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Impact of foreign direct investment inflows on environmental pollution in Turkey

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Abstract

The globalization accelerated especially as of 1980s and the countries began to integrate global economy and remove the constraints on the flows of goods, services and capital. In this context, the developed countries partly shifted their environmentally hazardous production activities to the developing countries especially by means of foreign direct investments. This study investigates the impact of foreign direct investment inflows on the environmental pollution in Turkey during the period 1974-2010 by using Toda and Yamamoto (1995) causality test. We found that there was a bidirectional causality between foreign direct investment inflows and CO_2 emissions.

Keywords: Foreign direct investment inflows, CO_2 emissions, causality analysis

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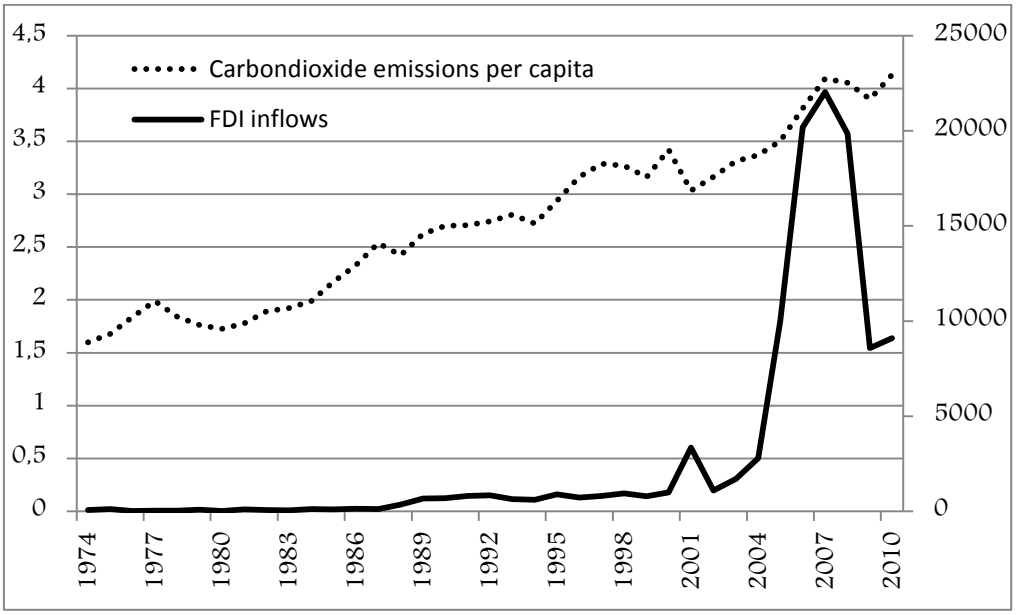
1. Introduction

The countries began to remove the constraints on the flows of goods, services and capital together with the globalization and the global foreign direct investment (FDI) inflows reached about 1.911 trillion dollars in 2007, then decreased to the 1.171 trillion dollars in 2009 with the negative effects of global financial crisis and the Eurozone sovereign debt crisis and presumably was 1.260 trillion dollars in 2014 (United Nations, 2015). On the other hand Turkey belatedly began to attract FDI inflows due to political and economic instability as of 2001 as seen in Chart 1.



Source: World Bank (2015a and 2015b)

Chart 1: CO_2 emissions per capita and FDI inflows (million USD) (1974-2010) in Turkey

There have been significant increases in the industrial production due to industrial revolution and globalization and global environmental began to deteriorate in parallel with increases in production and consumption. Turkey had the same environmental pollution pattern and CO_2 emissions per capita increased about 2.5 times during the period 1974-2010.

This study examines the role of FDI inflows and gross fixed capital formation in the increase CO_2 emissions per capita in Turkey during the period 1974-2010 by Toda-Yamamoto (1995) causality test. The remainder of the study is structured as follows. The next section overviews the existing literature on the relationship between CO_2 emissions and FDI inflows. Section 3 introduces the data, method, empirical application and major findings of the study and Section 4 concludes the study with conclusion and policy implications.

2. Literature Review

A large number of studies have conducted to determine the causes behind the global environmental degradation. These studies generally have focused on the role of economic growth and FDI inflows in the environmental pollution and they have reached mixed findings. Most of the studies such as Acharyya (2009), Mahmood and Chaudhary (2012), Blanco et al. (2013), Neelakanta et al.

(2014) and Bukhari et al. (2014) have found that FDI inflows had negative impact on the environment, while relatively few studies such as Yıldırım (2014) and Shaari et al. (2014) found that FDI did not have any significant impact on the environment.

