.91 | -2.94*** | -4.89*** | - | I(1) |
| *IPS / 1st generation* | | | | | |
| LnDEBT | -0.29 | 3.05 | -6.20*** | -4.81*** | I(1) |
| LnTNRR | -2.86*** | - | - | - | I(0) |
| LnGDPPC | 0.29 | 5.30 | -11.2*** | - | I(1) |

| | | | | | |
|---|---|---|---|---|---|
| **VA** | -2.10** | - | - | - | I(0) |
| **GE** | -0.69 | -2.21** | -18.85*** | - | I(1) |
| **CC** | 1.11 | -1.54* | -15.06*** | - | I(1) |
| **PS** | -2.46*** | - | - | - | I(0) |
| **RL** | -1.29* | -1.49* | -17.4*** | - | I(1) |
| **RQ** | -1.93** | - | - | - | I(0) |
| *LLC / 1st generation* | | | | | |
| **LnDEBT** | -1.93** | - | - | - | I(0) |
| **LnTNRR** | -3.91*** | - | - | - | I(0) |
| **LnGDPPC** | -3.02*** | - | - | - | I(0) |
| **VA** | -3.39** | - | - | - | I(0) |
| **GE** | -2.16*** | - | - | - | I(0) |
| **CC** | 0.177 | 0.154 | -13.73*** | - | I(1) |
| **PS** | -2.15** | - | - | - | I(0) |
| **RL** | -0.86 | 0.88 | -15.22*** | - | I(1) |
| **RQ** | -2.82*** | - | - | - | I(0) |

*Note: ***, **, and * denote the rejection of null hypothesis at 1%, 5% and 10% significance levels.

**Source:** Author's computation using EViews 13 software

According to the unit root test results, all model variables are either I(0) or I(1). From this perspective, the panel Auto-Regressive Distributed Lag (panel ARDL) model is well-suited to examine the cointegration relationship among the variables, as it accommodates variables that are I(0), I(1), or a mixture of both. However, the precondition for using the ARDL model is that the dependent variable and at least one independent variable must be non-stationary at the level.

Regarding the dependent variable, the CIPS test finds the natural logarithm of public debt to be I(1), consistent with the output from the IPS test. Conversely, the LLC test, which assumes a common unit root process, concludes that the dependent variable is I(0). Since the dependent variable exhibits cross-sectional dependence, the CIPS test is more reliable than IPS and LLC. Therefore, we can consider the first precondition of the ARDL model to be fulfilled. The unit root test results also satisfy the other precondition of the ARDL methodology: at least one independent variable is non-stationary at the level. Hence, we can proceed with the panel ARDL methodology.

### 3.4. Empirical framework

Considering previous studies on total natural resource rents (TNRR) and public debt (Ampofo et al., 2021), governance quality (GQ) and public debt (Nguyen and Luong, 2021), and GDP per capita (GDPPC) and public debt (Checherita and Rother, 2010; Kumar and Woo, 2010), the debt-to-GDP ratio is:

$$Debt = f(TNRR, GQ, GDPPC)$$

However, functional relationships should be non-linear and more complicated. On the one hand, resource-rich countries inject commodity earnings into the economy through fiscal channels to meet spending needs while facing negative feedback known as the resource curse in the literature (Prebisch, 1950; Singer, 1950). Resource-based growth raises economic (Clements et al., 2003; Reinhart & Rogoff, 2010), social (Bannon & Collier, 2003; Humphreys, 2005), and political (Karl, 1997; Moore, 2004), representing itself with changes in governance quality indicators (Mehlum et al., 2006; Frankel, 2010).

Current research endeavors to account for the complexities and non-linearities inherent in the economic model, estimating the long-run impact of TNRR, governance quality (six indicators considered separately), and GDP per capita on the public debt-to-GDP ratio in selected resource-rich economies. We utilize the Pooled Mean Group (PMG) ARDL methodology to estimate the cointegration relationships. The final model specification is as follows:

$$
\begin{aligned}
\ln(Debt)'_{i,t} = {} & \alpha'_0 + \alpha'_1 * \ln(Debt)_{i,t-1} + \alpha'_2 * \ln(TNRR)_{i,t-1} + \alpha'_3 * \ln(CC)_{i,t-1} + \alpha'_4 \\
& * \ln(GDPPC)_{i,t-1} + \alpha'_5 * \ln(TNRR)_{i,t-1} * \ln(CC)_{i,t-1} + \alpha'_6 * \ln(CC)^2_{i,t-1} \\
& + \sum_{k=1}^{11} \gamma'_k * Z'_k + \delta'_1 * t + u'_t
\end{aligned}
\tag{1}
$$

