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Inclusive Economic Growth: Relationship between Energy and Governance Efficiency

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Abstract: The ambitious goal of the European Union (EU) countries is to achieve carbon neutrality by providing inclusive economic growth, which requires the development of relevant incentives and initiatives. Furthermore, such incentives and initiatives should guarantee the achievement of the declared goals. Energy sectors are the core determinant of inclusive economic growth. Traditional energy resources (coal oriented) have a higher negative impact on nature and people's well-being than on economic and social benefits. However, the transition to renewable energy raises new issues in achieving goals of inclusive economic growth: affordable and clean energy, responsible energy consumption, and energy infrastructure. The analysis of the theoretical framework found that the digitalization of government could be a core instrument for handling the abovementioned issues. The paper aims to justify the role of green energy in achieving inclusive economic growth empirically. The study applies the following methods: fully modified Ordinary Least Square (OLS) and canonical cointegrating regression. The findings allow concluding that institutional quality passively affects inclusive economic growth and that the digitalization of government has a U-shaped impact on inclusive economic growth. In this case, countries should boost the digital transformation of public services and continuously increase the quality of institutions.

Keywords: sustainable development; renewable energy; quality of institutions; e-Governance; digitalization; inclusive innovation; trade openness

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1. Introduction

Agenda 2030 declared the ambitious goals to achieve sustainable development around the world. However, one of the core inhibitors in this way is to provide inclusive growth for all countries around the world. A vast range of scientists [1] empirically justified that the economic prosperity of a country is the core driver for reducing inequalities and poverty. However, scholars [2,3] confirmed that economic development does not guarantee the reduction in social, ecological, and economic inequalities. Mostly, it depends on a country's social, economic, ecological, and political climate, corruption, governance efficiency, etc. In this vein, Luiz, J. M. [3] justified that developing countries with high economic growth have issues with increasing gaps between those who actively participate and are involved in economic processes and those who are not involved. Achieving inclusive economic growth requires simultaneous reduction in inequalities and provision of the economic development of the country. Experts [4,5] from the World Economic Forum [4] and the United Nations Conference on Trade and Development [5] developed an alternative Gross Domestic Product (GDP) to estimate economic development considering the goals of inclusive growth. Reflecting studies [5,6], the inclusive growth index is based on four pillars (economy, living conditions, equality, and environment) that merge 27 indicators. The analytical report [5] showed that developing countries had the lowest level of inclusive growth index. At the same time, developed countries have different levels of inclusive economic growth. The environmental inequalities (affordable energy, access to resources, energy intensity, etc.) are mostly typical of developing countries, and ecological issues (waste, air pollution, etc.) are of developed ones [5,7].

It should be noted that scholars [8–15] confirmed that the energy sector is the core dimension of sustainable and inclusive economic growth. At the same time, it is the core polluter of nature producing the largest volume of carbon dioxide emissions. Furthermore, economic and social benefits from coal energy are less than their negative impact on nature and people's well-being. Studies [13,15,16] confirmed that providing affordable and clean energy allowed the alignment of ecological disadvantages with social and economic benefits. At the same time, it could not be realized without strong and well-developed institutions [15]. Furthermore, the ongoing trends for penetrating information technologies (IT) at all levels and sectors boost the digitalization of governance and all economic sectors. However, the extension of digitalization could result in the overconsumption of energy resources, which restricts the inclusive economic growth of the country [17,18]. On the other hand, digitalization is conducive to increasing the efficiency of using resources and extending new technologies and renewable energies [19,20]. Those controversial points of view on digitalization and energy require the relevant empirical justification to develop appropriate mechanisms for achieving inclusive economic growth. In this case, this paper fills the gaps in the theoretical framework of inclusive economic growth by developing approaches for justifying the long-run relationship between energy and governance efficiency (institutions quality, e-governance) while achieving inclusive economic growth considering affordable and clean energy, the efficiency of governance and digitalization of governance.

The paper has the following logical structure: a literature review analyses the theoretical framework of inclusive economic growth, core determinants, and inhibitors; material and methods describe dependent, independent, and control variables and their sources. Explains the methods to test the research hypothesis; results outline empirical findings on proposed methodology to prove the relationship between energy and governance efficiency for inclusive economic growth; discussion and conclusion summarize the results of research, policy recommendation, limitations, and future research implications.

2. Literature Review

2.1. Inclusive Economic Growth

The analysis of the theoretical framework showed that inclusive economic growth is examined from various points of view, including social inequalities, gender disparities, resource inequalities, income disparities, and well-being. The study [6] used the concept of the World Economic Forum on inclusive economic development, which was based on studying 12 indicators that merged into three groups. Scholars [21] applied the methodology of the United Nations Conference on Trade and Development [5] to estimate inclusive economic growth for East Java for 2011–2014. Considering the findings, the scholars confirmed that countries based on agriculture, fishing, and forestry have lower levels of inclusive economic growth than countries with powerful industrial and trade sectors. Specifically, they concluded that economic prosperity (capabilities to generate GDP) is a core driver of inclusive economic growth.

