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Foreign Direct Investments and CO_2 Emissions Relationship: The Case of Turkey

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Abstract: *In this study, it is aimed to analyze the environmental impact of foreign direct investment. The theoretical and applied literature on the relationship between foreign direct investment and carbon dioxide (CO_2) emissions is presented. The study examines the relationship between foreign direct investment and pollution by using Johansen Cointegration test and vector error correction model in Turkey, for 1974-2013 period. The main conclusion of the study is that foreign direct investment positively affects carbon dioxide emissions in the long run. The results indicate the validity of Pollution Haven hypothesis in Turkey.*

Keywords: Foreign Direct Investment, Carbon Dioxide Emissions, Pollution Haven Hypothesis, Pollution Halo Hypothesis

JEL Classification: Q56, F18, F21

1. Introduction

Foreign direct investment is important for both developed and developing countries. Especially after the 1980s, it has become important in developing countries. Recently, it seems that the investors take the environmental regulations of the country into consideration while making the choice of investment. As the level of development of the countries increases, the regulations related to the environment also increase as the increase in the income of consumers leads to more demand for environment friendly products and the increase of the pressure on the governance of the protection of the environment[1]. In addition to this, in developed countries, there is government intervention to technical, administrative, financial and legal arrangements to protect the environment, to prevent environmental pollution and to solve environmental problems in developed countries.

Government interventions related to environment may be both in the form of restrictions and incentives. Environmental taxes, environmental duties, funds, environmental labeling, permits, approvals and licenses and emissions taxes are restrictive instruments; while support for research and development investments, direct support for environment-friendly investments, financial subsidies and tax incentives are examples of environmental incentives (Karaca, 2012:183). Environmental regulations, such as taxation to avoid pollution, are factors that increase costs. Developing countries do not give much importance to environmental regulations due to reasons such as height of pollution absorption capacity, necessity of all kinds ofindustrial activity due to low income level, lack of development of environmental consciousness, the

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inadequacy of property rights (Gökalp and Yıldırım, 2004: 100). In addition to these, the fact that they do not make these arrangements in order to attract foreign direct investments to their countries may also be a result of low environmental standards. For these reasons, multinational companies operating in many countries are trying to provide cost advantage by preferring the countries where the legal regulations on the environment have not been determined yet. However, multinational corporations are ignoring the negative consequences of the investment they make about the environment.

This study tries to contribute to the literature by distinguishing pollution haven and pollution halo hypotheses from the theoretical literature on the relationship between FDI and CO_2 and by testing the validity of these hypotheses using the Johansen Cointegration test and the vector error correction model for Turkey for the 1974-2013 period.

In this study, it is aimed to examine the relationship between foreign direct investment and carbon dioxide (CO_2) emissions. The theoretical literature on the relationship between foreign direct investment and carbon dioxide emissions will be presented in the following section. Following the theoretical literature, the applied literature will be summarized. Literature review will be followed by methodology and data and in the final section the results will be discussed.

2. Theoretical Literature

In the literature, the relationship between foreign direct investment and environmental pollution for both developed and developing countriesis are explained by the approaches known as pollution haven hypothesis and pollution halo hypothesis.

2.1. Pollution Haven Hypothesis

Pollution haven hypothesis, predicts that as trade and investment obstacles between countries are abolished, the production of pollution-intensive goods by companies that are willing to escape from complying with costly legislation in their own countries will shift to countries with relatively poor environmental policies (Hoffman et.al., 2005: 311; Kellenberg, 2009: 242; Dean et al., 2009: 1; Copeland, 2008: 64). This shift in production may emerge as a result of trade or liberalization of investments. Countries with poor environmental policies have comparative advantage in pollution-intensive production. In addition, weak environmental policies determine the direction of foreign direct investment flows (Copeland, 2008: 64).

Differences in environmental regulations between developed and developing countries have become important factors affecting the comparative advantages of these countries and foreign direct investments. Environmental regulations can lead to an increase or decrease in investments for both the host country (developing country) and the home country (developed).

