

The Relation Between FDI Inflows and Environmental Pollution in CIS Countries

Asst. Prof. Dr. Suna Gönültaş [ORCID: 0000-0001-7194-2044](#)

Ph.D. candidate Ezgi Demiral [ORCID: 0000-0001-7822-7967](#)

Abstract

The role of the foreign direct investment (FDI) for the economic growth of countries is crucial in terms of the advantages it creates such as employment opportunities, providing long-term finance, facilitating competition, and technology spillover. Although countries are trying to attract FDI inflows and rise the volume of new projects, the concern of environmental issues is gaining much more importance than ever before.

In this respect, this study will aim to investigate the relationship between FDI inflows and environmental pollution from CIS countries for the period 2001-2014. By employing panel data analysis, the relation is analyzed by using Carbon dioxide emission as a proxy for environmental pollution. The data is obtained from the World Bank database for selected countries.

1 Introduction

Rapid industrialization after the Industrial Revolution brought mass production and consumption in its wake. Increasing production with mechanization has caused the unconscious use of natural resources and brought environmental destruction with it. The rise in fossil fuel consumption with the industrial revolution has led to the accumulation of greenhouse gases, especially CO₂, in the atmosphere. The rise in greenhouse gases causes global climate change, which is one of the critical problems facing humanity today. While the CO₂ level was 185 ppm at the Last Glacial Maximum, it has raised to 228 ppm because of human activities in 1750 (NASA, 2022). After the Industrial Revolution, the CO₂ level continued to rise steadily.

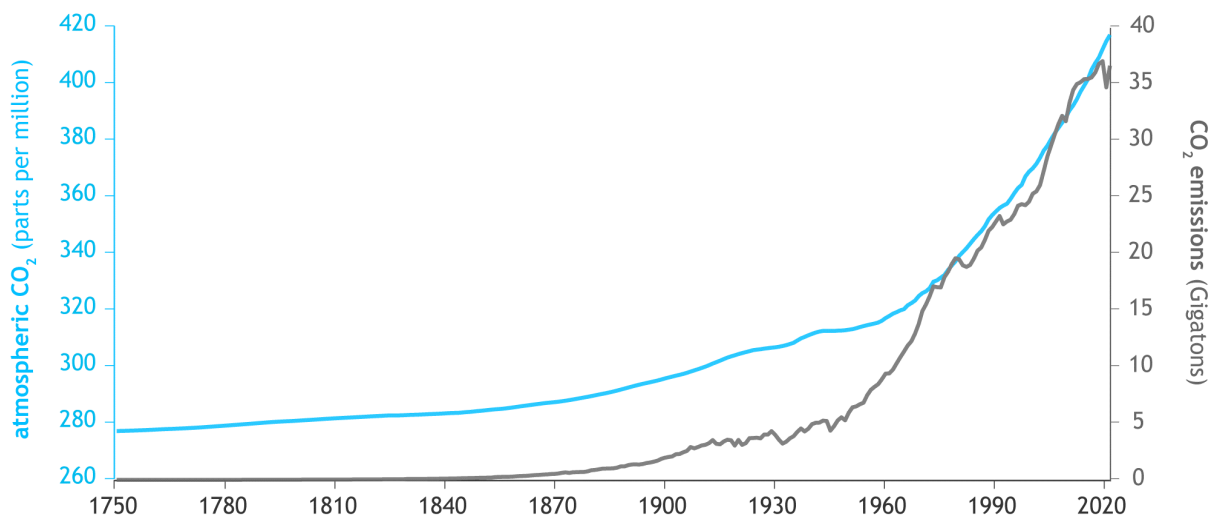


Figure 1. Atmospheric Carbon Dioxide Amounts and Annual Emissions (1750-2021) **Source:** NOAA Climate

In the economy, the main aim is providing a higher economic growth and an increase in welfare for countries. The Limits to Growth published in 1972 is the first report about the growth effect on environmental destruction. In the report, it is emphasized that if the growth of the world continues in this way, the limits of the planet will be reached and the growth trends must be changed (Meadows et al, 1968). Then, With the United Nations Conference in 1972 known as Stockholm Conference, the damage caused by economic growth to the environment has become more controversial in the international arena.

The Environmental Kuznets Curve (EKC) hypothesis refers to the relationship between income per capita and environmental pollution. According to the EKC hypothesis, initially, and environmental pollution rises to a certain income level, but then income reaches a threshold, environmental pollution begins to decline. The relationship between income per capita and environmental pollution shows an inverted U shape.

