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Environmental Sustainability in Developing Countries: Does Democracy Matter?

Zrównoważoność środowiskowa w krajach rozwijających się: czy demokracja ma znaczenie?

Neslihan Ursavaş*, Şükrü Apaydın**

** Zonguldak Bülent Ecevit University, Faculty of Economics and Administrative Sciences, Zonguldak, Turkey/ University of Liverpool, Geographic Data Science Lab, Liverpool, UK*
E-mail (Corresponding Author): karakoc.neslihan@gmail.com,
ORCID: 0000-0001-9922-9662
*** Nevşehir Hacı Bektaş Veli University, Faculty of Economics and Administrative Sciences Nevşehir, Turkey*
E-mail: sukruapaydin@nevsehir.edu.tr, ORCID: 0000-0003-4640-8135E

Abstract
One of the sustainable development goals is to reduce environmental degradation and promote a sustainable environment. One of the significant factors in promoting a sustainable environment is the level of democracy in a country. This study investigates the impact of democracy on the ecological footprint (EF) per capita in 68 developing countries from 1990 to 2018. To do so, we use the Feasible Generalized Least Squares (FGLS) and Panel Corrected Standard Errors (PCSE) estimators. The empirical findings show that there is a positive relationship between democracy and EF. In other words, an increase in democracy increases environmental degradation in developing countries. Besides, the findings also show that while an increase in GDP per capita increases EF, an increase in renewable energy consumption reduces EF. Overall, our findings show that democracy matters for environmental sustainability in developing countries. Therefore, governments and policymakers should consider democracy to formulate environmental policies.

Key words: sustainable development; ecological footprint; economic growth; renewable energy consumption

Streszczenie
Jednymi z celów zrównoważonego rozwoju jest ograniczenie degradacji środowiska i promowanie zrównoważonego środowiska. Jednym z istotnych czynników promujących zrównoważone środowisko jest poziom demokracji w kraju. W niniejszym badaniu zbadano wpływ demokracji na ślad ekologiczny (EF) na mieszkańca w 68 krajach rozwijających się w latach 1990-2018. W tym celu korzystamy z estymatorów wykonalnych uogólnionych najmniejszych kwadratów (FGLS) i skorygowanych błędów standardowych metodą panelową (PCSE). Wyniki empiryczne pokazują, że istnieje pozytywny związek pomiędzy demokracją a EF. Innymi słowy, wzrost demokracji zwiększa degradację środowiska w krajach rozwijających się. Poza tym ustalenia pokazują również, że podczas gdy wzrost PKB na mieszkańca zwiększa EF, wzrost zużycia energii odnawialnej zmniejsza EF. Nasze ustalenia pokazują, że demokracja ma znaczenie dla zrównoważenia środowiskowego w krajach rozwijających się. Dlatego też rządy i decydenci powinni wziąć pod uwagę demokrację przy formułowaniu polityk środowiskowych.

Słowa kluczowe: zrównoważony rozwój; ślad ekonomiczny; wzrost ekonomiczny; konsumpcja OZE

1. Introduction

The concept of sustainable development first emerged in the context of environmental concerns in the World Charter for Nature in 1982 and was detailed in Our Common Future in 1987. The concept of sustainable development produced by the Brundtland Report is defined as a development that meets the demands of the present without compromising future generations to meet their own needs. Difficulties in defining sustainability show that sustainable development is a more complex and multidimensional problem, which includes economic, social, legal, technical, environmental, and political aspects (Ciegis et al., 2009; Pawlowski, 2008, 2011). The United Nations Sustainable Development Conference was held to find solutions for environmental, economic, and political issues in 2012, and 17 significant topics were determined as SDGs which consist of numerous national and global concerns such as economics, poverty, inequality, education, institution, and environment (i.e. climate change, clean water and air, clean energy, etc.). Considering the environmental dimension of sustainable development, the SDGs emphasize that all countries in the world have suffered from climate change and focused on reducing environmental degradation and struggling with climate change. One of the most important issues in fighting environmental degradation and climate change is energy efficiency. In this context, ensuring reliable and adequate energy at affordable prices, in a secure and eco-friendly and compatible with economic, social, and environmental needs, is a significant element of sustainable development (Vera and Langlois, 2007). Thus, both the 2030 Agenda for Sustainable Development and the Paris Agreement on climate change rely heavily on energy. In this context, goal 7 of SDG, which emphasizes ensuring access to affordable, reliable, sustainable, and modern energy by 2030, is the first universal goal of energy efficiency. This goal aims to provide universal access to affordable, reliable, and modern energy services, increase the use of renewable energy, and improve global energy efficiency.