In other words, environmental regulation in the home country may cause a firm to either increase or decrease investments in its home country or, in countries where environmental standards are less stringent (Eskeland and Harrison, 2003: 2). For this reason, the governments of developing countries tend to make poor environmental regulations to attract foreign investment (Asghari, 2013: 92).

The first pollution haven model was developed by Pethig (1976). A model of two countries with identical features except for their environmental taxes was created, making the difference in pollution tax the only factor affecting trade. The northern[2] country with high pollution taxes has a comparative advantage in the production of clean goods. The southern country with low pollution taxes has a comparative advantage in the production of pollution-intensive goods. In Pethig's model, the pollution tax was accepted as exogenous. The model does not make any predictions about the countries that have turned into pollution havens. It is not possible for governments to interfere with inputs or outputs in pollution-intensive production as the pollution taxes are exogenous (Copeland, 2008: 64).

Copeland and Taylor (1994) developed the first model of pollution haven that takes internal environmental policy into account. A model of two identical countries was created, where the only difference was that the northern contry was richer. They argue that pollution haven will occur under the assumptions that environmental quality claims increase with income and governments are sensitive to the preferences of their citizens while applying pollution policy. South will have comparative advantage over pollution-intensive goods. Commercial liberalization shifts pollution intensive production to the South, and therefore the relatively poor country turns into pollution havens (Copeland, 2008: 64).

The view that the increase in foreign direct investment will also increase CO_2 emissions is called Pollution Havens Hypothesis. The Pollution Havens Hypothesis can occur in three ways (Aliyu, 2005: 3):

First, pollution industries arise through polluting industries to countries with more loose regulations than countries with strict environmental regulations.

Second, developed countries throw away hazardous wastes related to industrial and nuclear energy production into developing countries.

Third, multinational corporations should obtain unlimited sources of renewable resources such as oil and petroleum products, lumber and other forest resources, etc. in developing countries.

However, the Pollution Haven Hypothesis and Pollution Haven Effect are confused with each other. Differences in environmental policies among countries affected by pollution havens is the most important factor determining the establishment locations of factories and influencing trade movements. The pollution haven hypothesis, however, deals with the transfer of existing production sites of pollution-intensive industries to countries with loose environmental policies from countries with strict environmental policies. In other words, Pollution haven effect is the choice of establishment place in production and pollution haven hypothesis is influential on the change of production place that is established (Şahinöz and Fotourehchi, 2014:190).

In developing countries, the increase in income over time and thus increase in environmental awareness lead companies to produce environmentally sensitive products and use clean technologies. For this reason, the concentration of polluting industries will end after reaching a certain level (Mani-Wheeler, 1997: 20).

2.2. Pollution Halo Hypothesis

Contrary to the pollution haven hypothesis, the pollution halo hypothesis claims that foreign companies use better management practices and advanced technologies that result in clean environment in host countries (Zarsky, 1999). This implies that trends in environmental damage due to foreign direct investment are unsustainable (Asghari, 2013, 93)

Pollution Halo Hypothesis suggests that the increase in the amount of foreign direct investments will reduce CO_2 emissions. Multinational corporations (MNC's) that make foreign foreign direct investments will tend to spread clean technology, which is less harmful to the environment as they have more advanced technology than the domestic companies in the host country (Görg ve Strobl, 2004: 137). These companies contribute to the creation of cleaner environments in host countries through better management practices and more advanced technology (Zarsky, 1999: 8). Thus, it can provide less carbon emissions (Shahbaz et. al., 2011: 8). It can also lead to increased performance of domestic firms due to learning by doing and copying effects (Zarsky, 1999: 12). Multinational corporations tend to share green technologies with domestic companies in the host country (Hoffman, 2005: 2).

The Pollution Halo hypothesis suggests that multinational corporations disseminate superior knowledge and apply environmentally friendly practices that improve the environmental performance of domestic companies (Doytch and Uctum, 2016: 1).

