Araştırma Makalesi / Research Article

Green Growth or Financial Trap? Revisiting the Resource Curse Hypothesis with Evidence From a Panel Model

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Abstract

This study revisits the resource curse hypothesis by analyzing the long-run relationship between renewable energy production and financial development using a panel ARDL approach across 21 emerging markets (2000–2020). Findings reveal a negative association between renewable energy generation and stock market performance, while institutional quality promotes financial deepening. This suggests a green financial trap, where clean energy transitions may hinder capital market growth in structurally weak economies. The study contributes by linking environmental sustainability with financial infrastructure, addressing a gap in empirical dynamics on renewable-driven financial dynamics. Unlike prior studies focused on non-renewable resource dependence, this analysis underscores structural asymmetries and institutional factors influencing financial outcomes. Policy recommendations include introducing transparency-based reporting standards and sustainability-linked regulatory reforms to reduce market vulnerability. By highlighting the financial complexities of green transitions, the paper expands the resource curse framework and offers actionable insights for emerging economies seeking balanced energy and financial strategies.

Keywords: *Renewable Energy, Financial Development, Resource Curse, Institutional Quality*
JEL Codes*: Q43, G15, C33, O16*

Yeşil Büyüme mi, Finansal Tuzak mı? Panel ARDL Modeli ile Kaynak Laneti Hipotezinin Yeniden Değerlendirilmesi

Öz

Bu çalışma, 21 gelişmekte olan pazarda (2000–2020) panel ARDL yaklaşımı kullanarak yenilenebilir enerji üretimi ile finansal gelişme arasındaki uzun vadeli ilişkiyi analiz ederek kaynak laneti hipotezini yeniden ele almaktadır. Bulgular, yenilenebilir enerji üretimi ile borsa performansı arasında negatif bir ilişki olduğunu ortaya koyarken, kurumsal kalitenin finansal derinleşmeyi teşvik ettiğini göstermektedir. Bu, temiz enerjiye geçişin yapısal olarak zayıf ekonomilerde sermaye piyasasının büyümesini engelleyebileceği bir yeşil finansal tuzağı akla getirmektedir. Çalışma, çevresel sürdürülebilirliği finansal altyapı ile ilişkilendirerek, yenilenebilir enerji kaynaklı finansal dinamikler üzerine yapılan ampirik araştırmalardaki bir boşluğu doldurmaktadır. Yenilenemeyen kaynaklara bağımlılığa odaklanan önceki çalışmalardan farklı olarak, bu analiz finansal sonuçları etkileyen yapısal asimetrileri ve kurumsal faktörleri vurgulamaktadır. Politika önerileri arasında, piyasanın kırılganlığını azaltmak için şeffaflığa dayalı raporlama standartlarının ve sürdürülebilirlikle bağlantılı düzenleyici reformların getirilmesi yer almaktadır. Yeşil geçişlerin finansal karmaşıklığını vurgulayan bu çalışma, kaynak laneti çerçevesini genişletmekte ve dengeli enerji ve finansal stratejiler arayan gelişmekte olan ekonomiler için uygulanabilir içgörüler sunmaktadır.

Anahtar Kelimeler: *Yenilenebilir Enerji, Finansal Gelişme, Kaynak Laneti, Kurumsal Kalite*
JEL Kodları: *Q43, G15, C33, O16*

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Extended Summary

The purpose of this research is to examine the impact of countries with sufficient data on renewable energy production on energy output and financial development by focusing on stock market development. For this purpose, a panel ARDL model (Pesaran, Shin & Smith, 1999) was applied with the statistics of the 11 countries with the highest GDP. As a result, no trace of the resource curse was found but a certain level of negative relationship was found with stock market development. Table 2. outlines the selection criteria for countries and variables included in the study. It clarifies the rationale behind choosing specific macroeconomic indicators and renewable energy data, ensuring consistency in the dataset across all selected countries. Additionally, the table summarizes the empirical design and classification of the variables, which underpins the subsequent panel ARDL analysis. The pre form dataset, consisting of the Stocks traded, turnover ratio of domestic shares (%) (SMDSTTD), Renewable electricity output (% of total electricity output (NRAREO), GDP per capita growth (annual %) (GDPPCG), Index of Human Capital per Person (HCIPP) and Voice and Accountability which measures the level of citizens' participation in government selection and the freedom of expression, association, and media in a country: Estimate (QVA). have been gathered as detailed in the following section of the study, by the sources and characteristics. As the 'ln' forms of the variables are taken, the negative component involving series has been manipulated by taking the squire roots at the first place than taking the ln forms with this respect. Nevertheless, the Index of Human Capital per Person series for the chosen countries was found unstationary on its first derivative and excluded from the model. After this stage, stock market development proxy SMDSTTD is considered to be a function of the three variables.

After transforming all the variables to their logarithmic forms, the process of conducting an Autoregressive Distributed Lag (ARDL) study was initiated after certain tests. A panel ARDL study aims to analyze the long-run and short-run dynamics of a group of cross-sectional and/or time-series data. It is used to estimate and test the cointegration relationship among variables and also to examine the short-run dynamics among the variables in the model. The panel ARDL approach allows for the estimation of country specific as well as common factors influencing the variables of interest in the model.

The Panel ARDL framework is designed to capture dynamic relationships in panel datasets, which involve multiple cross-sectional units observed across time. According to the results of this study, the increase in renewable energy production is associated with a slight decrease in stock market development, while the increase in stock market development is associated with a slight decrease in economic growth. It also found that institutional quality has an effect on stock market development. Overall, the study did not find significant evidence of a "resource curse" in the sample countries producing renewable energy. Therefore, the study has limitations related to data, it is very important to conduct new studies with sufficient balanced data to better understand the validity of the hypothesis in terms of renewable energy.

