Environmental Responsibility and FDI: Do Firms Relocate Their Irresponsibilities Abroad? *

Rémi BAZILLIER†, Sophie HATTE‡ and Julien VAUDAY§

July 2013

Abstract

The goal of this paper is to study the influence of corporate environmental responsibility (CER) and national environmental standards on the location choices of the 600 biggest European firms. By using the environmental score provided by Vigeo, we are able to test the influence of the environmental performances of firms. We find a negative interaction effect between these environmental performances and national environmental regulations. This result is only valid when considering *de facto* environmental standards, not *de jure* environmental standards. All things being equal, firms with better environmental performances tend to be located in dirtier countries. This result contradicts Dam & Scholtens (2008) who found a positive interaction effect. We argue that this is explained by behavior differences between firms which *are improving* their CER and firms which *already* had a high level of CER.

J.E.L: D22 ; F23 ; M14 ; Q56
Keywords: Corporate Social Responsibility, Environment, Location decision, Regulation, Multinational Firms, Firm Heterogeneity

*__Acknowledgments:__ We would like to thank Vigeo which provided us with the data on the level of Corporate Social Responsibility. A partnership agreement which includes the present paper has been signed between Vigeo and the LEO (University of Orléans). We also would like to thank Mathieu Couttenier and Farid Toubal for their comments and advice, Carlo Altomonte and Armando Rurgi for providing us with Orbis data, and the Global Footprint Network for data on the ecological footprint.

†LEO, Université d'Orléans, CNRS, remi.bazillier@univ-orleans.fr
‡Université de Rouen and Paris School of Economics, sophie.hatte@gmail.com
§Université Paris 13 - CEPN and CNRS, julien.vauday@univ-paris13.fr

1 Introduction

The media, public opinion as well as researchers have become increasingly interested in the issue of Corporate Social Responsibility (CSR). Growing concerns about climate change, and more generally about the environment, have changed the way the responsibility of multinational companies is perceived. On the one hand, they are officially part of international discussions on this topic. The World Business Council for Sustainable Development aims at promoting their initiatives, while the United Nations encourages their involvement through the Global Compact, and the 2002 Earth Summit put a strong emphasis on their possible contribution towards sustainable development. But on the other hand, multinational companies have also been accused of exporting their pollution to developing countries, or relocating abroad when environmental regulations become too tight. This is the so-called pollution haven hypothesis (PHH). Their responsibilities are therefore discussed as their goodwill is questioned, and many of these companies suffer from a negative image in public opinion. The location decisions made by firms may have a strong impact on this image, but Corporate Environmental Responsibility (CER)[1] can also influence the way firms are perceived and therefore contribute to changing this perception. It is therefore important to study the interactions between CER and national environmental standards in the location choices made by firms.

Two alternative possibilities emerge with respect to this issue. We can expect either a positive or a negative interaction effect between national environmental standards and the environmental

[1]In this paper, we focus on the environmental dimension of CSR. This is why we will use the term Corporate Environmental Responsability (CER) rather than CSR. CER can be defined as the environmental dimension of CSR.

performances of firms. If there is a positive interaction, firms with a higher level of CER will locate their foreign activities in countries with relatively higher environmental standards. We will call this the "*complementarity hypothesis*". It implies that firms consider their location choices as part of their CER, depending on the level of a country's standards.

If the interaction is negative, firms with a higher level of CER will locate their activities in countries with relatively lower standards. It is worth noticing that a firm locating its activities in a dirty country can actually have good environmental performances. For instance, this may be the case if a firm decides to keep implementing its home country's environmental standards, whatever the level of standards in the country where it is investing. Firms may also try to produce at a lower marginal cost in order to compensate for the marginal cost increase implied by their CER policy at home. Such a cost minimization policy implies seeking countries that have lower environmental regulations. We will call this the "*substitution hypothesis*".[2] This paper aims at disentangling these two possibilities.

In order to know which hypothesis fits the data, we analyze the determinants of location choices in 2010 for the 600 biggest European firms taking both the firms' CER and the countries' environmental standards into account. In order to assess their level of CER, we use a unique database provided by Vigeo, the leading extra-financial rating agency. Regarding national standards, it is important to explore the differences between de jure and de facto environmental standards. De jure environmental standards refer to the national legislation or to the ratification

[2]By substitution, we do not mean that the relation between national standards and firm performances is negative. Only the interaction effect is expected to be negative, implying that firms with *higher* CER will not necessarily locate their activities in countries with *higher* standards.
In this case, firms with a higher CER will locate their activities in countries with *lower* standards, *marginally*.

of international treaties, whatever the effective level of enforcement. De facto standards focus on the outcome of such regulations. We therefore provide distinct measures of environmental standards. As for the empirical methodology, we rely heavily on the Foreign Direct Investment (FDI) literature and we run many robustness tests to assess the quality of the results.

We find a negative interaction effect between national environmental standards and firm-level environmental performances. This result clearly supports the *substitution hypothesis*. Firms located in countries with weak environmental regulations are also more likely to be active in CER. However, this negative interaction effect is only significant in the case of *de facto* environmental standards. This result is obtained while controlling for an extensive set of firm characteristics and is robust to the use of different indexes of national environmental standards and estimation techniques, as well as to changes in the sample. More specifically, we show that our results are not driven by one specific sector or by firms coming from, or investing in one specific country or group of countries. We also find that firms with higher environmental responsibility tend to be located abroad more, all things being equal.

The literature on the subject is still quite recent. An abundant literature has tried to deal with the pollution haven hypothesis, but empirical results are rather mixed (Copeland & Taylor, 2004; List & Co, 2000; Keller & Levinson, 2002; Dean, 2002; Eskeland & Harrison, 2003; Ederington *et al.*, 2005; Kellenberg, 2009). An important feature of this literature is the potential influence of foreign firms on national environmental regulations (Cole *et al.*, 2006; Cole & Fredriksson, 2009). Its main limit is that it implicitly assumes that firms are homogeneous in terms of environmental responsibility. Our goal is to test the influence of such heterogeneity on the location behavior of

firms.

To the best of our knowledge, only Dam & Scholtens (2008) have studied the relationship between the pollution haven hypothesis and the environmental responsibility of firms. The authors show that firms exhibiting the highest environmental responsibility levels tend to locate in less dirty countries. In another paper (Dam & Scholtens, 2012), they show that firms which pollute more are relatively more often located in countries with weak environmental regulations and that multinational firms do not influence local environmental regulations significantly.

The topic of our paper is similar, but our analyses differ widely. We use a different index of the environmental responsibility of firms and different measurements of environmental regulation. These differences bring completely opposite conclusions. We find a negative interaction effect between national standards and firm performances, while Dam & Scholtens (2008) find that firms with high environmental responsibility tend to locate in less dirty countries. The use of different indexes of environmental responsibility gives opposite results simply because these different indexes do not aim at measuring the same thing. In other words, it is necessary to take a closer look at what is really measured by these indexes of CER. We use the general environmental score provided by Vigeo. This index aims at measuring the overall performance of firms based on a combined evaluation of (1) the policies conducted by firms, (2) their level of implementation and (3) their results. Dam & Scholtens (2008) focus on four indicators (among a longer list of environmental indexes) published by EIRIS, another extra-financial rating agency: an index of environmental policy, an environmental management index, an environmental reporting index and an index measuring the *evolution* of the environmental impact performance. In

our view, these indexes measure current environmental policies and *evolutions* in environmental performance, but bring little information about the *current* performance. A firm which has a strong experience with environmental responsibility is less likely to exhibit a high dynamic of *improvement*, as we may expect that the cost of improving CER increases marginally. Hence the firms which are currently improving their CER the most are probably those that have the lowest starting point. The effects are therefore very likely to differ. This hypothesis is confirmed by a complementary analysis focusing on the *evolution* of Vigeo environmental scores, which gives results compatible with those of Dam & Scholtens (2008).

The other main difference is the choice of national environmental standards. Dam & Scholtens (2008) use two indexes: the percentage of firms which consider environmental regulation as a major constraint according to the World Business Economic Survey, and the number of international environmental treaties ratified by a country. We use the latter as a proxy of *de jure* environmental standards. Concerning the former, the country coverage is low with a bias towards poor countries. Also, there are inherent margins of error with any single survey that may alter the ability to compare across countries. We therefore adopt a different approach concerning the measurement of *de facto* standards. We focus on the effective environmental performances of countries, mainly using the Environmental Performance Index built by the Yale Center for Environmental Law and Policy and by the Center for International Earth Science Information Network. This index aims at measuring a country's environmental performance and '*"track environmental policy effectiveness through measurable outcomes"*. In order to assess the robustness of our results, we also provide solid evidence based on the Ecological Footprint per unit of GDP.

Our main result remains valid whatever the index chosen.

The remainder of the paper is organized as follows. Section 2 presents the data and Section 3 describes the empirical strategy. The results are presented in Section 4. Lastly, Section 5 concludes.

