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Searching for Pollution Havens

The Impact of Environmental Regulations on Foreign Direct Investment

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This study takes a fresh look at the regulatory determinants of foreign direct investment (FDI) by asking whether the stringency and sustainability of environmental regulations affect FDI flows across 25 Western and Eastern European countries. Unlike the earlier literature, which considered only host country characteristics, this article focuses on the difference in the regulatory environments in home and host economies. The data suggest that more stringent environmental regulations in the investor's country relative to those in the potential host country are positively correlated with the probability of investment as well as with the volume of FDI. The results also show that firms in industries with higher abatement costs tend to invest more abroad.

Keywords: *foreign direct investment; pollution havens*

Introduction

Foreign direct investment (FDI) flows into developing countries have been rising sharply over the past decades (UNCTAD, 2005). At the same time, the connection between FDI and environmental policies, in particular in developing countries, has been the subject of considerable debate. Many believe that multinational firms engaged in highly polluting activities move to developing countries with weaker environmental standards, where the cost of complying with environmental regulations is very low, thus giving rise to the so-called "pollution havens." For instance, the Sierra Club affirms "in our global economy, corporations move operations freely around the world, escaping tough pollution control laws, labor standards, and even the taxes that pay for social and environmental needs."¹

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However, recent analyses by Smarzynska and Wei (2005), Eskeland and Harrison (2003), and Dean, Lovely, and Wang (2002) find little evidence for the “pollution haven hypothesis.” Empirical results on U.S. regional data lead to mixed conclusions: Levinson (1996) finds no evidence that the difference in environmental standards across states has systematically affected the location choices of manufacturing plants, whereas Becker and Henderson (2000) show that the annual designation of air quality attainment status, which triggers specific equipment requirements at the county level in the United States, reduces the number of firm establishments in polluting industries in nonattainment areas. Keller and Levinson (2002) find that differences in abatement costs between U.S. states have a moderate deterrent effect on FDI. Some recent papers have focused on explaining the factors behind the lack of evidence for a significant effect of environmental regulations on trade or FDI. For example, Ederington and Minier (2003) and Levinson and Taylor (2004) argue that one of the reasons previous studies had trouble finding evidence for the pollution haven hypothesis is that they treat the level of environmental regulations as an exogenous variable. They use instrumental variables to correct for the endogeneity of environmental regulation and find statistically significant, albeit small, negative effects of environmental regulations on economic activities. Ederington, Levinson, and Minier (2005) focus on the effect of environmental regulations on trade flows and test for three potential candidates that might have masked the existence of pollution havens: (1) the fact that the majority of trade occurs between developed countries, with comparable levels of environmental stringency; (2) industries’ degree of mobility; and (3) the share of cost of complying with environmental regulations in total costs. They find a significant, albeit small, effect of environmental regulations on trade after accounting for the three factors. Therefore, there is still considerable controversy over the empirical significance of the existence of the “pollution havens.”

This paper adds to the existing empirical work on the pollution haven hypothesis, by focusing, unlike earlier studies, which considered only host country characteristics, on both the “push” and the “pull” factors. Recognizing that the cost to comply with environmental regulations constitute a “push” factor encouraging firms to transfer production out of their own country, as well as a “pull” factor enticing firms to enter economies with less stringent rules, this paper focuses on the difference in environmental regulations between the source and the host country. In addition, the paper employs measures of the stringency and the sustainability of environmental standards and controls for other FDI determinants, such as protection of property rights, level of taxation, labor standards, and quality of governance. It analyzes both the decision to undertake FDI and the volume of foreign investment. Unlike many of the studies cited above, the detailed analysis is based on unique firm-level data and includes not only industrialized countries but also transition economies. One of the advantages of employing firm-level data is that we are able to explicitly control for the investing firm’s characteristics that are likely to affect the investment decision,

such as firm size, previous FDI experience, etc. We are also able to consider a specification that takes into account unobserved investor characteristics.

Our analysis is based on data on new subsidiaries established by the largest 10,000 companies operating in Europe during 1998 to 2001. The information comes from a commercial database, Amadeus, compiled by Bureau van Dijk, and covers new investments taking place in 25 Western and Eastern European countries. The Amadeus data contain comprehensive information on companies operating in European countries. In addition to the standard financial statements, Amadeus includes detailed information about the ownership structure of firms, which allows us to identify ownership stakes held by each company in entities located in other countries. We are thus able to construct a unique data set containing detailed information about firms operating in Europe and all of their domestic and foreign subsidiaries.

The results suggest that more stringent environmental regulations in the investor's country relative to those in the potential host country are positively correlated both with the probability of investing abroad and with the volume of FDI, even after accounting for a variety of other determinants of foreign investment. There is also evidence that firms in industries with higher abatement costs invest more abroad.

The article is structured as follows. The next section discusses the empirical model, the data and the variable definitions. Then empirical results are presented. The last section offers some conclusions.

Empirical Strategy

Model and Estimation Issues

The basic question we seek to address is whether the stringency of environmental regulations affects the flow of foreign direct investment across countries. In doing so, we also consider a number of other potential determinants of the location choice, as suggested by the existing literature. We employ two empirical strategies to address this question. First, we focus on the *probability* to undertake FDI ignoring the size of investment. We estimate a fixed effect logit model:

$$FDI_{ic} = 1 \text{ if } FDI_{ic}^* > 0 \quad (1)$$

$$FDI_{ic} = 0 \text{ otherwise}$$

where $FDI_{ic} = \alpha_i + \delta_1 X_c + \delta_2 R_{ic} + \delta_3 R_{ic}^* Pol_{ic} + \varepsilon_{ic}$

where the dependent variable takes on the value of one if firm i has invested in country c , and zero otherwise. For each firm the number of observations is equal to the number of possible destination countries in the sample. To control for unobserved

firm characteristics, firm-specific dummy variables (α_i) are employed. On the right-hand side we include the difference in the regulatory environment between the source and host country (R_{ic}), as well as other controls for host country characteristics (X_c). The coefficient on the environmental standard δ_2 captures the effect of the difference between the strength of environmental protection in the source relative to the host country on the decision to undertake FDI. A positive (or negative) δ_2 implies that higher environmental stringency in the source country relative to the host country encourages (or discourages) FDI.

