

## The Effect of Environmental Regulation on the Locational Choice of Japanese Foreign Direct Investment

Kirkpatrick, Colin

Postprint / Postprint

Zeitschriftenartikel / journal article

Zur Verfügung gestellt in Kooperation mit / provided in cooperation with:

[www.peerproject.eu](http://www.peerproject.eu)

### Empfohlene Zitierung / Suggested Citation:

Kirkpatrick, C. (2008). The Effect of Environmental Regulation on the Locational Choice of Japanese Foreign Direct Investment. *Applied Economics*, 40(11), 1399-1409. <https://doi.org/10.1080/00036840600794330>

### Nutzungsbedingungen:

Dieser Text wird unter dem "PEER Licence Agreement zur Verfügung" gestellt. Nähere Auskünfte zum PEER-Projekt finden Sie hier: <http://www.peerproject.eu> Gewährt wird ein nicht exklusives, nicht übertragbares, persönliches und beschränktes Recht auf Nutzung dieses Dokuments. Dieses Dokument ist ausschließlich für den persönlichen, nicht-kommerziellen Gebrauch bestimmt. Auf sämtlichen Kopien dieses Dokuments müssen alle Urheberrechtshinweise und sonstigen Hinweise auf gesetzlichen Schutz beibehalten werden. Sie dürfen dieses Dokument nicht in irgendeiner Weise abändern, noch dürfen Sie dieses Dokument für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, aufführen, vertreiben oder anderweitig nutzen.

Mit der Verwendung dieses Dokuments erkennen Sie die Nutzungsbedingungen an.

### Terms of use:

This document is made available under the "PEER Licence Agreement". For more information regarding the PEER-project see: <http://www.peerproject.eu> This document is solely intended for your personal, non-commercial use. All of the copies of this documents must retain all copyright information and other information regarding legal protection. You are not allowed to alter this document in any way, to copy it for public or commercial purposes, to exhibit the document in public, to perform, distribute or otherwise use the document in public.

By using this particular document, you accept the above-stated conditions of use.



**The Effect of Environmental Regulation on the Locational Choice of Japanese Foreign Direct Investment**

Journal:	<i>Applied Economics</i>
Manuscript ID:	APE-05-0341.R1
Journal Selection:	Applied Economics
JEL Code:	F18 - Trade and Environment < , F21 - International Investment Long-Term Capital Movements < , Q56 - Environment and Development Environment and Trade Sustainability Environmental Accounting <
Keywords:	environmental regulation , foreign direct investment, Japanese multinationals

powered by ScholarOne  
Manuscript Central™

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33

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

Colin Kirkpatrick

Institute for Development Policy and Management

School of Environment and Development

University of Manchester, UK

and

Kenichi Shimamoto

Department of Economics

University of Birmingham, UK

34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57

## 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.

58  
59  
60

---

<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.

1  
2  
3 *JEL classification:* Q56, F21  
4

5 *Keywords,* Environmental regulation, foreign direct investment, Japanese multinationals.  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

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.

1  
2  
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  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

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

---

<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.

1  
2  
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.  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32

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>.  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54

---

55  
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>.

---

<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)



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

---

<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.

1  
2  
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.  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

### 26 *Environmental Regulations (ER)*

27  
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>.  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52

### 53 *Other Determinants of FDI*

54  
55  
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.

1  
2  
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>.  
6  
7

### 8 Market Size

9  
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).  
16  
17

### 18 Labour Costs

19  
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).  
32  
33

### 34 Distance

35  
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  
40  
41  
42  
43

---

44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
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).

