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THE POLLUTION HAVEN HYPOTHESIS AND FOREIGN DIRECT INVESTMENTS: EVIDENCE FROM THE CENTRAL ASIAN TURKIC REPUBLICS

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ABSTRACT

In recent years, the Central Asian Turkic Republics have started to become centers of attraction for the foreign direct investments of multinational companies. In the literature, it is a matter of debate whether the relocation of multinational companies with low environmental standards increases environmental pollution associated with foreign direct investments. In this context, this study aims to investigate the relationship between carbon dioxide (CO_2) emissions and foreign direct investments in the Central Asian Turkic Republics. For that purpose, a panel co-integration test was applied to the CO_2 emission rate and foreign direct investment data in six Turkic Republics (Azerbaijan, Kyrgyzstan, Kazakhstan, Turkey, Turkmenistan and Uzbekistan) in the period between 1995-2016. The long-term co-integration coefficients of variables were examined with the panel dynamic least squares method across the panel. The empirical estimation results demonstrate that foreign direct investments and CO_2 emissions have a long-term positive and significant relationship.

Key Words: pollution haven hypothesis, foreign direct investments, Turkic republics, panel data analysis, CO_2 emissions.

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INTRODUCTION

Investments are made in a country on the condition that the country has sufficient savings. If its savings are not sufficient, foreign direct investments (FDIs) are considered an attractive source of financing and investment contribution in order to ensure the inflow of foreign currency with export and production increase in the host country, enable technology transfer, provide employment and transfer new management information to the host country (Weigel, 1997: 12-13). Historically, the liberalization of international trade has triggered the removal of capital controls between countries. According to the World Investment Report 1991, global FDIs grew three times as much as global trade and twice as much as the global gross national product between the years 1983–1989 (World Investment Report, 1991: 4). Up until the 2008 global crisis, FDIs continued to grow thanks to reasons such as globalization, technological innovations, steady economic growth rates, ease of financing, the increasing number of multinational companies and their search for new markets, and increased company values due to mergers. Global FDIs, which were worth USD 53.3 billion in 1985, reached a value of USD 1.8 trillion in 2007. Following the global financial crisis of 2008, the shrinkage of the world economy also had an impact on FDIs. According to the World Investment Report 2017, global FDIs were worth USD 1.7 trillion in 2016 (World Investment Report, 2017: 4).

Even though it falls behind the mobility seen before the global crisis of 2008, today FDI still seems to be a mandatory choice for developing countries which have structural bottlenecks, suffer undercapitalization or are trying to make economic reforms in order to comply with the market economy. However, free movement of capital through the liberalization of trade brings about environmental problems. CO_2 and greenhouse gas emissions are the most significant causes of global warming and climate change. Originating with the industrial revolution and continuing to rapidly rise today, CO_2 emissions increase in relation to the production of sectors that cause pollution in the manufacturing industry (Mi et al., 2015: 455). Within this framework, the fact that the production activities of FDIs in host countries increase greenhouse emissions and damage the environment and thus biological diversity has been frequently discussed in the literature lately. In developing countries, new international regulations are being agreed to and environmental protection standards are being raised with the increased sensitivity to environmental pollution. In such cases, the costs for multinational companies also increase as they become obliged to fulfill their production without harming the environment and they lose their competitive edge. Thus, FDIs are turning away from the developed countries which enforce strict environmental regulations towards the developing countries that have less strict environmental regulations (Taylor, 2004: 2-3). In consequence, the developing countries which desire to enhance their production have become havens of the sectors that cause environmental pollution in the world due to FDIs. In the economic literature, this situation is defined as the “pollution haven hypothesis”. According to the pollution haven hypothesis, it is alleged that the more the amount of foreign direct investments increase, the more carbon emissions will increase.

Pollution haven hypothesis is three-dimensional. The first dimension is relocation of the industries causing intense pollution from the developed countries to the developing countries where strict environmental policies and similar policies do not exist, are loose or are not enforced. The second dimension is disposal of hazardous waste produced (industrial and nuclear energy generation) in the developed countries into the developing ones.

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And the last dimension is the extraction by multinational companies of non-renewable natural resources, such as oil and petroleum products, lumber and other forest resources, etc. without any restrictions in the developing countries (Siebert et al., 1980: 6). These dimensions suggest that the host countries requiring foreign investments should make conscious decisions in terms of their environmental policy and support such decisions via technological implementations.