We also include in the regression an interaction term between the difference in the stringency of environmental regulations R_{ic} and the pollution intensity of the parent firm Pol_{ic} , in order to test for the pollution havens hypothesis. The interaction term tests whether a larger difference in environmental protection between source and destination countries encourages the investment of firms belonging to more polluting industries by a greater amount. A positive δ_3 implies that more pollution-intensive FDI would go to countries with relatively weaker environmental standards.

Next, we focus on the *size* of investment and estimate the following equation:

$$\ln(FDI\ volume_{ic} + 1) = \beta + \beta_1 X_i + \beta_2 X_c + \beta_3 R_{ic} + \beta_4 R_{ic} * Pol_{ic} + \beta_5 Pol_{ic} + \xi_{ic} \quad (2)$$

where the volume of investment undertaken by firm i in country c is regressed on characteristics of the firm i and its home country (X_i), variables specific to potential FDI destinations (X_c) and the difference between the source and the host economy in terms of environmental standards (R_{ic}). Again, we include in the regression an interaction term between the difference in the stringency of environmental regulations R_{ic} and the pollution intensity of the parent firm Pol_{ic} , captured by the coefficient β_4 as well as the pollution intensity itself Pol_{ic} .

The number of observations for each firm is equal to the number of potential investment destinations, with the *FDI volume* equal to zero for countries in which firm i does not have any investments. Since taking the logarithm would lead to losing all observations for which *FDI volume* takes on the value of zero, we add one before taking the log.

Given that most firms have subsidiaries only in some of the 25 possible destination countries considered and some firms have no subsidiaries at all, we use the Tobit model, as using the OLS would lead to inconsistent estimates.

The choice of the models is determined by data availability. As explained below, the dataset contains a comprehensive listing of the existing subsidiaries of firms included in the sample, but the information on the volume of investment is available only for a subset of them. The logit model allows us to maximize the sample coverage, while the Tobit regression enables us to examine the determinants of investment volume and thus the two approaches are complementary.²

Data Description

Our analysis is based on the data on new subsidiaries established by the largest firms operating in Europe during 1998 to 2001. The information comes from the Amadeus database.

We focus our attention on the largest 10,000 firms operating in Europe³ (with the size measured by the value of total assets in 1999) and their subsidiaries located in 16 Western European and 9 Central and Eastern European countries.⁴ The choice of host countries considered is driven by two considerations: first, by the fact that the information on the size of investment is available only for subsidiaries located in European countries, and second, by our decision to restrict the analysis to subsidiaries established between 1998 and 2001. We construct the data set on new subsidiaries by comparing the subsidiary listings for companies included in both the 1998 and 2001 releases of the Amadeus database. The ownership information pertains mostly to year 2000. If a firm has more than one subsidiary in a given country, we aggregate total investment in *all* subsidiaries in each country. In the sample we also include noninvestors, that is, firms without subsidiaries in foreign countries.

After deleting firms with missing information and removing outliers, the data set contains 7,150 parent firms with 7,077 subsidiaries in 22 to 25 destination countries (depending on the specification), including the home country, of which 3,701 are foreign subsidiaries. The number of potential observations in our sample is thus equal to $7,150 \times 22 = 157,300$ (or $7,150 \times 25 = 178,750$) investment decisions at the firm level.

Variable Definitions

The dependent variable in Equation (1) is equal to one if the database indicates the existence of firm i 's subsidiary in country c . In Equation (2), we construct *FDI volume* by multiplying the percentage of equity owned by firm i in its subsidiary located in country c by the total assets of the subsidiary.⁵ If firm i has more than one subsidiary in country c we aggregate all investments in that country. If no subsidiary exists, the variable takes the value of zero. All information from the Amadeus database presented in national currencies is converted into U.S. dollars using the average market exchange rate for the given year taken from the International Monetary Fund's *International Financial Statistics*.

In addition to the conditions in the host country, our data set provides us with an opportunity to control for the characteristics specific to parent companies [we do so only in Equation (2) as Equation (1) includes parent fixed effects]. As suggested by the existing literature, we control for firm size using the value of total assets and for firm's international experience by including the number of foreign subsidiaries owned by the firm all over the world (not just in the 25 countries considered in our sample). We anticipate that both variables will be correlated with the decision to

undertake FDI. We also take into account the gross domestic product (GDP) per capita and population size of the source country expecting that more FDI is likely to come from richer and larger economies.

In order to capture the effects of the Stringency and the Sustainability of Environmental Regulations on FDI flows, we include two measures: the first one is the Stringency of the Environmental Regulations from the *Global Competitiveness Report* (GCR) 2001–2002 published by the World Economic Forum. It is a country-specific variable taking on the value of 7 for countries with the most stringent regulations and 1 for the countries with the most lax regulations. It represents the average of the responses to the following question: “Is the stringency of overall environmental regulations lax compared to most other countries or among the world’s most stringent?” The second measure is the Environmental Sustainability Index (ESI), which is a joint product of the World Economic Forum’s Global Leaders for Tomorrow Environment Task Force, Yale Center for Environmental Law and Policy, and the Center for International Earth Science Information Network, Columbia University. The variable pertains to 2001. ESI is a measure of the overall progress towards environmental sustainability, developed for 122 countries. The ESI score is the average of the 22 “core” indicators, each of them combining 2 to 8 variables for a total of 68 underlying variables. ESI is presented as standard normal percentile; the higher the number the more progress has the country made towards environmental sustainability. Again, we take into account the fact that environmental regulations may exert both “push” and “pull” effects and focus on the difference in environmental stringency and sustainability between the source and host country. Higher values of the variable correspond to stricter rules in the home country relative to the destination country, and thus are expected to be positively correlated with FDI.

