MEDZINÁRODNÉ VZŤAHY / JOURNAL OF INTERNATIONAL RELATIONS

Faculty of International Relations, University of Economics in Bratislava
2014, Volume XII., Issue 2, Pages 111-124.
ISSN 1336-1562 (print), ISSN 1339-2751 (online)
Submitted: 23. 10. 2013 | Accepted: 26. 3. 2014 | Published 15. 6. 2014

HYPOTÉZA EKOLOGICKÉHO NEOKOLONIALIZMU A PRIAME ZAHRANIČNÉ INVESTÍCIE: DÔKAZY Z VYBRANÝCH ÁZIJSKÝCH ŠTÁTOV

POLLUTION HAVEN HYPOTHESIS AND FOREIGN DIRECT INVESTMENT: EVIDENCE FROM SELECTED ASIAN COUNTRIES

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V uplynulom desaťročí sme mohli sledovať trend zrýchľujúcej degradácie životného prostredia, prejavujúci sa emisiami skleníkových plynov, odlesnením a stratou biodiverzity. Tieto vzorce ničenia životného prostredia vyvolala zvýšená ekonomická aktivita, ktorej významným determinantom boli priame zahraničné investície (PZI). Vlády odstránili mnohé prekážky medzinárodného obchodu a zjednodušili ekologické normy v rozvojových štátoch, čo využili nadnárodné spoločnosti. Našou otázkou v predkladanom článku je, či tento proces predstavuje pre prijímateľov PZI hrozbu. Panelovou analýzou dát overujeme hypotézu ekologického neokolonializmu na údajoch za 5 ázijských štátov od roku 1990 do roku 2011. Výsledky podporujú záver, že investori pri voľbe lokality uprednostňujú laxné environmentálne normy a poukazujú na platnosť hypotézy o environmentálnej Kuznetsovej krivke. [4]

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[4] The special thank goes to Martin Grančay, managing editor of this journal. The suggestions that he gave truly helped increase the quality of this paper. Also, we thank two anonymous referees for providing helpful comments.

Kľúčové slová: priame zahraničné investície, ekologický neokolonializmus, degradácia životného prostredia, environmentálna Kuznetsova krivka, panelová analýza dát.

The past decade has seen a trend of accelerating environmental degradation such as increasing greenhouse gas emissions, deforestation and loss of biodiversity. Such patterns of environmental destruction have been driven by increased economic activity, of which Foreign Direct Investment (FDI) has become an increasingly significant contributor. Governments have removed many restrictions on trade and eased environmental rules in developing countries, leading multinationals to flock in and take advantage of these liberalized trade rules. The question is posed as to whether this process is more of a threat for countries which accept FDI or not. The present paper tests the pollution haven hypothesis by employing a panel data on FDI inflows in five Asian countries for the period from 1990 to 2011. Results show support for the idea that investors favor lax environmental regulation when making FDI location decisions and also suggest the validity of Environmental Kuznets Curve (EKC) hypothesis.
Key words: foreign direct investment, pollution haven hypothesis, environmental degradation, Environmental Kuznets Curve, panel data analysis.
JEL: C23, F18, F21, Q53

1 INTRODUCTION

With increasing globalization, higher levels of openness and inflows of foreign direct investment (FDI) into developing countries, researchers have become concerned as to whether these phenomena improve or degrade the environment. Among these factors FDI appears to be increasing unabated. It seems to bridge the internal resource and savings gap, increases managerial abilities, reduces foreign currency shortage and improves balance of payment in less developed countries (Aliyu 2005).

Two perspectives exist about how trade channels might alter environmental outcomes. One channel is considered harmful to the environment: when foreign investor sets up production facilities in the host country or outsources to local factories, the total industrial output increases and leads to more pollution. Another channel is considered beneficial to the environment, assuming that the imported technology is clean. In this way, domestic producers could learn from foreign investors that often use more advanced and cleaner technology, or the dirtier domestic plants might be crowded out of the market when foreign investors expand and increase their domestic market share. In such cases, foreign investment will improve the environmental quality (Liang 2008). However, the response is commonly masked by a dirty secret, i. e. the pollution haven hypothesis or race to the bottom. It refers to the fact that direct and strict environmental regulation may increase production costs, and in an attempt to promote investment and attract foreign capital, trade liberalization may lead to lax environmental policies (Aliyu 2005). Particularly, developing countries are concerned

with gaining comparative advantages in international trade. Hence, they tend to weaken environmental regulations compared to their competitors, and they create a haven for manufacture of pollution-intensive goods.