Empirical studies have tested the pollution haven hypothesis on Turkey alone or alongside other country groups; however, the lack of research involving the Central Asian Turkic Republics and the investment need in this area through economic progress in recent years have encouraged us to focus on this region as a subject. The Turkic Republics of Azerbaijan, Kyrgyzstan, Kazakhstan, Turkmenistan and Uzbekistan have initiated the process of transition to market economies since the dissolution of the Soviet Union in 1991. From 1995 onward, these country economies started to recover and reached positive growth figures (in spite of negative growth in certain years). Defined by the OECD (1987) as the "magic diamond", the ratios of gross domestic product (GDP) to growth, unemployment, inflation and current deficit develop positively despite imbalances from time to time (Eyuboglu, 2017: 333-335). Additionally, these countries have basic energy resources, such as oil and natural gas, that may encourage FDIs, and they need the investments of foreign countries in order to develop (Tunay, 2017: 178). Having been integrated with the global system through economy policies since 1980, Turkey gained its highest levels of foreign direct investments after the 2000s and then entered a slowdown period with the global crisis of 2008 (Yildiz and Karan, 2016: 129).

In this study, we aimed to investigate the relationship between carbon dioxide (CO_2) emissions and foreign direct investments in Central Asian Turkic Republics. In this context, analyzing whether FDIs cause pollution in the developing Central Asian Turkic Republics or not may provide a projection according to which economic and environmental policies can be made by taking FDIs into account. Within this framework, previous studies on the pollution haven hypothesis will be evaluated after the introduction section. In the second part of the study, the data set and methods used will be explained, while the third part will provide an interpretation of study findings. Finally, the study will be completed with an overall assessment and suggestions.

LITERATURE REVIEW

Empirical and theoretical studies investigating the environmental impacts of foreign direct investments started to increase after the 1990s upon the liberalization of foreign trade and discussions about its potential impacts on the environment. Grosman and Krueger's study (1991), which analyzed the environmental impacts of free trade in North America on 42 countries using the Environmental Kuznets Curve[1] (EKC), was among the first studies of its kind in the literature. In the analysis that used the countries' environmental pollution and per capita income data it was concluded that in the beginning the quality of life deteriorated because of environmental pollution, but that this re-improved later on in these countries. Even though Eskeland and Harrison

1 *Kuznets (1955) states that per capita income increases in accordance with economic development, but that income inequality also increases in the first phase of development. Moreover, he suggests that income inequality starts to decrease after a certain turning point, depending on the continuation of economic development. Known as the Kuznets Curve, this shape that reveals the relationship between per capita income and income inequality is in the form of a bell curve or an inverted U.*

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(1997) found some evidence that foreign investors were involved in sectors having the high levels of air pollution, they mentioned the weakness of such evidence. They concluded that foreign companies used cleaner energy types than local firms. Mani and Wheeler (1998) confirmed the "pollution haven hypothesis", but they asserted that it is temporary. This is because they suggested that production may become cleaner over time through restrictions that are later made and the development of know-how. They also concluded that the pollution rate was very high in capital- and energy-intensive manufacturing sectors (iron-steel, chemistry, paper, non-metallic minerals, etc.), while relatively labor-intensive sectors (textile, electrical machine, non-electrical machine, etc.) were the cleanest ones.

Until the 2000s, the environmental impacts of foreign trade were focused on in the literature and empirical evidence was relatively weak. After that date, variables that represented foreign direct investments in models testing the pollution haven hypothesis started to be frequently used. There are also several studies that test the pollution haven hypothesis in China, as after the 2000s, multinational companies started to choose to direct their investments to China due to low-cost labor and China has thus become the factory of global markets (Zeren, 2015: 6443). Within this framework, some examples of empirical literature that have prioritized the impacts of foreign direct investments on pollution since the mid-2000s are as follows:

Hoffman et al. (2005) tested the pollution haven hypothesis for 112 countries. They determined that carbon emissions were the cause of foreign direct investments in low-income countries. While it was the other way around for middle-income countries, no causal relationship was encountered for high-income countries.

In their studies covering 33 countries, Cole et al. (2006) suggest that foreign direct investments affect environmental conditions negatively if there is increased corruption. When the corruption decreases, the increase in foreign direct investments lowers the pollution.