Climate change and global warming have increased in recent years, and the negative effects of global warming have caused substantial damage to the environment. The Paris Agreement provides a worldwide framework for preventing harmful climate change by reducing global warming to well below 2°C and pursuing efforts to reduce it to 1.5°C. However, according to the United Nations Environment Programme (UNEP) Report 2022, to limit global warming to 1.5°C, greenhouse gas emissions need to be reduced by 45 percent by 2030. On the other hand, global greenhouse gas (GHG) emissions have continued to increase in the last ten years, and the world average per capita GHG emissions were 6.3 tons of CO_2 equivalent in 2020. The emissions that cause climate change originate from all regions of the world and affect all nations, but some countries produce significantly more than others. The 100 countries with the lowest emissions account for 3 percent of total emissions. The 10 largest emitters contribute 68 percent. Developing countries such as Brazil, China, India, Indonesia, Russian Federation have a significant share in global GHG emission increases (UNEP, 2022). The share of CO_2 emissions is around of 63.4% of the global emissions in developing countries (IEA, 2018). These countries' growth strategies increase the use of fossil energy resources, leading to an increase in GHG emissions and accelerating environmental degradation. On the other hand, developing countries have ignored the problem of environmental degradation to reach higher economic growth, which leads to an environmental cost as pollution for countries (Usman and Jahanger, 2021). In this context, these countries need to consider both environmental quality and economic development for sustainable development.

Considering sustainable development in the context of environmental concerns, countries implement various environmental policies to reduce emissions and contribute to environmental quality. However, the effectiveness of these policies depends on several factors. One of these factors is the level of democracy in a country. In this context, it is a significant issue how democracy affects environmental degradation in developing countries. The impact of democracy on environmental quality is theoretically analyzed in the framework of democratic and autocratic regimes. Many studies reveal that there is a positive relationship between democracy and environmental quality. There are many reasons why democracy impacts environmental quality positively. First, the people's access to information in a democratic country, which enables them to be more aware of environmental issues, and the existence of institutions such as free media, helps to inform the people. Second, public participation in decision-making processes allows for communicating environmental priorities to decision-makers. Besides, citizens may protest decisions increasing environmental degradation (Kelso, 2011; Arwin and Lew, 2011). Third, democratic regimes are more sensitive to environmental issues than autocratic regimes through electoral accountability and the ability of groups to mobilize socially, achieve political representation, and influence public policymaking. Democracies hold regular and free elections, which can bring to power new parties, including those friendly to the environment (Li and Reuveny, 2006; Akalin and Erdogan, 2021). Fourth, in democratic administrations, due to accountability, policymakers may avoid decisions that cause the public's response by not passing and enforcing laws that protect the environment (Arwin and Lew, 2011). Fifth, democratic regimes are more likely to comply with environmental agreements because they respect the rule of law and human life than autocracies (Berge, 1994). In contrast, autocratic regimes are less likely to prevent environmental degradation. Reasons for this include i) the lack of accountability for leaders, ii) restrictions on free media, iii) power is concentrated in a small group who may use this power to personally advantage from activities related to environmental degradation (Olson 1993).

The other approach in the literature argues that democracy negatively affects environmental quality. According to Bernauer and Koubi (2009), as democratic countries develop and become more stable, the institutions might be more complex; at some point, the stability turns into a rigidity called institutional sclerosis. In democratic countries, there are many small special interest groups that have no incentive to make significant sacrifices in the interest of society. These groups control the legislative and administrative processes to appropriate a large amount of society's production. Consequently, when distributional coalitions such as special interest groups (labor unions or business associations) gain the upper hand, environmental policies become less important. The second argument claiming that democracy negatively affects environmental quality is political myopia. Accordingly, a selected government might have a shorter planning time, and environmental policies are long-term policies. However, the democratically elected might choose to increase economic growth and welfare instead of the environmental quality and save votes to come to power for one more period (Akalin and Erdogan, 2021). Consequently, the social costs of existing economic and political decisions occur over the long run and impose on future generations. Thus, democracies might be less willing to implement environmental policies due to the fear of punishment by myopic voters.

