DETERMINANTS OF CARBON EMISSIONS THROUGH THE QUANTILE REGRESSION METHOD: THE CASE OF TURKEY

Kenan İlarslan[1], Münevvere Yıldız[2], and Tuğrul Bayat[3]

[1]Afyon Kocatepe University Bolvadin Faculty of Applied Sciences, Accounting and Finance Department
[2]Afyon Kocatepe University Bolvadin Faculty of Applied Sciences, Banking and Insurance Department
[3]Afyon Kocatepe University Bolvadin Faculty of Applied Sciences, Logistics Management Department

ABSTRACT: The aim of this study is to determine the factors affecting the amount of carbon emission in Turkey. The amount of carbon emission is a dependent variable and inflation, foreign direct investments (FDI), number of passengers transported by air, and bank credits to the private sector are included as independent variables in the analysis covering the period 1960-2019. After determining the existence of cointegration relationship between variables, coefficients were estimated by quantile regression analysis. According to the results, low and medium quantile levels of inflation, FDI and the number of passengers transported by airline have a positive effect on carbon emissions. However, the reducing effect of bank loans given to the private sector on carbon emissions is significant at high quantile levels.

KEYWORDS: Carbon emission, bank loans, foreign direct investment, airline passenger transport, quantile regression.
JEL Classifications: Q50, R40, C22, G21

1. Introduction

Carbon emission is expressed as the amount of gas released into the atmosphere as a result of using existing resources. The level of carbon emission is at high levels in countries where fossil fuels such as coal are used as energy sources. The main factors in the gradual increase of carbon emission are; the insufficient use of renewable energy in industry, the increase in people's energy needs as a result of population growth, increase in urbanization, and decrease in green areas accordingly, agricultural and animal activities can be listed.

The global increase in carbon emission levels aroused concern, revealing the necessity of taking measures regarding the issue. Environmental pollution has begun to be discussed in the international platform and concrete steps have been taken with the Kyoto Protocol in 1997. Turkey was also one of the countries that signed the protocol. The greenhouse gas amount of Turkey is presented in Table 1 according to the National Inventory Report prepared by the Turkey Statistical Institute for the period 1990-2018 to be submitted within the scope of the United Nations Framework Convention on Climate Change.

In Table 1, the amount of carbon dioxide was determined 219.4 Mt in 1990 and 520.9 Mt in 2018 in Turkey. When compared between 2017-2018, there is an increase of 0.5% is seen. It is important for the future of the

[1]This study was presented in summary at the Online 5th ICBFP'2021: International Conference on Banking and Finance Perspectives (20-22 April 2021).

Email: ilarslan@aku.edu.tr, munevvereyildiz@aku.edu.tr, tbayat@aku.edu.tr

Table 1: Turkish Greenhouse Gas Inventory Report, 1990 – 2018

	1990	1995	2000	2005	2010	2015	2016	2017	2018
Total emissions (Mt CO2 eq. exc. LULUCF)	219.4	247.8	298.8	337.1	398.9	472.6	497.7	523.8	520.9
Change compared to 1990 (%)	-	12.9	36.2	53.7	81.8	115.4	126.9	138.8	137.5
Net emissions (Mt CO2 eq. exc. LULUCF)	163.6	190.4	237.2	262.5	325.5	375.3	401.8	423.9	426.4
Change compared to 1990 (%)	-	16.4	45.0	60.5	98.9	129.4	145.6	159.1	160.6

Source: TUIK, April 2020

country to investigate the factors affecting this increase, which is more than twice the amount of carbon dioxide released into the atmosphere approximately in three decades.

In this context, the aim of the study is to determine the factors that affect the carbon emission amount in Turkey. The amount of carbon emission is used as a dependent variable, inflation, foreign direct investments (FDI), the number of passengers transported by air and bank credits given to the private sector are included as independent variables in the analysis performed for a wide period of time between 1960 and 2019. Quantile regression model was used to determine the factors affecting the amount of carbon emission and the results of the variables for different quantile levels were examined. The results of the cointegration relationship between variables in the study revealed that the variables were cointegrated in the long run. It was determined that the slope of the coefficients estimated at nine different quantile levels by quantile regression analysis differed.

The first point that distinguishes the study from other studies in the literature is the use of different variables. Variables such as economic growth, income inequality, and population amount have been taken into consideration regarding the factors affecting carbon emissions in most of the studies in the literature. In addition, the fact that the period considered covers the long term also enables a wide range of comments to be made. Variables, period of the study, and method add originality to the study.