Temurshoev (2006) examined how free international trade impacted the environment in developed and underdeveloped countries. He tested the pollution haven hypothesis and factor endowment hypothesis for the USA and China using an input-output analysis. He concluded that CO_2, SO_2 (sulfur dioxide) and NO_3 emissions decreased due to increased trade in China and the USA, and the fact that the USA did not export capital-intensive goods. In this way, both the pollution haven hypothesis and factor endowment hypotheses were rejected.

Kearsley and Riddel (2010) estimated the pollution haven hypothesis for seven oft-studied pollutants using the Environmental Kuznets Curve. They obtained little evidence that pollution havens played an important role in shaping the EKC. Also, as they found that confidence intervals around the turning points of EKC, including values that were generally highly above the data interval, were very broad, they expressed their suspicion that economic growth caused developments in environmental quality.

Based on the panel data of 30 provinces of China between the years 1998-2008, Xian-Gang (2010) analyzed the relationship between foreign direct investments, environmental regulations and other factors in China. Estimation results show that environmental regulation has a certain negative influence on the flow of foreign direct investments. However, this influence is insignificant. The economic scale, infrastructure and the cumulative effect

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of investment have more important impacts on foreign direct investments. Also, as they concluded that Granger-based fluctuations did not exist in the inflow of foreign direct investments, they could not support the pollution haven hypothesis for China.

Shabaz et al. (2012) examined the relationship between CO_2 emissions, energy consumption, economic growth and trade openness in Pakistan during the period of 1971-2009. Co-integration and Granger causality tests were used in the empirical analysis. They demonstrated a long-term relationship between the variables and the EKC hypothesis was supported. According to estimation results, energy consumption increases CO_2 emissions in both the short term and long term, and trade openness is insignificant in the short run, in spite of decreasing CO_2 emissions in the long run. Additionally, the long-term change in CO_2 emissions is corrected by approximately 10% per year.

Al-Mulali and Tang (2013) investigated the validity of the pollution haven hypothesis in the Gulf Cooperation Council (GCC) countries using a multivariate framework. They applied panel data analysis using data from the 1980-2009 period. The results of Pedroni's co-integration test showed that the data was cointegrated. FMOLS results provided evidence that energy consumption and GDP growth increased CO_2 emissions and that the inflow of foreign direct investments had a negative relationship with CO_2 emissions in the long term. Also, based on the results of the short-term Granger causality test, they stated that FDI had a short-term causal relationship with CO_2 emissions and energy consumption, while energy consumption and GDP growth had a positive causal relationship with CO_2 emissions.

Akin (2014) questioned the impact of foreign capital investments on the level of CO_2 emissions. The study analyzed this relationship with the system GMM method using the data of 12 countries in the high-income group between the years 1970-2012. In the analysis, energy consumption and per capita income were used as auxiliary explanatory variables. The analysis results demonstrate a statistically significant, negative relationship between foreign capital investments from the countries in the high-income group and the levels of CO_2 emissions. Furthermore, while supporting the opinion that there is a positive relationship between energy consumption and the level of CO_2 emissions, the findings propose that the increase in per capita income decreases CO_2 emissions in high-income group countries.

Based on the panel data of 2000-2010 period, Ren et al. (2014) tested the impacts on FDI, trade openness, exportation, importation and CO_2 emissions per capita through two-step GMM estimation. The estimation results highlight that China's trade surplus is among the important causes of rapidly increasing CO_2 emissions, FDI inflows continue to worsen CO_2 emissions in China, and the relationship between the industrial sector's per capita income and CO_2 emissions indicate an Environmental Kuznets Curve. Therefore, they expressed that in order to achieve an environmentally sustainable development of the economy, China should make efforts to modify its trade growth model and foreign direct investment structure, strengthen energy efficiency and develop a low-carbon economy.

Kesgingoz and Karamelikli (2015) analyzed whether foreign trade, energy consumption and economic growth in Turkey between the years 1960-2011 had an impact on CO_2 emissions or not. The study used the ARDL limit test approach. According to the test results, CO_2 emissions were concluded to

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have a long-term relationship with foreign trade and growth. In other words, it was found that foreign trade, energy consumption and economic growth increased environmental pollution in the long term and the pollution haven hypothesis was confirmed.