There has been a long-standing interest in searching for evidence of pollution haven behavior among countries, but these studies have come to different conclusions. CUTS (2003) noted that countries like Papua New Guinea, the Philippines or Indonesia had lowered their environmental standards to attract FDI inflow in mining sectors. Eskeland and Harrison (2003) examined the pattern of foreign investment in four developing countries and found little evidence to support the pollution haven hypothesis. Keller and Levinson's study focusing on location of investment in the United States found evidence of the deterrent effects of abatement costs on foreign investments. More recently, Dean et al. (2009) tested for pollution haven behavior by estimating the determinants of location choice for equity joint ventures in China. Their results show that highly-polluting industries funded through Hong Kong, Macao, and Taiwan are attracted by weak environmental standards.

As a consequence, these conflicting results have not only created confusion among scholars about the response to the question "Is the pollution haven hypothesis a myth or does it hold in reality?" but they have also made it difficult for policy makers to look at this emerging literature for policy guidance.

This paper contributes to the large and growing literature that aims to explore the effect of FDI on environmental degradation. This phenomenon is new among Asian countries. Also, the paper seeks to further our understanding of how FDI can harm environment in a secretive way. In this way, this paper tries to estimate the interaction between FDI absorption process and environmental degradation. We use econometric techniques to clearly picture this relationship among selected Asian countries.

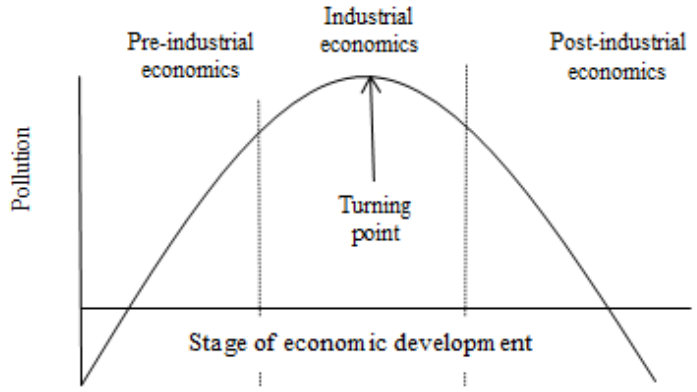
The setup of this paper is as follows: Second section as usual offers literature review. Section 3 is used to provide a look at pollution haven hypothesis. In section 4, model, variables and data are introduced. Section 5 describes econometric analyses and results. In section 6 we offer conclusions.

2 LITERATURE REVIEW

Grossman and Krueger's pioneering work (1993) on trade, growth and pollution laid foundation for a large body of research in this field. This work constituted the starting point of what is called the Environmental Kuznets Curve (EKC) literature. They proposed a model which suggests that a country's pollution rises with development and industrialization up to a turning point, after which it falls again as the country uses its increased affluence to reduce pollution concentrations. In this sense, the EKC is potentially a reflection of the pollution haven hypothesis, because one of the factors that may drive the increase in environmental degradation seen in pre-industrial economies is an influx of waste from post-industrial economies. This same transfer of polluting firms through trade and foreign investment could lead to the

decrease in environmental degradation seen in the downward-sloping section of the EKC, which models post-industrial economies (figure 1).

Figure 1: The Environmental Kuznets Curve



Source: Own elaboration

After that up to now, investigation of the relationship between FDI and pollution generation has become the focus of much interest, with a boom in the literature occurring in the last 15 years. Copeland and Taylor (1994) argued that free trade increases world pollution, because increased world income and its skewed distribution means that for a given set of endowments and degree of trade frictions, a country can import clean goods if its income is sufficiently high. Levinson (1996) surveyed the empirical literature on the sensitivity of investment to environmental regulations, both internationally and domestically within the U.S. He reported that differences in pollution across states do not affect plant location decisions and concluded more than twenty years of empirical research has been unable to show convincingly that stringent environmental standards deter investment or that weak regulations attract investment. Conversely, Xing and Kolstad (1998) reported strong evidence on the impact of lax environmental regulation in attracting foreign investment. However, while environmental pollution and movements of capital and dirty goods could be observed, the sources of environmental problems may be difficult to determine.

