

Political Orientations of Governments and Renewable Energy

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Abstract

This article empirically examines the relationship between the orientation of political powers and renewable energy in 21 developed countries from the period 1960–2018 using the panel ARDL approach. The political tendencies of the governments in developed countries are tested through three models that are created for this study. According to the first result obtained from the empirical study, a positive and statistically significant long- and short-term cointegration relationship is observed between left-leaning governments and renewable energy. It appears that it is essential to have strong environmental movements in the period of left-oriented governments in achieving this result. Second, a long- and short-term cointegration relationship is found between central governments and renewable energy. Finally, there is no statistically significant relationship between right-oriented governments and renewable energy in the short and long term.

Keywords: energy politics, renewable energy, the political orientation of governments, GDP, environmental pollution

1. Introduction

Recently, there has been a discussion on economic growth in peace with nature in the economics literature. Taking innovative measures related to the environment to ensure sustainable development encourages technological progress (Ulucak, 2020: 6). Developments in technological progress increase the use of renewable energy while reducing the use of non-renewable energy. The increase in the use of renewable energy reduces the emission of harmful gases such as CO₂ and GHG to the environment (Tawiah, Zakari, & Adedoyin, 2021). Renewable energy supports green growth and provides an important step in the realization of sustainable development.

The main factor that necessitates traditional energy sources cannot sustain economic growth additional energy sources. A necessary but not sufficient prerequisite for economic development is sustainable economic growth. Therefore, the ability to replenish energy resources emerges as an essential element for sustainable economic growth. The development of renewable energy sources is significant for sustainable economic growth and the environment. Achieving the balance between carbon emissions and economic development is one of the ways to achieve sustainable development goals (Saidi & Omri, 2020). The development of renewable energy sources plays an important role in ensuring this balance. The demand for energy resources is increasing rapidly due to the increasing population rate in the world, industrialization, and urbanization (Mohsin, Kamran, Nawaz, Hussain, & Dahri, 2020). The increasing energy demand is met from fossil energy sources since the technological infrastructure required for renewable energy sources has not yet been adequately provided in all countries. However, the high rate of toxic gas emitted by fossil energy sources creates difficulties in achieving sustainable development goals. Therefore, policies to increase the use of renewable energy to reach a cleaner environment have come to cover all countries around the world. For this reason, determining factors affecting the advancement of renewable energy sources gain importance.

There are many economic and non-economic factors affecting the development of renewable energy sources. As Geels (2002) and Geels et al. (2016) point out, renewable energy systems are socio-technical systems that change with the political framework. Bireselioglu and Karaibrahimoglu (2012) state that governments' political orientation directly impacts the use and promotion of renewable energy. Such understanding of the development of renewable energy sources, as stated by Gullberg (2011), increased environmental awareness of the media and the public, prompting political parties to include alternative energy sources such as renewable energy, without

environmental side effects in their programs. In summary, the ideological orientation of the political parties holding power emerges as an essential factor affecting the development of renewable energy resources. Therefore, this study aims to evaluate the perspectives of various political orientations on renewable energy.

In this study, the effects of the orientation of political powers, which is one of the non-economic factors, on renewable energy resources will be tested with the panel ARDL approach. Although in the literature on this subject, there are few studies such as Abban & Hasan (2021); Ahmadov & Van Der Borg (2019); Cousse (2021); Yadav, Ravindra Tripathi, & Tripathi (2022); Jahn (2021); Q.J.Wang, Feng, H.J.Wang, & Chang (2022); Chang, Wen, Zheng, Dong, & Hao (2018), one of the points that make this study unique is the application of an estimation method that takes into account cross-section dependence and second-generation unit root tests. In the first part of the study, the theoretical and empirical literature between the ideological orientations of the ruling political parties and the development of renewable energy sources is reviewed. In the second part, an empirical study that tested this relationship between the years 1960-2016 using the data of 21 developed countries is included. In the last section, the results obtained are evaluated.

2. Literature Review

Recently, when the theoretical relations between different political formations in power and the development of sustainable energy resources were reviewed in the theoretical literature, the existence of various approaches came to the fore.