Therefore, one can say that there is no consensus on how the level of democracy affects environmental degradation. Based on the theoretical discussion above, this study investigates the impact of democracy on environmental degradation. This study contributes to the existing literature in three folds: i) former studies use the democratic accountability index and political rights and civil liberties as an indicator of democracy. However, unlike the existing literature, we use the participatory democracy index as a measurement of democracy. Participatory democracy emphasizes the levels of rights of citizens to express their views and participate directly in discussions on social, economic, political, and primarily environmental problems that impact their lives. Thus, we can say that participatory democracy is an extremely important factor in terms of a sustainable environment. ii) numerous studies use CO_2 emissions as a proxy for environmental degradation. However, we use the ecological footprint (EF) developed by Wackernagel and Rees (1996) as an environmental degradation indicator. The EF allows for tracking aggregate human pressure on the biosphere's capacity (Wackernagel et al., 2004). Since the EF consists of six components (the footprints of fishing ground, carbon, forest land, cropland, grazing land, and built-up), it is a more comprehensive indicator than the other environmental indicators such as carbon dioxide emissions, air pollution, sulfur dioxide, etc. iii) this study is one of the few studies examining the link between democracy-environmental degradation for developing countries. iv) developing countries have a significant share in global carbon emissions. Thus, environmental policies implemented by these countries are very important for global environmental degradation.

In the next part of the study, we summarize the empirical literature on the relationship between democracy and environmental degradation. Section three presents data and econometric methodology. Section four provides the empirical results. Section five presents discussions, and finally, section six concludes the paper.

2. Literature Review

There are numerous studies examining the determinants of environmental degradation in the literature. Many of the studies such as Jalil and Mahmud (2009), Ozturk and Acaravcı (2013), Destek and Ozsoy (2015), Dogan and Turkekul (2016), Shahbaz et al. (2017), Zhang et al. (2017), Cetin et al. (2018), Pata (2019), Hassan et al. (2019), Ahmed et al. (2020), Sharif et al. (2020), Ling et al. (2021), Cakmak and Acar (2022) focus on the relationship between environmental degradation and economic indicators such as trade openness, economic growth, globalization, renewable energy consumption, financial development regarding the EKC hypothesis. The findings of these studies differ. Some studies show that there is a positive relationship between environmental indicators and economic variables, while other studies have opposite results.

Although the researchers focus on the determination of environmental degradation, the relationship between democracy and environmental degradation does not investigate widely. Different from existing literature, some studies analyze the impact of political indicators such as democracy on environmental degradation. The first group of studies focuses on the relationship between democracy and environmental policies. For instance, Congleton (1992), one of the pioneer studies, investigate the impact of political institutions on environmental policies under authoritarian and democratic regimes across 118 countries using the OLS methodology. The results show that democratic countries are more willing to develop and implement environmental policies than autocratic regimes. However, the findings support the view that political institutions impact on local and international environmental policies. Similarly, Fredriksson et al. (2005) follow different estimation methods by considering the years 1993, 1996, and 2000 across 94 countries to investigate the relationship between democracy and environmental policies. The results show that an increase in political competition leads to stricter environmental policies, while there is no relationship between political participation and environmental degradation. Pellegrini and Gerlagh (2006) test the relationship between democracy and environmental protection stringency among 44 countries over 1980-1985 using the OLS method. Findings imply that there is no relationship between democracy and environmental protection stringency. Scruggs (2009) shows that a positive democratic impact on the environment is accounted for more by economic change, not political liberalization across European and old Soviet countries for the period of

1972-2000. Romuald (2011) investigates the impact of democratic institutions on ~~the~~ environmental quality across 122 developed and developing countries over 1960-2008 using the GMM method. The results show that democratic institutions have a positive effect on environmental quality. However, the positive impact of democratic institutions on environmental quality is higher in developed countries than in developing countries. The democratic process in the first group increased their awareness of environmental protection.

