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Democracy and Environment Quality in Selected Countries: An Application of Panel Data

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Abstract

This study investigates the relationship between quality of environment and democracy among different countries over the period of 2002 - 2012. Democracy and accumulated democracy indices have been considered as political inequality variables influencing the quality of the environment among different countries in the reduced form of Kuznets' environmental curve (EKC) hypotheses model. The empirical analysis is conducted using four panel data sets for countries with different HDI from 2002 to 2012. The results indicate a significant positive relationship between the level of democracy and capital accumulation of democracy among all country groups. This relationship in group of countries with high human development index acts in form of N reversed which is the environmental Kuznets curve. This relationship in groups of countries with high, medium and low human development indices is in form of N. Based on the results, improvement of democracy indices leads to a better environment quality. Therefore, applying the relevant policies with democracy condition improvement in different countries, specifically in countries with low and medium human development indices, can make a positive impact on improving the quality of environment in these countries.

Keywords: Environment Quality, Environmental Kuznets Curve Hypothesis, Democracy Level, Democracy Stock.
JEL Classification: K33, O13. C23.

1. Introduction

In the literature on environmental economics, the environmental Kuznets curve (EKC) hypothesis plays an important role in analyzing the environmental consequences of economic development (income

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growth) .The EKC postulates an inverted-U shaped relationship between economic growth and certain types of pollution. In examining the EKC, studies initially rely on a simple reduced-form model in which measures of environmental quality (e.g., SO2 and CO2 emissions) are specified as only a function of income (e.g., Grossman andKrueger,1991; Shafik,1994; Agras and Chapman, 1999).

Although the recent EKC literature has identified several variables other than income affecting environmental outcomes, a less widely recognized variable is democracy, and stock of democracy (Gallagher and Thacker, 2008).Therefore, in this study, democracy and democracy stock have been considered as political variables which affect environment quality, in different countries. The countries studied, are classified into four categories based on the human development index including the countries with very high human development index, the countries with high human development index, the countries with medium human development index and countries with low human development index. Given that studies conducted on the environmental Kuznets curve have appraised the simple pollution indices like CO_2 and SO_2 (e.g. Stern et al., 1996; Kaufmann et al., 1998; Zarzoso and Morancho, 2004), in the present study, the intended model is evaluated using the environmental quality composite index (EPI).

The remainder of this paper is organized as follow: Section 2 investigates the literature review; Section 3 highlights modeling and methodology, Section 4 highlights empirical results, and the last one concludes with a summary of the main findings and policy implications.

2. Literature Review

Any contemporary empirical investigation that aims to identify the cross-national determinants of environmental quality must first situate itself within the EKC literature. In a now-classic study, Grossman and Krueger (1991) estimated the environmental impacts of the North American Free Trade Agreement (NAFTA) in Mexico and found a similar relationship between environmental degradation and levels of income - hence the term Environmental Kuznets Curve. As countries begin to raise their incomes, rates of natural resource depletion and

environmental pollution should proceed rapidly. When incomes reach higher levels later in time, they are able to lower their levels of environmental degradation.

A wide literature has been developed around the notion of the EKC, and it is not well understood in policy circles (Holtz-Eakin, Selden, 1995; Stern et al., 1996; Kaufmann et al., 1998 and List and Gallet, 1999).

In later studies, the models were analyzed using cross-sectional and panel data separately for every country to show the ECK hypothesis between pollution and income. Cole et al. (1997) found the evidence showing that only local pollution was consistent with EKC hypothesis. Herbagh et al. (2002) stated that the existence of an inverted U-shaped curve pattern is very sensitive to the changes in nations, cities and the sampled periods. The existence of EKC was investigated by Martinez-Zarzoso and Bengochea-Morancho (2004) in 22 member countries of OECD. No evidence was found for the existence of EKC in Turkey using the data of time series between the period of 1963 and 2003 related to the carbon emission and the panel data related to the sulfur emission between the period of 1992 and 2001.

Liao and Cao (2013) proved through the evidence of panel data for 132 countries that as the income increases, the amount of Carbon emissions per capita increases as well and when income reaches a specific level, the increase in Carbon stops. It also states that the results would depend on time and the countries. EKC is the common assumption in experimental literature regarding the pollution–income models. The explanatory variables have been less investigated in the mentioned models. Therefore, researchers have recently surveyed the democracy variables as effective political inequality variables for environmental quality in reduced model of Kuznets hypothesis.

The studies related to the effectiveness of democracy in environment are limited to two types: adverse effect or ineffectiveness of democracy in environmental quality and direct and positive effect of democracy on environment quality. First studies against the effectiveness of democracy in environmental quality are reported. Robert and Park's (2007) state that democracy almost has no impact on the emission rate of the pollution index CO_2. Scrogges (1998) mentioned that there is an insignificant and negligible relationship

between environmental quality indices (dissolved oxygen demand, particulate matter and waste pollution) and democracy controlling for the impact of income inequality.