Prior studies [22,23] defined inclusive economic growth as development that is based on social participation (through providing workplaces, public safety, and social infrastructure) and aims at achieving a balance between economic growth and environmental degradation. Rini and Tambunan [24] defined that inclusive economic growth depends on a vast range of factors: income inequality, quality of human resources, environmental degradation, social development, level of poverty, and industrialization. Scholars have applied a fixed effect model to define significant indicators of inclusive economic growth for Indonesian provinces. Considering the findings, they concluded that the share of households that own computers and the share of households that use liquefied petroleum gas (LPG) as fuel for cooking significantly affect Indonesian inclusive economic growth. The study [25] developed a composite indicator for estimating inclusive economic growth in India for 2001–2011. The proposed index contains six groups of indicators (Economic, Amenities, Sustainability, Gender and Financial inclusion, Human Development, and Governance) that merge 19 sub-indicators. Based on summarizing the approach for estimating inclusive economic growth, Chaikin and Usiuk [26] defined inclusive economic growth as the available human resources for being involved in effective economic activities and providing better living conditions and well-being. In particular, scholars [26] have emphasized that inclusive economic growth depends on income, poverty, quality of life, and gaps between the poor and the rich. Studies [7,27,28] suggested analyzing inclusive economic growth under the reduction in poverty and pro-poor development. McMullen [7] and Collier [28] underlined that more than 5 billion people living in poverty live in developing countries. McMullen [7] maintained that entrepreneurship development could be the way to decline poverty and, consequently, achieve inclusive economic growth. A similar conclusion was obtained in previous studies [29–34]. However, in contrast to [7], the latter considers the ecological dimensions. Kitagawa and Vidmar [35] analyzed inclusive growth in the framework of the sustainable development concept. They developed an innovative approach based on the Opportunity Areas Analysis Tool to measure the inclusive growth of the City Region Deal in Scotland (the United Kingdom). Based on the findings, they formulated recommendations for declining gaps between rural, semirural, and urban regions. Kitagawa and Vidmar [35] analyzed inclusive economic growth in view of geographical dimensions. Ali and Zhuang [36] indicated that effective inclusive economic growth should be based on two core goals of sustainable development: (1) developing options for appropriate and affordable conditions for employment and (2) social integration–providing equal access to capabilities for everyone. A previous study [37] underlined the trilemma connections between education, income, and poverty for providing inclusive economic growth. The researchers analyzed Asian developing countries in the period 1990–2016. Based on the empirical results, they concluded that education could reduce poverty if it was estimated due to poverty gaps and the coefficient of poverty, declining unemployment, and an increasing ratio of GDP to poverty reduction. The study [38] highlighted the effect of transport infrastructure on inclusive economic growth in China. The scholars confirmed that railways positively impact inclusive economic growth by providing a less negative impact on nature. Prior studies [39,40] have analyzed inclusive economic growth in the framework of declining gender inequalities. In this case, they defined the following dimensions of inclusive economic growth: fertility; female labor force; access of women to education; and women in the democratic system. Applying a Two-Stage Least Square model, the study [41] shows that household consumption, exports, and foreign direct investment positively affect inclusive economic growth in Indonesia. Similar conclusions are made by Awad-Warrad and Muhtaseb [42]. Based on the results of an OLS model, they empirically justify the positive effect of export and foreign direct investment on inclusive economic growth.

2.2. Inclusive Economic Growth & Affordable and Clean Energy

Scholars [8,14] have confirmed that the efficiency of the energy sector is the crucial dimension for inclusive economic growth. In [8], the researchers justified the necessity to unify energy regulation and provide innovation and green technologies in the energy sector. Based on empirical results, scientists [14] concluded that the Association of Southeast Asian Nations (ASEAN) countries should invest in green energy, which decreases disparities in access to energy resources. The growth of renewable energy allows reducing carbon dioxide emissions by 0.46%, which is the core dimension of inclusive economic growth. In addition, a relevant education program should be provided to enhance green consciousness and awareness. Consequently, it allows for reducing energy poverty and providing affordable clean energy for everyone, diminishing energy dependence and natural degradation, including decreasing air pollution [15,16,43]. In addition, the study [44] highlighted that affordable clean energy for households is the crucial dimension for declining gaps in life quality. The positive relationships between affordable energy and inclusive growth were confirmed by the study [45]. The researchers analyzed five Asian countries (India, Pakistan, Bangladesh, Sri Lanka, and Nepal) for the period of 1971–2010 and applied Pedroni's panel cointegration test to confirm the long-run relationship between renewable energies and a country's inclusive economic growth. Based on the results, the scholars [45] emphasized that affordable and clean energy allows reducing energy dependences and air pollution in India. Lee et al. [46] indicated that snowballing economic growth in Asian countries reduced poverty and improved the well-being of the people. However, the rapid growth led to overconsumption of energy resources and inequalities in access to energy recourses and clean nature. Thus, the scholars concluded that extending renewable energies, integration of energy infrastructures and markets, and intensification of research in alternative energy and green technologies allow for achieving inclusive economic growth in Asian countries. Prior studies [47,48] highlighted the energy consumption structure's effect on inclusive economic growth. Phung et al. [49] confirm that restructuring of country's energy balance due to increasing the share of renewable energies could promote inclusive economic growth. Anyway, foreign direct investment is conducive to renewable energy extension.