Although there are many factors such as economic (Gray, Ljungwaldh, Watson, & Kok, 2018; Rentschler, 2013), environmental (Stoutenborough, Shi, & Vedlitz, 2015), and energy security (Manley, Hines, Jordan, & Stoltz, 2013; Knox-Hayes, Brown, Sovacool, & Wang, 2013; Hess & Renner, 2019) for the promotion and development of renewable energy resources, such development varies between countries. Among the reasons for this is the importance attributed to renewable energy by those in power and their political orientation. Thonig et al. (2020) talk about three ideologically based approaches to energy politics: "the government-centered, the market-centered, and the grassroots-centered." In market-oriented logic, the role of the government in renewable energy policies is limited to setting general objectives and defining the "rules of the game." According to Thonig et al. (2020), the central government controls and manages the transition to renewable energy within a specific master plan in the state-centered approach. The failures of market-based policies give governments a leading role in the use and promotion of low-carbon energy sources (Lederer, Wallbott, & Bauer, 2018; Altenburg & Pegels, 2012; Lütkenhorst, Altenburg, Pegels, & Vidican, 2014; Neumayer, 2003). On the other hand, a transition to renewable energy sources in the grassroots-centered approach is carried out by local governments. Finally, Thonig et al. (2020) argue that the transition to renewable energy sources in the grassroots-centered method will be carried out by local governments within the framework of their available resources.

In general, it can be said that right-leaning governments adopt a market-based approach, while left-wing governments adopt a state-based approach (Schaffer & Bernauer, 2014; Biresselioglu & Karaibrahimoglu, 2012; Potrafke, 2010; Thonig et al., 2020). Within the framework of this distinction that affects the renewable energy policies of the ruling governments, it is thought that the theoretical foundations of the right and left governments for the development of renewable energy sources should be laid down.

It is argued that left-oriented governments encourage the development and consumption of renewable energy resources (Benton, 1997; Neumayer, 2003; Nicolini & Tavoni, 2017). The primary basis for this argument is that left-oriented governments are more receptive to environmental demands from consumers and environmental activists (Jahn, 1998; King & Borchardt, 1994; Benton, 1997). In that sense, as stated by Hirschl (2009); Panwar, Kaushik and Kothari (2011); Verbruggen et al. (2010), renewable energy is seen as an energy source that can cause fewer environmental problems. Besides, the interventionist nature of left-oriented governments emerges as an essential element in promoting renewable energy (Biresselioglu & Karaibrahimoglu, 2012). Fankhauser, Gennaioli and Collins (2015) claim that left-leaning governments with an interventionist nature can see low-carbon energy investments as a fiscal incentive.

Right-oriented political governments do not fully oppose the development of renewable energy sources. However, they seem to focus on energy policies that do not reduce dependence on fossil fuels by highlighting employment and security concerns, but rather support the transition to cleaner fossil fuels (Hess & Renner, 2019). This perspective may be because people do not want to pay more for renewable energy. According to Fobissie (2019), the fact that people do not want to pay extra for renewable energy stems from a political perspective rather than socio-economic conditions.

The transition to low-carbon energy and climate change has come to the fore among policymakers in the national and international arena, especially after the Paris Climate Agreement was signed in 2015 (Ćetković & Hagemann,

2020). Due to the increase in the world population and therefore energy is a resource that can be used in every field, the continuous increase in energy demand has further increased the importance of renewable energy sources. At the same time, continuous fluctuations in oil prices, the environmental damage caused by fossil energy sources, climate change caused by global warming and environmental degradation have also led to an increase in the demand for renewable energy (Yildiz, Arslan, & Sağlam Çeliköz, 2022). To create a sustainable environment, policy recommendations to limit and phase out polluting fossil fuel-based industries have become more important, as well as reliable and sustainable decarbonization efforts, and policy measures to support the developing low-carbon sectors and technologies (Ćetković & Hagemann, 2020). The transition from fossil fuels to renewable energy has been among the most important issues of all countries, from the UN Environment Conference in Stockholm in 1972 to the Paris Climate Agreement signed in 2015, to achieve a sustainable environment in the national and international arena.

