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FREEDOM TO POLLUTE

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ABSTRACT

The study analyzes the role of income and democracy on environmental quality in Turkey. Since economic growth and democratization are two main objectives of Turkey for decades, it is expected that improvements in democracy and increases in economic growth rate may have positive impacts on environment. Thus, to observe the short and long run impacts of income and democracy, an ARDL bounds test on per capita CO2 emission level in Turkey is employed for the 1960-2011 period. According to the results, we have found that an inverted U-Shape type relationship between income and CO2 emission level, and democracy and CO2 emission level. We have found that improvement in democracy leads to environmental degradation for Turkey. The findings of the analysis also show that renewable energy has a negative significant effect on carbon emission level, while trade openness and financial development have positive significant effects on it.

Keywords: ARDL Model, Democracy, Environmental Kuznets Curve, Turkey

KİRLETME ÖZGÜRLÜĞÜ

ÖZ

Çalışma, Türkiye'de gelir ve demokrasinin çevresel kalite üzerindeki rolünü analiz etmektedir. Ekonomik büyüme ve demokratikleşme Türkiye'nin başlıca iki ana amacı olduğundan, demokrasideki iyileşmelerin ve ekonomik büyüme oranındaki artışın çevre üzerine olumlu etkisi olacağı beklenmektedir. Dolayısıyla, gelir ve demokrasinin kısa ve uzun dönem etkilerini incelemek amacıyla, 1960-2011 periyodu için Türkiye'de kişi başı CO2 emisyon seviyesi ARDL sınır testi ile analiz edilmiştir. Sonuçlara göre, gelir ve CO2 emisyon seviyesi arasında, ve demokrasi ve CO2 emisyon seviyesi arasında, ters U eğrisi şeklinde ilişki bulduk. Türkiye'de demokrasideki iyileşmelerin çevresel bozulmalara yol açtığını bulduk. Analiz sonuçları ayrıca, ticari açıklık ve finansal gelişmenin karbon emisyon seviyesi üzerinde pozitif etkileri olduğu bulunurken, yenilenebilir enerjinin karbon emisyon seviyeleri üzerinde negatif anlamlı etkisi olduğu bulunmuştur.

Anahtar Kelimeler: ARDL Modeli, Demokrasi, Çevresel Kuznets Eğrisi, Türkiye

Introduction

Developing countries are still on the industrialization stage since decades to sustain the 'economic resource' of the development. The industrialization stage may cause environmental degradation due to the intense release of harmful gases to sustain higher production levels. Environmental aspect of the Kuznets Curve (EKC) asserts that, environmental degradation rises in earlier development phases. But beyond a certain level of income, it starts to decrease. Since economic development implies more than improvement in income level, the analysis focuses also on democracy. In this context, besides the classical EKC hypothesis, the existence of a potential nonlinearity between democracy and environmental degradation is going to be examined for the period 1960-2011 in Turkey.

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The data on income, democracy and CO2 emission around the world imply a non-linear relationship. According to the recent data, many developing countries have almost same or less emission levels with outstanding developed countries. For instance, the CO2 emission per capita level is 16.4 tones in United States, 13.5 tones in Canada, 9.8 tones in Japan, 9.2 tones in Germany, 7.2 tones in United Kingdom while the emission level is 2.4 tones in Brazil, 3.5 tones in Romania, 4.1 tones in Hungary and 4.2 tones in Turkey. Regarding the current trend, it might be asserted that the carbon emission levels in developing countries will rise in the following years due to industrialization process.

As a remarkable developing country, Turkey has made important transformations especially after the 1980s and has taken important steps for higher economic growth and more democratic environment. But, not only the democracy score but also all other aspects of governance scores for Turkey is also less than those of developed and even some of the developing countries. Although the commercial and financial liberalization processes of Turkey and her integration with the European Union have begun decades ago, environmental degradation in Turkey is higher compared to other developing countries since environmental investments require resources which were reserved primarily for industrialization and economic growth. In the process of democratization, the same steps will be taken in terms of environment. In the first stage, for the low levels of democracy below a certain level of threshold, the liberties and freedom only bear fruit to capital owners and investors seeking opportunities to invest. As it has been stated above, these economic activities lead to increasing pollution levels as well as contributing to economic growth. This phase fits what conservational authors called Hobbesian approach in 1960s and 1970s. At this stage, the power relationship between investors and government outweigh the public voice of the citizens and non-governmental organizations (NGOs). Although citizens and NGOs desire less pollution, their voice cannot be heard in government and senate against Hobbesian investors collaborating with powerful elites. However, in the second stage, for the high levels of democracy beyond a certain level of threshold, environmental sensitivity will outweigh and public authorities will steer investment in this area. At this stage, the citizens and NGOs use the instruments of democracy to mobilize government to take action against polluting firms. Since Turkey is in the first stage and the democracy in Turkey is still immature below a certain level of threshold, it is expected that improvement in democracy lead to environmental degradation. Because, improvement in democracy just improves the conditions for capital owners in the form of freedom to pollute by invest since it does not lead the environmental sensitivities of the citizens and NGOs to be heard by government. To investigate the situation discussed above, the following hypothesis will be tested for Turkey; '*The carbon emission level increases if the country is below a certain threshold level of income and democracy'*. Before examining this hypothesis via an econometric analysis, let us briefly review the existing literature on the subject.

Literature Review

Early studies in the literature analyzing CO2 emissions have only concentrated on providing evidence for the EKC by including variables income and squared income. Later studies incorporated other control variables as trade openness, human capital and financial development. There are few studies analyzing environment and democracy as in the form of higher CO_2 emissions. There exists no study inspecting the role of democracy on CO_2 emissions in Turkey.