Most of the studies in the literature [Shahbaz et al. (2015), Kivyiro and Arminen (2014), Omri, Nguyen and Rault (2014), Blanco, Gonzalez and Ruiz (2011), Acharyya (2009), Deng Bo-Sheng Song De-yong (2008), Yang et al.(2008), Aminu (2005), Taşpınar (2016), Karaca (2012), Mutafoglu (2012), Yılmazer, Açıkgöz Ersoy (2009)] have revealed that foreign direct investment increase environmental pollution shown by CO_2 emissions in the host country. Some studies (Tang and Tan (2015), Asghari (2013), Öztürk and Öz (2016), Atay Polat (2015), Şahinöz and Fotourehchi (2014)] show that FDI reduce CO_2 emissions. Some of the studies [Keho (2016), Kim and Adilov (2012), Zeren (2015)] have found both positive and negative results depending on the countries included in the analysis.

The examination of these studies shows that the effect of foreign direct investments on environmental pollution has emerged in three ways. First, foreign investors should avoid environmental constraints and regulations in their own countries. The effect of pollution havens arises when this movement is driven. Second, they are investing in cleaning technologies in host countries. This situation arises from the motives to increase their profits causing pollution from one side investing in cleaning technology from the other side with the investments they have made. Thirdly, when investing outside the country, they have to consider the other benefits of FDI more than the environmental constraints. Multinational companies use newer, cleaner technology while investing and better adapt to environmental standards. In the second and third cases, the effect of pollution halo can occur.

3. Applied Literature

A large number of studies are available in the literature on the impact of foreign direct investments on the environment. A summary of empirical studies investigating the causal link between emissions and FDI is given in Table 1, with multi-country *studies* and *country-specific studies.*

Table 1. Summary of Existing Empirical Studies

Author(s)	Time Period	Countries	Methodology	Conclusion	Pollution Haven or Pollution Halo Hypothesis
Panel A: multi-country studies					
Keho (2016)	1970-2010	ECOWAS	Bound test	Burkina Faso, Gambia and Nigeria; $(+)CO_2 \leftarrow FDI$ Benin, Niger, Senegal and Sierra Leone; $CO_2 - FDI$ Ghana, Mali and Togo; $(-)CO_2 \leftarrow FDI$	Pollution Haven Hypothesis valid
Zeren (2015)	1970-2010	USA France, UK, Canada	Granger causality test, Hatemi J cointegration test	USA, France, UK; $(-)CO_2 \leftarrow FDI$ Canada; $(+)CO_2 \leftarrow FDI$	USA, France, UK; Pollution Halo Hypothesis valid Canada; Pollution Haven Hypothesis valid
Shahbaz et al. (2015)	1975-2012	high, middle, and low-income 99 countries	FMOLS	$(+)CO_2 \leftrightarrow FDI$	Pollution haven hypothesis valid
Kivyiro and Arminen (2014)	1971-2009	6 Sub-Saharan Africacountries	ARDL Granger causality test	$(+)CO_2 \leftarrow FDI$	Kenya and Zimbabwe; Pollution Haven Hypothesis valid Democratic Republic of the Congoand South Africa; Pollution Halo Hypothesis valid
Omri, Nguyen and Rault (2014)	1990-2011	54 countries	Dynamic Panel Data Method	$(+)CO_2 \leftarrow FDI$ $CO_2 \leftrightarrow FDI$	Pollution Haven Hypothesis valid