Smarzynska and Wei (2001) took into account corruption levels and used a firm-level data set on investment projects in 24 transition economies. They found some support for the pollution haven hypothesis, but the overall evidence was relatively weak and did not survive numerous robustness checks. In that year, Antweiler et al. (2001) brought a substantial improvement to the work of Grossman and Krueger (1993). They developed a theoretical model to decompose the impact of trade on pollution into scale, technique and composition effects, and used a consistent dataset on sulfur dioxide concentrations to estimate jointly the three effects using a single

equation reduced form model. They found that, when combining the estimates of the three effects, trade liberalization appeared to be beneficial to the environment.

Dean (2002) also estimated the impact of trade and growth on water pollution in Chinese provinces. She used a Heckscher-Ohlin model with endogenous factor supply, which leads to a two-equation-system that captures the impact of trade liberalization on environment through its direct effect on the composition of output, and its indirect effects via income growth. The model thus disentangles the two effects, but its estimates using Chinese provincial data on water pollution show that these effects work in opposite directions and did not provide a clear overall picture of the impact on emissions in China.

Raspiller and Riedinger (2008) observed that in France the most pollution-intensive goods are imported relatively more often from the most environmentally strict countries and the pollution intensity of the imported goods remains positively correlated to the stringency of the environmental laws of the country where they are produced.

Ben Kheder (2010) used a data set on French FDI flows in a mix of developing, transitional, emerging and developed countries from 1999 to 2003. To build a system of three simultaneous equations for modeling the determination of FDI, she took into account the endogeneity of environmental policy and the impact of FDI and regulation on pollution. Results confirm a negative impact of environmental regulation on FDI location. Moreover, French manufacturing FDI seems to increase the overall emissions in host countries, although they reduce their pollution intensity.

Shofwan and Fong (2011) investigate the validity of the pollution haven hypothesis in the context of FDI in Indonesia by determining the correlations between carbon emission and FDI, gross domestic product, and population size between 1975 and 2009. Statistical results show that CO_2 emissions have a statistically significant negative relationship with GDP, and a statistically significant positive relationship with population size. However, there is a weak and insignificant relationship between CO_2 emissions and real FDI which indicates weak support for the pollution haven hypothesis.

In a recent study, Gao and Zhang (2013) investigated the impact of foreign investment on the technology diffusion effect or environmental efficiency. They state that foreign capital can promote environmental efficiency by improving the local innovation capacity through technology diffusion. This article analyzes the relationship between foreign investment, innovation capacity and environmental efficiency using structural equation models. The results show that, on one hand, foreign investment can directly promote local environmental efficiency; on the other hand, it is also effective in enhancing local innovation capacity, which is conducive to the improvement in local environmental efficiency.

All in all, the results from these studies were quite ambiguous and did not converge on a global conclusion concerning this issue. Building on this literature, in

the present paper we attempt to determine the validity of the pollution haven hypothesis among five Asian countries for the period from 1990 to 2011.

3 POLLUTION HAVEN HYPOTHESIS

In recent years, strong preference has emerged among developed countries to send out their industries and investment to developing and less developed countries. In 1995, developing countries received US$90 billion (38%) of worldwide FDI (World Bank 1996), with the majority going to Asia. FDI has been seen as a panacea for economic development, bringing in necessary technology, expertise and financial resources to developing countries. These countries often do not initially have the capacity to take advantage of liberalized trade and open markets and are unable to produce items for export. FDI can offer opportunities to foster this capacity (Gray 2002). On the other hand, increasing FDI may damage ecosystems due to pollution. More foreign investment may come to countries characterized by relatively weaker environmental standards, or with lesser willingness and capacity to enforce them. This is termed as the pollution haven theory or race to the bottom. That is, due to the role of FDI in developing a country, host countries attempt to weaken their environmental regulations in order to attract investment thereby engaging in a race to the bottom by setting ever weaker environmental standards in order to gain strategic trade advantage. Aliyu (2005) argued that strict environmental regulation is detrimental to the competitiveness of an industry, and that it induces phenomena such as ecological dumping, ecological capital flight, and regulatory chill in environmental standards. It is therefore not surprising that developing countries abate their rules with the aim of achieving international advantage.

