

Article

Sustainable Energy Supplies in Developing Countries: Does National Governance Matter?

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Abstract: In this paper, we examine the impact of national governance quality on clean energy supplies in developing countries. We used a large sample of 103 developing countries over 21 years. We employ pooled ordinary least squares as the primary estimator. Additionally, we apply a Fixed Effect and the Two-Step System-Generalized Method of Moments to mitigate contemporaneity bias. Following prior studies, we construct national governance quality from the six World Governance Indicators. Consistent with our expectations, we find a positive and significant association between national governance quality and clean energy supplies. The results show that countries with high national governance quality are more likely to generate high amounts of clean energy than low-governed countries and to experience a high green economy. The results are also significant when the governance indicator is disaggregated into individual components. However, in a continental analysis, we found that the link between national governance quality and clean energy supplies is stronger in Africa than on other continents. Our results are robust to alternative measurements and econometric identification strategies.

Keywords: developing countries; clean energy supplies sustainable energy; national governance quality; sustainable development



Citation: Shang, M.; Aleesa, N.; Zakari, A. Sustainable Energy Supplies in Developing Countries: Does National Governance Matter? *Energies* **2023**, *16*, 6607. <https://doi.org/10.3390/en16186607>

Academic Editors: Francesco Calise, Maria Vicidomini, Rafał Figaj and Francesco Liberato Cappiello

Received: 10 August 2023

Revised: 3 September 2023

Accepted: 6 September 2023

Published: 14 September 2023



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1. Introduction

This study investigates the influence of national governance quality on clean energy supplies in developing countries. Energy, in any form or use, remains the backbone of every economy. It is also a significant source of greenhouse gas emissions. The increasing use of energy in different forms, particularly from unsustainable, non-renewable sources such as fossil fuels, has been criticized as the cause of the rising global temperature [1,2]. Consequently, countries are relentlessly working towards clean and more environmentally sustainable energy supplies. Although developing countries are less polluting in the global warming crisis, they are the bearers of its anger [3,4] and they cannot afford to perform little or nothing to curb the growing carbon emissions.

The obvious answer to increasing clean energy supplies in developing countries might be financial. Hence, prior studies have primarily focused on the economic factors driving renewable energy production and consumption [5]. These economic factors include foreign aid, foreign direct investment, international trade, green bonds, economic growth, and economic development [6,7]. However, the success of these economic factors driving clean and sustainable energy supplies depends on the institutional and governance environment of the country [8]. For instance, politically unstable countries cannot generate much clean energy even if they have the largest financial capital because experts may not be willing to work in such countries. Further, corruption could cause workers to steal the financial

resources allocated for clean energy supplies [9]. Therefore, it is imperative to understand how these national governance environments drive the supply of clean energy, especially in developing countries where governance remains a critical issue.

The national governance environment of a country influences its clean energy supplies in at least three ways. First, national governance quality positively and significantly impacts economic growth and development [10,11]. For instance, [11] report that countries with high governance quality experience high economic growth and development. Countries with high growth and development have the resources and capacity to invest in many clean energy sources. It is worth noting that investment in clean energies requires massive initial outflows [5].

Second, countries with high national governance quality attract good and long-term investments from domestic and foreign investors [8,12]. Every investor prefers a stable environment that promises long-term investments. Prior studies argue that well-governed countries attract high levels of foreign direct investment and engage in large international trade [8,13]. According to the pollution halo hypothesis, foreign investment and international trade are mediums through which clean and sustainable technologies are transferred from developed to developing countries [14].

Third, arguably, a good governance environment offers freedom of speech, choices, peace, and the promise of a good future for generations [15]. Hence, the citizens of the countries will be willing and supportive of using clean and renewable energies, even if the cost is higher than the alternative. Furthermore, high national governance quality offers the government a chance to develop a long-term plan and forecast the future needs of the country.

Following these arguments, the primary objective of this paper is to examine the relationship between national governance quality and the generation of clean energy in developing countries. This study uses large sample panel data from 103 developing countries over 21 years to establish the relationship between national governance quality and clean energy supplies. This study employed pooled ordinary least squares as the primary estimator. Additionally, we apply a Fixed Effect and the Two-Step System-Generalized Method of Moments to mitigate contemporaneity bias brought on by possible endogeneity and its consequences peculiar to a specific nation. We find a positive and significant impact of national governance quality on clean energy supplies. The results show that countries with high governance quality generate large amounts of clean energy. The results are more robust for the individual governance indicators. We also identify that the link between national governance quality and clean energy supplies is stronger for African countries, followed by the Americas and Asia Pacific. Our study provides new insight into the relevance of national governance quality in developing countries toward achieving a greener and more sustainable world in light of the Sustainable Energy for All Initiative and the Sustainable Development Goals Agenda 2030.

