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The Impact of Environmental Taxes on Carbon Dioxide Emissions in Turkey

Türkiye'de Çevre Vergilerinin Karbondioksit Emisyonu Üzerindeki Etkisi

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ABSTRACT

Among the causes of environmental pollution, which has become a global problem, are the increase in consumption of fossil-based energy sources due to industrialization and technological development, population growth and urbanization. Countries use different methods of struggle at national and international level in solving environmental problems. The most effective way to be implemented within the scope of this struggle is environmental taxes. One of the taxes used to reduce greenhouse gas emissions is carbon taxes, which is a type of environmental tax. Most of the applications for these taxes in the world are seen in EU countries. Although carbon taxes have not been placed on a legal basis in Turkey, there are tax practices under the name of environmental taxes. In this context, the first tax applied directly within the scope of combating environmental pollution within the Turkish Tax System is the Environmental Cleaning Tax. The bag fee can also be evaluated within this scope. In this study, the effect of environmental taxes on CO2 emissions for the period of 1994-2015 in Turkey was examined. For this purpose, the long-term relationship between the series included in the analysis was investigated with the Johansen Cointegration test. Long-term coefficient estimates were made using FMOLS, DOLS and CCR Models. In the study, it was concluded that the series were co-integrated and that the environmental tax reduced CO2 emissions in the long run.

Anahtar Kelimeler:

Çevre Vergileri, CO_2 Emisyonu, Türkiye

ÖZET

Küresel bir sorun haline gelen çevre kirliliğinin nedenleri arasında sanayileşme ve teknolojik gelişmeye bağlı olarak fosil bazlı enerji kaynaklarına yönelik tüketimin artması, nüfusun artması ve kentleşme gibi olgular yer almaktadır. Ülkeler çevre sorunlarının çözümünde ulusal ve uluslararası düzeyde farklı mücadele yöntemleri uygulamaktadır. Bu mücadele kapsamında uygulanabilecek en etkin yol ise çevre vergileridir. Sera gazı emisyonunu azaltmak amacıyla kullanılan vergilerden biri de çevre vergilerinin bir türü olan karbon vergileridir. Dünyada bu vergilere yönelik uygulamaların çoğu AB ülkelerinde görülmektedir. Türkiye'de karbon vergileri yasal bir zemine oturtulmamış olsa da çevre vergileri adı altında vergi uygulamalarına rastlanmaktadır. Bu çerçevede Türk Vergi Sistemi içerisinde doğrudan çevre kirliliği ile mücadele kapsamında uygulanan ilk vergi Çevre Temizlik Vergisi'dir. Poşet ücreti de bu kapsamda değerlendirilebilir. Bu çalışmada Türkiye'de 1994-2015 dönemi için çevre vergilerinin CO2 emisyonu üzerindeki etkisi incelenmiştir. Bu amaçla, çalışmada analize dâhil edilen seriler arasındaki uzun dönemli ilişki Johansen Eşbütünleşme testi ile araştırılmıştır. Uzun dönemli katsayı tahminleri ise FMOLS, DOLS ve CCR Modelleri kullanılarak yapılmıştır. Çalışmada serilerin eş bütünleşik olduğu ve uzun dönemde çevre vergisinin CO2 emisyonunu azalttığı sonucuna ulaşılmıştır.

1. INTRODUCTION

It is not possible to consider the activities carried out by businesses separately from the environment. Many environmental problems caused by human-induced factors threaten the future of all living things at the global level. Global warming is the leading factor that causes the deterioration of the ecological balance. Climate changes are another adverse effect caused by global warming (Reeves and Lenoir, 2006: 16). Discussions on carbon taxes emerged as a result of the assertion that greenhouse gases were effective as the cause of climate change and global warming in the 1990s (Karakaya and Özçağ, 2001: 2) and that the most important factor affecting this formation was carbon dioxide gas (Vural, 2006: 159).

CO2 emissions, which are accepted as one of the important sources of global warming, are produced especially by coal, oil, gas etc. It has increased dramatically due to reasons such as excessive consumption of fossil fuels, widespread use in electricity generation and transportation activities (Alam, 2014: 36). In this direction, the most common and effective way of protecting the environment is taxation (Groosman, 1999: 539).