According to EKC hypothesis, pollution, hence CO_2 emissions first increase in the early stage of industrialization while income level of countries increases from low to middle since people consider environmental issues as luxury good and industrial products as normal good. Then it starts to decline beyond a threshold level of income as income level of countries increases from middle to high by using pollution control technologies. People start to demand for superior environmental quality in economically prosperous countries by phasing out of high pollutant industries (Seldon and Song, 1994; Komen et al. 1997; Rosser and Rosser, 2006; Torras, 2005; Gani, 2012). This perspective is biased since higher income level is considered as an only indicator of development level of countries. After the study of North (1990), the potential effect of governance on economic development and environmental issues has attracted the attention of researchers (Tarverdi, 2018). Although higher income countries have established better governance institutions, middle-income countries that below the threshold level can implement pollution control technologies by treating environmental quality as not a luxury good due to improving their governance institutions, especially democracy. The democracy provides check and balances against the selected public officials and government bodies. By attaining better civil liberties and political rights, individuals in the society have a right to choose or hold responsible the government for selection of production processes, technologies embodied and resources used, which have direct effect on environmental quality (Gani, 2012).

To the early studies starting in 1960s approach to environmental issues in a Hobbesian way that to conserve common goods, specifically the environment, individual freedom needs to be restrained. By considering the poor environmental performance in autarkic and communist states, a new aspect arose in 1980s maintaining the argument that democracy has positive effect on the environment. Their view is based on the argument that democracy provides transparency on environmental issues and improves the ability of citizens to make protests (Pellegrini and Gerlagh, 2006). Chadwick (1995) argues that state development plans in non-democratic regimes may silence or disregard environmental concerns in times of conflict and these regimes systematically neglects the cost of environmental degradation.

According to Payne (1995), thanks to the freedom of the press, citizens in democratic states are well-informed about environmental issues. Moreover, due to freedom of speech, citizens can express their concerns about environment. These freedoms will facilitate the establishment of environmental organizations due to freedom of association. Hence democracy may positively affects environmental quality since the public is more concerned about environmental issues, which will eventually require policymakers to address these concerns (Neumayer, 2002).

By considering democracy as dependent on economic development, Desai (1998) argues that democracy would not lead the protection of the environment since environmental pollution and ecological destruction are both gradually increases with economic growth and development.

Hotunluoğlu and Yılmaz (2018) found that democracy has a reducing effect on carbon dioxide emissions for Turkey over the 1972-2011 period. Mcguire and Olson (1996) concluded that democracy, which is proxied by the size of the ruling class, would positively affect environmental quality as a public good. Using an adoption of Mcguire and Olson (1996)'s autocrat model, Deacon (2003) reached the same conclusion as democracy has positive influence on environmental quality, which is considered as a public good. Torras and Boyce (1998) also reached the same conclusion as democracy has positive effect on environmental quality using EKC perspective. They found that increasing the quality of democracy positively affects environmental quality. Barrett and Graddy (2000) concluded that more democratic countries tend to have lower pollution levels by employing panel random effect regression. Congleton (1992) and Neumayer (2002) found that democracy has positive significant effect on environmental quality by using the probability of countries signing environmental treaties. However, the empirical findings suggested by Neumayer (2002) imply that democracy and environmental quality are significantly associated, while he found an insignificant relationship between democracy and environmental outcomes. By employing panel OLS regression, Bollen (1993) found that countries with higher democracy levels have higher emission levels. By employing panel OLS regression, Scruggs (1998) reached the conclusion that democracy is statistically insignificant when income inequality is included as a control variable. Roberts & Parks (2007) also concluded that democracy does not have any effect on carbon emissions.

Pellegrini and Gerlagh (2006) criticized the early studies as they focus on either democracy or corruption, which leads to overestimation bias since two variables are highly correlated. They employed cross sectional OLS analysis for a group of countries and concluded that corruption is the significant substantial policy tool for environment, while there is no significant evidence on the impact of democracy. Farzin and Bond (2006) also found that democracy has a positive impact on environmental quality.

Gallagher and Thacker (2008) found that democracy stock of a country significantly affects carbon emission level while contemporaneous democracy level has no significant effect for both developed and developing countries. They found an S-shaped relationship between the two.

Gani (2012) analyzed the impact of governance including democracy on CO2 emissions for 99 developing countries for 1998-2007. He found weak evidence for a positive association between freedom and carbon emissions.

Halkos and Tzeremes (2013) found the evidence that democracy has a negative significant impact on CO2 emissions in G-20 countries by using voice and accountability index from WGI. They concluded that the increased participation of citizens in selection of government, extension of free media, improvement in freedom of expression and association are all associated with lower carbon emissions. They also found that CO2 emission level of Turkey is affected only by political stability not by voice and accountability. They also concluded that the variations in regional and economic development of a country shape the way that different governance measures influence carbon emission levels.

Tarverdi (2018) employed parametric and nonparametric panel data regressions to analyze the role of governance including democracy on carbon emissions for 125 developing countries for the 1991-2011 period. After controlling heteroscedasticity and endogeneity, he found that only corruption has positive significant impact on CO2 emissions in panel data iv regressions. Hence, he could not find evidence for a statistically significant relationship between democracy and CO2 emissions.

You et al. (2015) found that democracy has a positive significant impact on CO2 emissions for the countries having lowest emission levels, while the relationship between the two is negative for countries having highest emission levels by employing panel quintile regression model for 1985-2005 including developed and developing countries. Hence, they concluded that countries having highest emission levels could benefit the most from improvement in democracy. Similarly, the empirical findings of the panel data analysis of Lv (2017) indicate the same condition. The results obtained from the analysis reveal that higher level of democracy reduces CO2 emission level only if the country has already attained a certain level of development. These types of findings increase the curiosity about the hypothesis mentioned at the beginning in the study. The panel data findings in the existing literature provide some evidences on multiple countries.

