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# THE EFFECT OF ENVIRONMENTAL REGULATION ON THE LOCATIONAL CHOICE OF JAPANESE FOREIGN DIRECT INVESTMENT<sup>1</sup>

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## Abstract:

This paper assesses the impact of environmental regulation in host countries on Japanese foreign direct investment (FDI) decision-making. It tests the pollution haven hypothesis using data on national environmental regulation standards and Japanese inward FDI in five dirty industries (iron and steel industry, non-ferrous metals industry, chemicals industry, paper and pulp industry, non-metallic products industry). The results do not support the pollution hypothesis. On the contrary, inward Japanese FDI appears to be attracted to countries which have committed themselves to a transparent and stable environment regulatory environment, suggesting that the quality of the regulatory framework in terms of its certainty and transparency has a greater influence on foreign investors' choice of location than the level of environmental regulatory measures.

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<sup>1</sup> We are grateful to the journal's referee and to Hulya Ulku for helpful comments on an earlier version of the paper.

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3 *JEL classification:* Q56, F21  
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5 *Keywords,* Environmental regulation, foreign direct investment, Japanese multinationals.  
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For Peer Review

# THE EFFECT OF ENVIRONMENTAL REGULATION ON THE LOCATIONAL CHOICE OF JAPANESE FOREIGN DIRECT INVESTMENT

## 1. Introduction

Foreign direct investment (FDI) has risen dramatically in recent years. In 2003, global FDI flows amounted to \$559,576 million, representing 23 per cent of world GDP (UN, 2004). FDI has in turn been a key driver of the growth in international trade and the growing integration of the global economy.

This increased integration of the world economy has been accompanied by a growing interest in the relationship between international investment and the environment. In part, this debate has reflected the concerns of environmentalists that the global trend towards trade and investment liberalization will intensify environmental pressures as countries compete for an increased share of foreign investment by engaging in a 'race to the bottom' on environmental regulations. Similar concerns have been raised by economists who have argued that the adoption of more stringent national environmental standards could reduce a country's competitive advantage and encourage pollution intensive industries to relocate to countries with lower standards. On the other hand, some commentators have argued that foreign investment may be attracted to locations where environmental regulations are more stringent, on the grounds that tighter regulation reduces the risks of environmental liabilities and allows foreign firms to exploit their competitive advantage based on technological innovation.

Growing international concern for the environmental impact of international trade and investment flows has been reflected in an increasing level of international cooperation on environmental regulation. The number of multilateral environmental agreements (MEAs) currently exceeds 200, with more than 20 of these incorporating trade measures (Brack and Gray, 2003). In addition, the World Trade Organisation (WTO) is committed to the goal of sustainable development, and negotiations on the relationship between WTO trade rules and environment regulation are a key component of the Doha Development Agenda.

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3 The objective of this paper is to provide an empirical investigation of the impact of  
4 environmental regulation on the pattern of Japanese outward investment during the 1990s.  
5 This introduction is followed by Section 2 which provides a short literature review. Section  
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The objective of this paper is to provide an empirical investigation of the impact of environmental regulation on the pattern of Japanese outward investment during the 1990s. This introduction is followed by Section 2 which provides a short literature review. Section 3 presents the methodology, and the data used in the study are discussed in section 4. The fifth section contains the results. The final section gives a summary of the paper's main findings.

## 2. Review of the Literature

Variations in the scope and effectiveness of environmental regulation have given rise to concerns about the impact of environmental regulation on international investment flows. If the costs of compliance with environmental regulations differ across national boundaries, then we might expect to see the relocation of pollution intensive industries to locations where the costs of compliance are lower. These shifts may in turn have a 'chilling' effect on the introduction of new environmental regulation as countries become more reluctant to increase environmental control measures or deliberately try to attract FDI by offering lower environmental standards, leading to a competitive 'race to the bottom'. Although this 'pollution haven' effect has been the subject of extensive empirical investigation, the literature has failed so far to produce conclusive evidence confirming that differences in environmental regulations across countries are a significant determinant of trade and investment flows (Smarzynska and Wei, 2001)<sup>2</sup>. A comprehensive review of the earlier literature concluded that 'fears of a "race to the bottom" in environmental standards, based on the idea of "pollution havens" may be generally unfounded' (OECD, 1997). The majority of more recent studies of the pollution haven hypothesis have confirmed this conclusion (see Jaffe et al., 1995; Levinson, 1996; Adam, 1997; Busse, 2004). A number of studies, however, have found (weak) evidence that differences in environmental regulations can affect FDI flows (Mani and Wheeler, 1997; List and Co, 2000; Eskeland and Harrison, 2003).

The existing empirical literature has a number of limitations, which may go some way in explaining the ambiguity in the results obtained. These limitations include differences in

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<sup>2</sup> Copeland and Taylor (2004) distinguish between the pollution haven *effect* and the pollution haven *hypothesis*. In the former case, a tightening of environmental regulations will, at the margin, have an effect on trade and investment flows. In the latter case, the effect of environment regulation dominates the influence of all other factors that affect trade and investment flows, and leads to a shift in pollution intensive industry from countries with more stringent regulations to countries with weaker environmental regulation.