The second group focuses on the relationship between democracy and environmental degradation. Some of these studies have results that democracy increases environmental degradation, whereas other studies show that an increase in the level of democracy increases environmental degradation. For instance, Midlarsky (1998) and Ward (2006) test the relationship between democracy and the environment using six measures of environmental degradation such as deforestation, air quality (CO_2 emissions), soil erosion by water, protected land area, freshwater availability, and soil erosion by chemicals. The study reports different findings. A rise in the level of democracy increases CO_2 emissions across 98 countries in 1990, increases soil erosion by water across 97 countries for the 1980s, and increases deforestation among 77 countries for the period of 1981-1990. Arwin and Lew (2011) test the impact of democracy on the various environmental indicators over 1976-2003 across developing countries using the OLS method. The findings indicate that democracy increases deforestation damage. Gani and Scrimgeour (2014) test voice accountability and water pollution across 21 OECD countries over 1998-2005 using the GMM method. The results show that voice accountability impacts water pollution positively. Charfeddine and Mrabet (2017) test the relationship between democracy and EF among 15 MENA and Middle East countries for the period of 1975-2007 using DOLS and FMOLS methods. The findings show that democracy increases the EF. Lv (2017) concludes that democracy increases carbon emissions across 19 emerging market economies over 1997-2010 using the OLS method. Akalın and Erdogan (2021) test the democracy and EF nexus across 26 OECD countries from 1990 to 2015 using the AMG method. According to the results, democracy increases the EF. Ursavas (2021) tests the relationship between democracy and the EF in Turkey for the period of 1980-2017. The findings of the ARDL method reveal that an increase in the level of democracy increases the EF. Similarly, Ursavas (2022) concludes that democracy increases greenhouse gas emissions in OECD countries over 1995-2018 using the CCEMG estimator.

Other studies in the literature investigate that democracy reduces environmental degradation. For instance, Torras and Boyce (1998) use the SO_2 emissions, smoke and particulate emissions, and water pollution as a proxy for air pollution to test democracy – environmental degradation nexus. The results indicate that democracy negatively impacts air pollution across 42 countries over 1977-1991. Therefore, a rise in the level of democracy decreases the water pollution among 58 counties. Bernauer and Kaubi (2004, 2009) test the democracy- air quality across 107 cities in 47 countries over 1971 to 1996 using the GLS regression approach. The results reveal that democracy decreases air pollution. Binder and Neumayer (2005) conclude that democracy affects low air pollution across 17 countries. Similarly, Winslow (2005) shows that democracy reduces air pollution in the USA and China. Farzin and Bond (2006) test the democracy and carbon dioxide emissions relationship in a set of countries over 1980-1996 using the FE method. The results show that democracy reduces CO_2 emissions. Li and Reuveny (2006) test the relationship between democracy and environmental degradation across 143 countries over 1961-1997. The results show that an increase in democracy decreases CO_2 emissions per capita decreases water pollution, deforestation, and nitrogen dioxide (NO_2) emissions. Buitenzorgy and Mol (2011) test the relationship between deforestation and democracy for 1990-2000 across 177 countries using the OLS approach. The findings reveal that an increase in democracy decreases deforestation. Similarly, Brenna (2015) shows that democracy decreases carbon emissions across 184 countries using the OLS method. You et al. (2015) analyze the relationship between democracy and CO_2 emissions across 97 countries over 1985-2005 using the OLS methodology. The findings indicate that democracy is related to CO_2 emissions positively for the least emissions countries, whereas the relationship is negative for the most CO_2 emissions countries. Adams et al. (2016) conclude that democracy decreases carbon dioxide emissions in Ghana over 1965-2011 using the Phillips-Hansen methodology. Adams and Klobodu (2017) conclude that an increase in the level of democracy decreases the carbon emissions across 38 African countries from 1971 to 2011 using the dynamic OLS method. Farzanegan and Markwardt (2018) conclude that democracy decreases environmental degradation among 17 Middle East and MENA countries over 1980-2005. Hotunluoğlu and Yılmaz (2018) conclude that an increase in democracy reduces carbon emissions in Turkey over 1970-2011. Adams and Acheampong (2019) analyze the link between democracy and carbon dioxide emissions for 46 sub-Saharan African countries over 1980-2015. The results show that democracy encourages the reduction of carbon dioxide emissions. Similarly, Adams and Nsiah (2019) conclude that democratic countries tend to decrease ~~the~~ environmental degradation in 28 sub-Saharan African countries over 1980-2014 using FMOLS and GMM methods. Kim et al. (2019) investigate that democracy reduces environmental degradation for 132 countries over 2014-2016 using the RE method. Chou et al. (2020) test the link between democracy and CO_2 emissions for 26 countries in America over 1992-2013 using a quantile regression method. The findings show that democracy decreases environmental degradation. Yasin et al. (2020) analyze the relationship between financial development, trade openness, urbanization, political institutions and EF among 110 countries for the period 1996-2016 using panel

