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Liberalization and greenhouse gases emissions in the EU-10

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Abstract

Purpose – The purpose of this paper is to analyze the relationship between liberalization and greenhouse gases (GHGs) emissions in Central and Eastern European countries (CEECs). After their memberships, most of the CEECs have already committed to reducing their GHGs emissions. Although emissions have decreased on average, there is a substantial heterogeneity among the countries. Within the liberalization and integration efforts, increasingly huge amount of foreign direct investment (FDI) has flown to the region. Therefore, the question is whether or not this increase in foreign investment to CEECs is related to the polluting industries. The coincidence of increased FDI and GHGs emission has led us to study the relationship between them.

Design/methodology/approach – The paper exploited cross-sectional and time series variation of the data.

Findings – The paper found that the polluting FDI is positively associated with GHGs emissions in CEECs.

Originality/value – Few previous studies have taken into account FDI and environmental performance together, so the analysis represents a notable contribution to the pollution haven literature.

Keywords Industry, Sustainable environment, CEECs, Liberalization, Foreign direct investment, Greenhouse gas emissions, Environment, EU

Paper type Research paper

1. Introduction

Economic integration with European Union (EU) provides a significant contribution to international trade and also to foreign direct investment (FDI) of Central and Eastern European countries (CEECs), now we are calling them as new members of EU. Particularly FDI has become a major channel of economic transformation of these countries. According to many studies (Lankes and Venables, 1996; Hunya, 1997, 2000; Borensztein *et al.*, 1998; Brenton and Di Mauro, 1999; Resmini, 2000; Ryszard and Prochniak, 2009; Varamani and Kaarash, 2010) GDP growth, productivity growth, structural change and profit rates were higher in these countries with the help of FDI inflow. The ten new member countries (EU-10; Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia), which joined the EU can be characterized by the magnet of inward FDI over the past two decades; almost all new members' FDI inflows as a share of GDP have increased during this period. Within the region, Hungary recorded the largest FDI inflows relative to GDP; in 1993 FDI inflows as a share of GDP in Hungary[1] increased from 5.97 to 6.88 percent in 2011. For the Czech Republic the same figure increased from 1.67 to 2.38 percent and for Poland it increased from 1.83 to 2.97 percent (Table I). These are the members of Vizegrad countries. The FDI sectors of these countries which accounted for more than 70 percent of total FDI inflows to EU-10, are mostly in traditional sectors, scale

World Journal of Science, Technology and Sustainable Development
Vol. 10 No. 4, 2013
pp. 288-296

2042-5945
DOI 10.1108/WJSTSD-08-2013-0027

	1993	1998	2000	2005	2008	2011
Bulgaria	0.37	4.11	7.76	14.18	19.87	4.84
Czech Republic	1.67	5.79	8.48	8.92	2.92	2.48
Estonia	–	10.38	6.82	22.49	7.88	1.97
Hungary	5.97	6.97	5.97	7.71	48.62	6.88
Latvia	1.01	5.39	5.7	5.06	4.26	5.32
Lithuania	0.41	8.22	3.31	4.58	4.04	3.38
Poland	1.83	3.68	5.45	3.64	2.84	2.97
Romania	0.36	4.82	2.80	6.94	6.92	1.42
Slovakia	1.23	1.92	7.15	4.89	4.16	3.81
Slovenia	0.89	0.99	0.68	2.72	3.34	1.65

Source: World Bank (2013)

Table I.
FDI Inflows to EU-10 as a share of GDP

intensive and science-based sectors. Some Baltic countries such as Latvia and Lithuania also have high FDI inflows as a share of GDP. In terms of investment perception, EU-10 has still continued to become one of the most attractive destinations around the world. Some of them have remained among the most popular country such as Poland; in spite of the global crisis in 2011, Poland has received nearly 19 billion FDI inflows which accounted for 47.3 percent of total EU-10.