1  
2  
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>.  
5  
6  
7

### 8 *Regional Dummy*

9  
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).  
14  
15  
16  
17

18  
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.  
23  
24  
25  
26  
27

## 28 **5. Results**

29  
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>.  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57

---

58  
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 *** [0.387]	0.187 *** [0.028]	0.212 *** [0.023]	0.363 *** [0.074]	0.178 *** [0.030]
Market size	0.104 *** [0.036]	0.081 *** [0.021]	0.054 *** [0.011]	0.012 [0.014]	0.110 *** [0.029]
Wage	-0.287 [0.208]	-0.008 [0.124]	0.005 [0.094]	-0.018 [0.025]	-0.030 ** [0.015]
Distance	-0.248 *** [0.083]	-0.361 *** [0.057]	-0.043 *** [0.004]	-0.058 *** [0.012]	-0.035 *** [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

1  
2  
3 and 1997, a view that has been confirmed by numerous surveys (see, for example, Amuro,  
4 1996, Ando, 1996, Letchumanan and Kodama, 2000).  
5  
6  
7

8  
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).  
17  
18  
19  
20  
21  
22  
23

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.  
32  
33  
34  
35  
36  
37  
38  
39

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  
52  
53  
54  
55  
56  
57  
58  
59  
60

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 *** [0.044]	0.161 *** [0.032]	0.173 *** [0.028]	0.233 *** [0.086]	0.1366 *** [0.037]
Market size	0.219 *** [0.075]	0.190 *** [0.059]	0.286 *** [0.053]	0.281 ** [0.014]	0.328 *** [0.069]
Wage	-0.044 [0.234]	0.122 [0.147]	0.307 *** [0.011]	-0.387 [0.485]	0.030 [0.189]
Distance	-0.082 [0.121]	-0.229 ** [0.098]	-0.116 [0.085]	-0.308 [0.00025]	-0.051 [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 (%)	Non-Ferrous Metals (%)	Chemicals (%)	Paper and Pulp (%)	Non-Metallic 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.



1  
2  
3 which are non-resource based industries, were found to be more likely to undertake FDI in  
4 regions with larger market size.  
5  
6  
7

8  
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.  
17  
18  
19  
20  
21  
22  
23

24  
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.  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

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

1  
2  
3 developing countries.  
4  
5

6  
7 In addition to the host countries' environmental regulations, this paper has found that  
8 Japanese FDI is dependent on various locational factors. . The host countries' market size and  
9 the distance between Japan and the host countries were both statistically significant  
10 determinants of firms' choice of location for dirty industry DFI. In contrast, host country  
11 wage costs did not appear to have a significant effect on Japanese FDI.  
12  
13  
14  
15

16  
17 Environmental regulations (and distance) were shown to have more impact on Japanese FDI  
18 decision-making than market size and wage costs. This can be due to the industries observed  
19 being dirty industries which are strongly affected by environmental regulations. Also, since  
20 pollution intensity is positively related to capital intensity, transaction costs such as import cost of  
21 capital products are crucial factors effecting FDI. The environmental regulations generally had  
22 larger impact on Japanese FDI decision for resource based industries compared to non-resource  
23 based industries, which may be explained by the limited product differentiation in resource  
24 based industries which limits the option of responding to differential environmental regulations  
25 by a change in technology.  
26  
27  
28  
29  
30  
31  
32  
33

34  
35 In conclusion, the pattern of Japanese FDI in dirty industries during the 1990s, did not conform  
36 with the pollution haven hypothesis, whereby weak environmental regulation in a host country  
37 may attract inward FDI by firms seeking to circumvent regulatory compliance. On the  
38 contrary, inward Japanese FDI appears to have been attracted to countries which have  
39 committed themselves to a transparent and stable environment regulatory framework, as  
40 demonstrated by through their participation in international environmental agreements. This is  
41 consistent with the general literature on FDI which shows that regulatory stability, consistency  
42 and transparency are at least as important as the level of the regulatory measures, in influencing  
43 an investor's choice of location for foreign investment. Policy makers' fears of a race to the  
44 bottom can be allayed therefore, and need not act as a deterrent to the progressive  
45 strengthening of environmental standards.  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## References

Adam, J. (1997), Environmental Policy and Competitiveness in a Globalisation Economy: Conceptual Issues and a Review of the Empirical Evidence, in OECD, *Globalisation and Environment: Preliminary Perspectives*, Paris, OECD.

