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THE VALIDITY OF THE ENVIRONMENTAL KUZNETS CURVE HYPOTHESIS FOR CO_2 EMISSIONS IN TURKEY: NEW EVIDENCE FROM SMOOTH TRANSITION REGRESSION APPROACH

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Abstract

This study examines to what extent the Environmental Kuznets Curve (EKC) hypothesis may be valid and applicable for Turkey. In the present paper, we employ a smooth transition regression (STR) model to test validity of the EKC hypothesis, using a dataset of carbon dioxide (CO_2) emission per capita and GDP per capita over the period of 1971–2014. The environmental pollution tends to rise with economic growth in the early stages of development. After exceeding a turning point of income ($8,022), it smoothly slows down but does not decline with further growth. Estimation results provide no evidence to support the presence of the EKC hypothesis, which implies that after passing a certain point, economic growth may actually be profitable for environmental quality. This study reveals that the relationship between income level and environmental pollution in Turkey depends on many factors, and therefore economic growth singly cannot solve environmental problems. Besides, the lack of sufficient environmental awareness among the society, neglecting sustainable development, and the lack of legal arrangements regarding the environment stand as a barrier to the process of reducing environmental degradation in Turkey. This research finding may be useful as a guide for policy makers and researchers to resolve environmental pollution and as a policy recommendation to ensure sustainable growth of Turkey in the long run.

Keywords: *Nonlinearity, CO_2 Emissions, Environmental Kuznets Curve, Smooth Transition Regression*

TÜRKİYE'DE ÇEVRESEL KUZNETS EĞRİSİNİN CO_2 EMİSYONU İÇİN GEÇERLİLİĞİ: YUMUŞAK GEÇİŞ REGRESYON YAKLAŞIMINDAN YENİ KANITLAR

Özet

Bu çalışma, Çevresel Kuznets Eğrisi (ÇKE) hipotezinin Türkiye için ne kadar geçerli ve uygulanabilir olabildiğini incelemektedir. ÇKE'nin geçerliliği 1971-2014 dönemi için kişi başına karbondioksit (CO_2) emisyonu ve kişi başına GSYİH veri seti *kullanılarak yumuşak geçiş regresyon modeli ile test edilmiştir. Elde edilen bulgular, çevresel kirliliğin kalkınmanın ilk evrelerinde ekonomik büyümeyle birlikte yükselme eğiliminde olduğunu göstermektedir. Gelir, belirli bir eşik seviyesini (8,022 $) aştıktan sonra ise kirlilik artış oranı yavaşlamakta ancak daha fazla büyüme ile birlikte düşüş göstermemektedir. Tahmin sonuçları, Türkiye'de belirli bir gelir düzeyinden itibaren çevresel koşullarda iyileşmelerin gözlenebileceğini ifade eden EKC hipotezinin varlığını destekleyecek kanıtlar sunmamaktadır. Bu çalışma, gelir düzeyi ile çevresel kirlilik arasındaki ilişkinin birçok faktöre bağlı olduğunu ve bu nedenle ekonomik büyümenin tek başına çevre sorunlarını çözemediğini ortaya koymaktadır. Ayrıca, Türkiye'de toplumsal çevre bilincinin yeterli düzeyde olmaması, sürdürülebilir kalkınmanın ihmal edilmesi ve çevreye ilişkin gerekli yasal düzenlemelerin yeterince yapılamaması büyüme oranı artarken çevresel kirliliğin azalmasını engelleyici birer faktör olarak ortaya çıkmaktadır. Bu araştırma bulguları, politika yapıcılar ve araştırmacılar için hem çevresel kirliliği gidermede bir rehber hem de uzun vadede Türkiye'nin sürdürülebilir büyümesinin sağlanmasında bir politika önerisi olarak yararlı olabilir.*

Anahtar Kelimeler: *Doğrusal Olmama, CO_2 Emisyonu, Çevresel Kuznets Eğrisi, Yumuşak Geçiş Regresyonu*

1. INTRODUCTION

Regardless of the development level or the economic system of countries, meeting the needs of people and raising their life qualities primarily underlie the economic activities carried out. Accordingly, increasing production and per capita income for achieving economic development has become a priority target. The production gaining speed especially after the Industrial Revolution has brought along environmental degradations due to excessive and unconscious use of resources and using mostly fossil fuels as energy input.

