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THE EFFECT OF ENVIRONMENTAL REGULATION ON THE LOCATIONAL CHOICE OF JAPANESE FOREIGN DIRECT INVESTMENT[1]

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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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Keywords, Environmental regulation, foreign direct investment, Japanese multinationals.

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.

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)[2]. 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

[2] 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.

econometric methodologies, data sources and proxies, as well as alternative conceptual frameworks (Letchumanan and Kodama, 2000). A major limitation of empirical studies that have examined the linkage between trade and investment flows and environmental regulation has been the almost complete lack of comparable data on environmental regulation across countries. In attempting to overcome this lacuna in the data, most studies have tested the pollution haven hypothesis indirectly, by examining the international changes in the emissions output of 'dirty' industries on the assumption that stricter environmental regulations results in better environmental conditions, and vice versa (Hoffmann et al 2005). Typically, US data on either emission intensity or the level of pollution-abatement costs as a fraction of value added are used in estimating output levels. Assuming that environmental regulation and compliance costs are increasing more rapidly in the developed economies (the 'North') than in the lower income economies (the 'South'), evidence of a rising share of pollution intensive output or investment in the South is taken as confirmation of the pollution haven hypothesis. An additional limitation has been that due to a paucity of data on international investment flows over time, most empirical studies have relied on FDI flows by US transnational corporations.

The methodology and data used in this study are intended to address a number of these difficulties. In particular, the model that is used allows for the effect of other determinants of FDI flows, in addition to the impact of environmental regulation and in this way tests for the separate impact of the pollution haven effect. Second, we use a direct measure of environmental regulation which is comparable across countries. Third, we focus on Japanese outward FDI, rather than US data, in recognition of the importance of Japan as one of the world's largest outward investors[3].

[3] Although there has been a large number of empirical studies on the determinants of Japanese FDI (e.g. Cassidy and O'Callaghan 2005; Farrell et al. 2004; In-Mee and Ozawa 2001; Co 1997), very few have examined the relationship with environmental regulations. An exception is the study by Friedman et al. (1992) who find that Japanese FDI in the U.S. choose to locate in regions with relatively lax environmental 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:

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

π_{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[4].

[4] 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. β is a vector of estimated parameters and u_{ij} is the random error component. It is generally acknowledged that if the u_{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 β.

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[5]. 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

[5] 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.

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

Environmental Regulations (ER)

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

Other Determinants of FDI

[6] Participation in international environmental agreements is also used as a measure of environmental stringency in Busse (2004) and Smarzynska and Wei (2001).

[7] National participation information for these five treaties is provided in World Bank (2000), *World Development Indicators*.

[8] 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.

A wide variety of variables have been used in the literature as possible determinants of inward FDI flows, although as noted by Globerman and Shapiro (2002), surprisingly few are consistently significant across the broad spectrum of studies that have been reported in the literature[9].

Market Size

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

Labour Costs

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

Distance

According to Chung (1997), the further a host country is from the parent company, the higher the cost of shipping and communications. Other things being equal, we therefore expect that distance will have a negative impact on the locational choice for FDI. This has been confirmed in a number of recent empirical studies, for example, the Smarzynska and Wei (2001) study for

[9] Dunning (1993) discusses these various factors and discusses the empirical evidence regarding their impact on FDI flows.

[10] This also holds for studies of Japanese FDI (Chen, T. 1992; MITI, 1993, 1994; Mito, 1997; Economic Planning Agency, Japan, 1993, 1994).

US FDI and MITI (1993) for Japanese FDI flows. This study uses the distance from Tokyo to the capital of each country[11].

Regional Dummy

In order to overcome the IIA issue raised in section 2, regional dummy variables were included in the estimation equation. The regions are: Asia Pacific (AP); Europe and Central Asia (EC); Latin America and Caribbean (LA); Middle-East and North Africa (MA); North America (NA); and Sub-Sahara Africa (SA).

The descriptive statistics for each dirty industry's independent variables are summarised in Appendix A. The correlation matrices for the independent variables of each dirty industry are presented in Appendix B. The results of the correlation matrix do not show a significant degree of correlation between any of the independent variables.

5. Results

The estimated results for the conditional logit model are summarised in Tables 1 and 2. We first report the results for all countries, and then consider the developing country results separately[12].

[11] The main data used were taken from CASIO (2002) supplemented where necessary with data from the Japanese Vexillological Association (2002) and the Geographical Survey Institute of Japan (2002).
[12] 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 ***	0.187 ***	0.212 ***	0.363 ***	0.178 ***
	[0.387]	[0.028]	[0.023]	[0.074]	[0.030]
Market size	0.104 ***	0.081 ***	0.054 ***	0.012	0.110 ***
	[0.036]	[0.021]	[0.011]	[0.014]	[0.029]
Wage	-0.287	-0.008	0.005	-0.018	-0.030 **
	[0.208]	[0.124]	[0.094]	[0.025]	[0.015]
Distance	-0.248 ***	-0.361 ***	-0.043 ***	-0.058 ***	-0.035 ***
	[0.083]	[0.057]	[0.004]	[0.012]	[0.006]
Log-likelihood	-219.503	-414.663	-623.776	-92.264	-310.855
Pseudo R^2	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

and 1997, a view that has been confirmed by numerous surveys (see, for example, Amuro, 1996, Ando, 1996, Letchumanan and Kodama, 2000).