When we look at the determinants of FDI for these countries, we observe a wide range of conditions including host-country and home-country factors such as characteristics of local market, cheap and availability of skilled labor, stability and effectiveness of government, incentives and promotion of investments and rules regarding investments[2]. Among these factors, particularly the large market size and educated and/or low-wage labor force are prominent. As it is seen, the mentioned group of FDI determinants includes almost everything except environmental factors. Generally environmental concerns are considered as a part of legal and administrative system which shapes the functioning of markets, but environmental standards and/or conditions are not spelling in this system. However, even it is not spelling there is some justification for the relationship between weak or strict environmental regulations and FDI inflows which implies pollution haven hypothesis (PHH).

PHH depends on the relationship between FDI in pollution-intensive industries (dirty-industries) and environmental regulations/legislations/rules or standards in host countries. It is argued that polluting industries try to find locations (countries) with weak or not stringent environmental standards; therefore these countries become an actor of pollution haven. Since developed world encourages more migration of the dirty industries to the developing countries, developing countries are concerned about their environment. On the other hand, it is also well-known trade liberalization of these countries makes this migration easier.

This paper is an attempt to analyze the relationship between greenhouse gases (GHGs) emissions and integration of CEECs with EU. Within the liberalization and integration efforts, increasingly huge amount of FDI has flown to the region and the region has become almost the magnet of inward FDI over the past two decades. Therefore, the question is whether this increase in foreign investment of the member CEECs has been related to the polluting industries or not. We make use of EU membership to analyze the joint effect of environmental regulations and integration. The membership is expected to have negative impact to GHGs emission thanks to the

stringent environmental regulations. On the other hand, integration might have a positive impact on pollution if polluting FDI inflows increase after integration. Thus our analysis puts some lights on the net effect of EU membership.

Note that the set of developing countries in our sample includes some of the CEECs due to the lack of data; therefore our countries are Czech Republic, Estonia, Hungary, Poland and Slovakia with relatively higher FDI figures. In the literature few of the previous papers has taken FDI and environmental performance together into account. In that sense, our analysis represents a notable contribution to the pollution haven literature. For this purpose after this introduction, in the next section, we explain the relationship between FDI and pollution haven analysis then we describe the methodology and the data employed. In the fourth section, we present the empirical results and in the last section we make our conclusion and discuss the results.

2. Environmental impact of FDI

FDIs are still one of the most important sources of developing countries; they bring financial resources, technology, know-how, human capital and in-service training to host developing countries. On the other hand, FDI are looking for cheap labor, large market opportunities, strategic locations for other close markets and lax environmental rules and regulations in these countries. In terms of FDI and environment nexus, the last factor becomes controversial in the literature. While it is argued that the relationship between FDI and environment is an empirical issue, there is a theoretical presumption includes three components of what Grossman and Krueger were the first explicitly put forth as the notions of scale, technique and composition effects. Scale effect refers to the positive relationship between economic activity and pollution (such as GHGs). FDI may easily expand the scale of existing and/or new industries and this brings an increase of pollution. Composition effect explains the impact of changing industrial structure on emissions and finally technical effect points that lowering GHGs emissions comes from technological improvements.

The above issues are being discussed in connection with some empirical literature; on one side some studies (Xing and Kolstad, 2002; Wenhua, 2007; Dean *et al.*, 2003) provide an empirical evidences which show FDI in polluting industries are attracted by lax environmental regulations on the other hand some (Dasgupta *et al.*, 1997; Eskeland and Harrison, 2003) finds little evidence to support PHH. For example, in their analysis of foreign investment in Mexico, Venezuela, Morocco and Cote d'Ivoire, Eskeland and Harrison (1997, p. 27) wrote that they find no evidence that foreign investors are concentrated in dirty sectors. Sometimes objection to PHH comes from hierarchical ranking of main determinants of FDI; Gray (2002, p. 313) argues that environmental regulations are not included as a substantial factor by foreign investors. However, Xing and Kolstad (2002) found an opposite result and their empirical study supported the effect of the laxity of environmental regulation on FDI. They emphasized that "lax environmental policy tends to attract more capital inflow from the US for pollution intensive industries" (Xing and Kolstad, 2002, p. 15). Again in the study of Smarzynska and Wei (2001), they found "some" support for PHH using the countries' participation in international environmental treaties; they found that the share of FDI in polluting industries in total inward FDI is lower for host developing countries with more stringent environmental regulations. On the other hand, there are some studies based on both results; for example, in the study of Dean *et al.* (2003), "relatively weak environmental levies in India are found a significant attraction for joint ventures with partners from Hong Kong, Macao, Taiwan and other Southeast Asian developing countries, but in