EGLS and multi-step GMM methods. The findings reveal that trade openness, urbanization, and political institutions decrease environmental degradation. Ahmed et al. (2021) test the relationship between democracy and EF in G-7 countries for 1985-2017 using CUP-FM methods. The findings indicate that democracy increases environmental quality. Ahmed et al. (2022) conclude that democratic accountability increases the EF in G-7 countries over 1985-2017 using the CUP-FM estimator. Ahmed et al. (2022) test democracy and ecological footprint nexus in Pakistan over 1984-2017 using the Augmented ARDL method. According to the results, democracy reduces the EF. Nazarov and Obydenkova (2022) test the link between CO2 emissions and political institutions for 153 countries over 1970-1990 and 1990-2015 using difference-in-difference analysis. The results reveal that democratization reduces CO2 emissions. Yasin et al. (2022) analyze the link between financial development, energy consumption, ethnicity diversity, urbanization, EF, and CO_2 emissions across 51 less- developed countries over 1996 to 2016 using GMM methodology. The results indicate that financial development and energy consumption increase environmental degradation. On the other hand, some studies such as Gallagher and Thacker (2008) and Usman et al. (2020) conclude that there is no strong relationship between democracy and environmental degradation.

3. Data and Econometric Methodology

3.1. Data

In this study, we use the EF per capita, democracy index, GDP per capita, and renewable energy consumption. The sample consists of 68 developing countries[1], and the data set covers the 1990-2018 period. We use the EF per capita as a proxy for environmental degradation. The data is obtained from the Global Footprint Network database. We use the participatory democracy index gathered from the Varieties of Democracy database. The participatory democracy index is measured on a 0-1 scale, and the higher index values show a higher level of democracy and vice versa. Moreover, we include the renewable energy share of total energy consumption and GDP per capita as a control variable, which are gathered from the World Bank database. We use all variables in logarithmic forms. Table 1 shows the descriptive statistics for the full panel sample.

Table 1. Descriptive statistics of the variables

Variables	Observation	Mean	Std. Deviation	Minimum	Maximum
lnefcons	1.972	0.5783871	0.4938055	-0.779246	2.085201
lndemocracy	1.972	-1.417159	0.6664855	-3.912023	-0.3552474
lngdp	1.972	7.899749	0.797303	5.898171	9.70739
lnrenewable	1.972	3.284174	1.222173	-2.830218	4.563514

3.2. Econometric methodology

The panel data model we adopt to analyze the impact of participatory democracy on the EF is as follows:

$$lnefcons_{it} = \alpha_0 + \alpha_1 lndemocracy_{it} + \alpha_2 lngdp_{it} + \alpha_3 lnrenewable_{it} + u_{it} \quad (1)$$

In Eq. (1), $logefcons_{it}$, $logdemocracy_{it}$, $loggdp_{it}, logrenewable_{it}$ represent the EF per capita, participatory democracy, GDP per capita, the renewable energy share of total energy consumption in the country i for period t, respectively and u_{it} is the error term.

