Succeeding in Energy Transition in Sub-Saharan Africa: Does Institutional Quality Matter?

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Abstract

The objective of this article is to examine the effect of the quality of institutions on energy transition in 19 sub-Saharan African (SSA) countries over the period 1996-2016. To achieve this, we proceed in two steps. We first use the principal component analysis (PCA) to construct a composite indicator of institutional quality, from Kaufmann's (1996) six indicators of governance. Then, we estimate an autoregressive distributive lag model (ARDL) on panel data using the pooled mean group (PMG) estimation technique. Our results show that the quality of institutions determines the energy transition in SSA. The associated coefficient is positive and statistically significant. In addition, our results show that economic growth and trade openness promote energy transition. On the other hand, it emerges that CO2 emissions hinder energy transition, due to the high dependence of the countries considered on fossil fuels. We suggest an improvement in the quality of institutions and the implementation of political incentives favorable to the adoption of new technologies.

Key words: Quality of institutions, Energy transition, sub-Saharan Africa, PMG

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1. Introduction

Sub-Saharan Africa (SSA) is faced with a significant energy deficit which slows its development. By way of illustration, its power consumption per capita is 181 kilowatt-hours (kWh) per year and per person, while it is 6500 kWh/year/person in Europe, and 13000 kWh/year/person in the United States (Rugamba et al., 2016). Out of a population estimated at over 950 million inhabitants, about 612 million do not have access to electricity, and it is also the only region in the world where the number of people living without electricity increases, as population growth is strong, despite the efforts made by the governments within the framework of the Sustainable Development Goals (SDGs) to ensure access to electricity (da Silva et al., 2018).

This energy deficit partly explains the weak economic performance recorded from the region over the recent period (Avila et al., 2017) and explains the observed delay in achieving the SDGs. Though Africa is full of enormous energy potentials, its exploitation is constrained on the one hand by qualitative and quantitative insufficiencies in energy infrastructures, and on the other hand by regulatory obstacles that limit the capacity of countries to mobilize the funds necessary for the increase in production capacities in electrical energy (Avila et al., 2017; Pueyo et al., 2015). In 2014, the electricity generation capacity in SSA was only 99 Gigawatt (GW); about 0.1 kW per capita, contrary to developed and some emerging countries, which had average internal generation capacities ranging from 1.0 to 3.3 kW per capita (Avila et al., 2017). The difficulties of SSA countries in producing electric power reliably have led part of the population, consisting mainly of the middle class of this region, to seek autonomous solutions from expensive diesel power plants. These choices explain the predominance of fossil energy sources (more than 70%) in the total energy consumption of countries in the region (US Energy Information Administration (EIA), 2017).

This strong dependence on fossil fuels and the energy deficit that prevails in SSA can hamper economic development and prevent the achievement of the SDGs in these countries (Ackah and Kizys, 2015). Indeed, fossil fuels are polluting and mainly responsible for the emission of greenhouse gases (GHGs), which are at the origin of global warming, and deteriorates the quality of the environment by causing the melting of natural glaciers, drought and declining agricultural production. In addition to being polluted, fossil fuels are exhaustible, and their reserves are constantly running out. In this context, the abundant endowment of renewable energy sources in SSA countries is an asset that will enable these countries meet their energy deficit, while promoting their sustainable development. Energy transition therefore appears to be an essential tool for the sustainable development of SSA countries.

Energy transition is widely used in literature to designate the shift from fossil fuels to renewable energies to make the modes of consumption and production more ecological (Afonso et al., 2021; Lange et al., 2018). Indeed, the shift from fossil fuels to renewable energies is meant to reduce GHG emissions (Apergis and Payne, 2010; Murshed, 2018). Furthermore, the replacement of fossil fuels by renewable energies should complement the energy diversification policies undertaken by the States to guarantee the energy security objectives of energy-deficit economies in particular and make it possible to achieve sustainable growth in general (Asif and Muneer, 2007; Olanrewaju et al., 2019). The Africa Progress Panel (2017) notes that the shift from fossil fuels to renewable energies could be the "golden thread" to achieve all the SDGs, as this transition will link growth, equity and environmental sustainability[1].

To fully understand the literature on energy transition, three stages should be distinguished. The first consists of the choice of indicators (Afonso et al., 2021; Bourcet, 2020; Damette et Marques, 2019). The second examines the effects of renewable energies on macroeconomic variables (Bölük and Mert, 2015; Danish et al., 2017; Omer, 2008). The last focuses on the determinants of energy transition (da Silva et al., 2018; Olanrewaju et al., 2019; Omri and Nguyen, 2014). Concerning specifically the third stage, Marques et al. (2010) and Aguirre et Ibikunle (2014) have highlighted some key factors of the deployment and consumption of renewable energies, which are notably economic, environmental, political and country-specific factors. However, the literature has focused on the economic and environmental factors such as GDP per capita, trade openness, gross fixed capital formation and CO_2 emissions (Apergis and Payne, 2010; Canh and Thanh, 2020; Marra and Colantonio, 2020; Pfeiffer and Mulder, 2013). Very little attention has been accorded to political factors. Studies that have taken into account the role of political factors in energy transition have focused more on factors related to public policy and energy security (Aguirre and Ibikunle, 2014; Marques and Fuinhas, 2011). These initial works on the political determinants of energy transition, although pertinent, ignored the institutional determinants that govern the operational framework of economies.

Recently, some studies have taken interest in institutional determinants of renewable energies. Among the existing works, some emphasized on democracy (Sequeira and Santos, 2018), others on corruption and political stability (Cadoret and Padovano, 2016; Mehrara et al., 2015). Despite this consideration of institutions, the majority of these works used a limited number of institutional indicators to explain the deployment and

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[1] Environmental sustainability refers to the protection of environmental resources and the constant improvement in the quality of the environment (Kasayanond et al. 2019; Murshed and Dao, 2020).

the consumption of renewable energies. In addition, most of these works are done essentially in developed countries and to an extent, on some developing countries.

SSA countries which face enormous challenges, particularly energy challenges, seem not to be the subject of empirical investigation on the institutional determinants of renewable energies. Yet, according to the institutional theory, the choices of individuals, companies and countries are influenced by social norms, laws and regulations (Kostova et al., 2008; Oliver, 1991; Scott, 1987). North (1990) defines institutions as the rules of the game of a society or more formally, the constraints it imposes on itself and which shape human interactions. Thus, the energy choices of a country are supposed to be influenced by the quality of its institutions. According to Cadoret and Padovano (2016), the choice and dissemination of renewable energies is above all a political and an institutional decision. Hence, the main question that this article attempts to answer is the following: can institutional quality promote energy transition in SSA countries?