contrast, joint ventures with partners from developed countries are attracted by stringent environmental levies" (Dean *et al.*, 2003, pp. 23-24). In a similar way, Jenkins (2003) examines the effect of liberalization on polluting activities in three Latin American countries; Argentina, Brazil and Mexico. He concluded that after at the beginning period of liberalization all three countries have increased their comparative advantage in "dirty" industries then only Mexico has started to specialize in relatively low-pollution industries due to the stricter enforcement of environmental regulations (Jenkins, 2003, p. 93).

3. Methodology and data

In order to analyze the impacts of polluting FDI on environment, this paper employs an unbalanced panel data set which consists of yearly observation for five CEECs (Czech Republic, Estonia, Hungary, Poland and Slovakia) during the period 1993-2010. The common feature of these countries is that, they became a member of EU in 2004. We excluded Latvia, Lithuania and Slovenia for data availability reasons. On the other hand, Bulgaria and Romania are eliminated as there are not enough observations after they became members in 2007. The data set includes GHGs emission, real GDP per capita, polluting FDI and other important determinants of pollution such as; human capital, institutional quality and macroeconomic stability.

For air pollution and polluting FDI, this paper utilizes the rich database of EUROSTAT. Air pollution variable is the total GHG emissions (1,000 tons of CO_2 equivalent). We define the polluting FDI variable as the share of manufacturing and construction FDI in total FDI inflows. Real GDP per capita (in PPP) and institutional quality series are collected from Penn World Tables and Polity IV Project, respectively (see Teorell *et al.*, 2011). We employ polity2 variable to measure the institutional quality. This variable ranges from 0 to 10 where 0 is least democratic and 10 most democratic countries. Finally, macroeconomic stability (current account balance of GDP) and human capital (primary school enrolment) data derived from world development indicators.

Following the literature, we estimate environmental Kuznets curve (EKC) with our variable of interest (polluting FDI) and several control variables[3] mentioned above. We begin by defining the following model:

$$\begin{aligned}\ln(P_{it}) =& \alpha_i + \beta_1(\ln rgpdch_{it}) + \beta_2(\ln rgpdch_{it})^2 + \beta_3(\ln rgpdch_{it})^3 \\ &+ \beta_4 PFDI_{it} + \beta_5 EU\_04_{it} + \beta_6 PFDI_{it} \times EU\_04_{it} \\ &+ \sum_{i=7}^{k} \beta_i Z_{it} + \varepsilon_{it}\end{aligned} \tag{1}$$

where P is the GHGs emission, *rgdpch* is the real GDP per capita (in PPP), *PFDI* is the polluting FDI, *EU*_04 is the dummy which takes 0 until 2004 and takes 1 afterwards and finally *Z* is the vector of control variables. Since a short panel data set is employed, we do not use any time series techniques such as panel unit root and cointegration tests. In above Equation (1), α_i is the country-fixed effect that captures the effects specific to each country do not change over time, such as culture and climate and ε_{it} is the idiosyncratic error term which is allowed to be heteroskedastic and autocorrelated. Subscripts i and t represent country and year, respectively.

It is worth noting several points. First, we do not include time fixed effects as the most relevant common shock is EU membership which is captured by our dummy in

the sample period. Moreover, the statistical tests cannot reject that the time dummies are jointly equal to 0 when our model includes EU dummy. Second, our identification assumption is that being a member of EU is an exogenous policy change. Hence, we can analyze whether the effects of polluting FDI changes after CEECs countries join the EU.