In the first section of the study, studies in the literature on the subject are mentioned. In the second part, information about the econometric methodology is given and in the following part, the findings are evaluated. In the last part of the study, the results of the analysis are interpreted and suggestions for possible improvements are discussed.

2. Literature Review

Most of the studies in the literature on how carbon emissions are affected by economic activities have taken into account economic growth. In these studies, it was aimed to test the Environmental Kuznet Curve (EKC) hypothesis. The EKC hypothesis argues that a country's economy increases environmental degradation in the early stages of growth, but with the increase in the development level of the country, it leaves its place to environmentally friendly technologies and policies in the following years. This also creates a positive effect on the environment[1].

There are many other factors that affect the gross national product, which expresses economic growth, also can have an impact on carbon emissions accordingly. The variables that are thought to be effective on carbon emissions in the literature can be listed as the use of renewable energy sources, financial development, foreign direct investments, import, export, energy consumption, income, inflation. In the literature section, it will be

carried out within the framework of studies on the variables used in the study and studies on carbon emission on Turkey.

Inflation is one of the variables whose impact on carbon emissions is examined. Inflation is defined as the continuous increase in the general level of prices. The general course of inflation contains important information about the general situtation of the economy. A negative inflation rate in the markets affects especially the production sector rapidly. Such situations that reduce production in the production sector will cause less energy use. Therefore, inflation is expected to have a negative impact on carbon emissions in general. [2] examined the relationship between inflation instability and pollution emissions in their research on 40 Asian economies. It has been revealed that the instability in inflation has a deterrent role in new investments and consumption in the study since it causes price volatility in economic terms. As a result of that, an increase in environmental quality has been detected. It is also seen that the ratio of bank loans to GDP given to the private sector in order to see the effects of financial development causes an increase in pollution emission in the opposite direction and deteriorates environmental conditions. [3] investigated the effect of food production index, renewable energy consumption, and inflation on carbon emissions in the coastal Mediterranean countries. It has been observed that there is a significant and negative relationship between carbon emission and inflation in the long run. Also, according to the Granger causality test results, the historical values of inflation are not suitable for estimating the future values of carbon emission. [4] used the relationship between governance and economic performance to identify the factors affecting carbon emissions in their study on the Organization of the Petroleum Exporting Countries (OPEC). It has been demonstrated that the governance index and economic growth have the greatest impact on carbon emissions. In addition, inflation negatively affects carbon emissions, while the increase in foreign direct investment increases the level of carbon emission. In other words, investments will increase production and cause high emissions.

Another variable included in the study is foreign direct investments. Foreign direct investments are an important development reason for the country's economy. However, it may bring an increase in energy consumption, which causes adverse environmental conditions. Especially the environmental conditions that the developing countries stretch in order to make foreign investment attractive lead to this situation. On the other hand, there are cases where foreign investments made in countries that prioritize environmental quality and offer opportunities and incentives for investors may have a positive effect on environmental factors. Therefore, the increase in foreign direct investments is expected to increase carbon emission for some countries' economies and decrease for others. Studies investigating the impact of foreign direct investments on carbon emissions in the literature have focused on different countries. [5] on BRIC countries (Brazil, Russia, India and China), [6] on ASEAN countries (Association of Southeast Asian Countries - Indonesia, Malaysia, Thailand, Philippines, Singapore, Bruney, Vietnam, Laos, Myanmar and Cambodia), [7] on G20 countries, [8] on India, [9] on BRICSAM countries (Brazil, Russia, India, China, South Africa and Mexico), [10] on Sub-Saharan African countries (The Republic of Congo, Democratic Republic of Congo, Kenya, South Africa, Zambia and Zimbabwe), they investigated the relationship between carbon emissions and economic growth, energy consumption and foreign direct investment. Cointegration and causality analyzes and panel data econometrics were used in these studies.

Research on Turkey will be mentioned respectively. [11] defined the relationships between foreign direct investments and carbon emissions, energy consumption, economic growth, foreign trade volume, the share