In this study, it is aimed to investigate the effect of environmental taxes on CO2 in Turkey for the period 1994-2015. Although there are theoretical studies in the literature in the case of Turkey, no empirical studies were found as a result of the literature review. Most empirical studies were carried out in the EU example. The study is important in terms of contributing to this gap in the literature. The study consists of five parts. After the introduction section, the second part focused on the Kyoto Protocol and environmental taxes, which were created to reduce greenhouse gas emissions on a world scale. In the third part of the study, environmental taxes applied in Turkey were evaluated. In the fourth chapter, a literature review on the subject is included. In the fifth part, model, data and analysis results are given. The work was completed with the resulting section.

2. KYOTO PROTOCOL AND ENVIRONMENTAL TAXES

In recent years, there has been a worldwide awareness as a result of all these negative consequences such as climate changes in the world, excessive temperatures, melting glaciers, storms and natural vegetation. Countries have taken action together to take urgent action. One of the most important steps taken in reducing emissions leading to climate change in this process is the "Kyoto Protocol" (Norregaard, and Reppelın-Khll, 2000).

The Kyoto Protocol, adopted in 1997 to reduce the use of greenhouse gases, came into force in 2005. The terms of the agreement were established in 1992. The Kyoto Protocol has not been signed by many countries as it will lead to energy loss. The United States is one of the leading countries that did not sign the protocol. Other countries that have not signed the protocol are Angola, Afghanistan, Central African Republic, Ivory Coast, Chad, Somalia, Tajikistan, Palestine, Vatican City, Taiwan, Republic of Congo (Samur, 2007: 145).

Turkey, on the other hand, did not remain indifferent to the global climate change problem and signed the Kyoto Protocol in 2009. Turkey, which is a party to the Kyoto Protocol, has an obligation to move from a fossil fuel-based development policy to renewable energy and development policy. As a requirement of Turkey's adoption of the Kyoto Protocol, its effective use of renewable energy sources will contribute to reducing existing CO2 emissions. Within the Kyoto Protocol, countries that cause CO2 emissions above the value determined by this application, which will take effect after 2020, will have to pay financial compensation if they do not have sufficient carbon certificates (Tanınmış, 2010: 106).

The most effective way to protect the environment is to ensure the monetary participation of the person in the cost of environmental consumption and this monetary participation is only possible through environmental taxes. The primary purpose of ecological taxes is to create an environmentally sensitive production and consumption structure through taxes in order to reduce the life threat posed by environmental pollution to all living things and to achieve the economic gains that will be achieved by improving the environment (Öner, 2014: 140).

When we look at "Ecological Taxes" as a concept, "eco-taxes" or "green tax" in English are defined as "green tax" in English and the concept of "tax" here is defined as payments to the state free of charge and mandatory, where the benefit cannot be divided into taxpayers. Environmental taxes, which are a compensatory tax received from polluters as a result of business activities, refer to the mandatory and unrequited payments received on the bases associated with the environment and the pictures and fees received in return for more or less the service offered (Çelikkaya, 2011: 98).

Environmental taxes are monetary values unilaterally collected by public administrations from real and legal persons in order to prevent environmental values and ecological destruction, to improve the environment, to eliminate degradation and to prevent environmental pollution. The main purpose of environmental taxes; first of all, it is the event of protecting the environment and minimizing the harmful effects of the resulting environmental pollution. In accordance with the pollutant pay principle, it is aimed to internalize environmental taxes and environmental costs caused by environmental pollution, i.e. negative externality (Reyhan, 2014: 113). Thus, it forces environmental damagers to pay the damages resulting from their activities (EEA, 1996: 8).

It is possible to list the characteristics of environmental taxes aimed at reducing harmful behaviors to the environment as follows (EEA, 1996: 8; Ferhatoğlu, 2003: 2-3; Toprak, 2006: 155):

- It increases the cost of environmentally harmful goods, services or activities, so it directs producers and consumers to activities that are not harmful to the environment, enabling them to avoid harmful behaviors.
- It contributes to technological development by directing manufacturers to develop new production techniques.
- It constitutes an additional source of income for governments.
- While increasing tax revenues, a positive contribution to the economy is made by reducing the tax burden on labor and capital.

It helps to eliminate the differences between the special social costs and special social benefits that individuals are burdened with caused by pollution.