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3 econometric methodologies, data sources and proxies, as well as alternative conceptual  
4 frameworks (Letchumanan and Kodama, 2000). A major limitation of empirical studies that  
5 have examined the linkage between trade and investment flows and environmental regulation  
6 has been the almost complete lack of comparable data on environmental regulation across  
7 countries. In attempting to overcome this lacuna in the data, most studies have tested the  
8 pollution haven hypothesis indirectly, by examining the international changes in the  
9 emissions output of 'dirty' industries on the assumption that stricter environmental  
10 regulations results in better environmental conditions, and vice versa (Hoffmann et al 2005).  
11 Typically, US data on either emission intensity or the level of pollution-abatement costs as a  
12 fraction of value added are used in estimating output levels. Assuming that environmental  
13 regulation and compliance costs are increasing more rapidly in the developed economies (the  
14 'North') than in the lower income economies (the 'South'), evidence of a rising share of  
15 pollution intensive output or investment in the South is taken as confirmation of the pollution  
16 haven hypothesis. An additional limitation has been that due to a paucity of data on  
17 international investment flows over time, most empirical studies have relied on FDI flows by  
18 US transnational corporations.  
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33 The methodology and data used in this study are intended to address a number of these  
34 difficulties. In particular, the model that is used allows for the effect of other determinants of  
35 FDI flows, in addition to the impact of environmental regulation and in this way tests for the  
36 separate impact of the pollution haven effect. Second, we use a direct measure of  
37 environmental regulation which is comparable across countries. Third, we focus on Japanese  
38 outward FDI, rather than US data, in recognition of the importance of Japan as one of the  
39 world's largest outward investors<sup>3</sup>.  
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56 <sup>3</sup> Although there has been a large number of empirical studies on the determinants of Japanese FDI (e.g.  
57 Cassidy and O'Callaghan 2005; Farrell et al. 2004; In-Mee and Ozawa 2001; Co 1997), very few have  
58 examined the relationship with environmental regulations. An exception is the study by Friedman et al.  
59 (1992) who find that Japanese FDI in the U.S. choose to locate in regions with relatively lax environmental  
60 regulations. However, this study is restricted to Japanese FDI inflows to the U.S., and covers the earlier  
period 1977 to 1988.

### 3. Methodology

Following the approach used in the recent literature (see, for example, Bartik, 1988; Levinson 1996; List and Co, 2000; McConnell and Schwab, 1990), an industry is assumed to have a latent (unobserved) profit function that is dependent on the characteristics of the country in which it locates:

$$\pi_{ij} = F(e_j, o_j) \quad (1)$$

$\pi_{ij}$  represents the latent profit that could be earned by firm  $i$  in country  $j$ , and  $e_j$  is a measure of the stringency of the country  $j$ 's environmental regulations. Other observable country characteristics that affect the location decision are represented by  $o_j$ . A conditional logit model can be used to represent the firm's location choice if the firm selects the country location at which its profit would be maximized<sup>4</sup>.

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<sup>4</sup> The conditional logit model is appropriate when the data consist of choice-specific attributes. This model is widely used when three or more dependent variables are not consecutively ordered (Green, 2000; McFadden, 1974)

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Profits for firms  $i$  at location  $j$  are given by:

$$\pi_{ij} = \beta' X_j + \mu_{ij} \quad (2)$$

where  $X_j = (e_j, o_j)$  is a vector of country characteristics that affect the firm's costs and accrued revenues from product sales.  $\beta$  is a vector of estimated parameters and  $\mu_{ij}$  is the random error component. It is generally acknowledged that if the  $\mu_{ij}$  in equation (2) follow a Weibull distribution and are independently and identically distributed, the probability that country  $j$  maximizes profits for firm  $i$  can be represented by equation (3).

$$P(ij) = \exp(\beta' X_j) / \sum_{k=1}^K \exp(\beta' X_k) \quad (3)$$

where  $K$  represents the total number of possible countries. In the empirical work that follows, the maximum likelihood is used to estimate parameter  $\beta$ .

However, while equation (3) has been widely used in the literature, the 'independence of irrelevant alternatives (IIA)' restriction may apply to the predicted probabilities under the assumption that the error term in equation (2) is independently and identically distributed Weibull<sup>5</sup>. This becomes a problem since it assumes that, for example, a foreign firm's decision not to locate in Germany is independent of its decision to reject the UK and the Netherlands. This paper mitigates this problem by including region dummies, as in the studies by Bartik (1988), Levinson (1996) and List and Co (2000). If the error terms are collated within regions and not across regions, the region dummies will capture this correlation and reduce the IIA problem.

#### 4. Data Description

##### *Foreign Direct Investment (FDI)*

Data on Japanese FDI are taken from the Kaigai shinsyutsu kigyo soran (Foreign Investing Companies Profiles) by Toyo Keizai Shinpo (1998). These data are based on a questionnaire survey, distributed to all listed and non-listed companies at the end of October 1997. The

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<sup>5</sup> An alternative assumption would be that FDI first selects a region and then a country within the region. This would require the use of a nested logit model. We are grateful to the referee for drawing out attention to this point.