Our study differs from previous literature and adds novel insights. In contrast to earlier studies that emphasized institutional quality, trade, and economic growth [8,9,14] we present new insights into how national governance quality influences the supply of clean energy in developing countries. This study makes an incremental contribution by offering empirical evidence of the positive impact of national governance quality on clean energy supplies, thereby highlighting the role of governance in sustainable development. In contrast to other research, we prioritize the main effects of national governance quality on clean energy supplies rather than the indirect influence of other variables. We also focused on clean energy, not necessarily renewable energy, because not all renewable energies are clean. A clean energy supply is by far better for the environment than some renewable energies. As a result, this study contributes by exploring the impact of national governance quality on sustainable energy consumption and production in developing countries. The study demonstrates the impact of institutional quality on achieving Agenda 2030 Sustainable Development Goals (Goal 12). For nations to achieve the 2030 Sustainable

Development Goals target and fulfill their commitment to the Sustainable Energy for All Initiative by 2023, governments should improve national governance quality.

The paper is structured as follows: Section 2 contains the literature review, and the methodology is presented in Section 3. In Section 4, we present the empirical results. The paper concludes in Section 5 with policy implications and suggestions for future research.

2. Literature Review

Empirical evidence has demonstrated that governance quality has significantly influenced the economic growth of many nations [10,11,16]. Moreover, empirical evidence shows that a weak governance framework negatively affects the economic growth of many nations [16,17]. For instance, research on the economic effects of poor governance quality has a detrimental impact on national growth and development [18]. Dang et al. show that in Asia, institutional quality decreases the growth of the shadow economy [19]. At the firm level, ref. [20] show that national governance quality mitigates the negative impact of COVID-19 on firm performance. Elamer et al. also report that high national governance quality is associated with high-risk management and disclosure practices in Islamic banks [21]. Still within the banking literature, ref. [22] shows that the impact of audit committees on bank stability depends on the institutional quality of the country. The results are also similar to the findings of [23]. It is impossible to overstate the significance of governance in deciding how a nation can foster economic progress. According to [24], governance quality, including institutions, favors economic development, although the level of benefit varies by country.

The effects of enhanced government and institution functioning on global commerce have also been noted in trade literature throughout the years, reinforcing the theory that improved governance quality and government regulations will boost the pace of international trade and globalization [24]. According to [25], the degree of institutional quality between two countries has a favorable impact on bilateral commerce. Moreover, ref. [17] supported the claims that improved institutions' quality boosts bilateral commerce and that this effect becomes more robust over time. Consequently, the quality of institutions across exporting and importing nations increases overall commerce among these countries [26].

Similarly, ref. [12] find that trade volume is more significant in nations with a governance quality framework for good governance than those without such an image. Correspondingly, ref. [27] suggest that improved institutional quality and effective governance lower trade costs and bankruptcy risks. These assertions are supported by studies showing that commerce is statistically significantly positively impacted by the degree of governance quality [28].

The second piece of literature describes how governance quality impacts economic growth as well as national development, which factors into clean energy supplies. Many scholars have identified that governance quality improves economic growth and enhances the governance system in many countries [25,29,30]. Existing studies confirm how poor governance quality may limit economic growth with a negative effect comparable to environmental costs, underscoring the importance of the link between governance quality and economic growth. Furthermore, weak governance performance can hinder economic growth and result in subpar global economic performance [31]. The impact of governance quality on economic growth is particularly apparent in developing nations [22]. To increase economic growth, especially in developing countries, this argument implies that implementing governmental reforms to enhance institutional quality should constitute a crucial element of government policy. However, ref. [32] found significant distinctions between the governance quality accomplishments in developed and emerging economies, with those in developed countries exhibiting more significant advancements in governance systems.