Al-mulali and Tang (2013)	1980-2009	GCC countries	Pedroni cointegration test, Panel FMOLS test ve Panel Granger causality test	$CO_2 - FDI$ $CO_2 \leftarrow EC, GDP$	This study reject the validity of pollution haven hypothesis
Asghari (2013	1980-2011	MENA Countries	Panel Data Analysis	$CO_2 \leftarrow GDP$ $(-)CO_2 \leftarrow FDI$	Pollution Halo Hypothesis valid
Kim and Adilov (2012)	1961-2004	164 developed and developing countries	OLS Regression Analysis	Developing Countries; $(+)CO_2 \leftarrow FDI$ Developed Countries; $(-)CO_2 \leftarrow FDI$	Developing Countries; Pollution Haven Hypothesis valid Developed Countries; Pollution Halo Hypothesis valid
Karaca (2012)	1995–2008	42 developing and 24 developed countries	Panel Data Analysis	Developing Countries $(+)CO_2 \leftarrow FDI$ Developed countries $(+)FDI_{out} \leftarrow Envtax$	Developing Countries; Pollution Haven Hypthesis valid
Blanco, Gonzalez and Ruiz (2011)	1980-2007	18 Latin American countries	Panel Granger causality test	Pollution-intensive sectors; $(+)CO_2 \leftarrow FDI$ Other sectors; $CO_2 - FDI$	Pollution-intensive sectors; Pollution Haven Hypothesis valid
Pao and Tsai (2011)	1980-2007, 1992-2007	BRIC countries	Panel cointegration testve Granger causality test	$CO_2 \leftrightarrow (+)FDI$ $GDP \rightarrow FDI$	Both the Pollution Halo Hypothesis and the Pollution Haven Hypothesis valid
Yılmazer and Açıkgöz Ersoy (2009)	1975–2006	Asian countries and Turkey	Panel cointegration test	$(+)CO_2 \leftarrow FDI$ $(+)CO_2 \leftarrow GDP$	Pollution Haven Hypothesis valid
Hoffmann et. al. (2005)	1971-1997	Low, medium and high income 112 countries	Panel Granger causality test	Low income countries; $(+)CO_2 \rightarrow FDI$ Medium income countries; $(+)CO_2 \leftarrow FDI$ High income countries; $CO_2 - FDI$	Low income and medium income countries; Pollution Haven Hypothesis valid
Aliyu (2005)	1990-2000	11 developing countries 14 developed countries	Panel Data Regression Analysis	11 developing countries; $(+)FDI_{out} \leftarrow Envtax$ 14 developed countries; $(+)CO_2 \leftarrow FDI$	Developed countries; Pollution Haven Hypothesis valid
Panel B: country-specific studies					
Solarin et. al. (2017)	1980-2012	Ghana	ARDL	$(+)CO_2 \leftarrow FDI$ $(+)CO_2 \leftarrow GDP, P, FD, IT$	Pollution Haven Hypothesis valid

Taşpınar (2016)	1974-2010	Turkey	Bound test, ARDL error correction model, Toda-Yamamoto causality test	$(+)CO_2 \leftrightarrow FDI$ $EC \leftrightarrow FDI$	Pollution Haven Hypothesis valid
Öztürk and Öz (2016)	1974-2011	Turkey	Maki cointegration test ve Granger causality test	$(-)CO_2 \leftrightarrow FDI$ $EC \rightarrow (+)GDP$	Pollution Halo Hypothesis valid
Tang and Tan (2015)	1976-2009	Vietnam	Multivariable Johansen Cointegration Test, Granger causality test	$(-)CO_2 \leftrightarrow FDI$ $GDP \leftrightarrow FDI$	Pollution Halo Hypothesis valid.
Atay Polat (2015)	1980-2013	Turkey	Gregory-Hansen Cointegration Test	$(+)CO_2 \leftarrow GDP$ $(+)CO_2 \leftarrow EC$ $(-)CO_2 \leftarrow FDI$	Pollution Halo Hypothesis valid
Yaylalı et al. (2015)	1980-2011	Turkey	ARDL	$CO_2 - FDI$	___
Şahinöz and Fotourehchi (2014)	1974-2011	Turkey	ADF test, KPSS test, Perron (1989) test	$(-)CO_2 \leftarrow FDI$	Pollution Halo Hypothesis valid
Mutafoglu (2012)	1987Q1-2009Q4	Turkey	Cointegration Test, ECM, Granger causality test	$GDP - FDI$ $(+)CO_2 \leftarrow FDI$	Pollution Haven Hypothesis valid
Acharyya (2009)	1980-2003	India	OLS	$(+)CO_2 \leftarrow FDI$	Pollution Haven Hypothesis valid
DENG Bo-sheng SONG De-yong (2008)	1995-2005	China	Panel Data Analysis	$(+)CO_2 \leftarrow FDI$	Pollution Haven Hypothesis valid
Yang et al. (2008)	1982-2006	China	VAR Analysis	$(+)CO_2 \leftarrow FDI$	Pollution Haven Hypothesis valid