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3 criterion for the inclusion of firms in the dataset is if the firm has two or more companies with  
4 more than 20 per cent of the shares abroad. The criteria for FDI cover newly established and  
5 merges and acquisition. In other words, if a firm has more than 20 per cent of the shares in two  
6 or more companies and has FDI through either newly established or merges and acquisition, it  
7 then gets a 1. In any other case, it gets a 0. The period covered is from 1992 to 1997. The  
8 industries observed are iron and steel, non-ferrous metals, industrial chemicals, paper and pulp,  
9 and non-metallic mineral products. Based on US emissions data for air, water and metal  
10 discharges, these industries are among the top ten industries in terms of actual emission  
11 intensity for overall pollutants and are commonly classified as dirty industries (Copeland and  
12 Taylor, 2004; Mani and Wheeler, 1997). It is expected that they will be sensitive to changes in  
13 environmental regulation, and they are therefore widely used in cross country studies as a  
14 proxy for pollution data.  
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### 26 *Environmental Regulations (ER)*

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28 In an attempt to overcome the problems of obtaining reliable cross country data on the extent  
29 and stringency of environmental regulation, this study uses a measure of environmental  
30 regulation based on participation in international environmental treaties<sup>6</sup>. The measure has  
31 the advantage of permitting cross national comparisons of environmental regulations in a  
32 systematic and quantitative fashion. The measure uses participation information on five  
33 international treaties: the Framework Convention on Climate Change; the Vienna Convention  
34 for the Protection of the Ozone Layer; the Montreal Protocol for CFC Control; the United  
35 Nations Convention on the Law of Sea; and the Convention on Biodiversity, over the period  
36 1982 to 1997<sup>7</sup>. We assume that the level of compliance and enforcement will increase over  
37 time (Chung, 1996). If, for example, a country has participated in a particular treaty for five  
38 years prior to 1992, it will be given a score of six for 1992. These annual scores are then  
39 aggregated for each international treaty the country belongs to, and the total is taken as a  
40 measure of the stringency of that country's environmental regulations<sup>8</sup>.  
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### 53 *Other Determinants of FDI*

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56 <sup>6</sup> Participation in international environmental agreements is also used as a measure of environmental stringency  
57 in Busse (2004) and Smarzynska and Wei (2001).

58 <sup>7</sup> National participation information for these five treaties is provided in World Bank (2000), *World Development*  
59 *Indicators*.

60 <sup>8</sup> We accept the referee's comment that the stringency of environmental control may vary between different  
treaties. However, we do not have the information that would allow us to make this differentiation in the variable.

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3 A wide variety of variables have been used in the literature as possible determinants of inward FDI  
4 flows, although as noted by Globerman and Shapiro (2002), surprisingly few are consistently  
5 significant across the broad spectrum of studies that have been reported in the literature<sup>9</sup>.  
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### 8 Market Size

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10 One variable that has been found consistently to be a significant determinant is a measure of  
11 the size of the host country, confirming that market size as an important determinant of  
12 FDI(Cheng and Kwan, 2000; Culem, 1988; Cushman, 1987; Loree and Guisinger, 1995;  
13 Moore, 1993; Schneider and Frey, 1985; Smarzynska and Wei, 2001; Wheeler and Mody,  
14 1992)<sup>10</sup>. In this study, we use real GDP (in constant 1995 U.S. dollars) as a measure of the level  
15 of income and demand in the economy. The data are from the World Bank (2001).  
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### 18 Labour Costs

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20 Labour force characteristics have been widely used as explanatory variables in empirical studies of  
21 FDI, with a range of different measures being used in the literature, including, wage rates, skills  
22 level, and educational achievement. The hypotheses tested have varied, and on occasion, been  
23 competing. In the earlier literature, low wage, unskilled labour was seen as being attractive to FDI,  
24 particularly to export-oriented, labour intensive assembly activities. More recent literature has  
25 stressed the quality of human capital, as measured by education attainment or health status. The  
26 empirical evidence on the influence of the labour force variable is not clearcut, and in a number of  
27 studies it has been found to be either statistically insignificant or appears with the 'wrong' sign in  
28 regression equations (Altomonte, 2000; Stein and Daude, 2003). In this study, we follow  
29 Smarzynska and Wei (2001) and use GDP per capita as a proxy for unit labour costs. Other  
30 things being equal, we expect to find that higher wage costs will discourage foreign direct  
31 investment. The data are provided in World Bank (2001).  
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### 34 Distance

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36 According to Chung (1997), the further a host country is from the parent company, the higher  
37 the cost of shipping and communications. Other things being equal, we therefore expect that  
38 distance will have a negative impact on the locational choice for FDI. This has been confirmed  
39 in a number of recent empirical studies, for example, the Smarzynska and Wei (2001) study for  
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58 <sup>9</sup> Dunning (1993) discusses these various factors and discusses the empirical evidence regarding their impact on  
59 FDI flows.

60 <sup>10</sup> This also holds for studies of Japanese FDI (Chen, T. 1992; MITI, 1993, 1994; Mito, 1997; Economic  
Planning Agency, Japan, 1993, 1994).