The green party, which started to prevail in the EU parliament in the 1960s, aimed to create a productive activity structure as a legislative/parliamentary activity targeting environmental regulatory policies (Mourao, 2019). For this purpose, they have made a significant contribution to increasing the activities aimed at reducing environmental polluting gases. At the same time, as a result of increasing political polarization and the increasing importance of populist radical right parties in the European parliament, negative views on the transition to low-carbon energy and climate change emerge (Huber, Maltby, Szulecki, & Cetkovic, 2021). It can be thought that the fact that populist views do not show a homogeneous feature in EU policy prevents the efforts to increase the use of renewable energy from progressing sufficiently. This may cause insufficient results from energy and climate policies to create a sustainable environment. While right-wing parties generally focus on reducing budget deficits, inflation, and economic growth in the parliaments of the world countries, including EU countries; Left-wing parties mostly focus on unemployment rates and income inequality (Anzia & Moe, 2016). The advantages of renewable energy sources over fossil energy sources are too great to be ignored, as they have a low environmental impact, create new employment areas and thus stimulate economic growth. However, despite the increase in the share of renewable energy sources in the world, the weight of the use of fossil energy sources continues. The reason for this is that the technological structure required for the use of renewable energy sources is costly. For this reason, there are different views on the development of renewable energy, both among countries and among political groups in these countries.

Populist polarization in Europe spans from the far left to the far right. Right-wing parties (conservative) in Europe are against the new environmental regulations because they pose a threat to the free market economy, weaken democracy because the public's opinion is not taken into account, and weaken the interest groups of the country (Şahin, 2020). Left-wing populist parties are in favor of international climate agreements and support policies to increase the use of renewable energy (Huber et al., 2021). Especially in recent years, environmental destruction, toxic gases emitted from fossil energy sources, destabilization of the ecosystem due to climate change as a result of damage to the ozone layer, and the decrease in biodiversity and economic, social, and environmental damage to community life, renewable energy sources have become more popular in the left-wing political circle. brought about. Right-wing populist parties, on the other hand, mainly support low-carbon energy production as a way to increase economic growth and energy security, while opposing it because they see coercive measures such as environmental taxes as an unnecessary burden on the economy and people (Lockwood, 2018). The views of right-wing populist parties, mostly towards economic growth, may be effective in the lack of support for the studies on renewable energy production. In addition, these attitudes of right-wing populist parties do not show a positive view in the formation of a policy in line with international studies and agreements signed to create a sustainable environment that affects all countries of the world. Although there are different opinions among political groups on the development of renewable energy resources, an incentive policy that can be implemented as a result of the full combination of policies can contribute to the development of renewable energy resources (Bayülgen & Ladewig, 2017). In the development of renewable energy sources; In addition to factors such as the geographical structure of the country, climate, and political environment, the political structure of the country is also effective. Although opinions on the use of renewable energy differ between political views, an increasing number of incentive policies are implemented in EU countries for the development of these energy sources.

Empirical studies confirm the relationship between less pollution and the power of traditional left parties (Neumayer, 2003). King and Borchardt (1994) found a relationship between left-oriented governments and less pollution in seventeen OECD countries. In the study conducted by Scruggs (1999) for OECD countries, a statistically significant and positive relationship was found between good environmental performance and left governments. Historically, we can witness the efforts of the left governments to reduce environmental pollution.

For example, as Gallagher (2013) points out, at the end of the 1990s, the Social Democrat (SPD) and Green Party coalition in Germany implemented various policies to reduce carbon emissions and increase renewable energy sources. Jacobsson and Lauber (2006) obtained results that empirically confirm the efforts of the Green Party and Social Democrats to support renewable energy in Germany. Biresselioğlu and Karabrahimoğlu (2012) provided important evidence in their study that left-wing forces support renewable energy. The study concluded that while left-oriented and center-oriented governments in Europe support the development and consumption of renewable energy resources instead of fossil fuels, right-oriented governments have a negative impact.