1. Introduction

The utilization of renewable energy sources has the capacity to offer a pure and sustainable source of energy while decreasing reliance on non-renewable fossil fuels. Nonetheless, the exploitation of renewable energy resources may also result in a "resource curse," where the plentiful availability of these resources may have some impact on production characteristics. This research was conducted to investigate the impact of this resource curse on financial and stock market development in countries with adequate data.

Unlike conventional resource curse frameworks that focus on hydrocarbon wealth, this study extends the hypothesis to include renewable energy-driven distortions in financial systems, emphasizing country-level institutional asymmetries.

The increased focus on sustainable development is driven by the belief that corporations have greater impact on human, financial, and natural resources for promoting economic growth than any other entities and governments (Van Horne and Wachowicz, 2005). This leads the corporations extract more natural resources, which requires a financial system to fund and manage costs and promote growth in the economy (Shahbaz, 2012). The connection between natural resources, finance, and economic growth has been a topic of interest for contemporary economists, with varying results on the relationship between them in the context of both natural and financial resource curse.

Recent research also suggests that clean energy transitions may not yield uniform economic benefits unless complemented by transparent governance and adaptive financial institutions.

The purpose of this study is to seek answers to the "resource curse" hypothesis from the renewable energy point of view. This refers to the negative impact that an over-reliance on natural resources can have on a country's economy and financial markets (Rajan and Zingales, 2003). The main research question centers on whether renewable energy production acts as a financial trap that limits equity market development in emerging economies lacking institutional safeguards. For example, a country heavily reliant on revenue from renewable energy resources may experience a decline in economic diversification and an overvaluation of its currency, which can make other industries less competitive and reduce foreign investment. Additionally, fluctuations in the global market for renewable energy resources can lead to volatility in a country's stock market. As such, it's important for countries to manage their renewable energy resources in a sustainable way to avoid these negative effects.

In actuality, the results of influxes from abundant natural or renewable resources possibly have a negative impact on entrepreneurship and lead to a decrease in economic growth. This is due to the incentives that divert attention away from activities that create value. (Baland and Francois, 2000; Mehlum, 2006). Another shortcoming could be a weakened overall institutional quality to be taken into consideration where the abundance

of resources may decline or vanish, and in some cases weakened some of the governance indicators and being harmful for the smoothness of democracy as well (Akça, Harun & Demiral, 2015).

By positioning renewable energy as both a sustainability asset and a source of financial friction, this study builds a conceptual link between climate-driven policy shifts and vulnerabilities in capital markets.

The human capital factor is taken into consideration as an essential for being a target of influence in times of resource abundance, where human capital tends to decline as excess funds help to soften the terms of unemployment. Nonetheless, sufficient human capital is an essential guarantee for evading the curse (Shao& Yang, 2014). Unfortunately, the international human capital index acquired from the FED web site, calculated and found unstable in the first derivative and could not be implemented in the model since the ARDL approach developed by (Pesaran Shin &Smith, 1999) can be applied for determining the long-run relationship among variables irrespective of the order of integration; however, it cannot be applied to variables integrated of order I (2) (Nkoro and Uko, 2016; Pata and Caglar, 2020). Those explained variables gathered with the variable regarding electricity production from renewable resources, are considered interrelated and stock market development dubbed to be a function of those variables to be regressed on the stock market development in order to find a quantitively relationship and explanation between them.

2. Literature Review

The natural resource curse theory, also known as the "paradox of plenty," suggests that countries with abundant natural resources may experience slower economic growth and development compared to countries without such resources. The theory identifies four main causes for this phenomenon. These can be summarized as follows. First, the Dutch disease, which occurs when a country's natural resource exports lead to a decrease in the competitiveness of other industries and a real appreciation of the exchange rate. Resource abundance could exploit natural resources lead to a decrease in the manufacturing sector and a shrinking of the trade sector, which is important for financial development. When natural gas fields were discovered in Groningen, Netherlands in 1959, the inflow of foreign currency to the city increased and the concept of the Dutch disease and resource curse spread. Contrary to expectations, the exchange rate of the country, which was rich in natural gas, increased and Dutch industrial products became expensive. This situation caused losses in foreign trade in international manufacturing. While the industry declined, the Netherlands, which became a country dependent on natural gas trade, was shown as an example of countries experiencing economic imbalance despite being rich in natural resources. Sachs and Warner (1995) argue that such imbalances emerge when resource wealth distorts market signals, weakening productive sectors in favor of extraction-

heavy activities. The instability in oil prices in the world economy, the fluctuations in price indexes in the 1970s, energy crises brought the natural resource curse approach to the agenda. The debt crisis in the 1980s, developing countries exporting to pay their debts, the collapse of planned economies in Eastern Europe and the former Soviet Union after 1989, the fall in commodity prices in the world economy, the fluctuations in price indexes in the 1970s, energy crises brought the natural resource curse approach to the agenda. The debt crisis in the 1980s, developing countries exporting to pay their debts, the collapse of planned economies in Eastern Europe and the former Soviet Union after 1989, the fall in commodity prices accelerated the economic decline in countries that sold their natural resources. Alan Gelb's research titled "Oil Winds: Blessing or Curse?", which analyzed the “Resource Curse theory”, is a published study in 1988, where the effects of the incomes of oil-rich countries on the economy create economic growth in the short term but cause a weakening of industrial production in the long term, causing imbalances in the local economy. The book is one of the pioneering studies that analyzes the economic effects of oil revenues in oil-rich countries in depth. The study showed that although oil rents bring economic growth in the short term, they can cause imbalances in local economies due to the weakening of non-industrial sectors (such as agriculture and manufacturing) and excessive increases in foreign exchange earnings in the long term. Gelb’s analysis, by relating this situation to the Dutch Disease, emphasizes the financial and structural problems that need to be considered in economies dependent on natural resources such as oil. The second study that draws attention to the negative effects of natural resources on economic growth is Richard Auty’s, 1993 (Azizullah,& Ak 2024). Auty (2001) further emphasizes that resource abundance can degrade institutional capacity and lead to inefficient allocation of rents, thereby obstructing fiscal reform and policy innovation.