The countries focusing on increasing their production and per capita income at the first stages of economic growth ignored environmental problems in the beginning. However, global warming and the associated climate change and environmental changes have become an important issue since the 1970s, which resulted in questioning the relationship between economic growth and environmental pollution (decline in environmental quality). The environmental pollution caused by growth and the results that came out with regards to sustainability required countries to shift towards cleaner technologies in the production process. Even though developed countries have shifted towards environmentally-friendly production systems since especially 1990s, developing countries are still continuing to increase their production despite the risk of damaging the environment because clean technologies require higher costs.

The concept of "the limits to growth," implying that environmental degradations will increase in parallel to economic growth, had considerable repercussions in academia in the 1970s and turned into an effective paradigm (Meadows et al., 1972). Since then, several studies seeking an answer to how a sustainable growth can be achieved have investigated how the development that countries need can be obtained in an environmentally-friendly way and focused on the role of several factors, especially per capita income, for the resolution of environmental problems. In these studies, it was concluded that developing counties maintained high growth rates mostly by increasing their energy consumptions despite the risk of neglecting effective technologies.

In recent years, the extension of this argument has been expressed on the basis of the Environmental Kuznets Curve (EKC). EKC is based on the theory asserted by Kuznets (1955) that an inverted U-shaped relationship exists between economic growth and income inequality. According to this theory, the wealth and capital accumulations of those who experience the first income growth due to industrialization, which is one of the first stages of economic growth, and industrial activities will rise, thereby resulting in income inequality. However, the benefits of growth will be spread to other people over time in the form of high salary and income growth. It is argued that the initial income inequality increasing during the first stages of economic growth will decline in the subsequent stages. In the 1990s, studies demonstrating that a relationship similar to the Kuznets Curve existed between economic growth and environmental pollution emerged in the literature of economics. The hypothesis that environmental growth and pollution increase at the first stage of economic growth process, but improvements in the environmental conditions are achieved after surpassing a certain income threshold is referred to as the "Environmental Kuznets Curve" in the literature.

The pioneering studies on such a relationship between environmental degradation and income were carried out by Grossman and Krueger (1991, 1995), Shafik and Bandyopadhyay (1992), Panayotou (1993), and Selden and Song (1994). Accordingly, the EKC hypothesis argues that environmental degradation increases during the first stages of economic growth, but such pollution declines with the progress of growth. As agricultural production is generally carried out in underdeveloped economies, the level of environmental pollution is expected to be low in these countries. However, environmental pollution is expected to increase with the rise in production in the subsequent stages when economic growth and industrialization are achieved. When a certain threshold (income) level is reached, it is expected that the production activities shift towards knowledge-intensive industries and services; environmental consciousness and regulations about the environment and environmental costs increase; and eco-friendly technologies are developed, which will reverse the whole process.

The discussions over the possibility of decline in environmental degradation or pollution with income increase go back to the 1970s. Ruttan (1971) indicates that the income elasticity of demand for environmental amenities increases while the income elasticity of demand for fundamental goods and services declines as the level of income increases in high-income economies. It is also highlighted that this situation is reversed in low-income economies. Since the beginning of the

1970s, the economy-environment interaction that first evolved from the dilemma of environment-economic development towards a sustainable development has become the subject of considerable academic research.

Today, economy and environment are two fundamental variables that have an "organic" relationship and affect each other directly. With the effect of global warming, climate changes have reached a perceivable dimension, which has brought to the forefront the focus on the relationship between energy consumption and environmental pollution. Thus, the studies investigating environmental pollution and economic growth as well as the validity of the Environmental Kuznets Curve have gained speed over the last years. The policies on energy use and economic development that have an impact on the environmental conditions of countries have become a current and controversial issue.

