ECONOMIC GROWTH AND ENVIRONMENTAL QUALITY IN TURKEY: ARE THEY OPPOSITE CONCEPTS?

E.Yasemin Bozdağlıoğlu

Adnan Menderes University

Assistant Professor

yuyar@adu.edu.tr

Mesut Çakır

Adnan Menderes University

Assistant Professor

mcakir@adu.edu.tr

Abstract

The growing interest in global environmental issues whose importance has been steadily increasing and the demand for environmental quality and their mutual relation with economic growth are closely related. Economic growth, while increasing the level of national income over time, brings with it concerns about environmental quality. The purpose of this study is to examine the relationship between Turkey's economic growth (Gross Domestic Income-GDP) and environmental quality. In this study, the Environmental Kuznet Hypothesis, which assumes a correlation between various indicators of environmental degradation and per capita income in examining the relationship, will be used. The Granger Causality Test and Cointegration Test methods will be used in determining the relationship between the course of environmental degradation in the first phase of economic growth and the degree of environmental effect in the period between 1960 and 2011 (with annual data) in Turkey.

Keywords: *Economic Growth, Environment and Environmental Quality*.

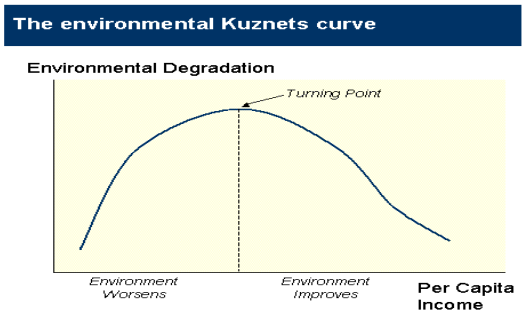
Topic Area: *Trade and Environment (International Economic Themes).*

1. INTRODUCTION

As the interest in global environmental issues rises, the relationship between the demand for environmental quality and economic growth becomes more important. Economic growth, despite an increase in the level of national income over time, brings about concerns about environmental degradation.

Kuznets, in line with the above views, proposed that together with economic growth, income distribution will first deteriorate, but when income keeps rising, injustice in income distribution will decline. This view, known as the Kuznets hypothesis in the economics literature, started to be used to describe the relationship between economic growth and environmental degradation in the 1990s. The view arguing that as economy grows environmental degradation will increase, but after a certain level of growth it will decrease is called the "Environmental Kuznets Curve". (Figure 1)

Figure-1: Environmental Kuznets Curve



Source: Panayotou, 1993.

The Environmental Kuznets Curve assumes that there is a relationship between various indicators of environmental degradation and income per capita. In Figure 1, environmental pollution increases until income level rises the level of Turning Point, but after that level it starts diminishing.

2. THE RELATIONSHIP BETWEEN ENVIRONMENT AND ECONOMIC DEVELOPMENT: THEORY AND LITERATURE

The relationship between economic growth and environmental quality is controversial one. It is generally thought that economic growth deteriorates environmental quality. Beckerman (1992), on the contrary, argues that economic growth is the most important means to prevent environmental degradation.

Panayotou (1993) seems to support this view by arguing that the realization of economic growth is a precondition for preventing environmental degradation especially in developing countries. The actual debate here is as follows: if a country follows growth policies, it will reach a sufficiently high level of income. This way, the country will be strong enough to follow an income-production strategy directed toward preserving and developing the environment. This argument directly conflicts with the pessimistic view of the Club of Rome-global economic growth will be unsustainable unless a zero growth rate is not adopted as a state strategy. The traditional economic theory proposes that there is a trade-off between economic growth and environmental quality. Kuznets (1955) informed that income per capita increases as a result of economic growth, however, in the first level of growth income inequality also rises. Furthermore, he argued that rising income inequality, as a result of continuing economic growth will start diminishing after a certain turning point.

Grossman and Kruger (1991) found that there is a inverted-U type relationship between economic growth and environmental quality. Grossman and Kruger (1991) in their study on urban air polluters, observed that pollution concentration first increased together with income per capita, but later, showed a tendency to decline. Therefore, the shape of the curve is inverted-U type. According to them, as economic growth continues, intensive and effective economic activities cause environmental pollution at first. Later, due to changing production techniques, more productive economic activities are formed, and this situation positively affect the level of environmental quality.