Altomonte C (2000) 'Economic Determinants and Institutional Frameworks: FDI in the Economies in Transition' *Transnational Corporations*, vol9, no 2, pp75-106

Amuro, K. (1996), Nihon no takokuseki kigyō niokeru kankyo kanri/kansa system nikansuru jittai chosa, [Empirical Study Concerning the Environmental Management/ Audit in Japanese Multinational Corporations], *Kenkyu Shiryo*, No.155, Kobe Shoka Daigaku Keizai Kenkyusho. (in Japanese)

Ando, M. (1996), *Chance ga ippai Ecobusiness*, [Chance for Ecobusiness], Tokyo, Diamond, Inc.. (in Japanese)

Antweiler, W. Copeland B. R. and Taylor M. S. (2001), Is Free Trade Good for the Environment?, *American Economic Review*, Vol. 91, No. 4, pp.877-908.

Bartik, T. J. (1988), The Effects of Environmental Regulation on Business Location on the United States, *Growth and Change*, Vol.19, pp. 22-44.

Brack D and Gray K (2003) *Multinational Environmental Agreements and the WTO*, Report. The Royal Institute of International Affairs: London

Busse M. (2004) 'Trade, Environmental Regulations and the World Trade Organization: New Empirical Evidence' *World Bank Policy Research Working Paper 3361*, July. Washington DC: World Bank

Cassidy J. F. and B. A. O'Callaghan (2005), Spatial determinants of Japanese FDI in China, *Japan and the World Economy*, In Press, Corrected Proof, Available online 30 March 2005.

CASIO (2002), <http://www.casio.co.jp/gpsw/city.html>

Chen, J. A. (1992), Japanese Firms with Direct Investment in China and Their Local Management, in S.Tokunaga, (ed.) , *Japan's Foreign Investment and Asian Economic Interdependence*, Tokyo, University of Tokyo Press.

Chen, T. J. (1992), Determinants of Taiwan's Direct Foreign Investment: The Case of a Newly Industrialising Country, *Journal of Development Economics*, Vol. 39, pp.397-407.

Cheng, L. K. and Y. K. Kwan (2000), What are the Determinants of the Location of Foreign Direct Investment? The Chinese Experience, *Journal of International Economics*, Vol. 51, pp. 379-400.