Since the early 1990s, a considerable number of empirical studies have tested the EKC hypothesis for many countries using a variety of indicators of environmental degradation (carbon dioxide emissions, sulphur dioxide emissions, exhaust emission, wastewater discharge, municipal waste and deforestation, etc.) and applying different models (linear, non-linear, pure-parametric, semi-parametric, non-parametric, and cubic). However, the empirical studies measuring the relationship between economic growth and pollution provide contradictory results on the empirical evidences of the EKC hypothesis. Some of these studies found a non-linear relationship between environmental pollutants and per capita income (Robers and Grimes, 1997; Apergis and Payne, 2009; Fodha and Zaghdoud, 2010; Lean and Smyth, 2010; Saboori et al., 2012; Baek and Kim, 2013; Chen and Chen, 2015); while others, such as Shafik and Bandyopadhyay (1992), Shafik (1994), Roca et al. (2001), York (2003), and Azomahou et al. (2006) reported a linear relationship. Apart from these, some of researches found a cubic N-shaped relationship (Sengupta, 1996; Friedl and Getzner, 2003; Martinez-Zarzoso and Bengochea-Morancho, 2004; Akbostancı et al., 2009; Akpan and Abang, 2014). Some studies, however, have found little or no evidence of the validity of the traditional EKC hypothesis (Carson et al., 1997; Roberts and Grimes, 1997; Dinda, 2001; Roca et al., 2001; Harbaugh et al., 2002; Focacci, 2003; Richmond and Kaufmann, 2006; Ozturk and Acaravci, 2010; Kearsley and Riddel, 2010; Iwata et al., 2011; Soytas et al., 2007; Saboori and Sulaiman, 2013; Nasr et al., 2015; Al-Mulali et al., 2015).

Over the last years, the economy of Turkey has also entered an increase trend, and its demand for energy is increasing with each passing day. This leads to a rise in the CO_2 emission level in developing countries such as Turkey where fossil fuels are used a lot. According to the data provided by the Ministry of Energy and Natural Resources of Turkey (2016), the share of fossil energy resources in Turkey's total energy consumption was 90.1% in 2014. This situation creates a problem for Turkey both in terms of the environment and the external energy dependence. Considering that the total CO_2 emission at global scale results mostly from fossil fuels in today's world, it is urgent to attach more importance to this issue. In Turkey, the studies concerning the validity of the EKC hypothesis are very limited. Among these studies, the study carried out by Lise (2006), Başar and Temurlenk (2007), Akbostancı et al. (2009), Ozturk and Acaravci (2010), Omay (2013), Koçak (2014), Erdoğan et al. (2015), and Tunçsiper and Uçar (2017) did not provide results that support the EKC hypothesis. However, the studies carried out by Atıcı and Kurt (2007), Saatçi and Dumrul (2011), Shahbaz et al. (2013), Bölük and Mert (2015), Artan et al. (2015), Albayrak and Gökçe (2015), and Lebe (2016) support the EKC hypothesis assuming an inverted U-shaped relationship between economic growth and environmental degradation. In these empirical studies adopting the linear model, there is a serious problem about the determination of a model type.

In recent years, the number of empirical studies using a non-linear approach for testing a non-linear relationship between economic growth and environmental degradation has increased. Among these studies, Fouquau et al. (2009) investigate this relationship for 44 countries; Chiu (2012) for 52 developing countries; Esteve and Tamarit (2012) for the Spanish economy; and Fosten et al. (2012) for the UK. The empirical results indicate that income has a threshold effect on environmental pollution and that a non-linear (inverted U-shaped) relationship suggested by the EKC hypothesis exists.

The present study investigates the impact of income on environmental pollution by utilizing an innovative non-linear model – the smooth transition regression (STR) model recently promoted by Teräsvirta and Anderson (1992), Granger and Teräsvirta (1993), and Teräsvirta (1994). The study focuses on the existence of the EKC for Turkey over the period 1971–2014. The rest of this paper is organized as follows: Section 2 describes the adopted methodology and data description. Section 3 provides the data sources, empirical results, and policy implications. Lastly, a conclusion is offered in Section 4.

