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What Drives Sector Allocation of Foreign Direct Investment in Iceland?

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What Drives Sector Allocation of Foreign Direct Investment in Iceland?*

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Abstract

The objective of this paper is to examine how the driving forces of investment in a small country like Iceland differ from those in larger countries. Special attention is given to the dominating investment sector in Iceland due to its resource intensity. Estimates are based on 1989-1999 panel data on foreign direct investment in various sectors. This may help explain why the investment pattern in Iceland differs from the general case.

Keywords: Foreign Direct Investment, Multinational Corporations.
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1 Introduction

Foreign direct investment (FDI) has played an important role in the economic development of many countries and proven to be an engine of economic growth (Grosse, 1997). Not only does FDI provide capital for development, but it also diversifies the capital base of countries. It is important for a small country like Iceland, in need of a more diversified economy, to attract FDI in order to sustain economic development and growth. FDI is generally believed to fuel economic growth, however a recent study by Gylfason and Zoega (2001) shows that economic growth may be hindered by the crowding out of physical and human capital by natural resource capital. Moreover, an interesting study by Alfaro et al. (2001) finds economic growth to be promoted by FDI in economies with sufficiently developed financial markets. The nature of FDI in Iceland seems to differ somewhat from FDI in other countries; in the third thesis paper, FDI in Iceland is found to flow particularly into one sector, the power intensive sector. Because of this, it is important to see to what extent natural resources drive Icelandic FDI and what factors lead to the diversification of this FDI across sectors.

A popular approach when analyzing the determinants of FDI is to apply the factor proportions hypothesis as to consider FDI dependence on factor endowments such as source and host country differences in skilled and unskilled labor. However, for small resource based economies like Iceland, the dependence on skilled and unskilled labor may not be the right endowment approach. Instead, resource based endowments need to be brought into the picture in order to reflect on the country's heavy dependence on marine and hydropower resources.

Anecdotally, the investment dominance of the sector incorporating power intensive industries is generally attributed to the smallness of Iceland, the nature of its natural resources (its natural resources composition), and how distant it is from other countries. In another paper by Kristjánsdóttir (2004c), driving forces for Icelandic FDI are found to be different from the general case when applying the Knowledge Capital (KK) model specification presented by Carr, Markusen and

Maskus (CMM, 2001). But does this help explain why the sectorial composition of Icelandic FDI seems to differ from other countries?

The objective of this paper is to seek a clearer explanation for this by further analyzing the sectorial decomposition of FDI. This paper is meant to explain the relative contribution of various sectors to foreign direct investment. One of the reasons for choosing the sectorial approach is to differentiate the power intensive sector from other sectors. This is comparable to a recent paper by Waldkirch (2003) where he seeks to explain heavy reliance of FDI in one particular industry in Mexico. However, Iceland differs from Mexico in various ways such as by size, location, and stage of development.

According to the *factor proportions hypothesis*, multinationals seek to integrate production vertically across borders in order to take advantage of different factor prices resulting from relative differences in factor supplies between countries. The *factor proportions hypothesis* has been a dominant explanation of multinational activity within conventional trade literature (Helpman, 1984; Helpman and Krugman, 1985).

Since factor abundance is critically linked to factor intensity that may vary across industries, one goal of this paper is to analyze whether the factor proportions hypothesis can help explain the sectorial composition of FDI. CMM use skilled labor percentages to represent factor abundance in the KK model specification.

Both the work of CMM and subsequent studies find that this is indeed important for aggregate FDI levels. This paper offers a refinement of CMM's KK model by incorporating measures for small economic sizes in population and gross domestic product (GDP) along with adding natural resource endowments to the conventional specification. The result supports the hypothesis that there are more factors at work than the two factors of skilled and unskilled labor in the basic specification.

Furthermore, this approach allows me to discuss how factor abundance may influence the allocation of FDI across sectors. In particular the relation between FDI and electricity prices may influence the predominance of FDI in the Icelandic power intensive industry. Also, by sectorial disaggregation, it is possible to determine how the economic size variables in the CMM specification affect individual sectors. Economic size is highly relevant in this paper, not only because the source countries are considerably larger than the host country Iceland, but also because during the research period a large part of FDI comes from one particular country, Switzerland. The dominance of Switzerland brings us back to the discussion on electricity prices, hydropower and the power intensive industry. Switzerland has a history of being specialized in using hydropower, as a natural resource, to generate electricity for power intensive industries like the aluminum industry. However, in the 1990s Switzerland had almost fully exploited its hydropower production potential (Czisch et al., 2004, pp. 8-3). Thus Swiss firms may have been especially intensive in hydroelectric power and actively seeking more of it. A prime example of this is AluSwiss, a Swiss headquartered multinational enterprise (MNE), which undertook greenfield investment in an aluminum smelter in Iceland in the 1990s. Overall, Icelandic foreign direct investment in power intensive industries greatly increased in the 1990s. Thus one of my goals is to determine how hydropower electricity prices affects FDI in the power intensive industries. This is in addition to the standard analysis of how skill differences between the source and the host country affect FDI.

Also, since fishing is very important to the Icelandic economy, I include the total fish stock caught in Icelandic waters in order to control for this factor. Moreover, issues such as infrastructure, pollution quotas, and fish catch are accounted for in this research. Since Iceland has a considerably larger pollution quota than all other countries engaging in the 1997 Kyoto Protocol on climate change, this may well affect the sector allocation of FDI.

The estimates obtained in this paper are based on unique FDI panel data on investment sectors in Iceland. The FDI data cover investments made by 17 source countries over a period of 11 years. The FDI is classified into 4 major sectors. These are as follows: power intensive industries (as sector 1), Commerce and Finance (sector 2), Telecom and Transport (sector 3), and finally Other industries (sector 4). More specifically the fourth sector accounts for the following industries: Manufacturing, Agriculture and Fishing, Mining and Quarrying, and other industries. Estimates are obtained for sector shares of country's FDI as well as levels of FDI in each sector, since FDI shares reflect the relative size of each sector within a particular year of investment. The application of sector shares allows for analyzing the relative importance of the power intensive sector compared with other sectors. An example of an application of FDI share proxy can be found in a paper by Brainard (1997). Brainard uses outward shares of U.S. sales to proxy FDI sector shares. In the case of Brainard, it is reasonable to apply shares of U.S. affiliate sales abroad as a proxy for outward FDI, rather than applying actual FDI data, because a considerable amount of U.S. outward FDI is derived from mergers and acquisitions. However, in the case of Iceland it is more reasonable to capture FDI with actual FDI, since Iceland has a short history for FDI, and FDI in the dominating power intensive industry has primarily been in the form of greenfield investment. In a related manner, Slaughter (2000) constructs an investment share variable as the share of "majority owned affiliates" in overall multinational investment.

Finally, one notable feature of the data is the large number of zeros, i.e. countries that do not invest in a particular sector. Because of this, I control for whether sample selection is driving my results, by using the Heckman's (1979) two-step procedure. In particular, since the theories of FDI assume a crucial role for fixed cost in determining whether FDI occurs, these final results provide some potential insights into this issue in a manner heretofore unexplored.

The paper is organized as follows. In Section 2 the model is laid out. Section 3 gives an overview of the data used in this research. Section 4 contains quantitative results from the sectorial decomposition. In Section 5 results from using a sample selection are introduced. Finally, conclusions are presented in Section 6.

2 Model Specification

The main issue of concern in this paper is to capture the driving forces behind investment incentives across sectors. In other words, to see whether it is possible to capture sector specific determinants of foreign direct investment. In an earlier paper (Kristjánsdóttir, 2004), I provide analysis on how the CMM (2001) specification performs for small countries like Iceland. A potential reason for the specification's poor results could be the dominance of one sector, the power intensive sector. Therefore, the objective here is to refine to the baseline CMM specification in order to allow for decomposition of FDI, and to determine what drives sector specific FDI.

I do this in two ways. One is adding factors such as natural resources to an improved version of the CMM specification in order to adjust the model to a resource based host country like Iceland. Thus, this is akin to the empirical trade literature that found it necessary to bring in more factors in order to resolve Leontief's classic critique of the Heckscher Ohlin factor proportions theory. Potentially because the CMM specification is designed to capture the effects of the level of skill on FDI, rather than effects of natural resources .

The breakdown of industries reveals that CMM performs differently for different sectors, although overall it still does not perform as expected. This leads me to a gravity approach similar to that used in my earlier paper (Kristjánsdóttir, 2004b).