2 Data

2.1 Measuring the Environmental Responsibility of Firms: The Vigeo Environmental Score

To assess the level of environmental responsibility of firms, we use the data provided by Vigeo, the leading European expert in the assessment of the practices and performances of firms on social, environmental and governance issues. Their rating received the CSRR-QS 2.1 certification of quality developed by the Association of Independent Corporate Sustainability and Responsibility Research. The Vigeo environmental rating takes the following into account: *"the protection, safeguard, prevention of attacks on environment, implementation of an adequate managerial strategy, ecodesign, protection of biodiversity and reasonable control of environmental impacts on the overall life cycle of products and services"*.[3] These objectives are evaluated by Vigeo analysts according to 33 *principles for action*.[4] For each principle for action, they use different

[3]See `http://www.vigeo.com/csr-rating-agency/en/2-2-referentiel-d-analyse` for an explanation of Vigeo's research framework.

[4]Such principles for instance include the "identification, evaluation, and reduction of the risks of environmental accidents", the "avoidance or reduction of the exploitation of sensitive ecosystems", the "reduction of water consumption", or "the effective management of energy consumption and atmospheric emissions".

angles combining precise information related to (1) the leadership or the policies conducted by the firm, (2) the implementation of such policies, and (3) the results. It means that the Vigeo environmental score does not only take firm policies into account, but also the scope of such policies and above all their effective performance.

We use the 2009 Vigeo environmental score. A high value of this index reflects a good evaluation of a firm's environmental performance. The extra-financial rating by Vigeo covers the 600 biggest European firms listed on DJStoxx600, EuroStoxx, SBF250, SBF120 or CAC40. Therefore, the span of our study is not limited to voluntary firms, which would introduce a major selection bias in the analysis.[5]

Within this 600-firm sample, we work with 551 firms for which we have data on other firm characteristics. These firm-level characteristics are presented in subsection 2.3. We observe a huge heterogeneity across these 551 multinational firms, but also across and within sectors. Table 1 presents the descriptive statistics for the whole sample and for each of the Nace 2-digit sectors. The "Transportation and Storage" sector has the highest mean score (0.43), while the "Administrative and Support Service Activities" and "Arts, Entertainment and Recreation" industries are the least responsible on average (0.279 and 0.198, respectively) when we exclude sectors with only one firm.[6]

[5]Since 2003, Vigeo has also been offering audit services to firms. But these two activities (the rating which concerns all firms, and the audit which is a service provided to voluntary firms) are completely separated. Since 2010, the separation between these two activities has been formally reinforced by the creation of two distinct business brands: Vigeo rating and Vigeo enterprise. As mentioned on the Vigeo website, *"The teams dedicated to SRI research (Vigeo rating) and to audits on social responsibility (Vigeo enterprise) are clearly separated, so are their workplaces. Less than 1% of the companies rated by Vigeo rating are clients of Vigeo enterprise"*.

[6]This exemplifies that the environmental performance of firms cannot be limited to the overall level of pollution generated in the production process. The index also takes the effectiveness of policies to reduce the environmental

Table 1: Descriptive Statistics of the Environmental Vigeo Scores

Nace 2-digit Industry	Obs	Mean	Std. Dev.	Min	Max
All	551	0.336	0.17	0	0.73
Accommodation and Food Service Activities	10	0.328	0.116	0.13	0.57
Administrative and Support Service Activities	15	0.279	0.187	0	0.52
Agriculture, Forestry and Fishing	1	0.12	.	0.12	0.12
Arts, Entertainment and Recreation	5	0.198	0.18	0	0.45
Construction	25	0.400	0.129	0.15	0.73
Electricity, Gas, Steam and Air Conditioning	26	0.405	0.094	0.2	0.58
Financial and Insurance Activities	112	0.302	0.188	0	0.67
Information and Communication	55	0.321	0.175	0	0.62
Manufacturing	205	0.345	0.17	0.02	0.71
Mining and Quarrying	18	0.408	0.104	0.13	0.55
Other Service Activities	1	0.23	.	0.23	0.23
Professional, Scientific and Technical Activities	12	0.288	0.135	0.12	0.49
Public Administration and Defense	1	0.16	.	0.16	0.16
Real Estate Activities	13	0.28	0.172	0.02	0.53
Transportation and Storage	16	0.43	0.218	0.01	0.7
Water Supply, Sewerage, Waste Management	5	0.388	0.09	0.26	0.49
Wholesale and Retail Trade	25	0.331	0.144	0.05	0.59
Unclassified	6	0.317	0.126	0.14	0.48

Note: These statistics are calculated on the *Vigeo* scores of the 551 firms for which we have data from Orbis on firm characteristics.

Vigeo indexes are certainly among the most reliable data to measure corporate social and environmental responsibility for European firms. Igalens & Gond (2005) extensively analyze their relevance[7] and conclude that "*this benchmark constitutes a proxy that is particularly suitable for corporate social performance, at least from a theoretical point of view"* (Igalens & Gond, 2005, p. 143). The quality of this data has also been confirmed by Chatterji *et al.* (2009). They use KLD for American firms and compare the "real" environmental performances of firms with

impact into account. In other words, a firm will not be considered as environmentally responsible only because it belongs to a sector which is by definition a low-polluting sector. In order to have a high score, the firm must implement effective policies reducing its overall impact on the environment.

[7]More precisely, in 2000 they studied the quality of ARESE data. Vigeo was founded in 2002, acquiring the activities of ARESE. They are still using a very similar research framework.

KLD's assessment. Their index includes measures of *strengths*[8] and *concerns*[9] that we find in the 33 *principles of action* evaluated by Vigeo. Chatterji *et al.* (2009) conclude that this data is a good predictor of past environmental performances, but a much weaker predictor of future ones.

KLD[10] is often seen as the American counterpart of Vigeo. This article is very useful to assess the quality of Vigeo data indirectly, as Igalens & Gond (2005) have shown that KLD and Vigeo data are very similar.[11] Therefore, we can reasonably assume that Vigeo data is a good predictor of past environmental performances.[12]

Dam & Scholtens (2008) use EIRIS data to measure the environmental responsibility of firms. EIRIS is another extra-financial rating agency which uses a methodology similar to KLD or Vigeo by looking at public data and relying on questionnaires sent to firms. However, there is a significant difference in the ranking process. EIRIS also aims at playing a positive role in the evolution of environmental responsibility. Their research framework clearly mentions they *"encourage the companies to address the issues of concern to investors and to* ***improve*** *their public reporting"*.[13] Also, among all the indicators published by EIRIS, Dam & Scholtens (2008)

[8]Beneficial products and services, Pollution prevention, Recycling, Clean energy, Communications, Property, plant, and equipment, and Other strengths.

[9]Hazardous waste, Regulatory problems, Ozone-depleting chemicals, Substantial emissions, Agricultural chemicals, Climate change, and Other concerns.

[10]Now the MSCI ESG indexes since KLD was bought by RiskMetrics in 2009 and transferred to MSCI in 2010.

[11]The only differences are mainly explained by *"different cultural sensitivities (...) and differences in methodological orientation"* (Igalens & Gond, 2005). The authors conclude that *"The method used to assess the criteria that ARESE developed seems relatively more finely-tuned than its Anglo-American counterpart"* (p. 145).

[12]Unfortunately, it is not possible to replicate the study of Chatterji *et al.* (2009) for European firms. US firms regulated by the US Environmental Protection Agency have to report their real level of carbon emissions and the number and values of penalties associated with violations of major environmental laws. Such harmonized data is not available for European firms.

[13]See the presentation of their research on their website: `http://www.eiris.org/managers/our_research.html`

focus on four indicators of environmental responsibility: "environmental policy", "environmental management", "environmental reporting" and "environmental performance impact improvement". All these indicators measure current policies and the *evolutions* of environmental performances. The drawback is that this brings little information about *current* environmental performances. For instance, the score for the environmental performance impact improvement is determined by the answer to the following question: "What level of improvements in environmental impact can the company demonstrate?". A firm's current overall performance cannot realistically be assessed using this question.

For these reasons, we argue that Vigeo data fit better to measure current environmental performances. Due to the choice of indexes, but also to the methodology used by EIRIS, the data chosen by Dam & Scholtens (2008) focuses much more on *improvements* of environmental performances. As the marginal cost of improving CSR increases, it is easier for a "dirty" company to improve its environmental impact, while it is much more difficult to do so for a firm which has already invested a lot. Due to these differences, our empirical results are very likely to differ from those obtained using EIRIS data. To test our interpretation of both Vigeo and EIRIS data, we run an analysis focusing on the *evolution* of Vigeo scores (See Section 4). We obtain results compatible with those of Dam & Scholtens (2008) confirming our hypothesis.[14]

[14]Unfortunately, we were not able to obtain EIRIS data to compare it directly with Vigeo data.

2.2 Measuring National Environmental Standards

There are two main approaches to measure the stringency of environmental standards: a *de jure* and a *de facto* approach. The goal of the former is to give a quantitative assessment of the stringency of environmental laws, whereas the goal of the latter is to assess the effects of environmental laws on environmental quality. If the environmental legislation is fully effective, any change in this legislation will have a direct impact on environmental quality. However, the effectiveness of environmental policies depends on various factors. First, if the institutional framework is too weak to ensure the effective enforcement of the law, legislation will have no impact on the practices of firms and thus on environmental quality. Also, the effectiveness of such legislation can be undermined by external forces such as tax evasion (in case of environmental taxation) or a strategic behavior of firms aiming at evading the law. Therefore, *de jure* environmental standards may not represent the real constraints which firms face.