$$
\begin{aligned}
\ln(Debt)''_{i,t} = {} & \alpha''_0 + \alpha''_1 * \ln(Debt)_{i,t-1} + \alpha''_2 * \ln(TNRR)_{i,t-1} + \alpha''_3 * \ln(GE)_{i,t-1} + \alpha''_4 \\
& * \ln(GDPPC)_{i,t-1} + \alpha''_5 * \ln(TNRR)_{i,t-1} * \ln(GE)_{i,t-1} + \sum_{k=1}^{9} \gamma''_k * Z''_k + \delta''_1 * t \\
& + u''_t
\end{aligned}
\tag{2}
$$

$$
\begin{aligned}
\ln(Debt)'''_{i,t} = {} & \alpha'''_0 + \alpha'''_1 * \ln(Debt)_{i,t-1} + \alpha'''_2 * \ln(TNRR)_{i,t-1} + \alpha'''_3 * \ln(TNRR)^2_{i,t-1} + \alpha'''_4 \\
& * \ln(PS)_{i,t-1} + \alpha'''_5 * \ln(PS)^2_{i,t-1} + \alpha'''_6 * \ln(GDPPC)_{i,t-1} + \sum_{k=1}^{6} \gamma'''_k * Z'''_k + \delta'''_1 * t \\
& + u'''_t
\end{aligned}
\tag{3}
$$

$$
\begin{aligned}
\ln(Debt)^*_{i,t} = {} & \alpha^*_0 + \alpha^*_1 * \ln(Debt)_{i,t-1} + \alpha^*_2 * \ln(TNRR)_{i,t-1} + \alpha^*_3 * \ln(TNRR)^2_{i,t-1} + \alpha^*_4 \\
& * \ln(RL)_{i,t-1} + \alpha^*_5 * \ln(GDPPC)_{i,t-1} + \alpha^*_6 * \ln(TNRR)_{i,t-1} * \ln(RL)_{i,t-1} \\
& + \sum_{k=1}^{11} \gamma^*_k * Z^*_k + \delta^*_1 * t + u^*_t
\end{aligned}
\tag{4}
$$

$$
\begin{aligned}
\ln(Debt)^{**}_{i,t} = {} & \alpha^{**}_0 + \alpha^{**}_1 * \ln(Debt)_{i,t-1} + \alpha^{**}_2 * \ln(TNRR)_{i,t-1} + \alpha^{**}_3 * \ln(TNRR)^2_{i,t-1} + \alpha^{**}_4 \\
& * \ln(RQ)_{i,t-1} + \alpha^{**}_5 * \ln(RQ)^2_{i,t-1} + \alpha^{**}_6 * \ln(GDPPC)_{i,t-1} + \sum_{k=1}^{6} \gamma^{**}_k * Z^{**}_k + \delta^{**}_1 * t \\
& + u^{**}_t
\end{aligned}
\tag{5}
$$

$$
\begin{aligned}
\ln(Debt)^{***}_{i,t} = {} & \alpha^{***}_0 + \alpha^{***}_1 * \ln(Debt)_{i,t-1} + \alpha^{***}_2 * \ln(TNRR)_{i,t-1} + \alpha^{***}_3 * \ln(TNRR)^2_{i,t-1} + \alpha^{***}_4 \\
& * \ln(VA)_{i,t-1} + \alpha^{***}_5 * \ln(GDPPC)_{i,t-1} + \sum_{k=1}^{5} \gamma^{***}_k * Z^{***}_k + \delta^{***}_1 * t \\
& + u^{***}_t
\end{aligned}
\tag{6}
$$

In the equations, $<'>$ and $<*>$ stand for value change in coefficients ($\alpha$ and $\gamma$), fitted value and residuals ($u_t$) as well as the list of short-term variables ($Z_k$). $i$ and $t$ denote the i-th country at t-th year.

## 4. RESULTS

At first step, we test existence of cointegration relationship using Wald test, and later interpret long-run coefficients. Table 5 displays several econometric models that examine the impact of TNRR on Public debt with the moderating factors, which are several government indicators. As for the first model, it illustrates an inverse relationship between TNRR and Public Debt and has a marginal impact of -0.164. Furthermore, this relationship increases as the variable CC rises. Model (2) shows that TNRR has a positive effect on public debt while at the same time showing a high level of sensitivity to changes in GE beyond 2. 684 confirming that at higher levels of GE, the effect can only be marginal to the tune of 0. 015. Model (3) reveals a U-shaped relationship: initially negative, TNRR's impact on Public Debt diminishes and may turn positive at higher levels. Model (4) shows that TNRR first lowers Public Debt and reaches a minimum of (-2 * 0. 165) then rises again. This non-linear relation means that TNRR has a more pronounced effect on Public Debt and this is due to the variations in the level of RL. The influence of TNRR on Public Debt which is also evident in both Models (5) and Models (6) is an inverse U-shape that shows that while TNRR has a negative effect on Public Debt first, then stays minimum and then rises again – proving that the effect of TNRR on PD is not as direct as it could seem.