Regarding sustainability and sustainable development, ref. [9] report a negative relationship between corruption and green growth. Given that corruption is a key ingredient of governance, their results suggest that poor governance hampers green initiatives and actions. Hence, national governance quality could drive the supply of clean energy. Good

governance countries have adequate economic growth and development [31,33] and can afford to invest in clean energy supplies such as hydroelectricity and solar. Moreover, countries with high national governance are stable and can plan for the future. High national governance quality implies low corruption, political stability, peace, and freedom of speech. These are also core factors that attract foreign aid, investment, and international trade [34,35]. Foreign investment and trade are found to increase renewable energies, which constitute clean energy supplies [36]. Therefore, high-quality governance will lead to an increase in clean energy supplies. Based on the discussions above, we expect a positive and significant association between national governance quality and clean energy supplies.

3. Research Methods

3.1. Data

Our sample comprises 103 developing countries over 21 years (2000–2021). Consistent with [37], we select developing countries based on the United Nations Economic Outlook Report. The sample selection is based on the availability of key variables. Specifically, the sample period is limited because of missing data on sustainable energy in the 1990s. Data are sourced from World Development Indicators, Sustainable Energy for All Initiatives data, and World Governance Indicators.

3.2. Variable Description and Measurement

National governance quality: In line with prior studies, we construct the national governance quality index from the six World Governance Indicators using principal component analysis—PCA [38,39]. This approach is widely used in the economic and finance literature [21,37,39–41]. The World Governance Indicator by [42] covers six areas, namely: the rule of law; control of corruption; government effectiveness; political stability and absence of violence; regulatory quality; rule of law; voice; and accountability. Given that, each indicator covers different aspects of institutional quality. Given the possible limitations of the PCA, we use the mean score of all six indicators as an alternative measurement to the PCA. These indicators range from -2.5 to $+2.5$; however, for easy interpretation, we normalize the data to 0–5, where higher numbers indicate higher governance quality.

Clean energy supplies: We measure clean energy supplies as the total clean and renewable energy production as a percentage of the total energy and fuel production of the country. Sustainable energy supplies include clean fuels and technologies and renewable electricity supplies. We collect data from Sustainable Energy for All Initiatives data hosted by the World Bank. This measurement is consistent with prior studies such as [7].

Control variables: Prior studies suggest that some macroeconomic variables influence the sustainable activities of the country, including clean energy supplies [28,43]. Therefore, we include the following control variables; Economic growth (GDP growth), Economic development (GDP per capita), population, international trade, foreign direct investment, and carbon emissions. Table 1 presents the variable description and sources.

Table 1. Variable description.

Variable Name	Measurement	Source
Clean energy supplies	Total clean and renewable energies, including clean fuel and technologies, as a proportion of total energy production.	Sustainable Energy for All Initiative
National governance quality	A composite index from the six World Governance Indicators, namely: rule of law; control of corruption; government effectiveness; political stability and absence of violence; regulatory quality; rule of law; voice and accountability	World Governance Indicators
Economic development	Ratio of the gross domestic product to the population	World Development Indicators
Economic growth	Annualized rate in gross domestic product	World Development Indicators
International trade	Proportion of GDP that is represented by the total of imports and exports	World Development Indicators

Table 1. Cont.

Variable Name	Measurement	Source
Foreign direct investment	The proportion of the gross domestic product that is made up of net foreign direct investment.	World Development Indicators
Carbon emission	The amount of carbon emission per capita.	World Development Indicators
Population	The number of people residing there, according to estimates	World Development Indicators

3.3. Econometric Identification Strategy

Arguably, governance quality as part of institutional structures is a slow-moving variable, consistent with existing literature. Prior studies use a pooled regression model as the primary estimator [9,44,45]. We also control inter-country differences and time variations by including country and year effects.

$$\begin{aligned}
 \text{Sustainable energy supplies}_{it} &= a + \beta_1(\text{National governance quality})_{it} \\
 &+ \delta_2(\text{Control variables})_{it} + \delta_3\sum(\text{Year effects})_t \\
 &+ \delta_4\sum(\text{Country effects})_i + \varepsilon_{it}
 \end{aligned} \quad (1)$$

4. Results and Discussions

4.1. Descriptive Statistics

The descriptive statistics are presented in Table 2. The descriptive statistics include the mean, median, standard deviation, and percentile of the dependent and independent variables. The mean of sustainable energy supplies is 45.9%, with a 75th percentile of 78.7% and a large standard deviation of 36.4%. This shows high variation across the sample countries. Similar to the dependent variable, national governance quality also has large variations across the sample countries. The average is 2.4, which translates to -0.24 on the original scale of -2.5 to $+2.5$. This suggests that most developing countries are characterized by below-average institutional quality, according to the World Governance Indicators. The large variation, as evidenced in the standard deviation, indicates a significant difference among the countries that could influence the supply of sustainable energy.