Second, we concisely report the studies done regarding the meaningfulness and positive relationship between democracy and environmental quality. Ericsson and person (2002) found that the impact of the income distribution equality on pollution depends on democracy index. With full democracy and stability in other circumstances, more equality of income distribution causes less pollution and vice versa. Wilson and Damania (2002) concluded that political competitions decrease environmental degradation. Political competitions also compel politicians to follow up social welfare. Jacobs (2002) compares environmental awareness and anxiety in Brazil, Latin America and Europe. He states that Brazilian border residents relate their anxiety about their surrounding environment to the international considerations. Moreover, international concerns about domestic environment are related to the domestic social environmental activities. Fredricson et al. (2005) investigated the data of 82 developing countries and 22 OECD member countries, world's top oil producers during 1996-2000. Their results showed that democratic participation depends on electoral competition and vice versa. High political competitions would improve the environment policy and this notably happens in countries with high levels of democratic participation. Hold and Hervey (2009) appraised the role of democracy in climate change concluding that governments play a key role in national and international policies. Governments which are responsible for international agreements, and legislation and technology should stop pollution. Mol (2010) stated that the EKC relationship between deforestation and democracy is significant. In an autonomous system or mature democracy, the rate of deforestation is relatively low, and the rate of deforestation in pseudo-democratic counties, democratic peak transition, is higher. Democracy is more important than income as a determinant of deforestation. Garcia (2010) surveyed the relationship between democracy and environmental quality for 19 countries in Latin America through simultaneous equations system using panel data during 1995-2008. The results indicated that democracy had a positive impact on environmental quality. Bernard et al. (2010) studied environmental condition in the presence of strong and weak democracy where people

individually or together control environment consequences via government. The results showed that democrat regimes produce less pollution than autocrat ones.

Yelin Tan (2012) investigated whether transparency policy can be created in the presence of domineering policy and how the transparency policy affects environment space improvement. He states although transparency is less expected in bureaucratic atmosphere of China with its dictatorship, non-governmental organizations (NGO) are able to create the international chain to help the environment.

Chen (2013) studied the relationship between democracy and environmental performance and the factors that has made this relationship. He concluded that democratic countries which have higher environmental performance are more effective in environmental health section.

However, some studies have reported different findings in terms of the relationship between democracy and environmental quality. Midlarsky (1998) declared that the indices of deforestation, CO_2 emission and soil erosion by water show a negative and significant relationship between democracy and environment. Nevertheless, the protected area index indicates a positive and meaningful relationship and the indices of the water availability and soil erosion by toxic chemicals do not show any significant relationship between democracy and environment. Pelegrini and Gerlagh (2005) stated that the impact of democracy on environment is not considerable; however, corruption can seriously affect the environment. Therefore, the increase in democracy indices must be accompanied by the decrease in corruption to motivate the strict environmental policies. Pavitkina et al. (2013) declared that generally the impact of democratic government policies on marine environment is negative. This negative effect can decline when the level of income changes from low to average. Wealthy countries with the net national income of over *20,000* dollars, nevertheless, report a positive effect.

3. Theoretical Principles and Model Structure

3.1 Environmental Kuznets Curve (EKC)

Simone Kuznets (1963) stated an inverted U-shaped relationship between income inequality and the per capita income. He indicated

that when per capita income increases, income inequality, at first, increases and then after reaching the certain level (turning point) it starts to decline. It means that, at early stages of the growth, income distribution becomes more and more unequal. It goes towards equality by the continuation of the economic growth.

The relationship between the per capita income and the income inequality can be depicted with a bell-shaped curve, well-known as Kuznets curve. Kuznets curve has found a new concept since1990s. The experimental samples regarding the relationship between the environmental degradation and the per capita income showed an inverted U-shaped relationship similar to the relationship between the per capita income and the income inequality in early Kuznets curve. After that, Kuznets curve has been used to describe the relationship between environmental quality levels and per capita income, named Environmental Kuznets Curve (EKC) for the first time in Panauto's research, 1993 and Dinda, 2007. Accordingly, at the first stage of the economic growth, environment is not taken into account because of the low level of environmental awareness and inaccessible environmental technologies. Environmental degradation increases by the income growth, declining after reaching the certain level of income, shown with an inverted U– shaped curve.

At the higher levels of economic growth, advanced environmental technology and higher level of environmental awareness would reduce the environmental degradation and environmental quality would be improved by income reaching the turning point. This process is indicative of natural economic development from an agriculture based economy to a polluting industrial economy and finally to a clean economy based on services (Dinda, 2007).

Studying the experimental studies about Kuznets hypothesis based on the simple theoretical model introduced by Andreoni and Levinson (2001) showed the following reduced formula is used to determine the relationship between income and environmental quality.

The classical reduced functional form representing the EKC is given by Eq(1)

$$EQ = \alpha \quad + \beta_1 Y_t + \beta_2 {Y^2}_t + \beta_3 {Y^3}_t + \beta_4 Z_t + \varepsilon_t \qquad (1)$$

Where EQ represents the general level of environmental stress and Y the income per capita. The inverted U-shaped curve deriving from such a formula requires β1 to be positive and β2 to be negative.

3.2 How is Environmental Quality Affected by Democracy?

Different discussions about democracy and environment imply that the relationship is not clear and ambiguous. For instance, Battig & Bernauer (2009) believed that although the impact of democracy on political commitment towards environment is positive, its impact on consequences of policies including the pollutants emission is ambiguous. On the other hand, some economists such as Glenditsch and Sverdrup (1995) insist on the positive relationship, and others such as Dinda (2011) mentioned the inverse relationship between democracy and environmental quality and other researchers like Mildarsky (1998) stated that if the groups playing the most important role in governments are not interested in environmental legislation, democracy may not have any effect on the increase in environmental quality.

Democracy means freedom in the press, freedom of speech, citizenship rights, equality and social justice. Enhancing the political participation, democracy allows the citizens to access more information, raising the environmental awareness and also valuing their opinions regarding the country as well as increasing the sense of responsibility for their surroundings amongst people. People can raise the environmental awareness, supporting the environmental justice and rights by lunching environmental campaigns. Given that when the level of income and life quality enhances, the higher level of environmental quality is expected, democracy can bridge the gap between the society's needs and politicians. Hence democracy creates international agreements, regulations and generally policies encouraging the politicians to make a purer environment (Danny García Callejas, 2010). Figure 1 shows the relationship between the environment quality and democracy.