This is why we extend the analysis by focusing also on *de facto* standards. The outcome of these policies is therefore the general environmental quality. However, we must notice that environmental quality is not only determined by environmental policies, but also of course by economic development among other factors. Yet, depending on the type of environmental quality under consideration, the effect will be very heterogeneous. The effect is particularly strong when focusing on the case of carbon emissions for instance.[15] For many other dimensions, economic development has the opposite effect. When considering wastes, the use of chemical products or water sanitation, economic development tends to be positively correlated with environmental

[15] According to the environmental Kuznets curve (EKC), the effects are likely to be non-linear, but empirical evidence of such a relation is scarce, at least for carbon emissions.

quality, mainly because of the development of appropriate policies to tackle these issues. It is therefore very difficult to disentangle the effect of economic development and that of environmental policies that can be endogenous to the level of economic development. However, there is no doubt that an inefficient environmental policy has no impact on environmental quality, while an efficient one tends to improve this quality. Environmental policies are also very diverse and it is very difficult to assess their effective impact for a wide range of policies and countries. For all these reasons, our measure of *de facto* regulation is based on environmental quality. The underlying assumption is that environmental quality is positively influenced by the effectiveness of environmental policies.

2.2.1 Measure of *De Jure* Environmental Regulation

A commonly accepted proxy for the level of environmental regulation is the number of international environmental treaties ratified by a country and the number of plans or strategies adopted by a country.[16] This statistic is provided by the World Bank (World Development Indicators) and used by Dam & Scholtens (2008). Beyond the fact that the *de jure* approach may only give little information on the efficiency of regulations with respect to environmental quality, another limit of such an approach should be pointed out. When focusing on international conventions, it is essential to bear in mind that most treaties define several levels of commitment depending on the level of development. For instance, the United Nations Convention on Climate Change

[16]Standardized values of the number of "Participation in treaties (Climate change, Ozone Layer, CFC control, Law of the Sea, Biological diversity, Kyoto Protocol, CITES, CCD, Stockholm Convention)" and "Environmental strategies or action plans" and "Biodiversity assessments, strategies or action plans".

(UNCCC) makes a distinction between annex 1 (mostly industrialized countries and countries in transition) and non-annex 1 countries. Only annex 1 countries have binding goals in terms of GHC reduction according to the Kyoto Protocol. Therefore for non-annex 1 countries, it is not costly to ratify such a protocol, as it does not imply any binding commitments to reduce emissions.

2.2.2 Measure of *De Facto* Environmental Regulation

The second approach relies on *de facto* measurements. The goal is not to measure the stringency of environmental regulations anymore, but to evaluate their real impact. As stated above, it is not possible to assess the effectiveness of environmental legislation directly for a wide range of policies and countries. We will therefore focus on the *outcome* of these policies which is environmental quality. We are aware that this quality can be influenced by many other aspects, but countries with more ambitious and effective environmental policies also tend to have better environmental quality. Therefore, we propose to use the Environmental Performance Index (EPI, 2008) built by the Yale Center for Environmental Law and Policy (YCELP) and the Center for International Earth Science Information Network (CIESIN, Columbia University). It provides "*quantitative metrics for evaluating a country's environmental performance in different policy categories relative to clearly defined targets*".[17] It covers environmental health, air quality, water resource management, biodiversity and habitat, forestry, fisheries, agriculture, and climate change. The goal of this index is explicitly to "*track policy effectiveness through measurable*

[17]See `http://sedac.ciesin.columbia.edu/data/set/epi-environmental-performance-index-2010` for more details.

outcomes". Each indicator included in the EPI is associated with a policy target. These policy targets are mainly drawn from international environmental treaties, echoing our *de jure* index. To the best of our knowledge, the EPI is the most complete index measuring real environmental performances for a large sample of countries.

Table 2 presents some descriptive statistics for these variables and Table 3 shows the correlation matrix between our two environmental standard indexes, GDP and GDP per capita. We can observe a very weak correlation between the environmental standard indexes, which justifies the use of both *de jure* and *de facto* indexes. We can also notice a weak correlation with GDP and GDP per capita. It is very close to 0 for treaties and 0.17 for the correlation between GDP per capita and the EPI. If we have a look at some selected countries (see Table 4), we can see some examples of broad disparities between the ratification of treaties and environmental performances. China for instance has ratified 11 treaties out of 12, but its EPI score is relatively low. On the contrary, Germany has only ratified 9 treaties, but its EPI score is much higher. It is noteworthy that a significant number of developing countries have excellent environmental performances according to the EPI. Costa Rica was for instance ranked third (after Iceland and Switzerland) in 2008. The position of the United States is ambivalent. Indeed, the number of treaties it has ratified is very low, and its EPI score is fair, yet below the level observed for other developed countries. This highlights the need to use different indexes to assess the impact of environmental regulation on the location choices of firms.

Table 2: Descriptive Statistics of Environmental Indexes

Variable	Obs	Mean	Std. Dev.	Min	Max
Treaties	140	9.357143	1.383726	1	11
EPI	140	0.7196143	0.1282365	0.391	0.955

Note: Treaties is the standardized value of the number of "Participation in treaties", "Environmental strategies or action plans" and "Biodiversity assessments, strategies or action plans". It is provided by the World Bank (WB) for 2009. EPI is the Environmental Performance Index measured by the Yale Center for Environmental Law and Policy and the CIESIN, Columbia University for 2008.

Table 3: Cross-Correlation Table

Variables	Treaties	EPI	GDP	GDP p.c.
Treaties	1			
EPI	-0.09	1		
GDP	-0.1001	0.56	1	
GDP p.c.	-0.0713	0.1712	0.3576	1

2.2.3 Additional Measures of *De Jure* / *De Facto* Environmental Regulation

To assess the robustness of our results, we also provide some estimations using alternative indexes both for *de jure* and *de facto* standards. The main problem with international treaties is the heterogeneity in their nature. Some treaties are binding (such as the Kyoto Protocol), some are not (the Ozone Layer Treaty or the 1992 Climate Change Treaty). Also, some treaties or environmental strategies are poorly connected with the stringency of regulations for firms. The link between the location of firms and the existence of a national biodiversity action plan or the country's participation in the Law of the Sea is more likely to be weak. In addition, we thus build two alternative indexes: the standardized value of the number of "participation in binding treaties" (CFC control, Law of the Sea, Biological diversity, Kyoto Protocol, CITES, CCD, Stockholm Convention) and the standardized value of the number of "participation in

Table 4: Environmental Country Indexes (Selected Countries)

Variables	Treaties	EPI
Argentina	10	81.8
Brazil	10	82.7
Canada	11	86.6
China	11	65.1
Costa Rica	11	90.5
France	10	87.8
Ghana	11	70.8
Germany	9	86.3
Japan	9	84.5
South Africa	10	69
South Korea	9	79.4
United Kingdom	11	86.3
United States	7	81
United Arab Emirates	8	64

binding treaties related to air pollutants"[18]. The latter variable is more likely to reflect binding constraints on firms. We will see that the results are similar when using these different indexes.

Concerning *de facto* standards, the alternative would be to focus on the subjective impact of environmental legislation on firms, based on surveys of entrepreneurs. The World Business Economic Survey (WBES) conducted by the World Bank in various countries identifies the percentage of firms considering environmental regulation as a major constraint. The problem of such a variable, used by Dam & Scholtens (2008), is that the country coverage is low, with a bias towards poor countries. Also, there are inherent margins of error associated with any single survey results that may alter the ability to compare across countries.[19]

We therefore focus on another index measuring the general environmental quality. One of the most popular aggregate indexes of environmental sustainability is the Ecological Footprint (EF). It is a measure given in global hectares measuring *"how much land and water area a*

[18]CFC control, Kyoto Protocol, Stockholm Convention

[19]This point is clearly mentioned in the conditions of use of the WBES.

human population requires to produce the resources it consumes and to absorb its wastes under prevailing technologies"' (Wackernagel & Rees, 1996). It is provided by the Global Footprint Network (2013).

Pillarisetti & Bergh (2010) consider the case of the three most influential aggregate indexes of sustainability: the World Bank's Adjusted Net Savings measure, the Ecological Footprint and the Environmental Sustainability Index (which is the former version of the Environmental Performance Index). They discuss the main limitations and weaknesses of each of these indexes and observe that they yield conflicting results. This highlights the need to test the robustness of our results using different indexes. For our study, the main limitation of the EF is the very strong correlation with the GDP level (0.91 in our data). It can be explained by the underlying assumption in this index. As noticed by Pillarisetti & Bergh (2010), *"EF considers depletion of natural resources as the central element of sustainability. (...) EF thus suggest [sic] that scale of economic activity is perhaps most crucial of all sustainability issues"*. Our focus here is not nations' sustainability as such, but the potential impact of environmental regulation on the location choices of firms. That is why we need to isolate the effect of environmental quality from the effect of wealth. In order to do so, we propose to use the Ecological Footprint per unit of GDP for the year 2008.

The last index considered by Pillarisetti & Bergh (2010) is the Adjusted Net Saving, which is a saving rate taking into account gross domestic savings, current expenditures on education, the rent from depletion of natural capacity, CO2 damage and other environmental damage. While this index may be relevant to assess the sustainability of countries, it is very difficult to justify

using it in our study, as it is based on gross saving rates and also includes measures of education.