Table 2. Summary statistics.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Mean	Std Dev	25th	50th	75th	Min	Max
Clean energy supplies	45.621	34.485	15.192	27.42	54.324	10.165	98.34
Institutional quality (Average)	2.486	0.665	2.377	2.833	3.237	0.652	4.429
Institutional quality (PCA)	5.108	2.261	3.257	4.615	6.712	0.001	9.640
Economic growth	4.280	4.726	1.966	3.986	6.612	-13.10	54.16
Carbon emission	3.635	4.881	0.834	2.000	4.474	0.0163	36.09
International trade	76.29	42.35	52.10	74.99	99.31	4.235	126.0
Foreign direct investment	1.135	11.94	0.0172	0.240	0.862	-89.66	219.9
Economic development	8.179	1.173	7.114	8.096	8.833	4.718	11.17
Population (Log)	16.38	1.669	15.27	16.37	17.45	11.15	21.05

4.2. Correlation Matrix

To mitigate the potential for superfluous and biased results, we perform the Pearson pairwise correlation matrix to check for possible multi-collinearity. The results of the Pearson Pairwise correlation matrix are presented in Table 3. The correlation between the variables is within the standard threshold of less than 0.8; hence, there is no threat of multi-collinearity [46,47].

Table 3. Correlation.

	1	2	3	4	5	6	VIF
National governance quality	1						
Carbon emission	0.52	1					1.53
Economic development	0.48	0.58	1				1.74
Economic growth	0.13	0.07	0.21	1			1.06
International trade	0.42	0.0	0.27	0.02	1		1.24
Foreign direct investment	0.28	0.08	0.09	0.06	0.10	1	1.02
Population	0.36	0.14	−0.26	0.15	−0.48	−0.16	1.32

4.3. Baseline Results

The baseline estimations using the pooled regression modeling are presented in Table 4. As stated in the methodology section, we use composite indices from PCA analyses to measure national governance quality. For robustness, we use the average of the six indicators. The result for the PCA value is presented in column 1, while that of the average approach is presented in column 2. Prior studies suggest that the changes or performance of one country are likely to affect the other and might be seasonal. Hence, in line with [9,48,49], we include the country and year dummy to control for country time variation.

Table 4. Baseline results.

	(1)	(2)
Variables	Clean Energy Supplies	Clean Energy Supplies
National governance quality (PCA score)	0.042 *** (3.329)	
National governance quality (Average score)		0.031 *** (3.192)
Carbon emission	0.005 ** (2.445)	0.003 * (1.984)
Economic development	0.079 ** (2.394)	0.026 ** (2.055)
Economic growth	−0.035 (−0.788)	−0.023 (−0.864)
International trade	0.013 *** (−4.160)	0.014 *** (−4.262)
Foreign direct investment	0.017 ** (2.043)	0.007 ** (2.109)
Population	−8.185 *** (−12.234)	−8.673 *** (−12.826)
Constant	9.214 *** (5.479)	11.018 *** (3.672)
Country effect	Yes	Yes
Year effect	Yes	Yes
Observations	2163	2163
R-squared	0.614	0.725

t-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The coefficient of national governance quality in both columns is positive and highly significant at 1 percent. In column 1, the coefficient is 0.042 ***, and in column 2, it is 0.031 *** indicating that national governance quality positively and significantly influences the supply of clean energies in the country. The result suggests that high national governance quality drives clean energy supplies. Arguably, good institutional structures and systems will likely manage their natural resources effectively to harness clean and sustainable energy. Further, given the rising dangers of climate change and the race to address greenhouse emissions, countries with good governance are more likely to pay

attention to these issues and take proper action. Moreover, well-governed countries have stable economies and can plan for the future. Poorly governed countries are always at risk of war, political instability, high poverty, and conflict. Hence, they are less likely to consider their environmental footprint and perform something about it. Prior studies also suggest that high-quality countries experience economic growth [16], which can lead to the production and consumption of clean energy utilities. The findings are, therefore, consistent with prior studies showing that [39] countries should look beyond economic factors in their attempts to find solutions to climate change. National governance quality is a crucial factor in achieving sustainable development.