Another recent study of Yi, Raghutla & Chittedi (2023) undertaken and come out with the results suggest that economic globalization, financial development and economic growth significantly increase renewable energy consumption.

Makarenko et al. (2023) provide cross-country evidence on how sustainability-related disclosure regulations impact financial market dynamics, including stock market capitalization, volatility, and investment inflows. Analyzing data from 74 developed and developing economies, they find that ESG disclosure rules positively influence portfolio and direct investments in strong institutional environments, while creating volatility and asymmetric responses in fragile contexts.

Alvarez-Perez and Fuentes (2024) examine the impact of ESG disclosure on corporate bond credit spreads within the oil and gas industry using two-stage least squares regressions. Their results demonstrate that higher ESG ratings are associated with lower borrowing costs, especially among non-state-owned companies, suggesting that ESG practices enhance financial performance through reduced risk premiums.

Lee et al. (2024) analyze the dual market impact of the ESG Disclosure

Simplification Act of 2021 across primary and secondary U.S. corporate bond markets. They observe that the so-called "sustainium"—a pricing premium for ESG-labeled bonds—disappears post-legislation in primary markets, while secondary markets exhibit no economically significant abnormal return differentiation between ESG and non-ESG bonds. These findings underline the ambiguity of investor reactions to mandated ESG disclosures and reinforce the argument that, without standardized enforcement mechanisms, ESG integration may fail to generate persistent financial advantages.

Using a propensity score matching approach, Li et al. (2025) find that U.S. corporate bonds issued by ESG leaders consistently display lower credit spreads—averaging 14.3 bps—compared to ESG laggards across both primary and secondary markets. The ESG premium is especially pronounced among financial issuers and is amplified by bond liquidity conditions, as reflected in Bloomberg LQA scores and bid–ask spreads. Interestingly, while ESG performance yields tangible spread benefits, ESG disclosure levels alone have negligible financial impact, suggesting that transparency must be accompanied by substantive sustainability action to influence investor behavior.

Ellili (2022) further extends this strand by examining how ESG disclosure and financial reporting quality jointly affect investment efficiency in the UAE. Her panel data findings suggest that ESG transparency mitigates underinvestment and improves capital allocation, particularly in high-quality reporting environments—reinforcing the systemic role of non-financial disclosure in financial resilience.

There is another study conducted on the risk management point of view which proposed resource curse risk assessment framework to be applied to individual contexts to help countries, companies, sectors, or projects maximize the positive outcomes of renewable energy development and avoid a renewable energy resource curse with the scenarios involved in the model (Leonard, Ahsan and Charbonnier, 2022). Hou et al. (2023), based on panel data from 53 countries, observed that green finance supports renewable energy uptake, but warned that weak institutions may expose such markets to volatility and fiscal inefficiency. Ullah et al. (2024) assess the relationship between resource abundance and energy security risk across BRICS economies, highlighting institutional fragility as a central mechanism. Their long-run estimations reveal that governance failures, rent-seeking, and corruption disrupt investment flows, thereby intensifying exposure to energy vulnerability. The findings indicate that institutional weakness not only hampers renewable energy integration but also deepens the structural symptoms of green financial traps within resource-dependent contexts. Alharbi et al. (2023) find that institutional quality plays a mediating role in how green investments translate into financial stability, offering a nuanced expansion of the resource curse framework for sustainability-focused economies.

Second, the rent-seeking, where individuals and groups attempt to capture a larger share of the economic rents from natural resources through corruption and other forms of political manipulation. Alim et al. (2024) analyze how political stability affects stock market performance in Pakistan, applying GARCH-family models to capture volatility asymmetries. Their results show that instability triggers disproportionate financial turbulence, with negative political shocks exerting stronger effects than positive ones. This volatility discourages long-term capital mobilization toward green sectors, emphasizing the role of institutional fragility in exacerbating green financial traps under political uncertainty. The exploitation of natural resources may lead to economic rents and increase the potential for corruption and rent-seeking. Studies of Petermannü, Maliqueo, Codne, Echiburú, Crisosto, Pérez, Pérez-Bravo& Cassorla (2007) have shown a link between mining and corruption, and corruption can harm a government's credibility and ability to implement financial reforms (Yuxiang and Chen, 2010). Additionally, resource abundance can create a false sense of security and discourage the need for financial reforms (Sachs and Warner, 1999). Furthermore, resource booms can decrease the number of entrepreneurs who promote financial development (Baland and Francois, 2000), which in turn can slow down financial development. Mehlum, Moene and Torvik (2006) highlight the distinction between “grabber-friendly” and “producer-friendly” institutions, noting that rent-seeking tendencies flourish where rule of law and regulatory transparency are weak.

Trade liberalization can lead to the strengthening of industries that promote financial growth and the weakening of those that oppose it. Previous studies have found a positive relationship between trade openness and financial development. Third, volatility in resource prices, which can lead to economic instability and a lack of long-term planning. And finally, fourth, crowding out of other sectors of the economy, as the abundance of natural resources can lead to a lack of investment in other sectors such as manufacturing and service industries. Since resource abundance negatively impacts the trade sector, it may also have a negative effect on the rate of financial growth. Van der Ploeg (2011) argues that price volatility and investment crowding are not only short-term challenges but also generate structural traps that diminish long-run fiscal discipline and planning capacity.