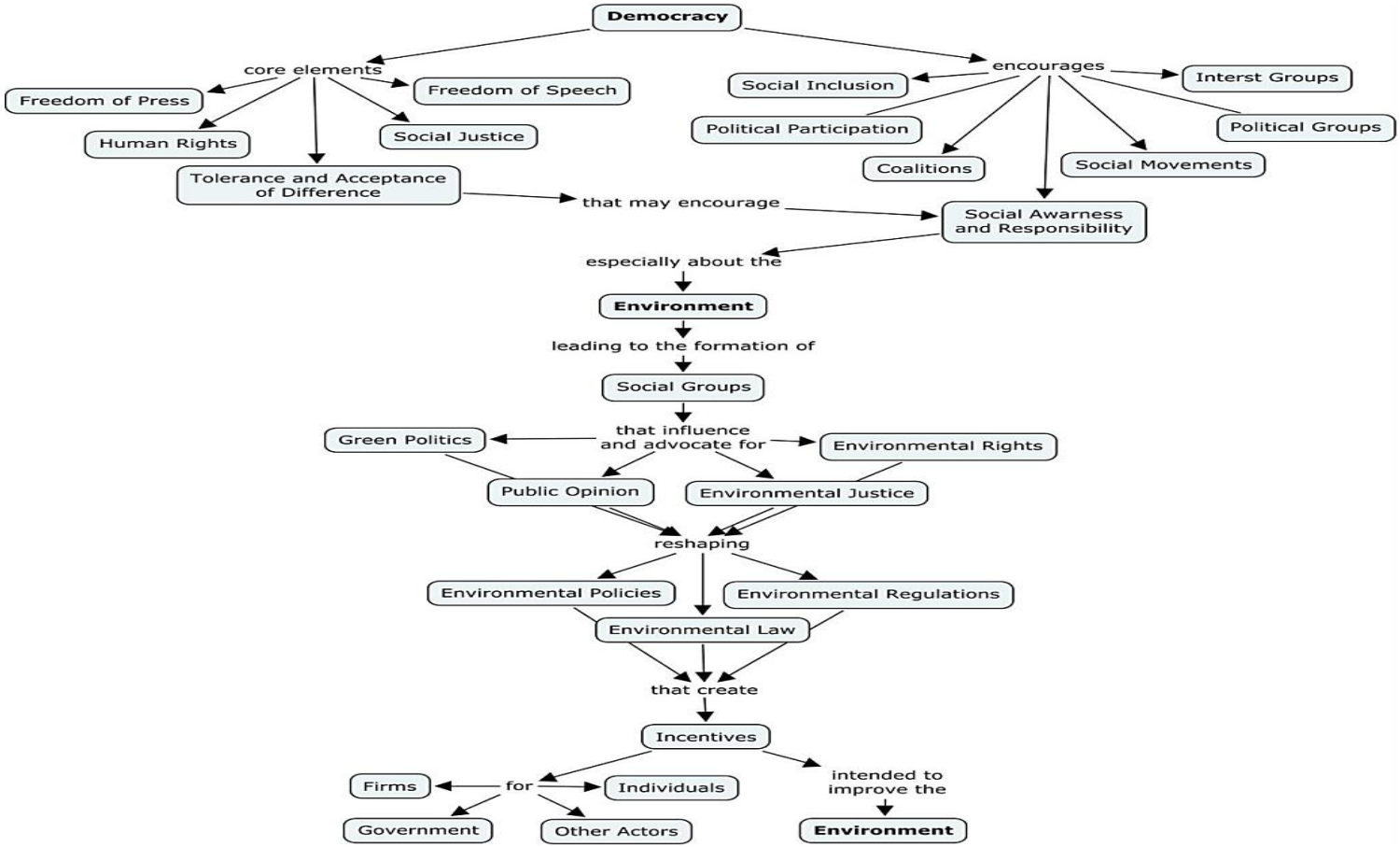

Figure 1: Democracy and the Environment

Callejas (2010) believed that the relationship between democracy and environmental quality can be investigated in four aspects. First, democracy highlights the problems with the political rights and freedom of information; hence people can hold political parties to access more information. Therefore, politicians have to pass environmental laws to satisfy the people. Second, democracy causes the division of political power, because it empowers not only one special class but all the citizens. Therefore, the environmentalists can cooperate more in enhancing the environmental quality. Third, democratic societies have more respect for regulations, private property rights and international agreements.

Finally, democracy can lead to economic equality. Therefore, the absolute power of the specific class would reduce, compelling the politicians to pass the social and economic laws according to the public opinions. By reducing the political corruption and collusion, they have to follow the regulations (including the environmental regulations), so that the environmental quality would be enhanced. Positive effect of democracy on the improvement of environmental quality is shown in Figure 2.