Notes: CO_2, FDI, GDP, EC, P, FD, IT and Envtax indicate the carbon dioxide emissions, foreign directinvestment, gross domestic product, energy consumption, population, financial development, international trade and environmental tax.

As can be seen from Table 1, there are different findings about the direction of the causality between the two variables. Some studies have shown that FDI affects CO_2 emissions. If this effect is positive, it is a pollution haven, if it is negative, it becomes pollution halo effect. In some studies, it is concluded that there is a two-way causality between two variables. There are also studies suggesting that there is no causality between the two variables. In some studies, both positive and negative results were found according to the development status of the countries participating in the analysis. The studies show that the relationship between FDI and carbon emissions may differ according to the period covered, the method used and level of development of countries.

4. Data and Methodology

The data concerning CO_2 emissions (kt) and Foreign direct investment (net inflows, BoP, current US$) have been acquired from World Development Indicators (WDI) database of the World Bank. This research deals with the time frame 1974–2013 for the Turkish economy. Each of the variables has been transformed into logarithm as it provides efficient, better and consistent results.This is necessary in order to eliminate the influence of the variable's dimension, to induce the stationary process and to reduce the possibility of heteroscedasticity and autocorrelation to exist (Bekhet and Othman, 2017: 7).

The functional form of the econometric model will be as:

$$\ln(CO_2)_{it} = \beta_0 + \beta_1 \ln(FDI)_{it} + \varepsilon_{it} \qquad (1)$$

where we take carbon dioxcide emissions ($\ln CO_{2(it)}$) as pollution indicator and dependent variable and foreign direct investment ($\ln FDI_{(it)}$) as the independent variable. e_{it} is the error term.

In this study, the impact of foreign direct investment on environmental pollution will be analyzed using Johansen cointegration test (Johansen, 1988) and (Johansen and Juselious, 1990) and VECM.

Before examining the cointegration analysis, stationary tests are essential for identifying the stationarity of time series. A stationary linear combination of economic variables indicates the existence of cointegration relationship, which is a long-run equilibrium (Ouyang and Lin, 2015: 843). A model generated by non-stationary series can lead to spurious regression, i.e., a significant relation might be indicated where, in fact, there is none. The Augmented Dickey-Fuller test (ADF, 1981) and Phillips–Perron test (PP, 1988) Unit Root test are used to test the stability of variables in this study.

In order to prevent impacts of higher-order serial correlation, the ADF test includes the lagged difference of dependent variable. The equation for a fixed and trendless model in the ADF test is shown below (Enders, 1995: 225).

$$\Delta y_t = \beta + \delta y_{t-1} + \sum_{i=1}^{p} \phi_i \Delta y_{t-1} + \varepsilon_t \qquad \varepsilon_t \approx WN\left(0, \sigma^2\right) \qquad (2)$$

With, y_t representing the variable at time t; Δy_{t-1} the $y_{t-1} - y_{t-2}$; ε_t as the disturbance with a mean 0 and a variance σ^2 ; and p is the lag order. The null hypothesis H_0 is: $\delta = 0$ in Eq. (2), if δ is significantly less than zero, the null hypothesis of a unit root is rejected.