The motivation for estimating individual sector shares is obtained from Brainard (1997). In her paper, Brainard applies "the share of affiliate sales accounted for by exports"...that is the..."share of exports in total sales" (Brainard, pp. 528)[1]. This corresponds to capturing the share of non-affiliate sales in total sales. Brainard is thereby able to use an inverse proxy for the share of FDI in foreign MNEs activities[2].

[1] Markusen (2002, pp. 409) says the following about the index used by Brainard in her 1997 paper: "The intra industry affiliate sales index measures the degree of international cross-investment in a particular industry: production and sales abroad by US MNEs and production and sales in the United States by foreign MNEs".

[2] Outward affiliate sales relative to exports and inward affiliate sales relative to imports for 64 industries in the United States are given in Brainard (1997).

The idea of using export shares is based on a similar argument as the one presented in this paper. However, in this paper the objective is to capture the sector shares of FDI. This is done by presenting the relative weight of sectors in those years when some investment takes place. One of the advantages of measuring sectorial FDI in shares, rather than levels, is that it reflects the relative weight of individual sectors. The way the model specification for shares is set up reflects the relative amount of investment made within each year, no matter the actual size of FDI.

Thus, even when there is little total FDI (as is often the case in small countries like Iceland) I can extract information from the data.[3]

An example using capital stock share to construct the dependent variable can be seen in Slaughter (2002). Slaughter calculates the share of MOFAs[4] in overall MNEs investment (Slaughter, 2002, pp. 457), whereas here the estimates are based on the share of sectorial FDI in overall FDI. Slaughter places the share of skilled labor on the left hand side of the equation, and the share of capital stock on the right hand side[5]. In my case, the share of capital stock is placed on the left hand side, and skilled labor on the right hand side following the exogenous endowment literature precedent.

When formulating the model specification, I start by choosing the share of FDI stock to be the dependent variable. The basic equation specification can be estimated as follows:

[3] Brainard (1997) believes that use of the share measure "should mitigate some of the concern about industry - country pair effects". This reasoning applies to my paper because I also deal with industry-country pairs, which may vary a lot in the amount they invest. CMM need not to deal with this issue in their paper, since they use time series data for countries and years. In his paper, Slaughter (2002, pp. 454), says that he uses shares "Because shares offer a rough control for some of these other forces acting MNE-wide I mostly focus on the share data. I interpret rising shares of affiliate activity to be evidence of MNE transfer."

[4] MOFA refers to majority-owned affiliates in which parent MNEs hold at least 50% stake. In comparson, FDI generally refers to at least 10% ownership of a single parent MNE.

[5] The dependent share variable used by Slaughter is based on the skilled labor share in the total wage bill. More specifically, he captures the share of skilled labor in the overall labor force by deviding the wage of nonproduction workers (referred to as skilled labor) by the total wage bill to production and nonproduction workers.

$$
\begin{aligned}
SHARE_{i,s,t} &\equiv \frac{F_{i,s,t}}{F_{i,t}} \\
&= \beta_0 + \beta_1 \textsc{Ysum}_{i,t} + \beta_2 \textsc{Ydiff}^2_{i,t} + \beta_3 \textsc{Sdiff}_{i,t} \qquad (1) \\
&\quad + \beta_4 \textsc{Ydiff}_{i,t} * \textsc{Sdiff}_{i,t} + \beta_5 \textsc{Invc}_t + \beta_6 \textsc{Tc}_t \\
&\quad + \beta_7 \textsc{Tc}_t * \textsc{Sdiff}^2_{i,t} + \beta_8 \textsc{Tc}_{i,t} + \beta_9 \textsc{Dis}_i + \varepsilon_{i,s,t}
\end{aligned}
$$

In Equation (1) the dependent variable $SHARE_{i,s,t}$ represents investment share of a particular sector s in particular year t by source country of investment i. Equation (1) has an error term $\varepsilon_{i,t}$ with $E[\varepsilon_{i,t} \mid x_{i,t}] = 0$, where $x_{i,t}$ represents the explanatory variables in the equation[6]. Note that because it is created from stock data, the dependent share variable represents sector specific FDI divided by accumulated investment. More specifically the dependent variable $SHARE_{i,s,t}$ is defined as $F_{i,s,t}$ divided by $F_{i,t}$, conditional on $F_{i,t} > 0$. The share of FDI in a particular sector[7] is calculated as $FDI_{i,t} = \sum_{s=1}^{n} FDI_{i,s,t}$ where s runs from 1 to n , and n equals 4.

The explanatory variables on the right hand side of the first regression equation are the same as in the CMM model specification. I start out by including all the variables in the CMM model, and then apply some data-driven refinements. The first variable in Equation (1) is $\text{Ysum}_{i,t}$ representing the sum of the source and host countries' GDP. The variable coefficient is typically expected to be positive, since more investment is believed to take place with an increase in the economic size of the source and recipient country. The second explanatory variable represents the absolute size difference $\textsc{Ydiff}^2_{i,t}$ of source and host countries' GDP. The coefficient sign is expected to be negative, since less investment is expected to take place as size difference increases. The literature on horizontal multinational activities, e.g. by Markusen (1984), explains well why more FDI is believed to take place between countries of similar economic size.

According to the *factor proportions hypothesis*, multinationals take advantage

[6] The coefficient estimates are therefore consistent, although not efficient.

[7] The share observations do not include the years when no FDI takes place.

of factor price differences by fragmenting production vertically across countries dependent on difference in relative factor supplies. Factor price differences give rise to vertical FDI (Helpman, 1984). Here, I include skill differences which are meant to account for difference in relative factor endowments. An analogous variable is used by CMM (2001). FDI is expected to increase as the source country's labor force becomes increasingly more skilled relative to host, and therefore the variable has a positive expected coefficient sign. A term $\text{YDIFF}_{i,t}{*}\text{SDIFF}_{i,t}$ is also included to capture the interaction between size and skill differences. The interaction term reflects the importance of skilled labor differences, depending on the magnitude of GDP differences between the source and host country. Furthermore, variables for trade costs and investment costs are included in the model. The motivation for including variables for trade and investment costs is to determine how investment is affected by restrictions of this type. An increase in investment costs of the host country INVC_t is expected to decrease investment in the host. An increase in the host country's trade costs TC_t is expected to trigger FDI, since then the source country is likely to prefer investment to costly trade. On the contrary, an increased trade cost in the source country $\text{TC}_{i,t}$ is believed to decrease its interest in investing in the host, since it becomes more costly for the source to import from overseas affiliates. Moreover, the interaction between skill differences and trade cost of the host $\text{TC}_t{*}\text{SDIFF}^2_{i,t}$ indicates the relevance of absolute skill differences, depending on the magnitude of trade costs in the host country. The higher the trade cost, the more important the skill differences. The variable coefficient is expected to have a positive sign.

The last variable in Equation (1) represents distance. Distance can be regarded to be a proxy for transport costs and associated transaction costs. The inclusion of distance to explain investment is well known in literature on FDI (CMM 2001; Jeon and Stone, 1999; Bergstrand, 1986). FDI is believed to decrease as distance between the source and host countries increases, and therefore the coefficient sign is expected to be negative.

In latter sections of this paper, some extensions of the basic model specification are used, including some additional control variables. These control variables are not in the model specification presented by CMM. First of all, I use a variable accounting for the catch in Icelandic waters. The main reason for including this variable is that it captures fluctuations in what has been referred to as the main natural resource of Iceland, the fish stock obtainable from the fishing grounds around the country. When the catch is large, this may draw labor or other resources from FDI. Furthermore this effect may vary across types of FDI. The variable CATCH_t represents an index of the total fish catch in the host country Iceland. More specifically the variable is defined as "Total catch at fixed prices, Seasonal adj. Indices". The index runs through the whole estimation period from 1989 to 1999, where 1995 has been set as a base year with a value of one. The catch variable is obtained from the National Economic Institute of Iceland. The second control variable used in this paper is INFDIFF_i which represents difference in infrastructure between the source and the host country in 1999. More specifically the variable can be presented as $\text{INFDIFF}_i \equiv (\text{INF}_i - \text{INF})$. All variables that represent differences between the source and host country are presented as the source country value minus the host country value. I use infrastructure to reflect host country competitiveness, partly because countries endowed with natural resources for the power intensive industry often suffer from poor infrastructure. These would for example be some of the African and South American countries. Furthermore, for multinationals seeking a power plant location, the strength of the infrastructure in Iceland can play an important role. This infrastructure measure is obtained from the World Competitiveness Yearbook 2000. The yearbook ranks countries by "competitiveness input factors", where infrastructure is one of them. Countries listed in the yearbook run from 1 to 47, with 1 being the most competitive country. By pooling a range of different competitiveness factors together, an overall competitiveness index is formed[8]. An increase in the INFDIFF_i variable indicates that the host country has increasingly less infrastructure, which may or may not increase FDI in the host

[8]Iceland was listed as the 17th most competitive country in 1999, moving up from being number 19 in 1998.