Abban and Hasan (2021) examined the 2007 and 2017 periods of 60 developed and developing countries. According to the GMM analysis, left and center-oriented ruling parties support renewable energy investments. These results are valid for both developed and developing countries. Therefore, while the left-wing or center-oriented parties of the government support the use of renewable energy, right-wing parties do not support the use of renewable energy. According to the results of the OLS regression analysis for EU countries covering the 1997-2015 period in the study of Ahmadov & Van Der Borg (2019), it is concluded that left and center-oriented parties do not support renewable energy production. According to the results of the multiple regression analysis based on the 2019 period by Cousse (2021), political orientations, mostly right-wingers, hurt the development of renewable energy technologies in Switzerland. The Average Treatment Effects (ATE) model was used in the study of Czyzewski, Polcyn, & Brellik (2022) for Poland. According to the findings obtained as a result of the analysis, according to Yadav et al. (2022), the right-wing party representing liberals and conservatives appears to have a positive effect on environmental quality. According to Mourao (2019), in the study of 36 countries using the GMM analysis and the period 1980-2014, it is revealed that the Green Party is effective in reducing environmental polluting gases such as carbon dioxide emissions and greenhouse gases. Therefore, it can be said that the green party supports the use of renewable energy in the 36 countries discussed. According to the results of the regression analysis conducted by Jahn (2021) for 28 EU countries covering the period, 1990-2018, right-wing and left-wing populist parties have different effects in various parts of Europe. While right-wing populist parties have an increasing effect on greenhouse gas emissions in North West and Eastern Europe, left-wing populist parties have a decreasing effect on greenhouse gas emissions in Southern Europe. Right-wing and centrist populist parties support the use of fossil fuels. Wang et al. (2022), carried out the GMM analysis by considering the 1990-2016 period of 98 countries. According to the study, it is revealed that CO₂ emissions are reduced in countries where the left view is dominant in power, and greenhouse gas emissions increase more in countries where the right view is dominant in power. As a result, it can be said that left-wing parties support the development of renewable energy sources and right-wing parties support the use of energy sources that increase greenhouse gas emissions. According to the group-mean dynamic common correlated estimator (DCCE) study conducted by Chang et al. (2018) using the period 1990-2014 in 31 OECD countries, left-wing parties reduce their energy intensity. Reducing energy intensity reduces the effects of climate change. Therefore, the polluting effect of toxic gases such as carbon dioxide emissions and greenhouse gases also decreases. In the study of Dalton (2015), OLS regression analysis was performed by taking the data of eight industrialized countries from 1993 to 2010. According to the results of the analysis, while the role of right-wing parties in environmental regulatory activities decreased in this period, those of left-wing parties increased. Left-wing parties support environmental regulation and activities to reduce fossil energy use. Nicolli and Vona (2019) support the policies (such as incentive tariffs, tax measures, and investment incentives) implemented by the green party for the development of renewable energy, according to the results of the regression analysis made using the data of 28 OECD countries for the period 1979-2007. In this way, they make a positive contribution to increasing the use of renewable energy.

When the theoretical and empirical literature is evaluated in general, it is possible to summarize the main elements that come to the fore. One of the reasons why different political parties in power have different approaches to renewable energy policies is the attitude of their voters to renewable energy. According to Karlstrøm and Ryghaug (2014), it can be said that while right-oriented governments try to win their voters through economic growth, development, etc., they do not prioritize the environmental issue. However, it can be argued that right-oriented governments do not entirely disregard renewable energy for sustainable growth and their development goals that do not destroy nature and resources.

On the other hand, it is seen that left-oriented governments are more receptive to the demands of both voters and environmental movements than other political orientations. This distinction in attitude leads left-leaning governments to encourage the use and development of renewable energy more often than their right-leaning counterparts.

3. Methodology and Data

In this study, which examines the relationship between various political orientations and renewable energy, the existence of a cointegration relationship in the short and long term was tested using the pooled-mean group (PMG) and mean group (MG) estimators developed by Pesaran & Smith (1995) and Pesaran, Shin, & Smith, (1999). The MG estimator derives its long-term parameters from the average of individual parameters. However, this estimator does not consider that certain parameters may be the same across groups. The PMG estimator allows the constant error variances and short-term parameters to change while restricting the long-term parameters to remain the same across groups (Pesaran et al., 1999). Therefore, which of the two estimators gave effective results was determined by the Hausman test.

