FDI and the Pollution Haven:

Evidence from Norwegian Manufacturing

Alief A. Rezza[a*]

Preliminary. Not for quotation

This version: April, 06, 2011

Abstract

This present work reports the results of an empirical study of the firm and country determinants of Norwegian outward foreign direct investment (FDI). Using disaggregated data on sales by Norwegian MNEs' affiliates over the 1999-2005 period, results show that the environmental stringency of host country and its enforcement negatively affects Norwegian MNEs with vertical motive. We first find that Norwegian affiliates in environmentally more regulated countries averagely receive less investment from their parents in terms of equity capital as well as capital stock and assets. After separating out the observations, we find that the total export from affiliates to parent companies in Norway are significantly decreasing with the level of environmental stringency in the host countries and its interaction variables with the level of enforcement.

Keywords: Environmental Regulations, Foreign Direct Investment, Pollution Havens

JEL Classification: Q28, Q56, F21, F23

[a]Norwegian School of Economics, Helleveien 30, Bergen, Norway, 5045

[*]Tel: + 47 55959349; Fax: +47 55959543; E-mail: alief.rezza@nhh.no.

I. Introduction

The Pollution Haven Hypothesis (PHH) has for decades served as a rallying call for an assortment of constituencies involved in the trade versus environment debate. As barriers to international trade continue to fall, a country's environmental regulations may become an important influence on its comparative advantage. Assuming that industries are responsive to inter-jurisdictional differences in regulatory stringency, the PHH refers to the possibility that pollution-intense multinational firms will relocate to countries with weaker environmental standards, where the costs of complying with environmental regulations are lower. Due to the close correlation between a country's per capita income and environmental stringency (Dasgupta et al. 1995), the PHH argues that developing countries will become pollution havens whilst the developed world will specialize in clean production.

The PHH focuses on the cost effect of environmental regulations on firms, and presumes that production cost differentials are a sufficient stimulus for firms to relocate their production facilities. Rationalizations for this view generally come from the notion that stricter regulatory regime for environmental standards will add to the costs of production through requirements for new equipment, the need to find alternative methods for disposal of waste due to rules against landfill, and restrictions on inputs and outputs. In the absence of any other factors, it is in a firms' interest to relocate their production activities to countries with less stringent environmental regulations.

Remarkably, there is plenty of theoretical support for PHH. Many previous studies employ a general equilibrium framework to show that countries with lenient environmental regulations will enjoy a comparative advantage and may further attract heavily-polluting industries.[1] Multinational enterprises (MNE), that already have international experience, appear to be the most likely agent to reorganize their production activities to countries with lenient environmental standards through foreign direct investment (FDI).

[1] See Pethig (1976), Siebert (1977), McGuire (1982), and Copeland and Taylor (1994).

Nonetheless, despite the well-established economic rationale behind the hypothesis, the empirical evidence is not yet conclusive, and evidence has been found on both sides of the argument; for and against the PHH. [2] Additionally, the effects of pollution havens found in previous works have ranged from nil to marginally significant in magnitude. Although these studies have been illuminating, their shortcomings suggest that the question has not yet been fully answered. For example, one deficiency of previous studies may come from the inability of the researchers to decompose the flows of FDI according to the motives behind them. To briefly summarize the forms of FDI, an MNE undertakes *horizontal* FDI in order to gain an advantage when supplying the local market. This type of FDI takes place between countries similar in factor costs and market size when exporting is costly. Conversely, *vertical* FDI occurs between dissimilar countries to take advantage of factor-price differences when trade costs are low. These imply that the sensitivity of FDI to the host countries' characteristics will vary according to the destination of production. Consistent with the theory of comparative advantage, the PHH is most likely to be found in vertical FDI. Since the preponderance of evidence suggests that the comparative advantage motive for FDI is far less important than the market access motive in explaining the bulk of FDI, the missing pollution-haven effect should not be a surprise. This paper examines that concern by employing data that allows FDI to be segregated according to motive.