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3 US FDI and MITI (1993) for Japanese FDI flows. This study uses the distance from Tokyo to  
4 the capital of each country<sup>11</sup>.  
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### 8 *Regional Dummy*

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10 In order to overcome the IIA issue raised in section 2, regional dummy variables were included  
11 in the estimation equation. The regions are: Asia Pacific (AP); Europe and Central Asia (EC);  
12 Latin America and Caribbean (LA); Middle-East and North Africa (MA); North America  
13 (NA); and Sub-Sahara Africa (SA).  
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19 The descriptive statistics for each dirty industry's independent variables are summarised in  
20 Appendix A. The correlation matrices for the independent variables of each dirty industry  
21 are presented in Appendix B. The results of the correlation matrix do not show a significant  
22 degree of correlation between any of the independent variables.  
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## 28 **5. Results**

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30 The estimated results for the conditional logit model are summarised in Tables 1 and 2. We  
31 first report the results for all countries, and then consider the developing country results  
32 separately<sup>12</sup>.  
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59 <sup>11</sup> The main data used were taken from CASIO (2002) supplemented where necessary with data from the  
60 Japanese Vexillological Association (2002) and the Geographical Survey Institute of Japan (2002).

<sup>12</sup> Regional dummies were included in the regressions: these results can be provided on request.

Table 1. Environmental Regulation and Japanese FDI Location Choice: All Countries

|                       | Iron and steel        | Non-ferrous metals    | Chemicals             | Paper and Pulp        | Non-metallic products |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| ER                    | 0.173 ***<br>[0.387]  | 0.187 ***<br>[0.028]  | 0.212 ***<br>[0.023]  | 0.363 ***<br>[0.074]  | 0.178 ***<br>[0.030]  |
| Market size           | 0.104 ***<br>[0.036]  | 0.081 ***<br>[0.021]  | 0.054 ***<br>[0.011]  | 0.012<br>[0.014]      | 0.110 ***<br>[0.029]  |
| Wage                  | -0.287<br>[0.208]     | -0.008<br>[0.124]     | 0.005<br>[0.094]      | -0.018<br>[0.025]     | -0.030 **<br>[0.015]  |
| Distance              | -0.248 ***<br>[0.083] | -0.361 ***<br>[0.057] | -0.043 ***<br>[0.004] | -0.058 ***<br>[0.012] | -0.035 ***<br>[0.006] |
| Log-likelihood        | -219.503              | -414.663              | -623.776              | -92.264               | -310.855              |
| Pseudo R <sup>2</sup> | 0.388                 | 0.397                 | 0.384                 | 0.448                 | 0.409                 |
| No.of obs.            | 9964                  | 19120                 | 28110                 | 4653                  | 14644                 |

Standard errors in parentheses

\*\*\* Statistically significant at 1%

\*\* Statistically significant at 5%

\* Statistically significant at 10%

First, analyzing the results for the environmental regulation variable, we find the coefficients for each of the five industries are positive and highly significant in both the all country and developing country samples. This is contrary to the environmental haven hypothesis and suggests that, other things being equal, Japanese firms in dirty industries are choosing regions with more stringent environmental regulations as opposed to regions with lax environmental regulations as a location for their FDI. This supports the results reported in the studies by McConnell and Schwab (1990) and Smarzynska and Wei (2001), which suggest that firms do not deliberately choose regions with relatively lax environmental regulations in order to reduce environmental compliance costs. Our results are also consistent with the argument that dirty industries will prefer to choose regions with more stringent environmental regulations, since these regions will have a high quality of environment in place and therefore will not require firms to invest in improvements to the general environmental infrastructure (Adam, 1997; OECD, 1997). The results may also imply that firms have become more aware of environmental issues on a global scale during the post- Earth Summit period between 1992

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3 and 1997, a view that has been confirmed by numerous surveys (see, for example, Amuro,  
4 1996, Ando, 1996, Letchumanan and Kodama, 2000).  
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9 Concerning the other FDI determining factors, the market size represented by GDP is  
10 positively signed as predicted, and is statistically significant in all cases other than the paper  
11 and pulp industry. This suggests that, other things being equal, FDI in these industries is  
12 attracted to host countries that have a large market. This supports the studies by Chen (1992),  
13 MITI (1993, 1994) and Mito (1997) on Japanese FDI, as well as studies of FDI in general,  
14 which have identified market size as a determinant of FDI (see Cheng and Kwan, 2000;  
15 Loree and Guisinger, 1995; Moore, 1993; Smarzynska and Wei, 2001; Wheeler and Mody,  
16 1992).  
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24 Concerning unit labour costs, as proxied by GDP per capita, the coefficient is not statistically  
25 significant (except for non metallic products), suggesting that wage costs are not a  
26 significant determinant of FDI by Japanese firms in these dirty industries. Finally, distance to  
27 the host country is shown to have a statistically significant (at the 1 per cent level), negative  
28 effect. As Chung (1997) points out, this may reflect the impact that distance from the parent  
29 (head) company has on the cost of shipping and communications. Similar results are reported  
30 for Japanese firms in the study by MITI (1993), and in Smarzynska and Wei (2001) for global  
31 FDI flows.  
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40 We also examined the flow of Japanese FDI in dirty industries, where the sample of host  
41 countries is restricted to developing countries. The purpose is to examine whether Japanese  
42 FDI to the South behaves similarly to global flows, particularly with respect to the  
43 environmental policy regime of the host country. Table 2 shows the results for Japanese FDI  
44 only to developing countries. The results show that stringency of environmental regulations has  
45 a significant and positive impact on locational decision-making of Japanese FDI within  
46 developing countries for each of the five dirty industries. This finding is contrary to the 'race  
47 to the bottom' hypothesis which is frequently advanced in the context of developing countries.  
48 The results for the other determinants are in general consistent with those reported in Table 1  
49 for the all countries sample. Market size has a statistically significant and positive effect for  
50 all dirty industries, and distance has a negative impact in each industry (although the  
51 coefficient is statistically significant only in the case of the non-ferrous metals). The wage  
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variable is not a significant determinant (except for chemicals) and fails to display a consistent sign pattern across the industries.