The relationship between economic development and environmental quality can be direct, inverse or a composition of both of them in a long period of time. This has been the topic of many studies and surveys. The process of the studies' development determined that during the recent decades there have been two general approaches, resulting in the third one. The first one focuses on a kind of trade-off between economic growth and the preservation of the environmental standards which means that the economic growth leading to the increase in production and consumption requires more raw materials and energy as input and resources and a growth in environment degradation in return. In other words, the increase in the level income by the process of economic development resulting in more exploitation of natural resources and environmental degradation declines the human welfare. As a result, the economic development is considered as a threat. Consequently, politicians have to make a decision to take the risk of environmental issues by focusing on the economic growth, or to resort to accept the lower level economic growth in order to protect the environment. There is a second approach on the other side of the spectrum. This approach

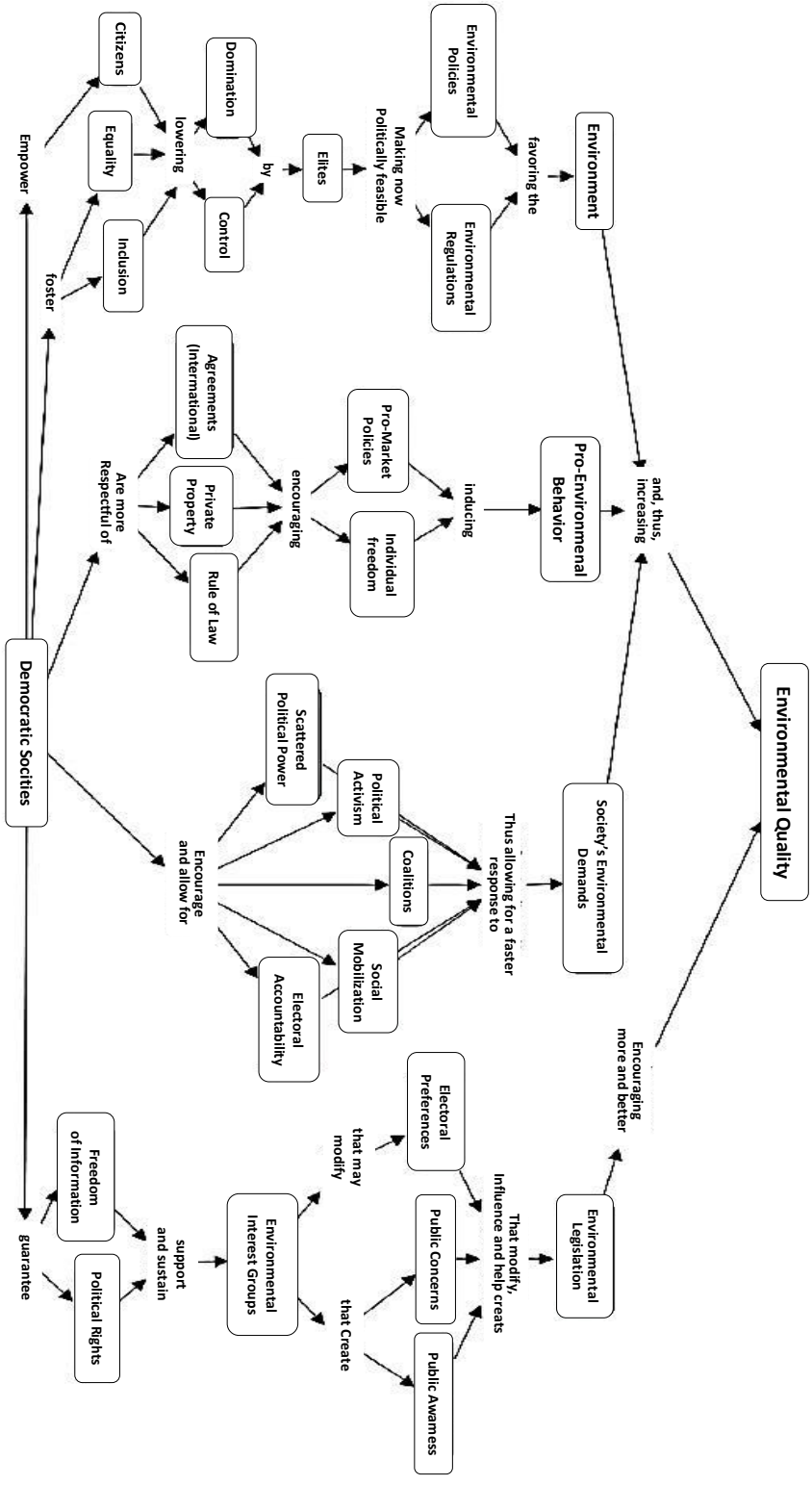

Figure 2: Theories Linking Democracy and Environment Quality

states that improvement of environmental quality parallels the economic growth and we need to follow the economic growth's footsteps to improve the environmental standards. The higher level of income basically increases demand for a better environmental quality, which means the acceptance of environmental regulations and criteria.

The third approach, brought up in 90s, shows an inverted u-shaped relationship between environmental pollution and economic growth known as environmental hypothesis. According to the Kuznets curve hypothesis, economic growth is at first accompanied by the environmental degradation until it reaches the maximum point, then the environment improves at the higher level of growth which is observable in figure (3) – (Pazhoyan and Morad Hasel, 1386).