- 1  
2  
3 Chung, H. (1996), Host koku no zeisei ga nichibei no taigai chokusetsu toshi ni oyobosu koka,  
4 [The Impact of Host Countries' Taxation on Japanese and American Foreign Direct  
5 Investment], *Hitotsubashi Ronso*, Vol. 116, No. 6, December, pp. 1158-1177. (in Japanese)  
6  
7  
8 Chung, H. (1997), Nihon no chokusetsu toshisakikoku no ukeire seisaku kettei yoin nitsuite-  
9 seizogyo no sogyo kyoka joken nikansuru jisho bunseki, [The Determining Factors of Host  
10 Country's Policy for Japanese Foreign Direct Investment], *Nihon Keizai Kenkyu*, No. 34, pp.  
11 118-144. (in Japanese)  
12  
13  
14 Co, K. Y. (1997), Japanese FDI into the U.S. automobile industry: An empirical  
15 investigation, *Japan and the World Economy*, Volume 9, Issue 1, March, pp 93-108.  
16  
17  
18 Cole, M. A. and R. J. R. Elliott (2002), FDI and Capital Intensity of 'Dirty' Sectors: A Missing  
19 Piece of the Pollution Haven Puzzle. University of Birmingham Discussion Paper in  
20 Economics No. 02-04.  
21  
22  
23 Cole, M.A., R.J.R. Elliott, and K. Shimamoto (2004) Characteristics, Environmental Regulations  
24 and Air Pollution: An Analysis of the UK Manufacturing Sector. University of Nottingham,  
25 Globalisation and Economic Policy Working Paper No. 2004/22.  
26  
27  
28 Copeland B. R. and Taylor M. S. (2004) 'Trade, Growth and the Environment' *Journal of*  
29 *Economic Literature*, vol. XLII, Mach, pp 7-71  
30  
31  
32 Culem, C. G. (1988), The Locational Determinants of Direct Investments among Industrialised  
33 Countries, *European Economic Review*, Vol. 32, pp.885-904.  
34  
35  
36 Cushman, D. O. (1987), The Effect of Real Wages and Labour Productivity on Foreign Direct  
37 Investment, *Southern Economic Journal*, Vol. 54, No.1, July, pp. 174-185.  
38  
39  
40 Dunning J (1993) *Multinational Enterprises and the Global Economy*. Wokingham:  
41 Addison-Wesley Publishing Co  
42  
43  
44 Economic Planning Agency, Japan (1993), *Keizai hakusho*, [Economic Survey of Japan 1993],  
45 Tokyo, Printing Bureau, Ministry of Finance, Japan. (in Japanese)  
46  
47  
48 Economic Planning Agency, Japan (1994), *Nihon keizai no genkyo*, [Economic Survey of  
49 Japan 1994], Tokyo, Printing Bureau, Ministry of Finance, Japan. (in Japanese)  
50  
51  
52 Eskeland GS and Harrison AE (2003) 'Moving to Greener Pastures? Multinationals and the  
53 Pollution Haven' *Journal of Development Economics*, vol70,pp1-23  
54  
55  
56 Farrell R., N. Gaston and J.E. Sturm (2004), Determinants of Japan's foreign direct investment:  
57 An industry and country panel study, 1984–1998, *Journal of the Japanese and International*  
58 *Economies*, Volume 18, Issue 2, June, pp 161-182.  
59  
60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82  
83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100  
101  
102  
103  
104  
105  
106  
107  
108  
109  
110  
111  
112  
113  
114  
115  
116  
117  
118  
119  
120  
121  
122  
123  
124  
125  
126  
127  
128  
129  
130  
131  
132  
133  
134  
135  
136  
137  
138  
139  
140  
141  
142  
143  
144  
145  
146  
147  
148  
149  
150  
151  
152  
153  
154  
155  
156  
157  
158  
159  
160  
161  
162  
163  
164  
165  
166  
167  
168  
169  
170  
171  
172  
173  
174  
175  
176  
177  
178  
179  
180  
181  
182  
183  
184  
185  
186  
187  
188  
189  
190  
191  
192  
193  
194  
195  
196  
197  
198  
199  
200  
201  
202  
203  
204  
205  
206  
207  
208  
209  
210  
211  
212  
213  
214  
215  
216  
217  
218  
219  
220  
221  
222  
223  
224  
225  
226  
227  
228  
229  
230  
231  
232  
233  
234  
235  
236  
237  
238  
239  
240  
241  
242  
243  
244  
245  
246  
247  
248  
249  
250  
251  
252  
253  
254  
255  
256  
257  
258  
259  
260  
261  
262  
263  
264  
265  
266  
267  
268  
269  
270  
271  
272  
273  
274  
275  
276  
277  
278  
279  
280  
281  
282  
283  
284  
285  
286  
287  
288  
289  
290  
291  
292  
293  
294  
295  
296  
297  
298  
299  
300  
301  
302  
303  
304  
305  
306  
307  
308  
309  
310  
311  
312  