This theory has been widely studied in the context of traditional natural resources, such as oil and minerals. However, with the increasing global interest in renewable energy, it is important to examine whether the resource curse hypothesis also applies to the abundance of renewable energy resources. Adebayo et al. (2023) analyze the asymmetric effects of structural transformation and renewable energy consumption on carbon emissions in Türkiye. Their findings underscore that green energy adoption within a modernization framework generates significant ecological improvements, offering an SDG-compatible roadmap for policy design. However, a significant positive relationship between natural resources and stock market development in Malaysia has been found validating the stock market resource blessing

hypothesis (Ali and Ramakrishnan, 2022). This contradiction underscores the need for regional context: while some economies demonstrate a 'resource blessing,' others reveal hidden vulnerabilities shaped by institutional fragility, policy misalignment, or external volatility. Degirmenci, Sofuoglu, Aydin, and Adebayo (2024) investigate how energy intensity, green transition, and environmental policy stringency influence sustainability across G7 economies. Their panel results confirm that environmental performance improves under stringent regulatory regimes and efficiency-focused energy usage, reinforcing the role of institutional asymmetry.

The authenticity of this study is to model the variables of the original resource curse hypothesis implemented for the renewable resources in the context of renewable energy abundance for the higher income countries, where the sufficient data was available to conduct such calculations. Specifically, the potential effects of renewable energy on economic growth and stock market development, as well as the institutional quality will be considered as a main component of the model. Through this analysis, it is aimed to gain a better understanding of the potential implications of renewable energy abundance and to inform the development of sustainable energy policies. By reframing the resource curse in the context of clean energy transitions, this study contributes to an evolving strand of literature concerned with 'green financial traps' and their implications for equity markets under institutional constraints. Basiru et al. (2023) provides a theoretical synthesis of financial management strategies in emerging markets, illustrating how firms respond to systemic volatility and institutional weakness. Drawing on agency theory, pecking order, and behavioral finance frameworks, they show that adaptive tools—such as microfinance, fintech adoption, and ESG-driven capital structures—offer financial buffers against sustainability risks. Their review emphasizes that locally resilient financial ecosystems and policy innovation are essential to escape the structural constraints posed by green financial traps. Caglar, Gonenc, and Destek (2024) examine the long-run impact of nuclear R&D investments on environmental quality in the U.S. and France. Through asymmetric modeling, they find that positive investment shocks reduce emissions, while negative shocks trigger instability, especially where innovation absorption capacity is low. Abbass et al. (2025) evaluate the dynamic relationships between financial development, economic globalization, and renewable energy consumption in Next-11 emerging economies. For Türkiye and its peers, the study shows that financial sector reforms and green energy adoption reduce carbon emissions, whereas globalization and trade openness contribute to environmental decline—emphasizing the need for region-specific sustainability frameworks

Yavuz, Kilic, and Caglar (2024) introduce an environmental Phillips curve model for Türkiye using the Load Capacity Factor framework. They reveal that rising unemployment correlates with increased environmental degradation, highlighting the need for inclusive labor–environment policies during energy transition.

Meanwhile, Adekoya et al. (2025) demonstrate that geopolitical risk expectations significantly predict green asset volatility, with fragile governance structures exacerbating the financial impact of climate-related shocks.

Drawing upon empirical insights from China's city-level datasets, Chang, Qian, & Dilanchiev. (2022) reported a direct relationship between financial development and renewable energy consumption. There is a 0.24 %-point increase in renewable energy usage for every 1% positive effect on firm development. Financial development's positive impact on the use of renewable energy has been observed in the study, explaining it lowers financial risk, creates new opportunities, reduces borrowing costs and provides more funds in terms of liquidity and availability in the economy.

3. Sample and Model

The financial impact of renewable energy production on stock market development therefore also the financial development, attempted to be undertaken for 11 countries having the most renewable energy production that proxied as the most abundant recourse owners. But those which are having the highest fraction of renewable energy on their electricity production consisted of the countries having insufficient data for the undertaking study. Therefore, the country selection was done by determining the top 11 countries with highest GDP (Gross Domestic Product) and the fraction of renewable energy on their electricity production with regard to the availability of sufficient data. Australia, Brazil, Canada, France, Germany, Japan, Mexico, Spain, Turkey, China and United States has been determined as sample countries. The table below shows the GDP ranking of the countries. The countries we included in the research are ranked first according to the GDP ranking 1-16.

Table 1

The top 11 Countries with Highest GDP

Rank	Country	GDP US $
1	United States (USA)	$30.507trilion
2	China	$19.231 trillion
3	Germany	$4,744 trilion
5	Japan	$4.186 trilion
7	France	$3.211trilion
9	Canada	$2.225trilion
10	Brazil	$2,125trilion
12	Spain	$1,799 trilion
14	Australia	$1,771 trilion
15	Mexico	$1,692 trilion
16	Türkiye	$1,437trilion

Source: https://www.jagranjosh.com/general-knowledge/worlds-largest-economies-1694256013-1

The countries participating in the study were randomly selected from among the top 16 countries in the world GDP ranking.

Table 2
Sample and Model Summary

Variables	Entry Code	Variable	Name of The Data
		GDP Sorting	GDP (current US$)
Dependent Variables	**SMD STTD**	Stock Market Development	Stocks traded, turnover ratio of domestic shares (%)
Independent Variables	**NRA REO**	Natural Resource Abundance	Renewable electricity output (% of total electricity output)
Main Control Variable	**GDP PCG**	Economic Growth	GDP per capita growth (annual %)
Control Variables	**IQ VA**	Institutional Quality	Voice and Accountability: Estimate

Source: The table was created by authors

Table 2 outlines the selection criteria for countries and variables included in the study. It clarifies the rationale behind choosing specific macroeconomic indicators and renewable energy data, ensuring consistency in the dataset across all selected countries. Additionally, the table summarizes the empirical design and classification of the variables, which underpins the subsequent panel ARDL analysis.