The objective of this article is to empirically examine the effect of institutional quality on energy transition in SSA countries. To do this, and to better understand the effect of institutions, we first construct a composite indicator of institutional quality, based on the six governance indicators of Kaufmann (1996), using the principal component analysis (PCA). To the best of our knowledge, only Uzar (2020) has used a composite indicator of institutional quality to study its effect on the consumption of renewable energies. However, the present study differs fundamentally from the latter by at least three points.

First, to construct his composite indicator, Uzar (2020) opted for an additive approach. Even if this approach has the advantage of being simple to implement, the fact remains that it is subject to numerous criticisms because it attributes the same weight to all the variables (Greco et al., 2019; Paruolo et al., 2013). Based on these shortcomings, this study uses the PCA to construct a composite index of institutional quality.

Second, the author uses only two control variables in his study, notably real GDP and CO_2 emissions. In our analysis, in addition to these variables, we use two other control variables from the literature, namely energy security and trade openness.

Third, unlike the study by Uzar (2020) which focused on 38 developed countries, which have already been the subject of studies on the institutional factors of energy transition, this study focuses exclusively on SSA countries.

After the construction of the composite indicator of institutional quality, an autoregressive distributive lag model (ARDL) on panel data is estimated by the pooled mean group (PMG) estimation technique. To account for cross-sectional dependency issues that have been ignored in most previous works, second generation panel data techniques are used. Thus, the empirical results of the present study provide solid and reliable conclusions based on comprehensive data and rigorous analysis across 19 sub-Saharan African countries.

The rest of the article is organized as follows. Section 2 presents a brief review of the literature. Section 3 presents the empirical strategy, the data and their sources. Section 4 presents the results and their economic interpretations. Section 5 concludes and suggests implications for economic policies.

2. Literature review

The theoretical grounding of the effects of institutions on energy transition seems to date back to the pioneering contribution of Scott (1987), who highlights their importance in the choices and behaviors of humans. The effects of institutions have been examined in institutional theory. According to this theory, social norms, rules and laws can influence the choices of companies, as well as the residents of a country, including energy choices. In this light, institutional quality is an essential factor influencing energy decisions and environmental strategies through at least two channels. First, good institutional quality reduces transaction costs and investment risks (North, 1990; Kousky et al., 2006), which encourages private investors to invest in new sectors such as those of renewable energies. Second, the quality of institutions can have a positive effect on energy transition through property rights (Mehrara et al., 2015). Indeed, a country characterized by strong institutions ensures respect for the law, which encourages new investors. Likewise, when a country has the capacity to put in place institutions that structure exchanges and protect property rights, then, the latter stimulates productive investments. The issue on the development of renewable energies in low-income countries has generally been centered on the lack of the necessary funds.

Furthermore, Fredriksson and Svensson (2003) affirmed that in countries with high levels of corruption and political instability, environmental policies were relaxed. This statement is not surprising in many ways, because in countries with high corruption, the country's elites tend to focus on maximizing their own interests and can approve projects that hinder energy transition. In this respect, institutional quality can directly influence energy transition. Uzar (2020) argues that in countries where the level of corruption is high, the rigors of energy policies are reduced due to the lobbying of traditional energy companies which corrupts the elites. Consequently, environmental regulations in these countries are wrought in function of the interests of these companies, which can slow down energy transition. For the latter, democracy and bureaucratic quality, are equally institutional factors that directly influence energy transition. In fact, democratic countries are more sensitive to universal debates on human rights, justice, the environment and renewable energies.

As far as they are concerned, Sequeira and Santos (2018) argue that in democratic countries, individuals possess the capacity to inform and freely express themselves on environmental issues. As a result, these persons are free to express their environmental exigencies, and these exigencies exert a certain degree of pressure on the authorities, thus improving environmental quality (Payne, 1995). According to Acemoglu et al. (2012), the desire of leaders to implement policies that are unfavorable to environmental quality, notably energy policies in favor of conventional energies, can be prevented by bureaucrats. Thus, the quality of bureaucrats is extremely relevant in the process of framing and implementation of energy policies. Ringquist (1993) and Povitkina (2015) equally argue that bureaucratic quality is an important element in the planning, implementation and supervision of environmental policies.

Despite the abundant theoretical literature on the influence of the quality of institutions on energy transition, there are very few empirical studies on the said link. Existing empirical studies generally focus on the effect of a limited number of basic institutional indicators such as democracy, corruption and political instability on renewable energies. Marques and al. (2010) and Marques and Fuinhas (2011) have shown that lobbying activities have a negative influence on the deployment of renewable energies in European countries. Mehrara et al (2015) examined the traditional and institutional drivers of renewable energies in OECD (Organization for Economic Co-operation and Development) countries over the period 1992-2012. The results of their study show that political stability had a positive effect on the consumption of renewable energies, while corruption had a negative effect on the latter. Sequeira and Santos (2018) analyzed the relationship between democracy and renewable energies in more than 100 countries. All the indicators of democracy used in the study had a positive effect on the consumption of renewable energies. Cadoret and Padovano (2016) analyzed the political, environmental and economic determinants of renewable energies in 26 EU (European Union) countries over the period 2004-2011. The results suggested that corruption, lobbying and political ideologies were determinants of renewable energy policies: lobbying and per capita income had a negative effect on the use of renewable energies, while corruption control and the so-called left-wing governments had a positive effect.

Two important findings emerge from the literature review. On the one hand, most of the studies used a limited number of institutional indicators to understand the effect of institutions on renewable energies. Thus, these indicators do not capture all the dimensions of institutional quality. On the other hand, most of the studies focused on developed countries, and very few on developing countries, especially SSA countries, which continue to present both a structural and an energy deficit.

3. Empirical strategy and data

a) Empirical specification of the model and estimation technique

To analyze the effect of institutional quality on energy transition in SSA countries, we are inspired by the works of Valdés Lucas et al. (2016), who formulated the energy transition equation as follows:

$$TE \circledcirc f \circledcirc ECO, ENV, SE \circledcirc \quad (1)$$

Where TE is the indicator of energy transition; ECO is a vector of economic variables such as GDP per capita and energy price; ENV takes into account environmental factors such as CO_2 emissions and energy consumption per GDP; and SE measures energy security through the dependence on energy imports and the diversification of energy sources for example.

With regard to the objective of this article and following the literature on the role of the institutional dimension on energy transition, we modify equation (1) as follows:

$$TE \circledcirc f \circledcirc QI, ECO, ENV, SE \circledcirc \quad (2)$$

With QI denoting the index of the quality of institutions that affects the behavior of countries towards energy transition. Thus, the estimated empirical model is presented as follows:

$$TE_{it} = \alpha_0 + \alpha_1 REV_{it} + \alpha_2 CO_{2_{it}} + \alpha_3 SE_{it} + \alpha_4 TO_{it} + \alpha_5 QI_{it} + \mu_{it} + \varepsilon_{it} \quad (3)$$

α_0[2] is the constant, μ_{it} is the country specific effect, ε_{it} are error terms which are supposed to be identically and independently distributed, of zero mean and variance σ^2 . the indices i and t respectively capture the individual (country) and temporal (year) dimensions.