3.1 Description of Data Sets

In this study, 21 countries were included in the analysis based on data availability for the years 1960-2018. The data showing the political orientation (government composition) of governments in power and real GDP are taken from the comparative political data set. This dataset includes data from OECD and European Union countries. This data is based on calculations of Schmidt & Bayer (1992) until 1991. whereas, renewable energy data is taken from OECD. Left party data is used to represent social democrats and political parties to the left of social democratic parties. The concept of a right-wing party has been used to express liberals and conservatives. Finally, center parties are used to describe the Christian democratic or Catholic parties. Renewable energy data is taken as the share of renewable energy in the primary energy supply.

Table 1. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
energy	1,228	14.73307	17.26265	0	89.75
gov_right	1,233	41.04794	38.85865	0	100
gov_cent	1,233	25.44775	30.71808	0	100
gov_left	1,233	31.40299	36.1361	0	100
realgdpgr	1,218	2.991364	2.820945	-9.13249	25.12017

3.2 Cross-Sectional Dependency

Before looking at the relationship between the political orientation of governments and renewable energy, it is necessary to determine the degree of integration by performing unit root tests of the variables. First-generation unit root tests do not consider cross-sectional dependency (Im, Pesaran, & Shin, 2003; Maddala & Wu, 1999; Hadri, 2000; Levin, Lin, & Chu, 2002).

In the words of Pesaran (2007), they are tests that assume that individual time series in the panel are distributed independently in cross-sectional terms. Therefore, second-generation unit root tests that take into account the cross-sectional dependency should be applied.

The cross-sectional dependency test is first based on the Breusch and Pagan (1980) LM test. Breusch and Pagan's (1980) LM test is a test that can be used when the cross-section units (N) are large and the period (T) is small. LM statistics used in determining cross-section dependency are as follows.

$$LM = T \sum_{i=j}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij}^2 \sim X_{N(N-1)/2}^2 \tag{1}$$

In equation (1), ρ_{ij} shows the correlation coefficients obtained from the error terms of the model. The asymptotic distribution of χ^2 is obtained from N for all (i, j) while $T_{(i,j)} \rightarrow \infty$.

Pesaran (2004) developed the Breusch and Pagan test and suggested the CDLM test, which can be applied in cases where both the cross-section (N) and the analysis period (T) are prominent.

$$CD_{LM} = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^N (T \hat{\rho}_{ij}^2 - 1) \tag{2}$$

In the CDLM test developed by Pesaran (2004), distortions occur when the cross-section (N) is larger than the period (T) (Pesaran, 2021). For this reason, Pesaran (2004) claims that a new cross-section dependency test is needed when N is significant and T is small, showing small sample properties. Pesaran (2004) tests cross-sectional dependency as follows.

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left\{ \sum_{i=1}^{N-1} \sum_{j=i+1}^N \rho_{ij} \right\} \tag{3}$$

CD statistics, unlike LM statistics, for various panel data models (heterogeneous, homogeneous, non-stationary), N and T values are zero. Pesaran and Yamagata (2008) developed the LMadj (Bias-Adjusted Cross-Sectional Dependency Lagrange Multiplier) test based on the Breusch and Pagan (1980) LM test.

$$LM_{adj} = \sqrt{\frac{2}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^N (T\hat{\rho}_{ij}^2 \frac{(T-k)\hat{\rho}_{ij}^2 - \mu_{Tij}}{\vartheta_{Tij}}) \tag{4}$$

While k shows the regressor's number, μ_{Tij} shows the average, and ϑ_{Tij} represents the variance. When the probability value obtained as a result of the test is less than 0.05, the presence of cross-section dependence is accepted.

3.3 Homogeneity Test

The homogeneity tests of the slope coefficients were tested using the delta test developed by Pesaran and Yamagata (2008). Pesaran and Yamagata's (2008) test is an improved form of Swamy's (1970) homogeneity test. Pesaran and Yamagata's (2008) homogeneity test is formulated as follows.

$$\tilde{N} = \sqrt{N} \left(\frac{N^{-1} \bar{s} - k}{\sqrt{2k}} \right) \tag{5}$$

$$\tilde{N}_{adj} = \sqrt{N} \left(\frac{N^{-1} \bar{s} - E(Z_{iT})}{\sqrt{Var(Z_{iT})}} \right) \tag{6}$$

The cross-section dependency results obtained for the variables and the three models are presented in Table 2. Table 2 also includes the delta and adjusted delta, showing the slope homogeneity test results.