According to Eurostat, environmental taxes are evaluated in four parts. These taxes are based on energy, transportation, pollution and natural resources. In the EU, energy taxes are mostly considered carbon taxes (Reyhan, 2014: 114).

A type of environmental tax, the carbon tax is a tax per emissions unit. Due to the problems encountered in determining the amount of this tax, Baranzini et al. (2000) stated that the carbon tax can be obtained in two ways, proportional to the amount of carbon emissions released when burned (Hotunluoğlu and Tekeli, 2007: 270):

- Determination of a carbon tax for each ton of carbon emissions released into the air,
- Determination of a carbon tax per specific energy unit.

Any economic institution that emits carbon emissions into the air becomes a taxpayer, that is, a tax debtor, by adding the social cost to its total cost, which is subject to tax per the amount of carbon emission resulting from the damage it causes to the environment. The economic institution, which is the carbon taxpayer, is obliged to pay this tax amount to the tax creditor at the rate of the amount of greenhouse gas emissions it releases into the environment. A carbon tax is not just a type of tax that the manufacturer will bear. Economic units taxed according to the carbon emissions limit can reflect this tax on their costs. In this case, the contractor of the carbon tax that the business will bear is the consumer (Yerlikaya, 2003: 697).

Today, carbon tax practices are largely seen in Europe. Countries that impose a national carbon tax are in Europe; Finland, Iceland, Norway, Sweden, Denmark, Estonia, Latvia, Ireland, Slovenia, Switzerland, Poland, Portugal and the United Kingdom. Outside Europe, it is Mexico, Colombia, Chile, India and Japan. In Canada, a carbon tax is not applied, but it is in the planning stage (Balı and Yaylı, 2019: 308). In the EU, carbon tax implementations are considered an important financial instrument in achieving environmental policy objectives (Tanrıvermiş, 1997: 3).

3. ENVIRONMENTAL TAXES IN TURKEY

The first tax enacted within the scope of combating environmental pollution in the Turkish Tax System is the Environmental Cleaning Tax (ECT). Bag fee can also be evaluated within this scope. Although it is not a direct environmental tax, Motor Vehicle Tax (MVT) and Special Consumption Tax (SCT) are considered other environmental taxes as they provide environmental contributions in terms of tariffs, rates, exemptions and exceptions (Ertekin and Dam, 2020: 66). In this context, the carbon tax, which is the application area especially in EU countries, is not yet implemented in Turkey (Balı and Yaylı, 2019: 318).

3.1. Environmental Cleaning Tax

The ECT, also known as the garbage tax, is a type of tax that is paid by those who use all housing, workplaces and other structures within the municipal boundaries. The tax fee is reflected in the water bill in the dwellings (Öz

and Kutbay, 2016: 256). The tax has no effect on the reduction of other solid waste, as it is calculated on the basis of the amount of water consumed only in buildings. As per the legal regulation, business owners pay this tax to the municipality in two equal installments every year. Some institutions specified in the law (general and added budget administrations, provincial special administrations, buildings used in the embassy and consular services, buildings belonging to the units established by municipalities and villages, buildings used by organizations and universities such as hospice, Red Crescent, KYK student dormitories, places of worship, etc.) are exempt from this tax (Çitil and Kınacı, 2011: 35).

ECT, which is determined in the Municipal Income Law No. 2464, is a tax that concerns those who use housing, workplace and other buildings. The amount of tax is determined on the basis of the amount of water consumption in the dwellings. ECT; for the year 2021, residents of metropolitan areas and housing units were determined as 50 cents for every 1 cubic meter of water they used and those living in other cities were 38 cents.

The main purpose of the ECT is to combat environmental pollution and to reduce the negative effects of environmental pollution on nature, health and economy. In terms of the subject matter of the tax, its tariff and the taxpayer, this purpose cannot be said to have been effectively fulfilled (Üyümez, 2016: 433). It is seen that this tax has not been successful in reducing environmental pollution and the waste amount and eliminating the collected wastes in practice. In 2018, the ECT in Turkey accounted for 4.42% of local government revenues and 0.051% of general administration budget revenues and has a very low share of total tax revenues of 0.085%. Current estimates show that the proceeds from the ECT cover only 25% of the cost of waste collection and disposal. (Samancı and Karagöz, 2019: 73). Therefore, it is very difficult to say that the ECT is a very effective tool in the protection of the environment and the fight against environmental pollution.