[2] The α_0 in the equation (3) represent the baseline level of the dependent variable when all other predictors are set to zero. It serves as an intercept in the regression model. The source of this constant is inherent in econometric modeling process where it captures unobserved factors that influence the energy transition but are not included in the model.

Generally, the most widely used estimator in the context of panel data is the generalized method of moments (GMM) due to its ability to present consistent and efficient results in the presence of endogeneity. However, based on the structure of our panel, that is a macro-panel, whose temporal dimension is greater than the individual dimension, this estimator seems to be unsuitable. Indeed, Roodman (2009, 2014) shows that the GMM estimators are neither consistent nor efficient because the number of instruments increases with the temporal dimension on the one hand, and the weakness of the individual dimension could lead to a biased autocorrelation test on the other hand. Under these conditions, the ARDL approach is better suited. Indeed, it permits to resolve the endogeneity problem given that it includes the average lags of the independent and dependent variables. In addition, this approach has the advantage of simultaneously estimating the short run and the long run equation.

If the variables are cointegrated, this implies that the error term follows a stationary process I(0). According to Pesaran et *al*. (1999), the ARDL (p, q) model, where p and q are the lags of the dependent and explanatory variables respectively, can be written in the form of an error correction model as follows:

$$\Delta Y_{i,t} = \sum_{j-1}^{p-1} \beta_{ij} \ \Delta Y_{i,t-j} + \sum_{j-0}^{q-1} \rho_{ij} \ \Delta X_{i,t-j} \ + \delta_i \left[Y_{i,t-1} \ - \left(\theta_{i0} + \theta_{i1} X_{i,t-1} \right) \right] + \mu_{it}. \qquad (4)$$

[illegible] and [illegible] are the coefficients of the short run model of X and Y lags, [illegible] is the vector of the long run coefficients, [illegible] measures the long run speed of adjustment to the equilibrium and is supposed to be negative. [illegible] is the differential operator between two successive periods. In this equation, Y designates the dependent variable corresponding to energy transition in equation (3), and X represents the vector of explanatory variables corresponding to the variables QI, REV, SE, CO_2 and TO in equation (3). Apart from the dependent variable that is energy transition, we use the logarithm of the explanatory variables in the estimation of equation (6).

The term in square brackets represent the long run dynamic derived from the following equation:

$$Y_{i,t-1} = \theta_{i0} + \theta_{i1} X_{i,t-1} + \varepsilon_{it} \qquad (5)$$

With $\varepsilon_{it} \sim I\ (0)$

For the estimation of the equation (6), several estimators can be used such as the Mean Group (MG), Pooled Mean Group (PMG) and Dynamic Fixed Effect (DFE) estimators.

The difference between the MG, PMG, DFE estimators is that the former allows heterogeneity of the panel parameters both in the short run and in the long run, while the PMG is more flexible by imposing common parameters in the long run, and by allowing these, as well as the adjustment parameters, to vary according to the individuals of the panel in the short run model. This flexibility, especially at the level of the adjustment parameter permits to avoid biased results (Kiviet, 1995).

The empirical specification of the ARDL model of energy transition derived from equation (6) is:

$$\Delta TE_{i,t} = \sum_{j-1}^{p-1} \beta_{0j} \ \Delta TE_{i,t-j} + \sum_{j-0}^{q-1} \rho_{1j} \ \Delta QI_{i,t-j} + \sum_{j-0}^{q-1} \rho_{2j} \ \Delta REV_{i,t-j} + \sum_{j-0}^{q-1} \rho_{3j} \ \Delta CO_{2\ i,t-j} + \sum_{j-0}^{q-1} \rho_{4j} \ \Delta SE_{i,t-j} + \sum_{j-0}^{q-1} \rho_{5j} \ \Delta TO_{i,t-j} + \delta_i \left[TE_{i,t-1} - \left(\theta_{00} + \theta_{01} QI_{i,t-1} + \theta_{10} + \theta_{11} QI_{i,t-1} + \theta_{20} + \theta_{21} REV_{i,t-1} + \theta_{30} + \theta_{31} CO_{2i,t-1} + \theta_{40} + \theta_{41} SE_{i,t-1} + \theta_{50} + \theta_{51} TO_{i,t-1} \right) \right] + \mu_{it}. \quad (6)$$

In equation (6), the dependent variable TE designates energy transition and QI is the independent variable of interest, measuring institutional quality. REV, CO_2, SE and TO are control variables designating GDP per capita, CO2 emissions, energy security and trade openness respectively.

The empirical equation of the long run dynamic becomes:

$$TE_{i,t-1} = \theta_{00} + \theta_{01} QI_{i,t-1} + \theta_{10} + \theta_{11} QI_{i,t-1} + \theta_{20} + \theta_{21} REV_{i,t-1} + \theta_{30} + \theta_{31} \text{CO2}_{\ i,t-1} + \theta_{40} + \theta_{41} SE_{i,t-1} + \theta_{50} + \theta_{51} TO_{i,t-1} + \varepsilon_{it} \quad (7)$$

However, estimating the ARDL model requires certain conditions. Specifically, the variables must be stationary at a level or in the first difference, but not in second difference. To do this, a certain number of preliminary tests are carried out in order to confirm the validity of the choice of the ARDL models for the estimation of the equation (8). We first perform Pesaran's (2004) cross-sectional dependency (CD) test. The results of this test make it possible to carry out the most adequate unit root test (first generation or second-generation tests), and subsequently the cointegration tests. In addition, in order to verify the existence of potential multicollinearity problems, the variance inflation factor (VIF) test is carried out.

b) Definition of variables and data sources

Energy transition, which is the dependent variable, is measured by the proportion of renewable energy in the energy mix or in total energy consumption. In the existing literature, several indicators have been used to measure energy transition. Among the most used measures, we can cite the share of renewable energies in the electricity mix (da Silva et al., 2018), the share of renewable energies in total energy consumption (Murshed, 2018), the ratio of energy production from renewable sources for energy production from fossil fuel sources (Afonso et al., 2021). Given that the sample countries face an energy supply deficit, it is assumed that their energy demand pushes suppliers to shift to renewable energy sources in order to meet this demand. Consequently, to capture energy transition, we use in this study, the ratio of the consumption of renewable energies in total energy consumption.