Another issue addressed in this paper is the inadequacy of the data used in many empirical studies to test PHH. To do this, this study uses a register of outgoing FDI from Statistics Norway (SSB) for the years 1999 to 2005, which gives financial information on overseas affiliates and transactions between them and their Norwegian parents. It also includes a large number of information gathered domestically at plant level. These features could be an advantage as the use of industry-level and more aggregated data is prone to aggregation bias, as pointed out by Levinson and Taylor (2004).

[2] See for instance Jeppesen et al. (2004) or Rezza (2010) for review and meta-analysis studies on environmental regulations, plant location and pollution haven.

Unlike most previous researches that assume that industries react homogenously to changes in environmental regulation, recent studies have shown that firms' (and industries') reactions may vary with respect to their polluting intensity (i.e. Javorcik & Wei 2005), energy intensity (Eskeland & Harrison 2003), or geographical mobility (Ederington et al 2005). Since not every researcher has access to unique and rich datasets with such characteristics, the underlying heterogeneity in the link between environmental regulation and FDI suggests that an improved investigation of PHH would be better accomplished using micro-data. This present work utilizes the panel aspect of the data and includes time and firms' fixed effects to reduce the possibility of omitted variable bias.[3] To the best of our knowledge, no previous studies have considered whether there is a pollution haven effect from environmental regulation using Norwegian data, despite the fact that Norway is subject to relatively stringent environmental regulations that are strongly enforced.

This paper contributes to the literature on the determinants of FDI and pollution havens in a couple of ways. First, it demonstrates that Norwegian parent companies invest less in terms of equity capital in affiliates with vertical motives in countries with more stringent environmental regulations. Further, affiliate production that is exported back to parent company in Norway is decreasing with stringency of the country's environmental regulations *and* their enforcement. On the other hand, Norwegian FDIs with horizontal motives do not seem to be affected by the stringency of environmental regulation in the host countries. These are, to some extent, in line with findings of Markusen and Markus (2001) who, using U.S. data, discover that FDI that is not undertaken to serve a specific market is more sensitive to investment costs because the MNE always has the option to choose another location.

The second contribution of this paper is to provide evidence that is in harmony with many predictions of the determinants of FDI. Among others, we confirm that market size plays an important role in determining the cross-country distribution of FDI. In our case, most outward Norwegian FDI goes to advanced industrial countries. Further, we examine the trade in intermediate

[3] Country level fixed effects should ideally be included. However, this is not possible given the short time dimension of the panel and the relatively small year-to-year changes in environmental policy variables.

inputs for further processing between parent firms and their foreign affiliates. Among our main findings are that the demand for imported inputs from parent companies is higher when affiliates (i) face lower environmental costs, (ii) engage in a country that relatively open in terms of international trade flows, and (iii) are set up in countries close to Norway, in terms of geographical distance.

The remainder of the paper is organized as follows: the following section provides an overview of Norwegian FDI during the period of analysis; Section 3 discusses empirical specifications; Section 4 describes the data; Section 5 discusses the results and Section 6 concludes.

II. Norwegian FDI during 1999 - 2005

Norwegian FDI saw a significant rise in the period covered by our data. The value of Norwegian firms' foreign holdings is calculated as the proportion of affiliates' total equity capital owned by the Norwegian parent. These holdings were approximately 50 billion NOK in 1990, but by 1999 had grown to approximately 300 billion, and by 2005 was approximately 620 billion.[4] Most investments were made in North America and Europe, but the quickest growth was seen in fuel-exporting countries, Asia and Eastern Europe. Through table 1, we observe that the large growth was caused by increases in both the number of affiliates and their average value. Table 1 also illustrates the mean and median values of affiliates in 2000 and 2005 and demonstrates the ascendency of a small number of large investments through the median that consistently being much smaller than the mean.

[4] Due to the lack of an appropriate deflator, we report nominal values.