of exports and imports in the GDP with inductive causal inference patterns in Turkey. In the research, it has been revealed that foreign direct investments trigger carbon emissions indirectly with the effect they create on foreign trade. [12] analyzed the relationships between carbon emissions, energy consumption, income and foreign trade in Turkey using the data of the period 1960-2005. It has been revealed in Turkey that income is the most important variable in explaining carbon emission. [13] revealed the effects of foreign direct investment, energy consumption and gross national product on carbon emissions with the data of 1974-2010. According to the long-term ARDL model results, the FDI variable has a positive effect on carbon emission. In addition, according to the causality test results, it was seen that there is a causal relationship from all variables towards carbon emission. In another study conducted to explore the effects on carbon emissions, [14] applied Maki cointegration and Granger causality tests, taking into account the variables of income, energy consumption, foreign direct investment. They determined the bidirectional causality relationship between carbon emission and FDI with a negative coefficient. This means that FDI has a positive effect on environmental conditions.[15] examined the relationship between foreign direct investment, growth and carbon emissions for Turkey based on the Environmental Kuznet Curve methodology for the period 1970-2014. According to the ARDL model results, the coefficient for foreign direct investment was not found to be statistically significant. For Turkey, a significant relationship between carbon emission and foreign direct investment was not revealed in the relevant period. [16] analyzed the relationship between energy consumption, foreign direct investment, economic growth and trade openness for Turkey using the data for the period 1980-2015. As a result of the study, it was seen that economic growth and trade openness positively affected energy consumption in the short and long term, while FDI positively affected only in the long term. In addition, the causality test results show that FDI, economic growth and trade openness are the cause of energy consumption in the long run. [16] investigated the effects of foreign trade and foreign direct investments on carbon emissions with a nonlinear ARDL model. The coefficients related to the asymmetric effects of exports, imports and foreign direct investments are statistically significant, but the long-term coefficient of FDI is not significant. Another variable is the share of bank loans to the private sector in GDP. The ratio of bank loans to GDP to the private sector is seen as a financial development factor and has a positive effect on the economy. This positive situation in the economy brings two different opinions on carbon emission to the fore. The first thought is that the increase in bank loans to the private sector will negatively affect environmental factors. The increase in the amount of credit used by the private sector stimulates the growth of the sectors and helps businesses create demand. The increase in demand for products and services means an increase in energy need, and it is thought to negatively affect environmental pollution, in other words, to increase the amount of carbon emission. Some studies in the literature suggest that these loans will increase the demand for users of technology and vehicles such as automobiles, and carbon emissions will increase with investments in energy-intensive sectors such as transportation and oil [17] [18] [19]. The opposite of this idea argues that an increase in bank loans can reduce carbon emissions. On the other hand, a decrease in carbon emission can be seen as businesses turn to alternative clean energy sources with low cost due to the increasing amount of energy [20]. There are studies in the literature that argue that the carbon emissions in the economy can be reduced through loans given to the private sector by financial institutions [21] [22] [23] [24] [25]. [26] determined the effects of loans given to the private sector by banks on the total amount of carbon emission and carbon emission intensity using Brazil's 1971-2014 data. The dynamic ARDL simulations were used and it was determined that bank loans given to the private sector have a short and long term reducing effect on the total

carbon emission and carbon emission intensity. [27] investigated the effects of bank loans to the private sector, foreign direct investment, and the degree of financial product innovation on the carbon emission intensity for 1992-2014 data in China. ARDL analysis revealed that bank loans extended to the private sector have a long-term decreasing effect on carbon emission intensity. For India's data, [8] revealed that there is a causal relationship between financial development and carbon emission, and according to Granger causality test results, the direction of causality is from financial development to carbon emission. [28] argued that financial development took place in Tunisia despite environmental pollution.

The last explanatory variable used in the study is the number of passengers transported by air. One of the factors affecting carbon emissions is the activities of people perform. The increase in international trade and the increase in cross-border activities have led to a significant increase in the airline passenger market. On the other hand, the increasing number of passengers in airlines increases the amount of carbon emissions from the aviation industry day by day [29] [30]. The amount of carbon emission caused by the transportation sector has a 25% share in the energy sector in Turkey [31]. [32] examined the relationship between climate change and the transportation sector in Turkey through the data of 1977-2015. The effects of the number of road motor vehicles, the number of airways and rail passengers on carbon emissions have been demonstrated through the ARDL test. Accordingly, the coefficients for the number of rail and airline passengers are negative but not statistically significant. Only the coefficient of the number of road motor vehicles was found to be statistically significant and positive. [33] revealed that carbon emission and growth in the transportation sector mutually affect each other. [34] investigates the link between air-rail transport and environmental pollution for Next-11 countries from 1975 to 2015. According to the result, it has been observed that airline passenger transport increases emissions. [35] analyzed the environmental the impacts of air and rail transport for the period 1975-2016 in Pakistan, Findings showed that rail passengers transported have a positive effect on emissions, while air-rail transport and travel services deplete natural resources and impair environmental quality. [36], using panel estimators, examines the effects of air and rail transport on environmental pollution by using annual time series data for a panel of the top 10 air passenger countries in the period 1995-2014. According to the estimation results, it is seen that air transport contributes to emissions, rail transport and urban growth reduce emissions during the study period.