The share of polluting FDI in total FDI inflows will test for pollution haven effect. We expect to estimate $\beta_4 > 0$, meaning that the higher amount of polluting FDI, the higher pollution. However, in order to determine the overall impact of polluting FDI, we carry out the following derivation:

$$\frac{\partial P_{it}}{\partial PFDI_{it}} = \beta_4 + \beta_6 EU\_04_{it} \tag{2}$$

If we find an insignificant β_6, this means that being a member of EU did not have any impact on the positive relationship between polluting FDI and GHGs emission. If joining the EU did not have any favorable impact in terms of regulations and polluting FDI inflows increased owing to the integration, we will estimate a positive and significant β_6. In contrast, if we find a negative and significant β_6 and $\beta_6 > \beta_4$ in absolute terms, we will conclude that EU helped these countries decrease the negative impacts of polluting FDI possibly via environmental regulations.

Regarding the relationship between income and pollution, we employ a cubic form to test the existence of EKC. The cubic form represents N-shaped EKC, meaning per capita pollution first increases at low levels of income and then decreases with rising income, but after a certain level of income it increases again. Therefore, the expected signs are $\beta_1 > 0$, $\beta_2 < 0$ and $\beta_3 > 0$. Finally, we expect to obtain negative and significant relationship between our control variables (institutional quality, macroeconomic stability and human capital) and GHGs emission.

4. Empirical results

Table II reports the results of the benchmark model; air pollution equation without any control variable. Focussing on the income variables, we find that the coefficients of real GDP per capita, its square and cube have their expected signs. The coefficients indicate an N-shaped relationship, which is consistent with the previous literature[4]. This means that as per capita output grows, air pollution increases at low level of income then the relations become negative and pollution falls with rising output. Finally the relation becomes positive after a certain level of income again.

Our variable of interest, polluting FDI is positively and significantly associated with the GHGs emission as expected. A 1-percentage point increase in polluting FDI leads to 0.05 percent increase in GHGs emission. Although this result confirms the previous studies, the central issue of our paper is not this. We are interested in whether being a member of EU has a significant effect on this relationship. Therefore, we carry out the following analysis:

$$\frac{\partial P_{it}}{\partial PFDI_{it}} = 0.000512 - 0.000523 EU\_04_{it} \tag{3}$$

Notice that the positive relationship between polluting FDI and GHGs emission vanishes after CEECs become members of the EU. Being a member of EU makes the effect of polluting FDI on GHGs emission negative. If a country becomes

	(1)	(2)
ln *rgdpch*	2.938	2.337
	(0.515)***	(0.458)***
ln $rgdpch^2$	−1.281	−1.025
	(0.222)***	(0.196)***
ln $rgdpch^3$	0.0186	0.015
	(0.003)***	(0.002)***
Polluting FDI	0.00051	0.00035
	(0.00023)*	(0.00015)*
EU_04	0.02	0.0310
	(0.022)	(0.016)
Polluting FDI × *EU_04*	−0.00052	−0.00036
	(0.00025)*	(0.00015)*
CURB/GDP		−0.008
		(0.002)*
HC		−0.005
		(0.001)**
Institutional quality		−0.06
		(0.006)***
R^2	0.28	0.54
Observations	68	60

Notes: Robust standard errors are given in parentheses under parameter estimates. Dependent variable is logarithm of GHGs emissions (1,000 tons per capita). *,**,*** Significant at the 90, 95 and 99 percent confidence levels, respectively

Table II.
Polluting FDI and GHGs emission

member of EU, GHGs emission decreases almost 0.001 percent. This result tells us that thanks to the environmental regulations, CEECs improved their environmental quality after the membership. This is also encountered behavior for developing countries as we observed in Jenkins (2003) or Eskeland and Harrison (2003) who argued that MNCs use and comply with advanced pollution and other environmental standards.

In the second column, we add control variables in order to check whether the aforementioned relationship between EU membership and pollution is robust to inclusion of other important determinants of pollution. We find out that, CEECs decrease environmental pollution if they are economically more stable, they have better institutions, and they have more human capital. Despite the facts that all control variables are significant and they have expected signs, our main result still holds. Notice that, in both of the estimations, β_6 is negative and larger than β_4 in absolute terms.