The results are also economically significant. Consistent with prior studies such as [37,50] we calculate the economic significance as follows: coefficient $\times$ standard deviation. In economic terms, the results in column one indicate that a one-point increase in national governance quality will lead to a 1.45% increase in the supply of clean energy in developing countries. Similarly, the results in column 2 suggest that a one-point increase in national governance quality is associated with a 1.06% increase in clean energy supplies in developing countries.

The results of most control variables are consistent with standard assumptions and prior studies. Arguably, high-emitting countries are more likely to generate clean energy due to global pressure; hence, it is not illogical to report a positive relationship between sustainable energy supplies and carbon emissions. Consistent with prior studies [14,28,43,51,52] we report a positive impact of foreign direct investment and trade openness on sustainable energy supplies. Similarly, population growth also decreases sustainable energy supplies.

4.4. Individual National Governance Indicators

Having established the positive impact of institutional quality on sustainable energy supplies, we are keen to understand whether the result is driven by one or a set of indicators. Including all six indicators in a single regression will cause superfluous results due to multicollinearity issues. Therefore, to overcome this challenge and be consistent with prior studies [38,39], we run separate regressions for each of the six indicators. The results are presented in Table 5. The coefficient of all six indicators is positive and significant at 5 percent. Arguably, an effective government has an incentive to protect the environment for future generations. Similarly, political stability gives the government and political leaders a sound environment to make better future plans and focus on the issues that matter, including clean energy supplies. Freedom of speech gives citizens the chance to campaign for climate action and investment, which is evident in the positive impact of voice and accountability on clean energy supplies. The result of the negative relationship between corruption and sustainable energy supplies is consistent with the findings of [9] that corruption limits sustainable development.

Table 5. Individual components.

Variables	(1) Corruption	(2) Gov't Effectiveness	(3) Political Stability	(4) Regulatory Quality	(5) Rule of Law	(6) Voice Accountability
Corruption	−0.071 ** (−2.081)					
Gov't effectiveness		0.028 ** (2.172)				
Political stability			0.013 ** (2.180)			
Regulatory quality				0.010 * (1.918)		
Rule of law					0.005 *** (3.887)	

Table 5. Cont.

Variables	(1) Corruption	(2) Gov't Effectiveness	(3) Political Stability	(4) Regulatory Quality	(5) Rule of Law	(6) Voice Accountability
Voice and accountability						0.003 *** (4.155)
Carbon emission	0.008 (2.071)	0.009 (2.073)	0.007 (2.469)	0.009 (2.063)	0.008 (2.073)	0.005 (2.072)
Economic development	0.012 *** (3.058)	0.033 *** (3.160)	0.032 *** (3.156)	0.017 *** (3.077)	0.078 *** (3.375)	0.009 ** (2.045)
Economic growth	−0.007 (−0.584)	−0.008 (−0.703)	−0.005 (−0.433)	−0.008 (−0.741)	−0.009 (−0.777)	−0.005 (−0.415)
International trade	0.013 *** (3.098)	0.015 *** (3.073)	0.014 *** (3.367)	0.012 *** (3.088)	0.013 *** (3.166)	0.011 *** (3.316)
Foreign direct investment	0.017 ** (2.364)	−0.018 ** (2.44)	0.007 ** (2.423)	0.019 ** (2.435)	0.017 ** (2.169)	0.019 ** (2.306)
Population	−1.341 *** (−9.389)	−1.427 *** (−10.448)	−1.424 *** (−8.463)	−1.308 *** (−7.309)	−1.315 *** (−11.457)	−1.311 *** (−10.492)
Constant	1.935 *** (3.652)	1.558 *** (3.725)	1.501 *** (3.717)	1.161 *** (3.733)	1.322 *** (3.635)	1.510 *** (3.569)
Country effect	Yes	Yes	Yes	Yes	Yes	Yes
Year effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2163	2163	2163	2163	2163	2163
R-squared	0.724	0.725	0.725	0.724	0.725	0.725

t-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.5. Continental Analyses

No two regions or continents are the same. Even though the two countries may be at similar stages of development, their geographical location could have a significant impact on their institutional quality and efforts toward sustainable energy supplies. For instance, the institutional quality of most African countries is characterized by the imposition of colonial rules, while Asian-Pacific and American institutions are driven by their cultural heritage. Eastern Europe, which contains the developing countries in that region, is influenced by the actions of Western Europe. Similarly, the effort of each country toward sustainable development depends on what is happening in the region and how international pressure changes the course of action in the region. Africa is known to be the largest bearer of the negative consequences of climate change, even though it is less polluting [14]. Asia-Pacific is more interested in how to protect its indigenous environmental heritage, while Europe is racing to be the leader in sustainability. Therefore, in this section, we will test whether our results differ between the different continents. We group countries into four continents based on their geographic location. These are Africa, the Americas (both North and South), Asia-Pacific (Asia and Pacific countries), and Europe. We ran separate regressions for each of the groups, and the results are presented in Table 6.