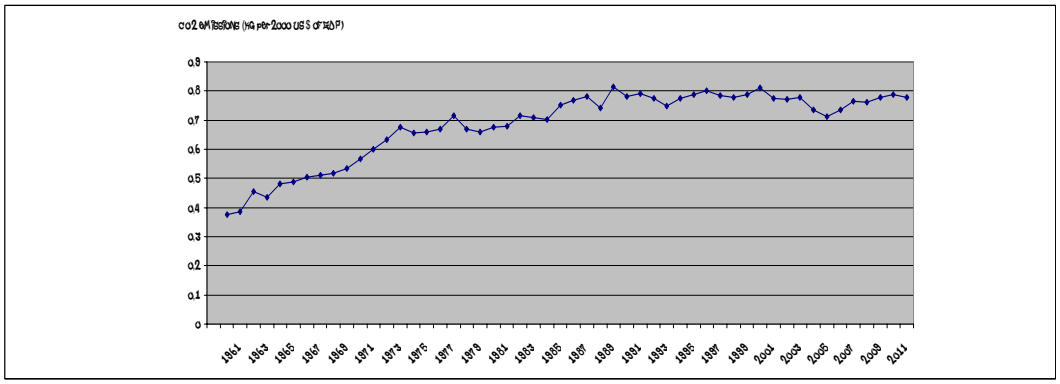
This fact was later termed by Panayotou (1993) as the Environmental Kuznets Curve (EKC). In summary, while developing countries, to increase their economic strength, industrialize by using their natural resources, an increase in their environmental pollution levels is unavoidable.

3. MATERIALS AND METHODS

3.1. Some Indicators Pertaining to Economic Growth and the Environment in Turkey

In Figure 3, per capita carbon monoxide emission values in kg in Turkey for the 1961-2011 period are given. As can be seen in the Figure, the amount of per capita carbon monoxide emission in Turkey in the above-mentioned period shows an upward tendency. This increase in carbon emission in Turkey is also thought to be related to energy consumption and increasing productivity problems in energy use in Turkey.

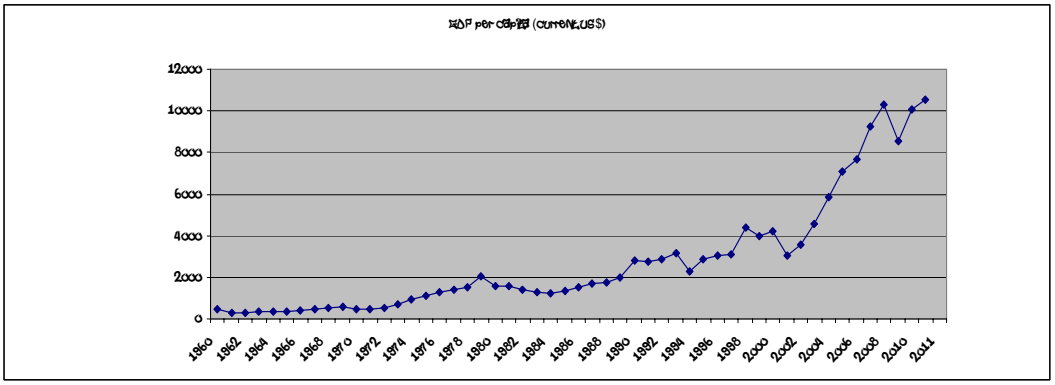
Figure 3: CO2 Emissions (kg per 2000 $ of GDP) in Turkey (1961-2011)



Source: Adopted from the World Development Indicator (WDI) databese.

As can be seen Figure 4, per capita carbon emission increases as GDP per capita in the same period.

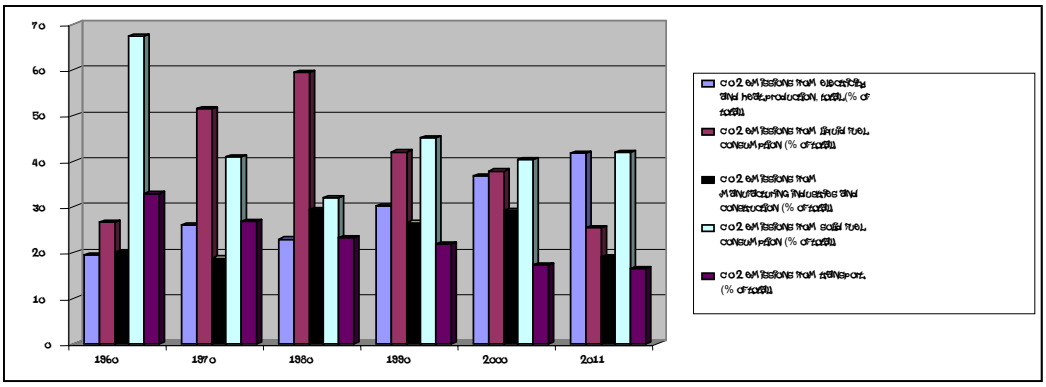
Figure 4: GDP/capita in Turkey (1961-2011)



Source: Adoptede from the World Development Indicator (WDI) databese.