In most of the studies in the literature, causality and cointegration tests were used to examine the factors affecting carbon emissions. In this sense, the quantile regression method, which is open to development was used, and it was aimed to contribute to the literature by examining the factors affecting carbon emission and putting forth the results in Turkey as a developing country.

3. Econometric Methodology

The Quantile regression (QR) model developed by [37], it does not require random error terms to precisely meet classical econometric assumptions such as zero mean, homoscedasticity, and normal distribution [38]. Estimated values of parameters in quantile regression are more robust for variables that are not normally distributed [39] [40]. QR can show the relationship between variables much better and more accurately. In other words, if the experimental time series are characterized by non-Gaussian features that are a feature of all selected agricultural commodities, quantile regression will provide more robust and therefore more efficient estimates [41]. The mathematical representation of the Quantile regression model can be done as follows [42].

$$y_i = x_i^i \beta_i + u_{w_i} \tag{1}$$

y_i is the dependent variable, β_θ denotes an unknown vector kx1 of regression parameters to be predicted for different values of θ (range from 0 to 1), x_i is a vector kx1 of the independent variables, and $u_{\theta i}$ is unknown error terms. Conditional quantiles of the y_i variable to the x_i variable can be written as follows.

$$Q_n (y_i \mid x_i) = x_i^* \beta_n \tag{2}$$

In order to predict the vector β_θ , an optimization problem in which the following function is minimized with respect to β is considered:

$$\left\{ \sum_{ty_1 > x_i} \theta \left| y_t - \dot{x}_t' \beta \right| + \sum_{t_{t_1}, x_i'} (1 - \theta) \left| y_t - \dot{x}_t \beta \right| \right\} \tag{3}$$

The use of the quantile regression procedure involves resolution using the generalized moment method or linear programming with the simplex algorithm.

4. Findings

4.0.1. Data, preliminary examination, and basic statistical tests

The amount of carbon emission (co2) was used as the dependent variable in the study and was obtained from the globalcarbonatlas.org website. The series of independent variables, consumer inflation rate (inf), foreign direct capital (fdi), number of passengers transported by air (airpass) and bank credits to the private sector (cps) have been compiled from the world bank website. The amount of carbon emission, bank loans to the private sector and consumer inflation data covers the years 1960-2019. On the other hand, direct foreign capital inflows and the number of passengers transported by air cover the years 1970-2019. Descriptive statistical information and correlation analysis results are presented in Table 2 below in order to get a general preliminary information about the variables used in the study and to have information about the nature of the relationship between them.

Table 2: Basic statistical information and correlation analysis results

	co2	**inf**	**Fdi**	**airpass**	**cps**
Mean	169.074	31.970	4.66E+09	22891108	24.94803
Median	144.539	18.233	7.94E+08	7310300.	17.97751
Maximum	425.329	105.215	2.20E+10	1.16E+08	65.93728
Minimum	16.798	1.11963	10000000	1035700.	12.72601
Std. Dev.	123.893	28.888	6.76E+09	33920422	15.40556
Skewness	0.562	0.842	1.245303	1.698580	1.737620
Kurtosis	2.078	2.427	3.105088	4.432595	4.517290
Jarque-Bera	5.286	7.923	12.946	28.318	35.948
Probability	0.071*	0.019**	0.001***	0.000***	0.000***

The fact that the mean and median values of the data are close to each other provides a priori information that the distribution is symmetrical and therefore shows a normal distribution. It is seen that the mean and median values of the variables used in the study are not close to each other. This situation provides preliminary information that the relevant variables do not show a normal distribution. As a matter of fact, it can be said that all variables are not normally distributed, with J-B test probability values p <0.01 for fdi, aripass and cps