Foreign direct investment is an important vehicle for developing countries which with a savings deficit. Trade and financial integration between countries accelerate in conjunction with globalization. Free movement of capital accelerates growth by way of FDI in developing countries. Developing countries are attractive to developed countries as they create a competitive advantage due to low-cost labor and cheap raw materials. FDI contributes to the host country in many ways. FDI is not only capital stock but also information of know-how and technology.

FDI promotes to transfer of technical information from firms in developed countries to firms in developing countries (Davies, 1977) and is therefore expected to rise growth and productivity (Dimelis, 2005). FDI promotes the development of labor training, managerial skills, and organizational regulation in the host country (Li&Liu, 2005). FDI also affect positively manufacturing productivity by the way innovation in the production process.

On the other hand, the standard of the environment is lower in developing countries and investing in developing countries is attractive due to the higher standard of the environment in developed countries. The higher standard in developed countries blocks the production process which is causing environmental damage. Changing the production process conformably to the standard environmental causes cost rises in firms. Firms in developed countries prefer to move productivity activity to developing countries. But investments in host countries are criticized for increasing environmental damage. The fact that FDI rises environmental damage in the host country is called the "Pollution Haven Hypothesis" in the literature. In contrast, there are much research that say that foreign companies have also better green technologies and effective management practice. The view that environmentally friendly production is made in the host country thanks to the technology transfer from developed countries is called the "Pollution Halo Hypothesis" in the literature.

Commonwealth of Independent States (CIS, Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, Uzbekistan) declared independence after the break-up of the Soviet Union in 1991. These countries transitioned from centrally planned economy to free market economies associated with political change. Growth rates decreased significantly in these countries in the early 1990s (Agayev&Yamak, 2009). The population of CIS was around 248 million in 2020. This corresponds to about 3% of the world's population.

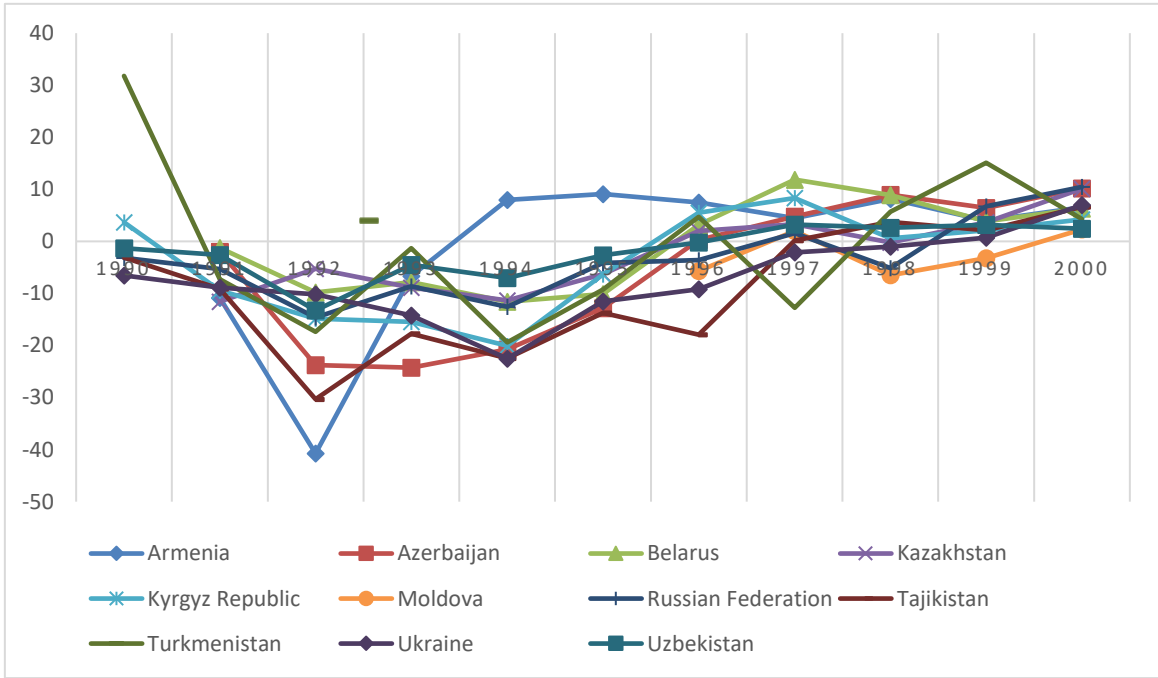


Figure 2. GDP Per Capita Growth (annual %, 1990-2000) Source: World Bank.

This the paper aims to relations between CO₂, growth, and foreign direct investment in CIS countries in the period 2000-2014. This paper is organized as follows. Section 2 presents literature on the impact of FDI on environmental damage and economic growth. Section 3 describes the impact of FDI and economic growth on the environment with the empirical model. Finally, section 4 concludes and presents policy implications.