2.3 Firm Location Variables

We combine our Vigeo dataset with Orbis, the ownership database provided by the Bureau van Dijk.[20] We use the procedure developed by Altomonte & Rungi (2013) to define the location of the firms in the Vigeo dataset. The Vigeo sample of firms represents 11.80% of the Orbis database in terms of total assets, but only 2.27% when we exclude financial firms. This can be explained by the fact that firms in the financial sector are over-represented in our sample, and those firms have very large total assets compared to firms in other sectors. Table 5 shows the share of firms by sector, in our sample and in the total population of Orbis firms. As Vigeo scores the largest firms in terms of market capitalization, some sectors (such as "Manufacturing" or "Financial and Insurance Activities") are obviously over-represented in our sample. However, these firms are also the ones that are more likely to be located abroad, which is consistent with the purpose of this paper. Furthermore, we will provide a wide range of robustness checks showing that our results are not driven by one specific sector that could be over-represented in our sample of firms.

The 551 firms of the *Vigeo* sample that are found in the Orbis database are located in 182 countries. On average, each firm has affiliates in 12 countries and the maximum number of location countries is 138. The number of firms located in each country is then very heterogeneous. It is summed up in Table 6 that shows that firms are more located in Europe than in other regions. It is completely straightforward since Vigeo is rating only European firms and we know from the

[20] Orbis covers around 100 million companies worldwide and provides information on shareholder links.

Table 5: Distribution of the Vigeo Sample

NACE 2-digit industry	% **of firms**		% **of total assets**	
	Vigeo	**Orbis**	**Vigeo**	**Orbis**
Financial and Insurance Activities	20.33	6.06	80.81	70.34
Manufacturing	37.21	11.97	7.89	8.20
Electricity, Gas, Steam and Air Conditioning	4.72	0.58	3.25	2.18
Mining and Quarrying	3.27	0.31	2.46	1.70
Information and Communication	9.98	4.58	2.43	1.92
Construction	4.54	12.93	0.81	1.53
Wholesale and Retail Trade	4.54	20.14	0.75	2.81
Transportation and Storage	2.90	3.25	0.43	1.45
Administrative and Support Service Activities	2.72	5.46	0.28	1.41
Professional, Scientific and Technical Activities	2.18	12.30	0.25	4.46
Real Estate Activities	2.36	7.53	0.19	1.71
Water Supply, Sewerage, Waste Management	0.91	0.48	0.17	0.27
Accommodation and Food Service Activities	1.81	3.74	0.14	0.33
Other Service Activities	0.18	3.07	0.06	0.63
Arts, Entertainment and Recreation	0.91	1.54	0.02	0.16
Public Administration and Defense	0.18	0.13	0.01	0.18
Agriculture, Forestry and Fishing	0.18	2.02	0.01	0.17
Others	0.00	3.93	0.00	0.56

Note: The data in the *Vigeo* sample are calculated on the sample of the 551 firms for which we have firm-level characteristics from *Orbis*. The data from the *Vigeo* and the whole *Orbis* samples are for the year 2010.

FDI literature that the distance between the headquarter and potential destination countries is a big (negative) determinant of firms' location decision. The first two destination countries are the United Kingdom and the US with respectively 90% and 79% of the firms that have affiliates there.

Table 6: Number of Firms of the Vigeo Sample

	# of firms, by country			
	Mean	Std Dev.	Min	Max
Europe	176.18	123.20	13	461
America	86.23	102.13	2	405
Asia & Pacific	85.14	85.73	1	253
Middle East	31.23	36.07	2	117
Africa	26.51	35.42	1	188

Table 7: Top 10 destination countries

	# of firms	Epi Index
GBR	461	0.86
USA	405	0.81
NLD	372	0.79
FRA	357	0.88
DEU	356	0.86
BEL	345	0.78
ESP	328	0.83
ITA	309	0.84
CHE	291	0.96
CAN	280	0.87

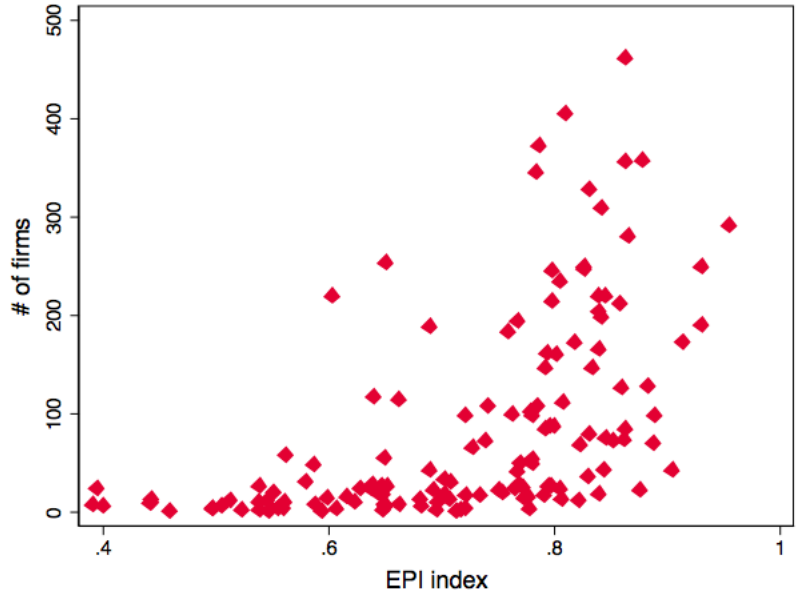
These two countries are only the 14th and 37th best countries in terms of this EPI index. Figure 1 presents the relationship between the EPI index of country-specific environmental performance and the number of firms that have affiliates in these countries. We observe that this relationship is positive but that some very environmentally responsible countries host a very low number of firms.

2.4 Other Control Variables

We control both for firm and country characteristics that may explain a firm's decision to locate in a given country. To define such a set of control variables, we mainly follow Blonigen & Piger (2011) whose goal is to define robust determinants of FDI. When country fixed effects are not included, we use GDP and GDP per capita to control for the size of the market. We also add a measure of market potential in the neighboring countries.[21] All these variables come from the World Development Indicators database. We also add a variable corresponding to the number

[21] This measure was firstly proposed by Harris (1954). Country i's market potential is measured as $MP_i = \sum \frac{x_j}{d_{i,j}}$ where x_j is the GDP of country j and $d_{i,j}$ is a measure of the geographical distance between countries i and j.

Figure 1: Environmental Standards and # of Firms, by Destination



Note: This Figure plots the *EPI* index in 2008 and the number of firms that have affiliates located in each country in 2010. This number of firms is measured thanks to the Orbis database.

of business days needed to obtain legal status to operate a firm (in 2008), from the World Bank Doing Business database. Finally, we use the distance between the country of the holding and that of the subsidiary and a dummy variable taking the value 1 when both countries share the same language. Both variables are from CEPII (Mayer & Signago, 2006).

At the firm level, we rely on variables used by Hakkala *et al.* (2008) and also propose a specification close to the one used by Dam & Scholtens (2008). All variables come from Orbis. We control for the assets, the age, the operating revenue, the liabilities, the liquidity and the total number of employees. Compared with the specification of Dam & Scholtens (2008), we prefer to use the asset level rather than the market capitalization, as the former is more stable than the latter, especially in times of crisis. We also use the operational revenue rather than

the sales level. The sales variable is not available for banks and the financial sector. Using this variable would introduce a sectoral bias in the analysis.

3 Hypotheses and Empirical Strategy

Our goal is to study the interaction between a firm's level of environmental performance (measured by the Vigeo CER score) and national environmental standards (measured by a set of *de facto* and *de jure* indexes) to explain the location choices of European firms. Arguably, two main hypotheses can be made on this relation.

Hypothesis 1 *Complementarity between CER and environmental standards: firms with a better environmental performance invest more in countries with higher environmental standards.*

Hypothesis 2 *Substitution between CER and environmental standards: firms with a better environmental performance invest less in countries with higher environmental standards.*

In order to discriminate between these two possible hypotheses, we estimate the effect of both country-specific and firm-specific environmental practices on the location decision of a firm and the country of destination. The location decision is a discrete variable, which is equal to 1 if firm i is located in destination country d, and to 0 otherwise. Thus, the use of a probit model is particularly appropriate.[22] The probability for firm i of being located in destination country d is:

[22]We are aware that the inclusion of fixed effects in non-linear models can bias the results due to the problem of incidental parameters. However, we introduce these fixed effects to control for unobserved heterogeneity which can be important among countries and sectors. Furthermore, this bias seems to be large for samples with small T which is not the case here. Hsiao (1996) has shown that the bias can be as much as +100% for $T(i) = 2$.

$$Prob(Y_{id} = 1) = \begin{cases} 1 & \text{if} \quad \alpha CER_i + \beta Env.Std_d + \gamma CER_i * Env.Std_d + \mathbf{Ctrl} + \epsilon_{\mathbf{id}} > \mathbf{0} \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

where CER_i is the *Vigeo* environmental performance of firm i and $Env.Std_d$ is the environmental standard in destination country d. $CER_i * Env.Std_d$ is the interaction between both firm-specific and destination country measures of environmental performance. We then include a vector of control variables, **Ctrl**, which aims at capturing firm and destination country variables that influence the location decision of firm i in country d. Firm-level controls include the logarithm of total assets, the operating revenue, liabilities, the number of employees, the age and the liquidity ratio of the headquarters. We control for country characteristics such as the logarithm of GDP, GDP per capita, market potential and the number of days needed to start a firm. We also include origin and destination country-specific variables to control for the effect of distance and common language between both countries on the location decision of multinational firms. Finally, we also control for industry-specific and origin country-specific potential omitted variables, including NACE 2-digit industry and origin country fixed effects.