In Figure 5, the sources of carbon emission in Turkey are illustrated. According to the this, the largest source of carbon emission in the 1960, was solid fuel consumption, in the 1980s, it was liquid fuel consumption. The most influential factors in carbon emission were electiricity, heat production and solid fuel consumption in 2011. The increase in these two consumption groups are seen considerably significant.

Figure 5: Turkey's Carbon Emissions in selected years.



Source: Adopted from the World Development Indicator (WDI) databese.

3.2. Scope Of Study, Data Sources And Definition

In this study, in order to show the relationship between economic growth and environmental quality in Turkey, annual time series covering the period between 1960 and 2011 were used. The data used in the study were obtained from the World Development Indicator (WDI). The variables of the study are Gross Domestic Income (GDP) (to represent income), Carbon Emissions (to represent environmental quality) and Population. The logarithm of all the variables used in the study were taken in order to bring variables to the same level and ensure parallelism. Thus, all variables were brought to the same level. All the variables were used in the log-form and calculated on the basis of per capita values.

3.3. Model Specification

In order to analyze the relationship between economic degradation and economic growth, Grossman and Krueger's (1995) model with reduced-form equation was used.

$$E_t = \beta_o + \beta_1 Y_t + \beta_2 Y_t^2 + Z_t + \varepsilon_t \qquad \text{(Equation 1)}$$

In Equation (1) E_t is a dependent variable and represents environmental quality. Y_t and Y_t^2 are independent variables representing national income and

the square of national income respectively. Z_t is another covariates. In this model, it is expected that Y_t will affect E_t as an inverted-U curve. It should be noted that this relationship requires β_1 to be positive and β_2 negative. The reason for using Grossman ve Krueger's (1995) reduced equation model in this study is its ability to illustrate the net effect of national income on environmental quality.

4. RESULTS AND DISCUSSION

4.1. Unit Root Test

The below table shows the result of stationarity and unit root test. To determine the level of cointegration between GDP/capita and Carbon Emissions/capita, the Augment Dickey-Fuller (ADF) and Phillip-Perron Tests were performed.

Table 1. ADF Unit Root Test Results on the Level value of Variables I (0)

Değişkenler	Intercept ADF Test İst.		Trend+Intercept ADF Test İst.	
LCO_2	-2.304102	-3.577723 (1 %) -2.925169 (5 %) -2.600658 (10 %)	-2.423455	-4.165756 (1 %) -3.508508 (5 %) -3.184230 (10 %)
LGDP	-0.103652	-3.577723 (1 %) -2.925169 (5 %) -2.600658 (10 %)	-2.583558	-4.165756 (1 %) -3.508508 (5 %) -3.184230 (10 %)

Note: Values in paranthesis represent the Mac-Kinnon critical values at the 1 %, 5 % ve 10 % significance levels.

According to Table 1, it is observed that because the ADF-t statistical values obtained for LCO2 and LGDP variables are smaller than Mac-Kinnon critical values at % 1, % 5 and % 10 significance levels, they are not stationary.

Table 2. Results of the Phillips-Perron Unit Root Test on the Level Values of Variables I (0

Değişkenler	Intercept ADF Test İst.		Trend+Intercept ADF Test İst.	
LCO_2	-2.449134	-3.577723 (1 %) -2.925169 (5 %) -2.600658 (10 %)	-2.411555	-4.165756 (1 %) -3.508508 (5 %) -3.184230 (10 %)
LGDP	-0.103652	-3.577723 (1 %) -2.925169 (5 %) -2.600658 (10 %)	-2.773827	-4.165756 (1 %) -3.508508 (5 %) -3.184230 (10 %)

Note: Values in paranthesis represent the Mac-Kinnon critical values at the 1 %, 5 % ve 10 % significance levels.

According to Table 2, since the Phillips-Perron statistical values obtained for LCO2 and LGDP variables are smaller than Mac-Kinnon critical values at % 1, % 5 and % 10 significance levels, they are observed to be non-stationary. Table 3 and Table 4 show the results of unit root test of the variables used in the analysis after taking their first difference. According to this, series become stationary after their first difference is taken.