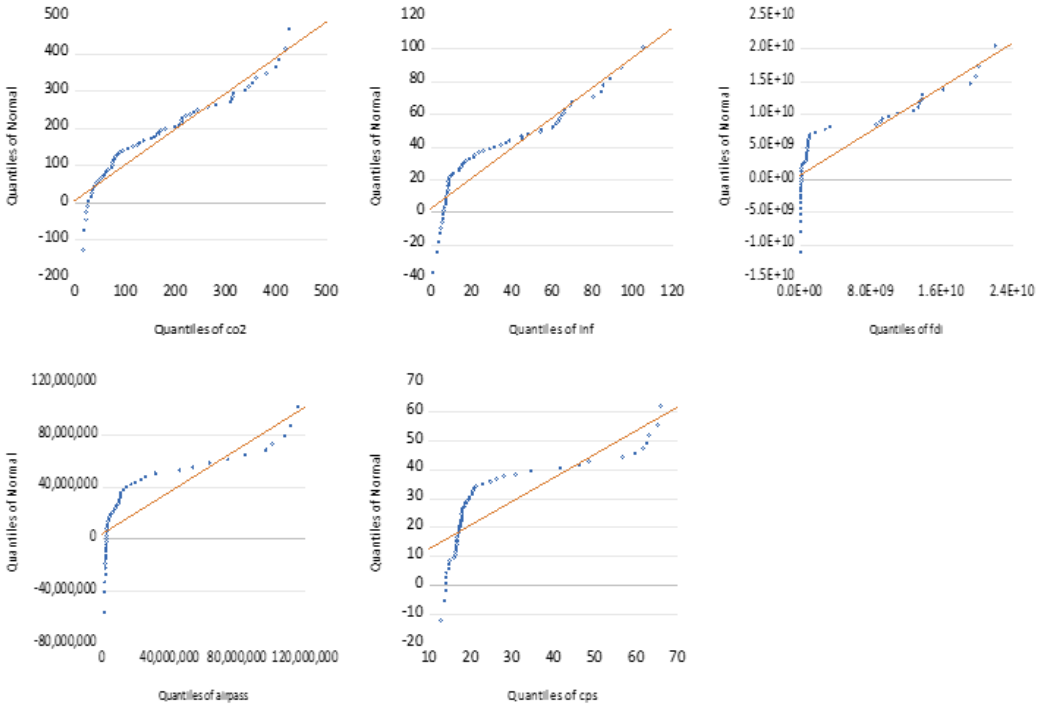

Figure 1: Q-Q probability distribution graphs of variables

variables, p <0.05 for the inf variable and p <0.10 for the co2 variable. Another tool that can be used at this point is the Q-Q plot. The Q-Q plot is a probability plot that visually reveals whether the data fits the normal distribution. If the points seen in the Q-Q plot coincide with the y = x line, it means that the data is normally distributed [43]. Otherwise, it is understood that the distribution of the data is skewed. The Q-Q probability distribution plots of the variables are shown in Figure 1 below.

Figure 1 shows that the distribution of all variables does not exactly coincide with the y = x line and therefore these variables are not normally distributed.

4.0.2. Stationary and Cointegration Analysis

At this stage of the study, the series are tested whether stationary or not through the unit root tests. If non-stationary data are used in econometric analysis, the results obtained will be statistically unreliable [44]. Therefore, in order not to make erroneous inferences, the stationarity analysis was performed with the traditional and structural breakage ADF unit root test. According to the results given in Table A1, all variables have a stationary feature in the first differences. In other words, all variables are I (1). Cointegration analysis was conducted to find out whether the data used in the study will be included in the regression analysis with the level values or with the first differences where they are stationary, and to see the long-term equilibrium relations between the variables. Johansen cointegration analysis has been applied since all the series are stationary at the same level. These test results are given in Table A2. In this context, the null hypothesis, expressed as no cointegration according to the Trace and Max-Eigen statistical values, was rejected and it was observed that there was a cointegrated relationship between the variables. This result shows that there are two important cointegration vectors in the model. Therefore, since it is determined that there is a long-term equilibrium relationship between variables, variables can be used with level values in quantile regression analysis.

4.1. Quantile regression analysis

The effects of independent variables on the dependent variable carbon emission at different quantile levels are presented in Table 3 below.

According to the result of the quantile regression, the effect of the consumer inflation rate on the dependent variable is positive except for the last quantile level, and this effect is statistically significant, especially at low and medium quantile levels. This result shows that the increase in consumer inflation has an increasing effect on carbon emissions. However, it has been observed that the effect of inflation on carbon emissions is heterogeneous. Accordingly, while inflation has an increasing effect on carbon emissions up to the median level, there is a decreasing effect after this level. As a result of the study, the positive effect of inflation on carbon emissions differed with the results of [2], [3], and [4]s' studies.

Foreign direct investment has a positive effect on carbon emissions and is statistically significant at all levels except the 9th quantile level. Accordingly, foreign capital investments from outside are a cause of carbon emissions in Turkey. The effect of foreign direct investments on increasing carbon emissions has shown similar results with [13] and [15]. However, the impact of foreign direct investment on carbon emissions decreases starting from the 7th quantile level.