Acharyya (2009) investigated the relationship among FDI, economic growth and CO_2 emissions in India during the period 1980-2003 and found that FDI inflows had large positive impact on CO_2 emissions. On the other hand Mahmood and Chaudhary (2012) investigated the impact of FDI on CO_2 emissions in Pakistan during the period 1972-2005 by using Autoregressive Distributed Lag model (ARDL) and found that FDI had positive impact on CO_2 emissions.

In another study Blanco et al. (2013) examined the relationship between sector specific FDI and CO_2 emissions in 18 Latin American countries during the period 1980–2007 by using panel Granger causality tests and found that there was unidirectional causality from FDI in pollution-intensive industries to CO_2 emissions per capita. On the other hand Neelakanta et al. (2014) examined causality among FDI, GDP per capita and pollution in India during the period 1978-2009 by using ARDL model and found that there was bidirectional causality between FDI and CO_2 emissions in the short run, while there was a unidirectional causality from FDI to CO_2 emissions in the long run.

Bukhari et al. (2014) examined the impact of FDI and capital formation on the environment in Pakistan during the period 1974–2010 by using ARDL model. They also found that FDI had negative impact on the environment, while capital formation had positive impact on the environment in both short and long run. On the other hand Zeren (2015) examined the impact of increases in FDI on carbon emission in the US, France, the UK and Canada during the period 1970-2010 by using Hatemi-J (2008) cointegration test, linear and nonlinear causality tests. He found that FDI was cause of the carbon emissions and also increases in FDI led decreases in CO_2 emissions for the US, France and the UK, while increases in FDI increased the CO_2 emissions in the Canada.

Yıldırım (2014) investigated the causality between FDI inflows and CO_2 emissions per capita in 76 countries during the period 1980-2009 by using bootstrap corrected panel causality test and correlation analysis. He found that increases in energy use due to FDI inflows did not increase the pollution level. In another study Shaari et al. (2014) examined the impact of FDI on CO_2 emissions in 15 developing countries during the period 1992-2012 by using Johansen cointegration and found that there was long run relationship between FDI, CO_2 and GDP and FDI did not any impact on CO_2 emission in the long run.

In another study Omri et al. (2014) examined the causality among FDI, economic growth and CO_2 emissions in 54 countries during the period 1990–2011 by using dynamic simultaneous-equation panel data model and found that there was bidirectional causality between FDI inflows and CO_2 emissions for all the countries except the ones in Europe and North Asia.

3. Data, Method and Empirical Application

We examined the impact of FDI inflows and gross fixed capital formation on environmental pollution in Turkey during the period 1974-2010. Firstly we will check the stationarity of the variables by Augmented Dickey Fuller (ADF) (1981) and Phillips and Perron (PP) (1988) and then the causality among the variables will be tested by Toda and Yamamoto (1995) causality test.

3.1. Data

We used annual data of FDI inflows (FDI), gross fixed capital formation (GFCF) and CO_2 emissions per capita (CO) during the period 1974-2010 to investigate the causality among FDI inflows, gross capital formation and CO_2 emissions. All the data were obtained from World Bank (2015a&b) and the logarithmic forms of FDI and GFCF variables were used in the analysis. The variables used in the

econometric analysis, their symbols and sources were presented in Table 1. We used Eviews 8 and Stata 12.0 software packages in the analysis of the dataset.

Table 1. Variables used in the study

Variables	Symbol
CO_2 emissions per capita	CO
Net FDI inflows as % of GDP	LFDI
Gross fixed capital formation as % of GDP	LGFCF

3.2. Unit Root Test

We tested the stationarity of the series by ADF (1981) and PP (1988) and the results of unit root test were presented in Table 2. The findings denoted that all the variables were not stationary at their levels, but became stationary after first differencing.

Table 2. Results of ADF and PP unit root tests

Variables	ADF		PP	
	Constant	Constant+Trend	Constant	Constant+Trend
CO	-0.105101 (0.9392)	-2.8375 (0.1940)	0.1147 (0.9625)	-2.8375 (0.1940)
D(CO)	-3.458217 (0.0175)**	-6.2439 (0.0000)***	-6.3437 (0.0000)***	-6.3553 (0.0000)***
LFDI	-0.3193 (0.9119)	-3.4263 (0.0674)*	-0.5204 (0.8756)	-4.1490 (0.0123)**
D(LFDI)	-8.5384 (0.0000)***	-8.4926 (0.0000)***	-8.8257 (0.0000)***	-9.0591 (0.0000)***
LGFCF	-0.2347 (0.9239)	-3.5105 (0.0542)*	-0.9245 (0.7688)	-2.8120 (0.2024)
D(LGFCF)	-3.7934 (0.0071)***	-3.7385 (0.0339)**	-6.0668 (0.0000)***	-5.9506 (0.0001)***

Note: Probability values were shown in the brackets.