3.2. Bag Fee and Recovery Contribution

Bag fee regulation in Turkey was made in 2018 with the additional article 13 added to the Environmental Law. Accordingly, the purpose of the regulation is stated in the relevant law as follows: “In order to efficiently manage resources and prevent environmental pollution caused by plastic bags, plastic bags are given to the user or consumer at the points of sale for a fee. The base fee to be applied is determined not less than 25 cents and is updated for each year through the commission to be established by the Ministry”. As of January 1, 2019, paid bags have been introduced in grocery stores (Environmental Law No. 2872, Annex 13).

It is aimed to prevent environmental pollution with the law that comes into force to reduce the use of plastic bags and packaging. Plastic bags and packaging also have some negative economic effects and are also made of oil (Romer, 2010: 443). It is known that our country is heavily dependent on the outside in oil (Çalışkan, 2009: 303). The current account deficit is also expected to decrease as the use of plastic bags and packaging will decrease with the law. As a matter of fact, with the introduction of the law, the citizens began to feel the bag fee paid for the development of tax awareness and it became visible that the use of plastic bags decreased at the points of sale.

The bags used for transportation purposes with the bag fee arrangement are made paid and 15 cents of this fee received from the consumer is declared under the name of “Recovery Participation Share” and paid by taxpayers to the tax authorities they are affiliated with and transferred to the Ministry of Environment and Urbanization. The remaining 10 cents must be accounted for as the cost of the plastic bag (Kısacık, 2019: 190).

For years, bag fee and recovery contribution are shown in Table 1.

Table 1. Bag Fee and Recovery Contributions (Cents) as of Years

Years	VAT 18%	Bag Fee	Recovery Contribution
2019	0,04	25 cents	15 cents
2020	0.04	25 cents	18 cents
2021	0.04	25 cents	19 cents

Source: Created by authors.

18% VAT is applied to the bag fee. In this case, for example, when you buy one bag from any grocery store in 2021, you also pay 0.04 cents VAT for Recovery Contribution. As the table shows, Recovery Contribution, which was 18 cents in 2020, was 19 cents for 2021, meaning that the share of the state from the 25-cent bag increased from 75.25 percent to 91.33 percent. In this case, 19 cents of the grocery bag purchased by the citizen is transferred to the Ministry of Environment, 2.2 cents to the markets and 3.8 cents to the Ministry of Finance and Treasury in VAT (Verginet.net, 2020).

3.3. Motor Vehicle Tax

Looking at the basic criteria of the tax, it is seen that the Motor Vehicle Tax (MVT), which is applied in different ways in developed or developing countries, aims to provide income and sometimes protect the environment, taking into account many different criteria from the age of the vehicle to the volume of cylinders, from passenger-carrying capacity to the amount of carbon dioxide emissions (McMorran and Nellor, 1994: 9). MVT is evaluated within environmental taxes because it contributes indirectly to the fight against environmental pollution.

Due to factors such as developing technological conditions and population growth, the increase in motor vehicle use has a negative effect on the environment. MVT, in terms of base structure, is one of the specific qualified tax practices. When creating a tax tariff; criteria such as age, type, the purpose of use, seating capacity, engine cylinder volume and a maximum takeoff weight of the vehicle covered by the tax are taken into account. The amount of tax increases as the engine cylinder volume and engine power of the vehicles increase. Because vehicles with a larger engine cylinder volume emit more emissions. In contrast, as the age increases, so does the tax (Sugözü et al., 2014: 122). MVT constitutes taxes levied on wealth. In the existing MVT system implemented in Turkey, older vehicles are taxed in lower amounts, while new vehicles are charged higher amounts of MVT (Öncel et al., 2008: 391; Bilici, 2008: 142).

When we look at the practices in the EU, it is seen that MVT is applied in the form of road and environmental tax. The criteria taken into account when determining the amount of MVT in EU member states focus on fuel consumption, weight, cylinder volume and CO2 emissions (Kaplan, 2012: 216). The weight criterion is directly proportional to the total weight of the vehicles as the damage they cause to the road they use. It is thought that the person's wealth increases as the total weight of the vehicle increases, and in this case the amount of tax to be paid increases. The underlying reason for the use of criteria such as fuel consumption, cylinder volume and CO2 emissions is the idea that toxic gas will be released into the environment (Bozdoğanoğlu, 2008: 2).