Table 3. Results of ADF Unit Root Test on First Difference Values of Variables I (1)

Değişkenler	Intercept ADF Test İst.		Trend+Intercept ADF Test İst.	
$DLCO_2$	-6.955989	-3.581152 (1 %) -2.926622 (5 %) -2.601424 (10 %)	-7.550043	-4.170583 (1 %) -3.510740 (5 %) -3.185512 (10 %)
DLGDP	-7.073008	-3.581152 (1 %) -2.926622 (5 %) -2.601424 (10 %)	-6.988935	-4.170583 (1 %) -3.510740 (5 %) -3.185512 (10 %)

Note: Values in paranthesis represent the Mac-Kinnon critical values at the 1 %, 5 % ve 10 % significance levels.

Tablo 4. Results of Phillips-Perron Unit Root Test on First Difference Values of Variables I (I)

Değişkenler	Intercept ADF Test İst.		Trend+Intercept ADF Test İst.	
$DLCO_2$	-6.965201	-3.581152 (1 %) -2.926622 (5 %) -2.601424 (10 %)	-7.550043	-4.170583 (1 %) - 3.510740 (5 %) -3.185512 (10 %)
DLGDP	-7.072522	-3.581152 (1 %) -2.926622 (5 %) -2.601424 (10 %)	-6.988548	-4.170583 (1 %) -3.510740 (5 %) -3.185512 (10 %)

.**Note:** Values in paranthesis represent the Mac-Kinnon critical values at the 1 %, 5 % ve 10 % significance levels.

Variables, according to Tables 3 and 4, become stationary after taking first difference. Thus, the evidence suggests that first differencing is sufficient for modeling the time series considered in this study.

4.2. Causility Test

The Standard Granger Causility Test developed by Granger (1969) is an approach used to determine whether there is a relationship between two variables, and if there is, to determine the direction of this relationship. Granger Causility tests whether or not independent variables in the model as a group equals to zero.

Table 5 shows the result of the Granger Causality Test related to the variables. The importance of this test arises from the opportunity it provides to

test and analyze the casual relationship between Carbon Emissions (CO2) and Economic Growth (GDP). The test at he same time informs about the direction of causality between variables. There are three probabilities in the test. The relationship can be unidirectional, bidirectional or neutral. According to the results obtained from this study, there is not a casual relationship between two variables.

Table 5. Results of Granger Causality Test

Null Hypothesis:	Lags	Obs.	F-Statistic	Probability
LNGDP does not Granger Cause LNCO2	2	46	1.46680	0.24251
LNCO2 does not Granger Cause LNGDP	2		0.65274	0.52594

4.3. Cointegration Test

A vector of variables integrated of order one is cointegrated if there is linear combination of stationary variables. This study adopts the approach of Johansen and Juselius (1990). Two likelihood ratio test statistics, the trace and maximal eigenvalue cointegration test statistics are shown in Table 6. According to the null hypothesis, H_0 there are no cointegrating vectors. A rejection of the hypothesis would lead to testing the alternative hypothesis H_1. The trace test statistics demonstrate that there is no cointegration among the variables. According to the results there is no cointegrating vector between the variables. Because the variables are not cointegrated, there is no long term relationship between variables. This also affirms the result of the Granger Causality test in which no relationship exists between economic growth and carbon emission in Turkey.

Table 6. Results of Unrestricted Cointegration Rank Test (Trace)

H_0	H_1	λ Trace Statistic	Critical Values	
			% 5	% 1
r≠0	R>0	10.62186	15.49	19.937
r≠1	R>1	4.266803	5.84	6.63

Note: Trace Test k= 2, r represents the number of cointegrating vectors while k represents the number of lags in the unrestricted VAR Model.

Table 7. Results of Unrestricted Cointegration Rank Test (Maximum Eigenvalue) Sonuçları

H_0	H_1	Max-Eigen	Critical Values

		Statistic	**% 5**	**% 1**
r=0	r=1	6.355055	14.26	17.52
r=1	r=2	4.266803	6.84	6.63

Note: Maximum eigen values Test k=2, r represents the number of cointegrating vectors while k represents the number of lags in the unrestricted VAR Model.

4.4. Model Estimation

As can be seen in Table 8, an increase in GDP by 1 unit ($ 1) decreases per capita CO2 emission by 0,98 kg. As GDP increases further, that is, as the value of the square of GDP increases, the level of emission also rises. This situation shows that the relationship between Turkey's GDP and emission is not congruent with the EKC.