313  
314  
315  
316  
317  
318  
319  
320  
321  
322  
323  
324  
325  
326  
327  
328  
329  
330  
331  
332  
333  
334  
335  
336  
337  
338  
339  
340  
341  
342  
343  
344  
345  
346  
347  
348  
349  
350  
351  
352  
353  
354  
355  
356  
357  
358  
359  
360  
361  
362  
363  
364  
365  
366  
367  
368  
369  
370  
371  
372  
373  
374  
375  
376  
377  
378  
379  
380  
381  
382  
383  
384  
385  
386  
387  
388  
389  
390  
391  
392  
393  
394  
395  
396  
397  
398  
399  
400  
401  
402  
403  
404  
405  
406  
407  
408  
409  
410  
411  
412  
413  
414  
415  
416  
417  
418  
419  
420  
421  
422  
423  
424  
425  
426  
427  
428  
429  
430  
431  
432  
433  
434  
435  
436  
437  
438  
439  
440  
441  
442  
443  
444  
445  
446  
447  
448  
449  
450  
451  
452  
453  
454  
455  
456  
457  
458  
459  
460  
461  
462  
463  
464  
465  
466  
467  
468  
469  
470  
471  
472  
473  
474  
475  
476  
477  
478  
479  
480  
481  
482  
483  
484  
485  
486  
487  
488  
489  
490  
491  
492  
493  
494  
495  
496  
497  
498  
499  
500  
501  
502  
503  
504  
505  
506  
507  
508  
509  
510  
511  
512  
513  
514  
515  
516  
517  
518  
519  
520  
521  
522  
523  
524  
525  
526  
527  
528  
529  
530  
531  
532  
533  
534  
535  
536  
537  
538  
539  
540  
541  
542  
543  
544  
545  
546  
547  
548  
549  
550  
551  
552  
553  
554  
555  
556  
557  
558  
559  
560  
561  
562  
563  
564  
565  
566  
567  
568  
569  
570  
571  
572  
573  
574  
575  
576  
577  
578  
579  
580  
581  
582  
583  
584  
585  
586  
587  
588  
589  
590  
591  
592  
593  
594  
595  
596  
597  
598  
599  
600  
601  
602  
603  
604  
605  
606  
607  
608  
609  
610  
611  
612  
613  
614  
615  
616  
617  
618  
619  
620  
621  
622  
623  
624  
625  
626  
627  
628  
629  
630  
631  
632  
633  
634  
635  
636  
637  
638  
639  
640  
641  
642  
643  
644  
645  
646  
647  
648  
649  
650  
651  
652  
653  
654  
655  
656  
657  
658  
659  
660  
661  
662  
663  
664  
665  
666  
667  
668  
669  
670  
671  
672  
673  
674  
675  
676  
677  
678  
679  
680  
681  
682  
683  
684  
685  
686  
687  
688  
689  
690  
691  
692  
693  
694  
695  
696  
697  
698  
699  
700  
701  
702  
703  
704  
705  
706  
707  
708  
709  
710  
711  
712  
713  
714  
715  
716  
717  
718  
719  
720  
721  
722  
723  
724  
725  
726  
727  
728  
729  
730  
731  
732  
733  
734  
735  
736  
737  
738  
739  
740  
741  
742  
743  
744  
745  
746  
747  
748  
749  
750  
751  
752  
753  
754  
755  
756  
757  
758  
759  
760  
761  
762  
763  
764  
765  
766  
767  
768  
769  
770  
771  
772  
773  
774  
775  
776  
777  
778  
779  
780  
781  
782  
783  
784  
785  
786  
787  
788  
789  
790  
791  
792  
793  
794  
795  
796  
797  
798  
799  
800  
801  
802  
803  
804  
805  
806  
807  
808  
809  
810  
811  
812  
813  
814  
815  
816  
817  
818  
819  
820  
821  
822  
823  
824  
825  
826  
827  
828  
829  
830  
831  
832  
833  
834  
835  
836  
837  
838  
839  
840  
841  
842  
843  
844  
845  
846  
847  
848  
849  
850  
851  
852  
853  
854  
855  
856  
857  
858  
859  
860  
861  
862  
863  
864  
865  
866  
867  
868  
869  
870  
871  
872  
873  
874  
875  
876  
877  
878  
879  
880  
881  
882  
883  
884  
885  
886  
887  
888  
889  
890  
891  
892  
893  
894  
895  
896  
897  
898  
899  
900  
901  
902  
903  
904  
905  
906  
907  
908  
909  
910  
911  
912  
913  
914  
915  
916  
917  
918  
919  
920  
921  
922  
923  
924  
925  
926  
927  
928  
929  
930  
931  
932  
933  
934  
935  
936  
937  
938  
939  
940  
941  
942  
943  
944  
945  
946  
947  
948  
949  
950  
951  
952  
953  
954  
955  
956  
957  
958  
959  
960  
961  
962  
963  
964  
965  
966  
967  
968  
969  
970  
971  
972  
973  
974  
975  
976  
977  
978  
979  
980  
981  
982  
983  
984  
985  
986  
987  
988  
989  
990  
991  
992  
993  
994  
995  
996  
997  
998  
999  
1000