However, Heckman (1981) found in a Monte Carlo study that the bias was towards zero and the order of 10% when $T(i) = 8$ and $N = 100$. This result has been widely discussed. Greene (2004) showed for instance that the bias was more important even for T(i)=8, but he found that this bias decreased strongly when T increased. Also, the bias is much lower for marginal effects (on which we focus here). Fernández-Val (2009) showed that "the bias [in average marginal effects] *is negligible relative to the true average marginal effect for a wide variety of distributions of regressors and individual effects and is identically zero in the absence of heterogeneity.*" (p.72). Considering the structure of our data, we therefore consider that the possible bias introduced by the inclusion of fixed effects is more likely to be negligible and much less problematic than the omitted variable bias and the problems of unobserved heterogeneity we will face if we do not include these fixed effects. Furthermore, as a robustness check, we ran logit regressions and obtained perfectly similar results.

If the *complementarity hypothesis* is verified, we expect a positive estimated coefficient for interaction term (γ). For a given level of environmental standard, firms with a higher environmental performance will tend to be located in countries with better environmental performances. On the contrary, if the *substitution hypothesis* is verified, we expect the estimated γ to be negative. Firms with a higher level of environmental performances will then tend to be located in countries with lower environmental standards.

4 Results

De Jure Standards

First, we estimate the effect of the environmental performance of a firm on the probability of locating abroad. We find that the effect of the CER index of the firm's environmental performance is positive and significant, as shown in column (1) of Table 8. This specification includes destination country, origin country, and NACE 2-digit industry fixed effects. These fixed effects aim at controlling for the omitted variable bias, taking the potential difference in the origin and destination country regulations into account, but also industry specificities that affect the location of firms. This last set of dummies allows to control for the fact that, for instance, firms in the *Mining and Quarrying* sector are more often located in countries with natural resources. In column (2), we include our set of firm-level variables that control for firm characteristics influencing the location decision, such as their size and age. We also use bilateral control variables for the distance and the common language between the origin and

destination country, which are known to influence firms' location decisions significantly in the FDI literature. We find that the marginal effect of the environmental performance of a firm is lower (0.0227 against 0.2151), but is still positive and highly significant. This first result suggests that the environmental behavior of a firm is a significant determinant of its location decisions.

In column (3), we then introduce an interaction term between the CER index and the *de jure* index of environmental standards: the destination country-specific number of environmental treaties ratified. We find no evidence that the effect of the environmental performance of a firm on its location decision is conditional on environmental standards in destination countries, measured at the *de jure* level. To test the robustness of our result on the interaction term, we do not include the CER variable in column (4), and then introduce firm, destination country fixed effects and bilateral country control variables. Even in this specification that controls for firm and destination country omitted variables, the interaction term is estimated to have no significant effect.

In column (5), we introduce destination country variables instead of fixed effects. The goal is to be able to compute the magnitude of the interaction effect properly. In non-linear models, the magnitude is not equal to the marginal effect and can be of opposite sign. The Ai & Norton (2003) procedure is then needed to estimate these effects correctly, but we have to include the two variables composing the interaction variable in the specification. This cannot be done when we include destination country fixed effects, so we introduce the main country characteristics influencing FDI instead: GDP per capita, GDP, market potential and the number of business days needed to obtain legal status to operate a firm. Our main result holds. The interaction

effect is not significant, while the environmental responsibility has a positive and significant impact on the probability of locating abroad. It is noteworthy that our index of environmental standards is positively correlated with the probability of being located in a country. This result may invalidate the pollution haven hypothesis. It should however be interpreted very carefully. As noticed by Cole *et al.* (2006) and Cole & Fredriksson (2009), environmental policies are likely to be endogenous to FDI. Dealing with the endogeneity of environmental standards goes beyond the scope of this paper.

All in all, we find that *de jure* environmental standards have no significant effect on the way environmental responsibility impacts firms' location choices. One potential explanation is the gap between legislation and effective enforcement. Also, and as mentioned already, countries have different levels of commitment when ratifying an international treaty. Within the framework of the UNCCC, non-annex 1 countries have no obligation to reduce their emissions. We should therefore look at the possible effect of *de facto* environmental standards.

De Facto Standards

We now analyze the potential conditional effect of CER on *de facto* standards in the destination country. Column (1) of Table 9 shows that the effect of a firm's environmental performance is conditional on *de facto* standards. Indeed, the interaction term between CER and the EPI measure of regulation has a negative and significant effect on the location of firms. This negative effect of the interaction term is robust to the inclusion of a firm fixed effect, instead of the firm-level control variables and industry and origin country fixed effects (column (2)). This

specification allows to ensure that the effect of the interaction term is not driven by firm or destination country omitted variables.

Then we introduce destination country variables instead of fixed effects as we did in the previous set of estimates. The main result holds. The interaction effect is still negative and highly significant. The estimated impact of corporate environmental responsibility remains very stable with a positive coefficient of 0.03. The estimated coefficient for the EPI is positive and significant again, suggesting that firms locate in countries with higher environmental performances. However, as noted above, great caution should be used in interpreting this result since we have not controlled for the possible endogeneity of these standards. All other control variables have the expected sign.[23]

Finally, we introduce jointly the number of treaties and the EPI in columns (4) to (6). The results are not affected by the common inclusion of both variables of countries' environmental standards. The interaction is still not significant for $CER \times \#\ of\ Treaties$, while it is negative and significant for $CER \times EPI$. This last result confirms the heterogeneous effect of *de jure* and *de facto* standards. It is worth noticing that the estimated effect of national standards remains positive and significant both for the number of treaties and the EPI. All other control variables keep the same sign and significance.

We calculate the estimated marginal effects for both the EPI and CER. The effect of a one

[23]It is noteworthy that the sign of the GDP per capita coefficient has changed compared with the one obtained in Table 8. The lack of stability of the estimated effect of GDP per capita is common in the literature. Blonigen & Piger (2011) do not include it in the set of robust determinants of FDI which they elaborate. The main problem of this variable is that it reflects two dimensions: consumers' living standards, but also labor costs. Depending on the main force driving FDI, the sign of the coefficient can either be positive or negative, but this should not affect our results concerning our variables of interest. As shown in Table 3, the correlation between the EPI and GDP per capita is very low (0.17).

standard deviation increase in the CER index on the probability that a firm be located in a given country when the EPI is at its mean (0.72) is 0.006 ($= 0.0349 \times 0.17$). Furthermore, we find that the estimated marginal effect of a one-standard-deviation increase in a firm's environmental responsibility on its probability of locating in a country decreases with the country's EPI. More precisely, the positive estimated marginal effect of the CER index becomes negative for countries with an EPI score of 0.8874 or more. The first country that has an EPI score greater than 0.8874 is Latvia (0.888). The group of countries for which the marginal effect of the CER index is negative represents 5% of our 140-country sample. Furthermore, 5 of the 7 countries in that group which are above the threshold are located in Europe. Similarly, we calculate the estimated marginal effect of the EPI and find that it decreases with the CER index, but that it is positive on the whole distribution of firms. The estimated marginal effect of a one-standard-deviation increase in the EPI when the CER index is at its mean (0.336) is 0.03.

All in all, we find that the environmental performance of a firm has a significant and positive impact on its location abroad. However, this effect is conditional on *de facto* environmental regulations in the destination country, not on *de jure* ones. More precisely, the country's environmental performance has a negative impact on the probability of environmentally responsible firms locating abroad. This result validates the substitution hypothesis in opposition to the complementary hypothesis.

Alternative Indexes of National Standards

We use alternative indexes of countries' environmental performances in our estimations. The results concerning "air pollutant treaties" and "binding treaties" are perfectly similar. When using WBES, the interaction variable is not significant, but this can easily be explained by the strong reduction in the sample size and the problems of international comparability mentioned in the conditions of use of this database.[24]

We therefore focus our analysis on one alternative index of *de facto* environmental standards proxied by environmental quality: the Global Ecological Footprint. In order to disentangle the effect of wealth and the effect of environmental quality, we divide the Global Ecological Footprint by the level of GDP. We therefore use a standardized value of the Ecological Footprint per unit of GDP. Our results are given in table 10, using the same specifications as in the previous sets of estimates. Contrary to the EPI, a higher value of the Ecological Footprint indicates a lower level of environmental quality.

The estimated coefficient of the interaction term is positive and significant in the three specifications. Our results are in line with those obtained using the EPI as a proxy for environmental standards, which confirms their robustness. The impact of CER on the probability of locating abroad is still estimated to be positive. However, in the third specification, the Ecological Footprint coefficient is positive, in contradiction with what was found using the EPI. This last result denotes the difficulty to isolate the effect related to the pollution haven hypothesis. However, our main result remains valid: the interaction effect between national standards and firm

[24]Results are available upon request.

performances is negative, confirming the substitution hypothesis.