Table 2. Cross-Sectional Dependency Test

Variables and Models	Breusch& Pagan (1980) LM Test	Pesaran (2004) CDLM Test	Pesaran et al. (2008) LMadj	Result Cross-Sectional Dependency
renergy	30000 (0.001)	172.7 (0.001)	1214 (0.001)	accepted
reelgdpgr	3528 (0.001)	14.84 (0.001)	73.07 (0.001)	accepted
gov_right1	5546 (0.001)	50.23 (0.001)	159.8 (0.001)	accepted
gov_cent1	8142 (0.001)	76.82 (0.001)	271.3 (0.001)	accepted
gov_left1	4615 (0.001)	43.53 (0.001)	119.8 (0.001)	accepted
Model 1	23000 (0.001)	148.8 (0.001)	816.8 (0.001)	accepted
Model 2	23000 (0.001)	149.1 (0.001)	816.1 (0.001)	accepted
Model 3	21000 (0.001)	142.1 (0.001)	-751.2 (0.001)	accepted
	Model 1	Model 2	Model 3	
\tilde{N}	3.015 (0.001)	3.696 (0.001)	2.0150 (0.048)	
\tilde{N}_{adj}	4.099 (0.001)	3.995 (0.001)	2.022 (0.043)	

The values in parentheses show the probability value (*p-value*).

Cross-section dependency results are presented in Table 2. As a result of the tests, cross-section dependency was determined in variables and models. For this reason, the second generation unit root test, which takes into account the cross-sectional dependence, was used.

3.4 Panel Unit Root Test

As mentioned before, cross-section dependency in variables and predicted models necessitates the application of second-generation unit root tests. One of the second-generation unit root tests is the Cross-sectional augmented Dickey-Fuller (CADF) test developed by Pesaran (2007). Pesaran's (2007) CADF test is a test that can be applied when the time dimension (T) is larger or smaller than the cross-section dimension (N). Pesaran's (2007) CADF test used in the study is as follows.

$$\Delta y_{it} = a_i + b_i y_{i,t-1} + c_i \bar{y}_{t-1} + d_i \Delta \bar{y}_t + e_{it} \tag{7}$$

CADF test statistics are calculated as follows.

$$t_i(N, T) = \frac{\Delta Y_i' \bar{M}_W Y_{i,-1}}{\hat{\sigma}_i (Y_{i,-1}' \bar{M}_W Y_{i,-1})^{\frac{1}{2}}} \tag{8}$$

On the other hand, it is calculated by taking the average of t statistics values for the cross-section; the panel CIPS test statistic equation is given below.

$$CIPS(N, T) = N^{-1} \sum_{i=1}^N t_i(N, T) \quad (9)$$

A stability test was performed by comparing the CIPS statistics calculated for 21 developed countries in the study with Pesaran's (2007) critical table values. The results obtained are presented in Table 3.

Table 3. CADF Panel Unit Root Test Results

Variables	CIPS STATISTICS		
	Test Statistics	P-value	Result
rnenergy	-1.780	0.501	I(1)
d.rnenergy	-4.380***	0.001	I(0)
gov_right1	-2.445***	0.001	I(0)
gov_cent1	-2.982***	0.001	I(0)
gov_left1	-2.907***	0.001	I(0)
reelgdpgr	-3.052***	0.001	I(0)

*** indicate significance at the 1% level

The CIPS statistics obtained from the CADF unit root test is a statistic calculated for the entire panel. Pesaran's (2007) CADF unit root test results show that all variables except renewable energy (rnenergy) are stationary at a level. When the difference in the renewable energy (rnenergy) variable is taken, it becomes stationary.