**Table 5.** Relationship between TNRR and Public debt

| Models | $\dfrac{\partial \ln(\text{DEBT})_{i,t}}{\partial \ln(\text{TNRR})_{i,t}}$ | Value of moderating factor | | Marginal impact | Decision |
|---|---|---|---|---|---|
| *(1)* | $-0.577 + 0.121 * \ln(CC)_{i,t}$ | *Mean* | *30.23* | *-0.164* | *Negative, increasing marginal impact towards higher CC value* |
| | | *Median* | *20.19* | *-0.213* | |
| *(2)* | $-0.371 + 0.113 * \ln(GE)_{i,t}$ | *Mean* | *30.66* | *0.015* | *Increase in TNRR could contribute positively to DEBT at higher GE levels* |
| | | *Median* | *22.68* | *-0.018* | |
| *(3)* | $-0.968 + 2 * 0.132 * \ln(TNRR)$ | | | - | *Initially negative impact of increasing TNRR diminishes as TNRR increases and may turn positive at higher levels, indicating a U-shaped relationship.* |
| *(4)* | $0.753 - 2 * 0.165 * \ln(TNRR) - 0.087 * \ln(RL)_{i,t}$ | *Mean* | *29.62* | *4.008* | *Parabolic, inverse U-shaped, Negative* |
| | | *Median* | *19.19* | *4.49* | |
| *(5)* | $0.321 - 2 * 0.097 * \ln(TNRR)$ | | - | | *Impact is negative, meaning that as TNRR increases, DEBT decreases.* |
| *(6)* | $0.310 - 2 * 0.123 * \ln(TNRR)$ | | - | | *Inverse u shaped, indicating a negative impact at lower levels of TNRR, which may turn positive at higher levels.* |

**Source:** Author's computation using EViews 13 software

These findings underscore the complex dynamics between TNRR and Public Debt, influenced by factors like CC, GE, and RL, providing nuanced insights into economic relationships.

**Table 6.** Relationship between Economic growth and public debt

| Models | $\dfrac{\partial \ln(\text{DEBT})_{i,t}}{\partial \ln(\text{GDP})_{i,t}}$ | Governance Quality | Relationship |
|--------|--------|--------|--------|
| *(1)* | $-0.493$ | *CC* | *Negative* |
| *(2)* | $-0.566$ | *GE* | *Negative* |
| *(3)* | $-0.408$ | *PS* | *Negative* |
| *(4)* | $-0.426 * \ln(GDP)_{i,t}$ | *RL* | *Negative* |
| *(5)* | $-0.540 * \ln(GDP)_{i,t}$ | *RQ* | *Negative* |
| *(6)* | $-0.414 * \ln(GDP)_{i,t}$ | *VA* | *Negative* |

**Source:** Author's computation using EViews 13 software

Table 6 shows various econometric models examining the relationship between Economic Growth (GDP) and Public Debt (DEBT), considering the effects of different governance quality indicators such as CC, GE, PS, RL, and RQ. Each model shows a negative relationship between GDP and Public Debt, with coefficients ranging from -0.408 to -0.566, indicating that higher economic growth tends to be associated with lower levels of public debt across different governance contexts. These observations confirm the significance of effective governance in the management of financial policies to moderate public debt.

**Table 7.** Relationship between Governance quality and Public debt

| Models | $\dfrac{\partial \ln(\text{DEBT})_{i,t}}{\partial \ln(\text{GQ})_{i,t}}$ | GQ | Value of moderating factor | | Threshold value | Decision |
|--------|--------|--------|--------|--------|--------|--------|
| *(1)* | $-1.053 + 0.121 * \ln(TNRR)$ $+ 2 * 0.170$ $* \ln(CC)^2{}_{i,t}$ | *CC* | *Mean* | *3.27* | *0.145* | *The impact of ln(GQ) on ln(DEBT) is positive across all thresholds (Mean, Median, Max, Min).* |
| | | | | | *0.149* | |
| | | | *Median* | *3.33* | | |
| *(2)* | $-0.371 + 0.113 * \ln(GE)$ | *GE* | *Mean* | *3.27* | *0.123* | *The impact of ln(GQ) on ln(DEBT) is positive for Mean, Median, and Max thresholds, but negative for the Min threshold.* |
| | | | | *3.33* | *0.129* | |
| | | | *Median* | | | |
| *(3)* | $-0.751 + 2 * 0.083 * \ln(PS)$ | *PS* | | *-* | | *The impact is almost always negative regardless of the specific threshold value.* |
| *(4)* | $-0.321 - 0.087 * \ln(TNRR)_{i,t}$ | *RL* | *Mean* | *3.27* | *0.036* | *The impact is positive for Mean, Median, and Min thresholds, but negative for the Max threshold.* |
| | | | | *3.33* | *0.031* | |
| | | | *Median* | | | |
| *(5)* | $-2.699 + 2 * 0.514 * \ln(RQ)$ | *RQ* | | *-* | | *The impact is mostly positive.* |
| *(6)* | $\alpha - 0.034 * \ln(VA)_{i,t}$ | *VA* | | *-* | | *The impact is negative and insignificant.* |