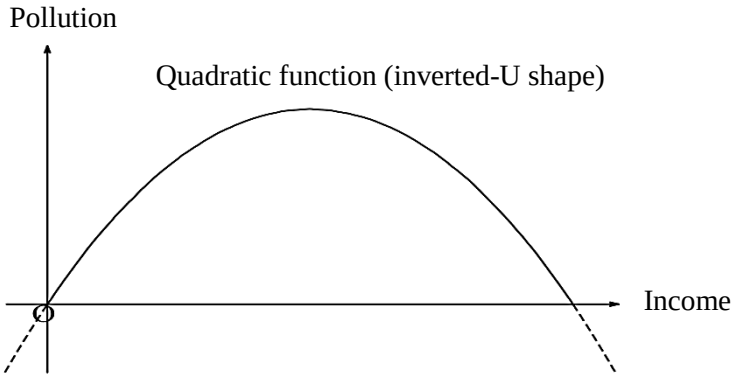

Figure 3: Inverted U-Shaped Relationship between Pollution and Income

The aim of this study is to show how democracy impacts the environmental quality for a group of countries with different levels of income classified based on the human development indices during (2002-2012) evaluated and analyzed in panel data. Therefore, the relationship can be clarified by the following formula according to Galacker and Tacker's study (2008).

$$\ln(POL/P)_{it} = \alpha_{it} + \beta_1 \ln(Y/P)_{it} + \beta_2 (\ln(Y/P)_{it}))^2 + Z_{it} + \varepsilon_{it} \qquad (2)$$

Where $\left(\frac{POP}{P}\right)$ an index of environmental quality is, $\left(\frac{Y}{P}\right)$ is the level of income per capita, i shows the target countries and t is the time period. Z is also a vector of variables such as democracy affecting

environmental quality. Researchers have introduced different indices to measure the environmental quality. These indices are divided into two groups of the simple ones (such as CO_2, SO_2 …) and the compound ones such as environmental performance index (EPI) and environmental sustainability index (ESI), designated for the model depending on the aim of the research and statistics limitations. EPI is the index of environmental performance and its data are obtainable from www.epi.yale.edu. Environmental performance index, published in 2002, classifies countries based on the importance they attach to the environment including two aspects. One providing protection for human health against environmental threats and the other one is protection for ecosystem.

Different indices are used to measure democracy freedom house (FH) and polity *2* is the most important one. Some economists worked on this FH index. This index indicates the level of democracy as well as satisfying the citizens' requests for supporting their environment. This index comprises freedom of speech, information transparency and the level of corruption formed by two sections, private right (PR) and civil freedom (CF) resulting in FH index. This index ranges from 2 to14, from the most democratic to the most autocratic country, respectively. Moreover, polity2, used in many studies, ranges from – 10 to +10, from the full autocracy to the full democracy, respectively. According to this, following model is used to appraise the impact of democracy on environment in the studied countries.

(3)

$$\ln(POL/P)_{it} = \alpha_{it} + \beta_1 \ln(Y/P)_{it} + \beta_2 (\ln(Y/P)_{it}))^2 + \beta_3 (\ln(Y/P)_{it}))^3 + \beta_4 DEMLEVEL_{it} + \beta_5 DEMSTOCK_{it} + \varepsilon_{it}$$

where, POL is the level of Environmental Performance Index. $\propto_{it}$ Intercept, Y per capita income, P population and $DEMSTOCK_{it}$ and $DEMLEVEL_{it}$ the level of democracy and democracy stock, respectively. B_i is the model parameter which must be estimated. i is also indicative of the country and t the year. DEMLEVEL variables or the level of democracy fluctuates between – 10 and +10 based on polity2 index. Furthermore, the data related to polity 2 index has been obtained since the beginning of the year of study to measure

democracy stock and applying the annual depreciation rate of 1% from the previous era to it.

DEMSTOCK index is separately calculated for each country according to the following equation:

$$DEMSTOCK_t = \sum_{t=1}^{T} DEMLEVEL_t - \frac{1}{100}\sum_{t=1}^{T-1} DEMSTOCK_t \qquad (4)$$

$DEMSTOCK_t$ and $DEMLEVEL_t$ are democracy stock and the level of democracy in the intended year, respectively. On the right side of the equation, the sum of the DEMLEVEL indices are separately calculated up to the specific year calculated separately for each country up to the intended year. Sum of the DEMSTOCK indices up to the year before intended year are calculated afterwards and 1% rate of depreciation is applied to it. Finally, the difference between the DEMLEVEL indices and the depreciated democracy stock is the democracy stock index in the intended year. DEMSTOCK calculation is important, because the current DEMLEVEL does not have a considerable effect on human resources development (Gerring et al., 2012), although the historical experiences of a country influence more on the human resources development than democracy. DEMLEVEL was only applied as an explanatory variable to the model in the previous studies, but the economists such as Gering et al. (2005) and Gallacker and Thacker (2008) also applied the DEMSTOCK to the model and tested its meaningfulness. System formation is a historical phenomenon and its structure is constructed during a time period regardless of the temporary changes, hence future and past effects are something to be considered. From this point of view, the whole democracy for a system must be considered as a stock variable not the DEMLEVEL for a specific period of time. The present democratic and autocratic thoughts are the concepts inherited from the past decades and centuries (Gerrring et al., 2005). The cumulative effect of the previous systems and the present conditions can clearly depict the democracy conditions and its impact on society, politics and economics.

As expected, there is an inverse relationship between environmental pollution and democracy, thus β_S, β_A must be negative

and significant. As a result, considering the other circumstances to be constant, we anticipate that the increase in democracy during a period of time in a country can result in the improvement of environmental quality.

4. Experimental Results Analytics

4.1 Distinction Tests

An important advantage of panel data compared to time series or cross-sectional data sets is that it allows identification of certain parameters or questions, without the need to make restrictive assumptions. That is, panel data are not only suitable to model or explain why individual units behave differently but also to model why a given unit behaves differently at different time periods (for example, because of a different past).

4.2 Experimental Results Analysis

Target countries are divided into four groups based on the human development index including countries with very high human development index, high human development index, medium human development index and low human development index. Kuznets environmental hypothesis model has been evaluated for four groups with DEMLEVEL and DEMSTOCK indices.