The independent variable of interest is the vector of institutional variables, referred to as institutional quality (QI). Although there is a multitude of indicators of institutional quality in the available literature, the most used are the six indicators developed by Kaufmann (1996), namely: political stability, control of corruption, voice and accountability, government effectiveness, regulatory quality and rule of law. The choice of these indicators is justified by their availability over a long period and on many countries. In addition, Kaufmann's (1996) indicators take into account all the dimensions of institutional governance. However, there is a strong risk of multicollinearity if the six indicators in question are simultaneously included in the model. Taking them into account simultaneously will significantly increase the number of explanatory variables and thus weaken the degree of freedom of the model. To correct these problems, we could alternately include each of these variables individually in the model, like Marques and Fuinhas (2011) and Mehrara et al. (2015). However, the weakness of this method is that it does not take into account all the dimensions of institutional quality; hence the importance of constructing a composite index of institutional quality using the PCA. The latter has the advantage of taking into account all the six indicators of institutional quality.

Regarding the control variables, this study retains four; namely: GDP per capita (REV), CO2 emissions (CO2), energy security (SE) and trade openness (TO).

Theoretically, the expected effect of economic growth, captured by REV on energy transition is positive (da Silva et al., 2018).

To study environmental factors of energy transition, we use CO2 [3] emissions. This choice is justified by the fact that these emissions are the main GHGs responsible for global warming,with a global rate of 77%, according to the Paris Climate Agency (PCA, 2019).

[3] The study accounts for the lower CO2 emissions associated with renewable energy.

Given that the countries that make up our study sample are still greatly dependent on fossil fuels and are in the developing phase, CO_2 emissions are expected to have a negative effect on energy transition (Olanrewaju et al., 2019).

Energy security is a key determinant of energy transition and specifically in the context of SSA countries, which are characterized by an energy supply deficit, and especially instability in the supply of electrical energy. Therefore, energy transition will tend to improve with energy security. Energy security, in our context, is measured by net energy imports, which are represented by the ratio of energy imports to the total primary energy supply (Przychodzen and Przychodzen, 2020). Trade openness is captured by the sum of exports and imports of goods and services as a percentage of GDP. In theory, with increased trade openness, countries can market surplus electricity produced by renewable energies (Afonso et al., 2021).

This study uses an unbalanced macro-panel of 19 SSA countries over the period 1996-2016. Our sample countries are: Angola, Benin, Botswana, Cameroon, Republic of Congo, Ivory Coast, Ethiopia, Gabon, Kenya, Mauritius Island, Mozambique, Namibia, Nigeria, Senegal, South Africa, Tanzania, Togo, Zambia, and Zimbabwe. The sample size and the study period are imposed by data availability. The data is obtained from two sources; notably: World Development Indicators (2021) and Worldwide Governance Indicators (2021).

4. Empirical Results

a) Descriptive statistics

Table 1 presents the results of descriptive statistics of the variables used to estimate the energy transition equation. These results show that the average rate of energy transition within the sample is 12.6% with a deviation of 8.9%. The highest rate of energy transition is 33%. This performance of SSA countries is relatively lower than that of developed countries and even that of some developing regions in Asia and Latin America (Afonso et al., 2021). In addition, we notice a total absence of efforts to transition to clean energies for some countries in the sample (average performance of energy transition is zero). For institutional quality, the results show that the mean score in the sample is 38.926, reflecting an average institutional quality in SSA countries in general. Nevertheless, a high standard deviation of average institutional quality (22.44) suggests that there is heterogeneity of institutional quality within SSA countries. This heterogeneity is equally confirmed in terms of the level of income per capita and CO_2 emissions.

To examine the opportunity of a multiple regression analysis, a correlation test between the different variables of the energy transition equation was performed. The results of the correlation matrix (Table A1 in the appendix) show, on the one hand, that the energy transition variable weakly correlated with institutional quality. On the other hand, it also emerges that energy transition is strongly correlated with REV, CO_2 emissions, as well as trade openness. These results thus confirm the opportunity of estimating a multiple regression equation, including the set of explanatory variables to explain energy transition.

Table 1: Descriptive Statistics

Variables	ObsMean	Std. Dev.	Min	Max
Energy Transition Consumption (TE)	3990.126	0.089	0	0.332
Quality of Institutions (QI)	34238.926	22.448	0	100
CO2 emissions (CO2)	3991.248	2.036	0.016	9.979
Energy Security (SE)	359-57.705	215.083	-1325.977	84.542
GDP per capita (REV)	3992627.786	2826.051	187.517	11949.282
Trade Openness (TO)	38070.842	25.225	20.723	152.547

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Furthermore, the correlation matrix equally reveals a significant correlation between certain explanatory variables of the model. For example, the correlation coefficient between real GDP per capita and CO2 emissions is 0.93 and statistically significant at the threshold of 1%. Such correlations could lead to potential multicollinearity problems in estimating the energy transition equation. To confirm the existence of such problems, the VIF test was performed. The results (see Table A2) reject the hypothesis of the existence of the problem of multicollinearity in the model. In fact, the average score of the VIF is 3.85; well below the threshold value of 10.

b) Stationary and cointegration tests

Before performing the unit root and cointegration tests, we first performed a cross-sectional dependency test in order to choose the unit root and cointegration tests best suited to the data.

The results of Pesaran's (2004) cross-sectional dependency test reject the hypothesis of cross-sectional independence between the countries in the panel at the 1% threshold (Table A2). Consequently, second generation unit root tests are more suitable in this case. Specifically, the results of the Pesaran's (2003) panel unit root test presented in Table A3 show that all variables are stationary at first difference, without exception. These results make it possible to verify the existence of a long run relationship between the variables before estimating the energy transition model. The panel cointegration tests of Pedroni (2004) and Westerlund (2007) were carried out for this purpose. The results of these tests presented in Table A4 all confirm the existence of a long run relationship between the variables of the model.

c) Results of the estimation of the energy transition model

In this study, three estimators are used to estimate the energy transition model in SSA, namely the MG, PMG and the DFE estimators. The Hausman test presented in Table A5 shows that the PMG model is better than the MG model. Moreover, the results of this test do not vary between the PMG and the DFE model because the probability associated with the Chi-Square statistic is significantly greater than the 10% threshold. Consequently, these results obtained from the Hausman test should privilege the PMG and the DFE estimators. However, we prefer the PMG estimator because it gives better results in terms of significance of the coefficients of the explanatory variable.

The results of the PMG estimator are presented in Table 2 and A6, while those of the DFE and MG are presented in Table A5 in the appendix.

The overall validity of the PMG results presented in Table 2 and A6 is attested by the negative adjustment coefficient significant at a threshold of 1%. The results of the long run model as well as those of the short run model all present significant coefficients. In addition, Pesaran's (2015) cross-sectional dependency test (Table A2) rejects the null hypothesis of cross- sectional dependence, thus confirming the consideration of cross-sectional dependence in the estimation of the energy transition model. Moreover, compared to the short run model, the long run equation presents more significant coefficients, confirming the idea according to which the issue of energy transition is a long-term problem. We decided not to transcribe the short run results, because we use the PMG estimator which imposes homogeneity on the long run estimators, but not on the short run estimators. Therefore, the short run results may vary from country to country and the average group does not provide good precision on the differences.