3.4. Special Consumption Tax

SCT is a tax taken from all goods and services except exceptions and exemptions, which comes into force within the framework of EU compliance and is taken in the manufacturing and importation of luxury consumer goods listed in the law and goods that harm human and environmental health, and which has a very important share in public revenues (Turhan, 1993: 260; Taylar, 2010: 450).

The SCT is collected on a limited number of goods that are easy to tax and have low elasticity of demand. With the introduction of SCT, many taxes such as Fuel Consumption Tax, Fuel Price Stability Fund, Vehicle Purchase Tax, Traffic Registration Fee, Environmental Pollution Prevention Fund, Additional Vehicle Purchase Tax have been repealed. SCT is included in the group of taxes received on consumption. The taxpayer of taxes on consumption is not actually consumers, but those who sell these goods or provide the services collect these taxes from the buyers together with the sale price. Therefore, taxes are reflected to the consumer of the goods together with the sales price. As a result, these taxes, which are deposited by the taxpayer in the tax office, are imposed on the final consumers (Oktar, 2020: 25-26).

4. LITERATURE REVIEW

Some of the studies on the impact of environmental taxes on the environment in the literature consist of theoretical and some of the studies consist of applied studies. Most of the empirical studies are aimed at EU countries, which are national carbon tax enforcers. In the case of Turkey, although there is no national carbon tax, environmental taxes are applied under the name of environmental tax. In this context, there is no empirical study in the literature that investigates the effect of these taxes on emissions in the case of Turkey.

In the theoretical studies, general evaluations were made regarding the effects of environmental taxes on the environment. Baranzini et al. (2000) examined the effectiveness of carbon taxes in reducing CO2 emissions in some examples of countries around the world. Countries around the world such as the Netherlands, Sweden, Norway, Denmark, the UK and Germany are the countries that impose carbon taxes. In these countries, the carbon tax is used as an effective policy tool for reducing the environmental pollution. Another study in the literature is the work of Pizer (2002). He stated that price control policies that support environmental taxes in reducing greenhouse gas emissions are a more effective tool than quantity control policies.

Üyümez (2016) examined the positive impact of motor vehicle tax on the environment in the case of the EU and Turkey. In eu member states from the past to the present, the contribution of motor vehicle tax on the environment was taken into account and the income it provided to the state was pushed to the second place. In Turkey, the opposite approach has been taken Balı and Yaylı (2019) evaluated the viability of the carbon tax in Turkey. They stated that it is necessary to implement the carbon tax as a new policy tool for reducing CO2 emissions in the process of achieving sustainable development in Turkey.

Some of the empirical studies examining the relationship between environmental tax and CO2 are summarized in Table 2 in terms of the author/authors of the study, the country/countries covered, the methods used and the results of the analysis.

Table 2. The Relationship Between Environmental Tax and CO2: Literature Summary

Authors/Authors	Country/Countries	Method	Results
Hotunluoğlu and Tekeli (2007)	18 EU Countries	Panel Data Analysis	In the countries included in the analysis, the impact of the carbon tax on emissions is negative but statistically meaningless.
Lin and Li (2011)	Finland, Norway, Denmark, Sweden, Netherlands	Variance of Difference Method	In Finland, a carbon tax has a negative and meaningful effect on CO2 emissions. In Denmark, Sweden and the Netherlands, this effect is statistically meaningless. The mitigating effect of the carbon tax on emissions is irrelevant, as the rapid growth in energy production in the oil and gas sectors in Norway has led to increased carbon emissions.
Allan et. al. (2014)	Scottish	Energy-Economy-Environment Model	The carbon tax imposed in Scotland has an emission-reducing effect.
Bayar and Şaşmaz (2016)	Denmark, Finland, Netherlands, Sweden and Norway	Panel Causality Test	There is no meaningful relationship between a carbon tax and emissions. However, a one-way causality relationship from economic growth to CO2 emissions has been identified.
Tekin and Şaşmaz (2016)	25 EU Countries	Panel Data Analysis	It has been determined that total environmental taxes and transportation taxes have no effect on emissions, while energy taxes have an emission-reducing effect.
Topal and Günay (2017)	53 OECD Ülkesi	Panel Data Analysis	Environmental taxes have a meaningful and positive impact on environmental quality. However, this effect has been seen to be stronger in developed economies than in developing economies.
Polat and Polat (2018)	25 EU Countries	Panel Data Analysis	There is a cointegration relationship between the series. The effect of an environmental tax on CO2 emissions is significant and negative.
Hajek et. al. (2019)	Sweden, Finland, Denmark, Ireland and Slavenya	Panel Data Analysis	It has been concluded that the carbon tax is effective in reducing emissions from fossil fuel consumption.
Kiuila et. al. (2019)	Czech Republic	Static General Balance Model	The impact of national emissions charges on CO2 is negative.
Ghazouani (2020)	Denmark, Finland, Sweden, Netherlands and Norway	Trend Score Matching Method	The carbon tax has a significant impact on reducing carbon emissions.