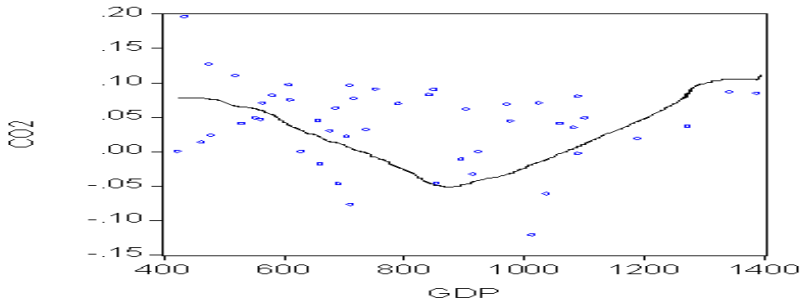
Table 8. Regression Results of Per Capita CO2 Pollution in Turkey.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLNGDP	-0.987636	0.172303	5.731986	0.0000
LGDP2	1.025195	0.010179	-2.475273	0.0172
C	0.350067	0.134961	2.593841	0.0128

R-squared	0.453084	Mean dependent var	0.040097
Adjusted R-squared	0.428225	S.D. dependent var	0.057001
S.E. of regression	0.043102	Akaike info criterion	-3.388796
Sum squared resid	0.081742	Schwarz criterion	-3.270702
Log likelihood	82.63672	F-statistic	18.22558
Durbin-Watson stat	2.618178	Prob(F-statistic)	0.000002

After having confirmed the long term relationship between these variables, the estimation of the regression model specifiying CO2 as a function of GDP becames the next step. It is expected that the regression eguation line would be useful by illustrating the shape of the Environmental Kuznets Curve for Turkey. The curve would demonstrate whether the relationship between CO2 and GDP actually supports the EKC or not. As is seen in Figure 6, the signs of GDP and GDP2 coefficients, contrary to the Environmental Kuznets Curve Hyphothesis where they are expected to be positive and negative respectively, are instead negative and positive respectively. The purpose here is to test whether or not the coefficient signs are conformity with these of the Grossman and Krueger (1995) model. Figure 6 shows that a U-shaped curve appeared. The figure refutes the EKC hypothesis in case of Turkey.

Figure 6. CO2 Emissions Regression Curve in Turkey



5. CONCLUSION

According to the Granger Causility Test results, there is no causal relationship between CO2 and GDP variables. This result, at the same time, is in congruence with the results of the Johansen Cointegration Test. Furthermore, the regression results do not support that the Environmental Kuznets Curve is not valid for the Turkish case. Results indicate that an increase in GDP by 1 ($1) decreases per capita CO2 emission bu 0,98 kg.As the GDP increases further the level of emission also increases. This situation shows that the relationship between Turkey's GDP and emission does not conform to the Environmental Kuznets Curve. This results show that a U-shaped not an inverted U-shaped curve exists.

REFERENCES

Granger, Clive W. J. (1969), "Investigating Casual Relations by Econometric Models and Cross-spectral Methods", *Econometrica*, , Vol.37, No:3, pp. 424-438

Grossman, Gene M. and Krueger, Alan B. (1991), "Environmental Impact of a North American Free Trade Agreement" , *NBER Working Paper* 3914: Cambridge.

Grossman, Gene M. and Krueger, Alan B. (1995), "Economic Growth and the Environment", *Quarterly Journal of Economics*, Vol.110, No:2, pp.353-377.

Johansen, Soren, and Juselius, Katarina (1990) "Maximum Likelihood Estimation and Inference on Cointegration With Applications to the Demand for Money", *Oxford Bulletin of Economics and Statistics*, Vol. 52, No:2, pp. 169-210.

Kuznets, Simon, (1955), "Economic Growth and Income inequality", *American Economic Review*, Vol. 45, No:1, pp. 1-28

Olusegun, AOmisakin (2009), "Economic Growth and Environmental Quality in Nigeria: Does Environmental Kuznets Curve Hypothesis Hold", *Environmental Research Journal,* Vol. 3, No:1, pp. 14-18.

Panayotou, Theodore (1993), "Empirical Tests and Policy Analysis of Environmental Degradation at Different Stages of Economic Development", *ILO Technology and Employment Programme Working Paper*, WP238.

World Development Indicator (WDI) Database.