Table 1: Total, Mean and Median Values of Norwegian FDI (in Million NOK)

Host Region	2000		2005	
	Mean	Median	Mean	Median
Europe	90.9	1.5	113.6	2.3
North America	90.0	3.5	258.4	5.8
Asia and Oceania	60.8	2.4	141.0	2.8
Fuel Exporting Countries	129.9	3.0	359.5	2.9
Transition Countries	18.7	0.6	63.9	2.2
Africa and the Middle East	18.8	3.3	40.1	4.9
Latin and South America	128.9	4.4	110.8	3.2

Table 2 gives information on the numbers of investments made abroad and the number of firms making those investments. We note that that the number of countries being invested in has increased, and that the number of affiliates is found larger than the number of investing firms, indicating that some firms have more than one foreign affiliate. Table 2 also shows the percentage of total activity that is concentrated to the top eight host countries: Sweden, Denmark, Finland, France, Germany, the Netherlands, the UK and USA.

Table 2: Norwegian FDI – Number of Countries and Investors

	1995	2000	2005
Number of countries where Norwegian firms invest	102	124	129
Number of Norwegian firms investing abroad	748	1098	1217
The percentage of firms active in the 8 most important hosts	77	78	75
Number of affiliates abroad owned by Norwegian firms	2720	4034	3733
The percentage of affiliates in the 8 most important hosts	68	66	60

The patterns in the destination of Norwegian FDI in Table 2 should not be a surprise. As illustrated by Navaretti and Venables (2004), FDI originates predominantly from advanced countries and goes predominantly to advanced countries too. As the advanced countries share similarly high levels of environmental stringency, the patterns of most FDI therefore seem to violate the hypothesis of pollution haven. However, before testing the hypothesis using regressions

analysis, we will take a closer look at the distribution of Norwegian FDI according to the environmental stringency of the host country. Table 3 shows the dissemination of Norwegian firms and their affiliates during the period of analysis. Regrettably, we have had to omit a few host countries from the table due to missing data on the stringency of their environmental regulation.[5]

Table 3: Norwegian Outward FDI: Firms' and Affiliates' Distributions According to Host Country's Environmental Stringency Relative to that of Norway

Year	Less Stringent than Norway		More Stringent than Norway	
	# of Firms	# of Affiliates	# of Firms	# of Affiliates
1999	381	1,516	490	1,715
2000	613	2,037	662	1,660
2001	742	2,557	819	2,023
2002	762	2,630	872	2,236
2003	760	2,790	793	2,168
2004	770	2,669	736	1,843
2005	782	2,763	708	1,945

A quick look at Table 3 displays shows that between 1999 and 2005 there has been a stream of Norwegian FDI to countries that are relatively more lenient than Norway in terms of environmental regulation. While it is appealing to attribute this pattern to a possible confirmation of the pollution haven hypothesis, it is important to consider the position of Norway in the ranking of environmental regulations. During this period, Norway has always been in the top ten in the rankings, meaning there are significantly more countries with less stringent environmental regulations than Norway; it is therefore reasonable to observe the patterns shown in Table 3. If anything, it gives us more motivation to carefully perform deeper investigation of the link between flows of outward Norwegian FDI and the environmental regulation of the host countries.

[5] We divide the host countries of Norwegian FDI according to data provided by the World Economic Forum (several publication years), which gives information on the stringency of environmental regulation for 50 countries in 1999, 57 countries (2000), 56 countries (2001), 58 countries (2002 and 2003), 60 countries (2004) and 62 countries (2005).

III. Empirical Model

We start with the conjecture that FDI flows are determined by the characteristics of the destination country that affect the profitability of the investment. Theories also suggest that the pattern of FDI should vary across country-firm pairs with the strength of market access and comparative advantage motives for FDI. The strength of the market access motive for FDI should vary with country-firm pair characteristics, such as transport costs, and country characteristics, such as market size and the country's openness.[6] The strength of the comparative advantage motive also varies across countries and firms depending on the importance of factor price differentials across countries given a firm's production technology.[7] Therefore, for each firm *i*, host country *j* in year *t*, we assume that the function relating these characteristics to the volume of Norwegian FDI can be approximated by