In the second part, the econometric methodology and the data will be outlined. The results of the unit root tests, the ARDL bounds test and Granger Causality test will be presented in the third section. Finally, the findings will be summarized and some policy implications will be presented.

Methodology and Data

To examine the study's hypothesis, three different models are estimated for different indicators of democracy to check the robustness of the analysis. To represent democratization, three different variables are used in the analysis, which will be given in the further parts of the study. The democracy variables are estimated in separate regressions in order to overcome multi-collinearity problem. The base model is given in the equations below.

$$CO2_t = \beta_1 + \beta_2 GPC_t + \beta_3 GPC_t^2 + \beta_4 TO_t + \beta_5 F_t + \beta_6 RE_t + \beta_7 DEM_t + \mu_t \quad (1)$$

where $CO2_t$ represents CO2 emissions, GPC_t is GDP per capita, GPC_t^2 denotes its square, TO_tdenotes trade openness. To proxy financialization, F_t is taken as the share of credits to private sector. RE_t represents renewable energy use, $D_t$stands for the variables that proxy democratization; civil liberties, political rights and democracy. Notice that the impacts of these three factors will be separately estimated in the empirical analysis. The μ_t term is a random error term.

The long-run and causal relationships between variables have been analyzed in two stages. First, the ARDL bounds testing approach of cointegration has been used to analyze the long-run relationship between variables. Secondly, Granger causality test has been used to investigate the causal relationships between variables.

The ARDL bounds test also gives consistent results even in small samples and allows for the use of different optimal lags for variables unlike other cointegration tests. In addition, the method can simultaneously estimate short and long run parameters.

The ARDL bounds testing procedure is based on standard F and t-statistics and the null hypothesis is the existence of no level relationship. One set of asymptotic critical values when all variables are I(1) and another set of asymptotic critical values when all variables are I(0), provide a band, which covers all possible classifications of the variables into I(0), I(1) or mutually cointegrated (Pesaran et al., 2001).

$$\Delta CO2_t = \alpha_0 + \sum_{i=1}^{p} \alpha_1 \Delta\, CO2_{t-1} + \sum_{i=0}^{p} \alpha_2\, \Delta GPC_{t-1} + \sum_{i=0}^{p} \alpha_3 \Delta\, GPC_{t-1}^2 + \sum_{i=0}^{p} \alpha_4\, \Delta TO_{t-1} + \sum_{i=0}^{p} \alpha_5\, \Delta F_{t-1} + \sum_{i=0}^{p} \alpha_6\, \Delta RE_{t-1} + \sum_{i=0}^{p} \alpha_7\, \Delta DEM_t + \lambda_1 CO2_{t-1} + \lambda_2 GPC_{t-1} + \lambda_3 GPC_{t-1}^2 + \lambda_4 TO_{t-1} + \lambda_5 F_{t-1} + \lambda_6 RE_{t-1} + \lambda_7 DEM_{t-1} + \varepsilon_t \quad (2)$$

where the expressions from λ_1 to λ_7 indicate the long-run relationship between variables, while the expressions from α_1 to α_7 with the summation signs represent short-run dynamics. On the other hand, α_0 represents constant term, Δ is the first difference operator, and ε_t is the Gaussian white noise term.

The F test is used to test the long-term relationship between variables. The null hypothesis of no cointegration ($H_0: \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = \lambda_7 = 0$) is tested against the alternative of cointegration ($H_0: \lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq \lambda_6 \neq \lambda_7 \neq 0$). If the calculated F statistic value exceeds the upper critical value, there is a long-run relationship between variables Pesaran et al. (2001). Otherwise, there is no long-run relationship between variables.

After deciding the existence of a long-run relationship between variables, a general error correction model (ECM) is estimated. The Eq. (2) for ECM estimation is as follows:

$$\Delta CO2_t = \beta_0 + \sum_{i=1}^{p} \theta_i \,\Delta CO2_{t-i} + \sum_{i=0}^{p} \varphi_i \,\Delta GPC_{t-i} + \sum_{i=0}^{p} \varphi_i \,\Delta GPC_{t-i}^2 + \sum_{i=0}^{p} \varphi_i \,\Delta TO_{t-i} \sum_{i=0}^{p} \varphi_i \,\Delta F_{t-i} \sum_{i=0}^{p} \varphi_i \,\Delta RE_{t-i} \sum_{i=0}^{p} \varphi_i \,\Delta DEM_{t-i} + \gamma ECT_{t-i} + \xi_t \quad (3)$$

where Δ is the first difference operator and ξ_t represents residual terms, which are identically, independently and normally distributed. α is the speed of adjustment parameter and ECT is the error correction term.

The statistical significance of ECT_{t-i} with negative sign validates the established long-run relationship between variables (Yusoff, 2010).

The ARDL bounds testing method shows a long-run relationship between variables, but does not give any information on the direction of causality. After the conclusion that there is a long-run relationship between the variables, the causality relation between the variables is examined by the Granger causality test. The Granger causality test is conducted as follows:

$$Y_t = \sum_{i=1}^{n} \omega_i X_{t-i} + \sum_{j=1}^{n} \lambda_j X_{t-j} + u_{1t} \quad (4)$$

$$X_t = \sum_{i=1}^{r} \eta_i X_{t-i} + \sum_{j=1}^{r} \delta_j X_{t-j} + u_{2t} \quad (5)$$

where u_{1t} and u_{2t} represent residual terms, which are identically, independently and normally distributed (Granger, 1969). Finally, cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) are used to test the consistency of the coefficients.

