

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/313846380>

Economic Growth and CO2 Emissions in Turkey

Conference Paper · May 2016

CITATIONS

2

READS

206

2 authors:



HASAN HUSEYİN Yildirim

Balıkesir University

64 PUBLICATIONS 274 CITATIONS

SEE PROFILE



Şakir Sakarya

Balıkesir University

97 PUBLICATIONS 633 CITATIONS

SEE PROFILE

Economic Growth and CO₂ Emissions in Turkey

H. H. Yildirim¹, Ş. Sakarya²

¹University of Balikesir, Burhaniye School of Applied Sciences, Department of Banking and Finance,
²University of Balikesir, Faculty of Economic and Administrative Sciences, Business Faculty,

Abstract

After the 19th century, Energy has become an important and indispensable input to production and consumption activities. At the same time energy, a determinant of growth for the national economies, is the main source of economic growth. We aim to investigate the relationship between economic growth and CO₂ emission for Turkey which is located in developing countries. In accordance with this aim, Turkey will be analysed with time series method over the period 1960-2011. In this study, GDP per capita will be taken for economic growth and CO₂ emissions (metric tons per capita) will be taken for CO₂ emission. The data in this study will be selected annually.

© 2016 IESEE. All rights reserved.

1. Introduction

Energy is one of the basic inputs required for the development of a country. In the absence of sufficient energy industry, transport and social life are subject of failure. Energy products constitute the largest cost item in the production processes of the modern economy. Being unable to meet energy demand due to population growth, industrialization and rising living standards can cause social, political and military conflicts.

Global primary energy consumption increased by just 0.9% in 2014, a marked deceleration over 2013 (+2.0%) and well below the 10-year average of 2.1%. Growth in 2014 slowed for every fuel other than nuclear power, which was also the only fuel to grow at an above-average rate. Growth was significantly below the 10-year average for Asia Pacific, Europe & Eurasia, and South & Central America. OECD consumption fell by 0.9%, which was a larger fall than the recent historical average.

Table 2: World Primary Energy Consumption (2014)

Region	Primary Energy Consumption							Percent (%)
	2014							
	Oil (Mt)	Natural Gas (Mtoe)	Coal (Mtoe)	Nuclear Energy (Mtoe)	Hydro-Electricity (Mtoe)	Renewables (Mtoe)	Total	
Total North America	1024.40	866.30	488.90	216.10	153.50	73.60	2822.60	0.22
Total S. & Cent. America	326.50	153.10	31.60	4.70	155.40	21.50	692.80	0.05
Total Europe & Eurasia	858.90	908.70	476.50	266.10	195.70	124.40	2830.30	0.22
Total Middle East	393.00	418.60	9.70	1.00	5.20	0.30	827.90	0.06
Total Africa	179.40	108.10	98.60	3.60	27.50	2.90	420.10	0.03
Total Asia Pacific	1428.90	610.70	2776.60	82.50	341.60	94.20	5334.60	0.41
Total World	4211.10	3065.50	3881.80	574.00	879.00	316.90	12928.40	
Percent (%)	0.33	0.24	0.30	0.04	0.07	0.02		

Table 1 shows us the distribution of primary energy consumption in 2014 (BP, 2015). We can see the utilization of primary energy sources for the regions shows proportions of 22% in North America, 5% in S. & Cent. America, 23% in Europe & Eurasia, 6%, in Middle East, 3% in Africa,

41% in Asia Pacific region. In 2014, oil which is the largest share of the world consumption of primary energy resources constituted 33% of whole consumption. Oil consumption is followed by coal, which is 30% of the world consumption. Natural gas is the third with 24% of primary energy consumption. 87% of world primary energy consumption is supplied by these three energy items, as a fossil source of energy. One of the most frequently-discussed global matters has been environmental destruction within contexts of global warming and climate change. The main reason for global warming is the very rapid increase in the ratio of gases that cause the greenhouse effect in the atmosphere. The increase in the emission of the carbon dioxide (CO₂) and methane gas in the atmosphere increases the temperature of the earth's surface. The main gas that causes the greenhouse effect is CO₂, which is emitted into the atmosphere by the use of fossil fuels such as gasoline, coal, and natural gas (Yavuz, 2014:229). Using fossil resources in global energy consumption causes environmental expenditures. "Sustainability" and "sustainable development" have come into prominence in order to maintain the economic growth without increasing environmental expenditures (Ergün&Polat, 2015:117)