Table 2. Environmental Regulation and Japanese FDI Location Choice: Developing Countries

|                       | Iron and steel       | Non-ferrous metals   | Chemicals            | Paper and Pulp       | Non-metallic products |
|-----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|
| ER                    | 0.173 ***<br>[0.044] | 0.161 ***<br>[0.032] | 0.173 ***<br>[0.028] | 0.233 ***<br>[0.086] | 0.1366 ***<br>[0.037] |
| Market size           | 0.219 ***<br>[0.075] | 0.190 ***<br>[0.059] | 0.286 ***<br>[0.053] | 0.281 **<br>[0.014]  | 0.328 ***<br>[0.069]  |
| Wage                  | -0.044<br>[0.234]    | 0.122<br>[0.147]     | 0.307 ***<br>[0.011] | -0.387<br>[0.485]    | 0.030<br>[0.189]      |
| Distance              | -0.082<br>[0.121]    | -0.229 **<br>[0.098] | -0.116<br>[0.085]    | -0.308<br>[0.00025]  | -0.051<br>[0.109]     |
| Log-likelihood        | -138.080             | -237.533             | -330.134             | -44.556              | -179.836              |
| Pseudo R <sup>2</sup> | 0.415                | 0.497                | 0.525                | 0.607                | 0.536                 |
| No.of obs.            | 5629                 | 11299                | 16628                | 2721                 | 9274                  |

Standard errors in parentheses

\*\*\* Statistically significant at 1%

\*\* Statistically significant at 5%

\* Statistically significant at 10%

Equation (3) explained the predicted probability of a firm choosing a region under the conditional logit model specification. We can use equation (4)<sup>13</sup> to interpret the size of the coefficient.

$$\frac{\partial P(ij)}{\partial X_k} = \beta P_k (1 - p_k) \quad (4)$$

This represents a coefficient as dependent on the characteristics of the region being analyzed. To understand these coefficients in context, Table 3 shows the percentage change in the probability of any one firm locating in a country with average characteristics, resulting from an increase in each of the listed parameters by one standard deviation<sup>14</sup>.

<sup>13</sup> See Greene (2000) for details. McConnell and Schwab (1990) use the same approach in their empirical study.

<sup>14</sup> For example, the Iron and Steel results suggest that, increasing the value of the ER Index from 9 to 16, while holding all of the other parameters at their averages, would mean a 0.946% increase in the probability that a firm would choose to invest in the hypothetical average country.

Table 3

The predicted percentage change in the probability of locating in a country with average characteristics as a result of standard deviation increase in each independent variable: all countries

|             | Iron and Steel<br>(%) | Non-Ferrous<br>Metals (%) | Chemicals (%) | Paper and Pulp<br>(%) | Non-Metallic<br>Products (%) |
|-------------|-----------------------|---------------------------|---------------|-----------------------|------------------------------|
| ER          | 0.946 ***             | 1.001 ***                 | 1.113 ***     | 1.875 ***             | 0.941 ***                    |
| Market size | 0.520 ***             | 0.404 ***                 | 0.266 ***     | 0.061                 | 0.547 ***                    |
| Wage        | -1.898                | -0.055                    | 0.033         | -0.120                | -0.200 **                    |
| Distance    | -6.429 ***            | -9.347 ***                | -1.127 ***    | -1.501 ***            | -0.920 ***                   |

\*\*\* Underlying coefficient (Table 1) is significant at 1%

\*\* Underlying coefficient (Table 1) is significant at 5%

\* Underlying coefficient (Table 1) is significant at 10%

When examining the cross industries sampled here, this result suggests that the paper and pulp, chemicals and non-ferrous industries, which are all resource based industries<sup>15</sup>, are more inclined to undertake FDI in regions with more stringent environmental regulations compared to the non-resource based industries<sup>16</sup>. Regions with more stringent environmental regulations are likely to have developed an environmental infrastructure, which provide FDI firms with certain benefits. Some examples are: less risk of environmental scandals by complying with regulations, less risk of the liability of cleaning up for past environmental damages by previous businesses, and a higher quality environment for living and health for its workers as well as for the local people (Adams, 1997; OECD, 1997). Compliance with environmental standards may also induce technological change which improves the competitiveness of firms (Porter and van der Linde, 1995). The nature of the resource based industries lead to little product differentiation and therefore is likely to suffer from the difference of environmental costs. Therefore, the cost savings in environmental costs and lower risks in stringently regulated countries may be more attractive to these industries. Environmental costs such as those identified above may form a large part of the total potential environmental costs incurred and there may therefore be a cost saving in undertaking FDI in host countries with more stringent environmental regulations. The iron and steel industry and non-metallic products industry