2. METHODOLOGY

In the present study, the non-linear relationship between CO_2 emission and real income is investigated. One of the methods that analyze the non-linear relationship between the variables is the Smooth Transition Models (STR) discovered by Bacon and Watts (1971) and developed further by Granger and Terasvirta (1993), Frances and van Dijk (2000), and van Dijk et al. (2002). The Standard STR model is defined as seen in Equation (1).

$$y_t = \phi' z_t + \theta' z_t g(s_t, c, \gamma) + u_t \qquad t = 1,2,\ldots,T \qquad (1)$$

In Equation (1), z_t is used as the explanatory variable vector that involves the lagged values of the explanatory variables in the model and of the dependent variable y_t. $\phi'$and θ' show the coefficient vectors of the model regarding the linear and non-linear parts respectively. While s_t accounts for the threshold value, $u_t \sim iid(0, \sigma^2)$ accounts for the error term. Also, $g(s_t, c, \gamma)$ is used as the transition function in the model in Equation (1). The transition function takes a value between

0 and 1 as it is the continuous function of the transition variable. In the case that the transition function is used in logistic function form in the model, the model is called logistic STR (LSTR) model. The logistic function form of the transition function is defined as seen in Equation (2).

$$g(\gamma, c, s_t) \ = [1 + \exp(-\gamma \prod_{k=1}^{K}(s_t - c_k))]^{-1}\,, \quad \gamma > 0, c_1 \le c_2 \le \cdots \le c_k$$ (2)

In Equation (2), γ (smoothing parameter) indicates the smoothness of the change in the value of the transition function (i.e., the shift from one regime to another), whereas c parameter is the threshold parameter between two regimes formulated as $g(s\_t, c, \gamma = 0 \; ve \; g(s\_t, c, \gamma) \ = 1$. As the smoothing parameter goes towards $(\gamma \to \infty)$ infinity, the shift from 0 to 1 in the transition function becomes sudden and sharp just like the shift from one regime to another in TAR model, at the point where the threshold variable is equal to ϑ. In such a case, the model is estimated using the TAR approach. When the smoothing parameter approaches zero$(\gamma \to 0)$, the transition function becomes equal to a fixed value and the model is reduced to the linear form when the smoothing parameter becomes equal to 0 $(\gamma = 0)$.

In Equation (1), when the transition function becomes 0, the regression coefficient takes the value of ϕ', whereas it becomes equal to the sum of $\phi' + \theta'$ when the transition function takes the value of 1 $(g(s_t, c, \gamma) = 1)$. On the other hand, when the transition function takes a value between 0 and 1 $(0 < g(s_t, c, \gamma) < 1)$, the regression coefficient is calculated as the weighed mean of ϕ' and θ'.

For estimating the LSTR model, the linear model suitable for the economic theories and the variables used in the model are determined first. Later, the right lagged numbers regarding the variables used in the model are determined according to Akaike (AIC) and Schwarz (SBC) criteria and included in the model. In the next stage, the alternative hypothesis “there is a non-linear relationship between the variables” is tested against the null hypothesis “the model is linear”. In such a case where it is not known which variable is the transition variable in the model, this test is repeated for each variable. If the null hypothesis cannot be rejected at the end of this stage, it is determined that the linear model is convenient, whereas the STR model is not valid. On the other hand, if the null hypothesis is rejected for any variable, the STR model is considered to be convenient for the data set. If the STR model is found convenient more than once through the re-administration of the test, the model rejecting the null hypothesis most strongly, that is, the model with the lowest probability value is used for estimation.

Due to the presence of unidentified nuisance parameters under the null hypothesis, it is not possible to use the conventional Lagrange Multiplier (*LM*) to test the null hypothesis. To overcome this problem, Luukkonen, Saikkonen, and Teräsvirta (1988) proposed a method based on the third-order Taylor expansion of the transition function (Fallahi and Montazeri, 2012). Also, if linearity is rejected for more than one transition variable, the variable rejecting the null hypothesis most strongly, in other words, the variable with the lowest probability value is considered as the transition value.

The coefficients in the model change depending on c and γ values. As the model is estimated through non-linear optimization, it is important to choose the right initial values for c and γ. In order to reduce the sensitivity of the estimations to the initial values and determine the most suitable c and γ values, a grid search approach was employed in the present study. For each value of these two parameters the square sum of the residuals (SSR) of the model can be calculated and the values with the minimum SSR are selected as the initial values of the c and γ. After having a good starting value for these parameters, the model can be estimated using different algorithms (Fallahi and Montazeri, 2012).