The coefficient of national governance quality is positive and significant at 1 percent for all four continents. However, the coefficient differs significantly among the continents, indicating that the result is stronger in one region than others. For instance, the coefficient for Africa in column 1 is 0.056 ***, which is greater than the Americas, Asia-Pacific, and Europe. The Americas follow with a coefficient of 0.031 ***, and next is Europe, with Asia-Pacific having the smallest coefficient of 0.017 ***. These results suggest that the impact of national governance quality is more pronounced in Africa than in other parts of the world. Arguably, Africa needs more efforts and investment in sustainable energy supplies. Africa is also behind in climate action, though it contributes less to climate change. Compared to other regions, Africa needs a sustainable environment for survival because of its geographical location. Hence, it is unsurprising to find a stronger relationship between national governance quality and sustainable energy supplies.

Table 6. Continental analyses.

Variables	(1) Africa	(2) Americas	(3) Asia	(4) Europe
Institutional quality	0.056 *** (3.667)	0.031 *** (3.873)	0.017 *** (2.970)	0.027 *** (3.104)
Carbon emissions	0.003 *** (3.351)	0.076 *** (3.368)	0.086 *** (4.946)	0.091 *** (4.026)
Economic development	1.033 ** (2.506)	0.345 * (1.732)	0.642 ** (2.303)	0.910 *** (4.451)
Economic growth	−0.009 (−0.294)	−0.020 (−1.567)	−0.031 (−1.321)	−0.006 (−0.626)
International trade	−0.047 *** (−4.091)	−0.001 (−0.349)	−0.016 *** (−5.407)	−0.005 * (−1.734)
Foreign direct investment	−0.037 (−0.781)	−0.002 (−0.071)	−0.003 (−0.103)	−0.003 ** (−2.156)
Population	−0.095 *** (−9.292)	−0.092 * (−1.944)	−0.063 *** (−2.898)	−0.696 *** (−3.494)
Constant	0.664 *** (9.264)	0.648 *** (8.273)	0.423 *** (2.846)	0.493 *** (3.136)
Country effect	Yes	Yes	Yes	Yes
Year effect	Yes	Yes	Yes	Yes
Observations	693	399	735	336
Number of countries	33	19	35	16
R-squared	0.613	0.543	0.665	0.451

t-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.6. Robustness—System GMM

Although we have used alternative measurements of the dependent variable and disaggregated the independent variable into its individual components, our result may be biased due to the econometric identification strategy and endogeneity. Therefore, to further allay concerns of bias and superfluous results, we perform different estimations to check the robustness of the findings of a positive and significant impact of national governance quality on sustainable energy supplies.

We begin the robustness process by addressing potential endogeneity issues. Although reverse causality is less likely to be an issue because clean energy supplies influence national governance quality, there could be a contemporary effect of the previous year's clean energy supplies on the current year's supplies. To address this potential issue, we follow prior studies [51] to employ the Two-step System Generalized Method of Moment (two step S-GMM). Prior studies argue that the two step S-GMM is superior because it includes the lagged effect of the dependent variable and also suffers from the problem of weak instrumental variables [12,53,54]. The results of the Two Step S-GMM are presented in Table 7. The results in columns 1 and 2 are qualitatively similar to the baseline results. Specifically, the coefficient of national governance quality remains positive and significant, confirming the positive impact of governance quality on sustainable energy supplies.

In the second robustness check, we use the fixed effect identification strategy. We perform Hausman's test to choose the fixed-effect model. The fixed-effect panel econometric modeling mitigates the effect of omitted variables. The results are presented in columns 3 and 4 of Table 7. Similar to the Two-step S-GMM, the results are similar to the baseline findings. This confirms the robustness of the findings for an alternative identification strategy. In sum, the two robust additional econometric models suggest that our main findings of a positive relationship between national governance quality and sustainable energy supplies are not sensitive to potential endogeneity issues or alternative identification strategies.