<sup>15</sup> For further details on the distinction between the categories in resource- and non resource based industries, refer to UNIDO (1982). Van Beers and van den Bergh (1997) also make this distinction.

<sup>16</sup> We tested for the non-linearity of the relationship by adding ER squared as an additional variable. The results were less significant and confirmed the superiority of the linear specification.

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3 which are non-resource based industries, were found to be more likely to undertake FDI in  
4 regions with larger market size.  
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9 When examining cross independent variables in Table3, the dirty industries examined here are  
10 more inclined to be influenced by environmental regulations and distance rather than market  
11 size and wage. This may simply be that environmental regulations are more influential factors  
12 for dirty industries because they will be more affected by environmental costs than non-dirty  
13 industries. Concerning distance, since pollution intensity is positively related to capital  
14 intensity (e.g. Antweiler et al. 2001; Cole and Elliott, 2002; Cole et al. 2004), we can draw the  
15 conclusion that for dirty industries, the transportation costs of capital products are an important  
16 factor affecting FDI.  
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25 With regard to Japanese FDI decision-making within developing countries, in terms of  
26 magnitude of the coefficient, Table 4 shows that the stringency of environmental regulations  
27 are the most important factor for dirty industries sampled here, similar to the all countries case.  
28 When examining non-ferrous metals industry, where environmental regulations, market size  
29 and distance are statistically significant, distance is the second most influential factor. Since  
30 dirty industries are more inclined to be capital intensive, indicating that transaction costs for  
31 capital goods will be expensive and that environmental costs will tend to burden more heavily  
32 on the dirty industries, the stringency of the environmental regulations and distance are  
33 important determinants factors for Japanese FDI decision. When examining the results cross  
34 industries, Table 4 shows that environmental regulations have an impact on Japanese FDI  
35 decision-making in developing countries for resource based industry\_rather than non-resource  
36 based industry. Market size has a weaker influence on FDI decision-making for non-resource  
37 based industry than resource based industry.  
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Table 4

The predicted percentage change in the probability of locating in a state with average characteristics as a result of standard deviation increase in each independent variable: developing countries

|             | Iron and steel (%) | Non-ferrous metals (%) | Chemicals (%) | Paper and Pulp (%) | Non-metallic products (%) |
|-------------|--------------------|------------------------|---------------|--------------------|---------------------------|
| ER          | 1.04 ***           | 0.951 ***              | 0.996 ***     | 1.327 ***          | 0.801 ***                 |
| Market size | 0.216 ***          | 0.185 ***              | 0.281 ***     | 0.273 **           | 0.322 ***                 |
| Wage        | -0.016             | 0.044                  | 0.112 ***     | -0.142             | 0.011                     |
| Distance    | -0.277             | -0.768 **              | -0.388        | -1.027             | -0.173                    |

\*\*\* Underlying coefficient (Table 2) is significant at 1%

\*\* Underlying coefficient (Table 2) is significant at 5%

\* Underlying coefficient (Table 2) is significant at 10%

## 6. Conclusion

The pollution haven hypothesis, which predicts that dirty industries will relocate their production activities to regions where environmental compliance costs are lower, has received considerable attention in recent years. Empirical testing has failed however, to produce robust evidence in support of the 'flight to the bottom' hypothesis. A number of alternative explanations of the ambiguous and sometimes contradictory nature of the empirical evidence have been proposed. It may be that the impact of different levels of compliance costs on the FDI location decision is out-weighted by the effect of the other determinants of FDI flows. Furthermore, there is the argument that the quality of the general environmental conditions is likely to be higher in regions with stringent environmental regulations. In so far as this may reduce the investment that firms will have to make in environmental improvements and lower the risk of having to clean up for past environmental damages, dirty industries would prefer to locate to such regions.

This paper has analysed the pattern of FDI by Japanese dirty industries in the 1990s. The methodology used in this analysis is the conditional logit model which can be applied to the non-ordered dataset which represents the choice-specific attributes of the location choices of Japanese firms. The results showed that for each of the five dirty industries examined, firms were found to be undertaking FDI in regions with more, rather than less, stringent environmental regulations. Very similar results were found for the case of Japanese FDI in

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developing countries.

In addition to the host countries' environmental regulations, this paper has found that Japanese FDI is dependent on various locational factors. . The host countries' market size and the distance between Japan and the host countries were both statistically significant determinants of firms' choice of location for dirty industry DFI. In contrast, host country wage costs did not appear to have a significant effect on Japanese FDI.