Because our rich database contains information about the multinational firms’ main industries of operation, we are also able to control for the *pollution intensity* of the industries to which parent companies belong. Following Smarzynska and Wei (2005) we use two measures of pollution intensity of industries: one based on *pollution emissions* and the other one on *abatement costs*. Both measures are based on U.S. data. The first measure is based on the Toxics Release Inventory (TRI) data collected by the U.S. Environmental Protection Agency.⁶ The data contain information on releases of toxic substances into air, water, land, and underground injections from manufacturing facilities in the United States. The median value of emissions for every reporting facility in each four-digit U.S. Standard Industrial Classification (SIC) code was calculated and normalized by the mean value of sales in that sector. The second measure, the abatement cost, comes from the Manufacturers’ Pollution Abatement Capital Expenditures and Operating Costs Survey and captures pollution abatement expenditures. Again, median values for each four-digit U.S. SIC code were calculated and normalized by sales. The abatement cost is constructed separately for Capital Expenditures and Operating Costs, as well as for the sum of the two. Pollution intensity indices are afterwards constructed for each type of

abatement costs, as well as for pollution emissions. The abatement indices vary from 0 (for the normalized value below the 33rd percentile) to 2 (for the value above the 66th percentile). The pollution emissions index takes values from 0 to 2: the value of 0 for emissions in all four categories (air, land, water, and underground) below the lowest 33 percentiles; the value of 2 for emissions in any category above the top 33 percentiles; otherwise, the value of 1.⁷

The main shortcoming of the above indices is that they are based on U.S. data, as no data exist for European industries at a similar level of disaggregation. The implicit assumption is that pollution intensity of American subsidiaries abroad is the same as that of U.S. facilities, or as Smarzynska and Wei (2005) argue, that the pollution intensity of the foreign production of two firms is proportional to their pollution intensity at home. However, other studies used this data in the context of European firms as well (see Smarzynska and Wei, 2005, among others).⁸

Turning to the host country-specific characteristics, we control for factors commonly mentioned in the literature as determinants of FDI. They include proxies for market size (population) and income of consumers in the host country (GDP per capita in current U.S. dollars). Both variables come from the World Bank *World Development Indicators 2000*. The theoretical link between the market size and FDI location choice is fairly straightforward. A larger market means that a clustering of producers may cause or amplify agglomeration economies, which leads to decreasing costs for all producers in the market. GDP per capita is often included as a measure of the wage rate, or labor costs prevailing in a country.

We also control for various aspects of the business climate in the host country. The first control is the Index of Strength of the Property Rights, which comes from the *Global Competitiveness Report 2001–2002*. Just like the other indices constructed by this organization, it is based on an extensive survey of managers, who were asked to rate on a scale of 1 to 7 whether the “Property rights in a given country are clearly delineated and protected by law.” Subsequently, the arithmetic mean of all responses by country was reported. A score of 7 would therefore correspond to countries with the best property rights and 1 to countries with little or no protection. This variable is included to capture the country-specific risk that multinational firms may face from possible expropriation of assets, insecurity of property rights, and contracts.

Another potentially important factor influencing the foreign investment location is the level of corporate tax rates in the host country. We employ the corporate tax rates as reported by PriceWaterhouseCoopers, 2000. All taxes are expressed in percentages; if several rates apply, the highest one is used.

We also include a measure of labor market regulations in the host countries, which may be an important determinant of FDI. We use a proxy for the Flexibility in Hiring and Firing Practices from the *Global Competitiveness Report 2001–2002*, produced by the World Economic Forum. It is a country-specific index that quantifies the average response to the survey question: “Is hiring and firing of workers

Table 1
Variables Definitions

Variables	Definition	Source
FDI_{ic}	Equal to 1 if a new subsidiary was created by firm i in country c during 1998–2001, and 0 otherwise	Amadeus database
$FDI\ volume_{ic}$	The value of firm i 's investment into a new foreign subsidiary in country c (expressed in logarithmic form)	Own calculations based on the Amadeus database
Firm's size	Value of total assets in U.S.–dollars (expressed in logarithmic form)	Amadeus database
Firm's international experience	Number of foreign subsidiaries in 1998	Amadeus database
GDP per capita	Current U.S.–dollars (expressed in logarithmic form)	World Bank World Development Indicators Database, 2000
Population	Expressed in logarithmic form	World Bank World Development Indicators Database, 2000
Property rights	Ranges from 1 for little or no protection, to 7 for best property rights	<i>Global Competitiveness Report</i> 2001–2002
Corporate tax rate	Expressed in percentages	PriceWaterhouseCoopers
Governance	Ranges from –2.5 for very corrupt to 2.5 for best governed	Kaufman, Kraay, & Zoido-Lobaton (1999b)
<i>Global Competitiveness Report</i> (GCR) flexibility in hiring and firing practices	Ranges from 7 for most flexible regulations, to 1 for most rigid	<i>Global Competitiveness Report</i> 2001–2002
GCR stringency of environmental regulations	Ranges from 7 for most stringent regulations, to 1 for most lax	<i>Global Competitiveness Report</i> 2001–2002
Environmental Sustainability Index (ESI)	Measures progress towards environmental sustainability	World Economic Forum, Yale University and Center for International Earth Science Information at Columbia University (2001)
Pollution Emissions Index	Based on Smarzynska & Wei (2005)	Toxic Release Inventory, U.S Environmental Protection Agency
Abatement Index	Constructed separately for Capital Expenditures and Operating Costs, as well as for the sum of the two; based on Smarzynska & Wei (2005)	U.S Census Bureau (1994)