- 1  
2  
3 Geographical Survey Institute of Japan (2002),  
4 <http://vldp.gsi.go.jp/sokuchi/surveycalc/bl2stf.html>  
5  
6  
7 Globerman S and Shapiro D (2002) 'Global Foreign Investment Flows: The Role of Governance  
8 Infrastructure' *World Development*, vol 30, no 11, pp1899-1919  
9  
10 Greene, W. H. (2000), *Econometric Analysis*, New York, Macmillan Publishing Company  
11  
12 Hoffmann R Lee C-G., Ramasamy B., and Yeung M. (2005) 'FDI and Pollution: A Granger  
13 Causality Test Using Panel Data' *Journal of International Development*, volume 17,  
14 pp311-317  
15  
16  
17 Inaba, K. (1999), *Chokusetsu-toshi-no-keizaigaku* [Foreign Direct Investment], Tokyo,  
18 Sobun-sha (in Japanese).  
19  
20  
21 In-Mee, B. and T. Okawa (2001), Foreign exchange rates and Japanese foreign direct investment  
22 in Asia, *Journal of Economics and Business*, Volume 53, Issue 1, January-February, pp 69-84  
23  
24  
25  
26 Japanese Vexillological Association (2002), [http://www.j-flags-java.org/new\\_page\\_15.htm](http://www.j-flags-java.org/new_page_15.htm) (in  
27 Japanese)  
28  
29 Letchumanan, R. and F. Kodama (2000), Reconciling the Conflict between the  
30 Pollution-Havens Hypothesis and An Emerging Trajectory of International Technology  
31 Transfer, *Research Policy*, Vol. 29, pp. 59-79.  
32  
33  
34 Levinson, A. (1996), Environmental Regulations and Manufacturers' Location Choices:  
35 Evidence from the Census of Manufactures, *Journal of Public Economics*, Vol. 62, pp. 5-29.  
36  
37  
38 List, J. A. and C. Y. Co (2000), The Effect of Environmental Regulation on Foreign Direct  
39 Investment, *Journal of Environmental Economics and Management*, Vol. 40, pp. 1-40.  
40  
41 Loree, D. W. and S. E. Guisinger (1995), Policy and Non-Policy Determinants of U.S. Equity  
42 Foreign Direct Investment, *Journal of International Business Studies*, Vol. 26 (second quarter),  
43 pp. 281-299.  
44  
45  
46 Mani, M. and D. Wheeler (1999), In Search of Pollution Havens?: Dirty Industry in the World  
47 Economy 1960-1995, in Fredriksson, P. G. (ed.) *Trade, Global Policy and the Environment*,  
48 World Bank Discussion Paper, No. 402, Washington, D. C., World Bank.  
49  
50  
51 McConnell, V. D. and R. M. Schwab (1990), The Impact of Environmental Regulation on  
52 Industry Location Decisions: The Motor Vehicle Industry, *Land Economics*, Vol. 66, pp.  
53 67-81.  
54  
55  
56 McFadden, D. (1974), Conditional Logit Analysis of Qualitative Choice Behaviour, in P.  
57 Zarembka (ed.), *Frontiers in Econometrics*, New York, Academic Press.  
58  
59  
60