There are many plausible reasons why there may be higher pollution intensity and looser environmental regulation in developing countries. Birdsall and Wheeler (1993) state three reasons. First, environmental amenities may be considered as normal goods. At higher income levels there is higher demand for a safer environment. Wealthier people tend to demand better environmental quality, support stricter laws and enforcement, and purchase costly green goods. Poor people who depend more on the environment than the wealthy lack the means to express this demand. Second, the relative financial strength of developing countries means that the costs of monitoring environmental standards are higher in developing countries. There is scarcity of trained manpower and equipment. Third, economic growth in developing countries is associated with a shift from subsistence agriculture to manufacturing. This and the resulting urbanization and increase in the investment in infrastructure would lead to a deteriorating environment.

Two opposite perspectives exist here about whether FDI brings in benefit or not. The first view states that FDI has potential benefits to both host and donor countries. The host may receive, for example, financial resources, new technology and management skills, employment and a skill-upgraded work force. The donor country

on the other hand receives benefits over and above those associated with factor costs, and looks for a combination of cheap labor (with qualifications), reliable infrastructure, technological capabilities, local demand within an efficient market system and the stability of a range of political, institutional and legal environments (Van den Bulcke and Zhang, 1998). The second alternative works in the opposite direction and suggests that if multinationals locate preferentially in some countries because of their lax environmental regulation, FDI should be positively correlated with pollution in the host countries.

4 MODEL, VARIABLES AND DATA

Aiming at obtaining a better understanding of the pollution-FDI nexus and considering the above mentioned literature, the basic idea of this paper is to study the relationship between CO_2 emission and FDI. The standard approach consists of analyzing the impact of trade liberalization on environment by decomposing its environmental impact into scale, technique and composition effects. The scale effect refers to the increase in the size of an economy resulting from liberalization and how that increased scale is likely to increase pollution. We expect this effect to carry a positive coefficient. The technique effect refers to the positive environmental consequences of changes in production methods that accompany trade liberalization and income growth. Indeed, liberalization induces higher income that causes people to increase their demand for a cleaner environment and stricter environmental regulations, encourages firms to adopt cleaner production processes and to reduce emissions. Finally, the composition effect reflects pollution performance of an economy's industrial composition. Given the same production scale, FDI might drive the industrial composition to contain a higher percentage of more polluting sectors. Therefore, we anticipate a positive coefficient for the composition effect. The impact of FDI on emissions is then captured through its influences on the scale, composition and technique characteristics of an economy. Since these three effects should play in opposite directions, empirical studies often attempted to assess the overall effects of trade liberalization on pollution. In line with the earlier discussion, analysis of the pollution haven hypothesis, with the goal of understanding the influence of FDI on pollution, is undertaken with the following proposed functional relationship:

$$CO_{2i,t} = \alpha_0 + \alpha_1 GDP_{i,t} + \alpha_2 ENG_{i,t} + \alpha_3 VLAD_{i,t} + \alpha_4 FDI_{i,t} + \alpha_5 GDP^2_{i,t+} \alpha_6 EX_{i,t+} \alpha_7 IM_{i,t} + \varepsilon_{i,t}$$

where CO_2 is carbon dioxide per capita, and the symbols of explanatory variables are: GDP for per capita gross domestic product, ENG for energy consumption per capita, VLAD for the share of manufacturing sector value added in GDP, FDI for foreign direct investment, EX for the log of export as a share of GDP, IM for the log of import as a share of GDP, *i*, *t* and ε represent country, time and error term respectively.

To estimate the effect of FDI on environmental quality, we observe its impact on CO_2 emissions. We have chosen CO_2 for many reasons. First, CO_2 is produced at important levels by manufacturing industries. Second, CO_2 is currently the most popular pollutant since it is the main greenhouse gas that is behind the principal concern of environmentalists and politicians, namely global warming. Finally, detailed data is available on CO_2 emissions by activity for a large panel of developed, emerging, transition and developing countries from 1960 to today (Ben Kheder 2010). With all these characteristics, CO_2 as a proxy for environmental pollution is well suited to our study.