With the use of a test statistic similar to ADF test, the PP test is remarkably insensitive to the heteroscedasticity and the autocorrelation of the residuals. The equation for a fixed and trendless model in the PP test is shown below (Enders, 1995: 239)

$$y_t = a_0^* + a_1^* y_{t-1} + \mu_t \qquad (3)$$

where a_0^*, a_1^* is denotes the conventional OLS regression coefficients; μ_t is a error term. The unit root hypothesis to be tested is $H_o : a_1 = 1$.

If the integration of each series is of the same order, then we examine the existence of the cointegration relationship over the sample period using Johansen cointegration test. The model can be expressed in Equation (4) (Kitamura, 1998: 518):

$$\Delta X_t = \alpha\beta' X_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-1} + \phi D_t + \varepsilon_t \quad (4)$$

where D_t is a deterministic vector series and α, the adjustment coefficients and β ,the cointegrating vectors, are $p \times r$ matrices. $\prod = \alpha\beta'$ (Johansen, 1991: 1552). The $\prod$ matrix transfers information about the long-run relationship between the X_t variables, and the rank of $\prod$ is the number of linearly independent and stationary linear combinations of variables studied. Thus, testing for co-integration involves testing for the rank of $\prod$ matrix r by examining whether the eigenvalues of $\prod$ are significantly different from zero (Hadi, 2016: 67). If $\prod$ is equal to zero, this means that there is no cointegration between variables.

The next step is to measure the short term and long term behavior of economic variables by using VECM test. Granger (1988) stated that, in the presence of a cointegration relationship between the series, it would be more appropriate to determine the short-term causality relationship between the series within the framework of the error correction mechanism (Artan et al., 2015: 317). The VECM can be written as: (Enders, 1995: 367).

$$\Delta Y_t = \alpha_1 + \sum_{i=1}^{m} B_{1i} \Delta Y_{t-i} + \sum_{i=1}^{n} \gamma_{1i} \Delta X_{t-i} + \sum_{i=1}^{m} \delta_{1i} ECT_{t-1} + u_{1t} \quad (5)$$

$$\Delta X_t = \alpha_2 + \sum_{i=1}^{m} B_{2i} \Delta Y_{t-i} + \sum_{i=1}^{n} \gamma_{2i} \Delta X_{t-i} + \sum_{i=1}^{m} \delta_{2i} ECT_{t-1} + u_{2t} \quad (6)$$

where α_1 and α_2 are constant coefficients; β and γ coefficients indicate the short-term relationship between the dependent variable and the independent variable; The δ coefficients represent long-term relationships between the dependent variable and the independent variables (Enders, 1995: 367). The size of the coefficients on ECT indicates how fast deviations from long-run equilibrium are eliminated. The null hypothesis H_0 is: $\delta_1 = 0$ and $\delta_2 = 0$ in Eq. (5) and (6)

5. Results

We employ the ADF and PP unit root tests to find out whether the variables contain unit root. Unit root test results are presented in Table 2.

Table 2. Unit Root Tests

	ADF (%5)		**P-P (%5)**		
Variable	*Level*	*1st. Different*	*Level*	*1st. Different*	**Order of integration**
$\ln CO_2$	-1.225268 (-2.938987)	-5.837879 (-2.941145)	-1.441511 (-2.938987)	-6.057403 (-2.941145)	I(1)
$\ln FDI$	-0.908346 (-2.938987)	-8.906670 (-2.941145)	-0.521979 (-2.938987)	-9.446663 (-2.941145)	I(1)

Note: The regressions in first difference include intercept.

Table 2 reports the results of unit root tests and the critical values for small samples. At the level, the ADF and PP tests statistics for all variables are less than the 5 percent critical value, meaning that the null hypothesis of a unit root cannot be rejected. However, at the first difference, the null hypothesis of a unit root can be rejected at the 5 percent significance level. The results of the Augmented Dickey Fuller test and Phillips-Perron test (Table 2) show that the variables are non-stationary at levels but they become stationary at first difference I(1). If the variables are integrated in the same order, then we can test for the existence of a long term cointegration relationship between the variables. In order to examine the cointegration relationship between the variables, Johansen cointegration approach was applied.