2.3. Inclusive Economic Growth & Governance Efficiency

The quality of government institutions has a priority role in the achievement of inclusive economic growth [47,50–54]. Thus, the institutional climate could enforce or restrict inclusive economic growth. Proceeding from the results of analyzing the theoretical framework of inclusive growth, Baud [52] emphasized that hybrid governance mechanisms could boost inclusive economic growth. In addition, all stakeholders should be involved in governance and in making strategic decisions. Brooks and Fairfull [55] theoretically justified that interactive governance theory was conducive to inclusive economic growth. They highlighted that it allows the achievement of the long-run goals of inclusive economic growth. Asongu and Odhiambo [56] analyzed sub-Saharan African countries for the period of 2000–2012 and applied the generalized method of moments (GMM) techniques. Considering the results of the analysis, they confirmed that effective governance (which is estimated by the World Governance Indicators from the World Data Bank) positively affects inclusive economic growth by reducing corruption and increasing transparency and political stability. The study [57] argued that the quality of institutions could promote inclusive economic growth and reduce social disparities and gaps. As indicators of institutional qualities, scholars [57] used the World Government Indicators. They found that voice and accountability, the rule of law, and corruption had a direct impact on the efficiency of social institutions. Efficacy of last positive effects on decreasing disparities and inequalities. The scholars [58] compared performance in achieving inclusive economic growth between China and India. Considering the results of the comparison, they confirmed that democracy, voice and accountability, and corruption could promote inclusive economic growth. In this case, the rapid economic growth in China and India (the countries with high levels of corruption, low levels of transparency, etc.) does not stimulate inclusive economic growth. In addition, the scholars emphasized the crucial role of social institution development and governance quality in providing inclusive economic growth [58]. Mangena [59] argued that bad governance and corruption were the core inhibitors of inclusive economic growth. In addition, corruption and shadow economies limit the effective development of renewable energies and consequently slow the achievement of inclusive economic growth [48]. The study [60] empirically justified the institutional quality effect on achieving the goals for inclusive economic growth of the EU countries. Considering the above, the second hypothesis of the research is as follows:

Hypothesis 1: *Institution quality directly impacts inclusive economic growth.*

It should be noted that snowballing expansion of IT and its penetration throughout all sectors require digitalization of governance at all levels [19,61–67]. In this case, the level of governance's digitalization impacts the energy sector [19,61,67–69] and energy security [70–75] and, consequently inclusive economic growth. Considering the study [19], the growth of e-governance by one point led to increasing renewable energy by 4.4 points. In addition, it was found that countries with a high value of e-governance had better values of the SDG7 Index–Clean and affordable energy. Using the logit model for the data of 103 countries for the period of 2003–2018, Castro and Lopes [76] empirically justified that e-governance was conducive to coherent policy for achieving inclusive economic growth, particularly in developing countries with transition economies. It should be noted that e-governance is the digital transformation of the government for providing effective and transparent government activities and public services and involving the public in making decisions [76]. Weak institutions restrict effective strategic decisions from providing inclusive economic growth. The scholars [77,78] assumed that digital technologies (cloud services, online administration, online public services, big data) play a core role in providing affordable and clean energy. However, past studies [76,77] concluded that e-governance nonlinearly affects clean and affordable energy. This means that achieving a certain level of governance digitalization could guarantee a positive effect on clean energy extension. Thus, the third hypothesis of this study is as follows:

Hypothesis 2: *E-governance nonlinearly impacts inclusive economic growth.*

The summarized results analyzing the theoretical background on linking energy and governance efficiency for inclusive economic growth are shown in Table 1.

Table 1. Summary of empirical research on links between energy and governance efficiency for inclusive economic growth.

Author	Object and Year of Analyzes	Methods, Models, Techniques	Conclusions
Amin et al. [14]	ASEAN, 1991–2018	non-linear EKC equation, cross section dependence test	renewable energy reduced carbon dioxide emissions by 0.46%
Miskiewicz [19]	EU, 2013–2019	the taxonomy method, the fixed and random effect models, pooled OLS regression model	(1) growth of e-governance by one point led to increasing renewable energy by 4.4 points; (2) improvement of e-governance positively effects SDG 7 Clean and affordable energy
Kitagawa and Vidmar [35]	City Region Deal in Scotland (the United Kingdom), 2020	Opportunity Areas Analysis Tool	declining gaps between rural, semirural, and urban regions allow achieving inclusive economic growth
Liu et al. [37]	Asian countries, 1990–2016	Regression models	Education effect on indicators of inclusive economic growth as follows: reduces poverty, decreases unemployment and increases the ratio of GDP to poverty reduction.
Zhang and Zong [38]	China, 2000–2016	non-parametric total factor productivity function, dynamic spatial Durbin model	transport infrastructure effects inclusive economic growth
Hidayat et al. [41]	Indonesia, 2011–2017	two-Stage Least Square model	household consumption, exports, foreign direct investment positively effect inclusive economic growth
Awad-Warrad and Muhtaseb [42]	Jordan, 1980–2014	heteroskedasticity-corrected OLS model	Export, foreign direct investment positively effects on inclusive economic growth
Vidyarthi [45]	India, Pakistan, Bangladesh, Sri Lanka and Nepal, 1971–2010	Cobb-Douglas production function, Pedroni cointegration test, Granger causality test	(1) long-run relationship between renewable energies and a country's inclusive economic growth; (2) affordable and clean energy allows reducing energy dependences and air pollution in India