Studying Turkey's primarily energy consumption for the last 30 years, it can be inferred that there is no change in consumption of hydrolic and coal energy. The dependence for oil can be decreased and there is a serious decrease in wood and waste energy source consumption. It is concluded that the dependence of natural gas has been rising rapidly for the last 20 years and the wind and solar energy have been expanding recently. However, over the last period of 30 years, it is determined that Turkey's structure on foreign energy-dependent did not change much (Doğaka, 2014). To reduce this dependence, the use of domestic resources should be expanded to maximum extent; the new energy fields should be identified; the use of new technology in using the energy efficiently should be promoted; new energy resources on the World should be discovered and the research for the country's potential should have priority.

According to BP statistics, in 2013, there is an increase of 0.4% on annual basis to 122.8 million TEP that constitutes Turkey's domestic primary energy demand of which constitutes approximately 1% of world demand. The largest share in the Turkey's primary energy demand is the natural gas with 33%. Petrol and coal come the second with the same portion of 27%. The share of hydro power 11% and the share of renewable energy is only at the level of 2%.

In the last 10 years in terms of energy demand in OECD countries at first place stand Turkey, according to the Ministry of Energy and Natural Resources Budget presentation in 2015 it is expected to reach 218 million TEP level of primary energy demand by 2023. It is also expected that in 2023 primary energy demand in the coal goes from 27% to 37% of the share, the oil shares of 27% decreases to 26% and the natural gas shares decreases from 33% to 23% ,and it is also predicted for hydropower's share level will be 4%, for renewable resources 6% and for the share of nuclear energy level 4%.

The relationship between economic progress and environment is presented as a model with kuznets curve. According to the model, both the development and the growth of countries have 3 phases. In the first, countries enhances economic growth and consequently the energy consumption. Since it is more affordable, countries use fossil energy. The usage of fossil energy causes CO₂ emission rise. In the second phase, countries have the economic growth in a particular way. The countries reach at a certain level. However, the usage of CO₂ has increased extremely. In the last phase, the countries desire to enhance the economic growth decreasing CO₂ (Dinda, 20014:433; Stern, 2004:519).

The economic growth of the countries bring about CO₂ rise as well. Developing countries want to reduce the CO₂ while maintaining economic growth in order to reach the developed country

level. The point at which CO₂ starts to decrease is called threshold point. Following the certain level of growth and the income rise, the measures to protect the environment are taken (Yandle vd., 2002:1-5). In this study, the relationship between Turkey's economic growth and the change in CO₂ has been analyzed.

This study consists of five chapters. The first part is about the definition and the importance of CO₂ with economic growth both in Turkey and the World. The second part is literature section of the CO₂ and economic growth. In the third part of the study, data sets and methods of the study in the methodology section are described. In the fourth section of the study empirical outputs gathered by the chosen method are presented. In the fifth chapter of this study, the results are concluded.

2. Literature Review

There is a vast amount of research on the relationship between the level of income of a country and environmental pollution. Since Grossmann and Krueger (1991, 1993, 1995), who detected this inverted U-shaped relationship between gross domestic product and some pollution indicators at the beginning of 1990s, together with the serious increase of environmental destruction, the literature concerning this topic has been rapidly growing. The relationship between income and environmental pollution has been studied for groups of countries and also for individual countries(Yavuz, 2014:230). Although some of the applied studies support the environmental Kuznets curve hypothesis, some others do not. The models in which the relationship between environmental destruction and growth is searched for are generally criticized because of the omitted variable and the estimations are assumed to be biased. Richmond and Kaufmann (2006) included energy consumption within the model in order not to be exposed to the undesirable effects of the omitted variable and they determined a positive relationship. Soyta,s et al. (2007) searched for the Granger type causal relation between real income and CO₂ emission. Table 2 summarizes some earlier relevant studies with their main features including methodology employed and main findings.