The pre form dataset, consisting of the Stocks traded, turnover ratio of domestic shares (%) (SMDSTTD), Renewable electricity output (% of total electricity output (NRAREO), GDP per capita growth (annual %) (GDPPCG), Index of Human Capital per Person (HCIPP) and Voice and Accountability which measures the level of citizens' participation in government selection and the freedom of expression, association, and media in a country: Estimate (QVA). have been gathered as detailed in the following section of the study, by the sources and characteristics. As the 'ln' forms of the variables are taken, the negative component involving series has been manipulated by taking the squire roots at the first place than taking the ln forms with this respect. Nevertheless, the Index of Human Capital per Person series for the chosen countries was found unstationary on its first derivative and excluded from the model. After this stage, stock market development proxy SMDSTTD is considered to be a function of the three variables. The research data was obtained from the World Bank and covers annual data for the years 2002-2015.

After transforming all the variables to their logarithmic forms, the process of conducting an Autoregressive Distributed Lag (ARDL) study was initiated after certain tests. A panel ARDL study aims to analyze the long-run and short-run dynamics of a group of cross-sectional and/or time-series data. It is used to estimate and test the cointegration relationship among variables and also to examine the short-run dynamics

among the variables in the model. The panel ARDL approach allows for the estimation of country specific as well as common factors influencing the variables of interest in the model.

The Panel ARDL framework is designed to capture dynamic relationships in panel datasets, which involve multiple cross-sectional units observed across time. A conventional Panel ARDL specification incorporates lags of both dependent and explanatory variables to assess short- and long-term linkages among panel entities.

$$y_{it} = \alpha_i + \beta_i D_t + \gamma_i L_t + \delta_i \gamma_{it-1} + \varepsilon_{it} \quad (1)$$

Where;
y_{it} : the dependent variable for individual i at time t
α_i : a fixed effect for individual i
β_i: the coefficient on the lagged dependent variable for individual i
γ_i: the coefficient on the lagged independent variable for individual i
D_t: a time trend variable
L_t: an independent variable
ε_{it}: an error term

The dynamic extension of the Panel ARDL structure permits multiple lags and interaction terms, enabling more nuanced estimation of temporal effects across units. This is known as a dynamic PARDL model, which can be represented as:

$$y_{it} = \alpha_i + \sum(\beta_{ij} \cdot D_{\{t-j\}}) + \sum(\gamma_{ik} \cdot L_{\{t-k\}}) + \sum\sum(\delta_{ijk} \cdot y_{\{i,t-j\}} \cdot L_{\{t-k\}}) + \varepsilon_{it} \quad (2)$$

As shown in Equation 2. is an extended panel ARDL model with full interactions. This extended formulation incorporates both lagged dependent and independent variables alongside their multiplicative interaction terms. It enables analysis of moderating or synergistic effects, which are crucial in understanding non-linear or interdependent dynamics within panel structures. While powerful, it requires a robust dataset to avoid multicollinearity and overfitting risks.

$$y_{it} = \alpha_i + \sum(\beta_{ij} \cdot y_{\{i,t-j\}}) + \sum(\gamma_{ik} \cdot x_{\{i,t-k\}}) + \varepsilon_{it} \quad (3)$$

As shown in Equation 3. is a basic ARDL model. This model provides a foundational structure for assessing how past values of both dependent and independent variables influence the present. It assumes fixed lag lengths and does not attempt to estimate long-run equilibria. It's often used for preliminary dynamic analysis, offering insight into short-run adjustments without accounting for error correction mechanisms.

$$y_{it} = \alpha_i + \sum(\beta_{ij} \cdot y_{\{i,t-j\}}) + \sum(\gamma_{ik} \cdot x_{\{i,t-k\}}) + \sum\sum(\delta_{ijk} \cdot y_{\{i,t-j\}} \cdot x_{\{i,t-k\}}) + \varepsilon_{it} \quad (4)$$

As shown in Equation 4. is an interaction-enhanced dynamic ARDL model. This hybrid model combines the dynamic ARDL framework with interaction terms, enabling researchers to explore conditional effects, such as whether the impact of a variable

depends on the level or lag of another. It is ideal for examining policy-moderated outcomes or threshold behavior, particularly in economic systems where variables influence each other in a multiplicative or non-linear fashion.

The selection of the extended panel ARDL model with interaction terms was driven by the study's objective to move beyond linear and isolated effects. Rather than examining the individual impact of lagged variables in isolation, this approach allows the analysis to capture more nuanced, conditional dynamics specifically, how the effect of one variable may depend on the lagged values of another.

In the context of this research, it is essential to understand whether changes in renewable energy output, institutional quality, or economic growth interact in a way that amplifies or mitigates their influence on stock market development. By including multiplicative interaction terms, the model reflects real-world complexities where variables seldom operate independently.

Moreover, this structure enables the identification of compound effects and allows for a more flexible estimation of dynamic behavior across time and cross-sectional units. Such an approach is particularly suited to panel data, where interdependencies are expected and conventional linear models may fall short in explanatory power. The extended panel ARDL framework thus offers a richer and more context-sensitive understanding of the underlying economic mechanisms. It aligns with the goal of the study to reveal deeper insights into the potential existence (or absence) of a financial resource curse linked to renewable energy abundance.