2 Literature

There are many papers that investigate the effect of growth and FDI on environmental damage in the literature. Some of them are mentioned in this section.

Grossman & Krueger (1991) probed the relation between economic growth and air pollution in 42 countries. The result shows that air pollution raise with per capita GDP in low-income economies but decreases with per capita GDP in high-income countries.

Borensztein et al (1998) analyzed that FDI has a positive impact on the economic growth in 69 developing countries over the period 1970-1989. The paper shows that FDI promotes to transfer of technology to the host country.

Bengoa & Sanchez-Robles (2003) probed the relationship between growth, economic freedom, and FDI for 18 Latin American countries from 1970 to 1999. The foreign direct investment affects positively the economic growth according to result.

Shahbaz et al (2015) examined the relationship between FDI, economic growth, and carbon dioxide emission using data from 99 countries of high-, middle- and low-income economies from 1975 to 2012. The findings from the study supported the pollution haloes hypothesis in high-income economies, in middle-low economies effect of environmental damage is positive in the beginning but then environmental quality improves. There is also a positive relationship between environmental damage and FDI in low-income economies.

Mike & Kardaslar (2018) tested to understand the effect of the foreign direct investment in environmental quality using three pollution indicators. They used data from 102 countries including low-, low-middle, upper-middle, and high-income over the period of 2000-2015. The article shows that the pollution halo hypothesis exists in low-middle, upper-middle- and high-income economies, pollution haven hypothesis exists in low-income economies.

Yıldırım et al (2017) investigated the validity of the pollution haven hypothesis in the period 1974-2012 in Turkey. Foreign direct investment affects negatively on environmental quality to a certain point but then this effect after certain point reverse.

Mulali (2012) examined the effect the foreign direct investment net inflows, total trade, energy consumption, and GDP affected by increasing CO₂ in 12 Middle Eastern countries. The test result shows that those factors are very effective in increasing CO₂ emission.

Hitam & Borhan (2012) probed the relationship between foreign direct investment and environmental damage over the period 1965-2010 in Malaysia. Foreign direct investment affects negatively the environmental.

Mutafoglu (2012), found the validity of the pollution haven hypothesis from 1987Q1 to 2009Q4 in Turkey. The variables in the study are foreign direct investment, carbon dioxide emission, and gross domestic product.

Lee (2013) analyzed the relationship between foreign direct investment, growth, CO₂ emission, energy, and clean energy for 19 nations of the G20 the period 1971-2009. The results show that the effect of the FDI on the rise of CO₂ emissions is limited.

An et al. (2021) tested to affect the foreign direct investment on the environmental by using growth, industrial structure, and capital-labor ratio in China. The result shows that there is an inverted U-shaped connection among FDI and environmental damage.

Baek (2016) analyzed ASEAN countries, over the period 1981-2010 and find that FDI has a positive effect rise of CO₂ emission. As a result, the pollution haven hypothesis is valid.

Kari & Saddam (2012) used CO₂ emission, foreign direct investment, and growth as research variables and found FDI contributes to air pollution in Gulf Cooperation Council.

3 Data and Methodology

All data are obtained from the World Bank Database for the years 2001-2014 for 11 CIS countries namely Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyz Republic, Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan.

In this study, in order to understand the effect of the foreign direct investment, economic growth and energy consumption on the carbon dioxide emission of the CIS countries, panel data methodology is employed. The dependent variable is taken as carbon dioxide emission measured by metric tons per capita. Explanatory variables are GDP per capita measured in current US\$, Foreign direct investment, net inflows measured in current US\$, Electric power consumption measured in kWh per capita, which all included into the model by taking their natural logarithms.

Functional representation of the model is as follows:

$$CO_{2it} = \beta_0 + \beta_1 \ln fdi_{it} + \beta_2 \ln gdp_{it} + \beta_3 \ln eng_{it} + \varepsilon_{it} \quad (1)$$

where *i* specifies cross-section units (countries) and *t* depicts time dimension of the study.

Prior to analyzing the model, it is important to control the absence of multicollinearity in order to have unbiased estimators. Regardless of the selection of the model, the Variance inflation factor (VIF) is used to detect whether there is a multicollinearity or not among the explanatory variables. According to the test results given in Table 1, mean VIF is less than 5, so there is no multicollinearity problem for the estimators.