All the data have been collected from *World Bank, Freedom House* and *Polity IV* database for the period 1960-2011, but civil liberties and political rights data are available for the period 1973-2011. Lower values of political rights and civil liberties correspond to better situations while higher values of democracy correspond to higher democracy. Thus, it is very important to consider this point when interpreting the findings. Table 1 shows the descriptive statistics. Since the study considers three different variables standing for democracy (Z) which are political rights, civil liberties and democracy index, we put three different abbreviations for them.

Table 1. Descriptive Statistics

Code	Variable	Source	Obs.	Mean	Min	Max	St. Dev.
CO2	CO2 emissions (metric tons per capita	WDI (2019)	52	0.713	-0.494	1.478	0.535
GPC	GDP per capita	WDI (2019)	52	7.457	5.65	9.267	1.034
GPC2	The aquare of GDP per capita	WDI (2019)	52	56.656	31.918	85.879	15.467

TO	Trade (% of GDP)	WDI (2019)	52	3.187	1.745	4.036	0.662
F	Domestic credit to private sector (% of GDP)	WDI (2019)	52	2.948	2.539	3.972	0.29
RE	Renewable energy (% of total energy)	WDI (2019)	52	1.138	-0.216	1.912	0.646
P	Political Rights	FRH (2019)	39	3.103	2	5	0.968
C	Civil Liberties	FRH (2019)	39	3.949	3	5	0.857
D	Democracy	Polity (2019)	52	17.558	6	20	3.908

Results

Checking the stationarity of the series is a crucial step before applying the cointegration tests (Granger and Newbold, 1974). In this study, stationarity of the time series variables have been controlled through the Augmented Dickey-Fuller and the Phillips-Perron unit root tests. According to the unit root test results on Table 2, *GPC, GPC2,* T*O* and *D* are stationary at their levels while the other variables are stationary at their first differences. In addition, none of the series are stationary at I(2). If any of the variables used in the analyses are I(2), the F statistic becomes invalid (Shahbaz et al, 2013). Hence, the use of the ARDL cointegration test is consistent.

Table 2. Unit Root Test

Variables	ADF		PP		Zivot-Andrews	
	t-stat	**p-value**	**t-stat**	**p-value**	**t-stat**	**Time Break**
CO2	-2.619	0.274	-2.667	0.253	-3.859 (0)	1978
GPC	-3.378	0.066	-3.779	0.025	-5.119 (0)**	1982
GPC2	-3.201	0.095	-3.476	0.052	-4.499 (0)	1982
TO	-3.492	0.051	-3.397	0.063	-5.777 (1)***	1980
F	-0.625	0.972	-1.032	0.930	-5.849 (1)***	2001
RE	-2.876	0.178	-2.739	0.225	-4.877 (0)	1975
C	-1.841	0.665	-2.026	0.568	-3.368 (0)	1981
P	-3.211	0.098	-2.729	0.231	-3.918 (0)	1993
D	-4.191	0.009	-4.782	0.001	-5.983 (0)***	1983
ΔCO2	-7.041	0.000	-7.042	0.000	-8.734 (0)***	1982
ΔGPC	-8.315	0.000	-8.315	0.000	-8.756 (0)***	1980
ΔGPC2	-8.044	0.000	-8.044	0.000	-8.642 (0)***	2003
ΔTO	-7.007	0.000	-7.088	0.000	-7.411 (0)***	1980
ΔF	-4.958	0.000	-6.176	0.000	-7.822 (0)***	1998
ΔRE	-9.413	0.000	-10.307	0.000	-9.926 (0)***	1974
ΔC	-3.892	0.005	-6.483	0.000	-8.127 (0)***	1983

ΔP	-4.004	0.004	-7.702	0.000	-5.934 (0)***	1983
ΔD	-4.325	0.001	-19.445	0.000	-7.933 (0)***	1983

Note: For the Zivot-Andrews unit root test, lag order is shown in parenthesis. The superscripts ***, ** and * denote the significance at 1%, 5% and 10% level, respectively.

The conventional unit root tests in the literature do not allow the existence of structural breaks. If series have structural breaks, unit root test results might be biased and spurious. Perron (1989) developed a unit root test that considers externally known as structural break point. Besides, Zivot and Andrews (2002) have proposed a unit root test in which the structural break point is identified internally for those cases in which the structural break period is not known precisely. Zivot-Andrews unit root test results are shown in the last column of Table 2.

According to the results of Zivot-Andrews, *GPC*, *TO*, *F* and *D* variables are stationary with structural break, whereas the other variables are non-stationary without structural break. As mentioned in the above explanations, the variables are stationary at different order of integration, which does not prevent the use of the ARDL bounds testing.

The optimal lengths of lags for the variables have been selected according to Akaike and Schwarz criteria. According to the results, lag 1 is appropriate for *CO2*, while lag 0 fits for *GPC*, *GPC2*, *TO*, *F*, *RE* and *C* in the Model 1. For the Model 2, lag 1 is appropriate for *CO2*, while lag 2 fits for *GPC*, *GPC2*, *TO*, *F*, *RE* and *P*. Finally, lag 1 is appropriate for *CO2*, while lag 2 is fitting for *GPC*, *GPC2*, *TO*, *F*, *RE* and *D* for the Model 3. The ARDL test results for each model are shown in Table 3. The findings imply that our calculated F statistics values for F(*CO2 | GPC, GPC2, TO, F, RE, C*), F(*CO2 | GPC, GPC2, TO, F, RE, P*) and F(*CO2 | GPC, GPC2, TO, F, RE, D*) exceed the upper critical value. According to the test results, it can be concluded that CO2 emission level is associated with per capita GDP, its square, openness, financial development, renewable energy, political rights, civil liberties and democracy at 5% significance level.