3.5 MG and PMG Estimations

The relationship between government policy orientations and renewable energy has been tested using PMG (pooled-mean group) and MG (mean group) estimators. MG and PMG are non-stationary dynamic panel estimators where intergroup parameters are heterogeneous. In this framework, three models created to investigate the long-term relationship are as follows.

$$\text{Model I: } rnenergy_{it} = \alpha_0 + \alpha_{1i}gov_right_{it} + \alpha_{2i}reelgdp_{it} + \epsilon_{it} \quad (10)$$

$$\text{Model II: } rnenergy_{it} = \alpha_0 + \alpha_{1i}gov_cent_{it} + \alpha_{2i}reelgdp_{it} + \epsilon_{it} \quad (11)$$

$$\text{Model III: } rnenergy_{it} = \alpha_0 + \alpha_{1i}gov_left_{it} + \alpha_{2i}reelgdp_{it} + \epsilon_{it} \quad (12)$$

Among the variables included in the models, gov_right indicates right-handed governments, gov_center central governments, realgdp equals real GDP and ϵ_{it} denotes the error term. In the first model, the cointegration relationship between right-oriented governments and renewable energy is examined. This model includes renewable energy (rnenergy), right-oriented governments (gov_right), and real GDP (realgdp) variables. In the second model, the cointegration relationship between central governments and renewable energy is investigated. The variable gov_cent in this model represents central governments. In the last model, the relationship between left-oriented governments and renewable energy is tested. The gov_left variable in the model represents left-oriented governments. For each model, PMG and mg were estimated, and the effective predictor was determined by the Hausman test. The long and short-term coefficients obtained from the estimation of the models are presented in table 4.

As seen in Table 4, according to Hausman test results, MG in the first model, PMG in the second model, and MG in the final model give effective results. Within the framework of the Hausman test, it was determined that the MG estimator gave more effective results for the first model. The Hausman p-value obtained in the first model is lower than 0.05, indicating that the MG estimator gives more effective results. In the results obtained from the first model in which the cointegration relationship between right-oriented governments and renewable energy was tested, a positive but not statistically significant coefficient was found in the long run. In other words, it can be said that there is no long-term cointegration relationship between right-oriented governments and renewable energy. On the other hand, the error correction term estimated for the first model is negative and statistically significant, which means that the error correction mechanism is working. Besides, when a deviation from the long-term balance occurs, it will come to balance again.

When the findings obtained from the estimation of the second model are evaluated, it is determined that there is a long-term and statistically significant relationship between central governments and renewable energy. The probability value of the Hausman test is more important than 0.05, indicating that the PMG estimator is effective. According to PMG estimation results, there is a long and short-term cointegration relationship between renewable energy and central governments. The long and short-term coefficients obtained in the model are

-0.2454312 and -0.1659659, respectively.

In the last model in which the relationship between left-oriented governments and renewable energy is tested, there is a cointegration relationship in the long and short term.

Hausman's test shows that the MG estimator is valid. It is seen in the model that the long-term cointegration coefficient is 0.1478609, and it is statistically significant at a one percent significance level. In addition, the short-term coefficient is also positive and statistically significant.

The results show that political orientations in EU countries have a direct effect on the use of renewable energy. In EU countries, central governments' investments in renewable energy are low and these governments are more supportive of fossil energy resource use. Left-oriented governments in EU countries consider natural resource use and social welfare more than central governments' right-oriented governments (Bireselioglu & Karabrahim, 2012). The fact that people live in a cleaner environment has an impact on their social and cultural lifestyle. For this reason, regulations made to prevent environmental pollution have a positive effect on social welfare. Accordingly, left-oriented support supports the use of renewable energy, which is both a natural resource and less harmful to the environment.