Seker et al. (2015) examined the impact of foreign direct investment, gross domestic product and energy consumption on carbon dioxide (CO_2) emissions in Turkey during the period of 1974-2010. They used the Hatemi-J test, which takes structural breaks into account in the integration analysis with a limit test approach (ARDL) that is superior, especially in minor examples. While the long-term coefficients of the ARDL model show that the impact of foreign direct investments on CO_2 emissions is positive but relatively minor, the impacts of GDP and energy consumption on CO_2 emissions are highly notable. In addition to this, short-term coefficients obtained by the error correction model (ECM) were found to be similar to those in the long-term model. The findings support the validity of the EKC hypothesis. The results of the Granger causality test reveal a causality between all explanatory variables and CO_2 emissions in the long term. In general, the findings suggest that Turkey should encourage energy efficiency through sustainable growth, as well as more inflow of foreign direct investments in technology-intensive and environmentally-friendly industries in order to increase environmental quality in particular.

Polat (2015) tested the relationship of CO_2 emissions in Turkey with economic growth, power generation and foreign direct investments for the period of 1980-2013. The study applied the Zivot-Andrews unit root test with a structural break allowing for single break. Whether a long-term relationship between the variables existed or not was examined with the Gregory-Hansen co-integration test for structural breaks. According to the Gregory-Hansen co-integration test results, a long-term co-integration relationship was determined between the CO_2 emissions and gross domestic product, power generation and foreign direct investments. The long and short-term relationships between the variables were tested with FMOLS and CCR co-integration coefficient estimators in which structural breaks could be included in the analysis as dummy variables. According to the estimation results, gross domestic product and power generation in Turkey influence environmental quality in a negative manner. Also, the coefficient was found to be insignificant, while the country's foreign direct investments decrease CO_2 emissions. Consequently, it was stated that the pollution haven hypothesis suggesting that foreign direct investments in a country increase CO_2 emissions was not valid for Turkey.

Milimet and Roy (2016) assert that production in polluting industries shifts towards the locations with environmental regulations. While simple, the existing empirical literature is inconclusive due to two deficiencies. Firstly, unobserved heterogeneity and measurement error are typically ignored because of the lack of a reliable, traditional, instrumental variable for control. Secondly, geographical spread was not included in the PHH tests sufficiently. Two new identification strategies within a model involving spread were used for these problems. Using USA state-level data, it is seen that their own environmental regulations impact inbound foreign direct investments negatively.

Solarin et al. (2017) examined the pollution haven hypothesis in the period of 1980-2012 by taking CO_2 emissions as an indicator of air pollution in Ghana. They also used gross domestic product (GDP), GDP square, energy con-

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sumption, renewable energy consumption, fossil fuel energy consumption, foreign direct investment, corporate quality, urbanization and trade openness as basic variables. They created a different time series model using an autoregressive distributed lag (ARDL) method. As a result of the analysis, a co-integration revealing a long-term relationship between the variables was demonstrated. Furthermore, while GDP, foreign direct investment, urban population, financial development and international trade influence CO_2 emissions positively, corporate quality decreases the emissions in Ghana. This situation proves that the pollution haven hypothesis applies to Ghana.

Kocak and Sarkgunesi (2018) investigated the potential impacts of foreign direct investments in Turkey on CO_2 emissions during the period of 1974-2013 using the Environmental Kuznets Curve model. In order to do this, they used the Maki structural breaks co-integration test, the Stock and Watson dynamic ordinary least squares estimator (DOLS), and the Hacker and Hatemi-J bootstrap test for causality method. The investigation results showed a long-term balance relationship between FDI, economic growth, energy consumption and CO_2 emissions. According to this relationship, the potential impact of FDI on CO_2 emissions is positive in Turkey. This result demonstrates that the pollution haven hypothesis applies to Turkey. They furthermore determined that changes in CO_2 emissions also influenced FDI inflows and that the Environmental Kuznets Curve hypothesis was valid in Turkey.

ECONOMETRIC ANALYSIS

In the econometric analysis, the purpose of the estimated model is examining the relationship between foreign direct investments and carbon emissions rates. Within this framework, panel data analysis was used and panel unit root, panel co-integration and PDOLS tests were applied. After the econometric model and the variables of the study are introduced, the tests used with panel data analysis will be briefly explained.