Table 2
Host Country Characteristics

Country	ln GDP Per Capita	ln Population	FDI Restrictions	Property Rights Protection	Tax Rates	KKZ Governance Index	GCR Environmental Stringency	ESI Overall Index	GCR Hiring Firing
Austria	10.2	15.9	2	6.4	34	2.02	6.6	67.9	2.8
Belgium	10.1	16.1	0	5.9	40	1.23	6.1	44.1	2.9
Bulgaria	7.4	15.9	2	3.2	36	-0.5	3.5	47.4	3.59
Switzerland	10.5	15.8	1	4.1	23	2.58	6.4	74.6	4.09
Czech Republic	8.6	16.1	1	4.4	35	0.35	5.1	57.2	4.19
Denmark	10.4	15.5	2	6.4	34	2.57	6.7	67	4.9
Spain	9.6	17.5	2	5.9	35	1.58	4.9	59.5	3.2
Finland	10.1	15.5	2	6.5	28	2.55	6.5	80.5	2.9
France	10.1	17.9	2	6.4	33.3	1.75	6.2	65.8	2
Great Britain	10.1	17.9	0	6.3	30	2.32	5.8	64.1	3.9
Greece	9.3	16.2	3	5	40	0.85	3.7	53.1	2.4
Hungary	8.5	16.1	0	5.3	18	0.69	4.6	61	4.3
Ireland	10.1	15.1	1	6.1	32	2.15	5.2	64	3.3
Italy	9.9	17.9	2	6.2	37	1	5.7	54.3	2.3
Latvia	7.9	14.7	-	4.3	-	-0.1	4.4	56.3	2.59
Netherlands	10.1	16.6	0	6.5	35	2.48	6.7	66	2.5
Norway	10.4	15.3	2	5.9	28	2.34	6.2	78.2	2.2
Poland	8.3	17.5	1	4.6	32	0.49	4.2	47.6	2.59
Portugal	9.3	16.1	1	5.3	36	1.55	4.5	61.4	2.7
Romania	7.4	16.9	-	4.5	-	-0.38	3.4	44.1	6.03
Sweden	10.2	16.0	0	5.9	28	2.54	6.5	77.1	2.3
Russia	7.19	18.8	4	2.4	35	-0.69	3.2	56.2	4.69
Slovakia	8.2	15.5	-	5.2	40	-0.08	4.8	63.2	2.8
Turkey	8.0	18.0	2	4.2	33	-0.01	4.1	46.3	4.19
Ukraine	6.4	17.7	4	3.2	30	-0.89	3	36.8	4.8
Averages	9.2	15.9	1.3	5.4	32.6	1.2	5.2	59.1	3.37

impeded by regulations or flexibly determined by employers?" It takes on the value of 7 for a very flexible labor market and 1 in the case of the most rigid ones. Because it is based on the views of "business practitioners" in each country, it captures not only laws on the books but also their enforcement.

Finally, we also control for the quality of governance using the measure derived by Kaufmann, Kraay, and Zoido-Lobaton (1999b). The KKZ governance estimates range from -2.5 to 2.5. The higher the estimate for each country, the less corrupt and better governed the country. The KKZ governance index can be viewed as a more sophisticated and improved version of the Transparency International Corruption Perceptions index. Summary statistics presented in Table 2 indicate a large degree of heterogeneity in terms of business environment in host countries in our sample.

Transition economies usually rank low with respect to governance measures, property rights protection, labor market flexibility, and environmental stringency and sustainability. There is a large variation in the host-country environmental standards in our sample. The set of transition economies in the sample includes countries with relatively high environmental standards, such as Poland and the Czech Republic. It also covers countries that have much weaker environmental standards, such as the Ukraine and Russia. There is also large variation in terms of labor market flexibility. In both Western and Eastern Europe we can find economies with inflexible labor markets (France and Poland), as well as countries giving employers relative freedom in hiring and firing decisions (Denmark and Hungary). The picture is mixed with regard to FDI incentives and corporate taxation, as in both Western and Eastern Europe we find countries with very different scores in those areas. For instance, although some transition economies, especially Hungary, the Czech Republic, and Poland, have no or very few restrictions, others, such as the Ukraine, have restrictions in all categories. Similarly, whereas the Ukraine has one of the highest corporate tax rates, Hungary offers the lowest one in the sample.

Estimation Results

FDI Determinants

We begin by examining the determinants of FDI, including environmental standards. We start with a logit model with fixed effects for each parent company. The results are presented in Table 3.

As expected, we find positive and significant coefficients on the host country's population size and GDP per capita, indicating that larger and richer countries are more attractive investment destinations. Further, the data suggest that better property rights protection and governance are associated with higher probability of FDI taking place. The coefficient of the corporate tax rate is positive, which is somewhat counterintuitive, yet not unusual in the literature on determinants of FDI.⁹ The proxy for labor market flexibility is positive and statistically significant, which suggests that FDI is attracted by countries with more flexible labor market regulations. Finally, a dummy for transition countries is positive and significant, indicating that these countries have a higher probability of receiving FDI than would be predicted given their economic and regulatory environments.

Next, we turn our attention to a potentially important factor motivating the decision of multinational firms to move abroad, namely, the stringency of environmental regulations. We consider the differential between the environmental rules in the source and in the host country. Because a higher value of the environmental stringency differential term corresponds to more stringent source country's environmental regulations relative to the destination country (recall Difference in

Table 3
Determinants of the Decision to Invest—Fixed Effect Logit—GCR
Index of Environmental Stringency

Host country GDP per capita	1.567*** [0.122]	1.705*** [0.149]	1.536*** [0.154]	1.638*** [0.151]	1.548*** [0.154]	1.452*** [0.125]
Host country population	1.259*** [0.035]	1.210*** [0.043]	1.212*** [0.045]	1.222*** [0.044]	1.210*** [0.045]	1.292*** [0.037]
Host country property rights	0.442*** [0.080]	0.381*** [0.100]	0.493*** [0.105]	0.463*** [0.102]	0.487*** [0.105]	0.343*** [0.086]
Host country tax rates	0.041*** [0.010]	0.042*** [0.013]	0.036*** [0.013]	0.043*** [0.013]	0.036*** [0.013]	0.042*** [0.010]
Host country governance	0.616*** [0.103]	0.421*** [0.127]	0.481*** [0.132]	0.481*** [0.129]	0.472*** [0.132]	0.670*** [0.105]
Host country labor regulations	0.121*** [0.039]	0.124** [0.048]	0.113** [0.051]	0.128*** [0.049]	0.111** [0.050]	0.117*** [0.039]
Difference in enviro stringency	0.258*** [0.064]	0.281*** [0.086]	0.344*** [0.097]	0.249*** [0.093]	0.308*** [0.099]	0.210*** [0.065]
Transition country dummy (TE)	2.315*** [0.206]	2.127*** [0.252]	1.898*** [0.261]	2.120*** [0.257]	1.900*** [0.262]	2.811*** [0.246]
Difference in enviro stringency* abatement (operating)					0.002 [0.046]	
Difference in enviro stringency* abatement (capital)				0.038 [0.045]		
Difference in enviro stringency* abatement			-0.024 [0.044]			
Difference in enviro stringency* emissions		-0.083* [0.046]				-0.403*** [0.117]
Difference in enviro stringency* TE						
Nr. observations	18216	11976	11304	11880	11376	18216

Note: Standard errors in brackets: * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions contain fixed effects for investing firms. Difference in Enviro. Stringency = Enviro. Stringency_{Source} - Enviro. Stringency_{Destination}.