Before proceeding to the cointegration test, the lag length must be firstly determined in the study. The VAR Order selection criteria are presented in Table 3. In Table 3, the study applies the Final prediction error (FPE), Likelihood ratio (LR), Akaike information criterion (AIC), Hannan–Quinn information criterion (HQ) and Schwarz information criterion (SC). The lag length is found to be 1 according to all information criteria.

Table 3. Lag Length Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-54.63191	NA	0.079698	3.146217	3.234191	3.176922
1	29.48579	154.2158*	0.000931*	-1.304766*	-1.040846*	-1.212651*
2	30.02686	0.931853	0.001131	-1.112604	-0.672737	-0.959078
3	30.90865	1.420649	0.001353	-0.939369	-0.323556	-0.724434
4	31.71386	1.207819	0.001635	-0.761881	0.029878	-0.485536

LR: sequential modified LR test statistic (each test at 5% level).
*Lag order selected by the criterion.

In diagnostic tests, the model is tested for serial correlation and Heteroskedasticity. Langrage Multiplier (LM) test was used to check the serial correlation among the residual terms and White Heteroskedasticity test was employed to determine whether variance of the residual terms changed over time. The results of the diagnostic tests are presented in Table 4.

Table 4. Diagnostic Tests Results

Autocorrelation LM Test			White Heteroskedasticity Test	
Lags	***LM-Stat***	***Prob***	***Chi-sq***	29.82951
1	5.907041	0.2062	***df***	24
2	3.559469	0.4689	***Prob.***	0.1905
3	0.507012	0.9728		

The diagnostic tests results suggest that there is no serial correlation among the residual terms and the functional form of model is also well specified. Similarly for the data set, functional form of model is also well specified and the null hypothesis of no serial correlation is rejected in this case.

The study uses the Johansen cointegration technique to estimate the long-term relationship between CO_2 emissions and foreign direct investment in Turkey. The result of the Johansen cointegration rank test is presented in Table 5.

Table 5. Johansen Cointegration Test

Unrestricted Cointegration Rank Test (Trace)					
Cointegration Vector Number Hypothesis (H_0)	Alternative Hypothesis (H_1)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob
$(r=0)$*	$(r=1)$	0.407397	20.34245	15.49471	0.0086
$(r\leq 1)$	$(r=2)$	0.012025	0.459706	3.841466	0.4978
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)					
Cointegration Vector Number Hypothesis	Alternative Hypothesis (H_1)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob
$(r=0)$*	$(r\geq 1)$	0.407397	19.88274	14.26460	0.0058
$(r\leq 1)$	$(r\geq 2)$	0.012025	0.459706	3.841466	0.4978

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5 shows that between 1974 and 2013, in case of null hypothesis, there is no cointegration in equation, the trace statistic is greater than critical value and prob is 0.0086 which is less than 5% ; Maximum Eigenvalue statistic is greater than critical value and Prob is 0.0058 which is less than 5%, so we can reject null hypothesis. According to this result, it is possible to argue that there is at least one cointegrating vector between the series. This implies that there is a cointegration relationship among the variables in the long-run or they move together in the long- run.

The cointegration equation among the variables is presented in Equation 7.

$$\ln CO_2 = 7.426406 + \underset{(0.01330)}{0.222864} \ln FDI \qquad (7)$$

The values in the equation (7) are the coefficient or elasticities of the variable. In the long run, positive effect of the FDI variable on the CO_2 emissions variable occurs. The coefficient of FDI shows that a 1% increase in FDI will lead to a 0,22 % increase in carbon emissions in Turkey.