Econometric Model and Data Set

In the empirical analysis, the Turkic Republics (Azerbaijan, Kyrgyzstan, Kazakhstan, Turkey, Turkmenistan and Uzbekistan) were chosen as the sample group. These countries, which constitute the sample group, endeavor to attract foreign direct investments in order to ensure contribution to their economic developments.

Foreign direct investment and gross national product data was obtained from World Development Indicators (WDI) and data on CO_2 emission rates was obtained from the WDI and Global Carbon Atlas (GCA) data set. The data is annual and covers the 1995-2016 period. The variables used in the models and the sources where they were obtained are given in Table 1.

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Table 1. *Variables Lists.*

Variables	Unit of Measure	Symbol	Data Source
Period: 1995 -2016			
Foreign direct investment	Real FDI inflows (USD)	LnFDI	WDI
Pollution indicator	Metric tonnes of CO_2 emissions per capita (t)	$LnCO_2$	WDI, CGA
Economic growth	Gross domestic product per capita (USD)	LnGDPP	WDI
Crisis dummy variable		Dmy	Made by us

Source: WDI and GCA.
Note: The symbol "Ln" refers to the logarithm of variables.

In this study, the FDI variable was used by applying dollar-based GDP deflators[2] (2010=100) of net inflow for foreign direct investments in USD on the sample countries . The economic growth variable was represented by gross domestic product data per capita. It was applied using dollar-based gross domestic product deflators (2010=100), such as foreign direct investments data. The values of CO_2 emissions in metric tons per capita of carbon dioxide were used as pollution indicators. Carbon dioxide emissions result from the burning fossil of fuels and cement production. Carbon dioxide is emitted through gas radiation during the consumption of solid, liquid and gas fuels. A crisis dummy variable was added to analyze the impacts of the global economic crisis that started in mid 2007. Accordingly, the crisis periods of 2008, 2009 and 2010 were assigned the value of 1 and other periods were assigned the value of zero to produce a dummy variable which is represented by the "Dmy" symbol. In the analyses, the logarithms of all variables except for the dummy variable were taken and Model 1 was estimated. The "i" and "t" sub-indices in the model show cross-sections and time, respectively.

$LnCO_2it = f\ (LnFDIsit,\ GDPPit)$

$LnCO_2it = \beta1 + \beta2LnFDsIit + \beta3\ LnGDPPit + \beta4Dmy + \mu it$
(1)

(i = 1,.....,6) and (t = 1995,......, 2016)

In the estimation of the model in Equation 1, a panel unit root analysis will be primarily carried out for each variable. Later, parameters will be obtained through panel co-integration tests. Finally, long-term parameters will be estimated via the panel dynamic ordinary least squares (PDOLS) test.

Econometric Model

Panel data analysis is a method used to estimate economic relations by bringing together the horizontal cross-sectional observations of units such as countries, individuals, firms and households that have a time dimension. The panel data consists of an N number of units and a T number of observations corresponding to each unit. The valuation of both sections in panel data analysis provides the researcher with more data to work with. In this case, the number of observations and therefore the degree of freedom increase. Thus, the degree of the multiple linear link between the explanatory variables decreases and the efficiency and reliability of the econometric estimates increase. In general, the basic panel data model is as follows (Baltagi, 2008: 12-13; Tatoglu, 2013: 9):

2 *Taken from the WDI database.*

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$Y_{it} = \alpha it + \beta k_{it} X k_{it} + u_{it}$ i = 1,.....,N (cross-section) ; t =1,.....,T (time)
(2)

In Equation 2, Y is the dependent variable, X_k is the independent variable, α is the constant parameter, β is the slope parameter, and μ is the error term. The i represents the sub-index units (individuals, firms, countries, etc.) and the t sub-index represents time (day, month, year, etc.). The fact that variables and parameters and the error term have i and t sub-indices indicates that they have a panel data set. In this model, constant and slope parameters adopt values according to both units and time.

Before analyzing the existence of a relationship between variables in the panel data analysis method, it is necessary to test the stationarity of the variables. According to Granger and Newbold (1974), the relationship between the variables studied cannot be reliable when one works with non-stationary data. For this reason, the stationarity must be checked before regression analysis is conducted. Fisher ADF (Maddala and Wu, 1999), Breitung (1999), Fisher PP (Choi, 2001), Levin, Lin and Chu (LLC, 2002), and Im, Peseran and Shin (IPS, 2003) are the most well-known examples of panel unit root tests. These tests assume that there is no correlation between the units and are based on the dynamic fixed effect model, which is generally similar to the Augmented Dickey Fuller (ADF). In Equation 3, the μi and τi parameters are used to show the fixed effects and trend parameters, respectively. The existence of stationarity can be examined by testing ρ with the appropriate methods.