(Iceland). Therefore the coefficient sign can be expected to be either positive or negative. Table 1 provides an overview of the variables used in this paper.

Table 1. Variable Definition

Variable		Expected signs
$\text{SHARE}_{i,s,t}$	Share of foreign direct investment (FDI) made by the source country (i) in the host country (j), in sector (s), over time (t).	
$\text{FDI}_{i,s,t}$	Foreign direct investment made by source country (i) in the host country (j), in sector (s), over time (t).	
$\text{YSUM}_{i,t}$	The sum of the Gross Domestic Product (GDP) of the source country (i) and the GDP of the host country (j), over time (t).	+
$\text{YDIFF}^2_{i,t}$	The GDP of the source country (i) minus the GDP of the host country (j), squared over time (t).	−
$\text{SDIFF}_{i,t}$	Skilled labor in the source country (i) minus skilled labor in the host country (j), over time (t).	+
$\text{YDIFF}_{i,t}*\text{SDIFF}_{i,t}$	Interation term, capturing the interaction between the GDP difference of the source and host countries and the skill difference variable, over time (t).	−
INVC_t	The investment cost foreign investors are faced with when investing in the host country (j), over time (t).	−
TC_t	Trade costs in the host country (j), over time (t).	+
$\text{TC}_t*\text{SDIFF}^2_{i,t}$	Interaction term, capturing interaction between trade costs in the host country and squared skill differences, over time (t).	+
$\text{TC}_{i,t}$	Trade cost in the source country (i), over time (t).	−
DIS_i	Geographical distance between the source country (i) and the host country (j), in kilometers.	−
CATCH_t	The "total catch index" for the host country, Iceland. The index represents development in overall catch in Icelandic waters. With 1995 as a base year.	+
INFDIFF_i	Infrastructure index differences between the source country (i) and the host country (j), in 1999.	+/−
POLLDIFF_i	Pollution Quota differences between the source country (i) and the host country (j). Based on the 1997 Kyoto Protocol.	−
$\text{GMTSTDIFF}_{i,t}$	Government Stability differences between the source country (i) and the host country (j).	+/−

Two more control variables are applied in the basic KK model specification, these are POLLDIFF_i and $\text{GMTSTDIFF}_{i,t}$. The variable POLLDIFF_i represents the difference in pollution quota in the source and host country. The data are classified as "Quantified emission limitation or reduction commitment", (percentage of base year or period) and obtained from the Kyoto Protocol to the United Nations Framework Convention on Climate Change[9]. The Third Kyoto session was signed in December 1997[10]. An increase in pollution difference of the source and host country indicates an increase in the pollution quota of the source relative to the host. An increase in this type of pollution quota is likely to diminish investment in pollutive industries in the host country, such as the power intensive industry. The measures for government stability refer to both countries and time, and the variable is denoted as $\mathrm{GMTST}\textsc{diff}_{i,t}$. Higher numberical value for stability is interpreted as a more stable economy. These Government Stability data are the year beginning data, however the data for Germany run only from 1991 (since German unification). This variable is meant to reflect the relative stability of the Icelandic government, where and increase in difference can be expected to either stimulate or hinder FDI. The government stability data is obtained from the International Country Risk Guide.

[9]What is of interest in this protocol is that Iceland has highest quota of all countries listed.

[10]More information on the Kyoto Protocol are to be found in Appendix B.

3 Data

The database on FDI and the share of FDI in various sectors in Iceland covers investments made by the main source countries of investment in Iceland over the time period 1989-1999. In order to give a taste of what is in the data, Table 2 classifies the sample countries by their share in overall FDI in Iceland. There are 17 source countries in the sample which account for about 99% of total FDI[11].

The percentage shares presented in Table 2 indicate that there is a substantial difference in the amount of investment made by various countries, with Switzerland being the main source country of foreign direct investment.

Table 2. Major Source Countries of FDI (1995 US dollars).

The Countries Reported Account for the Biggest Part of FDI.			
Switzerland	1,095,079,000	Sweden	65,178,950
United States	485,395,200	Luxembourg	58,259,560
Denmark	213,626,400	Germany	43,424,390
Norway	191,819,600	Finland	11,947,020
United Kingdom	112,070,400	Belgium	9,159,265
Japan	65,231,580	Netherlands	4,879,091

Source: Central Bank of Iceland.

The second major source country of investment in Iceland is the United States, with Denmark being the third. The sample countries with the least amount of investment in Iceland are Australia, Canada, Spain, Austria, and France. These countries are not displayed in Table 2, but are still used in estimation.

Table 3 exhibits the share of each sector in overall investment over the period of estimation. The sector disaggregation is as follows: the power intensive industry as sector 1, commerce and finance industry as sector 2, the telecom industry and the transport industry as sector 3, and finally sector 4 accounts for all other industries. More specifically, sector four accounts for the following industries: manufacturing, agriculture and fishing, mining and quarrying and other industries.

[11] Countries accounting for the remaining investment are: Chile, Faeroe Islands, Gibraltar, Israel, Latvia, Russian Federation.

Table 3. Decomposition of FDI in Iceland (1995 US dollars).

Sector Allocation of Industries		
SECTOR 1	- Power Intensive	1,524,921,000
SECTOR 2	- Commerce - Finance	468,544,300
SECTOR 3	- Telecom - Transport	50,800,210
SECTOR 4	- Manufacturing - Other	316,047,200
	Total	2,360,312,710

Source: Central Bank of Iceland

Due to the low overall FDI, the procedure is to decompose investment into a few main subsectors. When doing this, it is logical to separate the power intensive industry from the others due it its size. Subsequently, following previous research, the sectors are now classified with Commerce and Finance as sector 2, and Telecom and Transport[12] as sector 3. Sector 4 is primarily Manufacturing. However, Agriculture, Fishing, as well as Mining and Quarrying are classified with manufacturing, but these are a very small part of FDI. Together Agriculture, Fishing, and the Mining and Quarrying sector accounted for less than 2.5% of total FDI. It is worth noting that even though there is very small FDI in Fishing, the Fishing industry has been a dominant domestic industry in Iceland in the last several decades.

The numbers presented are inward stocks of FDI in Iceland, represented in 1995 US dollars. Data on FDI stock in Iceland are obtained from the Central Bank of Iceland. In a recent paper by Davies (2002), the advantages of using FDI stock are

[12] More specifically, the sector classification is often times "Transport & Communication" (Guo Ju-e, 2000), but I found it to be more direct to call it "Transport & Telecom".

well explained, as well as the reason it can be more applicable than FDI flows or affiliate sales representing multinational activities. Data on the level as well as the share of FDI are kindly provided by the Central Bank of Iceland.

Table 4. Summary Statistics

Variable	Units	Obs	Mean	StD.	Min	Max
$\text{Share}_{i,s,t}$	Index [0,1]	568	0.25	0.39	0	1
$\text{FDI}_{i,s,t}$	Million USD	748	3.16	13.89	-0.95	157.9339
$\text{Ysum}_{i,t}$	Trillion USD	740	1.23	1.96	0.02	8.59
$\text{Ydiff}^2_{i,t}$		740	5.29	13.78	0.00005	73.51
$\text{Sdiff}_{i,t}$	Index [-1,1]	516	0.03	0.06	-0.08	0.14
$\text{Ydiff}_{i,t}*\text{Sdiff}_{i,t}$		516	0.04	0.22	-0.27	1.11
Invc_t	Index [0,100]	340	33.01	1.92	29.92	35.28
Tc_t	Index [0,100]	340	48.18	3.79	43.7	52.50
$\text{Tc}_t*\text{Sdiff}^2_{i,t}$		260	0.18	0.25	0.00002	0.85
$\text{Tc}_{i,t}$	Index [0,100]	748	27.88	11.18	5.30	64.80
Dis_i	Million Kilometers	748	0.004	0.004	0.002	0.02
Catch_t	Fish Quota Index	748	1.01	0.04	0.92	1.07
INFdiff_i	Compet. Index	748	-1.76	6.44	-11	10
POLLdiff_i	Poll. Quota Index	748	-0.16	0.04	-0.18	-0.02
$\text{GMTSTdiff}_{i,t}$	Govmt Stab. Index	740	-0.09	1.49	-4	5

Sources: Central Bank of Iceland, Economic Institute of Iceland, Distance Calculator, International Labor Organization, World Bank, World Competitiveness Report, Kyoto Protocol.