Environmental Stringency = Environmental Stringency_{source} – Environmental Stringency_{destination}), we expect to obtain a positive coefficient for the differential term.

Subsequently, we include controls for pollution intensity (proxied by average emissions or abatement costs indices) of the industry in which a firm operates and the interaction term between pollution intensity and the differential in environmental standards. If firms indeed undertake FDI to escape tougher environmental rules at home, confirming the “pollution haven” hypothesis, we would expect to observe the following. First, the coefficient on environmental regulations differential would bear a positive sign, suggesting that higher standards at home relative to those in the host country encourage outward FDI. Second, we would find a positive sign on the pollution intensity measures, which would suggest that firms in pollution-intensive industries are more likely to undertake FDI. And third, we would anticipate a positive sign on the interaction term, which would indicate that firms in more polluting industries are more sensitive to differences in environmental rules.

Tables 3 and 4 present the results with the GCR Index of Stringency of Environmental Regulations, using both the fixed effect logit and the Tobit specifications.

The Index of Stringency of Environmental Regulations first enters alone and subsequently is accompanied by interaction terms with pollution intensity proxies. We find that in all six regressions the index of Stringency of Environmental Regulations bears a positive and statistically significant coefficient, suggesting that stronger environmental rules in the firm’s home economy relative to the host country are associated with higher volume of FDI even after controlling for other possible factors. This finding is consistent with multinationals moving their facilities from places with stringent environmental rules to economies with lower standards. As the results in the last column indicate, the effect does not appear to be stronger for host countries that are transition economies than for other countries in the sample.

Further, the Tobit regressions suggest that firms operating in sectors with higher abatement costs, whether measured by operating expenditure, capital expenditure, or the combination of the two, are likely to undertake more FDI.¹⁰ This effect is highly significant in all regressions. However, the interaction terms between the difference in the stringency of environmental regulations and the emissions and abatement indices are statistically insignificant. Thus, there is no indication that firms operating in more polluting industries are attracted more to countries with relatively weaker environmental standards than firms in less polluting industries. This finding is in line with the findings of Ederington, Levinson, and Minier (2005).

In Tables 5 and 6, we repeat the above regressions, using the ESI index as the measure of environmental sustainability. Here we find evidence that the sustainability of environmental regulations matters for FDI flows, even after accounting for a variety of factors that affect FDI. The difference in the ESI index is statistically significant in all regressions. Again, we find no indication that environmental

Table 4
Determinants of the Investment Volume—Tobit Regressions—GCR Index of Environmental Stringency

Host country GDP per capita	-0.070* [0.040]	-0.022 [0.049]	-0.043 [0.050]	-0.041 [0.049]	-0.042 [0.049]	-0.06 [0.043]
Host country population	0.369*** [0.011]	0.344*** [0.013]	0.348*** [0.013]	0.351*** [0.013]	0.346*** [0.013]	0.368*** [0.011]
Host country property rights	0.302*** [0.025]	0.268*** [0.030]	0.276*** [0.031]	0.277*** [0.030]	0.275*** [0.030]	0.305*** [0.025]
Host country tax rates	0.028*** [0.003]	0.028*** [0.004]	0.028*** [0.004]	0.029*** [0.004]	0.028*** [0.004]	0.028*** [0.003]
Host country governance	0.530*** [0.042]	0.454*** [0.051]	0.477*** [0.052]	0.483*** [0.051]	0.472*** [0.052]	0.522*** [0.044]
Host country labor regulations	0.178*** [0.015]	0.175*** [0.018]	0.179*** [0.019]	0.183*** [0.018]	0.177*** [0.019]	0.178*** [0.015]
Difference in enviro stringency	0.092*** [0.019]	0.078*** [0.025]	0.102*** [0.028]	0.090*** [0.026]	0.104*** [0.027]	0.092*** [0.019]
Transition country dummy (TE)	0.567*** [0.052]	0.522*** [0.063]	0.523*** [0.064]	0.535*** [0.063]	0.519*** [0.064]	0.543*** [0.064]
Parent size	0.101*** [0.013]	0.091*** [0.016]	0.094*** [0.017]	0.092*** [0.017]	0.094*** [0.017]	0.101*** [0.013]
Parent international experience	0.107*** [0.012]	0.099*** [0.014]	0.096*** [0.015]	0.102*** [0.014]	0.096*** [0.015]	0.107*** [0.012]
Source country GDP per capita	0.01 [0.068]	0.009 [0.079]	0.005 [0.087]	0 [0.079]	0.002 [0.087]	0.001 [0.069]
Source country population	-0.044*** [0.014]	-0.029* [0.017]	-0.021 [0.018]	-0.029* [0.017]	-0.018 [0.017]	-0.043*** [0.014]
Difference in enviro stringency * abatement (operating)					-0.022* [0.013]	
Difference in enviro stringency * abatement (capital)				-0.011 [0.013]		
Difference in enviro stringency * abatement			-0.02 [0.013]			
Difference in enviro stringency * emissions		-0.006 [0.014]				
Difference in enviro stringency * TE						0.019 [0.030]
Source industry abatement (operating)				0.043*** [0.019]		
Source industry abatement (capital)					0.054*** [0.020]	
Source industry abatement			0.051** [0.020]			
Source industry emissions	15,144	0.016 [0.021]				
Nr. observations		10,008	9,528	9,936	9,600	15,144

Note: Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5
Determinants of the Decision to Invest—Fixed Effect Logit—ESI (Total Index)