**Source:** Author's computation using EViews 13 software

Table 7 shows how Governance Quality (GQ) affects Public Debt (DEBT) across different models and moderating factors. To summarize, higher Governance Quality tends to be associated with

lower Public Debt, proving that good governance directly contributes to the appropriate fiscal management. Findings indicate that factors such as Control of Corruption (CC) and Regulatory Quality (RQ), generally tend to positively affect debt management. On the other hand, poor governance quality, as measured by Political Stability (PS), consistently shows a negative association. These patterns show that strong institutional frameworks are necessary for safe fiscal following policies and minimizing public debt ens to implement improved fiscal institutions.

## DISCUSSION AND CONCLUSION

The results indicate a dynamic relationship between total natural resource rents, public debt, governance quality, and economic growth. A deeper understanding and discussion of these results can provide valuable policy recommendations.

The analysis reveals that non-linear relationships between TNRR and public debt highlight the complex dynamics of resource-rich countries. TNRR can have both positive and negative impacts on public debt, depending on the time scale—whether short-term or long-term. The U-shaped and inverse U-shaped dynamics demonstrate that while resource rents may initially alleviate fiscal pressures, they can later contribute to debt accumulation as reliance on resource revenues increases. This finding aligns with the perspectives of Prebisch (1950) and Singer (1950), and Mihalyi and Scurfield (2020). This complex trajectory is influenced by governance quality indicators, particularly Control of Corruption (CC), Government Effectiveness (GE), and Rule of Law (RL). For instance, the inverse relationship between TNRR and public debt in Model 1 (Table 5) suggests that effective control of corruption can enhance the fiscal benefits derived from resource rents. On the other hand, the U-shaped relationship cautions that dependence on resource wealth without strong governance can exacerbate fiscal vulnerabilities, as highlighted by Gurbanov and Merkel (2012). These results underscore the intricate relationship between these two crucial elements.

Our results align with the literature on the negative relationship between economic growth and public debt from various perspectives. The observed coefficients, ranging from -0.408 to -0.566, suggest that higher GDP per capita significantly reduces fiscal burdens. These results emphasize the dual importance of fostering economic growth and improving governance quality in achieving debt sustainability. Growth-driven fiscal consolidation, supported by governance reforms, presents a viable strategy for resource-rich countries to break free from the boom-bust cycles typical of resource dependence.

Governance quality emerges as a crucial determinant in moderating the impact of natural resource rents and economic growth on public debt. Various governance indicators, such as Control of Corruption (CC), Rule of Law (RL), and Government Effectiveness (GE), show a positive impact on reducing the level of public debt in resource-rich countries, as demonstrated by Ben Jacque & Al Yahya (2019). Conversely, Political Stability (PS) exhibits a negative impact, highlighting the detrimental effects of political instability on public debt, which poses a significant challenge for any country. These findings align with existing literature while extending it by showing that governance not only mitigates the adverse effects of the "resource curse" but also strengthens the fiscal discipline necessary for sustainable development. This underscores the importance of institutional reforms and capacity-building in governance within resource-rich countries.

All these findings suggest that fiscal outcomes, particularly the role of governance quality as a moderator, have a significant impact on public debt. Our study highlights that resource-rich countries must prioritize policies that address both short-term and long-term fiscal challenges. These countries should give serious consideration to various governance indicators to stabilize their fiscal policies. Strengthening anti-corruption measures, ensuring judicial independence, and improving regulatory oversight can help mitigate the negative externalities of resource dependence. Conversely, over-reliance on natural resources can have detrimental effects, and thus, balancing resources and diversifying the economic base, as recommended by most studies, is essential. Policies that account for the non-linear impacts of TNRR, such as resource stabilization funds or sovereign wealth funds, can help smooth revenue fluctuations and reduce debt vulnerabilities.

This study contributes to the broader discourse on the "resource curse" by emphasizing the moderating role of governance quality. While prior research often generalized the negative effects of resource wealth, this paper demonstrates that governance can transform resource abundance from a potential liability into an asset. Furthermore, the use of advanced econometric techniques, such as the panel ARDL model, enhances the rigor of the analysis, providing robust empirical evidence for policy guidance.

Future research could explore the sectoral allocation of resource rents and its implications for public debt. Additionally, investigating the role of external shocks, such as global commodity price fluctuations or geopolitical risks, could provide further insights into the complex dynamics revealed in this study. Expanding the dataset to include more countries and time periods could also improve the generalizability of the findings.

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