Sectorial and Geographical Robustness Checks

As mentioned above, the firms in our sample belong to very different sectors. In Table 11, we check whether some particular sectors could drive our results. In column (1), we estimate the same specification as in column 1 of Table 9, but we restrict our sample to firms that do not belong to the *Mining and Quarrying* sector. Arguably, our results are robust: the positive and significant effect of the firm-specific CER index and the negative and significant effect of the interaction term hold. We replicate this exercise excluding firms of the *Finance and Insurance Activities* sector (column 2), and then all firms in the service sector (column 3). We define the service sector as firms belonging to "Accommodation and Food Service Activities", "Administrative and Support Service Activities", "Financial and Insurance Activities", "Information and Communication", "Professional, Scientific and Technical Activities", "Public Administration and Defense" and "Other Service Activities". The results are also qualitatively the same. We also test the robustness of our results replicating specifications 1 and 2 presented in Table 11, extending them to all other sectors. We find that the results obtained with both *de jure* and *de facto* measures of environmental standards hold in all of these specifications.

We run similar exercises, but testing whether our results are driven by firms coming from or going to some specific countries. We thus exclude firms from one of the European origin countries from our sample each time, and find that our results still hold in each of the specifications (see Table 12). Finally, we run regressions excluding destination countries by group. We consider

12 groups of countries here, defined on a geographical basis.[25] In the case of *de jure* standards, our result holds for all specifications. However, we find that in the case of *de facto* standards, our results are robust in all of these specifications, except for the specification which excludes Europe from the list of potential destination countries (see Table 13). In this case, the effect of the environmental performance of firms is not estimated to be conditional on destination country regulations. This could be explained by the fact that most of the countries for which the effect of the EPI becomes negative are located in Europe. All of these results are robust when we use logit or nested logit estimations, and when we run the Ai & Norton (2003) procedure.

Further Analysis

Our results and robustness checks support the hypothesis that firms with a high environmental performance index are less located in cleaner countries (when measuring the environmental performance of the country with *de facto* indexes). However, this totally contradicts the findings of Dam & Scholtens (2008). As we have already mentioned, the main difference between our analysis and that of Dam & Scholtens (2008) is the use of firm-specific indexes of environmental performance that differ widely. Dam & Scholtens (2008) focus on indicators provided by EIRIS measuring *current* environmental policies and *evolutions* of environmental performance. We use $Vigeo$ scores of environmental performances measuring *current* performances. We claim that firms which are currently improving their CER (i) are probably those that have the lowest start-

[25] We classify countries as belonging to one of the following groups: Europe, North America, South America, Central America, Middle East, Northeast Asia, Southeast Asia, South Asia, Central Asia, North Africa, Rest of Africa and Pacific.

ing point (the lowest $CER\ Vigeo$ indexes in our sample of firms), and (ii) should be the ones that try to avoid dirty countries, since they are investing money to improve their environmental image. In other words, if firms that improved their $CER\ Vigeo$ index over the past years were less located in dirty countries in 2010, it would reconcile our findings with those of Dam & Scholtens (2008).

We now focus on the *evolution* of the Vigeo environmental scores of the firms in our sample and estimate how it affected the location decisions of these firms in 2010. Columns 1 to 3 in Table 14 replicate our main specifications (columns 1 to 3 in Table 9), but they explain the location decisions by the evolution of each firm's CER index between 2005 and 2009 ($CER\ evolution$)[26], instead of the CER index in 2009. We also use an interaction term between this $CER\ evolution$ variable and the EPI destination country-specific measure of environmental performance. We find no significant effect of the $CER\ evolution$ index and of the interaction term. Nevertheless, note that the signs of the estimated (nonsignificant) coefficients are the opposite of those we find when using the CER index in 2009. Then, we create a dummy that is equal to 1 if the $CER\ evolution$ index is higher than 1, and 0 otherwise. This variable captures whether the firm experienced a positive or a negative evolution of its environmental performance between 2005 and 2009. Columns 4 to 6 of Table 14 show the results of the estimation using this dummy variable of the environmental performance evolution. We find that the $CER\ evolution$ still does not affect firm location decisions. However, we do find a positive and significant effect of the interaction term: firms that have a better CER score in 2009 than in 2005 are less located in

[26] $CER\ evolution$ is measured by the ratio between the CER index in 2009 and the CER index in 2005: $CER\ evolution = CER_{2009}/CER_{2005}$.

dirty countries. This last result provides empirical evidence that our main finding is not driven by the fact that the *Vigeo* sample of firms is not the same as the one used by Dam & Scholtens (2008). Above all, we are able to replicate their main finding with our sample of firms when explaining the location decisions of firms by an index of environmental evolution.

5 Discussion and Conclusion

Focusing on the current environmental performances of firms rather than on their current managerial decisions gives a completely different picture from the one described by Dam & Scholtens (2008). Our main result is that firms with good environmental performances tend to be located in "dirtier" countries, at least when considering *de facto* national performances in terms of environment. More precisely, we show that national environmental performances downgrade any positive effect which the environmental responsibility of firms may have on their probability of being located abroad. This result is robust to various specifications and econometric methods. It tends to confirm the *substitution hypothesis* between CER and environmental standards.

It is worth noticing that the negative interaction term which we found between CER and national standards is only significant when considering *de facto* standards, but not when considering *de jure* ones. One may think that being located in countries with very weak environmental legislation is counterproductive for a firm which aims at improving its environmental responsibility. However, as it is much more complicated to observe a country's real environmental performance, this limitation is raised for countries which have good environmental legislation,

but enforce it poorly. One possible explanation is that firms which invest in dirty countries must have a higher level of CER to minimize the risk of reputation loss.

Two main conclusions can be drawn from this result; advocating one or the other is left for future research. The first hypothesis is that firms may compensate for their investments in CER in developed countries by adopting a pure cost-minimizing behavior when locating abroad. In other words, firms may relocate their irresponsibility abroad and try to hide it. Ratifying environmental agreements to improve a country's image or reputation without ensuring that these agreements are respected may then be a deliberate strategy for states, thus offering firms an apparently clean image with significant tolerance in day to day business in fact.

However, the other hypothesis is that these firms actually perform well in these countries. This would be consistent with the general observation that foreign firms tend to perform better than local ones. This can be positive for these countries, as it may reinforce their environmental performances in the long run. It may explain why we found a positive relation between a country's environmental performance and the probability for a firm of being located in this country. Nevertheless, it raises the issue of the motivation of firms that deliberately choose to invest in countries with poor environmental performances, even if these firms actually perform well in terms of environment.

More generally, we have shown that firms with relatively good environmental performances tend to be located abroad more often than other firms, all other things being equal. There is no apparent contradiction for a firm between being responsible and being multinational.

This paper has shown that good CER firms can either be angels, locating in dirty countries

and thus allowing these countries to improve their environmental standards, or demons, trying to hide their environmentally harmful behavior abroad by exploiting the differences between *de facto* and *de jure* standards. Further investigations are therefore needed, in particular to explain the motivations of firms that both invest in CER and locate in dirty countries.

References

Ai, Chunrong, & Norton, Edward C. 2003. Interaction terms in logit and probit models. *Economics Letters*, **80**(1), 123–129.

Altomonte, C., & Rungi, A. 2013. *Business Groups as Hierarchies of Firms: Determinants of Vertical Integration and Performance.* mimeo - ÒPaolo BaffiÓ Centre Research.

Blonigen, Bruce A., & Piger, Jeremy. 2011 (Jan.). *Determinants of Foreign Direct Investment.* NBER Working Papers 16704. National Bureau of Economic Research, Inc.

Chatterji, Aaron K., Levine, David I., & Toffel, Michael W. 2009. How Well Do Social Ratings Actually Measure Corporate Social Responsibility? *Journal of Economics & Management Strategy*, **18**(1), 125–169.

Cole, Matthew A., & Fredriksson, Per G. 2009. Institutionalized pollution havens. *Ecological Economics*, **68**(4), 1239–1256.

Cole, Matthew A., Elliott, Robert J. R., & Fredriksson, Per G. 2006. Endogenous Pollution

Havens: Does FDI Influence Environmental Regulations? *Scandinavian Journal of Economics*, **108**(1), 157–178.

Copeland, Brian R., & Taylor, M. Scott. 2004. Trade, Growth, and the Environment. *Journal of Economic Literature*, **42**(1), 7–71.

Dam, Lammertjan, & Scholtens, Bert. 2008. Environmental regulation and MNEs location: Does CSR matter? *Ecological Economics*, **67**(1), 55–65.

Dam, Lammertjan, & Scholtens, Bert. 2012. The curse of the haven: The impact of multinational enterprise on environmental regulation. *Ecological Economics*, **78**(C), 148–156.

Dean, Judith M. 2002. Does trade liberalization harm the environment? A new test. *Canadian Journal of Economics*, **35**(4), 819–842.

Ederington, Josh, Levinson, Arik, & Minier, Jenny. 2005. Footloose and Pollution-Free. *The Review of Economics and Statistics*, **87**(1), 92–99.

EPI. 2008. *2008 Environmental Performance Index (EPI)*. Yale Center for Environmental Law and Policy (YCELP)/Yale University, Center for International Earth Science Information Network (CIESIN)/Columbia University, World Economic Forum (WEF), Joint Research Centre (JRC)/European Commission. 2010. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). http://sedac.ciesin.columbia.edu/data/set/epi-environmental-performance-index-2010.