4. Empirical Findings

Jarque-Bera test in a descriptive statistics table, with the probability (p-value) associated with the test statistic explains that the p-value is less than the level of 0,05 significance indicates that the series except the SMDSTTD is not normally distributed. At this point, it is important to remember. According to the Central Limit Theorem, with sufficiently large sample sizes, the distribution of sample means converges to normality regardless of the population distribution. The sample size of 30 is widely considered as the lower limit of sample size for the central limit theorem to hold. With the 140 observations, the distribution is dubbed to normally distributed according to the CLT to be conducted forward procedures. On the other hand, all the series except the NRAREO have the negative skewness with the Kurtosis values indicating that all the series except NRAREO are leptokurtic or narrow curves which indicate fatter tails resulting in a greater chance of extreme positive or negative events occurrence.

Table 3 shows the overall distribution of variables used in the model. The values for mean, standard deviation, and skewness reveal variation and distributional tendencies. Furthermore, the Jarque-Bera test results confirm the normality assumptions for most variables, which helps in assessing their suitability for econometric testing.

Table 3
Descriptive Statistics

Statistics	SMDSTTD	NRAREO	IQVA	GDPPCG
Mean	4.444	2.981	-0.831	0.640
Median	4.457	2.725	0.231	1.087
Maximum	6.010	4.488	1.023	4.551
Minimum	2.935	2.014	-16.72	-7.161
Std. Dev.	0.602	0.754	2.696	2.272
Skewness	-0.419	0.742	-3.311	-1.106
Kurtosis	3.165	2.274	17.35	4.289
Jarque-Bera	4.269	15.92	1458.	38.28
Probability	0.118	0.000	0.000	0.000
Sum	622.200	417.262	-116.4	89.678
Sum Sq. Dev	50.520	79.116	1011.	717.910
Observations	140	140.	140	140-

Source: The table was created by researchers.

The correlation matrix below indicates the correlation coefficients between the variables as interpreting the independent variables, except the NRAREO positively related with the dependent variable. Negative association has been calculated between the stock market development proxy variable SMDSTTD and the renewable energy output NRAREO. The correlation coefficient is a measure of the linear association between the two variables, with values ranging from -1 to 1. Identification of strength of -0.25 with a negative direction reveals that there is supposed to be a negative effect of renewable energy output on the stock market development.

Table 4
Correlation

Statistics	SMDSTTD	NRAREO	IQVA	GDPPCG
SMDSTTD	1	-0.25	0.203	0.179
NRAREO	-0.250	1	-0.12	0.098
IQVA	0.203	-0.12	1	-0.21

Source: The table was created by researchers.

Table 4 indicates the pairwise correlations between variables serve as a preliminary check for potential multicollinearity. Of particular interest is the inverse association between renewable energy output and stock market performance, supporting an initial hypothesis of a negative linkage. Conversely, moderate positive correlations exist between financial development and both institutional quality and economic growth.

Unit root tests are a crucial step in the panel ARDL (Autoregressive Distributed Lag) model estimation process, as they help to determine whether the variables in the panel are stationary or non-stationary. The results of the unit root tests will determine the appropriate estimation technique for the panel ARDL model. Before conducting unit root tests, it was important to ensure that the panel data was balanced, and the cross-sectional units are homogenous. The balanced panel has been obtained by limiting the time range according to the availability of the data which ended up from the year 2002 to 2015. The

choice of unit root test is also important as it should be robust to cross-sectional dependence. The summary of the obtained test and results are as tabled below.

Table 5

Panel-Level Stationarity and Granger Causality Diagnostics

Variable	ADF Test Statistic	ADF p-value	Order of Integration	Granger Causality Toward SMDSTTD	Granger Causality Toward GDPPCG
SMDSTTD	–7.124	0.000	I(1)	—	—
NRAREO	–4.983	0.000	I(1)	No (p = 0.5138)	—
IQVA	–10.255	0.000	I(1)	No (p = 0.8760)	Yes (p < 0.05)
GDPPCG	–6.209	0.000	I(0)	Yes (p < 0.05)	—

ADF Test (Augmented Dickey-Fuller): Used to assess whether each variable is stationary. A variable is considered I(1) if it becomes stationary after first differencing. Only GDPPCG is stationary in level (I(0)). Granger Causality Tests: Performed via Dumitrescu & Hurlin (2012) procedure on panel structure. "No" indicates that the null hypothesis of non-causality could not be rejected. Significance thresholds applied at 5%.

SMDSTTD (Stocks traded turnover ratio) is the dependent variable in subsequent panel ARDL estimation. NRAREO (Renewable electricity output) and IQVA (Voice and Accountability index) serve as explanatory variables. GDPPCG (Economic growth) functions as a control variable with its own causal relationships examined.

This consolidated table presents the foundational econometric diagnostics necessary for model estimation and interpretation. The stationarity structure confirms the appropriateness of the panel ARDL methodology, allowing for mixed integration orders (I(0) and I(1)). Notably: NRAREO exhibits no statistically significant impact on stock market development. IQVA is not causally linked to SMDSTTD but shows a positive causal relationship with GDPPCG, underscoring institutional quality's role in economic expansion. GDPPCG, although stationary, displays predictive power over SMDSTTD—indicating the influence of macroeconomic growth on financial activity.

Together, these insights support the hypothesis that renewable energy abundance may not directly stimulate capital market development without strong institutional underpinnings and sustained economic growth.

Table 6

VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-641.469	NA	4.748	12.90	13.010	12.951
1	-348.638	556.377	0.018	7.372	7.893*	7.583
2	-312.933	64.983	0.010	6.978	7.910	7.358
3	-296.384	28.795*	0.012	6.967*	8.322	7.515

Note: Indicates lag order selected by the criterion.
Source: The table was developed by researchers.