We employ a two-stage methodology. The first step is to choose the best panel data model. To be able to choose between different panel models at this step, firstly, we test for the presence of unobservable/individual-specific effects. Following Park (2011), we use the Fischer (F) test for fixed effects and the Breusch and Pagan Lagrange Multiplier (LM) test for random effects. In addition, when there are both fixed and random effects, the Hausman test determines which estimator to use. The classical OLS assumptions of homoskedasticity, autocorrelation, and cross-sectional dependence are used in panel data models. However, panel data can be distinguished by complex error structures and frequently violate these standard assumptions. Problems such as heteroscedasticity, serial correlation, and cross-section dependency have long been recognized as potential problems for panel data and are present in many empirical applications (Podesta, 2002; Reed and Ye, 2011). Thus, we use diagnostic tests to check the validity of these assumptions. In the second step of our study, we estimate the impact of participatory democracy on the EF. For this purpose, we employ the Feasible Generalized Least Squares (FGLS) and Panel Corrected Standard Errors (PCSEs) estimators. Because of this, as demonstrated in detail by Reed and Ye (2011) and Moundigbaye et al. (2018), these estimators simultaneously handle heteroscedasticity, serial correlation, and cross-section dependency and produce effective and consistent results.

[1] Albania, Algeria, Angola, Argentina, Bangladesh, Benin, Bhutan, Bolivia, Botswana, Brazil, Bulgaria, Capo Verde, Cambodia, Cameroon, China, Colombia, Comoros, Congo Rep., Costa Rica, Cuba, Dominican Rep., Ecuador, Egypt, El Salvador, Equatorial Guinea, Eswatini, Fiji, Gabon, Ghana, Guatemala, Guyana, Haiti, Honduras, India, Indonesia, Iran, Iraq, Jamaica, Jordan, Kenya, Lebanon, Lesotho, Malaysia, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Nepal, Nicaragua, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Romania, Senegal, South Africa, Sri Lanka, Tanzania, Thailand, Tunisia, Turkey, Vietnam, Zambia, Zimbabwe.

4. Empirical Results

As previously stated, we first used the F test to compare different panel data models. The p-value for the F test is small enough to reject the null hypothesis that all individual intercepts are equal to zero, according to the results summarized in Table 2, and thus fixed effect estimator should be preferred over the Pooled OLS estimator. Similarly, the Breusch-Pagan LM test rejected the null hypothesis that all individual specific variance components were equal to zero at the 1% confidence interval. Accordingly, there are random effects in the panel, and it is appropriate to prefer the RE model instead of the Pooled OLS. According to these findings, the panel contains both fixed and random effects. We used the Hausman test to determine which estimator to use. The chi-square statistic (9.94) has a p-value of 0.0191. This result led us to reject the null hypothesis at the 5% confidence level, demonstrating that our panel regression model is a fixed effects estimator.

Table 2. Model Selection and Diagnostic Tests

	Statistics	Probability
Model Selection Tests		
F test (67, 1901)	239.78	0.0000*
Breusch-Pagan LM Test	21134.11	0.0000*
Hausman Test	47.13	0.0191**
Diagnostic Tests		
Modified Wald Test	34042.18	0.0000*
Wooldridge Test	65.512	0.0000*
Pesaran (2004) CD Test		
lnefcons	40.42	0.0000*
lndemocracy	56.73	0.0000*
lngdp	185.87	0.0000*
lnrenewable	82.34	0.0000*

Note:* and ** indicate the significance levels at the 1%. and 5%

On the other hand, the variance of the error term in many panel data models may differ for all cross-section units. In this regard, we perform the modified Wald test to determine whether our fixed-effect panel regression model has groupwise heteroscedasticity. The chi-square statistic (34042.18), with a p-value of 0.0000, strongly rejects the hypothesis that all cross-sectional units of error term variance are the same. Likewise, the Wooldridge test, which we use to test the presence of first-order autocorrelation in the model, shows similar results. Accordingly, in addition to the heteroskedasticity problem, there is also autocorrelation in our model. Finally, we use the Pesaran (2004) test to examine for cross-section dependence in error terms. The findings show that there is cross-sectional dependence for all variables.