Table 3. ARDL Bounds Test

Estimated Models	Optimal Lag	F-statistic	Critical Values %5		Critical Values %10	
			I(0)	I(1)	I(0)	I(1)
F(CO2 | GPC, GPC2, TO, F, RE, C)	(1, 0, 0, 0, 0, 0,0)	4.36	2.45	3.61	2.12	3.23
F(CO2 | GPC, GPC2, TO, F, RE, P)	(1, 2, 2, 2, 2, 2, 2)	3.71	2.45	3.61	2.12	3.23
F(CO2 | GPC, GPC2, TO, F, RE, D)	(1, 2, 2, 2, 2, 2,2)	6.73	2.45	3.61	2.12	3.23

Note: The critical values for the lower I(0) and upper I(1) bounds are taken from Pesaran et al. (2001).

After observing the existence of cointegration between the variables, relationships between emission level, income, the square of income, openness, financial development, renewable energy, political rights, civil liberties and democracy are examined. The short and long term estimation results obtained from the ARDL model are given in Table 4. To the results for Model 1, GDP per capita, openness and financial development are positively related to CO2 emissions and they are statistically significant at 1% level in the long run. Also, the square of GDP per capita, renewable energy and civil liberties are negatively related to CO2 emissions and they are statistically significant at 1%, 10% and 10% level, respectively. According to the results for Model 2, GDP per capita, openness and financial development are positively related to CO2 emissions and they are statistically significant. Also, the square of GDP per capita, renewable energy and political rights are negatively related to CO2 emissions and they are statistically significant at 5%, 10% and 10% level, respectively. Examining the results for Model 3, GDP per capita, democracy, openness and financial development are positively related to CO2 emissions and they are statistically significant at 1% level in the long run. Also, the square of GDP per capita and renewable energy are negatively related to CO2 emissions and they are also statistically significant.

The level of democracy in Turkey mighty be weak compared with developed countries. Convergence hypothesis is not only valid for income per capita but for the level of democracy as well. Democracy improves in Turkey through time but still under the certain level of threshold like a country in middle-income trap, which cannot converge to income per capita level of developed countries. If Turkey were above the certain threshold level of democracy, the marginal effect of incremental change in the level of democracy would improve environmental outcomes more than the improvement of same effect in developed counterparts, since Turkey is lagged behind developed countries. Since Turkey is below the certain threshold level of democracy, the benefits of democracy are not shared equally among investors and common citizens. Investors in collaboration with powerful elites have not only the right of protection of property rights but also have right to pollute against the common good of the citizens. The instruments of democracy cannot be utilized efficiently against the investors in league with powerful elites.

The negative impact of renewable energy on carbon emissions might be due to two facts. First, renewable energy sources do not produce greenhouse gasses as CO2 since they are not based on fossil fuels. Second, replacement of energy production sources based on fossil fuels with renewable energy production sources decrease CO2 emissions.

Table 4. The ARDL Estimation Results

Dependent variable = CO2						
Variables	Model1		Model2		Model3	
	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat
Short run analysis						
GPC	1.2494**	2.701	1.8332***	3.9197	0.0422	0.1509
GPC(-1)			0.2344	0.4823	-0.7126***	-3.4403
GPC2	-0.0714**	-2.5676	-0.0969***	-3.4714	0.0087	0.5099
GPC2(-1)			-0.0177	-0.5864	0.0389***	3.0445
TO	0.1845***	5.3036	0.2784***	5.6379	0.1719***	4.4794
TO(-1)			-0.1498***	-3.6382	-0.1535***	-4.1945
F	0.1062***	2.8744	0.1199***	3.1919	0.1543***	4.7245

F(-1)			0.0113	0.2614	0.0493	1.4603
RE			-0.1544***	-4.7463	-0.1228***	-5.1212
RE(-1)			0.0513	1.6993	0.0585**	2.7326
C	-0.0181*	-1.7509				
P			0.0037	0.4835		
P(-1)			0.0136**	2.3045		
D					-0.0007	-0.4415
D(-1)					-0.0034**	-2.3151
ECM(-1)	-0.4806***	-5.1138	-0.5621***	-4.7218	-0.2157***	-3.3225

Table 4. Continued

Dependent variable = CO2						
Variables	Model1		Model2		Model3	
	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat
Long run analysis						
Constant	-11.7933***	-3.3175	-13.3324***	-3.173	-11.3179***	-5.3801
GPC	2.5999***	3.0379	2.9093**	2.8955	2.2229***	4.5556
GPC2	-0.1486***	-2.8063	-0.1678**	-2.7086	-0.1420***	-4.2738
TO	0.3838***	6.1305	0.4286***	7.4295	0.7068***	4.2559
F	0.2210***	2.7635	0.2574***	3.167	0.4842***	3.6765
RE	-0.1711*	-1.9453	-0.2122*	-1.911	-0.4429**	-2.4446
C	-0.0377*	-1.7551				
P			-0.0218*	-1.9896		
D					0.0268**	2.1235
Diag. tests	F-stat.	P-value	F-stat.	P-value	F-stat.	P-value
χ^2*NORMAL*	0.8934	0.6397	0.8495	0.654	1.5794	0.454
χ^2*SERIAL*	0.8241	0.4486	1.9624	0.1773	0.7204	0.4957
χ^2*WHITE*	0.5343	0.9086	1.424	0.2387	0.9948	0.4949
χ^2*RESET*	0.8513	0.3744	0.8183	0.426	1.9943	0.1557