3. MODEL, DATA, AND EMPIRICAL RESULTS

3.1. Model

In order to investigate the non-linear relationship between CO_2 emission and per capita income, a two-regime fixed LSTR model was created based on the model used by Gonzalez et al. (2005), Fouquau et al. (2008), and Chiu (2017). It can be seen in Equation (3):

$$LnCO_{2_t} = \alpha_0 + \beta_0 LnGDP_t + \beta_1 LnGDP_t * g(q_t, \gamma, \theta) + \varepsilon_t \qquad (3)$$

where $LnCO_2$ represents log-transformed per capita CO_2 emissions; *LnGDP* is log-transformed per capita real GDP; ε is the error term; t = 1, 2, …, T time periods. Coefficient α_0 is constant, and the variable q_t is a potential threshold variable. In Equation (3), $g(q_t, \gamma, \theta)$ is used as the transition function.

3.2. Data Specifications

In this study, the relationship between CO_2 emissions and real income in Turkey was investigated for the period using LSTR analysis taking into account the per capita real GDP threshold level. This study uses annual data for the period 1971–2014. The variables include per capita CO_2 emissions ($LnCO_2$) and per capita real GDP (*LnGDP*), which are respectively measured in metric tons and constant 2005 US dollars. All variables come from the International Energy Agency (IEA) database and are expressed in natural logarithm. Table 1 reports the descriptive statistics of all variables.

Table 1: *Descriptive statistics of variables in levels over the period 1971–2014*

Full Sample	*CO_2 per capita*	*GDP per capita*
Mean	2.49	6951.16
Std. Dev.	0.85	2127.98
Max.	4.04	11366.87
Min.	1.15	4109.13
Obs.	44	44

Note: Std. Dev. is the abbreviation of standard deviation. Max. is the maximum value. Min. is the minimum value. Obs. means the number of observation.

As shown in Table 1, on average, per capita CO_2 emissions and per capita real GDP for Turkey are approximately 2.49 mt and US $ 6951.16 respectively. In addition, per capita real GDP is significantly and highly positively correlated to per capita CO_2 emissions for Turkey (0.98). This result means that higher income levels lead to higher CO_2 emissions.

3.3. Empirical Results

In the present study investigating the non-linear relationship between per capita CO_2 emission and per capita income, the stability of the series regarding the variables used in the model were investigated first with a unit root test allowing for a structural break, developed by Saikkonen and Lütkepohl (2002) taking structural break into account. The obtained results are shown in Table 2. According to these results, the null hypothesis "the series include unit root" in the case of a structural break was rejected for the *$LnCO_2$* and *LnGDP* series. This situation proves that the series were stable at level values (*I(0)*)

Table 2: *UR unit root test results with structural break (Constant&Trend)*

	$LnCO_2$	*LnGDP*
Test statistics	-3.36**	-3.15**
Critical Values		
1%	-3.55	
5%	-3.03	
10%	-2.76	
Break Date	2000	2001

Notes *, **, *** indicate significance at 10%, 5% and 1% levels, respectively.

The first step in the STR model after finding out that the variables used in the model were stable at level values was to determine the right number of lags regarding the variables used in the model. In this stage, the right length of lags for *$LnCO_2$* and *LnGDP* variables was determined as 1 according to Akaike (AIC) and Schwarz (SBC) criteria. The lagged values of *$LnCO_2$* and *LnGDP* variables were included in the STR model as explanatory variables giving the model a dynamic structure.

Table 3: *The results of the linearity tests against the STR model*

Transition Variable	F-statistics	Suggested Model
$LnCO_{2_{t-1}}$	1.15E-04	LSTR1
$LnGDP_t$*	2.36E-07	LSTR1
$LnGDP_{t-1}$	2.25E-05	LSTR1
Trend	5.44E-05	LSTR1

Notes: The suggested transition variable is shown by an asterisk.