$Yit = \mu i + \tau it + \rho Yit - 1 + \delta i\theta t + \varepsilon it$
(3)

There are two kinds of assumptions about ρ. The first of these assumes that ρ does not change from unit to unit, in other words, that there is a general unit root process. This is called the First Group Panel Unit Root Test. LLC (2002) and Breitung's (2000) tests take on this assumption. In these tests, the basic hypothesis is "there is at least one unit root".

In the Second Group Panel Unit Root Test, ρ is assumed to change from unit to unit. IPS (2003), Fisher ADF (Maddala and Wu, 1999) and Fisher PP (Choi, 2001) are examples of these tests. Here, each unit is allowed to have its own auto-correlation coefficient. In these tests, the basic hypothesis of "no unit is stationary" is tested against the alternative hypothesis that "at least one of the units is stationary". The linear combinations of these series can be stable if the series belonging to the variables contain a unit root as a result of the applied unit root tests. In this case, the existence of a long-term relationship can be investigated through panel co-integration tests.

Kao (1999) and Pedroni's (1999, 2004) co-integration tests are commonly used for panel co-integration analysis in the literature. These two tests were also used in the empirical application of the study. The Kao Panel Co-integration Tests are Dickey Fuller (DF) and Augmented Dickey-Fuller (ADF) based tests. The basic hypothesis of "there is no co-integration" is tested. The tests developed by Pedroni are based on the remnants (error term) obtained from an equation (Equation 4) as follows. For this reason, the first step is to calculate the remnants from the co-integration regression (Pedroni, 1999: 656).

$Yit = \alpha i + \delta i, t + \beta 1i \times 1i,t + \beta 2i \times 2i,t + ... + \beta mi, \times mi,t + \varepsilon i, t$
(4)

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t = 1,...,T; i = 1,...,N; m = 1,...M

Pedroni (1999, 2004) suggested seven different tests (Panel-ν, Panel-ρ, Panel-PP, Panel-ADF, Group-ρ, Group–PP, Group-ADF) whose hypothesis is "there is no co-integration" (H0 : Φi = 0). Heterogeneity is allowed under an alternative hypothesis. The rejection of the basic hypothesis implies that a sufficient number of units have statistics that diverge from their individual average value. The first four of these are panel co-integration tests within sections, and the other three are panel co-integration statistics between sections. The comparative advantages of these statistics vary greatly depending on the data generation process. The significance of the panel-ν statistic is an important indicator of co-integration as the group-ρ statistical sample size begins to grow in small samples (Pedroni, 2004: 614).

Long-term parameters can be estimated using the PDOLS (Stock and Watson, 1993) method if there is a long-term relationship between the series of variables. The PDOLS Estimator (Kao and Chiang, 2000) is obtained by estimating the regression in Equation 5 below by using the values of the leading and lagging variables of the differentiated I (1) variables.

$$LnYit = \beta 0i + \beta 1i\ LnK1i + \beta 2i\ LnX1i + \sum_{k=-Kii}^{Kii} \alpha ik\ \Delta LnKit + \sum_{k=-Kii}^{Kii} \lambda ik \Delta\ Xit + \varepsilon it \quad (5)$$

The -Ki and Ki here represent the leading and lagging variables. The PDOLS method is a method that is capable of removing deviations in the static regression by incorporating dynamic elements into the model.

EMPIRICAL FINDINGS

In order to examine the validity of the pollution haven hypothesis in Central Asian Turkic Republics, the primary investigation tested through panel unit root tests whether CO_2 emission rates and the variables of FDI and GDP were stationary or not. The Unit root tests of the LLC, Breitung, IPS, Fisher-ADF and Fisher-PP models were used in the study. The definitive statistical values of the variables are provided in Table 2 in detail.