The increase in the number of passengers transported by air has an increasing effect on carbon emissions. This effect is statistically significant at medium and high quantile levels. According to this result, the airline sector, which has grown rapidly in Turkey in recent years, has an effect that increases carbon emissions. This relationship between the number of passanger transported by air and carbon emissions is similar to [34], [35], and [36].

The impact of bank loans to the private sector on carbon emissions is heterogeneous. While there is a positive effect on carbon emission especially at low quantile levels, this effect has turned from positive to negative after the 4th quantile level. At the 7th and 8th Kantil levels, this negative effect has a statistically significant effect. This relationship between bank loans and carbon emissions is similar to [21], [22], [23],[24], and [25]. Therefore, banks transfer more funds to reduce carbon emissions with the loans they give to the private sector.

The equality of the slope of the coefficients estimated at nine different quantile levels was also tested through the quantile regression analysis in the study. For this purpose Wald test is applied and the results are presented in Table 4 below.

According to the test results, the null hypothesis that the slopes between quantiles are equal was rejected at the 10% significance level. Hereunder, the result seen in Chart 1 is verified and serves as proof that the relationship between explanatory variables and the explained variable varies across quantiles.

5. Conclusion

In this study, the effect of the inflation rate, direct foreign capital investments, the number of passengers transported by air, and bank credits given to the private sector on carbon emissions was tried to be determined as of the period 1960-2019 in specific to Turkey. For this purpose, basic statistical tests, unit root tests, Johansen cointegration test and quantile regression analysis were used. According to the results of the study, we have found evidence that inflation rate, direct foreign capital inflows and air passenger transport increase carbon emissions, while bank loans to the private sector reduce them.

Table 3: Quantile regression results

	Quantile	Coefficient	Std. Error	t-Statistic	Prob.
İnf	0.10	0.614644	0.573306	1.072104	(0.289)
	0.20	1.144982	0.414075	2.765155	(0.008)***
	0.30	1.223825	0.403613	3.032175	(0.004)***
	0.40	1.262300	0.382605	3.299224	(0.001)***
	0.50	1.502226	0.354790	4.234128	(0.000)***
	0.60	1.110579	0.554480	2.002921	(0.051)*
	0.70	0.623042	0.504598	1.234729	(0.223)
	0.80	0.360529	0.480528	0.750277	(0.457)
	0.90	-0.257799	0.766539	-0.336316	(0.738)
fdi	0.10	9.95E-09	1.16E-09	8.594840	(0.000)***
	0.20	9.84E-09	9.11E-10	10.80535	(0.000)***
	0.30	9.81E-09	1.00E-09	9.761336	(0.000)***
	0.40	9.52E-09	1.14E-09	8.316066	(0.000)***
	0.50	1.02E-08	1.17E-09	8.672995	(0.000)***
	0.60	9.48E-09	1.56E-09	6.089989	(0.000)***
	0.70	1.05E-08	3.89E-09	2.697734	(0.009)***
	0.80	8.37E-09	2.49E-09	3.366248	(0.001)***
	0.90	2.83E-09	3.53E-09	0.802024	0.426
airpass	0.10	1.60E-06	2.10E-06	0.764355	(0.448)
	0.20	1.60E-06	1.75E-06	0.911061	(0.367)
	0.30	1.46E-06	1.81E-06	0.805794	(0.424)
	0.40	2.39E-06	1.71E-06	1.396208	(0.169)
	0.50	2.65E-06	1.43E-06	1.847020	(0.071)*
	0.60	4.52E-06	1.99E-06	2.264949	(0.028)**
	0.70	5.07E-06	1.49E-06	3.406899	(0.001)***
	0.80	5.18E-06	1.54E-06	3.369073	(0.001)***
	0.90	1.75E-06	1.51E-06	1.161437	(0.251)
cps	0.10	1.258513	4.894328	0.257137	(0.798)
	0.20	1.263138	4.018336	0.314344	(0.754)
	0.30	1.581623	4.142207	0.381831	(0.704)
	0.40	-0.455411	3.962719	-0.114924	(0.909)
	0.50	-0.981753	3.252313	-0.301863	(0.764)
	0.60	-4.952103	4.182907	-1.183891	(0.242)
	0.70	-6.958240	2.893812	-2.404523	(0.020)**
	0.80	-6.712794	2.735707	-2.453770	(0.018)**
	0.90	-0.116057	2.941647	-0.039453	(0.968)
c	0.10	12.79928	101.4637	0.126146	(0.900)
	0.20	9.869169	81.54031	0.121034	(0.904)
	0.30	4.521984	83.55969	0.054117	(0.957)
	0.40	49.91533	80.61216	0.619204	(0.538)
	0.50	54.54377	65.93849	0.827192	(0.412)
	0.60	147.2320	88.11979	1.670816	(0.101)
	0.70	215.7004	57.52832	3.749465	(0.000)***
	0.80	234.7560	44.56741	5.267437	(0.000)***
	0.90	215.7345	43.88291	4.916138	(0.000)***