Table 1. *Cont.*

Author	Object and Year of Analyzes	Methods, Models, Techniques	Conclusions
Geng et al. [47]	China, 2005–2018	regression model, the entropy method	(1) energy consumption structure effect on inclusive economic growth; (2) renewable energy positively effect on inclusive economic growth
Sedmíková et al. [48]	EU, Ukraine, 2015–2016	modified model of economic growth, Unit root test, Johansen cointegration test	(1) energy consumption structure effect on inclusive economic growth; (2) shadow economy negatively effects energy consumption structure and extension of renewable energy
Asongu and Odhiambo [56]	sub-Saharan African countries, 2000–2012	GMM techniques	(1) effective governance has statistically significant positive impacts on inclusive economic growth; (2) reducing corruption and increasing transparency and political stability allow improving governance of the countries
Castro and Lopes [76]	103 countries, 2003–2018	logit model	(1) e-governance positively effects indicators of inclusive economic growth; (2) e-governance nonlinearly affects clean and affordable energy

3. Materials and Methods

Data for Research

Similarly to previous studies [79–81], the energy dimension of inclusive economic growth was measured by the indicator that revealed the achievement of SDG 7–Clean and affordable energy. This indicator was developed by experts from the Sustainable Development Solutions Network under the framework of the Paris Agreement and Project of Assessment of SDG implementation [82]. Progress towards the target SDG 7, "Clean and affordable energy," is measured as a synthetic indicator which includes the following items: Population with access to electricity; Population with access to clean fuels and technology for cooking; CO_2 emissions from fuel combustion per total electricity output; Share of renewable energy in total primary energy supply. This indicator was chosen as the dependent variable. According to the updated EU policy within Green Deal Policy [83], digital technologies are a critical enabler for attaining sustainability goals. Thus, the successful strategy for realizing EU policies ought to assess the need for more transparency on the environmental impact of e-communication services. The explanatory variables were obtained from the aggregated indicator institution quality (IQ) and individual samples of indicators of electronic government (eGov). The aggregated indicator IQ was calculated as the average value of six worldwide governance indicators calculated by [84]: voice and accountability; political stability and absence of violence/terrorism; government effectiveness; regulatory quality; the rule of law; and control of corruption. The electronic government (eGov) was measured by technical prerequisites for the e-government services applications–$eGov_{ke}$ (Key enablers) and availability of government services aimed at foreign companies on the Internet, usability and implementation of eID and eDocument capabilities–$eGov_{dps}$ (Digital Public Services for Businesses). The study used the following control variables: economic growth and economic openness. The results of the studies [85,86] found that economic growth and economic openness are inextricably linked to electricity consumption. In particular, scholars [86] empirically justified that economic growth and economic openness significantly impacted the use of renewable energies in the long run. The researchers used panel data from 25 countries from the Organization for Economic Co-operation and Development (OECD). The findings [87] using the Granger causality test reveal the long-run relationship between renewable energy and economic openness and find that trade openness stimulates renewable energy consumption, improving the efficiency of primary energy consumption in South Asia. These conclusions were consistent with findings from the previous study [88]. It confirmed that economic growth, technological innovations, and trade openness were the important drivers of enhancing renewable energies in Latin American countries (Argentina, Brazil, Mexico, Colombia, Chile, and Guatemala).

The sample of variables and countries for analysis was chosen considering the requirements to maximize the sample size and time of the study period. Considering the abovementioned factors and data availability, the study period was 2011–2020. The object of the research covered 26 EU countries. It should be noted that the availability of the relevant data limited the final sample of countries during the analyzed time. Consequently, the lack of comparable data for Cyprus caused its exclusion from the research. The explanations and descriptive statistics of the applied panel data are shown in Table 2.

Table 2. The explanations and descriptive statistics of the dependent, independent, and control variables.