$$FDI_{i,j,t} = x_{j,t}^{'}\beta_i + z_j^{'}\gamma_i + \eta_{i,j,t} \quad (1)$$

where $x_{j,t}$ is a vector of time-varying attributes of country j, z_i is a vector of time-varying attributes of the firm, while $\eta_{i,j}$ is an idiosyncratic disturbance that varies with time, country and firm. The dependent variable, $FDI_{i,j,t}$, is a measure of the operations performed by multinational firm j. Furthermore, we use the destination market for the sales of affiliates to distinguish between vertical and horizontal FDI. Following Aizenman and Marion (2004), $FDI_{i,j,t}$ in equation (1) can represent either the real value of affiliate exports, the real value of affiliate local sales or the ratio of affiliate exports to local sales. For the independent variables, among the important characteristics represented by $x_{j,t}$ are the environmental regulatory stringency, $ES_{j,t}$; the host country's market size, $MKTSZ_{j,t}$; the country's openness, $OPEN_{jt,}$ and the distance of the host country from Norway, $DIST_{j,}$

If the data are consistent with the market access motive, then FDI should increase with distance ($DIST_{j,}$) as firms seek to avoid shipping costs by investing abroad. Furthermore, FDI

[6] Since we have no access to the detailed transport cost spent by each firm, we apply the simplifying assumption that trade costs are associated with distance. Limao and Venables (2002), for instance, build on such an approach and find that trade costs rise with distance at an elasticity of 0.3.

should rise with respect to market size (*MKTSIZEj*), as a large market increases the scale of sales of multinationals that invest. Therefore, we expect the coefficient of both variables to be positive. Conversely, the comparative advantage motive for FDI enters into equation (1) via $ES_{j,t}$. Since the actual costs of complying with environmental regulation are not observed, the stringency of the environmental standards of the host country is employed as a proxy. Everything else being equal, firms operating in less environmentally-regulated countries may have to pay reduced environmental taxes, enjoy higher emission limits, face less risk of environmental lawsuits and see many other benefit of lenient regulation. These benefits may lessen the cost of key inputs to goods with pollution-intensive production and so increase a country's comparative advantage in those goods.

In cases where all the independent variables are observable, the simple Ordinary Least Square (OLS) regression could be used to estimate equation (1). This hypothesis is, unsurprisingly, seldom respected and subsequently raises concern. Given that some characteristics of firms or countries are unobservable, bias may occur in the OLS regression if (a) the omitted variable(s) is the determinant of the dependent variable *and* (b) it is correlated with one or more of the included independent variables. Given the complexity of FDI and the structures and operations of MNEs, this concern is likely to occur. As a result, we are unable to use a panel setting with random effect regression because this approach necessitates the implementation of a strong exogeneity assumption. As shown by Baltagi et al. (2003), a slight endogeneity among the independent variables could cause both OLS and random effect estimators to be substantially biased and to yield misleading inferences. We address these concerns by carefully incorporating important right-hand-side variables and bringing in the year and the firm's fixed effects into the regression.

IV. Data

Norway is a good country to test the PHH for a number of reasons. Firstly, it has one of the highest stock of FDI abroad and, as was shown earlier, both the number and the value of outward FDI has been increasing.[8] Additionally, Norway has some of the most stringent environmental standards in the world that are rigorously enforced. (World Economic Forum et. al., various editions). As a result, pollution-intensive industries in Norway face stronger incentives than in most other countries to relocate their activities abroad. Finally, Norwegian firms have a wide choice of potential destination countries with a wide range of attributes.[9]

This study's categorization of vertical and horizontal FDI output according to destination is not as accurate as we would have liked because while SSB collects data on the sales of partially-owned manufacturing affiliates of Norwegian firms and these sales data are disaggregated by destination market, they do not provide information on whether they involve horizontal or vertical FDI.