Table 4 represents an overview of the overall sample, where the total number of observations is the multiplication of the 17 countries, 4 sectors and 11 years.

In his paper, Slaughter (2002, p. 454), says that he uses shares "Because shares offer a rough control for some of these other forces acting MNE-wide I mostly focus on the share data. I interpret rising shares of affiliate activity to be evidence of MNE transfer."

Data on GDP, both in sum and squares, are taken from the World Bank CD Rom (2002), and are in constant 1995 US dollars. Data on GDP in Germany in

1989 and 1990 are not included here, since these are the years before the unification of Germany. Data on investment and trade costs are obtained from the World Competitiveness Report and data on distance comes from the Distance Calculator. The quota index for the catch variable is obtained from the former Economic Institute of Iceland. Data on Infrastructure are obtained from the World Competitiveness Yearbook 2000. Data on pollution quotas come from the Kyoto Protocol (1997) in the section on country-by-country emission targets. The government stability data is obtained from the International Country Risk Guide (ICRG), published by The PRS Group on Government Stability[13]. All regressions results are obtained using STATA version 7.0.

[13] More specifically it is taken from: Political Risk Points by Component, Table 3B.

4 Estimation Results

4.1 FDI Shares, Basic Specification

This section provides us with results for shares of individual sectors. In the standard models, there are generally two sectors: an FDI sector x and a numerarie sector y. In reality, a single FDI sector x is really several sectors in which there is FDI. Here, I analyze four such sectors, i.e. I decompose x into $x1$, $x2$, $x3$, and $x4$.

An overview of the regression results for the CMM specification in Equation (1) as shown in Table 5[14].

Table 5. CMM Specification for Sector Shares

	Sector 1	Sector 2	Sector 3	Sector 4	S. 2 to 4
Regressors	Power inten.	Com. & Fin.	Tel. & Trans.	Oth. Ind.	
$\text{Ysum}_{i,t}$	−0.29*** (−4.59)	0.13 (0.94)	0.19 (1.49)	−0.03 (−0.42)	0.09 (1.30)
$\text{Ydiff}^2_{i,t}$	0.05*** (4.02)	−0.02 (−0.94)	−0.02 (−0.88)	−0.004 (−0.25)	−0.02 (−1.12)
$\text{Sdiff}_{i,t}$	−1.19 (−0.66)	−3.78 (−1.52)	2.71 (1.19)	2.26 (1.23)	0.39 (0.28)
$\text{Ydiff}_{i,t} * \text{Sdiff}_{i,t}$	−0.56 (−1.39)	0.63 (1.12)	−0.21 (−0.37)	0.15 (0.34)	0.19 (0.51)
Invc_t	0.001 (0.03)	−0.01 (−0.27)	0.02 (0.80)	−0.01 (−0.47)	−0.0004 (−0.01)
Tc_t	−0.009 (−0.53)	−0.001 (−0.04)	0.0002 (0.01)	0.009 (0.63)	0.003 (0.23)
$\text{Tc}_t * \text{Sdiff}^2_{i,t}$	0.10 (0.30)	0.04 (0.09)	−0.54 (−1.15)	0.39 (0.99)	−0.03 (−0.10)
$\text{Tc}_{i,t}$	0.03*** (5.67)	−0.01*** (−2.71)	−0.008** (−2.08)	−0.004 (−0.89)	−0.009*** (−3.02)
Dis_i	−30.99*** (−3.71)	−15.39* (−1.77)	−16.18* (−1.95)	62.57*** (7.77)	10.33 (0.72)
Constant	0.23 (0.35)	1.09 (1.43)	−0.47 (−0.80)	0.14 (0.19)	0.26 (0.19)
Observations	57	57	57	57	171
R-squared	0.64	0.39	0.31	0.51	0.09

Note: Robust t-statistics are in parentheses below coefficients. ***, ** and * denote significance levels of 1%, 5% and 10% respectively.

[14] All robust t-statistics are calculated using White's (1980) heteroskedaticity correction.

Some changes in exogenous variables can be important for some sectors and not others. This is what the research for sector shares tests for. If variable estimates for an individual sector in Table 5 are insignificant, it does not indicate that chosen variables do not affect the level of FDI in any sector. What it does indicate is that the variable in question affects FDI levels in each sector in roughly a proportional fashion. If this were true for all variables, then the standard way of estimating FDI (aggregating across sectors and using a single FDI variable) might be sufficient. What this approach adds to the debate is that the standard approach may overlook important heterogeneity across sectors. Furthermore, this indicates that the factor proportions hypothesis can be important even within what is typically called x, i.e. it can affect $x1$ and $x2$ differently.

In Table 5, the first two size variables are estimated to be significant, however with coefficient signs different from what is predicted by the theory. The negative coefficient of the first variable indicates that the share of the power intensive sector, in overall investment, decreases with an increase in the sum of the economic size of the host and the source country. When the investment weight of small countries in Table 2 is considered, especially Switzerland, these results need not be surprising. As for the second variable, a positive coefficient indicates that as the squared difference between the source and host country increases, FDI in sector one increases relative to other sectors. Taken together the results for the first two variables are somewhat puzzling, since it seems as they go against each other. One way of interpreting this is to say that the share of sector one, in overall FDI, is negatively affected by an increased in the size of the source countries; however the relationship can be regarded as increasing based on the positive sign of the latter size variable, so that the relationship is negative but increasing[15]. Estimates for sectors 2 to 4 indicate that the coefficient signs for the first two size variables have signs opposite from that which is obtained for the first sectors. This indicates that forces driving

[15] This interpretation refers to the fact that the variation in the size variables is primarily due to variation in the size of the source country, since almost all source countries are considerable larger than the host country, Iceland.

investment in sectors 2 to 4 are of different nature from those driving investment in the first sector. What is interesting is that economic size is only estimated to be of significant importance in the case of the power intensive industry, not other industries.

The results obtained for distance indicate that an increase in distance of 1 million kilometers is predicted to decrease the share of the power intensive sector one by about 31%, or (based on the average distance measures in Table 4) a more realistic thing would be to say that a distance increase by 100,000 would result in a 3% decrease in sector one investment[16].

In Table 5 foreign direct investment (FDI) is disaggregated into four sectors. These are the power intensive industry in Iceland as sector one, commerce and finance as sector two, the telephone and transport industries as sector three, and other industries as sector four[17]. Finally industries 2, 3, and 4 are aggregated in the last column. Sector one is not included in last column since by definition the share of all sectors combined is always one. The addition of sectors 2, 3, and 4, provided in the last column, is presented to reflect on the interaction between sector 1 and all remaining sectors. The first column shows estimates for sector one. Overall, an increase in distance shifts FDI from sectors 1 - 3 into sector 4. It may or may not increase the level of FDI in any single sector[18].

When the skill difference variable $\text{SDIFF}_{i,t}$ is considered, it turns out that it is not found out to be significant (neither when estimated individually, nor when estimated as an interaction term with other variables)[19].

[16]Note that all inference assums normality, thus the usual caveats to this discussion apply.

[17]More specifically sector four accounts for the following industries: Manufacturing, agriculture, fishing, mining and quarrying and other industries.

[18]For example in Table 6 in Kristjánsdóttir (2004c), it could be that distance has a negative coefficient across the board, which it does. This means that an increase in distance decreases FDI in all sectors.

[19]A potential way to analyze the skill variable further would be to apply the same procedure as Markusen and Maskus (MM, 2002). MM include skill differences in two interaction terms, accounting for the cases seperately when skill differences are positive and negative. This approach has the advantage that only two more degrees of freedom are lost, when compared to the CMM model. However, the approach applied by Blonigen, Davies and Head (BDH, 2003) involves a much greater loss of degrees of freedom, since it implies a division of the sample to two subsamples, depending on the whether skill differences are positive or negative.

When it comes to the variables for host country investment cost INVC_t, and host trade cost TC_t as well as the interaction between trade cost host and skill differences $\text{TC}_t * \text{SDIFF}^2_{i,t}$, they are all estimated to be insignificant. Taken together these results may be interpreted such that the variables do not affect FDI allocation to different sectors. In other words, it can be said that MNEs do not choose one sector rather than another based on these factors; the sectors are all equally sensitive to changes in these variables. Recall, however, that FDI levels may change, thus this is not itself a rejection of the factor-proportions hypothesis.