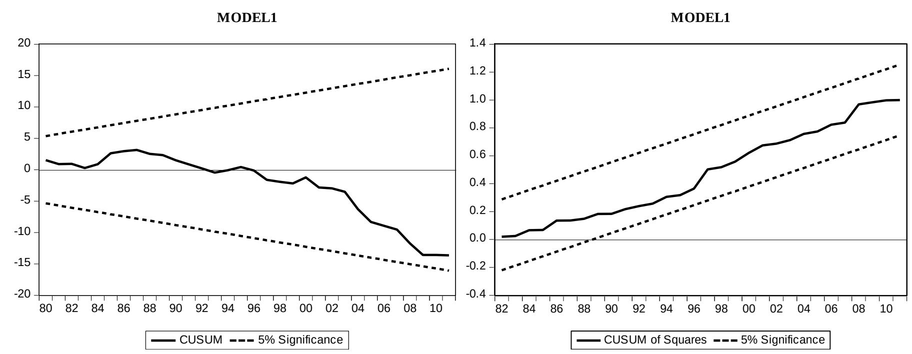
Note: The asterisk signs ***, ** and * stand for the significance at 1%, 5% and 10% respectively.

In summary, the results reveal that income, openness, financial development and democracy has a positive relationship with carbon emission level while the renewable energy usage has a negative relationship with carbon emission level as expected. Please remember that the directions of the three democracy indices were not same. In this context, the lower values for the political rights and civil liberties variables imply a better situation while the higher values for the democracy variables imply a better situation. Thus, the findings obtained from the Models 1, 2 and 3 are consistent with each other. Each model implies that higher levels of political rights, civil liberties and democracy lead to higher levels of carbon emissions.

When interpreting the results in terms of the EKC hypothesis, it is clear to suggest that the hypothesis cannot be rejected. Since the country is still on the developing stage, higher producing in higher levels, foreign trading in higher volumes and improving the financial structure require higher amounts of energy and positively affect the CO2 emission level.

The ECM values for each model have been negatively estimated and statistically significant which implies the validity of the relationships. Moreover, according to the diagnostic test results, there is no diagnostic problem such as autocorrelation, heteroskedasticity, misspecification and lack of normality in regression models. Additionally, the tests, which show the structural stability of our models also confirms the findings on validity. The results on Figure 1 show that the estimated coefficients are inside the critical bounds of 5% significance level.

The results on Table 4 also show that all the three variables that represent the impact of democratization are consistent with each other and positively associated with CO2 emissions. As in the income-environmental degradation type EKC, we can examine the non-linear relationship between democratization and environmental degradation by making an additional analysis covering the CO2 emissions, democracy and the square of democracy. Since the POLITY 4 index has been widely used as the most significant democracy variable, ARDL model is applied for this variable. The results are given in Tables 5, 6 and Figure 2. Similar to the findings of the income based EKC, the findings of this model reveal that in for lower values of democracy, the deterioration of environment increases. Then, beyond a certain threshold level it starts to decline. The result supports our previous claim.



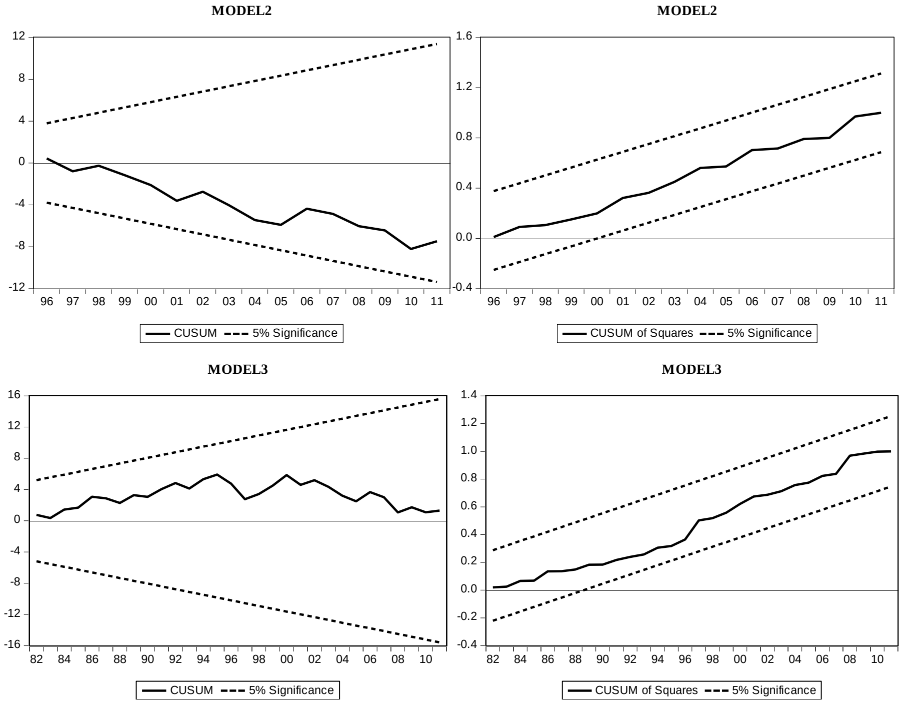


Figure 1. Plots of the Tests for the Parameter Stability

Note: The dashed lines represent critical bounds at 5% significance level.

Table 5. ARDL Bounds Test Results for Robustness

Estimated models	**Optimal lag**		**Critical Values %5**		**Critical Values %10**	
		F-stat.	**I(0)**	**I(1)**	**I(0)**	**I(1)**
F(CO2 | D, D2)	(1, 2, 2)	4.32	3.79	4.85	3.17	4.14

Note: The critical values for the lower I(0) and upper I(1) bounds are taken from Pesaran et al. (2001).