Table 4: Quantile Slope Equality Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Wald Test	14.78611	8	0.0634

We consider the results from this study to be important because they provide practical advice for decision-making authorities, businesses and investors. In this context, railway transportation, which has been scientifically proven to reduce carbon emissions in passenger transportation by public authorities, should be highlighted, infrastructure investments in this regard should be accelerated, if necessary, this area should be opened to the private sector. It is important for the banking sector to be selective in its investments in the private sector and to transfer resources to renewable energy investments supported by the public. In this regard, the efforts of the banking sector to increase funds should be further encouraged. The public authority should approach foreign capital inflows not only with the focus on economic reflections (such as employment, foreign exchange inflows) but also with environmental priorities, and direct foreign capital should be encouraged to invest in green energy investments.

References

[1] G. M. Grossman and A. B. Krueger, *The quarterly journal of economics*, 1995, **110**, 353–377.

[2] W. Ahmad, S. Ullah, I. Ozturk and M. T. Majeed, *Energy & Environment*, 2021, **32**, 1275–1291.

[3] A. A. Alola, K. Yalçiner and U. V. Alola, *Environmental Science and Pollution Research*, 2019, **26**, 34448–34458.

[4] M. Ronaghi, M. Reed and S. Saghaian, *Environmental Economics and Policy Studies*, 2020, **22**, 153–172.

[5] H.-T. Pao and C.-M. Tsai, *Energy*, 2011, **36**, 685–693.

[6] V. Chandran and C. F. Tang, *Renewable and Sustainable Energy Reviews*, 2013, **24**, 445–453.

[7] J. W. Lee, *Energy policy*, 2013, **55**, 483–489.

[8] M. A. Boutabba, *Economic Modelling*, 2014, **40**, 33–41.

[9] K. Qayoom and S. Irfan, *International Journal of IT, Engineering and Applied Sciences Research (IJIEASR)*, 2014, **3**, year.

[10] P. Kivyiro and H. Arminen, *Energy*, 2014, **74**, 595–606.

[11] M. Benli, *Uluslararası Ekonomi ve Yenilik Dergisi*, 2020, **6**, 35–59.

[12] F. Halicioglu, *Energy policy*, 2009, **37**, 1156–1164.

[13] F. Seker, H. M. Ertugrul and M. Cetin, *Renewable and Sustainable Energy Reviews*, 2015, **52**, 347–356.

[14] Z. Öztürk and Ö. Damla, *Çankırı Karatekin Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 2016, **6**, 269–288.

[15] U. Uzar and K. Eyuboglu, *Environmental Science and Pollution Research*, 2019, **26**, 28092–28105.

[16] A. A. Haug and M. Ucal, *Energy Economics*, 2019, **81**, 297–307.

[17] Z. Xu, M. A. Baloch, F. Meng, J. Zhang, Z. Mahmood *et al.*, *Environmental Science and Pollution Research*, 2018, **25**, 28378–28390.

[18] K. U. Ehigiamusoe and H. H. Lean, *Environmental Science and Pollution Research*, 2019, **26**, 22611–22624.

[19] M. A. Nasir, T. L. D. Huynh and H. T. X. Tram, *Journal of environmental management*, 2019, **242**, 131–141.

[20] A. Tamazian, J. P. Chousa and K. C. Vadlamannati, *Energy policy*, 2009, **37**, 246–253.

[21] M. Bowman, *Environment and Planning Law Journal*, 2010, **27**, 448.

[22] C. N. Brunnschweiler, *Environment and development economics*, 2010, **15**, 241–274.

[23] S. Chen, in *LTLGB 2012*, Springer, 2013, pp. 457–461.

[24] E. Campiglio, *Ecological economics*, 2016, **121**, 220–230.

[25] R. Levine, C. Lin, Z. Wang and W. Xie, *Bank liquidity, credit supply, and the environment*, National bureau of economic research technical report, 2018.

[26] C. Nwani and P. C. Omoke, *Environmental Science and Pollution Research*, 2020, **27**, 31408–31426.