Although all the countries in our sample became members of EU in 2004, the negotiations started earlier and CEECs joined the EU after closing all the chapters. Therefore, CEECs have started to change their environmental regulations before 2004. Despite the implementation of new regulations takes time, it might be the case that the impact of EU via environmental regulations materialized earlier. For this reason, we probe whether our main result survive when we assume that the effect of regulations started before 2004. In Table III, we create another dummy variable (*EU_01*), which takes 0 until 2001 and 1 afterwards and interact it with the polluting FDI variable[5].

	(1)	(2)
ln *rgdpch*	2.7	1.425
	(1.09)**	(0.67)*
ln $rgdpch^2$	−1.17	−0.629
	(0.47)**	(0.288)*
ln $rgdpch^3$	0.017	0.015
	(0.006)**	(0.009)**
Polluting FDI	0.00234	0.0026
	(0.0005)**	(0.0002)***
EU_01	0.082	0.075
	0.031**	(0.012)***
Polluting FDI × *EU_01*	−0.00235	−0.0026
	(0.0005)*	(0.0002)***
CURB/GDP		−0.009
		(0.001)***
HC		−0.08
		(0.001)***
Institutional quality		−0.028
		(0.15)
R^2	0.33	0.65
Observations	68	60

Note: See notes under Table II

Table III.
Polluting FDI and GHGs emission with new dummy variable

In column 1 of Table III, we run our benchmark regression. According to the results, a 1-percentage point increase in polluting FDI is associated with an estimated increase of the GHGs emission by 0.23 percent. Performing the previous calculation, we get:

$$\frac{\partial P_{it}}{\partial PFDI_{it}} = 0.00234 - 0.00235 EU\_01_{it} \tag{4}$$

As in the previous case, joining EU makes environmental quality increase. After becoming members of EU, GHGs emission decreases 0.001 percent.

In the second column, we add control variables. All the variables have the same signs and significance levels expect the institutional quality variable. Though it has negative effect on pollution, it is marginally insignificant. Regarding our variables of interest, the interaction term is negative and larger than the coefficient of polluting FDI variable. Therefore, we obtain the same negative relationship between EU membership and GHGs emission.

5. Conclusion

There is a serious debate on the behavior of private FDI in developing countries; it is argued that facilitating environmental regulations is an attractive and important factor when private investors deciding on the locations of their investments. So the FDI-environment nexus is a decisive component. This paper investigates the evidence for the PHH for CEECs and assesses the extent to which FDIs, through polluting intensive industries and integration with EU, has brought about environmental pollution.

Our findings are verifying the previous results related with EKC and PHH. First of all, during the period covering 1993-2010, as per capita output grows, air pollution increases at low level of income, then the relations become negative and pollution falls

with rising output. Finally the relation becomes positive after a certain level of income again. This result obviously verifies the observation of EKC in EU-10 members. Meanwhile, due to the lack of suitable data, the study examines only five of ten EU new members (Czech Republic, Estonia, Hungary, Poland and Slovakia).

The econometric results presented in this study show that at a first glance, polluting FDI is positively and significantly associated with the GHGs emissions in these countries, confirming the PHH. Regarding the integration of CEECs with EU, we find out that the new members have benefited from the integration via stricter environmental regulations. Joining the EU alleviates the negative impacts of polluting FDI on GHGs emissions. Furthermore, having controlled for human capital, macroeconomic stability and institutional quality, polluting FDI still exhibits positive, statistically significant relationship with pollution. Our main result, the favorable impacts of integration with EU also survives inclusion of the control variables.

Notes

1. Hungary is the most attractive country with Czech Republic and Poland. We call them as Vizegrad countries.
2. For detailed determinants of FDI, see UNCTAD (1998) World Investment Report, trends and determinants, Geneva, UN.
3. We also estimate the model with other control variables (trade openness, agriculture value added as a share of GDP, financial market development) but we do not report these results since they are statistically insignificant.
4. See Grossman and Krueger (1995) among others. For the opposite result, see Cole (2004) and Atici (2012).
5. The same story is also meaningful for FDI inflows. If FDI increased in advance because it was expected that CEECs would join EU, we have to use lag level of FDI inflows as well. However, data shows that it is exactly the opposite; FDI inflows increased after 2004.

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