Table 2. *Descriptive Statistics on Variables.*

	CO_2	**FDIs**	**GDPP**
Medium	5.87	3.440	3.528
Median	4	1.139	1.571
Maximum	16	22.047	13.891
Minimum	1	2.360	258
Standard Deviation	4.06	5.039	3.689
Number of observations	132	132	132

Source: Author's estimates, WDI and GCA.

Table 3 shows the result of applying the unit root tests of the variables on stationary and trend panel data, as well as the t-statistic and probability val-

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ues in the first differences. According to the results of the LLC, Breitung, IPS, ADP and PP tests, the null hypothesis is accepted, which argues that the level values of the series contain unit roots. In other words, the series are not stationary between levels. As the presence of the series' unit roots in the level was insufficient for the co-integration test, a stationary and trend unit root test was applied after performing a difference operation. It was understood that all variables were stationary in the first degree (1).

Table 3. *Panel Unit Root Test Analysis Results*.

Test	LLC	Breitung	IPS	ADF	PP
Variable	**Individual intercept and trend**	**Individual intercept and trend**	**Individual intercept and trend**	**Individual intercept and trend**	**Individual intercept and trend**
CO_2	1.0165	0.967	2.159	2.042	3.478
	(0.845)	(0.248)	(0.984)	(0.996)	(0.967)
FDIs	1.650	0.258	0.050	10.022	21.088
	(0.950)	(0.601)	(0.520)	(0.614)	(0.149)
GDPP	-0.008	2.645	0.607	6.909	3.729
	(0.496)	(0.995)	(0.728)	(0.863)	(0.987)
ΔCO_2	-4.56437***	-3.07201***	-4.95258***	45.0831***	115.950***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
ΔFDIs	-2.039**	-2.707***	-4.146***	37.874***	303.793***
	(0.020)	(0.003)	(0.000)	(0.000)	(0.000)
ΔGDPP	-3.267***	-0.943*	-1.318*	19.305*	18.914*
	(0.000)	(0.071)	(0.093)	(0.081)	(0.090)

Source: Author's estimates.
*Note: * (**) *** symbols imply significance at the levels of 10%, (5%) and 1%, respectively. Those in parentheses ( ) are p-values.*

$LnCO_{2it} = \beta1 + \beta2\ LnFDIs_{it} + \beta3LnGDPP_{it} + \beta_4 Dmy + \mu_{it}$	
Pedroni test statistic	**Individual intercept and individual trend**
Panel-v	-0.1033
	(0.5411)
Panel-rho	0.2570
	(0.6014)
Panel-PP	-2.0900**
	(0.0183)
Panel-ADF	-1.6472**
	(0.0498)
Group-rho	0.7281
	(0.7668)
Group-PP	-2.8529***
	(0.0022)
Group-ADF	-2.693017***
	(0.0035)
Kao test statistics	Constant
ADF	-1.6453**
	(0.0499)

Source: Author's estimates.
*Note: * (**) *** symbols imply significance at the levels of 10%, (5%) and 1%, respectively. Those in parentheses ( ) are p-values.*

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According to the findings obtained by the analysis of the PDOLS model in Table 5, the coefficients of per capita income variables, which were included in the model as control variables, and foreign direct investments in the model for the overall panel are statistically significant. On the other hand, the crisis dummy variable was not found to be statistically significant. The coefficients of both foreign direct investments and per capita income variables are marked positively. In the PDOLS analysis where carbon dioxide emissions were dependent variables, estimation results validate the pollution haven hypothesis. The long-term estimation findings obtained show that a 1% increase in foreign direct investments causes a 2.7% increase in carbon dioxide emissions, and a 1% increase in per capita income causes a 0.03% increase in carbon dioxide emissions in the Turkic Republics chosen for the overall panel. R^2 value represents 0.93 in the model.

Table 5: *PDOLS Long Term Coefficient Estimation.*

$LnCO_2$ (Dependent Variable)	LnFDIs	LnGDPP	Dmy
Panel	2.7110***	0.0362***	-0.0291
	(5.0856)	(0.0054)	(-0.0396)
Diagnostic	R-squared: 0.93		
Statistics	Number of observations (except dummy variable): 396		
	Mean depend. var.: 5.8712		

Source: Author's estimates.
*Note: * (**) *** symbols imply significance at the levels of 10%, (5%) and 1%, respectively. Those in parentheses ( ) are t-statistics.*

This result is an evidence that foreign direct investments in the Central Asian Turkic Republics have negative impacts. The control variable (per capita income), which represented economic growth in the model, also has a negative impact on carbon dioxide emissions even though such impact is proportional. However, it can be considered insignificant compared to the coefficient of foreign direct investments. The coefficient of the crisis dummy variable is marked negatively, but it is statistically insignificant. Consequently, the findings of the empirical analysis support the pollution haven hypothesis in the Central Asian Turkic Republics.