- 1  
2  
3 Ministry of International Trade and Industry, Japan (MITI) (1993), *Tsusan hakusho*, [White  
4 Paper on International Trade: Japan], Tokyo, Printing Bureau, Ministry of Finance, Japan. (in  
5 Japanese)  
6  
7  
8 Ministry of International Trade and Industry, Japan (MITI) (1994), *Tsusan hakusho*, [White  
9 Paper on International Trade: Japan], Tokyo, Printing Bureau, Ministry of Finance, Japan. (in  
10 Japanese)  
11  
12  
13 Ministry of International Trade and Industry, Japan (MITI) (2001), *Tsusho hakusho*, [White  
14 Paper on International Trade: Japan], Tokyo, Gyosei. (in Japanese)  
15  
16  
17 Mito, Y. (1997), *India eno chokusetsu toshi doko*, [Foreign Direct Investment and India],  
18 *Journal of Kyushu Kyoritsu University Faculty of Economics*, No. 70, Sep., pp.49-66. (in  
19 Japanese)  
20  
21  
22 Moore, M. O. (1993), Determinants of German Manufacturing Direct Investment: 1980-1988,  
23 *Weltwirtschaftliches Archiv*, Vol. 29, No. 1, pp.120-138.  
24  
25  
26 OECD (1997), *Foreign Direct Investment and the Environment: An Overview of the Literature*,  
27 <http://www.oecd.org/daf/cmif/fdi/fdienv.htm>  
28  
29  
30 Porter M. and van de Lande C. 'Toward a New Conception of the  
31 Environment-Competitiveness Relationship' *Journal of Economic Perspectives*, vol.9, no4  
32 (Autumn), pp97-118  
33  
34  
35 Schneider, F. and B. S. Frey (1985), Economic and Political Determinants of Foreign Direct  
36 Investment, *World Development*, Vol. 13, No.2, pp. 161-175.  
37  
38  
39 Smarzynska, B. K. and S. J. Wei (2001), *Pollution Havens and Foreign Direct Investment:  
40 Dirty Secret or Popular Myth?*, NBER Working Paper 8465, Cambridge, Mass.  
41  
42  
43 Stein E and Daude C (2001) 'Institutions, Integration and the Location of Foreign Direct  
44 Investment' Inter-American Development Bank Research Department. Inter-American  
45 Development Bank: Washington DC  
46  
47  
48 Toyo Keizai Shinpo (1998), *Kaigai shinshutsu kigyo soran:kaishabetuhen*, [Foreign Investing  
49 Companies Profiles], Tokyo, Toyo Keizai Shipo. (in Japanese)  
50  
51  
52 UN (2004) *World Investment Report 2004: The Shift Towards Services* United Nations:  
53 Geneva  
54  
55  
56 UNIDO (1982), *Changing Patterns of Trade in World Industry: An Empirical Study on  
57 Revealed Comparative Advantage*, New York, United Nations.  
58  
59  
60 Van Beers, C. and J. C. J. M. van den Bergh (1997), An Empirical Multi-Country Analysis of  
the Impact of Environmental Policy on Foreign Trade Flows, *Kyklos*, Vol. 50, No. 1, pp. 29-46.  
Wheeler, D. and A. Mody (1992), International Investment Location Decisions: The Case of  
U.S. Firms, *Journal of International Economics*, Vol. 33, pp. 57-76.

1  
2  
3  
4 World Bank (2000), *World Bank Indicators*, Washington, D. C., World Bank.  
5  
6

7 World Bank (2001), *World Bank Indicators on CD-ROM*, Washington, D. C., World Bank.  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

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 &amp; 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