Per capita GDP is the most likely variable to capture the effect of local economic activity on pollution. We use GDP to measure the scale effect, because GDP represents the total economic activity inside a country. The technique effect is captured through various indices representing environmental regulation. Different variables have been used in previous studies as proxies for assessing the level of regulation. Some of them include consumption of energy and "dirty" fuel, degree of ratification of international environmental protection treaties, index of water and air quality, emission standards and level of corruption in a country. Here, as in the study of Stern (2010), we use energy consumption as a proxy which is a much more precise and direct measure of technique effect than other proxies often used. The composition effect has often been captured through capital/labor (K/L) ratios in previous studies (e.g. Antweiler et al. 2001). However, high K/L ratio in an economy could be consistent with an increased share of high-tech services that are not energy intensive (e.g. telecommunications). Therefore, we use here a more accurate measure expressing the share of the manufacturing sector in terms of outputs, i.e. the share of manufacturing sector value added in GDP. We suppose that an economy where the manufacturing sector prevails should have a higher level of CO_2 emissions, thus we expect a positive coefficient for this variable. Also, in order to get a complete picture of the Environmental Kuznets Curve, GDP squared has been entered in the model. In addition, to advance our understanding of the impact of trade liberalization, import and export data have been used.

We use World Bank data for 22 years, from 1990 to 2011. The sample of this study comprises five developing countries with middle, namely China, Iran, Malaysia, Thailand and Turkey. Our choice of countries is dependent on data availability, the amount of FDI received and the fact that these countries have become suitable destinations for foreign investors in recent years.

5 ECONOMETRIC ANALYSIS AND RESULTS

Our analysis starts by testing the stability of the available data using panel unit root test. The Levin, Lin and Chu (LLC), Im, Pesaran and Sin (IPS), ADF- Fisher and PP-Fisher tests are used which provide the best results in efficient testing power. The reported probability of all statistics and a 5% significance level are used for making a

decision on whether to reject null hypothesis or not. The results indicate that probabilities are greater than the significance level which leads to the failure to reject null hypothesis of existence of a unit root in the series, and hence the data are stationary after the first difference for all unit root tests. These results confirm that the model meets requirements to proceed with the panel cointegration test.

Table 1: Results for LLC, IPS, ADF and PP tests

Variables	***LLC***	***IPS***	***ADF***	***PP***
CO_2	-6.3284	-6.2563	53.2694	55.1165
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GDP	-2.5194	-2.3736	32.5217	32.2870
	(0.0059)	(0.0088)	(0.0003)	(0.0004)
ENG	-6.2104	-5.9310	51.1354	68.0438
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
VLAD	-6.1599	-5.7718	49.5753	68.5568
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
FDI	-2.8350	-3.3103	40.4694	71.7715
	(0.0001)	(0.0000)	(0.0000)	(0.0000)
GDP^2	-5.1211	-7.6406	72.7236	392.958
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
EX	-8.0083	-6.6089	56.2118	60.8939
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
IM	-6.9994	-6.1819	52.2018	60.9549
	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Note: P values are in parentheses.
Source: Own calculations.

The Pedroni cointegration test is used in order to test whether the dependent variable and all the independent variables exhibit fundamental long-run relationships with each other. The results of the Pedroni test show that the values of statistics are under the 5% critical value. Therefore, we reject the null hypothesis of there being no cointegration vector found in the long run. This indicates that at least one cointegration vector exists that offers a stable relationship among variables (Tables 1 and 2).

Table 2: Results for Pedroni test

Statistics	***Within dimension***	
	Statistic	***Prob.***
Panel v-Statistics	2.79	0.002
Panel rho-Statistics	1.84	0.967
Panel pp-Statistics	-5.71	0.000
Panel ADF-Statistics	-7.34	0.000
Statistics	***Between dimension***	
	Statistic	***Prob.***
Group rho-Statistics	4.24	1.000
Group pp-Statistics	-3.43	0.0003
Group ADF-Statistics	-4.18	0.0042

Source: Own calculations.

Next, we perform a test in order to choose between fixed effects and random effects. In order to validate the results, the Hausman specification test is performed which has an asymptotic chi-square distribution. The resulting probability (0.524) is higher than the critical value of 5% which supports our intention to use the random effect model.

In most regressions, the data suffer from heteroscedasticity. Using the Likelihood ratio test, the hypothesis of existence of homoscedasticity in variances is rejected and thus the model has heteroscedasticity. Therefore we decided to apply a remedy for this disturbance in form of using GLS method in order to obtain efficient and robust results. Table 3 shows the results of the coefficients for each variable.