Table 2: Results of the PMG estimator

Dependent variable: TEC	Coefficient	Std. Error	p-value
Long run equation			
Institutional Quality (LnQI)	0.0366	0.0197	0.0630
GDP per capita (LnREV)	0.0118	0.0216	0.5830
CO_2 emissions ($LnCO_2$)	-0.0503	0.0143	0,0000
Energy security (LnSE)	-0.0013	0.0019	0.4750
Trade openness (LnTO)	0.1405	0.0081	0.0000
Adjustment coefficient	-0.1949	0.0828	0.0190
Short run equation			
Institutional quality (LnQI)	0 .0039	0.0332	0.9050
GDP per capita (LnREV)	0.0070	0.2149	0.9740
CO2 emissions (LnCO2)	-0.0152	0.0221	0.4910
Energy security (LnSE)	0 .0261	0.0066	0.0000
Trade openness (LnTO)	0.0040	0.0295	0.8920
Constant	-0.1231	0 .0540	0.0230

The long run results of the PMG dynamic show that institutional quality has a positive effect on energy transition. Specifically, a 100% improving in the quality of institutions increases energy transition efforts of the sample countries by 3.66 units. Although the effect of institutional quality found is weak, our results are consistent with those found by some works in the empirical literature (Cadoret and Padovano, 2016; Uzar, 2020). It equally confirms the interest of institutions in African countries to use clean energies. Indeed, the participation of many African countries in the different world summits on climate, the ratification of numerous agreements, conventions, treaties on the environment and climate change (Kyoto Protocol, 1997; COP21, 2015), is the result of the will of the institutions of these countries to improve environmental quality through environment friendly production and consumption modes.

Furthermore, as shown by Fredriksson and Svensson (2003), good quality institutions are synonymous to the control of corruption and ensuring political stability. Thus, the government is unlikely to be corrupted in exchange for non-environment friendly project choices. Likewise, in periods of political instability, characterized by weak and less efficient functioning institutions, it is understandable that environmental problems are being left behind. In addition, good quality of institutions is associated with freedom of speech. Thus, in countries where citizens have freedom of speech and expression, civil societies could exert pressure on the public authorities in place, to promote the exploitation of less polluting energy sources.

On the other hand, the results of the disaggregated effect of institutional quality (appendix 2 , table A7) show that the energy transition is affected differently by each dimension. On the one hand, “Voice and Accountability” and “Regulatory Quality” are the main institutional dimensions that stimulate the energy transition. On the other hand, factors such as “Control of Corruption”, “Political Stability”, “Rule of Law” and “Government Effectiveness” tend to slow down the energy transition in the long term. These factors tend to maintain the status quo by protecting traditional energy industries, which limits the adoption of green technologies.

Our results show that environmental factors and trade openness play an important role in the dynamics of energy transition in SSA. Thus, the results suggest that an increase in CO_2 emissions has a negative effect on energy transition in the countries considered over the study period. Specifically, a 100% increase in CO_2 emissions reduces energy transition by 5.03 units. This result is consistent with those of Przychodzen and Przychodzen (2020) in the case of transition countries and those of Olanrewaju e al., (2019) in Africa. The negative effect of CO_2 emissions on energy transition in the specific case of SSA countries could be explained by the fact that the prices of fossil fuels are still relatively cheaper than those renewable energies. Consequently, the African population, being mostly poor, shifts to the use of these cheap energies, which increases CO_2 emissions and impedes energy transition. In addition, given that SSA countries have high levels of corruption, the effectiveness of energy policies may be reduced, especially by the lobbying of companies that use and produce conventional energies, by corrupting leaders. Thus, energy projects and environmental regulations can be shaped in function of the interests of these companies. This could increase CO_2 emissions and slow down investments in renewable energies (Cadoret and Padovano, 2016; Strunz et al., 2016).

Our results equally show that countries’ trade openness positively affects energy transition during the study period. These results are in accord with those of Afonso et al. (2021). Indeed, thanks to trade openness, developed countries could transfer their clean energy technologies to SSA countries, which will have a stimulating effect on the deployment of renewable energies in these countries.

Summarily, the results indicate that institutional quality positively affects the political choices of SSA countries in terms of energy transition. In addition, our results confirm that environmental factors and trade openness are important drivers of energy transition in SSA countries.

5. Conclusion

The question about the choice of the type of energy is now of paramount importance in view of these economic and environmental implications. Thus, the scientific community has paid particular attention to the determinants of energy choices through rich and abundant literature. However, despite this interest, most of the works analyzed the subject through purely energetic, economic and environmental factors. Very little attention has been accorded to institutional factors, which, however, are at the heart of the efficiency of the economic system. It is therefore to contribute to fill up this void in the literature that this article has set out to examine the effect of the quality of institutions on energy transition, using a sample of 19 SSA countries over the period 1996-2016. To do this, we first used the principal component analysis to construct a composite index of institutional quality, from Kaufmann's (1996) six indicators of governance. Then, we carry out an econometric estimation based on the PMG method. The results suggest that institutional quality and trade openness positively affect energy transition in SSA countries over the period 1996-2016. Furthermore, the results reveal that CO_2 emissions hamper the energy transition in SSA countries due to the strong dependence of these countries on fossil fuels, which are still relatively cheaper compared to renewable energies.

From these results, important suggestions in terms of energy transition can be made to political decision makers. The transition to renewable energy represents a crucial political choice. In the context of certain sub-Saharan African countries, where initial investment costs and infrastructure limitations can make these energies seem more expensive, it is imperative to establish a robust institutional framework. This framework must be capable of implementing strategic plans aimed at reducing investment costs in renewable energy, particularly through the allocation of budgets dedicated to research and development activities. In addition, given that economic development is the actual priority SSA countries, these countries are uncertain that by switching to renewable energies, development will not be held back. The establishment of strong institutions could reduce this uncertainty by strengthening the confidence of these countries vis-a-vis the use of renewable energies. This could be an important tool to improve energy security, economic growth and environmental quality in these countries. In this context, the results suggest the implementation of policies that can improve the rule of law, political stability, corruption control, market regulation efficiency and income per capita to promote the energy transition in these countries. Future researchers could explore the existence of a threshold effect of income per capita with regard to the weak effect of the quality of institutions on energy transition compared to that found by other studies in developing countries.

APPENDIX

Appendix 1: Construction of the composite index of institutional quality

In order to construct the composite index of governance, we apply the PCA, which is a statistical procedure that transforms a set of observations (correlated variables), into a set of linearly uncorrelated variables called principal components (Johnson and Wichern, 1999). Each principal component contains a certain amount of information which decreases from the first principal component to the n[th] principal component. Consequently, the application of the PCA in our context is justified by the correlation of the six indicators of governance.