In the following stage in the STR analysis, the null hypothesis 'the model is linear' was tested against the alternative hypothesis "there is a non-linear relationship between the variables." The F-statistics are given in Table 3. As seen in Table 3, the null hypothesis 'the relationship between the variables is linear' was rejected at 1% significance level, and it was concluded that the relationship was not linear. It was also seen that the lowest F-statistics value was that of $LnGDP_t$ variable. For this reason, this variable was selected as the transition variable.

In the next step, we used a two-dimensional grid search using 30 values within the rages [8.37, 9.34] and [0.5, 7.97] respectively to obtain adequate starting values for the θ and γ. The selected initial values for θ and γ are 9.003 and 7.970. With the initial values indicated afterwards, the STR model was estimated. The estimation results are given in Table 4.

Table 4: *Estimated results of the STR model*

Threshold variables (LnGDP)		Linear Part	Nonlinear Part
Constant		-8.044***	1.770
		(2.008)	(2.890)
$LnCO_{2_{t-1}}$		0.244	-0.198
		(0.178)	(0.344)
$LnGDP_t$		1.110***	-0.799**
		(0.174)	(0.368)
$LnGDP_{t-1}$		-0.119	0.624
		(0.241)	(0.481)
Location parameters, θ	8.990		
Slope parameters, γ	67.833		
Adj. R^2	0.99		

Notes: t-statistics are shown in the parentheses. ** and *** show the significance at the 5% and 1%, respectively.

To get the model for regime 1, we put $g(q_t, \gamma, \theta)$ =0 and also $g(q_t, \gamma, \theta)$ =1 to get the model for the regime 2 as follows:

$$LnCO_{2_t} = -8.044 + 0.244LnCO_{2_{t-1}} + 1.110LnGDP_t - 0.119LnGDP_{t-1} \quad for\ regime\ 1$$

$$LnCO_{2_t} = -6.274 + 0.046LnCO_{2_{t-1}} + 0.311LnGDP_t + 0.505LnGDP_{t-1} \quad for\ regime\ 2$$

ARCH(1) p-value = 0.459 *Jarque-Bera p-value* = 0.519 *AR(1) p-value* = 0.718 *AR(2) p-value* = 0.911

As shown in Table 4, the estimated coefficient of real income per capita (β_0) is significantly positive (1.110) in the first regime. In the second regime, the sum of β_0 and β_1 is still positive (0.311), and smaller than that in the first regime. The results suggest that an increase in real income raises CO_2 emissions, and after reaching a certain level of income (θ=8.990, about US$8,022.46), the impact of real income on CO_2 emissions becomes weak, but still positive - that is, CO_2 emission does not automatically drop as real income increases.

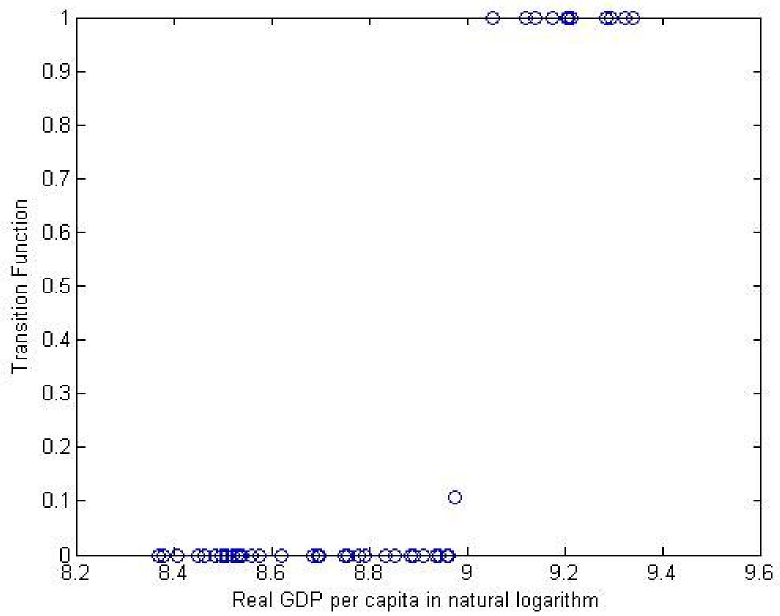

Figure 1: *Estimated transition function of the STR model against real GDP per capita*

In addition, the results show that estimated threshold level for real income is 8.99%. Figure 1 illustrates the estimated logistic transition function against the transition variable, i.e., *$LnGDP_t$*. The estimated γ is equal to 67.0833 which indicates that the regime change in Turkey has occurred slowly. In other words, it shows that real income slowly affects CO_2 emissions.