Countries introduced by UNO include 168 (out of 192) members of UNO. 24 members of UNO are excluded due to the lack of information regarding the human development index. Target countries are divided into different groups based on the UNO classification. Iran belongs to the group of countries with high human development index, according to the countries classification by UNO.

Table 1: A Comparison of Indicators between the Groups of Countries

Index / group countries	HDI	Y	EPI
countries with very high human development index	0/875	35142	66/07
countries with high human development index	0/751	6653	55/4
countries with medium human development index	0/632	2558	46/5
countries with low human development index	0/468	676/89	37/63

Table 1 shows the means of the human development indices, per capita income and EPI in four groups of the target countries.

A reduction in human development index (HDI), as seen in table 1, is observable moving from the countries with very high human development index towards the countries with low human development index. It means the maximum of this index belongs to the countries with very high human development index and the minimum belongs to the countries with low human development index. Maximum and minimum of environmental performance indices belong to the countries with every high and low human development indices, respectively. Hence, we see that the change in environmental performance is in accordance with the change in human development index among the target countries.

4.3 Environmental Performance Index

Environmental performance index (EPI) comprises two main groups, environmental health and ecosystem vitality. Environment health calculates the protection for human health against the hazards induced towards environment. It calculates the ecosystem vitality, resources management and ecosystem protection. These two groups are divided into nine subgroups including the most important environmental issues such as weather quality, forests, aquatics, environmental variation, water resources and so forth. These nine groups are calculated by 20 indices for different countries. Total classification and subgroups of the environmental performance index are shown in Figure 4.

The EPI index ranges from *0* to *100*,as zero is the indicative of the maximum distance from the aim (minimum value) or the worst environmental performance and *100* is the indicative of the minimum distance from the aim (maximum value) or the best environmental performance. Figure 5 shows this concept.

Figure 4: The Framework of Indicators EPI

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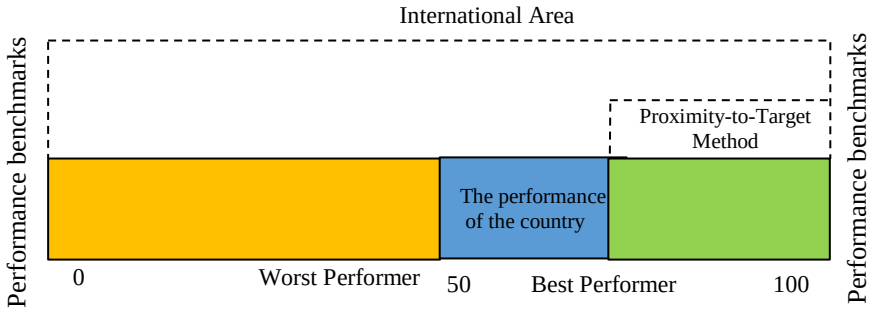

Figure 5: Performance Benchmarks EPI

4.4 Model Kind Identification Tests

Before estimating the model, it is necessary to determine the appropriate approach based on fixed or random effect models.

4.4.1 Individual Fixed Effect Test

F-Limer test has been used in this paper to find the features of the data as being pooled or panel. The findings show all data related to the countries group are panel. F-limer indicates the rejection of hypothesis (H0). Rejection of null hypothesis means that the intercept for each test is different, so the model is a panel.

4.4.2 Fixed Effects Test vs. Random Effects Test

For the panel analysis, the F test and Hausman test is employed to determine whether Fixed Effect model or Random Effect model is more appropriate to be employed. Table 2 shows the results for Fixed Effects Model, Random Effects Model, and Pooled Model.

We use the F-limer and Hausman tests for each group respectively, based on table 2 regarding the EPI index in different countries group.

Table 2: F-limer and Hausman Test Results in Regard to EPI

Test group countries		F-Limer	Hausman	Result
countries with very high HDI	Prob	0/0000	0/1430	Random effect
	Accept or reject the hypothesis H_0	195/06029	8/250293	

countries with high HDI	Prob	0/0000	0/0034	Fixed effect
	Accept or reject the hypothesis H_0	283/092568	17/639184	
countries with medium HDI	Prob	0/0000	0/0325	Fixed effect
	Accept or reject the hypothesis H_0	528/615004	12/170765	
countries with low HDI	Prob	0/0000	0/5925	Random effect
	Accept or reject the hypothesis H_0	850513/765	706024/3	

In countries with very high human development index, F-limer shows the rejection of H_0 and the model is panel. Moreover, Hausman test confirms the hypothesis (H_0) and the model is random regarding the random and fixed effects in every segment. F-Limer and Hausman tests show the rejection of the hypothesis (H_0) in countries with high human development index and the model fixed effects. In countries with medium human development index, F-Limer and Hausman tests indicate the rejection of hypothesis (H_0) and the model is fixed effects. In countries with low human development index, F-Limer test also indicates the rejection of hypothesis (H_0) and the model is panel; Hausman test confirms the hypothesis H_0 and the model is random in each segment.

4.5 Model Evaluation

As mentioned before, the model introduced in this paper is evaluated for EPI index between 2002 and 2012 in four country groups. Kuznets environmental Curve model is in the following form with EPI index:

$$\ln(EPI/P)_{it} = x_{it} + \beta_1 \ln(Y/P)_{it} + \beta_2 (\ln(Y/P)_{it}))^2 + \beta_3 (\ln(Y/P)_{it}))^3 + \beta_4 DEMLEVEL_{it} + \beta_5 DEMSTOCK_{it} + \varepsilon_{it} \quad (5)$$

Table 4: Estimate for EPI Model Indicates in Group of Countries with Very High Human Development Index

Variables	Coefficient	.Std. Err	t-statistics	Prob
LOG(Y?)	-3/929801***	0/6013757	-6/53	0/000
LOG(Y?)^2	0/3996961***	0/060128	6/65	0/000
LOG(Y?)^3	-0/013425***	0/0019956	-6/73	0/000
DEMLEVEL	0/0061204***	0/0007983	7/67	0/002
DEMSTOCK	0/0001621***	0/0000526	3/08	0/000

Note: Significance at the 1% level is denoted by ***, **denoted significance at the level 5% , and * significance at the 10% level.