Using Hanson et al.'s (2002) method, we use affiliates' exports to Norway as the measurement of vertical FDI, assuming that these are intermediate goods that need further processing. Horizontal FDI is then the total sales less sales from exporting the goods back to Norway, assuming that all other sales are final goods and that the goods are produced locally to reduce the costs of supplying the market from Norway. However, this classification fails to consider that some exports to Norway may be final goods and that some local sales may later be exported for further processing.

The variables covering the stringency of environmental regulations we use come from the Global Competitiveness Report (GCR) published by the World Economic Forum (WEC), which started surveying executives on environmental issues in the mid-1990s. Since the questions they use

[8] List is available online at https://www.cia.gov/library/publications/the-world-factbook/rankorder/2199rank.html (accessed on December 20, 2010)

[9] For example, a firm based in Oslo that would like to open a plant across Europe could have options include sites in EU countries with equally stringent (Denmark, Netherlands), or almost equally stringent (Belgium, France) environmental regulations as well as non-EU countries with almost similar environmental standards such as Switzerland and others like Poland and the Czech Republic where environmental regulation is significantly less stringent.

have changed over the years, the results from earlier years are not directly comparable. In this paper, two of the questions that have been asked on environmental policies since 2000 are used. The first questions executives about the stringency of environmental regulation in their country, whereas the second inquires the consistency of enforcement of the given regulations. We create the environmental stringency index, by multiplying the responds for each question from each country. Negative values represent greater stringency and more rigorously-enforced regulations, which could have an impact on the profitability of the firms.

The GCR is used because it is the only dataset that measures both the stringency and the enforcement levels in different countries. In addition, since this survey is answered by companies' executives, their answers are likely to be based on the effects of regulation on their own firms that may be influenced by some otherwise unobserved measures.

As the GCR is a survey, it may be criticized based on its methodology or the selection of its sample, but the GCR has taken measures to counteract these criticisms by taking a representative samples from each country based on sectors, employment, firm size, and firm nationality. Whenever possible, WEC compare the results of the GCR with hard data and find that the results from their surveys are fairly comparable. A number of previous studies, such as Blonigen et al. (2003), Carr et al. (2001), Ekholm et al. (2007), Markusen and Maskus (2002) and Yeaple (2003), have as well used the GCR to measure various influences on MNE activities, although none of them have previously employed the environmental variables.

Next, this study examined some host-country characteristics that have traditionally been identified as factors in the decision on location for MNEs. The covariates were chosen in order to control for factors that may have an effect on the return on an investment in any specific location (Markusen 1995). The size of the market is one of the main factors affecting the profits from local affiliates. We take the example of a number of other studies and use a function of *Population* and *GDPPercap* to determine market size. Furthermore, profitability of FDI as a substitute for trade may be affected by the degree of the country's openness to trade (*Openness*). Accordingly we

employ the proportion of a country's GDP made up by imports and exports as a proxy for *Openness* (Javorcik and Wei, 2004). The final characteristic examined is the geographical distance of the host country from Norway (*DIST*) that is readily available from the CEPII website. Finally, to re-examine the relationship between the domestic size of a firm and its outward FDI (Blomstrom & Lipsey, 1991) the number of employees (*Totemp*) is operated as a proxy and is included as one of the independent variable.

To summarize, this paper has examined the PHH in the period between 1999 and 2005. As not every firm undertakes outward investment in every year, the panel data is naturally unbalanced. A summary of the values for our variables are provided in the following table.

Table 4: Summary Statistic

Variable	# Obs.	Mean	Std. Dev.	Min	Max
Proxies of Flows of FDI					
Equity Capital (*ECAP*)	3,758	13,57	2,41	3,93	21,89
Capital Stock + ASSETS (*CASSETS*)	3,929	12,17	2,63	3,93	21,17
Total Sales (*TSALE*)	3,818	10,93	2,29	1,38	17,75
Sales to Parent (*XSALE*)	4,492	1,30	3,12	0	15,26
Local Sales (*LSALE*)	4,474	9,15	4,51	0	17,75
Other Covariates					
Environmental Stringency (*STRING*)	3,370	1,68	0,22	0,78	1,91
Enforcement of Env. Stringency (*ENF*)	3,370	1,59	0,20	0,64	1,85
GDP Per Capita (*GDPPC*)	3,370	9,98	0,88	-1,64	10,63
Total Firms' Employment (*TOTEMP*)	3,352	5,15	1,84	0	8,34
Distance (*DIST*)	4,493	7,54	1,13	6,03	9,79
Openness (*OPEN*)	3,336	4,24	0,55	2,94	6,06
Population (*POP*)	3,370	17,12	1,49	12,53	20,98