In sum, the results of this paper provide some evidence of non-linear relationship between real income and CO_2 emissions in Turkey; however, this non-linear relationship is not an inverted U-shaped. This situation proves that the EKC hypothesis is not valid for Turkey. Global pollution might be one of the reasons why the EKC hypothesis is not valid (Chiu, 2017: 283). This is because a country might be affected by the CO_2 emissions of neighboring countries, even though it takes an action to reduce its own CO_2 emissions. Helland and Whitford (2003) found that the CO_2 emissions in a region on the border of the USA are 604% higher than those in a region not bordering the USA.

4. CONCLUSION

Meeting the needs of people, increasing their welfare or life quality underlie the economic activities carried out in a country. That the energy used in production is mostly obtained from nonrenewable resources and the CO_2 and similar gases coming out with the use of fossil fuels lead to environmental pollution puts the future of the world in jeopardy. The increasing threat of global warming and climate change across the world has brought into the forefront the focus on the relationships between economic growth, energy consumption, and environmental pollution. This paper tackles the question of whether or not environmental pollution can decrease through greater income levels – generally known as the environmental Kuznets curve (EKC) hypothesis. The study has focused on Turkey over the period 1971–2014.

In most of the previous studies investigating the validity of the EKC hypothesis for Turkey, linear models were used and a non-linear characteristic was given to the models through logarithmic transformation and cubic functions. Thus, it was attempt to find a potential non-linear relationship between the variables. Though this approach is not technically wrong, it is known that the model type determined manually will fail to specify the real form of the relationship, and thus, it is likely to obtain prejudiced and inconsistent results. To improve these problems, this study has applied an innovative non-linear model – the smooth transition regression (STR) model, recently developed by Teräsvirta and Anderson (1992), Granger and Teräsvirta (1993), and Teräsvirta (1994) to investigate the impact of economic development on environmental pollution. STR model enables to find out whether the relationship between income and pollution is linear, and, if not, to determine its form internally. The empirical findings of this study show that per capita income has a non-linear effect on environmental pollution. However, this relationship does not have an inverted U-shape as asserted with the EKC hypothesis. At first, the rise in real income increases the CO_2 emission rapidly and the emission amount continues to increase though at a slower rate after the real income reaches $8,022. These findings can be interpreted as 'the EKC hypothesis is not valid for Turkey", but it is also possible to explain them as follows: "Turkey's development pathway may not have reached yet the turning point where economic growth naturally leads to improvements in environmental quality". One of the reasons why the EKC hypothesis is rejected for the relationship between environmental pollution and income level in Turkey or why this relationship is not inverted U-shaped is because Turkey was not able to experience the industry-related economic stages prominently. Developing countries like Turkey tried to undergo the industrialization period that European economies had been through for 200 years in a short period of time. As a result, such countries had – and still have – serious problems related to both growth and development. Especially the lack of sufficient environmental awareness among the society, neglecting sustainable development, technical and economic problems experienced in the transfer to environmentally friendly technologies and the lack of legal arrangements regarding the environment stand as a barrier to the process of reducing environmental degradation.

The results of the present study point that it will be wrong to have very optimistic expectations about the future of the world considering the data demonstrating that the environmental quality has improved in developed countries. They also urge policy makers and researchers to make changes in the policies on energy supply resources and waste management used for the resolution of environmental problems. The increase in environmental consciousness and the dissemination of sustainable development policies along with economic growth will help to reduce environmental degradation. In this sense, policy makers, legislators, non-governmental organizations, universities and entrepreneurs should take joint action. Incentives to be provided by the government to the industrialists and raising environmental awareness among the society may contribute to mitigation of environmental problems.

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