Variables	Explanations	Sources	Mean	SD	Min	Max
Energy	SDG 7 Clean and affordable energy	Sustainable Development Solutions Network [82]	76.050	8.109	50.500	94.600
IQ	Institutional quality	World Bank [89]	1.026	0.495	0.109	1.862
$eGov_{ke}$	Technical prerequisites for the e-government services applications	Eurostat [90]	55.198	25.860	7.000	100.000
$eGov_{dps}$	Availability of government services aimed at foreign companies on the Internet		59.342	19.154	16.000	97.500
GDP	Gross domestic product per capita, USD	World Bank [89]	34,230.800	22,833.260	7074.681	123,678.700
TO	Trade openness, % GDP		132.296	68.868	54.868	380.104

Note: Mean is the average value of data; SD is a standard deviation; Min is the minimum values of data; Max is the maximum value of data.

The analyzed data are panels that allow dynamic analysis. In addition, applying panel data increases the number of degrees of freedom, reduces collinearity issues, simplifies model identification, and eliminates or reduces the bias of the estimator [68,69]. The functional model's form relationship between energy and governance efficiency considering the nonlinear impact of electronic government, similar to studies [76,77], can be written as follows:

$$\text{Energy}_{it} = f\left(\text{IQ}_{it},\ \text{eGov}_{it},\ \text{eGov}^2_{it},\ \text{GDP}_{it},\ \text{TO}_{it}\right) \tag{1}$$

where $eGov_{it}$ is the relevant indicator of electronic government for i-country in t-time.

The logarithmic form of function (1) can be written as the equation:

$$\text{Energy}_{it} = \alpha_0 + \beta_1 \text{IQ}_{it} + \beta_2\ \text{eGov}_{it} + \beta_3\ \text{eGov}^2_{it} + \beta_4 \text{GDP}_{it} + \ \beta_5 \text{TO}_{it} + \varepsilon_{it} \tag{2}$$

where α_0 is a constant of the equation, $\beta_1 \ldots \beta_5$ are searching parameters; ε_{it} is an error term.

Since the model parameters were taken in logarithm, the coefficients $\beta_1 \ldots \beta_5$ reveal the elasticity of the dependent variable {Energy) relative to the independent variables (IQ, eGov, GDP, TO). The parameters β_1 should be expected to be positive since effective institutions with economic growth and trade openness allow countries' governances to focus on production and services development considering the ecological dimensions (enhancing green consciousness and awareness). Furthermore, it allows for direct investments in innovative technologies and increasing environmental expenditure for nature protection. The calculated variables β_2 and β_3 showed the type of relationship between energy and electronic government: $\beta_2 = 0$ and $\beta_3 = 0$—no relationship; $\beta_2 > 0$ and $\beta_3 = 0^{-}$ a monotonous increase in energy is caused by the effect of electronic government; $\beta_2 < 0$ and $\beta_3 = 0$—a monotonous decline in energy is caused by the effect of electronic government; $\beta_2 < 0$ and $\beta_3 > 0$—the relationship between energy and electronic government is characterized by a U-shaped curve; $\beta_2 > 0$ and $\beta_3 < 0$—the relationship between energy and electronic government is characterized by an inverted U-shaped curve.

In the first step, the study applies a test for cross-sectional dependence since cross-dependence could bias the results of the model estimates. This study applies Pesaran cross-sectional dependency (CD) [91]. The analysis of the data is developed by the nonstationary process and requires the use of the methods of long-term analysis applying cointegration tools. The core requirement for the cointegration relationship between variables is their non-stationary at level (i., I(1) processes). The study applied, Im–Pesaran–Shin [92] and cross-sectional augmented Dickey-Fuller (CADF) [93] unit root tests to check the stationarity of the data. The rejection of a zero hypothesis "Panels contain unit root" in Im–Pesaran–Shin test confirmed the stationary process of the panel (alternative hypothesis–panels are stationary).

In the next stage, the study tests the hypothesis on the long-run relationship among the analyzed parameters. The conclusion on the existence of cointegration is made based on the results of the following tests: Kao [94], Pedroni [95,96], and Westerlund [97]. After cointegration identification, the long-run relationship is checked by panel fully modified OLS (FMOLS) [98]. This method has the advantage of correcting the problem of serial correlation and simultaneous shift. In addition to FMOLS, this study applies canonical cointegration regression (CCR) [99] to check the stability and validity of the results. Both methods use semiparametric correction to eliminate the correlation issues between explanatory and random components. In the last stage, the study applies the Dumitrescu and Hurlin heterogeneous panel causality test to check the Granger causality. Considering the abovementioned factors, the framework of the study is shown in Figure 1.