This relation aims to find out if the relationship among the variables such as $DEMLEVEL_{it}$ and $DEMSTOCK_{it}$ is significant with EPI index for target countries. The results are depicted in the following tables. After conducting multicollinearity and other specification tests, the results are show in Tables 4 to 7.

The model with EPI as the dependent variable has been estimated with GLS method and autoregressive process in order to remove the autocorrelation and heteroscedasticity for the countries with very high human development index. The results indicate the positive and significant relationship between democracy and the environmental performance index. Furthermore, there is a negative relationship between the logarithms of the first and the third exponent of the per capita income and the dependent variable, so by the increase in the two independent variables, the dependent variable decreases. However, there is a positive relationship between the logarithm of the second exponent of the per capita income and environmental performance index (EPI), meaning that by the increase in per capita income, environmental quality increases. It implies that there is an inverted N-shaped relationship between EPI and per capita income in all target countries. We study the relationship between the level of democracy and democracy stock with dependent variable, after we study the relationship between the per capita income and the environmental performance index.

According to the results of table 4, there is a positive and significant relationship between the environment quality and the level of democracy, so the increase of one percent in the level of democracy index can make a change of **0/0061204** percent in environment performance index. Conclusively, when the democracy conditions improve, environmental quality improves too in countries with very high human development index. Similarly, democracy stock has a positive and significant effect on environmental quality. The increase of one percent in democracy stock can make a change of **0/0001621** percent in environmental quality.

The model with EPI as the dependent variable has been estimated with GLS method and autoregressive process in order to remove the autocorrelation and heteroscedasticity for the countries with high human development index. The results indicate the positive and significant relationship between democracy and the environmental

Table 5: Estimate for EPI Model Indicates in Group of Countries with High Human Development Index

Variables	Coefficient	Std. Err.	t-statistics	Prob
LOG(Y?)	1/065485**	0/5240035	2/03	0/042
LOG(Y?)^2	-1/1212151*	0/0636058	-1/91	0/057
LOG(Y?)^3	0/0046838*	0/0025576	1/83	0/067
DEMLEVEL	0/0032306***	0/0007822	4/13	0/000
DEMSTOCK	0/0004094***	0/0001286	3/18	0/001

Note: Significance at the 1% level is denoted by ***, **denoted significance at the level 5% , and * significance at the 10% level.

performance index. Furthermore, there is a positive relationship between the logarithms of the first and the third exponent of the per capita income and the dependent variable, so by the increase in the two independent variables, the dependent variable increases. However, there is a negative relationship between the logarithm of the second exponent of the per capita income and environmental performance index (EPI) meaning that by the increase in per capita income, environmental quality decreases. Hence, there is an N-shaped

relationship between pollution and income in all target countries. We study the relationship between the level of democracy and democracy stock with dependent variable, after we examined the relationship between the per capita income and the environmental performance index.

There is a positive and significant relationship between environmental quality and the level of democracy. According to table 5, increase of one percent in the level of democracy index can make a change of **0/00032306** percent in environmental performance index, which means when democracy condition improves, environmental quality improves too in the countries with high human development index. Similarly, democracy stock has a positive and significant effect on environment quality, so the increase of one percent in democracy stock can make a change of **0/0004095** percent in environment quality.

Table 6: Estimate for EPI Model Indicates in Group of Countries with Medium Human Development Index

Variables	Coefficient	Std. Err.	t-statistics	Prob
LOG(Y?)	1/301714***	0/4223477	3/08	0/002
LOG(Y?)^2	-0/1460072**	0/0635733	-2/30	0/022
LOG(Y?)^3	0/0054442*	0/0031525	1/73	0/084
DEMLEVEL	0/0049267***	0/0013863	3/55	0/000
DEMSTOCK	0/0002895**	0/0001133	2/56	0/011

Note: Significance at the 1% level is denoted by ***, **denoted significance at the level 5% , and * significance at the 10% level.

The model with EPI as the dependent variable has been estimated with GLS method and autoregressive process in order to remove the autocorrelation and heteroscedasticity for the countries with medium human development index. The results indicate the positive and significant relationship between democracy and the environmental performance index. Furthermore, there is a positive relationship between the logarithms of the first and the third exponent of the per capita income and the dependent variable, and so by the increase in

the two independent variables, the dependent variable increases. However, there is a negative relationship between the logarithm of the second exponent of the per capita income and environmental performance index (EPI), meaning that by the increase in per capita income, environmental quality decreases. Hence, there is an N-shaped relationship between pollution and income in all target countries. We examined the relationship between the level of democracy and democracy stock with dependent variable, after we investigated the relationship between the per capita income and the environmental performance index.

According to table 6, there is a significant and positive relationship between the environmental quality and the level of democracy, so the increase of one percent in the level of democracy index can make a change of **0/0049267** percent in the environmental performance index. It means that when democracy condition improves, environment quality improves too in countries with medium human development index. Similarly, democracy stock has a positive and significant effect on environmental quality, as the increase of one percent in democracy stock can make a change of **/0002895** percent in environmental quality.