Based on the statistical criteria presented in Table 6, a lag length of two was selected as optimal. The Akaike Information Criterion (AIC) guided this selection by providing the lowest value, thus ensuring a balance between explanatory accuracy and model efficiency in capturing the dynamic relationships among the variables.

Table 7

Johansen Fisher Panel Cointegration Test

Hypothesized No. of CE(s)	Fisher State fromtrace test	Prob.	From Max-eigen test	Prob
None	147.4	0.000	130.6	0.000
At most 1	183.8	0.000	166.5	0.000
At most 2	42.54	0.002	37.11	0.011
At most 3	34.12	0.025	34.12	0.025

Findings presented in Table 7 demonstrate statistically significant cointegration, suggesting the existence of enduring equilibrium relationships among the primary indicators. These findings validate the assumption of equilibrium interactions in the model and provide justification for proceeding with long-run coefficient estimations.

Granger causality analysis (Granger, 1969) is conducted, which assumes that there is homogeneity among the cross-sectional units. The results of this analysis are as presented below. The null hypothesis has been rejected only with the 2 outcomes according to the probabilities calculated. Those can be interpreted as, the economic growth (GDPPCG) does Granger Cause stock market development (SMDSTTD) and institutional quality (IQVA) do Granger Cause economic growth (GDPPCG) for the selected sample of the countries.

Table 8

Panel ARDL results

Variable	Coefficient (Long Run)	t-Statistic	p-Value	Short-Run Effect	Interpretation
NRAREO (Natural Resource to Economy Ratio)	-0.435	-6.007	0.000	Negative	Significant long-run negative impact on financial markets.
GDPPCG (Per Capita GDP Growth)	-0.026	-2.797	0.007	Weak/Negative	Higher economic growth associated with lower stock development at the margin.
IQVA (Industrial Value Added Index)	0.073	2.920	0.005	Mixed effects	Indicates positive structural contribution in the long run.
COINTEQ01 (Error Correction Term)	-0.554	-4.749	0.000	Converges to equilibrium	Suggests a strong adjustment speed to long-run equilibrium.
Other Lags and Differenced Terms	Mostly insignificant	-	-	Statistically insignificant	Implies that short-term causal effects are weak.

Source: The table was developed by researchers

This research focused on the relationship between renewable energy production and stock market development across 11 countries, employing a panel ARDL model. The long-run results show a statistically significant negative effect of renewable energy production on stock market development, aligning with the idea of a financial resource burden. In contrast, institutional quality contributes positively, underscoring its role in fostering financial growth. The short-run effects, however, appear limited, suggesting that the primary influences emerge over the long term. As determined by the optimal lag length of 2, the model runs at this length and the outcomes calculated as follows. The interpretations shall be made by considering the probability values of each coefficient have to be below 0.05 in order to take them significant.

According to this research a significant negative relationship was found between renewable electricity output (NRAREO) and stock market development (SMDSTTD). There is a negative relationship between stock market development and Economic growth (GDPPCG) Stock market development positively influences Institutional quality (IQVA). As renewable energy production increases, stock market development shows a slight downward trend. Stock market dynamics are affected by the development of renewable energy sources and show a downward trend.

Table 9.
Pairwise Granger Causality Tests Sample 2002-2015

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Long-Run Equation				
NRAREO	-0.435	0.072	-6.007	0.000
GDPPCG	-0.026	0.009	-2.797	0.007
IQVA	0.073	0.025	2.920	0.005
Short-Run Equation				
COINTEQ01	-0.554	0.116	-4.749	0.000
D(SMDSTTD(-1))	0.008	0.113	0.074	0.941
D(NRAREO)	-0.720	1.078	-0.668	0.507
D(NRAREO(-1))	-0.145	0.420	-0.346	0.730
D(GDPPCG)	-0.012	0.024	-0.526	0.600
D(GDPPCG(-1))	0.002	0.013	0.199	0.843
D(IQVA)	0.356	0.263	1.356	0.181
D(IQVA(-1))	-1.041	0.552	-1.885	0.065
C	3.262	0.673	4.842	0.000

Source: The table was developed by researchers

The negative relationship between NRAREO and GDPPCG shows that the increase in renewable energy outputs and economic growth causes a decrease in stock market development. High institutional quality positively affects stock market performance. Short-Term Results As evidence on the short-term effects of renewable energy on stock

market development, it has shown that there is a significant relationship between the variables. The negative relationship between NRAREO and GDPPCG shows that the increase in renewable energy outputs and economic growth causes a decrease in stock market development. High institutional quality positively affects stock market performance. Short-Term Results As evidence on the short-term effects of renewable energy on stock market development, it has shown that there is a significant relationship between the variables. The research shows that renewable resources are a "resource curse" in rich countries. Renewable energy resources can positively affect stock market development and economic growth if managed carefully.

In this context, coefficients in the long run, appear to be all significant where there will be a 0.43% decrease in the coefficient of the stock market development (SMDSTTD) for each 1% increase in the renewable energy outcome (NRAREO). Similarly, there will be a 0.27% decline in the economic growth (GDPPCG) as stock market development increases by 1%. On the other hand, for every 1% increase in the institutional quality (IQVA), stock market development (SMDSTTD) is calculated to be affected 0.07%. In the short run, all the coefficients appeared to be insignificant according to the probability values for interpretation. Therefore, the model's short run outcomes would be the only explanations from the model.

The long-run effects obtained from the panel ARDL estimations are visualized in Figure 1, offering an intuitive overview of how institutional factors and economic growth shape the trajectory of stock market development.