Table 3: Summary of Previous studies on the relationships between CO₂ emission and economic growth

Study	Country	Period	Methodology	Results (Causality)
Ang (2007)	France	1960-2000	Johansen-Juselius, ARDL bounds test, EKC, VECM	EC →GDP
Halicioğlu (2008)	Turkey	1960-2005	ARDL bounds test, Johansen-Juselius, VECM	CO ₂ ↔ EC, CO ₂ ↔ GDP
Jalil and Mahmud (2009)	China	1975-2005	ARDL bounds test, EKC, VECM	GDP → CO ₂
Zhang and Cheng (2009)	China	1960-2007	Toda-Yamamoto procedure	GDP→EC EC→CO ₂
Lean and Smyth (2010)	Five ASEAN countries	1980-2006	Johansen Fisher panel cointegration EKC, panel VECM	CO ₂ ↔ GDP
Menegaki (2011)	27 European countries	1997-2007	Panel cointegration test	CO ₂ ↔GDP

In Table 2, from many studies a certain part of the relationship between the CO₂ and the economic growth is shown. There are differences in the results of these studies with regard to GDP, GDP per capita, pollution level and the usage of pollution level per person, the kind of pollution emission used, usage of different explanatory variable apart from the variable in hand, differences of theoretical models, the terms and the countries analyzed. These differences can cause variant results even at the analyzes of the same countries.

3. Methodology

3.1. Data Set

Data set used in this study includes the period 1960-2011 and analyses have been studied by using 52 observations on annually data basis. Closing data (\$) pertaining to GDP per capita, metric tons per capita for CO₂. Both data have been obtained from worldbank data base. Excel 2010 and Eviews 8.0 package program have been used for arranging the data and implementation of econometric analyses.

3.1. Methods

Firstly, natural logarithms of data have been taken before passing to the analysis process. Then, stationary analysis has been performed for data pertaining to the variables used in the study. The most widely used tests among parametric test are Augmented Dickey-Fuller (ADF-1979) and Philips-Perron (PP-1988) test that considers possible structural fracture and trend in the time series analyses. A long term relationship between time series has been searched by applying cointegration test developed by Granger Cointegration. Finally, the direction of the relationship between variables has been examined with Granger Causality test.

3.2.1. Unit Root Test

A series, which does not have unit root problem, is regarded as a stationary series. In case of considering time series, there is a possibility of encountering with spurious regression problem. In this case, the result obtained by regression analysis will not reflect the real relationship (Gujarati, 1999). Certain problems arise in models formed by using unstationary time series and a relationship that does not exist between variables is interpreted wrongly, and assessed as if it exists. Various parametric and non-parametric tests have been developed for finding whether a series is stationary or not or includes unit root.

Augmented Dickey-Fuller (ADF-1979) and Philip-Perron (PP-1988) test methods are famous to determine for the unit roots testing. It is decided upon rejection or acceptance of the H₀ hypothesis by comparing the statistics obtained by the test with critical value (Enders, 2008). H₀ hypothesis shows that series is not stationary and has unit root, alternative hypothesis shows that series is stationary. If the calculated value is bigger than the absolute critical value, then H₀ hypothesis is rejected and a series is decided to be stationary.

H₀: Series is not stationary (There is unit root)

H₁: Series is stationary (There is no unit root)

Among the variables in the equations $\Delta Y_t = Y_t + Y_{t-1}$; t is the trend variable, stochastic error terms and T coefficient is the total number of observations.

3.2.2. Granger Cointegration Test

Researchers look time series for stationarity in order to prevent spurious regression. Even though there are many solutions for non-stationary time series, to wipe out the trend by taking the difference of the variables is a must. However, the realization of said process leads to the loss of long-term information and inhibit the long-term dynamic analysis. Engle and Granger (1987) who introduced literature cointegration analysis, reveals that examining long-term relation in time series even if it is a trend (Utkulu, 1994).