The composite index is obtained according to the following the specification:

$$X_{1it=} \sum_{k=1}^{K} \alpha_{1k}\ Y_{ki}\ ; \dots ; X_{qi}\ = \sum_{k=1}^{K} \alpha_{qk}\ Y_{ki}\ ; \dots ; X_{Ki}\ = \sum_{k=1}^{K} \alpha_{Kk}\ Y_{ki}$$

With X_{qit} the value of the indicator of institutional quality q in the countries i, at the period t; Y_{ki} is the value of the principal component k for the i[th] country; and α are the parameters of the model. The coefficients are estimated and the system is inverted to derive of Y_{ki} for each principal component as follows:

$$Y_{pi=} \sum_{k=1}^{K} \beta_{Pk}\ X_{Pi}$$

The first principal component explains as much as possible the variability of the data. Each principal component has the highest possible variance under constraint of being orthogonal to the other components. The principal components are eigenvectors of the covariance matrix of the original variables. The first principal component gives an index ensuring maximum discrimination between countries. The results of the PCA are presented in Table A6.

Appendix 2 Table of Results

Table A1: Correlation matrix

Variables	TE	LnQI	LnREV	LnCO2	LnSE	LnTO
TE	1.000					
LnQI	-0.507	1.000				
LnREV	-0.767	0.529	1.000			
LnCO2	-0.810	0.524	0.927	1.000		
LnSE	-0.074	0.505	0.110	0.136	1.000	
LnTO	-0.286	0.177	0.437	0.391	0.171	1.000

Table A2: Model diagnostic tests

Test	Test statistics	p-value	Decision
Variance inflation Test (VIF)	3.85	-	Absence of multicollinearity
Panel homogeneity	-0.723	0.470	There is Homogeneity
Cross-sectional Dependence	11.144	0.000	There is dependence
Weak cross-sectional dependence test	11.144	0.000	Absence of weak dependence

Table A3: Panel stationarity test (Pesaran, 2003)

Variables	Z(t-bar)	P-value	Constant	Trend	Lag
Level					
TE	-1.021	0.154	Yes	No	1
LnQI	1.610	0.946	Yes	No	1
LnREV	1.452	0.927	Yes	No	1
LnCO2	0.018	0.507	Yes	No	1
Ln SE	0.645	0.741	Yes	No	1
Ln TO	-0.546	0.293	Yes	No	1
First Difference					
TE	-4.041	0.000	Yes	No	1
LnQI	-2.107	0.018	Yes	No	1
LnREV	-3.588	0.000	Yes	No	1
LnCO2	-5.603	0.000	Yes	No	1
LnSE	-3.499	0.000	Yes	No	1
LnTO	-5.168	0.000	Yes	No	1

Note: test effectuated with constant, without trend, and one lag

Table A4: Cointegration test quation 3

Cointegration Test		Statistic	Statistic	Prob.	Decision
Pédroni, 2004	Panel	V	-2.185	-	Cointegrated
		Rho	2.378	-	
		T	-2.5	-	
		Ad	2.284	-	
		f	-	-	
	Group	V	4.321	-	
		Rho			
		T	-3.05	-	
		Adf	3.44	-	
Westerlund, 2007			1.2290	0.1005	Cointegrated

Table A5: MG and PMG estimation and Hausman Test

Dependent	DFE			MG		
TEC	Coefficient	Std.Dev	P-value	Coefficient	Std.Dev	P-value
Long run equation						
LnQI	-0.0678	0 .0900	0.4510	-0.0928	0.0835	0.2660
LnREV	-0.18063	0.1192	0.1300	-0.1460	0.1066	0.1710
LnCO2	-0.2837	0.0945	0.0030	-0.1045	0.0825	0.2050
Ln SE	-0.0054	0.0172	0.7500	-0.0283	0.0376	0.4520
Ln TO	0.0238	0.0258	0.3560	0.0828	0.0531	0.1190
Adj Coeff	-0.1919	0.0575	0.0010	-1.0186	0.1679	0.0000
Short run equation						
Ln QI	-0.0295	0.0201	0.1420	0.0040	0.0188	0.8300
Ln REV	-0.0675	0.0545	0.2150	0.1762	0.1890	0.3510
LnCO2	0.0407	0.0155	0.0090	-0.0075	0.0184	0.6820
Ln SE	0.0220	0 .0037	0.0000	0.0054	0.0083	0.5110
Ln TO	0.0110	0.0077	0.1540	0.0005	0.0255	0.9820
Constant	0.2277	0.1657	0.1690	1.0647	0.6568	0.1050
	Countries 19			Observations 380		

	(MG/PMG) = 0.47(0.99)
Hausman Test	(PMG/DFE) = 0.03 (1.0000)

Table A6: PCA values

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	5.202	4.815	0.867	0.867
Comp2	0.387	0.216	0.065	0.931
Comp3	0.171	0.066	0.029	0.960
Comp4	0.104	0.023	0.017	0.977
Comp5	0.081	0.026	0.013	0.991
Comp6	0.055	.	0.009	1.000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Unexplained
ControlofC~e	0.413	-0.146	-0.694	-0.198	-0.358	0.398	0
Government~a	0.417	-0.303	-0.144	0.102	0.838	0.012	0
PoliticalS~e	0.361	0.909	0.011	0.064	0.142	0.139	0
Regulatory~Q	0.414	-0.222	0.470	0.596	-0.283	0.350	0
RuleofLawE~T	0.427	-0.014	-0.144	0.183	-0.253	-0.836	0
VoiceandAc~a	0.414	-0.105	0.506	-0.746	-0.066	-0.018	0

Table A7: result of estimation PMG

		Dependent variable: TEC				
		Estimation technique: PMG				
Variable	**Long run equation**					
LnREV	-0.00954	0.166***	0.207***	0.0847***	-0.198***	-0.0983**
	(0.0287)	(0.0292)	(0.0386)	(0.0322)	(0.0565)	(0.0383)
LnCO2	-0.222***	-0.325***	-0.257***	-0.0760***	-0.248***	-0.204***
	(0.0232)	(0.0489)	(0.0193)	(0.0151)	(0.0351)	(0.0291)
ln_enegyss	0.00205	-0.00301***	-0.0224**	-0.00191	-0.0143**	-0.00307
	(0.00319)	(0.00107)	(0.0112)	(0.00649)	(0.00586)	(0.00330)
Ln TO	0.0653***	0.115***	0.0912***	0.0784***	0.159***	0.118***
	(0.0224)	(0.0248)	(0.0198)	(0.0135)	(0.0376)	(0.0299)
ControlofC~e	-0.240***					
	(0.0342)					
PoliticalS~e		-0.0683***				
		(0.0134)				
VoiceandAc~a			0.222***			
			(0.0503)			