Table 7. Robustness—SGMM and Fixed effect.

Variables	Two-Step S-GMM		Fixed effect	
	(1) Clean Energy	(2) Clean Energy	(3) Clean Energy	(4) Clean Energy
National governance quality	0.063 *** (2.990)	0.039 ** (2.538)	0.051 *** (4.028)	0.068 *** (4.199)
Lagged deponent variable	0.844 *** (12.326)	0.843 *** (18.410)		
Carbon emission	0.043 *** (2.679)	0.042 *** (2.928)	0.032 ** (2.445)	0.028 ** (2.984)
Economic development	0.019 *** (3.130)	0.019 *** (3.816)	0.017 *** (3.394)	0.026 *** (3.055)
Economic growth	−0.015 (−0.933)	−0.014 (0.771)	−0.009 (−0.788)	−0.003 (−0.264)
International trade	0.003 *** (3.624)	−0.003 *** (−3.961)	−0.013 *** (−4.160)	−0.013 *** (−4.262)
Foreign direct investment	0.004 ** (2.130)	0.005 ** (2.164)	0.007 ** (2.423)	0.007 ** (2.309)
Population	−0.826 *** (−3.759)	−0.800 *** (−2.885)	−0.815 *** (−3.234)	−0.673 *** (−3.826)
Constant	3.424 *** (3.376)	3.293 *** (3.958)	1.210 *** (4.408)	1.260 *** (4.659)
Observations	2163	2163	1246	1246
R-squared			0.148	0.159

z-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$.

5. Conclusions

As the consequences of climate change unleash on the world, governments, policymakers, and global leaders are racing at high speed to turn off high carbon emissions. A significant step towards turning off high carbon emissions is the supply of clean energy. Prior studies have articulated different strategies and factors that affect sustainability; however, these studies have mainly focused on the very obvious factors such as foreign investment, international trade, energy consumption, carbon emissions, and economic development.

Therefore, in this paper, we have examined the impact of national governance quality on a country's effort towards clean energy production in developing countries. We employed robust econometric modeling on a large sample of 103 developing countries between 2000 and 2021. The results show a positive and significant impact of national governance quality on clean energy supplies. The results suggest that countries with high national governance quality are more likely to increase the production and consumption of clean energy, leading to the attainment of sustainable development goals. We find similar results when the governance indicator is disaggregated into individual components. In further analysis, we also find that the relationship is more pronounced in Africa. The results are robust to different measurements of the variables, suggesting that the measurement approach does not drive our findings. To allay potential endogeneity concerns, we use alternative identification modeling to check the robustness of the results. The results of the Two Step Generalized Moment Method and fixed effect are qualitatively similar to the main findings, confirming the positive and significant impact of national governance quality on clean energy supplies.

The findings of a positive association between national governance quality and clean energy supplies indicate that improvement in governance quality in developing countries will significantly drive the achievement of sustainable development goals both at the national and global levels. Our study makes an incremental contribution by providing new insights into how the national governance quality of a country influences the supply

of clean energy. This study responds to the calls by [9] for more research into other forms of institutional quality indicators for sustainable development. The findings suggest that policy efforts to improve national governance quality in developing countries can play a pivotal role in achieving sustainable development goals through increased clean energy production.

Future studies can extend this line of research by examining the impact of governance quality on different sources of clean and renewable energy supplies. Future research could delve into analyzing the mechanisms through which specific aspects of governance quality influence clean energy supplies as well as exploring the potential variations across different renewable energy sources.

Author Contributions: Conceptualization, A.Z. and M.S.; methodology, A.Z.; software, N.A.; validation, N.A., A.Z. and M.S.; formal analysis, A.Z.; investigation, A.Z.; resources, N.A.; data curation, M.S.; writing—original draught preparation, A.Z.; writing—review and editing, M.S.; visualization, N.A.; supervision, A.Z.; project administration, A.Z.; funding acquisition, N.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Princess Nourah bint Abdulrahman University Researchers Supporting Project Number (PNURSP2023R391), Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia.

Data Availability Statement: Data will be available on request.

Acknowledgments: We thank the Princess Nourah bint Abdulrahman University Researchers Supporting Project for their support.

Conflicts of Interest: The authors declare no conflict of interest.

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