3.3. Toda-Yamamoto (1995) Causality Test

Toda and Yamamoto (1995) causality test is a modified version of Granger (1969) causality test and test the causality among the variables without pretesting cointegration. Firstly the optimal lag length p is determined in the VAR model, then the highest integration degree (d_{max}) among the variables is added to the p. At the next stage VAR model is estimated with the level values of the variables for the $p + d_{max}$ lag. The estimated VAR model is as follows:

$$Y_t = \alpha_0 + \sum_{i=1}^{p+d_{max}} \alpha_{1i} Y_{t-i} + \sum_{i=1}^{p+d_{max}} \alpha_{2i} X_{t-i} + u_t \qquad (1)$$

$$X_t = \beta_0 + \sum_{i=1}^{p+d_{max}} \beta_{1i} X_{t-i} + \sum_{i=1}^{p+d_{max}} \beta_{2i} Y_{t-i} + v_t \qquad (2)$$

At final stage the constraints are imposed on the coefficients obtained from the d_{max} and the significance of these constraints are tested by modified Wald test. The null hypothesis for the (1) numbered equation is that there is no causality from X to Y and the null hypothesis for the (2) numbered equation is that there is no causality from Y to X.

We firstly estimated the VAR model with the level values of the variables to determined optimal lag length. The results were presented in Table 4. The optimal lag length was found to be 1.

Table 3. Determination of optimal lag length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-61.11372	NA	0.008720	3.771395	3.906074	3.817325
1	**9.725041**	**125.0096***	**0.000230***	**0.133821***	**0.672537***	**0.317539***
2	13.43513	5.892498	0.000319	0.444992	1.387744	0.766498
3	21.42975	11.28652	0.000351	0.504132	1.850921	0.963426

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

We found that optimal lag length was 1 and checked whether there were autocorrelation and heteroscedasticity problems with LM tests and White heteroscedasticity tests. The results of the tests were presented in Table 4 and 5. The findings demonstrated that there were no autocorrelation and heteroscedasticity problems.

Table 4. Results of serial correlation LM tests

Lags	LM-Stat	Prob.
1	8.961095	0.4409
2	10.21828	0.3331
3	3.663816	0.9321
4	11.29003	0.2564
5	5.616277	0.7776
6	6.076643	0.7322
7	6.694971	0.6688
8	10.53151	0.3092
9	4.810130	0.8505
10	11.69295	0.2312
11	8.371273	0.4972
12	9.206731	0.4184

Table 5. Results of White heteroscedasticity test (includes cross terms)

Chi-sq	df	Prob.
80.36399	54	0.0115

In our study, the highest integration level of the variables (d_{max}) was 1 and p was found to be 1. Therefore the regression model with 2 lags ($p + d_{max} = 1 + 1 = 2$) was estimated and the results of the Toda and Yamamoto (1995) causality test were presented in Table 6. The findings demonstrated that there was bidirectional causality between FDI inflows and CO_2 emissions.

Table 6. Results of Toda and Yamamoto (1995) causality test

Null Hypotheses	Prob.
LFDI does not Granger cause of CO	**0.0543**
LGFCF does not Granger cause of CO	0.2050
CO does not Granger cause of LFDI	**0.0794**
LGFCF does not Granger cause of LFDI	0.6265
CO does not Granger cause of LGFCF	0.6608
LFDI does not Granger cause of LGFCF	0.3100

4. Conclusion

The environment has begun to deteriorated in Turkey as of 1980s and the CO_2 emissions per capita increased 2.5 times during the period 1974-2010. We examined the role of FDI inflows in this increased environmental pollution. We firstly tested the stationarity of the variables by ADF (1981) and PP (1988), then conducted Toda and Yamamoto (1995) causality test to determine the casual relationship among the CO_2 emissions per capita, FDI inflows and gross fixed capital formation.

The results of causality test demonstrated that there was bidirectional causality between FDI inflows and environmental pollution in Turkey and it means FDI inflows is a cause of CO_2 emissions and CO_2 emission feedbacks the FDI inflows. This finding was consistent with findings from studies for the other developing countries (see Acharyya (2009), Mahmood and Chaudhary (2012)). This finding could be arisen from low environmental regulations of the developing countries in order to attract foreign investments. But developing countries should consider taking measures against the increases in CO_2 emissions, because it may pose a challenge for a sustainable environment and economic growth in the long run.

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