RuleofLawE~T				-0.0728**		
				(0.0298)		
Government~a					-0.259***	
					(0.0595)	
Regulatory~Q						0.166***
						(0.0208)
Adjustment coefficient	-0.124***	-0.103***	-0.111***	-0.205***	-0.103***	-0.154***
	(0.0387)	(0.0369)	(0.0502)	(0.0909)	(0.0423)	(0.0439)
	Short run equation					
D.Ln REV	-0.0650	-0.0982	-0.206	-0.0253	-0.0922	-0.127
	(0.173)	(0.160)	(0.205)	(0.171)	(0.149)	(0.167)
D.LnCO2	-0.00315	-0.00505	-0.00940	-0.0162	-0.0130	-0.00110
	(0.0240)	(0.0253)	(0.0271)	(0.0224)	(0.0260)	(0.0238)
D.ln_enegyss	0.0256***	0.0251***	0.0256***	0.0253***	0.0263***	0.0253***
	(0.00663)	(0.00678)	(0.00691)	(0.00672)	(0.00678)	(0.00673)
D.Ln TO	0.0320*	0.0247	0.0199	0.0242	0.0250	0.0202
	(0.0192)	(0.0153)	(0.0166)	(0.0210)	(0.0156)	(0.0186)
D.ControlofC~e	0.00948					
	(0.0204)					
D.PoliticalS~e		-0.00388				
		(0.00667)				
D.VoiceandAc~a			0.0374			
			(0.0381)			
D.RuleofLawE~T				0.0337*		
				(0.0201)		
D.Government~a					0.0144	
					(0.0243)	
D.Regulatory~Q						-0.00442
						(0.0162)
Constant	-0.0730***	-0.204***	-0.205**	-0.205**	0.0125	0.0359**
	(0.0259)	(0.0746)	(0.0948)	(0.0904)	(0.0201)	(0.0171)
Observations	266	266	266	266	266	266

Referencces

1. Acemoglu, D., Johnson, S., & Robinson, J. A. (2012). The colonial origins of comparative development: An empirical investigation: Reply. *American Economic Review*, *102*(6), 3077–3110. https://doi.org/10.1257/aer.102.6.3077.
2. Ackah, I., & Kizys, R. (2015). Green growth in oil producing African countries: A panel data analysis of renewable energy demand. *Renewable and Sustainable Energy Reviews*, *50*, 1157–1166. https://doi.org/10.1016/j.rser.2015.05.030.
3. Afonso, T. L., Marques, A. C., & Fuinhas, J. A. (2021). Does energy efficiency and trade openness matter for energy transition? Empirical evidence for countries in the Organization for Economic Co-operation and Development. *Environment, Development and Sustainability*, *0123456789*. https://doi.org/10.1007/s10668- 021-01228-z.
4. Africa Progress Panel. (2017). Lights, Power, Action: Electrifying Africa.
5. Aguirre, M., & Ibikunle, G. (2014). Determinants of renewable energy growth: A global sample analysis. *Energy Policy*, *69*, 374–384. https://doi.org/10.1016/j.enpol.2014.02.036.
6. Apergis, N., & Payne, J. E. (2010). Coal consumption and economic growth: Evidence from a panel of OECD countries. *Energy Policy*, *38*(3), 1353–1359. https://doi.org/10.1016/j.enpol.2009.11.016.
7. Asif, M., & Muneer, T. (2007). Energy supply, its demand and security issues for developed and emerging economies. *Renewable and Sustainable Energy Reviews*, *11*(7), 1388–1413. https://doi.org/10.1016/j.rser.2005.12.004.
8. Avila, N., Carvallo, J. P., Shaw, B., & Kammen, D. M. (2017). *Le défi énergétique en Afrique subsaharienne : Guide pour les défenseurs et les décideurs Première partie : Produire l ' énergie pour un équitable*. 1–86.
9. Bölük, G., & Mert, M. (2015). The renewable energy, growth and environmental Kuznets curve in Turkey: An ARDL approach. *Renewable and Sustainable Energy Reviews*, *52*, 587–595. https://doi.org/10.1016/j.rser.2015.07.138.
10. Bourcet, C. (2020). Empirical determinants of renewable energy deployment: A systematic literature review. *Energy Economics*, *85*, 104563. https://doi.org/10.1016/j.eneco.2019.104563.
11. Cadoret, I., & Padovano, F. (2016). The political drivers of renewable energies policies. *Energy Economics*, *56*, 261–269. https://doi.org/10.1016/j.eneco.2016.03.003.

12. Canh, N. P., & Thanh, S. D. (2020). Financial development and the shadow economy: A multi-dimensional analysis. *Economic Analysis and Policy*, *67*, 37–54. https://doi.org/10.1016/j.eap.2020.05.002.
13. Da Silva, P. P., Cerqueira, P. A., & Ogbe, W. (2018). Determinants of renewable energy growth in Sub-Saharan Africa: Evidence from panel ARDL. *Energy*, *156*, 45–54. https://doi.org/10.1016/j.energy.2018.05.068.
14. Damette, O., & Marques, A. C. (2019). Renewable energy drivers: a panel cointegration approach. *Applied Economics*, *51*(26), 2793–2806. https://doi.org/10.1080/00036846.2018.1558359.
15. Danish, Zhang, B., Wang, B., & Wang, Z. (2017). Role of renewable energy and non-renewable energy consumption on EKC: Evidence from Pakistan. *Journal of Cleaner Production*, *156*, 855–864. https://doi.org/10.1016/j.jclepro.2017.03.203.
16. Fredriksson, P. G., & Svensson, J. (2003). Political instability, corruption and policy formation: The case of environmental policy. *Journal of Public Economics*, *87*(7–8), 1383–1405. https://doi.org/10.1016/S0047- 2727(02)00036-1.
17. Greco, S., Ishizaka, A., Tasiou, M., & Torrisi, G. (2019). On the Methodological Framework of Composite Indices: A Review of the Issues of Weighting, Aggregation, and Robustness. *Social Indicators Research*, *141*(1), 61–94. https://doi.org/10.1007/s11205-017-1832-9.
18. Kiviet, J. F. (1995). On bias, inconsistency, and efficiency of various estimators in dynamic panel data models. *Journal of Econometrics*, *68*(1), 53–78. https://doi.org/10.1016/0304-4076(94)01643-E.
19. Kostova, T., Roth, K., & Dacin, M. T. (2008). Institutional theory in the study of multinational corporations: A critique and new directions. *Academy of Management Review*, *33*(4), 994–1006. https://doi.org/10.5465/AMR.2008.34422026.
20. Kousky, C., Luttmer, E. F. P., & Zeckhauser, R. J. (2006). Private investment and government protection. *Journal of Risk and Uncertainty*, *33*(1–2). https://doi.org/10.1007/s11166-006-0172-y.
21. Lange, M., O'Hagan, A. M., Devoy, R. R. N., Le Tissier, M., & Cummins, V. (2018). Governance barriers to sustainable energy transitions – Assessing Ireland's capacity towards marine energy futures. *Energy Policy*, *113*(November 2017), 623–632. https://doi.org/10.1016/j.enpol.2017.11.020.
22. Marques, António C., Fuinhas, J. A., & Pires Manso, J. R. (2010). Motivations driving renewable energy in European countries: A panel data approach. *Energy Policy*, *38*(11), 6877–6885. https://doi.org/10.1016/j.enpol.2010.07.003.