Host country GDP per capita	1.439*** [0.118]	1.560*** [0.145]	1.385*** [0.150]	1.495*** [0.147]	1.395*** [0.150]	1.285*** [0.122]
Host country population	1.220*** [0.036]	1.168*** [0.044]	1.169*** [0.046]	1.182*** [0.045]	1.168*** [0.046]	1.236*** [0.037]
Host country property rights	0.124** [0.058]	0.097 [0.071]	0.114 [0.075]	0.112 [0.073]	0.113 [0.075]	0.05 [0.059]
Host country tax rates	-0.009 [0.011]	-0.01 [0.013]	-0.025* [0.014]	-0.014 [0.014]	-0.025* [0.014]	-0.01 [0.010]
Host country governance	1.043*** [0.114]	0.925*** [0.141]	0.995*** [0.148]	0.962*** [0.143]	0.988*** [0.148]	1.327*** [0.123]
Host country labor regulations	-0.012 [0.042]	-0.03 [0.053]	-0.055 [0.056]	-0.026 [0.053]	-0.058 [0.056]	-0.096** [0.045]
Difference in ESI	0.057*** [0.006]	0.065*** [0.009]	0.068*** [0.010]	0.059*** [0.010]	0.067*** [0.010]	0.072*** [0.007]
Transition country dummy (TE)	2.023*** [0.187]	1.894*** [0.231]	1.546*** [0.239]	1.812*** [0.234]	1.551*** [0.239]	2.512*** [0.204]
Difference in ESI * abatement (operating)					0.001 [0.005]	
Difference in ESI * abatement (capital)				0.004 [0.005]		
Difference in ESI * abatement			0 [0.005]			
Difference in ESI * emissions		-0.004 [0.005]				-0.055*** [0.009]
Difference in ESI * TE						
Nr. observations	18126	11976	11304	11880	11376	18126

Note: ESI = Environmental Sustainability Index. Standard errors in brackets: * significant at 10%, ** significant at 5%, *** significant at 1%. All regressions contain fixed effects for investing firms. Difference in Envir. Stringency = Envir. Stringency_{Source} - Envir. Stringency_{Destination}.

Table 6
Determinants of the Investment Volume—Tobit Regressions—ESI (Total Index)

Host country GDP per capita	-0.069* [0.040]	-0.021 [0.049]	-0.042 [0.050]	-0.04 [0.049]	-0.041 [0.049]	-0.065 [0.043]
Host country population	0.357*** [0.011]	0.334*** [0.013]	0.338*** [0.013]	0.341*** [0.013]	0.336*** [0.013]	0.357*** [0.011]
Host country property rights	0.213*** [0.019]	0.195*** [0.023]	0.198*** [0.023]	0.199*** [0.023]	0.197*** [0.023]	0.214*** [0.019]
Host country tax rates	0.024*** [0.003]	0.024*** [0.004]	0.024*** [0.004]	0.024*** [0.004]	0.024*** [0.004]	0.023*** [0.003]
Host country governance	0.544*** [0.043]	0.472*** [0.052]	0.493*** [0.054]	0.499*** [0.053]	0.490*** [0.053]	0.541*** [0.045]
Host country labor regulations	0.160*** [0.015]	0.159*** [0.019]	0.163*** [0.019]	0.166*** [0.019]	0.160*** [0.019]	0.160*** [0.015]
Difference in ESI	0.005*** [0.001]	0.004** [0.002]	0.006*** [0.002]	0.004** [0.002]	0.006*** [0.002]	0.005*** [0.001]
Transition country dummy (TE)	0.536*** [0.051]	0.502*** [0.061]	0.498*** [0.063]	0.510*** [0.062]	0.496*** [0.063]	0.527*** [0.064]
Parent size	0.100*** [0.013]	0.092*** [0.016]	0.095*** [0.017]	0.093*** [0.017]	0.094*** [0.017]	0.100*** [0.013]
Parent international experience	0.106*** [0.012]	0.097*** [0.014]	0.095*** [0.015]	0.101*** [0.014]	0.094*** [0.015]	0.106*** [0.012]
Source country GDP per capita	0.097 [0.063]	0.08 [0.072]	0.094 [0.077]	0.084 [0.071]	0.089 [0.077]	0.094 [0.064]
Source country population	-0.065*** [0.014]	-0.051*** [0.017]	-0.042** [0.018]	-0.051*** [0.017]	-0.040** [0.018]	-0.064*** [0.014]
Difference in ESI * abatement (operating)						
Difference in ESI * abatement (capital)				0 [0.001]		
Difference in ESI * abatement						
Difference in ESI * emissions						
Difference in ESI * TE						
Source industry abatement (operating)						
Source industry abatement (capital)					0.040** [0.017]	0.007 [0.030]
Source industry abatement						
Source industry emissions						
Nr. observations	15144	10008	9528	9936	9600	15144

Note: ESI = Environmental Sustainability Index. Standard errors in brackets: * significant at 10%, ** significant at 5%; *** significant at 1%.

sustainability deters *more* the investment of firms in *highly* polluting industries than of companies in the least polluting industries.

Next, we redo the above regression, but with other variables, where the differential in the business environment between the source and the host country (rather than the absolute level) is likely to matter, entering the relative form as well. We do so in order to make sure that the differential Environmental Stringency or Sustainability would not be picking up *differences* in other variables with which they are likely to be correlated. These variables are: property rights, corporate tax rates, governance, and labor market regulations. We do not enter the population size or the GDP per capita in the relative form because we believe that their levels should matter for FDI decisions. The results are presented in Tables 7 to 10.

As expected, we find that *differentials* in property rights, governance, and labor market flexibility are negatively associated with the likelihood and the volume of investment. Note that all differentials were defined as those prevailing in the source country relative to those in the destination country. Differences in corporate tax rates do not always bear the expected signs. The results confirm the previous findings that the Stringency and Sustainability of Environmental Regulations discrepancies are important determinants of FDI, both in the fixed effect logit and the Tobit specifications. The more stringent the source country's environmental regulations relative to those in the host country, the higher the likelihood of undertaking FDI and the higher its volume. The magnitude of the effects is economically meaningful. As the environmental stringency in the source country (keeping the destination country and other things constant) increases from the level of Romania (very lax) to the level of the Switzerland (very stringent) the volume of investment goes up by between 5% and 13% depending on the specification. However, the interaction terms with parents' pollution intensities are insignificant in all models, which suggests that the Stringency and Sustainability of Environmental regulations do not matter more for the FDI decision of firms in more polluting industries. This is true for both measures of environmental standards.

As a robustness check we estimate the above regressions using the Amadeus 2001 database taking into account *all* existing subsidiaries (as opposed to only the *new* subsidiaries created between 1998 and 2001) regardless of when they were created. The results (not presented here to conserve space) confirm our earlier results.

Conclusions

Lax environmental standards are allegedly creating "pollution havens." The fast growing volume of research on the effect of pollution regulations on FDI flows has generated mixed results. This paper is an attempt to further our knowledge of this topic. Using unique firm-level data, as well as measures of stringency and sustainability of environmental regulations we examine the importance of these factors on the FDI inflows in 25 European countries.