5. MODEL, DATA AND ANALYSIS RESULTS

5.1. Estimated Model and Data Definitions

In this study, the effect of environmental taxes on CO2 emissions in Turkey was investigated for the period 1994-2015. The data and data definitions used in the analysis are shown in Table 3.

Table 3. Description of Variables

Variables and Measurement	Source	Symbol
CO2 Emissions (Metric Tons Per Capita)	World Bank, World Development Indicators Database	CO2
Environmental Tax (% of GDP)	OECD Database	ET
GDP Growth Rate (annual %)	World Bank, World Development Indicators Database	GDP
Renewable Energy Consumption (% of total final energy consumption)	World Bank, World Development Indicators Database	REC

Source: World Bank (2021); OECD (2021).

Natural logarithm of all variables used in the analysis was taken. The model predicted in the study is as follows:

$$LCO2_{it} = \alpha + b_1 LET_{it} + b_2 LGDP_{it} + b_3 LREC_{it} + \varepsilon_{it} \quad (1)$$

5.2. Analysis Results

Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were used to determine the stationarity of the series. Then, the cointegration relationship between the series was examined with the Johansen Cointegration Test. The long-term coefficients of the variables were estimated with FMOLS, DOLS and CCR Models.

The ADF test, developed by Dickey and Fuller (1981), includes the regression of the series whose stationarity is to be investigated, its own lagged value and differences, and the regression is as shown in equation 2:

$$\Delta Y_t = \alpha + \beta_t + \delta Y_{(t-1)} + \vartheta \sum \Delta Y_{(t-1)} + \varepsilon_t \quad (2)$$

Δ in equation 2, the difference processor is ε_t is the term for stationary error. In the unit root test, the latency length for each series can be selected according to the Akaike and Schwartz information criteria. In ADF testing, the zero hypothesis states that the series contains unit roots at the level value. If the coefficient of δ is statistically significant, the zero hypothesis is rejected and the series is considered stable (Kızılgöl, 2006: 57).

ADF testing within unit root tests is a heavily used test. With the PP test developed by Phillips and Peron (1988), the serial correlation and changing variance problem caused by errors in the ADF test was eliminated. The equation in which the PP test is applied is as follows:

$$\Delta Y_t = \alpha Y_{t-1} + x_t' \delta + \varepsilon_t \quad (3)$$

In equation 3, $\alpha = \rho - 1$, x_t means "intercept" or "trend and intercept". In PP testing, the basic hypothesis is that there is a unit root. In this test, the hypotheses are $H_0: \alpha = 0$ and, $H_1: \alpha < 0$. The probability distribution of test statistics is the same as the ADF test (Çağlayan and Saçaklı, 2006: 124).

Table 4 provides unit root test results. As seen in Table 4, according to the ADF and PP test results, while the CO2 and REC variables for the intercept model contain unit root in the level value, they become stationary when the first difference is taken. ET and GDP variables are stationary both at level value and first difference. According to the results of the ADF and PP unit root tests for the trend and intercept model, most of the variables contain a unit root at the level value. When the first difference of the variables is taken, the series becomes stationary. Accordingly, the series became stationary when the first difference of CO2, ET and REC variables was taken. The GDP variable, on the other hand, is stationary at the level value and the first difference.