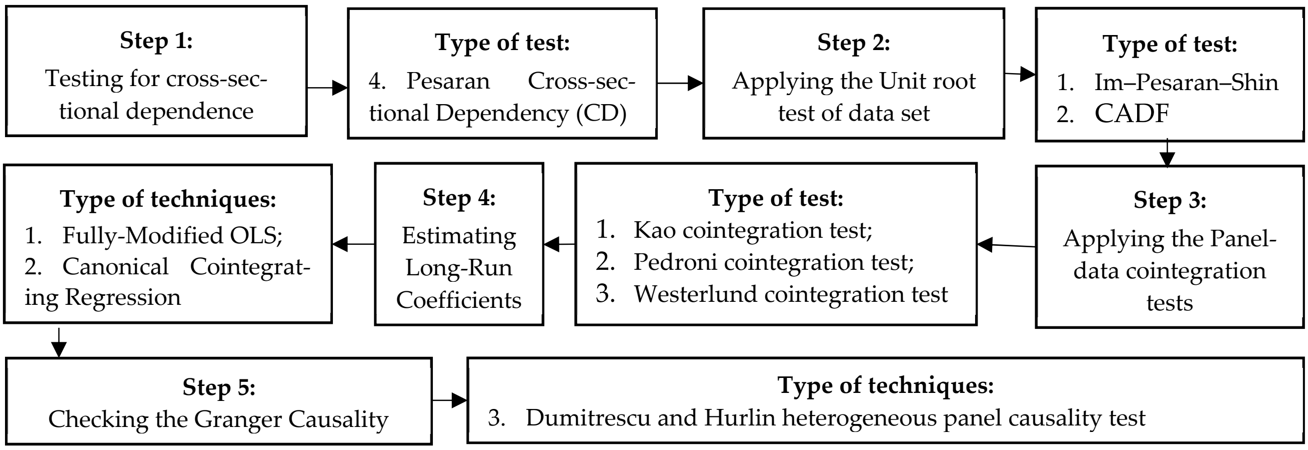

Figure 1. The main stages of the research and relevant methods, tests, and techniques.

4. Results

The findings of testing cross-sectional independence are presented in Table 3.

Table 3. The empirical results of Pesaran's test of cross-sectional independence.

	Statistic	Probability
Pesaran's test of cross-sectional independence	3.057	0.0022

The empirical findings in Table 3 show that the statistic value of Pesaran's test probability is 0.000. It allows rejecting the null hypothesis at the 1% significance level in all panel data and reveals the cross-dependence.

At the next stage of the research, all data are checked for the existence of a unit root by Im–Pesaran–Shin [92] and cross-sectional augmented Dickey-Fuller (CADF) [93]. The findings of the panel unit root test are presented in Table 4.

Table 4. The empirical results of panel unit root tests for analyzed variables.

Variables		Im–Pesaran–Shin		CADF	
		Stat.	**Stat.**	**Stat.**	***p* Value**
Energy	at level	0.1025	0.0052	−1.949	0.162
	at first difference	−34.6879	0.0000	−2.959	0.000
IQ	at level	−0.6255	0.0000	−1.814	0.367
	at first difference	−12.7904	0.0000	−3.335	0.000
$eGov_{ke}$	at level	−0.3221	0.9433	−1.787	0.422
	at first difference	−2.4838	0.0000	−3.461	0.000
$eGov_{dps}$	at level	1.0709	0.9891	−1.658	0.342
	at first difference	−6.1430	0.0000	−3.534	0.000
GDP	at level	−12.9935	0.0000	−1.627	0.742
	at first difference	−8.8053	0.0000	−2.734	0.000
TO	at level	−1.7887	0.0000	−1.937	0.161
	at first difference	−7.0943	0.0000	−2.352	0.001

Note: Stat. means statistic; Energy is SDG 7 Clean and affordable energy; IQ means institutional quality; $eGov_{ke}$ means technical prerequisites for the e-government services applications; $eGov_{dps}$ means availability of government services aimed at foreign companies on the Internet, usability and implementation of eID and eDocument capabilities, GDP means gross domestic product per capita, TO means trade openness.

The results of Im–Pesaran–Shin and cross-sectional augmented Dickey-Fuller test confirmed that not all data were stationary at level. However, at the first difference, all variables had become stationary with statistical significance at the **1%** level. If the data are stationary, the next step could be realized analysis of cointegration between selected variables (Energy, IQ, $eGov_{ke}$, $eGov_{dps}$, GDP, and TO). The empirical results of panel data cointegration tests are shown in Table 5.

Table 5. The findings of panel data cointegration tests.

Type of Cointegration Tests	Test Statistics	Stat.	*p* Value
Kao	Modified Dickey–Fuller t	3.939 *	0.000
	Dickey–Fuller t	3.158 *	0.001
	Augmented Dickey–Fuller t	5.061 *	0.000
	Unadjusted modified Dickey–Fuller t	−1.633 ***	0.051
	Unadjusted Dickey–Fuller t	−3.490 *	0.000
Pedroni	Modified Phillips–Perron t	10.733 *	0.000
	Phillips–Perron t	−10.920 *	0.000
	Augmented Dickey–Fuller t	−9.556 *	0.000
Westerlund	Variance ratio	20.441 *	0.000

Note: Stat. means statistic; * and *** mean statistical significance at the 1% and 10% levels, respectively.

The empirical findings in Table 5 allow for rejecting the null hypothesis in all cases at the statistically significant levels of 1% and 10%. It allows concluding that the variables were cointegrated. Thus, in the next step, the measure of the long-run relationship could be implemented. Considering the proposed methodology, the FMOLS and CCR techniques are applied to check the long-run relationship between Energy, IQ, $eGov_{ke}$, $eGov_{dps}$, GDP, and TO (Table 6).