Let us then consider the variable for trade cost in the source country $\text{TC}_{i,t}$. It is estimated to be positively significant in the case of sector 1 and negative for sectors 2 and 3. The positive coefficient can be interpreted such that an increase in source country trade cost has positive effects on the share of sector one in overall investment, while the contrary holds for other sectors. One way of interpreting these results is to say that only for sector one does high trade cost trigger investment. An increase in trade cost in the source country might trigger investment in sector one only if the goods produced by the power intensive sector are not faced with conventional trade costs when shipped back home. This possibility is explored in Section 5.

Finally, the distance variable is estimated to be significantly negative for sectors 1 through 4. This greater distances seem to hurt FDI in these industries relative to the manufacturing heavy sector 4.

The last column accounts for sectors 2, 3, and 4, and the number of observations in the last column is the sum of observation number for 1-3 sectors. The estimates obtained for the regression in the last column are insignificant, except the source trade cost, consistent with the regressions on sectors.

Many of the variables are estimated to be insignificant in Table 5. Therefore, it is interesting to continue the research by estimating levels of FDI, since the CMM is designed for level estimates and therefore has potential to do better for levels than shares. Furthermore, these results describe relative shares across sectors, which leaves out potential information regarding levels of FDI in each sector.

5 FDI Levels, Tobit Estimates

I next investigate the degree to which sectorial FDI can be explained, when presented in levels, rather than shares of FDI like before. By doing so, it is possible to capture the effects of the CMM specification variables on actual levels of FDI.

Table 6. Tobit Estimates for the CMM Model Specification

	SECTOR 1	SECTOR 2	SECTOR 3	SECTOR 4	S. 2 TO 4
Regressors	Power inten.	Com. & Fin.	Tel. & Trans.	Oth. Ind.	
$\text{YSUM}_{i,t}$	-123.43^{*} (−1.92)	4.54^{**} (2.09)	5.18^{**} (2.18)	-4.85^{**} (−2.09)	0.62 (0.35)
$\text{YDIFF}^2_{i,t}$	19.69^{*} (1.92)	-1.10^{**} (−2.01)	0.32 (0.38)	1.13^{***} (2.67)	0.15 (0.45)
$\text{SDIFF}_{i,t}$	323.54 (0.57)	−34.94 (−1.12)	65.42 (0.88)	12.79 (0.33)	−1.41 (−0.05)
$\text{YDIFF}_{i,t} * \text{SDIFF}_{i,t}$	−197.42 (−0.81)	85.76^{***} (3.32)	−31.29 (−0.85)	−8.37 (−0.72)	2.50 (0.27)
INVC_t	−0.46 (−0.06)	0.27 (0.59)	−0.07 (−0.11)	0.11 (0.15)	−0.02 (−0.03)
TC_t	−2.86 (−0.64)	0.12 (0.52)	0.01 (0.04)	-0.62^{*} (−1.69)	−0.30 (−1.03)
$\text{TC}_t * \text{SDIFF}^2_{i,t}$	−147.62 (−0.99)	-50.32^{***} (−4.61)	−4.51 (−0.37)	−3.65 (−0.44)	−6.23 (−0.94)
$\text{TC}_{i,t}$	7.24^{***} (4.81)	-0.18^{***} (−2.98)	-0.34^{**} (−2.24)	-0.22^{**} (−1.98)	-0.21^{**} (−2.49)
DIS_i	−25,621.77 (−1.12)	$-6,422.14^{***}$ (−4.87)	$-11,896.84^{*}$ (−1.91)	−246.68 (−0.91)	-601.06^{**} (−2.27)
CONSTANT	58.77 (0.32)	9.17 (1.01)	25.50 (1.55)	33.59^{**} (2.33)	19.97^{*} (1.72)
TOTAL OBS.	65	65	65	65	195
LEFT CENS. OBS. FDI≤0	47	29	50	21	100
UNCEN. OBS.	18	36	15	44	95
PSEUDO R-SQ.	0.21	0.29	0.38	0.17	0.07

Note: Robust t-statistics are in parentheses below coefficients. ***, ** and * denote significance levels of 1%, 5% and 10% respectively.

In Table 6 the results for level estimates are presented. The main difference between estimating shares or levels of FDI is that the level estimates allow us to determine the direct variable effects on the level of investment, while share estimates indicate how the share of FDI in individual sectors is determined.

By presenting FDI in levels rather than shares, estimates for individual sectors are independent of estimates for other sectors. In Table 6 the Tobit estimates for individual sectors are introduced. The row labelled "left censored" observations in Table 6 represents those observations that are zero or negative. The left censored observations are in most cases zero values[20], since the observations are rarely negative[21]. There is a higher number of left censored observations in sectors 1 and 3 than there is in sectors 2 and 4. This is as could be expected, since sectors 2 and 4 are composed of a bigger variety of industries than 1 and 3.

It appears that the size variables continue to have the same signs for sectors 1 and 4 as those in Kristjánsdóttir (2004c). This may provide further support for the hypothesis that estimates for sectors 2-4 combined are crowded out by the power intensive sector due to the power sector size.

What is also noteworthy in Table 6 is that the skill difference variable is not estimated to be significant for individual sector FDI. This suggests that skilled labor differences do not have significant impact on the amount of FDI in individual sectors. An exception, though, maybe found for sector 2, where both of the interaction terms are estimated to be significant. The significance of the interaction terms in the case of sector 2 can be interpreted such that endowments of skilled labor may be important in the telecom industry, especially during periods of Icelandic protectionism. What is also of particular interest in sector one is that distance is not estimated to be significant, indicating that other factors than distance are more important when multinationals choose to invest in Iceland.

[20]The Tobit lower limit is set at zero, then negative values are not trucated but accumulated around the zero value. The overall results are weak because of how many observations are left censored.

[21]However, negative observations are identified in the case of France, UK, Luxembourg, Norway and Sweden.

On the whole however, the CMM specification of the KK model does not seem to do well either when I estimate FDI in levels, since most of the variables are insignificant.

There is reason to expect that variation in the power intensive sector may be driving the results for level estimates of FDI. This is because investment in the power industry is often a lump sum investment indicative of high fixed costs. Alternatively, it may be that the baseline CMM specification ignores important omitted variables. I investigate this in the next section.

6 FDI Levels, Modification of the CMM Specification

Let us next investigate estimates for an alternative model specification. The new specification is presented in Equation (2):

$$\begin{aligned}\text{FDI}_{i,s,t} &= \beta_0 + \beta_1 \text{YSUM}_{i,t} + \beta_2 \text{YDIFF}^2_{i,t} + \beta_3 \text{SDIFF}_{i,t} \\ &\quad + \beta_4 \text{DIS}_i + \beta_5 \text{CATCH}_t + \beta_6 \text{INFDIFF}_i + \varepsilon_{i,s,t}\end{aligned} \quad (2)$$

The variables in Equation (2) that are originated in the CMM specification are the two first variables accounting for economic size, the third variable represents skills, and the fourth variable distance. The reason for the choice of those particular variables from the CMM specification is that, for the first thing, determination of size effects are a key issue in the case of Iceland (due to its smallness) and distance is also very important (due to the country's geographical location). Finally the variable accounting for skilled labor endowments is a crucial variable in the Knowledge-Capital framework.

Variables for trade costs and investment cost are not included in Equation (2) for two reasons. First, because there is reason to expect these not to be directly applicable to inward FDI in Iceland, since the host country trade and investment cost is estimated to have low significance. Second, although significant, source country trade cost is not of primary interest for inward FDI in Iceland. Also as Table 4 in Section 3 reveals, the trade and investment costs together with interaction terms have the fewest observations of all the variables and therefore act as being most restrictive.

Two new variables are introduced in Equation (2), these are CATCH_t which is an index for fish catch in Icelandic waters, and INFDIFF_i cross sectional variable accounting for differences in infrastructure of the source and the host. More specifically, the CATCH_t variable captures how investment incentives are affected by the size of available fish stock in Icelandic waters, and infrastructure INFDIFF_i in Iceland compared to the infrastructure in source countries (in the year 1999). These new variables are interesting for the reason that they reflect upon issues concerning horizontal and vertical foreign direct investment. By incorporating a proxy for the main natural resource of Iceland, the fishing area, it helps indicate further whether the sources of FDI are of vertical nature (that is, whether FDI is driven by cheap access to natural resources, as a form of relative endowments)[22]. Based on the fact that FDI in fisheries (fish processing firms and trollers) is prohibited in the period analyzed, we now want to estimate whether we can identify whether FDI is affected by the catch variable.