If there is a cointegration between variables, These variables include at least one directional causality (Utkulu,2003). When one or more than one non-stationary series has a mutual action in

the long-term, it is called cointegration. There are three methods used to estimate the cointegration between the variables in time series (Brooks, 2008). 1. Engle- Grangers Two Step Method, 2. Engle and Yoos Three Phase Method, 3. Johansen VAR Approach.

In this study we analyse the relation between variables by using two methods which is known as a single equation approach. Third method is, making without the distinction between dependent and independent variables, of the variables used in the determination of cointegration relationship (Brooks, 2008).

If the variables are not stationary after testing by unit root test in level and the variables is stationary in first difference, using OLS methods can be applied to the variables. After the OLS results, the unit root testing is applied for residual. If the residual is stationary in level, the variables are co-integrated.

H₀: Residual Series is not stationary (There is no cointegration)

H₁: Residual Series is stationary (There is a cointegration)

Cointegrated variables means that, among variables with long-term there is the presence of the joint movement. In case of co-variables it means that integrated error correction mechanism (Error Correction Mechanism-ECM) occurs. If between the variables there is error correction mechanism, variables are cointegrated at the same time and in the long term there is a causality in at least one direction between these variables (Gujarati, 2002). The testing of causality between variables is done with Granger causality test Granger (1969). If Granger causality test is performed in non-stationary time series, it leads to false causality (Granger and Newbold, 1974; Stock and Watson, 1989). Because of that, the Granger causality tests are applied to stationary time series. If the result of the unit root tests is not stationary time series, by rendering inert causality test is applied on the first difference. The cointegration of the variables mean that the variables have a long-term simultaneous movement. When there is a cointegration result, ECM occurs. If there is a ECM between the variables, the variables are co-integrated same level and there is at least one direction on causality (Gujarati, 2002).

Granger (1969) causality test is done for the testing of causality between variables. Granger causality test is not applied for non-stationary time series. Because non-stationary series cause the spurious regression (Granger and Newbold, 1974; Stock and Watson, 1989). Because of this reason Granger causality test is applied for stationary time series. If the time series is not stationary after unit root testing, first difference needs to be taken. Causality testing can be applied after converting this data.

3.2.3. Granger Causality Test

Granger causality test has been performed in the study in order to determine the direction of the relationship between the variables used in the model. Granger causality test is performed in order to determine the direction of the relationship between variables (Granger, 1969). The following model has been estimated in order to determine the direction of causality:

$$Y_t = \alpha_0 + \sum_{i=1}^{k1} \alpha_i Y_{t-i} + \sum_{i=1}^{k2} \beta_i X_{t-i} + \varepsilon_t \quad (3)$$

$$X_t = x_0 + \sum_{i=1}^{k3} x_i X_{t-i} + \sum_{i=1}^{k4} \delta_i Y_{t-i} + v_t \quad (4)$$

In the models above, k shows the lag length and it is assumed that error terms are independent from each other (white noise) (Granger 1969). If all of the coefficients in the equation numbered (5) are meaningless as a whole, and coefficients in the equation numbered (6) are meaningful as a whole, then there is a one way causality from Y (independent variable) to X (dependent variable). Y is Granger causal of X. If causality relationship has one way direction like above, this condition might mean that Y and X from variables in the model are external and internal variables, respectively (Greene, 2008).

4. Empirical Results

4.1. Descriptive Statistics Results

Basic statistical values of the data were calculated in the first phase regarding the data examined in the study and are shown in table 3. When descriptive statistics shown in table 3 related to the variables considered in the scope of the analysis are examined, the average values of variables were found to be CO₂ (2.3102), GDP (2821.72), standard deviation values are found to be CO₂ (2.2494), GDP (1642.25).