Note: All variables are in log.

V. Results

We now proceed with the econometric analysis of the determinants of FDI on the level of Norwegian affiliates. There have been many proxies used to represent firms' FDI. In the following regressions, we employ the total stock of equity capital as well as the total stock of capital and

assets at the end of reporting year for each affiliate as the dependent variables. In addition to investigating the elasticity of FDI with respect to environmental regulation, enforcement and the combination of both, we also want to estimate the previous three estimates conditional on the motive of affiliates. We introduce two dummy variables to equally categorize affiliates according to the share of exports to parent company in Norway in total revenues for foreign affiliates Norwegian multinationals. The first dummy called *VFDI_M* is equal to 1 if the mentioned share is greater than a third or less than two third. Otherwise, this would equal to zero. Likewise, the dummy called *VFDI_H* is equal to 1 if the mentioned ratio is greater or equal to two third or less than 1. As a reference base, we should later evaluate the coefficient of the dummies to the firms who have the mentioned ratio less than a third. All firms without export to parent company, that is the firms with horizontal motive, are included in this base case. We estimate equation (1) with these two additional variables as well as year and parent company's fixed effects. To avoid any contemporaneous correlation between variables, all the independent variables except those that are time-invariant are lagged a year. The results of our analyses are shown in table 5.

Table 5: Determinants of Norwegian Outward FDI

Variable	(1)	(2)
Environmental Stringency (*STRING*)	-0.207 (0.288)	0.044 (0.305)
Enforcement of Env. Stringency (*ENF*)	0.465 (0.401)	0.325 (0.417)
STRING x *ENF*	0.005 (0.063)	-0.004 (0.067)
VFDI_M	-0.046 (0.468)	0.461 (0.424)
VFDI_H	0.204 (0.598)	0.560 (0.522)
N	2,523	2,502
R^2	0,26	0.25

Notes: The regression in column (1) employs the log of affiliate's total equity capital as the dependent variables while that of (2) makes use of the log of affiliate's total capital and assets. Both regressions are estimated using year and parent company's fixed effects and cover the period 1999-2005. All variables except the dummies are lagged one year to prevent any contemporaneous correlation. Coefficients of other independent variables as well as the fixed effects are not reported. Robust standard errors are in parentheses.

* Statistically significant at the 10% level

** Statistically significant at the 5% level

*** Statistically significant at the 1% level

As is typical in the empirical literature of FDI and pollution haven, simple correlation between outward FDI and environmental regulations fail to uncover a strong relationship. This can be seen by coefficient of, consecutively, *STRING*, *ENF* and interaction variables between the two (*STRING* x *ENF*) that are not significant statistically. Because both *VFDI_M* and *VFDI_H* are not statistically significant too, we could likewise conclude that there are no differences in firms' behavior when it comes to investing in affiliates with different motives. However, table 1 cannot answer the more important question about whether or not firm with vertical motive would invest less in more environmentally regulated countries. We tackle this issue by introducing an interaction term between each of the dummies with stringency of environmental regulation. If our hypotheses are correct, those interaction terms will have negative coefficients, indicating that only in affiliates with vertical motive do changes in environmental regulations have significant effect on parent companies' investment to their affiliates. We re-estimate equation (1) with these two new interaction variables. The results are presented below.