Table 7. New Model Specification for FDI Levels

	Sector 1	Sector 2	Sector 3	Sector 4	All Sts
Regressors	Power inten.	Com. & Fin.	Tel. & Trans.	Oth. Ind.	
$\text{Ysum}_{i,t}$	-22.342^{***} (−4.74)	0.934 (1.24)	0.588 (1.38)	-5.118^{***} (−3.19)	-6.485^{***} (−3.92)
$\text{Ydiff}^2_{i,t}$	3.343^{***} (5.21)	−0.095 (−1.02)	−0.054 (−0.77)	0.949^{***} (3.36)	1.036^{***} (4.00)
$\text{Sdiff}_{i,t}$	-207.470^{***} (−3.70)	6.182 (0.75)	−0.284 (−0.18)	-9.883^{*} (−1.71)	-52.864^{***} (−3.42)
Dis_i	-964.076^{***} (−3.83)	-269.435^{***} (−5.41)	-57.889^{***} (−2.68)	-153.809^{***} (−2.88)	-361.302^{***} (−5.24)
Catch_t	−60.442 (−0.73)	−2.749 (−0.27)	-5.488^{*} (−1.67)	−16.691 (−1.43)	−21.343 (−0.93)
INFdiff_i	-0.393^{*} (−1.84)	−0.048 (−0.83)	-0.043^{*} (−1.70)	−0.019 (−0.38)	-0.126^{**} (−2.44)
Constant	89.033 (1.06)	5.107 (0.50)	5.4695^{*} (1.65)	20.484^{*} (1.72)	30.023 (1.29)
Observatons	129	129	129	129	516
R-squared	0.19	0.09	0.16	0.60	0.07

Note: Robust t-statistics are in parentheses below coefficients. ***, ** and * denote significance levels of 1%, 5% and 10% respectively.

[22] Which brings us back to the *factor proportion hypothesis.*

Furthermore, FDI in various sectors is potentially affected by fluctuations in the fishing industry. This is due to the dominance of the fishing industry and related industries. The inclusion of the catch variable is particularly interesting when considering FDI in the power intensive sector, for two reasons: First because the economy is heavily dependent on these two industries, and second because these industries are both related to the two main natural resources of Iceland. Estimates obtained for Equation (2) are presented in Table 7.

A negative sign of the catch coefficient would give indication of that there existed some substitutional effects, since it indicates that FDI decreases as catch increases, that is, an increase in the fishing industry has negative effects on FDI in sector 4 (other industries)[23]. Although the catch variable is estimated to have negative coefficient for individual sectors, as well as for all sectors combined[24], it is only significant in the case of the Telecom and Transport sector.

Moreover, estimates for the infrastructure variable $\text{INF}\textsc{diff}_i$ indicate that investment is reduced in sectors 1 and 3, as the infrastructure in the source countries improves. This would be consistent with a story in which power intensive firms would seek to invest in the power intensive sector (sector 1) in Iceland, dependent on Iceland's firm infrastructure. Another noteworthy result in Table 7 is that estimates are primarily significant in the case of sector 1 and 4. Also the skill difference variable is estimated to be insignificant in most cases, with the exception of the power intensive industry, where a negative coefficient indicates that FDI is increases in a sector as Iceland becomes more skilled than the source country.

[23]Even if the fishing industry has been important in its contribution to GDP, it is classified with "other industries" when considering FDI, because of restrictions on foreigners to undertake investment in the fishing industry.

[24]All sectors combined, are here referred to as ALL STS, that is the last column. Recall that here, I am using levels of FDI, not shares.

7 FDI Levels, Sectors of Allocation

Next I include sector dummies, as given in Equation (3), to capture sector specific effects.

$$\begin{aligned} \text{FDI}_{i,s,t} &= \beta_0 + \beta_1 \text{YSUM}_{i,t} + \beta_2 \text{YDIFF}^2_{i,t} + \beta_3 \text{SDIFF}_{i,t} \\ &\quad + \beta_4 \text{DIS}_i + \beta_5 \text{CATCH}_t + \beta_6 \text{INFDIFF}_i \\ &\quad + \gamma_2 \text{D}s_2 + \gamma_3 \text{D}s_3 + \gamma_4 \text{D}s_4 + \varepsilon_{i,s,t} \end{aligned} \tag{3}$$

In Equation (3) the coefficient of the first sector γ_1 has been set equal to zero.

Table 8. Fixed Sector Effects for Levels of FDI

Regressors		Eq. from Table 7	Eq. w/ sectors
$\text{YSUM}_{i,t}$		-6.485^{***} (−3.92)	-6.485^{***} (−4.12)
$\text{YDIFF}^2_{i,t}$		1.036^{***} (4.00)	1.036^{***} (4.25)
$\text{SDIFF}_{i,t}$		-52.864^{***} (−3.42)	-52.864^{***} (−3.59)
DIS_i		-361.302^{***} (−5.24)	-361.302^{***} (−4.55)
CATCH_t		−21.343 (−0.93)	−21.343 (−0.97)
INFDIFF_i		-0.126^{***} (−2.44)	-0.126^{***} (−2.19)
D*Sector*_2	Com. & Fin.		-7.911^{***} (−3.09)
D*Sector*_3	Tel. & Trans.		-9.871^{***} (−3.89)
D*Sector*_4	Oth. Ind.		-8.303^{***} (−3.26)
CONSTANT		30.023 (1.29)	36.544 (1.59)
OBSERVATIONS		516	516
R-SQUARED		0.07	0.13

Note: See note following Table 7.

The estimates obtained indicate that sector 2, 3, and 4 are estimated to have significantly less FDI than sector 1, since the coefficients of the dummy variables for sectors 2, 3, and 4 are all estimated to be negative. The other coefficients are comparable to the last column of Table 7, indicating that there is more variation within sectors over time than between individual sectors.

Furthermore, in order to consider other types of fixed effects than fixed sector effects, I also tested whether there was difference in investment between the three major legal regimes foreign investors are faced with when considering Iceland as an investment option.

> "Icelandic legislation providing permission for inward foreign direct investment (FDI) in Iceland is from 1991. However, this legislation allowed for limited inward FDI, since FDI was not allowed in fisheries or the fishing industry. By laws from 1993 companies from all countries were allowed to invest in Iceland, regardless of domestic restriction in the parent country. Finally by legislation from 1996, foreigners were allowed to make indirect investment in fisheries and the fishing industry in Iceland." Act on Investment (1996), based on the Icelandic Government Gazette.

The division applied to test for fixed effects between law regimes, relied on Act on Investment (1996). The fixed effects tested account for three legal regimes. The first regime ranges from 1989-1992, the second regime from 1993-1995, and the last regime from 1996-1999. However, the results obtained indicated that there did not appear to be a significant difference between subperiods. More specifically, legal regimes two and three do not appear to be different from the first legal regime. Therefore, these results indicated that relaxation in the legal environment over time did not trigger investment, and the results are therefore not reported.

8 Sample Selection

One of the features of Icelandic FDI data is the large number of zero observations. This is particularly true for sector level data. Therefore in order to determine whether my estimation results are driven by sample selection, I turn to using the so-called Heckman selection model, or the Heckman's (1979) two-step procedure estimation technique.

An example of Heckman applied to FDI data can be found in Razin, Rubinstein and Sadka (2003), where they apply the procedure to analyze FDI flows. Their reasoning for using Heckman is to offer what they refer to as "yet another reconciliation of the Lucas' paradox, based on fixed setup costs of new investments" (Razin et al., 2003). By referring to the Lucas (1990) paper, where Lucas asked why capital does not seem to have tendency to flow from rich to poor countries, they include the Heckman procedure in order to simultaneously estimate country selection for FDI and the determinants of FDI flows. Following the same procedure as Razin et al., I start out with the same set of variables in both the first and the second step of the Heckman procedure. According to Jeroen Smits (2003) discussion on the Heckman model, it is desirable for the selection equation to contain at least one variable that is unrelated to the dependent variable used in the second stage. If such a variable is not present (and sometimes even if such a variable is present), there may arise severe problems of multicollinearity. Addition of the correction factor to the substantial equation may also lead to estimation difficulties and unreliable coefficients. In addition to using the Heckman procedure in this section I focus only on sector one, the power intensive sector. The power intensive industries are important for Iceland, since it produces considerable amount of aluminum, despite its small economic size. In 1997 Iceland was ranked 27th on the list of world aluminum producing countries (Wagner, 1998), a high rank for such a small country. Because of the importance of aluminum production making it the single biggest investment industry, it is the biggest single industry in FDI, and thus my section of focus.