Table 4: Descriptive Statistics Results

Observations			
Statistics/ Variables	CO₂	GDP	
Mean	2.3102	2821.72	
Median	2.2494	1642.25	
Maximum	4.3831	10584.16	
Minimum	0.6104	284.18	
Std. Dev.	1.0518	2856.54	
Skewness	0.1284	1.5003	
Kurtosis	1.9602	4.2514	
Jarque-Bera	2.4852	22.9025	
Probability	0.2886	0.0001	
Observations	52	52	
Correlations			
	CO₂		
	GDP	1	0.8874
		0.8874	1

When we look the skewness and kurtosis value for these variables We If kurtosis value of relevant variables is bigger than 3, it indicates that series is sharp, if it is smaller than 3, it indicates that series is oblate. In consideration of skewness values, if skewness value is equal to zero, it indicates that series have normal distribution, if the skewness value is bigger than zero; it means that series are skew in the positive direction, if skewness value is smaller than zero; it indicates that series are skew in negative direction. Following values were found:skewness value of CO₂ variable (0.1284), kurtosis value (1.9602), Jarque-Bera value(2.4852);skewness value of GDP variable (1.5003), kurtosis value (4.2514), Jarque-Bera value (22.9025). According to these calculated values; it has been found that CO₂ variable is skew (inclined) and oblate in the positive direction, GDP variable is skew (inclined) and sharp in positive direction. After analysing correlation between CO₂ and GDP (0.8874), a positive relationship is concluded.

4.2. Unit Root Test Results

Before applying unit root test which analyse stability of time series, whether there is a trend or not can be looked for in the chart of time series.

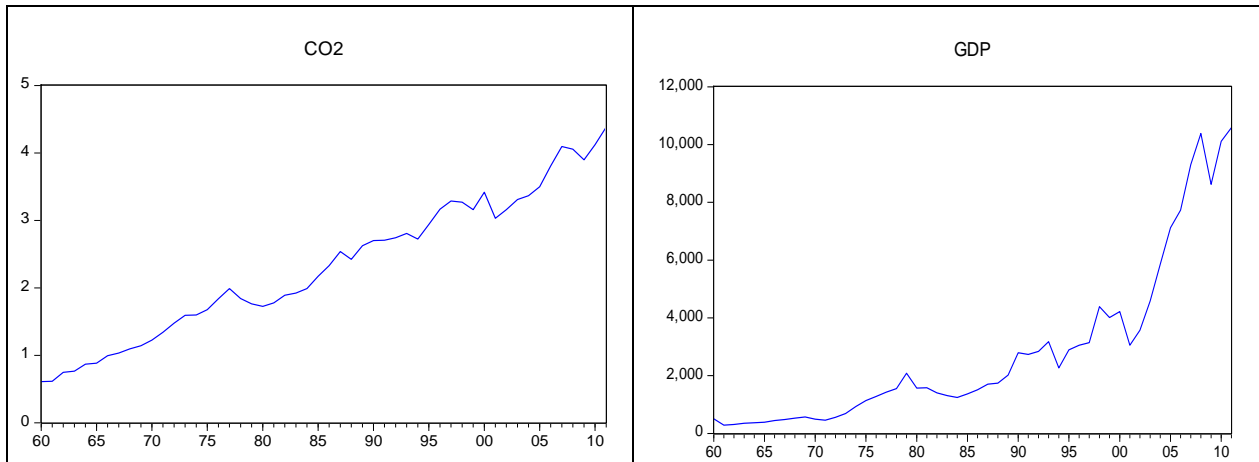


Figure 1: CO2 and GDP variables in time series graph

In the figure 1, time series are formed which belong to the whole variables. Referring to figure 1, it can not concluded easily that series are stationary in the level of value. However, when we look on the variable's time series charts, whether it is stationary or not cannot be determined sufficiently. The best way is to analyze the series for stationary or not by the test statistics. Unit root test for the series are applied to determine if they are stationary or not on level value. In the first phase, it was examined whether variables are stationary in the level I(0).