Environmental regulations (and distance) were shown to have more impact on Japanese FDI decision-making than market size and wage costs. This can be due to the industries observed being dirty industries which are strongly affected by environmental regulations. Also, since pollution intensity is positively related to capital intensity, transaction costs such as import cost of capital products are crucial factors effecting FDI. The environmental regulations generally had larger impact on Japanese FDI decision for resource based industries compared to non-resource based industries, which may be explained by the limited product differentiation in resource based industries which limits the option of responding to differential environmental regulations by a change in technology.

In conclusion, the pattern of Japanese FDI in dirty industries during the 1990s, did not conform with the pollution haven hypothesis, whereby weak environmental regulation in a host country may attract inward FDI by firms seeking to circumvent regulatory compliance. On the contrary, inward Japanese FDI appears to have been attracted to countries which have committed themselves to a transparent and stable environment regulatory framework, as demonstrated by through their participation in international environmental agreements. This is consistent with the general literature on FDI which shows that regulatory stability, consistency and transparency are at least as important as the level of the regulatory measures, in influencing an investor's choice of location for foreign investment. Policy makers' fears of a race to the bottom can be allayed therefore, and need not act as a deterrent to the progressive strengthening of environmental standards.

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For Peer Review

## Appendix A. Descriptive Statistics

Table A1a. Descriptive Statistics: Iron and Steel Industry for the World

|             | Means   | S.D.    | Minimum | Maximum |
|-------------|---------|---------|---------|---------|
| ER          | 9.06    | 7.48    | 0       | 29      |
| Market Size | 1710    | 6870    | 2       | 79400   |
| Wage        | 5683.59 | 9091.74 | 98.73   | 44447   |
| Distance    | 10339   | 3554.71 | 1153    | 18578   |

Table A2a. Descriptive Statistics: Non-Ferrous Industry for the World

|             | Means   | S.D.    | Minimum | Maximum |
|-------------|---------|---------|---------|---------|
| ER          | 8.70    | 7.35    | 0       | 29      |
| Market Size | 1700    | 6840    | 2       | 79400   |
| Wage        | 5673.59 | 9061.91 | 98.73   | 44447   |
| Distance    | 10339   | 3554.71 | 1153    | 18578   |

Table A3a. Descriptive Statistics: Chemicals Industry for the World

|             | Means    | S.D.    | Minimum | Maximum |
|-------------|----------|---------|---------|---------|
| ER          | 8.54     | 7.19    | 0       | 29      |
| Market size | 1700     | 6830    | 2       | 79400   |
| Wage        | 5673.64  | 9058.32 | 98.73   | 44447   |
| Distance    | 10341.28 | 3553.78 | 1153    | 18578   |

Table A4a. Descriptive Statistics: Paper & Pulp Industry for the World

|             | Means    | S.D.    | Minimum | Maximum |
|-------------|----------|---------|---------|---------|
| ER          | 8.14     | 7.11    | 0       | 29      |
| Market size | 1690     | 6800    | 2       | 79400   |
| Wage        | 5660.73  | 9019.01 | 98.73   | 44447   |
| Distance    | 10340.74 | 3548.71 | 1153    | 18578   |

Table A5a. Descriptive Statistics: Non-Metallic Products Industry for the World

|             | Means    | S.D.    | Minimum | Maximum |
|-------------|----------|---------|---------|---------|
| ER          | 9.01     | 7.26    | 0       | 29      |
| Market size | 1710     | 6860    | 2       | 79400   |
| Wage        | 5688.96  | 9087.6  | 98.73   | 44447   |
| Distance    | 10337.73 | 3549.45 | 1153    | 18578   |

Table A1b. Descriptive Statistics Concerning Iron and Steel Industry for Developing Countries

|             | Means    | S.D.    | Minimum | Maximum |
|-------------|----------|---------|---------|---------|
| ER          | 7.82     | 6.81    | 0       | 28      |
| Market Size | 464      | 1120    | 2       | 8350    |
| Wage        | 2444.08  | 4165.93 | 98.73   | 26066   |
| Distance    | 10564.55 | 3817.52 | 1153    | 18578   |

Table A3b. Descriptive Statistics: Chemicals Industry for Developing Countries

|             | Means    | S.D.     | Minimum | Maximum |
|-------------|----------|----------|---------|---------|
| ER          | 1.68     | 1.07     | 0       | 3.36    |
| Market size | 465      | 1120     | 2       | 8350    |
| Wage        | 2465.45  | 4173.809 | 98.735  | 26066   |
| Distance    | 10557.44 | 3814.35  | 1153    | 18578   |

Table A5b. Descriptive Statistics: Non-Metallic Products Industry for Developing Countries

|             | Means    | S.D.    | Minimum | Maximum |
|-------------|----------|---------|---------|---------|
| ER          | 7.62     | 6.69    | 0       | 28      |
| Market size | 465      | 1120    | 2       | 8350    |
| Wage        | 2461.89  | 4176.53 | 98.73   | 26066   |
| Distance    | 10559.16 | 3812.12 | 1153    | 18578   |