Table 6. The findings of the long-run relationship between the analyzed variables: FMOLS.

Variables		Key Enablers ($eGov_{ke}$)				Digital Public Services for Businesses ($eGov_{dps}$)			
		Linear Model		Nonlinear Model		Linear Model		Nonlinear Model	
		Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
Energy	IQ	0.087 **	0.028	0.071 **	0.035	0.060 **	0.035	0.046 ***	0.069
	eGov	−0.002	0.942	−0.307 **	0.046	0.042	0.211	−0.094 ***	0.051
	$eGov^2$	–	–	0.044 ***	0.054	–	–	0.033 ***	0.067
	GDP	0.061 ***	0.078	0.059 **	0.044	0.060 **	0.022	0.061 **	0.047
	TO	0.174 *	0.000	0.174 *	0.000	0.170 *	0.000	0.185 *	0.000
	Constant	5.799 *	0.000	6.285 *	0.000	5.584 *	0.000	6.085 *	0.000
	R^2	0.342		0.443		0.107		0.346	
	Adjusted R^2	0.327		0.428		0.087		0.327	

Note: Coef. means long-run coefficient; prob. means probability; *, **, and *** mean statistical significance at the 1%, 5% and 10% levels, respectively; Energy is SDG 7 Clean and affordable energy; IQ means institutional quality; $eGov_{ke}$ means technical prerequisites for the e-government services applications; $eGov_{dps}$ means availability of government services aimed at foreign companies on the Internet, usability and implementation of eID and eDocument capabilities; GDP means gross domestic product per capita; TO means trade openness; R^2 means a coefficient of determination.

The empirical findings of the FMOLS showed that IQ, GGD, and TO linearly impact affordable and clean energy. Thus, the growth of institutional quality by one point led to increasing Energy: in the model with $eGov_{ke}$–by 0.087 (statistical significance at 5%); in the model with $eGov_{dps}$ by 0.06 (statistical significance at 5%). GDP also positively affects Energy in both models. The GDP increase provokes the growth of Energy by 0.06 in both models. Furthermore, trade openness has a positive statistically significant effect on Energy. So, the increase in clean and affordable energy by 0.17 could be caused by the growth of trade openness by one point. The findings proved that e-Governance has a significant nonlinear connection with affordable and clean energy. This means that digital public services could have a negative effect on clean and affordable energy if they cause a gap between energy supply and demand and a reduction in energy supply capacity. However, if the digitalization scale increases, it is conducive to the transparency of the energy sector for all stakeholders. The nonlinear relationship between digital public services and energy has a U-curve relationship. The estimated elasticity coefficients for GDP and TO indicators had a positive and statistically significant impact on the achievement of Goal 7 of sustainable development of the countries.

The obtained findings of CCR (Table 7) have a coherent tendency with the results of FMOSL. Similar to the FMOLS technique, the results of CCR found that e-Governance has a significant nonlinear connection with clean and affordable energies. The empirical results showed that the growth of institutional quality positively affected affordable and clean energy. Increasing IQ led to the growth of SDG 7 by 0.087 for the model with $eGov_{ke}$ and by 0.06 for the model with $eGov_{dps}$. The impact of institutional quality is statistically significant at 5% 087 for the model with $eGov_{ke}$ and 10% for the model with $eGov_{dps}$. In addition, the extension of GDP and TO causes the growth of affordable and clean energy.

Table 7. The findings of the long-run relationship between the analyzed variables: CCR.

Variables		Key Enablers ($eGov_{ke}$)				Digital Public Services for Businesses ($eGov_{dps}$)			
		Linear Model		Nonlinear Model		Linear Model		Nonlinear Model	
		Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
Energy	IQ	0.087 **	0.040	0.073 **	0.035	0.060 **	0.045	0.046 ***	0.071
	eGov	−0.002	0.938	−0.307 **	0.050	0.042	0.255	−0.168 **	0.012
	$eGov^2$	–	–	0.043 ***	0.059	–	–	0.029 **	0.030
	GDP	0.060 ***	0.098	0.060 **	0.042	0.059 **	0.031	0.061 **	0.047
	TO	0.175 *	0.000	0.174 *	0.000	0.170 *	0.000	0.185 *	0.000
	Constant	5.799 *	0.000	6.297 *	0.000	5.582 *	0.000	6.039 *	0.000
	R^2	0.324		0.499		0.102		0.424	
	Adjusted R^2	0.309		0.485		0.082		0.408	

Note: Coef. means a long-run coefficient; prob. means probability; *, **, and *** mean statistical significance at the 1%, 5% and 10% levels, respectively; Energy means SDG 7 Clean and affordable energy; IQ means institutional quality; $eGov_{ke}$ means technical prerequisites for the e-government services applications; $eGov_{dps}$ means availability of government services aimed at foreign companies on the Internet, usability and implementation of eID and eDocument capabilities; GDP means gross domestic product per capita; TO means trade openness; R^2 means a coefficient of determination.