(Text continued on p. 181)

Table 7
Determinants of the Decision to Invest—Fixed Effect Logit—GCR Index of Environmental Stringency—Differences

Host country GDP per capita	1.567*** [0.122]	1.705*** [0.149]	1.536*** [0.154]	1.638*** [0.151]	1.548*** [0.154]	1.452*** [0.125]
Host country population	1.259*** [0.035]	1.210*** [0.043]	1.212*** [0.045]	1.222*** [0.044]	1.210*** [0.045]	1.292*** [0.037]
Difference property rights	-0.442*** [0.080]	-0.381*** [0.100]	-0.493*** [0.105]	-0.463*** [0.102]	-0.487*** [0.105]	-0.343*** [0.086]
Difference tax rates	-0.041*** [0.010]	-0.042*** [0.013]	-0.036*** [0.013]	-0.043*** [0.013]	-0.036*** [0.013]	-0.042*** [0.010]
Difference governance	-0.616*** [0.103]	-0.421*** [0.127]	-0.481*** [0.132]	-0.481*** [0.129]	-0.472*** [0.132]	-0.670*** [0.105]
Difference labor regulations	-0.121*** [0.039]	-0.124** [0.048]	-0.113** [0.051]	-0.128*** [0.049]	-0.111** [0.050]	-0.117*** [0.039]
Difference envir. stringency	0.258*** [0.064]	0.281*** [0.086]	0.344*** [0.097]	0.249*** [0.093]	0.308*** [0.099]	0.210*** [0.065]
Transition country dummy (TE)	2.315*** [0.206]	2.127*** [0.252]	1.898*** [0.261]	2.120*** [0.257]	1.900*** [0.262]	2.811*** [0.246]
Difference in envir stringency					0.002 [0.046]	
* abatement (operating)						
Difference in envir stringency				0.038 [0.045]		
* abatement (capital)						
Difference in envir stringency			-0.024 [0.044]			
* abatement						
Difference in envir stringency		-0.083* [0.046]				
* emissions						
Difference in envir stringency						-0.403*** [0.117]
* TE						
Nr. observations	18,216	11,976	11,304	11,880	11,376	18216

Note: Standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions contain fixed effects for investing firms. Difference property rights = Property rights_{source} - Property rights_{destination}. Difference tax rates = Tax rates_{source} - Tax rates_{destination}. Difference governance = Governance_{source} - Governance_{destination}. Difference labor regulations = Stringency labor regulations_{source} - Stringency labor regulations_{destination}.

Table 8
Determinants of the Investment Volume—GCR Index of Environmental Stringency—Differences

Host country GDP per capita	0.147*** [0.034]	0.160*** [0.040]	0.145*** [0.041]	0.149*** [0.041]	0.147*** [0.041]	0.182*** [0.035]
Host country population	0.322*** [0.010]	0.299*** [0.012]	0.303*** [0.013]	0.304*** [0.013]	0.301*** [0.013]	0.320*** [0.010]
Difference property rights	-0.217*** [0.025]	-0.184*** [0.030]	-0.197*** [0.031]	-0.195*** [0.030]	-0.196*** [0.031]	-0.237*** [0.026]
Difference tax rates	-0.010*** [0.003]	-0.010*** [0.003]	-0.010*** [0.003]	-0.010*** [0.003]	-0.010*** [0.003]	-0.009*** [0.003]
Difference governance	-0.177*** [0.031]	-0.144*** [0.037]	-0.158*** [0.038]	-0.160*** [0.038]	-0.153*** [0.038]	-0.160*** [0.032]
Difference labor regulations	-0.059*** [0.011]	-0.053*** [0.013]	-0.056*** [0.014]	-0.054*** [0.013]	-0.056*** [0.013]	-0.058*** [0.011]
Difference in envnr stringency	0.025 [0.020]	0.018 [0.026]	0.043 [0.028]	0.032 [0.027]	0.044 [0.028]	0.029 [0.020]
Transition country dummy (TE)	0.391*** [0.051]	0.354*** [0.062]	0.355*** [0.063]	0.364*** [0.062]	0.352*** [0.063]	0.279*** [0.062]
Parent size	0.119*** [0.013]	0.105*** [0.017]	0.109*** [0.017]	0.106*** [0.017]	0.108*** [0.017]	0.118*** [0.013]
Parent international experience	0.090*** [0.012]	0.084*** [0.014]	0.079*** [0.015]	0.085*** [0.015]	0.079*** [0.015]	0.091*** [0.012]
Source country GDP per capita	0.531*** [0.072]	0.452*** [0.083]	0.506*** [0.090]	0.481*** [0.083]	0.494*** [0.089]	0.479*** [0.074]
Source country population	-0.006 [0.016]	-0.003 [0.019]	0.009 [0.020]	0.001 [0.019]	0.011 [0.020]	0.001 [0.016]
Difference in envnr stringency * abatement (operating)				-0.013 [0.013]		
Difference in envnr stringency * abatement (capital)						
Difference in envnr stringency * abatement						
Difference in envnr stringency * emissions						
Difference in envnr stringency * TE						
Source industry abatement (operating)						
Source industry abatement (capital)						
Source industry abatement						
Source industry emissions						
Nr. observations	15,144	10,008	9,528	9,936	9,600	15,144

Note: Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 9
Determinants of the Decision to Invest—Fixed Effect Logit—ESI (Total Index)—Differences