Eskeland, Gunnar S., & Harrison, Ann E. 2003. Moving to greener pastures? Multinationals and the pollution haven hypothesis. *Journal of Development Economics*, **70**(1), 1–23.

Fernández-Val, Iván. 2009. Fixed effects estimation of structural parameters and marginal effects in panel probit models. *Journal of Econometrics*, **150**(1), 71–85.

Global Footprint Network. 2013. *National Footprint Accounts, 2011 Edition.* Available online at `http://www.footprintnetwork.org`.

Greene, William. 2004. Fixed Effects and Bias Due to the Incidental Parameters Problem in the Tobit Model. *Econometric Reviews*, **23**(2), 125–147.

Hakkala, Katariina Nilsson, Norbäck, Pehr-Johan, & Svaleryd, Helena. 2008. Asymmetric Effects of Corruption on FDI: Evidence from Swedish Multinational Firms. *The Review of Economics and Statistics*, **90**(4), 627–642.

Harris, Chauncy D. 1954. The Market Factor in the Localization of Industry in the United States. *1nnals of the Association of American Geographers*, **64**, 315–348.

Heckman, J.J. 1981. The incidental parameters problem and the problem of initial conditions in estimating a discrete-time data stochastic process. *In:* Manski, C.F., & McFadden, D. (eds), *Structural Analysis of Discrete Data with Econometric Applications.* New York: MIT Press.

Hsiao, C. 1996. Logit and probit models. *In:* Matyas, L., & Sevestre, P. (eds), *The Econometrics of Panel Data: Handbook of Theory and Applications. Second Revised Edition.* Dordrecht: Kluwer Academic Publishers.

Igalens, J., & Gond, J.P. 2005. Measuring Corporate Social Performance in France: A Critical and Empirical Analysis of ARESE Data. *Journal of Business Ethics*, **56(2)**, 131–148.

Kellenberg, Derek K. 2009. An empirical investigation of the pollution haven effect with strategic environment and trade policy. *Journal of International Economics*, **78**(2), 242–255.

Keller, Wolfgang, & Levinson, Arik. 2002. Pollution Abatement Costs and Foreign Direct Investment Inflows to U.S. States. *The Review of Economics and Statistics*, **84**(4), pp. 691–703.

List, John A., & Co, Catherine Y. 2000. The Effects of Environmental Regulations on Foreign Direct Investment. *Journal of Environmental Economics and Management*, **40**(1), 1 – 20.

Mayer, T., & Signago, S. 2006. *Note on cepii's distances measures.* mimeo.

Pillarisetti, J., & Bergh, Jeroen. 2010. Sustainable nations: what do aggregate indexes tell us? *Environment, Development and Sustainability*, **12**(1), 49–62.

Wackernagel, M., & Rees, W. 1996. *Our ecological footprint: Reducing human impat on the earth.* Gabriola Island, Canada: New Society Publishers.

6 Tables

Table 8: Location Determinants: the Effect of CER and *De Jure* Standards

Dependent Variable	Location				
Specifications	(1)	(2)	(3)	(4)	(5)
CER	0.2151***	0.0227***	0.0220***		0.0259***
	(0.0081)	(0.00740)	(0.00742)		(0.00786)
CER × # of Treaties			0.00494	0.00213	0.00810
			(0.00488)	(0.00257)	(0.00524)
# of Treaties					0.0150***
					(0.00156)
Distance		-0.0838***	-0.0839***	-0.0481***	-0.0353***
		(0.00704)	(0.00704)	(0.00441)	(0.00311)
Com. Language		0.0428***	0.0428***	0.0294***	0.0503***
		(0.00724)	(0.00724)	(0.00485)	(0.0108)
Assets		0.0122**	0.0122**		0.0129**
		(0.00532)	(0.00532)		(0.00620)
Age		0.0129***	0.0129***		0.0147**
		(0.00189)	(0.00189)		(0.00218)
Op. Revenue		0.0485***	0.0485***		0.0550***
		(0.00255)	(0.00255)		(0.00324)
Liabilities		-0.0268***	-0.0268***		-0.0294***
		(0.00456)	(0.00456)		(0.00535)
Liquidity		0.00777***	0.00778***		0.00948***
		(0.00247)	(0.00247)		(0.00292)
# of Employees		0.00395***	0.00395***		0.00436***
		(0.000424)	(0.000424)		(0.000473)
GDP per Capita					0.0150***
					(0.00231)
GDP					0.0496***
					(0.00183)
Market Potential					0.00769
					(0.00783)
# of Days					-0.00650***
					(0.00241)
Observations	51,649	51,649	51,649	51,649	48,256
Pseudo R2	0.382	0.443	0.443	0.567	0.401

Note: Robust standard errors clustered at the origin-destination country pair level in parentheses,*** significant at the 1%, ** at the 5%, and * at the 10% level. Probit estimations including origin country, destination country, and NACE industry fixed effects in specifications 1 to 4. Specification 5 includes origin country and NACE industry fixed effects. Marginal effects computed at means. CER is the firm-level *Vigeo* score of *Corporate Environmental Responsibility*. $\#\ of\ Treaties$ is the destination country-specific standardized values of the count of "Participation in treaties (Climate change, Ozone Layer, CFC control, Law of the Sea, Biological diversity, Kyoto Protocol, CITES, CCD, Stockholm Convention)" and "Environmental strategies or action plans" and "Biodiversity assessments, strategies or action plans", provided by the World Bank. Both CEP and $\#\ of\ Treaties$ are centered.

Table 9: Location Determinants: the Effect of CER and *De Facto* Standards

Dependent Variable	Location					
Specifications	(1)	(2)	(3)	(4)	(5)	(6)
CER	0.0305***		0.0349***	0.0345***		0.0374***
	(0.00694)		(0.00786)	(0.00756)		(0.00841)
CER × EPI	-0.168***	-0.0831***	-0.208***	-0.186***	-0.0449**	-0.219***
	(0.0485)	(0.0274)	(0.0585)	(0.0533)	(0.0210)	(0.0622)
EPI			0.231***			0.195***
			(0.0585)			(0.0283)
CER × # Treaties				0.00377	0.00179	0.00599
				(0.00501)	(0.00174)	(0.00511)
# Treaties						0.0116***
						(0.00156)
Distance	-0.0796***	-0.0439***	-0.0316***	-0.0856***	-0.0377***	-0.0331***
	(0.00669)	(0.00414)	(0.00302)	(0.00722)	(0.00348)	(0.00303)
Com. Language	0.0403***	0.0272***	0.0514***	0.0436***	0.0298***	0.0539***
	(0.00698)	(0.00457)	(0.0107)	(0.00750)	(0.00436)	(0.0109)
Assets	0.0121**		0.0122**	0.0121**		0.0125**
	(0.00507)		(0.00559)	(0.00551)		(0.00599)
Age	0.0121***		0.0131***	0.0132***		0.0141***
	(0.00178)		(0.00195)	(0.00195)		(0.00209)
Op. Revenue	0.0458***		0.0495***	0.0502***		0.0531***
	(0.00434)		(0.00305)	(0.00264)		(0.00319)
Liabilities	-0.0257***		-0.0270***	-0.0275***		-0.0285***
	(0.00434)		(0.00482)	(0.00473)		(0.00517)
Liquidity	0.00735***		0.00398***	0.00791***		0.00926***
	(0.00236)		(0.00265)	(0.00258)		(0.00282)
# of Employees	0.00369***		0.00398***	0.00400***		0.00423***
	(0.000402)		(0.000426)	(0.000438)		(0.000456)
GDP per capita			-0.00526**			0.00248
			(0.00266)			(0.00307)
GDP			0.0484***			0.0494***
			(0.00667)			(0.00177)
Market Potential			0.00667			0.00706
			(0.00722)			(0.00763)
# of Days			-0.00901***			-0.00738***
			(0.00226)			(0.00234)
Observations	51,649	51,649	49,764	49,387	49,387	48,256
Pseudo R2	0.445	0.569	0.405	0.442	0.570	0.404

Note: Robust standard errors clustered at the origin-destination country pair level in parentheses,*** significant at the 1%, ** at the 5%, and * at the 10% level. Probit estimations including origin country, destination country, and NACE industry fixed effects in specifications 1, 2, 4 and 5. Specifications 3 and 6 include firm and destination country fixed effects. Marginal effects computed at means. CER is the firm-level $Vigeo$ score of *Corporate Environmental Responsibility*. EPI is the destination country-specific *Environmental Performance Index* provided by the Yale Center for Environmental Law and Policy (YCELP) and the Center for International Earth Science Information Network (CIESIN), Columbia University. $\#\ of\ Treaties$ is the destination country-specific standardized values of the count of "Participation in treaties" and "Environmental strategies or action plans" and "Biodiversity assessments, strategies or action plans", provided by the World Bank. Both CER, EPI and $\#\ of\ Treaties$ are centered.