The error correction mechanism is a method used to distinguish between the long-term balance between series and short-term dynamics and to determine short-term dynamics. In this direction, after the relationship between the series in the long-run has been identified in the study, the error correction mechanism has been used to determine the causality between the series (Artan et al., 2015: 317).

An error correction model (ECM) can be then estimated to highlight the short term dynamics. The error correction term suggests that once a shock emerges, it indicates the speed of adjustment of the dependent variable towards its long term equilibrium (Abbasi and Riaz, 2016: 106). Error correction mechanism test results are presented in Table 6.

Table 6. Vector Error Correction Mechanism Test Results

	$\ln FDI$	C
$\ln CO_2$	0.222864 (0.01330)	7.426406
ECM adjustment coefficient: -0.128320 (0.06298) [-2.03748]		

Note: The values in parentheses are the standard error, the values in square bracket are the significance.

As shown in Table 6, ECM adjustment coefficient should have a statistically significant value at the 5 percent level coefficient with a negative sign. According to the results obtained, the error correction model coefficient is -0.13. Such a situation means that a shock in the CO_2 emissions is corrected by the FDI variable by about 14% in the following year. The time required for the CO_2 emissions to reach the equilibrium value before the deviation is 1/0.13, indicating a period of about 8 years.

6. Conclusion

Foreign investment is increasingly important for countries. Investors take the country's environmental regulations into consideration as they choose the country they will invest in. Investor countries prefer host countries with lax environmental tax regulations. Foreign investments can cause positive or negative environmental effects in host countries in the form of two conditions called pollution haven and pollution halo effect. If the environmental impact of foreign direct investments is positive, it is a pollution haven hypothesis. If it is negative, it becomes pollution hale effect. There have been many studies on this subject with different results. Most of the studies in the literature have revealed that FDI increases CO_2 emissions in the host country. In some of the studies, however, FDI has been shown to reduce CO_2 emissions. Some of the studies observed that the results supporting the two hypotheses were obtained according to the level of development of the countries participating in the analysis.

Many studies explain the relationship between FDI and environmental pollution. Most of these studies support the pollution haven hypothesis. In this study, we analyzed the environmental impact of foreign direct investment. CO_2 emissions have been selected as environmental indicators. Johansen Cointegration test and VECM were used to examine the relationship between FDI and environmental pollution for Turkey. The period of analysis was between 1974 and 2013. In the long run, foreign direct investment positively affects carbon dioxide emissions. In other words, foreign direct investment is also contributing to the growing emission level in Turkey. Johansen Cointegration test shows that a 1% increase in FDI will lead to a 0,22 % increase in CO_2 emissions in Turkey.According to VECM model,a shock in the CO_2 emissions is corrected by the FDI variable by about 14% in the next year. However, the time required for the CO_2 emissions to reach the equilibrium value before the deviation is a period of about 8 years. The results indicate the validity of Pollution Haven hypothesis in Turkey. Environmentally sensitive investments, cleaning technology investments and environmentally friendly research and development activities should be encouraged to increase the quality of the environment. In addition, tax policies for foreign investments that pollute the environment should also be observed to mitigate the negative impact of FDI on CO_2 emissions. Trade policies and development plans should be established in consideration of environmental factors. Also, foreign direct investment sensitive to the environment should be provided to the country.

In future research, the distinction between developed and developing countries can be used to examine the impact of the level of development of countries on foreign direct investment - environmental pollution relationship. Besides this, a great majority of studies in the literature is related to the impact of foreign direct investment on air pollution of countries. Thus, the number of studies on the impact of foreign direct investments on the water pollution of the countries and on the local air pollution can be increased.

End Notes

1. *The Environmental Kuznets Curve Hypothesis is based on the beginning of practical work by Grossman and Kruger (1991) (Saatçi and Dumrul, 2011:66). Panayotou (1993) called this finding as EKC hypothesis in his study.*
2. *Throughout Copeland and Taylor's paper the 'North' refers to developed countries whilst the 'South' refers to developing countries.*

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