Table 6. The ARDL Estimation Results for Robustness

Dependent variable: CO2	**Coefficients**	
Variable	**Short run coefficients**	**Long run coefficients**
D	-0.0075 (-0.3480)	0.7646 (2.4333) **
D(-1)	-0.0156 (-0.6565)	
D2	0.0003 (0.3532)	-0.0302 (-2.5200)**
D2(-1)	0.0006 (0.7253)	

CONSTANT		-2.1800 (-1.2272)
ECT(-1)	-0.0546 (-3.8168)***	
Diagnostic tests		p-value
χ^2*SERIAL*		0.3537
χ^2*WHITE*		0.6757
χ^2*NORMAL*		0.4527
χ^2*RESET*		0.3261

Note: The asterisk signs ***, ** and * stand for the significance at 1%, 5% and 10% respectively.

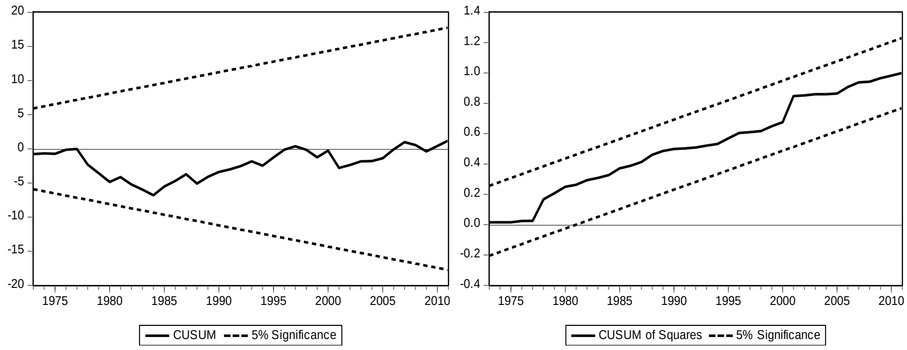


Figure 2. Plots Showing the Stability of the Parameters

Lastly, to observe the direction of the relationship, the causality, the Granger causality test has been applied. According to Granger causality test results on Table 8, there are four bi-directional and four one-way causality relationships. There is bi-directional Granger causality between carbon emissions and GDP per capita, between carbon emissions and the square of GDP per capita, between carbon emissions and financial development and between carbon emissions and democracy. There are unidirectional Granger causalities running from trade openness to CO2, from renewable energy to CO2, from civil liberties to CO2 and from political rights to CO2.

Table 7. Granger Causality Test

Dependent Variables	CO2	GPC	GPC2	TO	F	RE	C	P	D
CO2	-	5.325	6.471	4.596	11.704	2.584	2.45	2.078	2.067
		(0.025)	(0.003)	(0.037)	(0.001)	(0.086)	(0.063)	(0.076)	(0.085)
GPC	5.721	-	2096.518	27.148	0.492	1.537	4.081	1.117	6.336
	(0.021)		(0.000)	(0.000)	(0.486)	(0.221)	(0.026)	(0.297)	(0.015)
GPC2	6.339	1374.34	-	22.489	0.761	0.37	3.034	1.292	5.43
	(0.015)	(0.000)		(0.000)	(0.388)	(0.546)	(0.029)	(0.296)	(0.024)

TO	0.744	21.197	23.724	-	0.744	0.963	2.962	0.354	3.992
	(0.567)	(0.000)	(0.000)		(0.392)	(0.331)	(0.094)	(0.555)	(0.016)
F	11.373	0.571	0.618	0.766	-	0.639	0.614	0.687	0.492
	(0.001)	(0.453)	(0.453)	(0.385)		(0.427)	(0.546)	(0.412)	(0.486)
RE	2.506	1.283	1.064	0.268	0.151	-	1.542	0.496	1.576
	(0.121)	(0.263)	(0.308)	(0.607)	(0.699)		(0.216)	(0.485)	(0.218)
C	2.188	1.902	1.898	4.015	0.044	0.574	-	6.006	4.616
	(0.110)	(0.177)	(0.177)	(0.028)	(0.834)	(0.453)		(0.001)	(0.009)
P	1.559	2.166	1.866	7.097	0.446	2.073	9.156	-	9.161
	(0.213)	(0.132)	(0.172)	(0.000)	(0.508)	(0.144)	(0.000)		(0.000)
D	1.332	1.974	1.753	6.921	0.568	1.106	1.008	0.996	-
	(0.271)	(0.104)	(0.145)	(0.000)	(0.724)	(0.298)	(0.431)	(0.438)	

Note: Values in the parantheses are p-values.
Causality Inference: *CO2↔GPC, CO2↔GPC2, TO→CO2, CO2↔F, RE→.CO2, C→.CO2, P→.CO2, D↔CO2*

Discussion and Conclusion

In this study, how income and democratization affect environmental quality in Turkey has been analyzed. Since sustainability is an essential condition for modern economic development theories, it is crucial to discuss the environmental issues. The extent of the environmental economics, on the other hand, is expanding day by day and it is realized that many economic or non-economic factors might have impacts on environmental quality. For this purpose, to observe the possible impacts of income and democracy on carbon emission level, an ARDL bounds test analysis has been made. The results of the study provide substantial findings that income and democracy level have a non-linear impact on CO2 emission level which imply the existence of an EKC hypothesis.

Democracy is a significant aspect of governance and it is one of the main indicators of development level of a country. According to the results of empirical analysis, it is found that improvement in democracy leads to environmental degradation. Since the democratization in Turkey is below the certain threshold level, the power relationship between investors and government outweigh the public voice of the citizens and NGOs. Although citizens and NGOs desire less pollution, their voice cannot be heard in government and senate against Hobbesian investors collaborating with powerful elites.

The study also used several control variables that might have an impact on carbon emission level. Openness and financial development have positive effect on CO2 emission level. However, the emission level decreases as the share of renewable energy increases, as expected. Hence increasing the use of renewable energy may significantly reduce carbon emission level in the short run for a given democracy and income level for a developing country as Turkey. Despite some outstanding indicators such as income, democracy, openness and financial development drive the development process of countries, they may harm the environment in the early stages due to the amount of the energy they require. Hence, to protect the environment which is a common good, it might be suggested that freedom of investors should be constrained.