Table 5: Result of ADF,PP for Unit Root Test (Level Values)

Değişkenler	ADF		PP	
	Sabit	Sabit&Trend	Sabit	Sabit&Trend
CO2	0.3260 (0.9775)	-2.9482 (0.1567)	0.9581 (0.9955)	-2.9482 (0.1567)
GDP	1.6998 (0.9995)	-0.5045 (0.9802)	1.6998 (0.9995)	-0.3340 (0.9875)

Accordingly, ADF and PP tests were performed in terms of 2 separate models being with constant and constant-trend. PP test is a test that is applied in supporting of ADF test. Lag numbers applied in performance of ADF unit root test are lag values determined according to Schwarz Information Criterion (SIC). In PP test, dependent variable is not included into lag model so that it will be sufficient to eliminate auto-correlation, instead Newey-West method was used. Results of unit root test applied in the levels for variables were presented in Table 4. When Table 4 is examined, it has been observed that all variables are not stationary in both 2 separate models (constant and constant-trend) in ADF, PP tests and they have unit roots. If both variables are not stationary after unit root tests performed in their levels, relevant variables are made stationary by taking their differences. Accordingly, I(1) ADF, PP unit root tests were performed again by taking the first differences in order to make the variables stationary and results are shown in Table 5.

Table 6: Result of ADF, PP for Unit Root Test (First Differences)

Değişkenler	ADF		PP	
	Sabit	Sabit&Trend	Sabit	Sabit&Trend
CO2	-7.3209 (0.000)	-7.2968 (0.000)	-7.6037 (0.000)	-7.8043 (0.000)
GDP	-7.2446 (0.000)	-7.9763 (0.000)	-7.2520 (0.000)	-7.9752 (0.000)

When results of ADF, PP unit root test are examined after their performance by taking the differences of series from first degree, it is observed that all variables are not I(0) stationary in their levels and they become stationary when their first degree differences I(1) are taken. Findings found by ADF unit root test are also supported by the results of PP test. According to these results, as all variables are integrated from the first degree I(1), it is concluded that there can be a co-integrated relationship between variables. Therefore, it will be possible to look into the matter, whether there is a long term relationship (cointegration) between CO₂ variable and GDP variables.

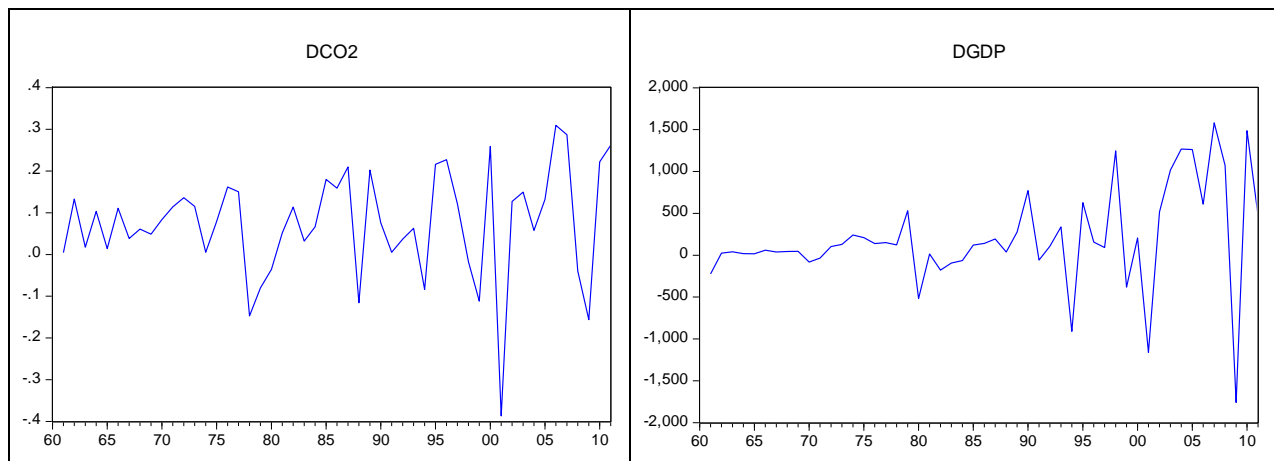


Figure 2: CO₂ and GDP variables in time series graph after first difference

4.3. Granger Cointegration Test Results

Stationarity of each variable is provided after first difference operation for the variables. Regression equation of oil prices and the first level of stability for each independent variables were estimated by the OLS regression method. With using the ADF&PP method from table 5, the unit root test is applied to the residuals of the regression equation. According to the both unit root test results, it was concluded that the level of residual has been stationary. According to these results of the test, variables are cointegrated.