Table 6: Determinants of Norwegian Outward FDI According to Its Motive

Variable	(1)	(2)
Environmental Stringency (*STRING*)	-0.228 (0.288)	0.030 (0.304)
Enforcement of Env. Stringency (*ENF*)	0.424 (0.398)	0.287 (0.415)
STRING x *ENF*	0.014 (0.063)	0.003 (0.067)
VFDI_M	8.250 (2.222)***	6.616 (1.855)***
VFDI_H	4.337 (2.241)*	5.926 (1.845)***
VFDI_M x STRING	-1.514 (0.400)***	-1.131 (0.343)***
VFDI_H x STRING	-0.786 (0.383)**	-1.040 (0.313)***
N	2,523	5,502
R^2	0.27	0.26

Notes: See notes for Table 5.
* Statistically significant at the 10% level
** Statistically significant at the 5% level
*** Statistically significant at the 1% level

While we obtain different sign for coefficient of environmental stringency, the rest of the coefficients seem to be robust between column (1) and (2). In general, relative to the affiliates with less export to Norway, we find that affiliates with both medium and high vertical FDI motive averagely receive more investments, both in terms of equity capital, capital stock, and assets. More importantly, we discover statistical support for our prior hypothesis, namely that Norwegian firms will invest less in the affiliates with vertical motives that are located in countries with more stringent environmental regulation. The performances of the regressions are fairly decent. Using the U.S. data for investigating almost the same instance, Yeaple (2003) obtain roughly similar goodness of fit values in his regressions.

We carry on our analysis now by considering as our dependent variable the extent of total sales by Norwegian affiliates by firm and country. We are also to compare the determinants of the level of Norwegian sales abroad intended to serve the host country markets with the determinants of FDI intended for export back to Norway. These are variables that have been the focus of many of the recent empirical investigations into the determinants of FDI. As noted by other authors (see, for instance, Markusen and Maskus 2001 and Yeaple 2003), the identifying feature of vertically integrated multinational firm is that they concentrate production in foreign markets to serve their home market. In doing so, we do not treat horizontal and vertical FDI as mutually exclusive options. Having firm-level data allows us to examine the factors that determine where different affiliates fall in continuum with pure horizontal FDI at one extreme and pure vertical FDI at the other extreme. We assume that Norwegian parent firms have previously chosen in which countries to locate affiliates. The remaining decision is over which production affiliates should perform. Moreover, we take the affiliate-level scale of production as given and focus on what factors shape the composition of production inside these affiliates.

We follow the approach taken by Yeaple (2003) and estimate all three specifications using a standard tobit procedure. These approaches are chosen to prevent attenuation bias from making our comparison nonsensical because of a large number of zeros observed for *XSALE*. The results, as

well as the robust standard errors, are reported in column 1 (*XSALE*), 2 (*LSALE*) and 3 (*TSALE*) of table 6.

Table 6: Determinants of Norwegian Outward FDI According to Its Motive

Variable		(1) *XSALE*	(2) *LSALE*	(3) *TSALE*
GDPPC		0.606 (0.020)***	0.250 (0.117) **	0.246 (0.118)**
TOTEMP		0.472 (0.033)***	0.011 (0.097)	0.021 (0.096)
(*STRING*)		-1.453 (0.121)***	-1.493 (1.412)	-1.189 (1.405)
(*ENF*)		10.709 (0.128)***	0.720 (1.678)	-0.283 (1.669)
STRING x *ENF*		-1,095 (0.070) ***	1.465 (0.924)	1.182 (0.918)
DIST		-0.538 (0.026)***	0.029 (0.048)	0.015 (0.757)
POP		0.500 (0.012)***	0.099 (0.040)**	0.085 (0.040)**
OPEN		1.059 (0.478)***	-0.206 (0.097)**	-0.214 (0.918)**
	N	2,804	2,805	2,805
	R^2	0.186	0.114	0.109