23. Marques, António Cardoso, & Fuinhas, J. A. (2011). Drivers promoting renewable energy: A dynamic panel approach. *Renewable and Sustainable Energy Reviews*, *15*(3), 1601–1608. https://doi.org/10.1016/j.rser.2010.11.048 Marra, A., & Colantonio, E. (2020). The path to renewable energy consumption in the European Union through drivers and barriers: A panel vector autoregressive approach. *Socio-Economic Planning Sciences*, *July*, 100958. https://doi.org/10.1016/j.seps.2020.100958.
24. Mehrara, M., Rezaei, S., & Razi, D. H. (2015). Determinants of Renewable Energy Consumption among ECO Countries; Based on Bayesian Model Averaging and Weighted-Average Least Square. *International Letters of Social and Humanistic Sciences*, *54*(2010), 96–109. https://doi.org/10.18052/www.scipress.com/ilshs.54.96.
25. Murshed, M. (2018). Does Improvement in Trade Openness Facilitate Renewable Energy Transition? Evidence from Selected South Asian Economies. *South Asia Economic Journal*, *19*(2), 151–170. https://doi.org/10.1177/1391561418794691.
26. North, D. C. (1990). Institutions, Institutional Change and Economic Performance. In *Institutions, Institutional Change and Economic Performance*. https://doi.org/10.1017/cbo9780511808678.
27. Olanrewaju, B. T., Olubusoye, O. E., Adenikinju, A., & Akintande, O. J. (2019). A panel data analysis of renewable energy consumption in Africa. *Renewable Energy*, *140*, 668–679. https://doi.org/10.1016/j.renene.2019.02.061.
28. Oliver, C. (1991). Strategic Responses To Institutional Processes. *Academy of Management Review*, *16*(1), 145–179. https://doi.org/10.5465/amr.1991.4279002.
29. Omer, A. M. (2008). Energy, environment and sustainable development. *Renewable and Sustainable Energy Reviews*, *12*(9), 2265–2300. https://doi.org/10.1016/j.rser.2007.05.001.
30. Omri, A., & Nguyen, D. K. (2014). On the determinants of renewable energy consumption: International evidence. *Energy*, *72*, 554–560. https://doi.org/10.1016/j.energy.2014.05.081 Paper, W., Eni, F., & Mattei, E. (2004). *www.econstor.eu*.
31. Paruolo, P., Saisana, M., & Saltelli, A. (2013). Ratings and rankings: Voodoo or science? *Journal of the Royal Statistical Society. Series A: Statistics in Society*, *176*(3), 609–634. https://doi.org/10.1111/j.1467- 985X.2012.01059.x.
32. Payne, R. A. (1995). Freedom and the Environment. *Journal of Democracy*, *6*(3). https://doi.org/10.1353/jod.1995.0053.
33. Pesaran, M. H. (2015). Testing Weak Cross-Sectional Dependence in Large Panels. *Econometric Reviews*, *34*(6–10), 1089–1117. https://doi.org/10.1080/07474938.2014.956623.

34. Pfeiffer, B., & Mulder, P. (2013). Explaining the diffusion of renewable energy technology in developing countries. *Energy Economics*, *40*, 285–296. https://doi.org/10.1016/j.eneco.2013.07.005.
35. Povitkina, M. (2015). *Democracy, Bureaucratic Capacity and Environmental Quality*. *July*. https://qog.pol.gu.se/digitalAssets/1536/1536058_2015_13_povitkina.pdf.
36. Przychodzen, W., & Przychodzen, J. (2020). Determinants of renewable energy production in transition economies: A panel data approach. *Energy*, *191*. https://doi.org/10.1016/j.energy.2019.116583.
37. Pueyo, A., Orraca, P., & Godfrey-Wood, R. (2015). *What Explains the Allocation of Aid and Private Investment for Electrification? 123*. http://opendocs.ids.ac.uk/opendocs/handle/123456789/5944.
38. Ringquist, E. J. (1993). Does Regulation Matter?: Evaluating the Effects of State Air Pollution Control Programs. *The Journal of Politics*, *55*(4). https://doi.org/10.2307/2131946.
39. Roodman, D. (2009). Practitioners' corner: A note on the theme of too many instruments. *Oxford Bulletin of Economics and Statistics*, *71*(1), 135–158. https://doi.org/10.1111/j.1468-0084.2008.00542.x.
40. Rugamba, A., Urama, K. C., Growth, G., Pal, M., Nyong, A. O., Nalikka, A., Amadou, Z., Negash, E., Lonsway, K., & Jalard, M. (2016). The Bank Group's Strategy for The New Deal on Energy for Africa 2016-2025. *Engedasew Negash*, 1–58. https://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/Bank_s_strategy_for_New_Energy_on_Energy_for_Africa_EN.pdf.
41. Scott, W. R. (1987). The Adolescence of Institutional Theory. *Administrative Science Quarterly*, *32*(4), 493. https://doi.org/10.2307/2392880.
42. Sequeira, T. N., & Santos, M. S. (2018). Renewable energy and politics: A systematic review and new evidence. *Journal of Cleaner Production*, *192*, 553–568. https://doi.org/10.1016/j.jclepro.2018.04.190.
43. Strunz, S., Gawel, E., & Lehmann, P. (2016). The political economy of renewable energy policies in Germany and the EU. *Utilities Policy*, *42*, 33–41. https://doi.org/10.1016/j.jup.2016.04.005.
44. US Energy Information Administration (EIA). (2017). International Energy Outlook 2017 Overview. *International Energy Outlook 2017*, *IEO2017*(2017), 143. https://www.eia.gov/outlooks/ieo/pdf/0484(2017).pdf.
45. Uzar, U. (2020). Political economy of renewable energy: Does institutional quality make a difference in renewable energy consumption? *Renewable Energy*, *155*, 591–603. https://doi.org/10.1016/j.renene.2020.03.172.

46. Valdés Lucas, J. N., Escribano Francés, G., & San Martín González, E. (2016). Energy security and renewable energy deployment in the EU: Liaisons Dangereuses or Virtuous Circle? *Renewable and Sustainable Energy Reviews*, *62*, 1032–1046. https://doi.org/10.1016/j.rser.2016.04.069.
47. Westerlund, J. (2007). Testing for error correction in panel data. *Oxford Bulletin of Economics and Statistics*, *69*(6), 709–748. https://doi.org/10.1111/j.1468-0084.2007.00477.x