Table 10: Alternative *De Facto* Standards: Ecological Footprint Index per GDP unit

Dependent Variable	Location		
Specifications	(1)	(2)	(3)
CER	0.0346***		0.0396***
	(0.00781)		(0.00889)
CER × Footprint	0.119***	0.0516*	0.158***
	(0.0401)	(0.0286)	(0.0470)
Footprint			0.0553**
			(0.0243)
Distance	-0.0887***	-0.0524***	-0.0355***
	(0.00750)	(0.00485)	(0.00345)
Com. Language	0.0451***	0.0318***	0.0526***
	(0.00779)	(0.00540)	(0.0116)
Assets	0.0128**		0.0133**
	(0.00576)		(0.00634)
Age	0.0136***		0.0150***
	(0.00202)		(0.00220)
Op. Revenue	0.0514***		0.0561***
	(0.00273)		(0.00329)
Liabilities	-0.0285***		-0.0306***
	(0.00494)		(0.00546)
Liquidity	0.00939***		0.0106***
	(0.00265)		(0.00297)
# of Employees	0.00421***		0.00460***
	(0.000453)		(0.000488)
GDP per capita			0.0143***
			(0.00306)
GDP			0.0534***
			(0.00201)
Market Potential			0.00890
			(0.00815)
# of Days			-0.00903***
			(0.00271)
Observations	49,010	49,010	49,010
Pseudo R2	0.439	0.566	0.391

Note: Robust standard errors clustered at the origin-destination country pair level in parentheses,*** significant at the 1%, ** at the 5%, and * at the 10% level. Probit estimations including origin country, destination country, and NACE industry fixed effects in specification 1, and origin country, destination country, and firm-level fixed effects in specification 2. Specification 3 includes firm and destination country fixed effects. Marginal effects computed at means. *Footprint* is the Global Ecological Footprint per GDP unit and is provided by the Global Footprint Network. The value is standardized between 0 and 1.

Table 11: Location Decision: Sectorial Analysis

Dependent Variable	Location		
Sample:	Without Mining & Quarrying	Without Financial & Insurance Activities	Without Services
Specifications	(1)	(2)	(3)
CER	0.0269***	0.0311***	0.0219**
	(0.00692)	(0.00714)	(0.00894)
CER × EPI	-0.131***	-0.178***	-0.125**
	(0.0483)	(0.0503)	(0.0584)
Distance	-0.0766***	-0.0814***	-0.0824***
	(0.00648)	(0.00683)	(0.00739)
Com. Language	0.0406***	0.0417***	0.0358***
	(0.00687)	(0.00719)	(0.00713)
Assets	0.00925*	0.00925*	0.00398
	(0.00514)	(0.00533)	(0.00654)
Age	0.0119***	0.0122***	0.0112***
	(0.00179)	(0.00182)	(0.00241)
Op. Revenue	0.0441***	0.0496***	0.0480***
	(0.00242)	(0.00259)	(0.00277)
Liabilities	-0.0230***	-0.0262***	-0.0162***
	(0.00432)	(0.00446)	(0.00572)
Liquidity	0.00729***	0.00749***	0.00150
	(0.00233)	(0.00247)	(0.00321)
# of Employees	0.00364***	0.00391***	0.00308***
	(0.000392)	(0.000415)	(0.000442)
Observations	49,183	50,827	39,420
Pseudo R2	0.451	0.445	0.446

Note: Robust standard errors clustered at the origin-destination country pair level in parentheses,*** significant at the 1%, ** at the 5%, and * at the 10% level. Probit estimations including origin country, destination country, and NACE industry fixed effects. Marginal effects computed at means. Specification 1 is based on the sample of firms that are not included in the "Mining and Quarrying" sector. Specification 2 excludes firms in the "Financial and Insurance Activities" sector. Specification 3 excludes firms in service sectors, i.e. "Accommodation and Food Service Activities", "Administrative and Support Service Activities", "Financial and Insurance Activities", "Information and Communication", "Professional, Scientific and Technical Activities", "Public Administration and Defense" and "Other Service Activities".

Table 12: Location Decision Robustness Check: Origin Country

Dependent Variable	Location			
	Coefficient	SE	# of obs.	Pseudo R2
Exclusion of:				
Austria	-0.172***	0.0489	50,827	0.447
Belgium - Luxembourg	-0.176***	0.0496	50,184	0.440
Bermuda	-0.168***	0.0485	51,649	0.445
Switzerland	-0.176***	0.0503	48,008	0.440
Germany	-0.222***	0.0475	45,560	0.444
Denmark	-0.140***	0.0495	50,827	0.443
Spain	-0.162***	0.0498	48,498	0.448
Finland	-0.157***	0.0493	49,320	0.447
France	-0.115*	0.0498	41,888	0.446
United Kingdom	-0.115*	0.0685	36,720	0.454
Greece	-0.178***	0.0489	51,101	0.444
Ireland	-0.175***	0.0503	50,553	0.443
Iceland	-0.168***	0.0485	51,649	0.445
Italy	-0.172***	0.0499	50,005	0.445
Netherlands	-0.188***	0.0504	48,824	0.444
Norway	-0.171***	0.0485	50,964	0.446
Portugal	-0.171***	0.0489	51,238	0.445

Note: Robust standard errors clustered at the origin-destination country pair level in parentheses,*** significant at the 1%, ** at the 5%, and * at the 10% level. Probit estimations including origin country, destination country, NACE industry fixed effects and firm-specific and bilateral control variables. Marginal effects computed at means.

Table 13: Location Decision Robustness Check: Destination Countries, by Group

Dependent Variable	Location			
	Coefficient	SE	# of obs.	Pseudo R2
Exclusion of:				
Africa	-0.224**	0.111	38,831	0.426
Central America	-0.186***	0.0530	47,125	0.444
Central Asia	-0.184***	0.0514	50,141	0.442
Europe	-0.0391	0.0263	38,728	0.432
Middle East	-0.206***	0.0547	46,748	0.444
North Africa	-0.161***	0.0476	50,141	0.451
North America	-0.154***	0.0463	50,518	0.437
Northeast Asia	-0.166***	0.0468	49,764	0.446
Pacific	-0.177***	0.0495	50,141	0.445
South America	-0.180***	0.0492	47,502	0.451
South Asia	-0.160***	0.0509	49,387	0.446

Note: Robust standard errors clustered at the origin-destination country pair level in parentheses,*** significant at the 1%, ** at the 5%, and * at the 10% level. Probit estimations including origin country, destination country, NACE industry fixed effects and firm-specific and bilateral control variables. Marginal effects computed at means.

Table 14: Corporate Environmental Responsibility Evolution (2005 - 2009) and Location Decision

Dependent Variable	Location					
Explanatory variables:	Evolution Ratio:			Dummy variable		
($CER\ Evolution$)	CER_{2009}/CER_{2005}			$X = 1$ if Evolution Ratio > 1		
				$X = 0$ otherwise		
Specifications	(1)	(2)	(3)	(4)	(5)	(6)
CER Evolution	-0.00806		-0.00431	-0.00183		-0.00246
	(0.0226)		(0.0224)	(0.00329)		(0.00358)
EPI			0.267***			0.211***
			(0.0329)			(0.0388)
CER Evolution × EPI	0.195	0.223	0.145	0.0737***	0.0357**	0.0846***
	(0.187)	(0.153)	(0.189)	(0.0265)	(0.0172)	(0.0312)
Distance	-0.0970***	-0.0639***	-0.0360***	-0.0972***	-0.0642***	-0.0360***
	(0.00886)	(0.00595)	(0.00364)	(0.00887)	(0.00597)	(0.00365)
Com. Language	0.0543***	0.0413***	0.0611***	0.0543***	0.0415***	0.0610***
	(0.00903)	(0.00674)	(0.0129)	(0.00902)	(0.00676)	(0.0129)
Assets	0.0207***		0.0211***	0.0207***		0.0210***
	(0.00706)		(0.00727)	(0.00712)		(0.00733)
Age	0.0135***		0.0139***	0.0137***		0.0141***
	(0.00258)		(0.00266)	(0.00257)		(0.00265)
Op. Revenue	0.0459***		0.0471***	0.0459***		0.0471***
	(0.00351)		(0.00391)	(0.00350)		(0.00389)
Liabilities	-0.0227***		-0.0231***	-0.0226***		-0.0230***
	(0.00615)		(0.00637)	(0.00618)		(0.00640)
Liquidity	0.0147***		0.0151***	0.0147***		0.0151***
	(0.00369)		(0.00381)	(0.00368)		(0.00379)
# of Employees	0.00322***		0.00320***	0.00321***		0.00318***
	(0.000513)		(0.000518)	(0.000516)		(0.000521)
GDP per capita			-0.00652*			-0.00650*
			(0.00345)			(0.00346)
GDP			0.0594***			0.0595***
			(0.00209)			(0.00209)
Market Potential			0.0201**			0.0198**
			(0.00879)			(0.00875)
# of Days			-0.0105***			-0.0106***
			(0.00290)			(0.00290)
Observations	37,859	37,859	37,859	37,859	37,859	37,859
Pseudo R2	0.444	0.563	0.401	0.445	0.563	0.401

Note: Robust standard errors clustered at the origin-destination country pair level in parentheses,*** significant at the 1%, ** at the 5%, and * at the 10% level. Probit estimations with marginal effects computed at means. Specifications 1 and 4 include origin country, destination country, and NACE industry fixed effects. Specifications 2 and 5 include destination country and firm fixed effects. Specifications 3 and 6 include origin country and NACE industry fixed effects. CER Evolution is computed as CER_{2009}/CER_{2005} in specifications 1 to 3. In specifications 4 to 6, CER Evolution is a dummy variable that is equal to 1 when $CER_{2009}/CER_{2005} > 1$ and 0 otherwise.