Variable	VIF	1/VIF
lnfdi	4.16	0.240600
lngdp	3.13	0.319883
lneng	2.26	0.442671
Mean VIF	3.18	

Table 1. Analyzing Multicollinearity

For the selection of correct model, the existence of unit and/or time effects should be analyzed. Hence, Likelihood-ratio (LR) Test is conducted and according to the results the null hypothesis that unit and time effects are equal to zero is rejected. From this, it can be stated that there exist at least one effect and classical model is not applicable. To deep further, unit and time effects are analyzed separately, and it is found that the model is a one-way model with unit effects.

In order to choose between fixed effect and random effect models, Hausman test is performed. Both classical and robust Hausman test results confirm that random effect model is appropriate for the study. According to the test results, there is no correlation between regressors and unit effects, it can be concluded that random effect model is efficient (Yerdelen Tatoğlu, 2020).

The results of the Hausman test are presented at Table 2. It has decided that the random effects' estimator is valid as H_0 has failed to reject upon finding $p > 0.52$ and $p > 0.99$ respectively for Hausman and robust Hausman test.

	Test value	Prob>chi2
Hausman	2.23	0.5266
Robust Hausman	0.07	0.9954

Table 2. Hausman and Robust Hausman Test Results

Furthermore, in order to have efficient and unbiased estimators the basic assumption about the existence of heteroskedasticity, autocorrelation and cross-sectional independence should be checked and if exists robust estimators should be used (Baltagi, 2008). In the random effect model, heteroskedasticity is tested with the Levene, Brown and Forsythe test. According to the findings given Table 3 below, H_0 hypothesis stating equal variance among units is rejected, hence there exists heteroskedasticity.

W0	14.017125	df(10, 143)	Pr > F = 0.00000000
W50	11.932606	df(10, 143)	Pr > F = 0.00000000
W10	13.953844	df(10, 143)	Pr > F = 0.00000000

Table 3. Levene, Brown and Forsythe Test

To check for autocorrelation, Durbin–Watson test suggested by Bhargava, Franzini and Narendranathan and LBI test suggested by Baltagi-Wu are conducted. The results confirm that the model has autocorrelation.

Modified Bhargava et al. Durbin-Watson	Baltagi-Wu LBI
0.49159693	0.80356222

Table 4. Tests for Autocorrelation

Finally, Friedman test shows the presence of cross-sectional independence with the result of 18.439, $Pr > 0.0480$.

Therefore, Driscoll-Kraay standard errors model is used considering the existence of heteroskedasticity, autocorrelation, and cross-sectional independence (Yerdelen Tatoğlu, 2020).

Regression with Driscoll-Kraay standard errors	Number of obs	=	154
Method: Pooled OLS	Number of groups	=	11
Group variable (i): countries	F(3, 10)	=	387.26
maximum lag: 2	Prob > F	=	0.0000
	R-squared	=	0.6195
	Root MSE	=	2.6377

co2emissions	Drisc/Kraay		t	P> t	[95% Conf. Interval]	
	Coef.	Std. Err.				
lnfdi	.3075755	.1141874	2.69	0.023	.0531501	.5620009
lngdp	.8183079	.2152573	3.80	0.003	.3386847	1.297931
lneng	4.940481	.194186	25.44	0.000	4.507807	5.373154
_cons	-45.76298	2.656714	-17.23	0.000	-51.68251	-39.84346

Table 5. Driscoll-Kraay Standard Errors Model Regression Results

According to the findings presented at Table 5, foreign direct investment inflows, GDP per capita and energy consumption per capita have significantly and positively have an impact on CO₂ emissions of the selected countries.

Specifically, 1 percent rise in FDI inflows into countries rises CO₂ emissions by 0.307 metric tons per capita, while 1 percent rise in GDP per capita rises CO₂ emissions by 0.818 metric tons per capita. Importantly, 1 percent rise in energy consumption per capita rises CO₂ emissions by 4.94 metric tons per capita.

4 Conclusion

The main purpose of the study to analyze the effect of the foreign direct investment, economic growth, and energy consumption on the carbon dioxide emission of the CIS countries. In order to do that, panel data methodology used for selected 11 countries for the years between 2001-2014.

The main finding of the analysis suggests that foreign direct investment inflows, GDP per capita and energy consumption per capita positively affects CO₂ emissions of these countries under question. The main findings of the study are in line with the environmental Kuznets curve hypothesis which states at the initial stages of economic growth environmental pollution rises with the GDP per capita. As for the economic conditions of the CIS countries are taken into account, the economies can be considered as the rising part of the inverted U-shaped curve.