Figure 1

Long-run Impacts of Institutional Indicators and Growth on Stock Market Development

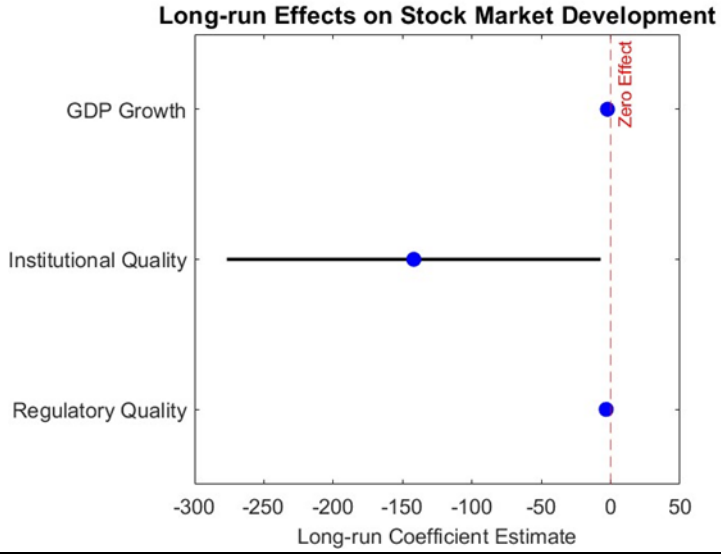

Figure 1 presents the long-run coefficients of key explanatory variables affecting

stock market development. The estimated effects reveal that institutional quality—encompassing aspects of governance, regulatory capacity, and accountability—exerts a substantial negative elasticity, emphasizing its structural role in shaping financial market outcomes. Regulatory Quality also demonstrates a statistically significant influence, reinforcing the importance of institutional soundness. In contrast, the coefficient for GDP Growth falls within an inconclusive range, suggesting that short-term economic expansion may not reliably translate into persistent capital market growth.

By centering the zero-effect baseline and contrasting directional estimates, the figure facilitates a clear distinction between policy-relevant levers and transient economic signals. These results underscore the primacy of institutional depth over cyclical performance, aligning with broader theoretical perspectives in finance and development economics.

Based on the panel ARDL study conducted on the selected countries data, it can be concluded that the renewable resources curse does not appear to be present. The study found no evidence to suggest that an abundance of renewable resources negatively impacts economic growth as the institutional quality, and economic growth has significant positive effects on the stock market development.

5. Conclusion and Discussion

This study investigates the relationship between renewable energy production and stock market development across 11 emerging market economies through the panel ARDL framework. Contrary to the conventional resource curse hypothesis—which often highlights the detrimental effects of fossil resource dependence—our findings indicate no direct curse effect for renewable energy. However, the results suggest a distinct structural dynamic, wherein increased renewable energy output correlates with a marginal decline in stock market performance, particularly in economies with institutional fragility.

The observed negative association implies a potential “green financial trap,” a term used to characterize the unintended financial consequences of sustainability transitions in contexts lacking adaptive governance. Institutional quality, on the other hand, positively contributes to financial deepening, underscoring the critical role of regulatory and democratic capacity in steering economic outcomes.

From an economic standpoint, the absence of the resource curse in renewable-rich countries may be attributed to fundamental structural differences. Renewable energy sectors often exhibit higher capital intensity, decentralization, and require long-term policy consistency, which can create volatility in investment flows if institutions are weak. Politically, energy transitions demand reforms in transparency, regulatory oversight, and fiscal coordination—areas where emerging markets may struggle to sustain resilience.

To address these vulnerabilities, the study proposes several actionable policy measures:

- Introducing sustainability-linked financial instruments, such as green bonds backed by institutional benchmarks
- Strengthening ESG disclosure requirements across energy-related industries to reduce information asymmetry and attract long-term investment
- Integrating governance indicators into energy planning, ensuring that clean energy transitions do not exacerbate financial imbalances

While these recommendations aim to mitigate financial risks associated with renewable expansion, their effectiveness hinges on context-specific implementation and the capacity for institutional learning. It is therefore imperative that policymakers acknowledge both the environmental and financial dimensions of energy policy.

Beyond its core empirical contributions, this study underscores the imperative of contextualizing sustainability transitions within region-specific policy frameworks aligned with the UN Sustainable Development Goals (SDGs). For instance, countries like Türkiye exhibit moderate performance in SDG 7 (Affordable and Clean Energy) and SDG 16 (Peace, Justice, and Strong Institutions), suggesting that clean energy expansion must be complemented by governance reforms to ensure financial resilience. The findings advocate for the integration of institutional indicators—such as regulatory quality and democratic accountability—into energy strategy design. Such alignment not only enhances the efficacy of green financial instruments but also bolsters SDG-compatible development by linking environmental transitions with fiscal coordination and social inclusion. Therefore, policymakers should calibrate energy reforms to reflect localized SDG priorities, ensuring that renewable energy progress translates into equitable and stable financial outcomes.

Despite offering valuable insights, the study carries certain limitations. First, data availability restricted the temporal scope for key institutional variables, potentially constraining dynamic estimations. Second, indicators such as ESG maturity levels, green asset flows, or cross-sectoral liquidity ratios were excluded due to inconsistent data sources. Third, while the panel ARDL framework captures both short- and long-run effects, nonlinear or threshold behaviors may require alternative modeling techniques such as regime-switching analysis or spatial econometrics.

Future research could expand upon this foundation by exploring sector-specific financial indicators, assessing policy diffusion across countries, or integrating behavioral finance dimensions into green transition strategies. Exploring how fintech adoption, microcapital structures, and climate-related financial disclosures interact with market depth could further illuminate the institutional mechanics underlying sustainable development.

In summary, this study reframes the resource curse hypothesis in light of renewable energy transitions, offering a nuanced view of how institutional strength governs the intersection between environmental reform and financial stability. By identifying the conditions under which green energy may pose financial risks, the research contributes to a more holistic understanding of sustainability economics in emerging contexts.

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