The findings we present in summary table 2 indicate that we should choose the fixed effect panel regression model. However, the structure of error terms also includes simultaneous relationships between panel heteroskedasticity, autocorrelation, and cross-sectional units. As a result, the method used to estimate the coefficients must produce robust, efficient, and consistent results for these three problems. Therefore, following Reed and Ye (2011) and Moundigbaye, et al (2018), we use the FGLS estimator in panel regression. This method, also called the Parks model, typically models cross-sectional covariances parametrically. However, the FGLS model contains several problems (depending on whether T/N is greater or less than 1.50) that can cause underestimation of the standard errors of the estimated coefficients, which can make hypothesis testing useless (Moundigbaye, et al, 2018). For this reason, we also use the PCSE estimator developed by Back and Katz (1995) for robustness in panel estimation. In addition, Moundigbaye, et al (2018) state in their analysis that the PCSE estimator is the best for hypothesis testing in any case where T/N is less than or greater than 1.50.

Table 3. Estimation Results of FGLS

FGLS				
Dep. var. lnefcons	Coeff.	Std. Err.	*t* Stat.	Prob.
lndemocracy	0.02714	0.00912	2.98	0.000*
lngdp	0.37639	0.01298	28.99	0.000*
lnrenewable	-0.07562	0.00952	-7.94	0.000*
constant	-2.13733	0.12428	-17.20	0.000*
Wald χ^2		1480.22 (0.0000)		
Observations		1972		
Groups		68		

Note:* indicates the significance levels at the 1%. The value in the parentheses are *P* values.

Table 4. Estimation Results of PCSE

PCSE				
Dep. var. lnefcons	Coeff.	Std. Err.	*t S*tat.	Prob.
lndemocracy	0.04325	0.01521	2.84	0.004*
lngdp	0.35152	0.02168	16.21	0.000*
lnrenewable	-0.07130	0.01225	-5.82	0.000*
constant	-1.90723	0.19529	-9.77	0.000*
Wald χ^2		578.92 (0.000)		
Observations		1972		
Groups		68		

Note:* indicates the significance levels at the 1%. The value in the parentheses are *P* values.

According to the estimation results in Table 3 and Table 4, all variables are statistically significant in both models. However, the impact of participatory democracy and GDP per capita on the EF is positive, while there is a negative relationship between the EF and renewable energy consumption. In other words, an increase in the level of participatory democracy and GDP per capita increases the EF. On the other hand, increasing renewable energy consumption reduces the EF.

5. Discussion

Our results show that participatory democracy and GDP per capita increase environmental degradation, whereas renewable energy consumption decreases environmental degradation for 68 developing countries over the 1990-2018 period. The empirical results of FGLS and PCSE estimators indicate that an increase in participatory democracy increases EF. This result does not support the view that democracy could reduce environmental degradation. One can say that an increase in the level of participatory democracy encourages investments and economic growth in the long run. However, since developing countries do not implement strict environmental policies, foreign direct investments tend to be invested in dirty industries. Thus, we can say the impact of participatory democracy on addressing environmental issues is weak in developing countries. Consequently, an increase in investments and economic activities, which ignore environmental quality, leads to higher environmental degradation in these countries.

To the authors' best knowledge, there is no study in the literature to link EF and participatory democracy across developing countries. However, many studies focus on the relationship between democracy and environmental degradation. Therefore, we may compare our results with these studies. Our results are consistent with some studies such as Arvin and Lew (2011), Gani and Scrimgeour (2014), Lv (2017), Akalın and Erdoğan (2021). Arwin and Lew (2011) investigate the impact of democracy on the various environmental indicators over 1976-2003 across developing countries using the OLS method. The results show that democracy increases deforestation damage. Charfeddine and Mrabet (2017) test the relationship between democracy and the EF among 15 MENA and Middle East countries for the period of 1975-2007 using the DOLS and FMOLS methods. The findings show that democracy increases EF. Lv (2017) concludes that democracy increases carbon emissions across 19 emerging market economies over 1997-2010 using the OLS method. Akalın and Erdoğan (2021) test the democracy and the EF nexus across 26 OECD countries over 1990-2015 using the AMG method. According to the findings, democracy increases EF.