Notes: The regression results from estimating equation (1) with above-listed explanatory variables using export sales back to parent company in Norway (column 1), local affiliate sales in the host countries (column 2) and total sales by affiliates (column 3). All three regressions are estimated using year and parent company's fixed effects and cover the period 1999-2005. All variables except the dummies are lagged one year to prevent any contemporaneous correlation. Coefficients of other independent variables as well as the fixed effects are not reported. Robust standard errors are in parentheses

* Statistically significant at the 10% level

** Statistically significant at the 5% level

*** Statistically significant at the 1% level

The results in table 6 reveal large differences between the determinants of the two types of sales and the domination of the local sales when total sales are used as the dependent variable. First, there are systematic differences in the coefficients on the transport cost variable. As we don't have the factual data, we rely on the coefficient of variable *DIST*. It is negative and statistically significant in the *XSALE* specification but positive and statistically insignificant for *LSALE*. This indicates that the trade cost must be sufficiently low for vertical FDI to occur since this mode entails international trade of intermediate and final goods. Conversely, consistent with their trade costs saving purpose, the affiliates with local sales purpose are not affected by the distance of host country from Norway. From this perspective, both statistically significant positive and negative

coefficients of *OPEN* are fully expected. Another interesting finding is the effect of larger market size (*GDPPC* and *POP*) is more important for export sales than it is for local sales. Whilst both have positive and statistically significant effect, the coefficients of both GDPPC and POP are larger in column (1) than they are in column (2). This result is in fact consistent with knowledge-capital models where the presence of transport costs makes it attractive to consolidate offshore production in large host countries (see Zhang and Markusen, 1999).

Turning to the environmental stringency and its enforcement, it seems that both types of FDI are deterred by the stringency of environmental regulation. However, we find that *STRING* is negative and significant deterrent to FDI for export but has no effect in the specification for local sales. Further, we address the concern that countries might be competing in environmental policy in the less transparent of the policy dimension. While it could be argued that the stringency of environmental regulation is widely accessible through countries' environmental laws, the level of actual enforcement of those policies is far less transparent. We address this concern by introducing the interaction term between *STRING* and *ENF*. Results show that coefficients for this variable confirm our previous finding, mainly that firms with export purpose are significantly deterred by the stringency of environmental regulation and its enforcement while it is the opposite for FDI with local sales intention. We note that effect of enforcement of environmental regulation is positive for both FDI purpose but significant for those with export purpose. We reason that *ENF* might partially pick up the effect of law enforcement in the host country. Since we are not able to find proper proxy of law enforcement for the period of analysis, we leave the regression as it is. Overall, results are as expected and consistent with FDI for export being footloose in comparison with FDI for local markets (Markusen and Maskus 2001, Yeaple 2003).

Finally, column (3) demonstrates the importance of decomposing FDI by motives of affiliate operations. Given the dominant presence of FDI with local sales purpose in total Norwegian FDI, results for total sales as dependent variable are fairly close to what has been found in column (2).

This also explains why the bulk of empirical researches on pollution haven fail to find any significant effect of environmental stringency on the flows of FDI.

VI. Conclusion

The lack of empirical support for the proposition that country's environmental stringency affects the flows of FDI has been a puzzle in the trade and environment literature. In this present work, we have explored various features of the structure of FDI in a highly disaggregated sample of Norwegian FDI. Unlike most previous researches that employ industry level or more aggregated data, we have access to firm-level data set for Norwegian manufacturing activities both domestically and abroad for 1999 until 2005 as well as transactions carried between parent and affiliates. As a result, we are able to decompose the FDI flows according to their motive. We also utilize the panel aspect of the data and include time and firms' fixed effects to reduce the possibility of omitted variable bias.

Our most novel result is that the pattern of Norwegian outward FDI with vertical motive is consistent with theory of comparative advantage based on countries differences in environmental stringency. We find Norwegian-parent firms invest less in terms of capital stock and total capital and assets in affiliates located in countries with more stringency environmental regulation with export sales intention. We also find that affiliates consider not only on-paper environmental regulations of host countries but also how these regulations are enforced in practice. It would be an interesting topic of future work to see if the same patterns exist for other regulations such as health and safety standards or labor regulations.

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