CONCLUSION

While foreign direct investments were tending towards the developed countries, they started to focus on the developing countries after 1980. However, owing to lax environmental standards in the developing countries, there has been a debate in recent years in the literature within the framework of the pollution haven hypothesis as to whether FDIs increase the CO_2 emissions of production activities in the host countries and damage the environment and therefore biological diversity. According to this hypothesis, multinational companies face increased costs and lose their competitive edge in developed countries where environmental awareness is high. For that reason, FDIs turn away from the developed countries enforcing strict environmental regulations towards the developing countries that have less strict environmental regulations.

Gaining independence upon the dissolution of the Soviet Union in 1991, the

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Turkic Republics were willing to attract foreign investments in their efforts to adapt to the global liberal market and overcome the structural bottlenecks impeding economic growth and development, lack of sufficient capital accumulation, etc. At the same time, the fact that they are rich in terms of resources such as petroleum and natural gas was influential in attracting the investments of multinational companies. During this process, Turkey also steered towards policies that could attract foreign direct investments, with the expectation of transmitting new and/or developed production know-how to local firms, enhancing employment opportunities and contributing to the economic growth (Karagoz, 2007: 933). In this context, investigating whether FDIs harm the environment in these developing Central Asian Turkic Republics and Turkey (Azerbaijan, Kyrgyzstan, Kazakhstan, Turkey, Turkmenistan and Uzbekistan) may help contribute to the planning of economic and environmental policies. From this point of view, the main purpose of this study was to investigate the relationship between CO_2 emissions and FDIs in Central Asian Turkic Republics with an empirical approach. The relationships were assessed using annual data for the period 1995-2016 with panel co-integration tests, and long-term coefficients were estimated via the PDOLS method.

The empirical estimate findings confirm a long-term relationship between variables made up of data from the Central Asian Turkic Republics. The variable of per capita gross national product was added as a control variable representing economic growth into the model where CO_2 emissions were defined as dependent and FDIs were defined as independent variables. Moreover, a crisis dummy variable was produced in order to evaluate the impact of the 2008 global economic crisis. According to long-term estimation findings, a 1% increase in FDIs within the Central Asian Turkic Republics corresponds to a 2.7% increase in CO_2 emissions for the overall panel. A 1% increase in the economic growth, on the other hand, corresponds to a 0.03% increase in CO_2 emissions although it is a low rate compared to the FDI coefficient. The crisis dummy variable was found to be statistically insignificant.

The empirical analysis findings confirm the pollution haven hypothesis. In other words, the estimation results can be interpreted as evidence that FDIs in Central Asian Turkic Republics increase CO_2 emissions and that environmental quality is damaged by the impact of multinational companies. In the light of the study's findings, if policymakers in the relevant countries discuss and evaluate the following suggestions, this may contribute to eliminating the negative impact.

One of the suggestions to be emphasized primarily is the need for analysis of the sectors on which FDIs focus and/or may focus in the Central Asian Turkic Republics. It is then important that the environmental protection and audit regulations which are in effect be reviewed, that the compliance of the effective ones with international standards be examined, that new regulations in the areas with shortcomings be made and that they be put into practice. Another suggestion is to implement regulations by incorporating sustainable development strategies that combine economic, social and environmental dimensions in long-term development plans. In developed countries, a deterrence effect is created by applying high environment taxes. However, such taxes are not preferred in developing countries because they could discourage foreign investors. Therefore, it can be recommended that these countries allow only FDIs that take aspects of environmental protection into account and that will contribute to the development of the country, as well as create respective systems.

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Finally, among the limitations of the study are the fact that environmental pollution is represented by rates of CO_2 emissions due to difficulty in accessing data in some of the Central Asian Turkic Republics and that the results of the overall panel are shared. Thus, improving the study with various variables applied on a country basis and/or that represent the environmental pollution, energy use and location choice of multinational companies will help policymakers take more rational decisions.

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