Concerning the other FDI determining factors, the market size represented by GDP is positively signed as predicted, and is statistically significant in all cases other than the paper and pulp industry. This suggests that, other things being equal, FDI in these industries is attracted to host countries that have a large market. This supports the studies by Chen (1992), MITI (1993, 1994) and Mito (1997) on Japanese FDI, as well as studies of FDI in general, which have identified market size as a determinant of FDI (see Cheng and Kwan, 2000; Loree and Guisinger, 1995; Moore, 1993; Smarzynska and Wei, 2001; Wheeler and Mody, 1992).

Concerning unit labour costs, as proxied by GDP per capita, the coefficient is not statistically significant (except for non metallic products), suggesting that wage costs wage costs are not a significant determinant of FDI by Japanese firms in these dirty industries. Finally, distance to the host country is shown to have a statistically significant (at the 1 per cent level), negative effect. As Chung (1997) points out, this may reflect the impact that distance from the parent (head) company has on the cost of shipping and communications. Similar results are reported for Japanese firms in the study by MITI (1993), and in Smarzynska and Wei (2001) for global FDI flows.

We also examined the flow of Japanese FDI in dirty industries, where the sample of host countries is restricted to developing countries. The purpose is to examine whether Japanese FDI to the South behaves similarly to global flows, particularly with respect to the environmental policy regime of the host country. Table 2 shows the results for Japanese FDI only to developing countries. The results show that stringency of environmental regulations has a significant and positive impact on locational decision-making of Japanese FDI within developing countries for each of the five dirty industries. This finding is contrary to the 'race to the bottom' hypothesis which is frequently advanced in the context of developing countries. The results for the other determinants are in general consistent with those reported in Table 1 for the all countries sample. Market size has a statistically significant and positive effect for all dirty industries, and distance has a negative impact in each industry (although the coefficient is statistically significant only in the case of the non-ferrous metals). The wage

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 ***	0.161 ***	0.173 ***	0.233 ***	0.1366 ***
	[0.044]	[0.032]	[0.028]	[0.086]	[0.037]
Market size	0.219 ***	0.190 ***	0.286 ***	0.281 **	0.328 ***
	[0.075]	[0.059]	[0.053]	[0.014]	[0.069]
Wage	-0.044	0.122	0.307 ***	-0.387	0.030
	[0.234]	[0.147]	[0.011]	[0.485]	[0.189]
Distance	-0.082	-0.229 **	-0.116	-0.308	-0.051
	[0.121]	[0.098]	[0.085]	[0.00025]	[0.109]
Log-likelihood	-138.080	-237.533	-330.134	-44.556	-179.836
Pseudo R^2	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)[13] to interpret the size of the coefficient.

$$\partial P(ij) / \partial X_k = \beta P_k (1 - p_k) \qquad (4)$$

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[14].

[13] See Greene (2000) for details. McConnell and Schwab (1990) use the same approach in their empirical study.

[14] For example, the Iron and Steel results suggest that, increasing the value of the ER Index from 9 to16, 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[15], are more inclined to undertake FDI in regions with more stringent environmental regulations compared to the non-resource based industries[16]. 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

[15] 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.

[16] 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.

which are non-resource based industries, were found to be more likely to undertake FDI in regions with larger market size.

When examining cross independent variables in Table3, the dirty industries examined here are more inclined to be influenced by environmental regulations and distance rather than market size and wage. This may simply be that environmental regulations are more influential factors for dirty industries because they will be more affected by environmental costs than non-dirty industries. Concerning distance, since pollution intensity is positively related to capital intensity (e.g. Antweiler et al. 2001; Cole and Elliott, 2002; Cole et al. 2004), we can draw the conclusion that for dirty industries, the transportation costs of capital products are an important factor affecting FDI.

With regard to Japanese FDI decision-making within developing countries, in terms of magnitude of the coefficient, Table 4 shows that the stringency of environmental regulations are the most important factor for dirty industries sampled here, similar to the all countries case. When examining non-ferrous metals industry, where environmental regulations, market size and distance are statistically significant, distance is the second most influential factor. Since dirty industries are more inclined to be capital intensive, indicating that transaction costs for capital goods will be expensive and that environmental costs will tend to burden more heavily on the dirty industries, the stringency of the environmental regulations and distance are important determinants factors for Japanese FDI decision. When examining the results cross industries, Table 4 shows that environmental regulations have an impact on Japanese FDI decision-making in developing countries for resource based industry rather than non-resource based industry. Market size has a weaker influence on FDI decision-making for non-resource based industry than resource based industry.

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

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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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 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 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 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

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

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 & 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 & 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