The FDI inflows to those countries also contribute to the CO₂ emissions. FDI coming to the developing countries had contributed to the economic performance of the local industries and services, rise competition and bringing advanced technologies and managerial skills. However, for the case of CIS countries, the abundance of natural resources attracts MNC to invest even though regulatory and bureaucratic problems. For example, as Tondel (2001) states majority of FDI in Azerbaijan were in oil and gas industry with huge contribution to CO₂ emission.

Reaching higher economic growth rates with minimal environmental degradation is gaining importance and becoming a major concern for both developed and developing countries. Even developing countries which emphasize economic growth more than environment will have to change the way of old thinking. With the modern technologies FDI inflows may contribute both economic growth as well as the environmental quality.

References

- Ağayev&Yamak, 2009. "Bağımsız Devletler Topluluğu Ülkelerinde Ekonomik Büyümenin Belirleyicileri", *Journal of Economics and Administrative Sciences University of Ataturk*, 23:4 p. 179-204.
- Al-Mulali, 2012. "Factors Affecting CO₂ Emission in The Middle East: A Panel Data Analysis", *Energy*, 44 p. 564-569.
- An et al., 2021. "The Impact Of FDI On Environmental Pollution In China: Evidence From Spatial Panel Data", *Environmental Science and Pollution Research*, 28 p. 44085–44097.
- Baek, 2016. "A new look at the FDI–income–energy–environment nexus: Dynamic panel data analysis of ASEAN", *Energy Policy*, 91 p. 22-27.
- Baltagi et al., 2008, "Testing for Heteroskedasticity and Serial Correlation in a Random Effects Panel Data Model", *Center for Policy Research Working Papers* 111
- Bengoa&Sanchez-Robles, 2003. "Foreign direct investment, economic freedom and growth: new evidence from Latin America", *European Journal of Political Economy*, 19:3 p. 529-545.
- Borensztein et al., 1998. "How Does Foreign Direct Investment Affect Economic Growth?" *Journal of International Economics*, 45 p.115-135.
- Climate.gov, 2022. Carbon dioxide statistics, <https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide>
- Davies, 1977. "Technology Transfer Through Commercial Transactions", *The Journal of Industrial Economics*, 26:2 p. 161-175.
- Dimels, 2005. "Spillovers from foreign direct investment and firm growth: technological, financial and market structure effects", *International Journal of the Economics of Business*, 12:1 p. 85-104.
- Grossman&Krueger, 1991. "Environmental Impacts of a North American Free Trade Agreement", *National Bureau of Economic Research, Working Paper No. 3914*
- Hitam&Borhan, 2012. "FDI, Growth and the Environment: Impact on Quality of Life in Malaysia", *Procedia - Social and Behavioral Sciences*, 50 p. 333 – 342
- Kari&Saddam, 2012. "Growth, FDI, Imports, and their Impact on Carbon Dioxide Emissions in GCC Countries: An Empirical Study", *Mediterranean Journal of Social Sciences*, 3:5 p. 25-31
- Lee, 2013. "The Contribution of Foreign Direct Investment to Clean Energy Use, Carbon Emissions and Economic Growth", *Energy Policy*, 55 p. 483-489

- Li&Liu, 2005. "Foreign Direct Investment and Economic Growth: An Increasingly Endogenous Relationship", *World Development*, 33:3 p. 393–407
- Meadows et al, 1972. **The Limits to Growth**. Universe Book, New York
- Mika&Kardaslar, 2018. "Doğrudan Yabancı Sermaye Yatırımlarının Çevre Kirliliği Üzerine Etkisi", *Journal of Management and Economics Research*, 16:3 p. 178-191
- Mutafoğlu, 2012. "Foreign Direct Investment, Pollution, and Economic Growth Evidence from Turkey" *Journal of Developing Societies* 28:3 p. 281–297
- NASA, 2022. <https://climate.nasa.gov/vital-signs/carbon-dioxide/>
- Shahbaz, 2015. "Does Foreign Direct Investment Impede Environmental Quality in High, Middle and Low-income Countries?", *Energy Economics*, 51 p. 275-287
- Tondel, 2001. Foreign Direct Investment During Transition. Determinants and Patterns in Central and Eastern Europe and the Former Soviet Union. Chr. Michelsen Institute. WP 2001:9.
- World Bank, 2022. GDP statistics, <https://data.worldbank.org/indicator/NY.GDP.PCAP.KD.ZG?end=2000&locations=AM&start=1988>
- Yerdelen Tatoğlu, 2020. **Panel Veri Ekonometrisi, Stata Uygulamalı**, Beta Yayınları, İstanbul
- Yıldırım et al., 2017. "Doğrudan Yabancı Yatırımlar ve Kirlilik Sığınağı Hipotezi", *Journal of Economics and Administrative Sciences* 18:2 p. 99-111