Table A2b. Descriptive Statistics: Non-Ferrous Industry for the Developing Countries

|             | Means    | S.D.    | Minimum | Maximum |
|-------------|----------|---------|---------|---------|
| ER          | 7.38     | 6.72    | 0       | 28      |
| Market Size | 462      | 1110    | 2       | 8350    |
| Wage        | 2453.57  | 4151.61 | 98.73   | 26066   |
| Distance    | 10563.69 | 3810.66 | 1153    | 18578   |

Table A4b. Descriptive Statistics: Paper & Pulp Industry for Developing Countries

|             | Means    | S.D.    | Minimum | Maximum |
|-------------|----------|---------|---------|---------|
| ER          | 7.3      | 6.49    | 0       | 28      |
| Market size | 463      | 1110    | 2       | 8350    |
| Wage        | 2474     | 4188.75 | 98.73   | 26066   |
| Distance    | 10556.06 | 3809.17 | 1153    | 18578   |

## Appendix B. Correlation Matrix

Table B1a. Correlation Matrix; Iron and Steel for the World

|             | ER    | Market Size | Wage   | Distance |
|-------------|-------|-------------|--------|----------|
| ER          | 1.000 |             |        |          |
| Market Size | 0.237 | 1.000       |        |          |
| Wage        | 0.374 | 0.410       | 1.000  |          |
| Distance    | 0.020 | -0.041      | -0.172 | 1.000    |

Table B2a. Correlation Matrix; Non-Ferrous Metals for the World

|             | ER    | Market Size | Wage   | Distance |
|-------------|-------|-------------|--------|----------|
| ER          | 1.000 |             |        |          |
| Market Size | 0.238 | 1.000       |        |          |
| Wage        | 0.376 | 0.410       | 1.000  |          |
| Distance    | 0.017 | -0.041      | -0.172 | 1.000    |

Table B3a. Correlation Matrix; Chemicals for the World

|             | ER    | Market Size | Wage   | Distance |
|-------------|-------|-------------|--------|----------|
| ER          | 1.000 |             |        |          |
| Market Size | 0.242 | 1.000       |        |          |
| Wage        | 0.383 | 0.410       | 1.000  |          |
| Distance    | 0.016 | -0.041      | -0.172 | 1.000    |

Table B4a. Correlation Matrix; paper &amp; pulp for the World

|             | ER    | Market Size | Wage   | Distance |
|-------------|-------|-------------|--------|----------|
| ER          | 1.000 |             |        |          |
| Market Size | 0.241 | 1.000       |        |          |
| Wage        | 0.383 | 0.410       | 1.000  |          |
| Distance    | 0.013 | -0.041      | -0.173 | 1.000    |

Table B5a. Correlation Matrix; Non-Metallic Products for the World

|             | ER    | Market Size | Wage   | Distance |
|-------------|-------|-------------|--------|----------|
| ER          | 1.000 |             |        |          |
| Market Size | 0.246 | 1.000       |        |          |
| Wage        | 0.388 | 0.409       | 1.000  |          |
| Distance    | 0.019 | -0.041      | -0.173 | 1.000    |

Table B1b. Correlation Matrix; Iron and Steel for Developing Countries

|             | ER    | Market Size | Wage   | Distance |
|-------------|-------|-------------|--------|----------|
| ER          | 1.000 |             |        |          |
| Market Size | 0.216 | 1.000       |        |          |
| Wage        | 0.059 | 0.187       | 1.000  |          |
| Distance    | 0.093 | -0.163      | -0.148 | 1.000    |

Table B2b. Correlation Matrix; Non-Ferrous Metals for Developing Countries

|             | ER    | Market Size | Wage   | Distance |
|-------------|-------|-------------|--------|----------|
| ER          | 1.000 |             |        |          |
| Market Size | 0.216 | 1.000       |        |          |
| Wage        | 0.058 | 0.185       | 1.000  |          |
| Distance    | 0.090 | -0.161      | -0.149 | 1.000    |

Table B3b. Correlation Matrix; Chemicals for Developing Countries

|             | ER    | Market Size | Wage   | Distance |
|-------------|-------|-------------|--------|----------|
| ER          | 1.000 |             |        |          |
| Market Size | 0.221 | 1.000       |        |          |
| Wage        | 0.062 | 0.189       | 1.000  |          |
| Distance    | 0.088 | -0.167      | -0.153 | 1.000    |

Table B4b. Correlation Matrix; Paper &amp; Pulp for Developing Countries

|             | ER    | Market Size | Wage   | Distance |
|-------------|-------|-------------|--------|----------|
| ER          | 1.000 |             |        |          |
| Market Size | 0.224 | 1.000       |        |          |
| Wage        | 0.063 | 0.187       | 1.000  |          |
| Distance    | 0.090 | -0.166      | -0.153 | 1.000    |

Table B5b. Correlation Matrix; Non-Metallic Products for Developing Countries

|             | ER    | Market Size | Wage   | Distance |
|-------------|-------|-------------|--------|----------|
| ER          | 1.000 |             |        |          |
| Market Size | 0.220 | 1.000       |        |          |
| Wage        | 0.059 | 0.187       | 1.000  |          |
| Distance    | 0.091 | -0.165      | -0.151 | 1.000    |