Another finding shows that an increase in GDP per capita increases the EF. The use of fossil energy sources and old technologies in the production process increases environmental degradation. This result is consistent with Hassan et al. (2019), Ahmed et al. (2020), and Cakmak and Acar (2022). Hassan et al.(2019) conclude that economic growth increases the EF in Pakistan over 1971-2014 using the ARDL method. Ahmed et al. (2020) show that an increase in economic growth increases the EF in China over 1970-2016. Cakmak and Acar (2022) find that the impact of economic growth on EF is positive for oil-producing countries over 1999-2017.

Finally, renewable energy consumption decreases the EF. This finding shows that countries with high consumption of renewable energy can contribute to environmental quality, therefore providing a sustainable response to climate change. This section of the results is consistent with the former literature. For instance, Sharma et al. (2021) find that renewable energy consumption decreases the EF in developing countries of Asia for the period 1990-2015 using the CS-ARDL method. Sharif et al. (2020) indicate that renewable energy consumption decreases the EF in Turkey over 1965Q1-2017Q4 using the quantile ARLD method.

Finally, it is important to consider the impact of the COVID-19 pandemic, which has affected humanity not only in terms of health but also in terms of environment, climate change, hence sustainable development. First, COVID-19 has positive impacts on the environment, such as a decrease in air pollution and GHG emissions, a decrease in water pollution, and ecological restoration (Rume and Islam, 2020). A slowdown in economic activities, shutdown of industries, and decrease in transportation activities caused a significant decrease in GHG emissions. Comparing the first three months of 2020 to the same period in 2019, the International Energy Agency (IEA) reports that oil demand has decreased by 435,000 barrels, which significantly decreased GHG emissions (IEA, 2020). According to OECD (2021) report, energy-related emissions declined by 7%, and agriculture-related environmental pressures by around 2% in the short run. Globally, it is observed that CO_2 emissions decreased by 8.8 percent (1551 Mt CO_2), which is larger than the annual reduction (790 Mt CO_2) during World War II (Liu et al., 2020). Considering all the environmental effects of COVID-19, the direction of the COVID-19 pandemic over the next few years will determine the process of sustainable development in the world.

6. Conclusion and Policy Recommendations

This study tests the impact of participatory democracy on environmental degradation across 68 developing countries over the 1990 to 2018 period using the Feasible Generalized Least Squares (FGLS) and Panel Corrected Standard Errors (PCSEs) estimators. To do so, first, we test the presence of unobservable/individual-specific effects to choose between different panel models. For this purpose, we use the Fischer (F) test for fixed effects and the Breusch and Pagan Lagrange Multiplier (LM) test for random effects following Park (2011). The results show that the panel contains both fixed and random effects. Thus, we use the Hausman test to determine which estimator to use and choose to fix the effect panel regression model. Second, we use FGLS and PCSE estimators, which consider heteroskedasticity, autocorrelation, and cross-sectional dependence problems to estimate the coefficient. Our results show that participatory democracy and GDP per capita have a positive impact on EF whereas renewable energy consumption decreases EF in developing countries. Based on the results, several policies can be recommended to contribute to environmental quality in developing countries. Governments should address the issue of environmental sustainability and economic development together. In this context, first, policymakers should encourage investments in new technologies which contribute to environmental quality. For instance, the use of carbon-free technologies, such as solar, wind, and hydro energy resources, in the production process could reduce GHG emissions. Besides, the share of renewable energy in the production side and consumption side should be increased. To do so, the public and private sectors should increase investment in renewable energy. Second, governments should implement strict environmental policies such as environmental taxation, emission trading, etc., to reduce the negative environmental effects of dirty industries in the long-run. Third, governments should cooperate with stakeholders, such as non-governmental organizations, the private sector, civil society, etc., in determining policies to improve environmental quality. Moreover, implementing the regulations properly requires stronger institutions such as democracy. Fourth, the level of education of society plays a significant role in a sustainable environment. Thus, governments should implement strategies to improve public awareness of environmental issues by enhancing the quality of education.

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