8.1 LEVELS Heckman for the KK model

Since the KK model is the one currently in vogue, here I begin using the KK model on level data. That is, the Heckman procedure[25] is applied to level FDI data on a modified version of the KK model.

Estimates in Tables 9A and 9B show results for three different regressions. More specifically, Table 9A shows results for the Heckman first step, while Table 9B shows results for the second step. The difference between the three results lies within the first Heckman step[26]. In the first step, the likelihood of some FDI occurring is estimated by the Probit technique. In column (1) there is the same set of variables in the first and second step, in column (2) pollution $\text{P}\textsc{diff}_{i,1997}$ is added to the first step, and in column (3) difference in government stability is added $\text{GMTST}\textsc{diff}_{i,t}$. The pollution variable is included in order to reflect on the pollution quota difference between Iceland and the source countries[27]. It is based on percentage pollution quota deviation of source countries from the host country quota. These are obtained from the 1997 Kyoto agreement[28].

[25] For more information see Greene (1997).

[26] In the first Heckman model for FDI levels, regressions were done on the full KK model specification. These KK variables were included in both step one and two, but then I only get 18 observations. Therefore, I considered these to be too few for the Heckman procedure to work effectively. The next regression was run with fewer variables, leaving out the variables that limted the sample size the most. These are trade cost for host and source, as well as investment cost host and the term for interaction between trade cost host and skill differences.

Variables from the restricted version of the KK model are applied together with an energy index. This index is a proxy of the endowment factor of natural resources. Since data on wholesale electricity prices of various countries are only available for 1999, it only provides us with country specific data. I therefore chose to create my own energy index, which combines the price of wholesale electricity in Iceland with the world USD price of oil. The index was calculated so that it represents the electricity price of the dominating wholesale electricity company in Iceland, divided by the world oil price. Three versions of this index are applied here, firstly the plain ratio, then the ratio of one year lagged variables, and finally a ratio of two year lagged variables. None of these regression results are shown here, since these specifications did not turn out to be informative, especially not the marginal incentives for making FDI.

[27] According to the Kyoto Protocol, the pollution submission allowance for Iceland is substaintially higher than that for most other countries. Iceland received a quota of 110% while most other nations reveived a quota of 92%.

[28] Quantified emission limitation or reduction commitment, (percentage of base year or period).

Table 9A. KK model (LEVELS) Sample Selection

	First Step Probit Results		
	(1)	(2)	(3)
Regressors	Plain Vanilla	Pollution	Gvmt Stability
$\text{PDIFF}_{i,1997}$		42.261^{***} (2.64)	
$\text{GMTSTDIFF}_{i,t}$			0.294^{**} (2.03)
$\text{YSUM}_{i,t}$	-5.436^{***} (−3.68)	-3.912^{***} (−2.84)	-5.8571^{***} (−3.90)
$\text{YDIFF}^2_{i,t}$	1.146^{***} (3.95)	0.773^{***} (3.25)	1.306^{***} (4.10)
$\text{SDIFF}_{i,t}$	-5.559^{**} (−1.76)	-12.769^{**} (−2.33)	−5.329 (−1.60)
$\text{YDIFF}_{i,t}*\text{SDIFF}_{i,t}$	-28.442^{***} (−3.66)	-16.443^{***} (−3.18)	-34.8199^{***} (−3.85)
DIS_i	-1132.559^{**} (−2.36)	-526.832^{***} (−2.61)	-1647.853^{***} (−2.86)
CONSTANT	3.551^{***} (2.72)	9.038^{***} (2.74)	4.869^{***} (3.06)

Note: Heckman's consistent Z - values are in parenthesis below coefficients.
***, ** and * denote significance levels of 1%, 5% and 10% respectively.

The variables presented in the Probit part determine the probability that some positive investment takes place in industry one. As in the Razin et al. (2003), the Probit zero/one binary distribution can be regarded to be a threshold measure of whether investment takes place, and can therefore be regarded to proxy fixed investment costs. However, in the second Heckman step, an OLS procedure is applied to capture marginal effects on the dependent variable by the explanatory variables.

The difference between the regressions presented in Table 9 is reflected in a different set of explanatory variables in Table 9A. One of the interesting things about the regression results is that skill differences are estimated to be negative. A negative sign indicates that as source country becomes more skilled abundant, fixed costs are higher (first step), and so are the marginal costs (second step). Other estimates for individual variables indicate that $\text{PDIFF}_{i,1997}$ is estimated to be positively significant, indicating that source countries with higher pollution quota are more likely to invest in Iceland, a country that also has fairly high pollution quotas. The government difference $\text{GMTST}\textsc{diff}_{i,t}$ is estimated as being positive; this indicates that countries with more stable governments tend to invest more than others.

Together, the economic size variables indicate that investment is more likely made by smaller countries than large countries (since sum GDP is negative and squared difference is positive). A negative interaction term indicates that as countries grow bigger, skill differences may have negative effects. Finally, the distance coefficient indicates that investment is more likely to take place by countries that are geographically closer.

Table 9B. KK model (LEVELS) Sample Selection

	Second Step OLS Results		
	(1)	(2)	(3)
Regressors	Plain Vanilla	Pollution	Gvmt Stability
$\text{Y}\textsc{sum}_{i,t}$	−94.008 (−0.53)	−84.862 (−0.61)	−117.984 (−0.78)
$\text{Y}\textsc{diff}^2_{i,t}$	11.255 (0.45)	10.548 (0.55)	11.852 (0.58)
$\text{S}\textsc{diff}_{i,t}$	−423.763 (−1.28)	−79.548 (−0.31)	−473.903* (−1.75)
$\text{Y}\textsc{diff}_{i,t}*\text{S}\textsc{diff}_{i,t}$	50.581 (0.07)	−26.593 (−0.05)	156.234 (0.34)
$\text{D}\textsc{is}_i$	26338.389 (0.29)	17183.577 (0.24)	42809.456 (0.71)
Constant	−50.997 (−0.38)	−1.676 (−0.01)	−63.198 (−0.63)
Mills Ratio (λ)	80.439 (1.20)	63.589* (1.67)	68.152* (1.92)
Observations	129	129	129
Uncens. Obs.	30	30	30

Note: Heckman's consistent Z - values are in parenthesis below coefficients.
***, ** and * denote significance levels of 1%, 5% and 10% respectively.

The Mills ratio reported in Table 9B is estimated to be significant in the two latter regressions, indicating that the sample selection is estimated to be significant in these regressions; it is displayed in columns (2) and (3). Beyond this, the regression results in Table 9B tell us little about the sign of investment. This implies that although the KK model does fairly well in explaining fixed investment cost, consistent with my earlier results presented in Kristjánsdóttir (2004c), it does not do well in explaining the level of investment.

8.2 SHARES Heckman for the KK model

Although the KK model did not perform well for the Section 1 FDI level, the results from before offer hope that it will perform for FDI shares in Section 1. In section 1, the sample selection basis is that investment shares are only observed when multinationals undertake investment in Iceland within a particular year t. Step one identifies only the cases when some investment takes place in sector one. Therefore, when FDI is presented in shares, the years of no investment are not accounted for (since each sector has zero investment), so the binary variable takes zero value in these cases. The results for this series of regressions are in Tables 10A and 10B.

Table 10A. KK model (SHARES) Sample Selection

	First Step Probit Results		
	(1)	(2)	(3)
Regressors	Plain Vanilla	Pollution	Gvmt Stability
$\text{PDIFF}_{i,1997}$		42.261^{***} (2.64)	
$\text{GMTSTDIFF}_{i,t}$			0.294^{**} (2.03)
$\text{YSUM}_{i,t}$	-5.436^{***} (−3.68)	-3.912^{***} (−2.84)	-5.857^{***} (−3.90)
$\text{YDIFF}^2_{i,t}$	1.146^{***} (3.95)	0.773^{***} (3.25)	1.306^{***} (4.10)
$\text{SDIFF}_{i,t}$	-5.559^{*} (−1.76)	-12.769^{**} (−2.33)	-5.329 (−1.60)
$\text{YDIFF}_{i,t}*\text{SDIFF}_{i,t}$	-28.442^{***} (−3.66)	-16.443^{***} (−3.18)	-34.819^{***} (−3.85)
DIS_i	-1132.559^{**} (−2.36)	-526.832^{***} (−2.61)	-1647.854^{***} (−2.86)
CONSTANT	3.551^{***} (2.72)	9.038^{***} (2.74)	4.869^{***} (3.06)

Note: Heckman's consistent Z - values are in parenthesis below coefficients.
***, ** and * denote significance levels of 1%, 5% and 10% respectively.