Table 7: Estimate for EPI Model Indicates in Group of Countries with Low Human Development Index

Variables	Coefficient	Std. Err.	t-statistics	Prob
LOG(Y?)	0/6589243**	0/3142195	2/10	0/036
LOG(Y?)^2	-0/0926468*	0/0496524	-1/87	0/062
LOG(Y?)^3	0/0044555*	0/0025896	1/72	0/085
DEMLEVEL	-0/0018089**	0/0008633	-2/10	0/036
DEMSTOCK	0/0006083***	0/0001311	4/64	0/000

Note: Significance at the 1% level is denoted by ***, **denoted significance at the level 5% , and * significance at the 10% level.

According to table 7, there is a positive relationship between the logarithms of the first and the third exponent of the per capita income and the dependent variable, so by the increase in the two independent

variables, the dependent variable increases. However, there is a negative relationship between the logarithm of the second exponent of the per capita income and environmental performance index (EPI) meaning that by the increase in per capita income, environmental quality decreases. Results show that there is an N-shaped relation between environmental performance index and gross income. Hence, there is an N-shaped relationship between pollution and income in all target countries. We examined the relationship between the level of democracy and democracy stock with dependent variable, after we study the relationship between the per capita income and the environmental performance index.

According to table7, there is a negative and meaningful relationship between the environmental quality and the level of democracy. The increase of one percent in the level of democracy index can make a change of **%-0/00180089** in environmental performance index, meaning that the environmental quality decreased in countries with low human development index, when democracy condition improves. On the contrary, democracy stock has a positive and significant effect on environmental quality, as the increase of one percent in democracy stock can make a change of **0/0006083** percent in environment quality.

5. Conclusion and Policy Implications

Democracy means the freedom of the press, social justice, and freedom of speech, human rights and the acceptance of social and individual differences. Democracy makes more space for political groups, social movements, social capacity, coalition, political participation, social responsibility and awareness. Tolerating and accepting the differences are the internal factor of the democracy leading to the raising social responsibility and awareness. The social awareness and responsibility include the environmental issues forming social groups. The social group supports the environmental rights, social justice, public opinions and green policies resulting in the renewal of the environmental policies and laws. Therefore, there is a close relationship between environment and democracy. Given this, investigating the impact of democracy on environmental quality in the group of different countries is the main purpose of this paper. Target

countries are classified in four groups: countries with very high human development index, countries with high human development index, countries with medium human development index and countries with low human development index. The model used is based on the reduced form of Kuznets environmental hypothesis (EKC) and the level of democracy and democracy stock indices are considered as political inequality variables affecting the environmental quality. These two indices are calculated with the data of polity2 index. Combinational indices of environmental performance are used as a criterion for environmental quality. The index is calculated using 20 factors for different countries, ranging from 0 to 100, which zero shows the low performance and 100 shows the high performance. The index is better in comparison to the simple indices such as $CO_2$and SO_2, because apart from the air quality, it comprises other aspects of environment such as water and sewage quality, water resources and forests quality and so forth.

The results of the F-test indicate the suitability of panel model for estimation model in all four groups of the target countries. The results of the Hausman test shows the suitability of the estimation method with fixed effects for two groups of the countries with high and medium human development index and the suitability of the method with random effects for two groups of the countries with very high and low human index. What is more, the model regarding the environmental performance index is analyzed in different countries. Statistically, the results show that there is a significant relationship between the level of democracy and the democracy stock with EPI. When the democracy conditions improve, environment quality improves too.

Additionally, after appraising the relationship among the environmental quality index and the level of democracy and democracy stock, the accuracy of Kuznets environmental hypothesis has been studied with democracy variables. According to the results of the model estimation, in countries group with very high human development index, all the variables related to income are statistically significant and there is an inverted N-shaped relationship between EPI and per capita income. It means that when per capita income increases environmental performance index decreases, and after per capita

income reaches a certain level, the environmental performance index starts to increase. The increase in EPI is considered as an improvement in environmental quality, and the decline shows poor environmental performance. Hence, the increase in EPI is in accordance with the reduction in environmental pollution.

The results of the model estimation in the groups of countries with high, medium and low human development index depict that all variables related to per capita income are statistically significant and there is an N-shaped relationship between per capita income and environmental performance index. At first by the increase in per capita income EPI increases too and after the per capita income reaches a certain level, EPI starts to decrease. Democracy makes more space for political participation raising awareness. It also attaches more importance to public opinions in a country, encouraging them to be more responsible for their surroundings. Therefore, the followings are highly recommended. Forming social groups and political organizations supporting the environment in different countries lead to raising awareness, environmental rights and justice. In different countries group, when the mean of per capita income increases, the society demands higher environment quality. The environment quality improvement in different countries group is the result of the formation of social groups, political organizations supporting the environment and the increase in income. Therefore, applying the policies regarding the improvement of democracy and public participation especially in countries with medium and low human development index results in the improvement of environmental quality and sustainable development. Moreover, facilitating the formation of NGOs leads to extension activities within the different domains of democracy such as environment in different countries group.

It is recommended for future studies that combinational indices such as EPI , ESI, EVI (environmental vulnerability index) , SB (surplus Bio capacity) are taken into consideration as well as the simple ones within the domain of environmental issues involving different aspects of effective factors in environment quality. It is also wise to study separately the effective factors in Kuznets environmental curve such as the effects of scale, technology and combination in future studies .Given this, it is possible for Kuznets

environment hypothesis curve to transform in the presence of the environmental combinational indices.

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