Table 3: Results for estimation by GLS method

Variables	***Coef.***	***Z***	***P>|z|***
GDP	0.0005	7.70	0.000
ENG	0.0000	1.47	0.142
VLAD	0.1160	3.92	0.000
FDI	0.0000	1.93	0.000
GDP^2	-0.0000	-5.98	0.000
EX	0.0678	4.05	0.000
IM	-0.0892	-5.00	0.000
Prob= 0.000		Wald Chi2= 467.74	

Source: Own calculations.

From the probability and Wald statistic tests, we can see that the model fits well. The results in Table 3 show that the positive coefficient of per capita GDP indicates that carbon dioxide emission increases with per capita GDP. This result suggests that in the selected countries the increase of income is accompanied by an increase of pollution. The scale of income's effect on pollution is small. In addition, higher income signifies economic vibrancy and larger market size, which is a point of attraction for foreign investors, in turn leading to more pollution. Somewhat surprisingly, contrary to what the theory expects, energy consumption does not exhibit a significant coefficient. The share of manufacturing sector value added in GDP displays a positive relationship with CO_2. This result seems to assert the statement: an economy with a larger share of manufacturing on total GPD is consistent with an overall higher level of pollution. The greater the share of the most-polluting industries in the economy, the less strict the environmental regulation appear to be.

The empirical results show that FDI is a significant determinant of the amount of pollution. The statistically significant positive value of coefficient α_4 shows the association between FDI and pollution. Hence, sustained growth of FDI is one of the causes of environmental degradation in the selected developing countries. With the influx of FDI, the environmental quality becomes worse. It is therefore important that effective actions should be taken. Governments should enhance their FDI policies and environmental protection laws. Also, they should guide the orientation of FDI properly to optimize the industrial structure, using FDI to develop capital intensive and high-tech industries. Improved environmental supervision and management of foreign enterprises should reduce pollution transfer. As can be seen, empirical findings related to scale and composition effects are consistent with theory: the scale and composition effects raise pollution emissions, while the technique effect was insignificant.

In case of pollutant CO_2 the anticipated EKCs is found to exist. The coefficient of GDP is +0.0005 and GDP^2 is -0.0000 which follows the EKC theory. This theory shows an inverted-U relationship with income: environmental degradation gets worse in the early stages of growth, but eventually reaches a peak and starts declining as income exceeds a certain level. However, while the main conclusion of most studies supply evidence on EKC, policy makers should avoid simplistic recommendations. More specifically, the possibility that environmental degradation may eventually fall as income grows, does not necessarily mean that growth will automatically solve the problems it causes in the early stages of development. Much work remains to be done to get a deeper understanding of the environment-income relationship. In the future, it would therefore be interesting to perform some more studies on this subject.

The export and import data were included in the study to explain the effect of trade on pollution. Import decreases emissions of pollutant, while export increases the emissions of industrial CO_2. This may be due to the fact that by exporting, countries have to produce goods which lead to more pollution, but the opposite occurs when they import.

6 CONCLUSION

The last decade has witnessed a proliferation of investment flows, of which FDI is the main contributor. FDI is an increasing stimulant of economic growth and is therefore of growing importance to global environmental protection. In contrast, another perspective emphasizes that FDI can fuel economic development at a scale and pace that overwhelms the host country regulatory capacity, resulting in inefficient and irreversible environmental destruction and even potentially a decline in overall welfare. Much of this debate has focused on the pollution haven hypothesis, and the search for evidence that industries from industrialized countries will move to countries with lower environmental standards. This study asks whether those developing countries receiving more FDI have higher air pollution. By using a panel data covering five countries (China, Iran, Malaysia, Thailand and Turkey), which have been among the largest receivers of foreign direct investment in recent years in Asia and employing econometric techniques this paper has tried to answer this question.

Regarding the environmental impact of FDI, we observe a positive relationship between FDI inflows and pollution in the selected countries. This damaging impact is due to the lack of adequate environmental governance in host countries and a result of competitive pressures to attract or retain FDI. In our opinion, governments should stop using environmental or social deregulation and financial incentives in order to prevent destructive competition for FDI. We suggest protecting the rights of local communities and industries – this will undoubtedly increase national welfare.

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