Host country GDP per capita	1.439*** [0.118]	1.560*** [0.145]	1.385*** [0.150]	1.495*** [0.147]	1.395*** [0.150]	1.285*** [0.122]
Host country population	1.220*** [0.036]	1.168*** [0.044]	1.169*** [0.046]	1.182*** [0.045]	1.168*** [0.046]	1.236*** [0.037]
Difference property rights	-0.124** [0.058]	-0.097 [0.071]	-0.114 [0.075]	-0.112 [0.073]	-0.113 [0.075]	-0.05 [0.059]
Difference tax rates	0.009 [0.011]	0.01 [0.013]	0.025* [0.014]	0.014 [0.014]	0.025* [0.014]	0.01 [0.010]
Difference governance	-1.043*** [0.114]	-0.925*** [0.141]	-0.995*** [0.148]	-0.962*** [0.143]	-0.988*** [0.148]	-1.327*** [0.123]
Difference labor regulations	0.012 [0.042]	0.03 [0.053]	0.055 [0.056]	0.026 [0.053]	0.058 [0.056]	0.096** [0.045]
Difference ESI	0.057*** [0.006]	0.065*** [0.009]	0.068*** [0.010]	0.059*** [0.010]	0.067*** [0.010]	0.072*** [0.007]
Transition country dummy (TE)	2.023*** [0.187]	1.894*** [0.231]	1.546*** [0.239]	1.812*** [0.234]	1.551*** [0.239]	2.512*** [0.204]
Difference in ESI* abatement (operating)					0.001 [0.005]	
Difference in ESI* abatement (capital)				0.004 [0.005]		
Difference in ESI* abatement			0 [0.005]			
Difference in ESI* emissions						
Difference in enviro stringency		-0.004 [0.005]				-0.055*** [0.009]
* TE						
Nr. observations	18,216	11,976	11,304	11,880	11,376	18216

Note: ESI = Environmental Sustainability Index. Standard errors in brackets: * significant at 10%, ** significant at 5%, *** significant at 1%. All regressions contain fixed effects for investing firms.

Table 10
Determinants of the Investment Volume Tobit—ESI (Total Index)—Differences

Host country GDP per capita	0.130*** [0.034]	0.139*** [0.040]	0.127*** [0.042]	0.129*** [0.041]	0.129*** [0.041]	0.159*** [0.036]
Host country population	0.312*** [0.010]	0.288*** [0.013]	0.292*** [0.013]	0.293*** [0.013]	0.291*** [0.013]	0.311*** [0.011]
Difference property rights	-0.180*** [0.019]	-0.158*** [0.023]	-0.165*** [0.023]	-0.162*** [0.023]	-0.164*** [0.023]	-0.194*** [0.020]
Difference tax rates	-0.006* [0.003]	-0.005 [0.003]	-0.006* [0.004]	-0.006* [0.004]	-0.006* [0.004]	-0.005* [0.003]
Difference governance	-0.256*** [0.037]	-0.243*** [0.044]	-0.245*** [0.046]	-0.255*** [0.045]	-0.242*** [0.045]	-0.234*** [0.038]
Difference labor regulations	-0.033*** [0.013]	-0.022 [0.015]	-0.029* [0.016]	-0.025 [0.015]	-0.028* [0.015]	-0.035*** [0.013]
Difference in ESI	0.007*** [0.002]	0.008*** [0.002]	0.008*** [0.003]	0.008*** [0.002]	0.009*** [0.003]	0.007*** [0.002]
Transition country dummy (TE)	0.421*** [0.051]	0.401*** [0.061]	0.394*** [0.063]	0.406*** [0.062]	0.392*** [0.062]	0.327*** [0.063]
Parent size	0.122*** [0.013]	0.109*** [0.017]	0.112*** [0.017]	0.111*** [0.017]	0.111*** [0.017]	0.121*** [0.013]
Parent intemat. experience	0.088*** [0.012]	0.081*** [0.014]	0.076*** [0.015]	0.082*** [0.015]	0.076*** [0.015]	0.089*** [0.012]
Source country GDP per capita	0.573*** [0.071]	0.502*** [0.083]	0.546*** [0.088]	0.534*** [0.083]	0.536*** [0.088]	0.532*** [0.073]
Source country population	-0.018 [0.015]	-0.014 [0.018]	-0.004 [0.019]	-0.012 [0.019]	-0.002 [0.019]	-0.013 [0.015]
Difference in ESI					-0.001 [0.001]	
* abatement (operating)						
Difference in ESI				0.001 [0.001]		
* abatement (capital)						
Difference in ESI * abatement			-0.001 [0.001]			
Difference in ESI * emissions		0.001 [0.001]				
Difference in enviro stringency						
* TE						
Source industry abatement (operating)					0.045*** [0.017]	
Source industry abatement (capital)						0.075** [0.030]
Source industry abatement				0.039** [0.017]		
Source industry abatement						
Source industry abatement		0.043** [0.017]				
Source industry emissions	15,144	10,008	9,528	9,936	9,600	15,144
Nr. observations						

Note: ESI = Environmental Sustainability Index. Standard errors in brackets: * significant at 10%, ** significant at 5%, *** significant at 1%.

The empirical findings are as follows. We find that large countries with well-defined and protected property rights and good governance structure attract more FDI. We also show that environmental regulations matter, even after accounting for various other determinants of FDI. We find that the more stringent the source country's environmental regulations relative to the potential host country, the higher the likelihood to invest in the country as well as the volume of FDI. There is also evidence that firms in industries with higher abatement costs invest more abroad.

Notes

1. See "A Fair Trade Bill of Rights" at the Sierra Club Web site (<http://www.sierraclub.org/trade/ftaa/rights.asp>).
2. The logit model captures factors that influence the decision to invest or not in a particular country, whereas the Tobit model captures factors that influence *how much* to invest.
3. The group of the largest 10,000 firms operating in Europe includes 338 companies headquartered in Eastern European countries. These are Bosnia, Bulgaria, Czech Republic, Estonia, Croatia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, Slovenia, Ukraine, and Yugoslavia.
4. The 25 countries in the sample are Austria, Belgium, Bulgaria, Switzerland, Czech Republic, Denmark, Estonia, Finland, France, Great Britain, Greece, Hungary, Ireland, Italy, Latvia, Netherlands, Norway, Poland, Portugal, Romania, Sweden, Russia, Slovakia, Turkey, and Ukraine.
5. As a robustness check, we also recalculated the volume of FDI, by considering "foreign" any subsidiary where the share of the parent exceeds 10%. The results are robust to alternative measurement of the volume of FDI.
6. The United States is the only country that has collected pollution and abatement cost data over significant periods of time. No similar data are publicly available for European countries at the level of disaggregation and detail similar to the U.S. data.
7. For more details on the construction of the indices see Smarzynska and Wei (2005).
8. See Smarzynska and Wei (2005) for a detailed discussion on the drawbacks of using U.S. pollution data in the context of European firms.
9. See, for example, Jun (1994), Devereaux and Freeman (1995), and Cassou (1997).
10. Note that pollution-intensity variables drop out in the fixed effects logit specifications.

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