Table 4. MG and PMG Estimations Results

Dependent Variable:	MODEL I		MODEL II		MODEL III	
	MG	PMG	MG	PMG	MG	PMG
Long-run coefficients						
ReelGDP	0.437 (0.590)	-0.802 (0.355)	0.351 (0.604)	-0.593 (0.331)	0.818 (0.516)	-0.377046 (0.3109586)
Gov_right	0.002 (0.227)	-0.013 (0.208)				
Gov_centre			-0.221 (0.027)***	-0.245 (0.251)***		
Gov_left					0.147 (0.024)***	0.2158078 (0.0185453)***
Short-run coefficients						
ReelGDP	0.460 (0.460)	1.149 (0.246)***	0.655 (0.381)	1.056 (0.253)***	0.406 (0.381)	1.025539 (0.2515729)***
Gov_right	-0.020 (0.141)	-0.013 (0.007)				
Gov_centre			0.173 (0.014)***	-0.165 (0.008)***		
Gov_left					0.078 (0.015)***	0.1022176 (0.100543)***
Statistics						
Hausman test (p-value)	8.34 (0.015)		5.27 (0.071)		19.87 (0.0001)	
Number of observations	1128		1128		1128	

The values in parentheses show the probability value (*p-value*). *** indicate significance at the 1% level

4. Results

The use of renewable energy is an important factor in realizing sustainable development by reducing the spread of toxic gases that occur in nature to the environment. For this reason, the development of renewable energy sources is an important element for sustainable growth and the environment, which has been one of the important agenda topics for the continuation of social life in recent years.

The increase in energy demand due to the continuous increase in the world population and urbanization rate, the fluctuations in oil prices, and the negative effects of climate change and environmental pollution due to the toxic gases emitted by fossil energy sources to the environment, the importance of renewable energy sources gradually increases. In this context, the transition plan from fossil fuels to renewable energy has become the common goal of all countries from the 1972 UN Environment Conference to the 2015 Paris Climate Agreement and has become one of the most important agenda items among policymakers. However, there are different opinions in the political environment regarding the decisions taken and the policies implemented to increase the use of renewable energy resources. In the political environment, right-wing governments generally support the use of cleaner fossil energy that does not reduce dependence on fossil fuels, taking into account more macroeconomic factors such as budget deficits, inflation, and economic growth. Although these attitudes of right-wing political

parties do not completely oppose the transition to renewable energy, they may cause insufficient results from energy and climate policies to create a sustainable environment. Left-wing governments, on the other hand, have a more positive view of the transition to renewable energy, as they are more sensitive to environmental demands from consumers and environmental activists and that renewable energy causes less environmental damage. Therefore, transition policies to renewable energy can create differences in the political environment according to the government's perspectives on economic and social life.

In the econometric analysis part of the study, Panel ARDL analysis was used to examine the cointegration relationship between political orientations and renewable energy. The first of the findings is that there is no cointegration relationship between right-oriented governments and renewable energy in the short and long term. There may be two reasons for these results. First of all, it may arise from the fact that the business world, which is the financier of right-oriented political powers, sees renewable energy as a factor that increases costs. Renewable energy is a sector that requires long-term investments. In addition, while profit maximization is the main goal for corporations, the goal of governments is to increase social welfare. This can lead to a conflict between corporations' goals and government policies. For this reason, right-oriented governments may take a hesitant stance in implementing long-term renewable energy policies that prioritize social welfare.

The second finding shows the long and short-term cointegration relationship between centrist governments and renewable energy. However, the long-term and short-term cointegration coefficient is negative. The term error correction is negative and statistically significant.

The main finding obtained from the last model is that there is a positive and statistically significant cointegration relationship between left-oriented governments and renewable energy in the long and short run. This result is parallel with empirical studies that apply different statistical methods (Biresselioglu & Karaibrahimoglu, 2012; Neumayer, 2003). This study is unique because it considers the cross-sectional dependency, and the second-generation unit root tests are applied. One reason for the long- and short-term relationship between left-oriented governments and renewable energy is thought to be the strengthening of environmental movements under left-oriented governments. Second, left-leaning governments are open to demands from the electoral base for economic growth and development that are environmentally friendly.

In summary, although there are many factors affecting the consumption and development of renewable energy, the political orientations in power have different perspectives on the subject for various reasons, which is an element that affects renewable energy.

Russia's intervention in Ukraine due to the current Russia-Ukraine war has caused an energy crisis in Europe. Here, we can say that renewable energy investments will reduce Europe's energy dependency. Therefore, it is extremely important for Europe's energy security that all political orientations focus on policies that support renewable energy. Ensuring energy security in Europe can take an important toward achieving sustainable and environmentally friendly development.

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