5. Discussion

Considering the empirical results, the quality of institutions has a statistically significant connection with affordable and clean energy, which is consistent with the results of previous studies [69–77]. Thus, countries with weak institutions should provide effective and transparent ecological policies. In addition, it is necessary to enlarge the green investment, initiatives, and grants for projects oriented toward renewable energies. At the same time, the green financial process should be transparent [14,15,19,100,101]. The government should provide an effective system of monitoring and accounting to eliminate corruption. Local communities should be involved in decision-making, and their voices should be considered [18,24,43,102,103]. In addition, considering the prior study [56], the government should provide relevant incentives to involve society in making a decision on green financing. It also allows for increasing accountability, transparency, and, consequently, reduction in corruption, involving society could reduce the political manipulations in making decisions for green investment, initiatives, and grants for projects oriented toward renewable energies. In addition, ecological legislation should be coherent with other policies, directives, and norms [100,104,105]. Furthermore, snowballing digitalization of the world economy's effects on countries' development intensify business processes. However, digitalization has not covered all stakeholders and processes. In addition, a vast range of countries is not ready for digitalization and does not have a well-developed digital infrastructure, relevant digital knowledge, and skills [63,66,106–109]. Consequently, it provokes the exclusion of social groups, companies, and communities from this process, which leads to the growth of digital gaps and limits inclusive economic growth. It should be noted that previous studies [76,77] also confirmed the U-curve relationship between e-Governance and affordable and clean energies. In this case, the government should provide active policies on digital infrastructure development to increase countries' readiness for digitalization [17,64,65]. It is necessary to implement educational programs to enhance the digital skills and competencies of all stakeholders and workers at all government levels (local, regional, and national) [63,66,106,109].

6. Conclusions

Inclusive economic growth is an integral part of sustainable development. Considering the assumption, the growth of one indicator could lead to the growth of the integrated indicators of inclusive economic growth. Thus, extending affordable and clean energy (as the core force of inclusive economic growth) promotes inclusive economic growth. The empirical results of this research allow making the conclusion that e-Governance has nonlinear statistically significant connections with affordable and clean energy. So, at the first stage, digitalization causes the decline in SDG7 (growth of e-Governance leads to a decline in SDG7: FMOLS–by 0.307 in the key enablers model and 0.94 in the digital public services for businesses model; CCR–by 0.307 in the key enablers model and 0.168 in the digital public services for businesses model). However, the scaling of digitalization has a positive effect on clean and affordable energy. In this case, considering the findings of the CCR technique, the growth of key enablers is conducive to affordable and clean energy by 0.043 points, and the growth of digital public services for businesses is conducive by 0.029.

Therefore, policies should prioritize the growth of key enablers and digital public services for businesses, which are found to be conducive to affordable and clean energy growth according to the findings of the CCR technique. By implementing policies that promote the scaling up of digitalization while also prioritizing affordable and clean energy, governments and organizations can contribute to inclusive economic growth in a sustainable manner. Some practical examples of policies that could prioritize the growth of key enablers and digital public services for businesses to promote affordable and clean energy growth. Developing digital public services for businesses that encourage the adoption of renewable energy sources, such as solar panels or wind turbines. This could include creating online platforms where businesses can access information about local incentives and subsidies for renewable energy installations. Investing in smart grid technology that allows efficient distribution of clean energy. This could involve creating partnerships between energy companies and technology providers to develop and implement smart grid solutions. Providing training for small and medium-sized enterprises (SMEs) to adopt sustainable practices, including the use of renewable energy sources. This could involve creating online training courses and workshops, as well as offering financial incentives for SMEs that adopt sustainable practices. Developing policies that encourage the adoption of electric vehicles (EVs) by businesses. This could include creating tax incentives for companies that purchase EVs for their fleet, as well as investing in charging infrastructure that is accessible to businesses. Encouraging the development of innovative technologies that support clean energy growth, such as energy storage systems or hydrogen fuel cells. This could involve creating research and development partnerships between businesses, universities, and government agencies.

Overall, policies that prioritize the growth of key enablers and digital public services for businesses can help to accelerate the adoption of clean energy sources and support inclusive economic growth in a sustainable manner.

Despite the valuable findings, this research has a few limitations. Thus, the study focuses on SDG7 as a core driver of inclusive economic growth. However, inclusive economic growth depends on a vast range of social, economic, and ecological dimensions [4,5,21,24], which should be considered in future research. In addition, within the study, institutional qualities are analyzed as integrated indicators. However, it would be necessary to understand what indicators of the integrated index of institutional qualities could reduce or increase inclusive economic growth (corruption, transparency, voice and accountability, the rule of law, etc.). It should be emphasized that digitalization provokes a vast range of cybersecurity issues [110–113], the impact of which could be considered within the further analysis. In addition, the sample of analysis should be extended to compare the inclusive economic growth of the EU and other countries (the USA, the UK, China, etc.). Besides, it is necessary to analyze each EU country separately to justify the relevant incentives depending on the country's social, economic, and ecological development.

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