With the informations obtained from Table 6, it has been concluded that the variables are co-integrated. It means that, there is a simultaneous long-term movement among the variables.

4.4. Granger Causality Test Results

Results of Granger Causality-Block Exogeneity Wald test performed based on Vector Error Correction Model(VECM) with the purpose of revealing whether there is a causality relationship between variables in each model, are shown in Table 7. By looking at Table 7, one will observe that only GDP (0.0154) is granger cause in the 5% significance level of CO₂. According to the obtained results, it can be said that CO₂ has not causality relationship in the direction of GDP. Also GDP has one way causality relationship in the direction of CO₂.

Table 7: Result of ADF for Regression Residuals Unit Root Test (Level Values)

Dependent Variable	Independent Variable			Constant		Constant & Linear Trend	
				t-Statistic	Prob.*	t-Statistic	Prob.*
DCO ₂	DGDP	ADF test statistic		-7.2774	0.0000	-7.2649	0.0000
		Test critical values	1% level	-3.5683		-4.1525	
			5% level	-2.9211		-3.5023	
			10% level	-2.5985		-3.1806	
DGDP	DCO ₂	ADF test statistic		-7.2027	0.0000	-7.9472	0.0000
		Test critical values	1% level	-3.5683		-4.1525	
			5% level	-2.9211		-3.5023	
			10% level	-2.5985		-3.1806	
DCO ₂	DGDP	PP test statistic		-7.4181	0.0000	-7.5845	0.0000
		Test critical values	1% level	-3.5683		-4.1525	
			5% level	-2.9211		-3.5023	
			10% level	-2.5985		-3.1806	
DGDP	DCO ₂	PP test statistic		-7.2100	0.0000	-7.9472	0.0000
		Test critical values	1% level	-3.5683		-4.1525	
			5% level	-2.9211		-3.5023	
			10% level	-2.5985		-3.1806	

Table 8: Granger Causality - Block Exogeneity Wald Test Results

Models	Dependent	Independent	Chi-Square	Df	Prob.	Direction
	DCO ₂	DGDP	8.3458	2	0.0154	Unidirection
	DGDP	DCO ₂	1.3190	2	0.5171	No Direction

Table 8 shows us regression results. In this regression CO₂ is dependent variable and GDP per capita is independent variable.

Table 9: Regression Equation Results

Dependent Variable: DCO ₂				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
DGDP	0.000114	2.57E-05	4.449689	0.0000
C	0.051358	0.016158	3.178523	0.0026
R-squared	0.287788	Prob(F-statistic)		0.000050
F-statistic	19.79973	Durbin-Watson stat		2.092785

From this result We can say that for the period 1960-2011 the slope coefficient was about (0.000114), suggesting that for the sample period an increase in GDP per capita of 1(\$ led, on average, to an increase of about (0.000114) CO₂ emission per capita.

5. Conclusion

In this study, the relationship between the variables using the data of GDP Per Capita in the economic growth and the CO₂ per person for CO₂ emission from 1960 to 2011 in Turkey has been analyzed. Therefore, the stability of variables has been examined first. Afterwards, variables have been examined to find out whether there is a cointegration among the variables

or not. For the last step, granger causality test has been applied to the variables in order to determine the direction of the effect.

Short and Long Term causality relationships among the variables have been detected as a result of granger cointegration. The simplex direction of the relationship has become evident thanks to granger causality test results. The relationship is from GDP per capita to CO₂. According to this result, the growth in Turkey increases CO₂ as in most developing countries. Developing countries use more fossil fuel for their energy consumption in order to achieve their economic growth. The energy sources in Turkey consist of mainly fossil fuel. For this reason, economic growth brings forth the increase in energy consumption and consequently increases CO₂. The increase in economic growth for Turkey, one of the developing countries, is substantial. However, it should not increase the CO₂ while maintaining its economic growth since CO₂ emission leads to environmental issues. Considering the environment fact in maintaining economic development, sustainable development concept will be achieved if we appreciate the politics for the renewable energy, which is one of the cleanest energy sources.