Until a threshold level of development, the only way to minimize the CO2 emission level is enhancing and promoting the use of renewable energy. Therefore, authorities and policy makers should realize this fact and implement appropriate policies to minimize the environmental degradation in the development process.

References

Barrett, S., Graddy, K. (2000). Freedom, growth, and the environment. *Environment and Development Economics, Vol 5; No:4,* 433-456.

Bollen, K. (1993). Liberal Democracy: Validity and Method Factors in Cross-National Measures, *American Journal of Political Science, Vol 37;* l207-l230.

Chadwick, B. P. (1995). Fisheries, sovereignties and red herrings', *Journal of International Affairs,* 559-584.

Congleton, R. D. (1992). Political institutions and pollution control, *The Review of Economics and Statistics*, 412-421.

Deacon, R. T. (2003). Dictatorship, democracy and the provision of public goods, In Department of Economics, University of California at Santa Barbara, Working Paper.

Desai, U. (1998). *Ecological policy and politics in developing countries: Economic growth, democracy, and environment*, SUNY Press.

Farzin, Y. H., Bond, C. A. (2006). Democracy and environmental quality, *Journal of Development Economics, Vol 81; No:1,* 213-235.

FRH (2019). Freedom in the World Data and Resources, *Freedom House*, Washington D.C.

Gallagher, K. P., Thacker, S. C. (2008). Democracy, income, and environmental quality.

Gani, A. (2012). The relationship between good governance and carbon dioxide emissions: Evidence from developing economies, *Journal of Economic Development, Vol 37; No:1*, 77.

Granger, C. W., Newbold, P. (1974). Spurious regressions in econometrics, *Journal of Econometrics, Vol 2; No:2,* 111-120.

Halkos, G. E., Tzeremes, N. G. (2013). Carbon dioxide emissions and governance: A nonparametric analysis for the G-20, *Energy Economics, Vol 40;* 110-118.

Hotunluoğlu, H., Yilmaz, G. S. (2018). Demokrasi Karbondioksit Emisyonu İçin Önemli mi? Türkiye İçin Bir Uygulama, *Siyaset, Ekonomi ve Yönetim Araştırmaları Dergisi, Vol 6; No: 1.*

Komen, M. H., Gerking, S., Folmer, H. (1997). Income and environmental R&D: empirical evidence from OECD countries, *Environment and Development Economics*, *Vol 2; No:4*, 505-515.

Lv, Z. (2017). The effect of democracy on CO 2 emissions in emerging countries: Does the level of income matter?, *Renewable and Sustainable Energy Reviews*, *Vol 72;* 900-906.

McGuire, M. C., Olson, M. (1996). The economics of autocracy and majority rule: the invisible hand and the use of force', *Journal of Economic Literature, Vol 34; No:1*, 72-96.

Neumayer, E. (2002). Do democracies exhibit stronger international environmental commitment? A cross-country analysis, *Journal of Peace Research*, *Vol 39; No:2,* 139-164.

Payne, R. A. (1995). Freedom and the environment, *Journal of Democracy*, *Vol 6; No:3*, 41-55.

Pellegrini, L., Gerlagh, R. (2006). Corruption, democracy, and environmental policy: an empirical contribution to the debate, *The Journal of Environment & Development*, *Vol 15; No:3*, 332-354.

Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis, *Econometrica: Journal of the Econometric Society*, 1361-1401.

Pesaran, M. H., Shin, Y., Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships, *Journal of Applied Econometrics*, *Vol 16; No:3*, 289-326.

Phillips, P. C. B., Perron, P. (1988). Testing for a unit root in time series regression, *Biometrika*, *Vol 75; No:2*, 335–346.

Polity. (2019). Polity IV project, *Integrated Network for Societal Conflict Research*, VA-USA.

Rosser Jr, J. B., Rosser, M. V. (2006). Institutional evolution of environmental management under global economic growth, *Journal of Economic Issues*, *Vol 40; No:2*, 421-429.

Scruggs, L. A. (1998). Political and economic inequality and the environment, *Ecological Economics*, *Vol 26; No:3*, 259-275.

Shahbaz, M., Khan, S., Tahir, M. I. (2013). The dynamic links between energy consumption, economic growth, financial development and trade in China: fresh evidence from multivariate framework analysis, *Energy Economics*, *Vol 40;* 8-21.

Tarverdi, Y. (2018). Aspects of Governance and CO2 Emissions: A Non-linear Panel Data Analysis. *Environmental and Resource Economics*, *Vol 69; No:1*, 167-194.

Torras, M. (2005). Income and power inequality as determinants of environmental and health outcomes: some findings, *Social Science Quarterly*, *Vol 86; No:1*, 1354-1376.

Torras, M., Boyce, J. K. (1998). Income, inequality, and pollution: a reassessment of the environmental Kuznets curve, *Ecological Economics*, *Vol 25; No:2*, 147-160.

WDI. (2019). World Development Indicators, *The World Bank*, Washington D.C.

You, W. H., Zhu, H. M., Yu, K., Peng, C. (2015). Democracy, financial openness, and global carbon dioxide emissions: heterogeneity across existing emission levels, *World Development*, *Vol 66;* 189-207.

Yusoff, M. B. (2010). The effects of real exchange rate on trade balance and domestic output: a case of Malaysia, *The International Trade Journal*, *Vol 24; No:2*, 209-226.

Zivot, E., Andrews, D. W. K. (2002). Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis, *Journal of Business & Economic Statistics*, *Vol 20; No:1*, 25-44.