Table 4. ADF and PP Unit Root Test Results

For Intercept		**ADF**		**PP**	
		Level	**First Difference**	**Level**	**First Difference**
Dependent Variable	**LCO2**	-1.309105 (0.6054)	-4.940497* (0.0009)	-1.302836 (0.6083)	-5.126654* (0.0006)
Independent Variables	**LET**	-3.174646** (0.0362)	-4.533175* (0.0021)	-7.869287* (0.0000)	-4.533175* (0.0021)
	LGDP	-3.720362** (0.0116)	-5.688914* (0.0002)	-3.702082** (0.0120)	-10.71479* (0.0000)
	LREC	-1.735573 (0.4000)	-5.674081* (0.0002)	-1.930421 (0.3129)	-6.228956* (0.0001)
For Trend and Intercept		**ADF**		**PP**	
		Level	**First Difference**	**Level**	**First Difference**
Dependent Variable	**LCO2**	-2.605128 (0.2815)	-4.806674* (0.0054)	-2.665778 (0.2585)	-4.941851* (0.0042)
Independent Variables	**LET**	-1.90967 (0.6140)	-6.117606* (0.0004)	-2.716027 (0.2404)	-7.137129* (0.0001)
	LGDP	-3.620376*** (0.0523)	-5.522578* (0.0013)	-3.599501*** (0.0544)	-10.42279* (0.0000)
	LREC	-2.434656 (0.3531)	-4.399909** (0.0129)	-2.434656 (0.3531)	-7.370016* (0.0000)

Note: *, ** and *** indicate that the coefficients of 1%, 5% and 10% respectively do not contain unit-roots.

Johansen (1988) and Johansen and Juselius (1990) use the Maximum Eigen Value and Trace statistics to determine the long-term relationship between variables. These tests are expressed in equations (4) and (5), respectively.

$$J_{trace} = -T \sum_{i=r+1}^{n} ln(1-\gamma_i) \quad (4)$$

$$J_{max} = -T\ ln\ (1-\gamma_{r+1}) \quad (5)$$

Here T is the sample size and γ_i is the i. largest canonical relationship. In the Maximum Eigen Value test, the existence of at most r cointegration vectors is tested against the alternative hypothesis claiming the existence of r+1 cointegration vectors. On the other hand, in the Trace test, the existence of at most r cointegration vectors is tested against the alternative hypothesis expressing the existence of at least r+1 cointegration vectors (Sinan, 2018: 688; Özcan and Arı, 2013: 111; Altay Topcu, 2021: 35).

Johansen Cointegration test results are shown in Table 5.

Table 5. Johansen Cointegration Test Results

	Trace Test			
Hypotheses	**Eigenvalue**	**Trace Statistic**	**Critical Value (5%)**	**Prob Value**
r = 0* None*	0.882572	86.00750	47.85613	0.0000
r ≤ 1* At most 1*	0.742424	45.31081	29.79707	0.0004
r ≤ 2 At most 2	0.556688	19.53843	15.49471	0.0116
r ≤ 3 At most 3	0.193343	4.082277	3.841466	0.0433
	Max Eigen-Value Test			
Hypotheses	**Eigenvalue**	**Trace Statistic**	**Critical Value (5%)**	**Prob Value**
r = 0* None*	0.882572	40.69668	27.58434	0.0006
r ≤ 1* At most 1*	0.742424	25.77238	21.13162	0.0103
r ≤ 2 At most 2	0.556688	15.45616	14.26460	0.0323
r ≤ 3 At most 3	0.193343	4.082277	3.841466	0.0433

* The Trace statistic indicates that there is 4 cointegrated vector at 0.05 significance level.
* The Maximum Eigen-Value statistic indicates that there is 4 cointegrated vector at 0.05 significance level.

As seen in Table 5, Trace and Maximum Eigen-Value statistics for all hypotheses are greater than the critical value. Accordingly, the first hypothesis is rejected at the 5% significance level and the other hypotheses are accepted. In other words, all test results show that there are four long-term cointegrating vectors among the variables. According to this result, there is a significant long-term relationship between CO2 and ET, GDP and REC.

After the cointegration relationship was found between the variables, the long-term coefficients of the series were estimated using FMOLS, DOLS and CCR Models. FMOLS, DOLS and CCR estimation results are shown in Table 6.