[27] Y. Tian, W. Chen and S. Zhu, *Natural Hazards*, 2017, **88**, 759–777.

[28] S. Farhani and I. Ozturk, *Environmental Science and Pollution Research*, 2015, **22**, 15663–15676.

[29] S. Sgouridis, P. A. Bonnefoy and R. J. Hansman, *Transportation Research Part A: Policy and Practice*, 2011, **45**, 1077–1091.

[30] B. P. Loo and L. Li, *Energy policy*, 2012, **50**, 464–476.

[31] C. Soruşbay, *Küresel iklim değişikliğinde ulaştırma sektörünün rolü ve Türkiye'deki durumun değerlendirilmesi (İstanbul Teknik Üniversitesi, Makina Fakültesi)*, 2006, https://web.itu.edu.tr/sorusbay/EGE/EGE_FILES/CO2.pdf.

[32] Z. D. Çalışkan, K. Ünzüle and A. G. M. C. Timur, International Congress of Energy, Economy and Security Proceedings ENSCON'17, 2017, p. 78.

[33] S. K. Ribeiro, S. Kobayashi, M. Beuthe, J. Gasca, D. Greene, D. S. Lee, Y. Muromachi, P. J. Newton, S. Plotkin, D. Sperling *et al.*, 2007.

[34] H. Saleem, W. Jiandong, K. Zaman, E. E. Elashkar and A. M. Shoukry, *Transportation Research Part D: Transport and Environment*, 2018, **62**, 152–168.

[35] B. Shouket, K. Zaman, A. A. Nassani, A. M. Aldakhil and M. M. Q. Abro, *Environmental Science and Pollution Research*, 2019, **26**, 12574–12589.

[36] S. Erdogan, F. F. Adedoyin, F. V. Bekun and S. A. Sarkodie, *Journal of Air Transport Management*, 2020, **89**, 101935.

[37] R. Koenker and G. Bassett Jr, *Econometrica: journal of the Econometric Society*, 1978, 33–50.

[38] B. Xu and B. Lin, *Energy*, 2020, **206**, 118159.

[39] Y. Huang, H. Zhu and Z. Zhang, *Science of The Total Environment*, 2020, **727**, 138578.

[40] M. Youssef and K. Mokni, *Journal of Multinational Financial Management*, 2020, **55**, 100625.

[41] D. Živkov, S. Manić and J. Đurašković, *Borsa Istanbul Review*, 2020, **20**, S11–S25.

[42] M. Sevillano and F. Jareno, *Risk Management*, 2018, **20**, 51–76.

[43] B. Lin and B. Xu, *Renewable and Sustainable Energy Reviews*, 2018, **94**, 15–27.

[44] J. H. Stock, M. W. Watson *et al.*, *Introduction to econometrics*, Addison Wesley Boston, 2003, vol. 104.

Table 5: Unit root test results for stationary analysis

Traditional ADF unit root tests				Structural break ADF unit root tests		
Variab.	Levet t-stat. (critical value)	First difference t-stat. (critical value)	Conc.	Level t-stat. (critical value) break date	First difference t-stat. (critical value) break date	Conc.
co2	1.647 (-3.546)	-6.675 (-3.548)***	I (1)	-0.587 (-4.949)	-7.291 (-4.949)*** 2017	I (1)
inf	1.892 (-3.546)	-8.211 (-3.548)***	I (1)	-2.595 (-4.949)	-8.983 (-4.949)*** 1994	I (I)
fdi	-1.577 (-3.571)	-5.741 (-3.574)***	I (1)	-7.578 (-4.949)*** 2005		I (0)
airpass	3.589 (-3.605)	-5.472 (-3.605)***	I (1)	0.749 (-4.949)	-6.690 (-4.949)*** 2003	I (1)
cps	0.248 (-3.548)	-9.738 (-3.548)***	I (1)	-3.815 (-4.949)	-6.560 (-4.949)*** 2003	I (1)

Note: Significance: ***1%, ** 5%, *10%.

Table 6: Results of Johansen co-integration test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.656	126.394	88.803	0.000
At most 1 *	0.566	77.224	63.876	0.002
At most 2	0.396	38.760	42.915	0.122
At most 3	0.219	15.538	25.872	0.530
At most 4	0.085	4.114	12.517	0.725
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.656	49.169	38.331	0.002
At most 1 *	0.566	38.464	32.118	0.007
At most 2	0.396	23.221	25.823	0.106
At most 3	0.219	11.424	19.3870	0.470
At most 4	0.085	4.114	12.517	0.725