6. References

- [1] Ang, J.B.,2007, "CO2 emissions, energy consumption and out put in France", *Energy Policy* 35,4772-4778.
- [2] BP.,2015, *Statistical review of world energy*. British Petroleum, Available at: (<http://www.bp.com/content/dam/bp/pdf/energy-economics/statistical-review-2015/bp-statistical-review-of-world-energy-2015-full-report.pdf>).
- [3] Brooks, C., 2008, "Introductory econometrics for finance", Cambridge university press.
- [4] Dickey, D. A.,& Fuller, W. A., 1979, "Distribution of the estimators for autoregressive time series with a unit root", *Journal of the American statistical association*, 74(366a), 427-431.
- [5] Dinda, S., 2004, "Environmental Kuznets Curve Hypothesis: A Survey", *Ecological Economics*, 49, pp. 431-455.
- [6] Enders, W., 2008, "Applied econometric time series", John Wiley & Sons.
- [7] Ergün, S., Polat,M., 2015, "OECD Ülkelerinde CO2 Emisyonu, Elektrik Tüketimi ve Büyüme İlişkisi", *Erciye Üniversitesi, İktisadi ve İdari Bilimler Fakültesi Dergisi*, Sayı:45, Ocak-Haziran, 2015, s.115-141
- [8] Greene, W. H., 2008, "The econometric approach to efficiency analysis. The measurement of productive efficiency and productivity growth", 92-250.
- [9] Grossmann, G. M., and Krueger, A. B. 1991. "Environmental impact of a North American free trade agreement". NBER Working Paper 3914.
- [10] Grossmann, G. M., and Krueger, A. B. 1993. "Environmental impact of a North American free trade agreement. In: *The Mexico-US Free Trade Agreement*", Garber, P. (Ed.). Cambridge, MA: MIT Press, pp. 13-56.

- [11] Grossmann, G. M., and Krueger, A. B. 1995. "Economic growth and the environment", *Q. J. Econ.* 110:353-377.
- [12] Gujarati, D. N., & Porter, D. C. (1999). *Essentials of econometrics*.
- [13] Halicioglu, F., 2009, "An econometric study of CO₂ emissions, energy consumption, income and foreign trade in Turkey", *Energy Policy* 37, 1156-1164.
- [14] Jalil, A., Mahmud, S.F. ,2009, "Environment Kuznets curve for CO₂ emissions: a cointegration analysis for China", *Energy Policy* 37, 5167-5172.
- [15] Lean, H.H., Smyth, R., 2010, "CO₂ emissions, electricity consumption and output in ASEAN", *Applied Energy* 87, 1858-1864.
- [16] Menegaki, A. N., 2011, "Growth and renewable energy in Europe: A random effect model with evidence for neutrality hypothesis" *Energy Economics*, 33(2), 257-263.
- [17] Richmond, A. K., and Kaufmann, R. K., 2006, "Is there a turning point in the relationship between income and energy use and/or carbon emissions", *Ecol. Econ.* 56:176-189.
- [18] Soyta, S. U., Sarı, R., and Ewing, B. T., 2007, "Energy consumption, income, and carbon emissions in the United States", *Ecol. Econ.* 62:482-489.
- [19] Stern, D., 2004, "Environmental Kuznets Curve", *Encyclopedia of Energy*, 2, pp. 517-525.
- [20] Utkulu, U., 2003, "Türkiye'de Bütçe Açıkları Ve Dış Ticaret Açıkları Gerçekten İkiz Mi? Koentegrasyon ve Nedensellik Bulguları"
- [21] Yandle, B., Maya, V., Madhusudan, B., 2002, "The Environmental Kuznets Curve", *Perc Research Study* 02-1, pp. 1-24
- [22] Yavuz, N. Çil, 2014, "CO₂ Emission, Energy Consumption, and Economic Growth for Turkey: Evidence from a Cointegration Test With a Structural Break", *Energy Sources, Part B: Economics, Planning, and Policy*, 9:3, 229-235, DOI: 10.1080/15567249.2011.567222
- [23] Zhang, X.P., Cheng, X.M., 2009, "Energy consumption, carbon emissions, and economic growth in China", *Ecological Economics* 68, 2706-2712.