Table 6. Estimation Results

Dependent Variable: LCO2			
Methods			
	FMOLS	**DOLS**	**CCR**
Variables	**Coefficient**	**Coefficient**	**Coefficient**
LET	-0.185363** (0.0362)	-0.357855* (0.0001)	-0.169035** (0.0388)
LGDP	0.025742 (0.3920)	0.059743*** (0.0817)	0.027984 (0.4410)
LREC	-0.875858* (0.0000)	-0.880184* (0.0005)	-0.878140* (0.0000)
C	1.681268* (0.0000)	1.753588* (0.0000)	1.674057* (0.0000)
$\boldsymbol{R^2}$	0.845633	0.979070	0.844939

Note: *, ** and *** indicate that the coefficients are significant at the 1%, 5% and 10% significance level, respectively.

As shown in Table 6, the LET and LREC variables have a statistically significant effect according to the FMOLS and CCR Model results. According to the DOLS results, all the variables included in the analysis were found to be significant. According to all estimation results, the 1% increase in LET leads to a decrease of 0.18%, 0.35% and 0.16% in CO2, respectively. In other words, the effect of environmental taxes on CO2 emissions in Turkey is negative. On the other hand, according to the FMOLS and CCR estimation results, it was concluded that the LGDP variable did not have an effect on CO2. According to the DOLS model results, the LGDP variable has a positive and statistically significant effect on CO2.

Another conclusion obtained from FMOLS, DOLS and CCR models is that the effect of renewable energy consumption on Turkey's carbon dioxide emissions is negative and statistically significant at the level of 1% importance. This effect is stronger than the negative effect of environmental taxes on carbon dioxide emissions in Turkey. It was concluded that the 1% increase in LREC resulted in a decrease of 0.87%, 0.88% and 0.87% in CO2, respectively. The results obtained in the analysis are consistent with theoretical literature and largely empirical literature.

CONCLUSION

The unconscious consumption of scarce natural resources and the destruction of nature, directly and indirectly, threaten countries. In this context, the problem of environmental pollution becomes a global problem. The fact that greenhouse gas emissions continue to increase globally and the negative effects of climate change are becoming increasingly palpable has brought the Kyoto Protocol into the spotlight. Our country became a party in 2009 to this protocol, which many countries in the world are parties to. The countries that are parties to this protocol have undertaken different rates of greenhouse gas emission reduction/limitation obligations as a result of the negotiations. Our country does not yet have a commitment to limit/reduce digitized emissions.

Carbon tax, one of the types of taxes used to solve the problem of environmental pollution, affects the cost of the product produced, increasing the cost of using these products through the price mechanism and encouraging the use of fossil fuels less. The producer is subject to a tax on the amount of carbon dioxide gas it releases into the environment. Thus, the manufacturer, which is a taxor, adds social cost to the total cost of the product and ensures the internalization of negative externalities. The state, which has become a tax creditor, generates revenue and imposes an extra expense on taxpayer-owned businesses. The carbon tax implemented in this way both reduces harmful CO2 emissions to the environment and provides an additional income to the state budget. The fact that countries with large economy do not participate in global agreements such as the Kyoto Protocol, which can contribute positively to the environment, does not achieve the desired purpose of this tax.

In this study, the effectiveness of environmental taxes on CO2 emissions in Turkey was examined in 1994-2015. According to the results of the analysis, although environmental taxes applied in Turkey are effective on CO2 emissions, it is seen that the coefficient value of the environmental tax variable is low. In order for this effect to be stronger, the revenues from the ECT in Turkey should be at least sufficient to cover the costs of collecting and disposal waste. In addition, it can be said that if a carbon tax is implemented in our country, whose direct focus is on reducing greenhouse gas emissions in nature, this tax will have a more positive impact on the environment.

The implementation of a carbon tax can be considered as an effective policy tool in the country's focus on renewable energy sources and its contribution to the environment. Thus, the country's sustainable development goal should be supported. Therefore, the state is required to establish tax arrangements in this regard. In addition, it is seen that the environmental taxes in the Turkish Tax System do not have the desired level of environmental impact. Therefore, environmental taxes should be used effectively along with other financial or market instruments within the scope of combating environmental pollution.

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