Since the sample selection stage in Tables 9A and 10A are the same, there is obviously no difference between them. New results are in Table 10B, which account for the marginal effects on the FDI of sector 1 relative to other sectors.

Table 10B. KK model (SHARES) Sample Selection

	Second Step OLS Results		
	(1)	(2)	(3)
Regressors	Plain Vanilla	Pollution	Gvmt Stability
$\text{YSUM}_{i,t}$	0.015 (0.10)	0.014 (0.12)	−0.012 (−0.11)
$\text{YDIFF}^2_{i,t}$	−0.011 (−0.52)	−0.013 (−0.87)	−0.018 (−1.21)
$\text{SDIFF}_{i,t}$	0.544* (1.96)	0.807*** (3.89)	0.706*** (3.17)
$\text{YDIFF}_{i,t}*\text{SDIFF}_{i,t}$	0.177 (0.29)	0.274 (0.59)	0.687** (2.01)
DIS_i	56.761 (0.75)	68.562 (1.16)	118.704** (2.54)
CONSTANT	0.754*** (6.77)	0.765*** (7.62)	0.685*** (9.04)
MILLS RATIO (λ)	0.067 (1.20)	0.039 (1.26)	0.006 (0.22)
OBSERVATIONS	129	129	129
UNCENS. OBS.	30	30	30

Note: Heckman's consistent Z - values are in parenthesis below coefficients.
***, ** and * denote significance levels of 1%, 5% and 10% respectively.

Given the share results from earlier in the paper, it is no surprise that many of the variables in Table 10B are insignificant. What is primarily interesting about the results in Table 10B is that the skill difference variable is estimated to be positive and significant in all three regressions even though it is insignificant in step one. These positive estimates for skill differences indicate a tendency for investment to occur in sector 1 relative to other sectors, because the source country becomes more skilled[29] relative to Iceland.

As Iceland becomes more skill abundant relative to the source, $\text{SDIFF}_{i,t}$ falls, and the price of Icelandic skilled labor is expected to fall relative to skilled labor price in the source country. According to these estimates, this increases the probability of FDI in sector 1, but reduces its importance relative to overall FDI. Thus, cheap Icelandic skill is important in fixed costs but not in production in sector 1.

[29]Since skill differences are defined as skillness of the source country minus the skillness of the host country.

8.3 LEVELS Heckman for the GRAVITY model

When the results for Tables 9A, 9B, 10A, and 10B are taken together, it appears as if the KK model analysis say something about whether countries are likely to overcome fixed cost. However, it appears that the KK model does not do too well in explaining the level of investment. Thus, for comparison, I turn to the gravity model presented and used in my earlier papers Kristjánsdóttir (2004a, 2004b).

As with the KK results in previous sections, I now explore sector 1 levels and shares. The levels results are in Tables 11A and 11B. Again, following Razin et al. (2003), my approach is to initially include the same variables in each stage. As presented in column (1), the traditional gravity model does not do well in the second stage. Therefore, in columns (2), (3), and (4), some additional factors are added to the original gravity specification to overcome the multicollinearity. problem. In column (2) source country skill[30] is added to step 1. Since the point of the KK model is that endowments matter, it seems reasonable to include an endowment proxy in the model. The level of skill is also added to the second step in column (3) and (4).

In all three of these new specifications, higher source skill is associated with a higher probability of investment in sector 1. However, it is not significant in stage 2. The abundant, i.e. cheap source skill may be important for whether investment occurs but not in the level of FDI. Source GDP is also positively correlated with the likelihood of some FDI in sector 1. However, it is significantly and positively related to the level of FDI. Contrast this with source population, which is significantly negatively correlated with both the probability and level of FDI. Thus, at least for levels, the wealth story of presented in Kristjánsdóttir (2004b) is again found. The Icelandic variables appear insignificant for the selection stage. In the second stage, however similar to the source wealth, higher Icelandic wealth is positively

[30] Source skill is used here, rather than skill difference for three reasons mainly. First, the sample size would have too few observations, since skill difference may turn zero or negative in several occations, because of the logarithm use. Second, when including skill differences in the KK model, sample size was limited considerable because of few observations for level of skill in the host country and insufficient overlap of those with f.x. trade cost variables.

correlated with FDI levels. A noteworthy difference is that whereas the source GDP and population have coefficients of roughly equal magnitudes, the Icelandic population's coefficient is roughly four times that of Icelandic GDP. Moreover, distance seems only important in the level stage, where it has the now the familiar negative coefficient. Finally, the Mills ratios imply that the sample selection is not driving the unconditional OLS estimates.

When everything is considered, it appears that one of the main advantages of applying the gravity specification rather than the KK specification to the Heckman model is that the gravity specification gives an indication of how host country characteristics affect FDI, whereas the KK specification does not. It is nevertheless important to include endowment data in the gravity model, a lesson that needs to be credited to the KK literature.

Table 11A. Gravity (LEVELS) Sample Selection

	First Step Probit Results			
	(1)	(2)	(3)	(4)
Regressors	Plain Vanilla	Skill in St 1	Skill in St 1&2	Gvmt Stab.
$\ln(\text{GMTST}_{\text{OTH}_{i,t}})$				-2.514^{**} (-2.08)
$\ln(\text{SKILL}_{\text{OTH}_{i}})$		3.326^{***} (2.76)	3.326^{***} (2.76)	4.678^{**} (2.03)
$\ln(\text{Y}_t)$	1.057 (0.30)	2.763 (0.55)	2.763 (0.55)	3.616 (0.51)
$\ln(\text{Y}_{i,t})$	9.162^{***} (4.87)	17.728^{***} (3.40)	17.728^{***} (3.40)	28.870^{*} (1.96)
$\ln(\text{N}_t)$	-20.199^{*} (-1.73)	-22.552 (-1.40)	-22.552 (-1.40)	-52.182 (-1.47)
$\ln(\text{N}_{i,t})$	-8.438^{***} (-4.94)	-17.085^{***} (-3.53)	-17.085^{***} (-3.53)	-27.735^{**} (-2.02)
$\ln(\text{D}_i)$	-1.485^{**} (-2.04)	-1.560 (-1.05)	-1.560 (-1.05)	-3.361 (-0.93)
Constant	-1.650 (-0.17)	38.012^{**} (2.26)	38.012^{**} (2.26)	31.621 (1.09)

Note: Heckman's consistent Z - values are in parenthesis below coefficients.
***, ** and * denote significance levels of 1%, 5% and 10% respectively.

Table 11B. Gravity (LEVELS) Sample Selection

	Second Step OLS Results			
Regressors	(1)	(2)	(3)	(4)
$\ln(\text{SKILL}\textsc{Oth}_i)$			1.183 (1.64)	0.628 (0.75)
$\ln(Y_t)$	6.525 (0.44)	7.353*** (2.98)	7.674*** (3.02)	7.309** (2.23)
$\ln(Y_{i,t})$	−9.577 (−0.28)	9.905*** (4.80)	12.215*** (5.06)	9.424*** (5.48)
$\ln(N_t)$	−7.816 (−0.12)	−30.955*** (−4.33)	−31.291*** (−4.24)	−29.559*** (−4.08)
$\ln(N_{i,t})$	10.017 (0.32)	−8.184*** (−4.34)	−10.583*** (−4.55)	−7.967*** (−4.78)
$\ln(D_i)$	−3.529 (−0.70)	−5.509*** (−8.65)	−5.048*** (−7.30)	−4.745*** (−4.26)
Constant	−24.912 (−0.45)	−5.794 (−0.68)	7.467 (0.59)	0.318 (0.02)
Mills Ratio (λ)	−4.319 (−0.58)	0.189 (0.33)	0.638 (1.12)	0.013 (0.03)
Observations	185	159	159	107
Uncens. Obs.	36	36	36	27

Note: Heckman's consistent Z - values are in parenthesis below coefficients.
***, ** and * denote significance levels of 1%, 5% and 10% respectively.

8.4 SHARES Heckman for the GRAVITY model

The final regression results presented in this paper include the Heckman procedure applied to a gravity specification on FDI share data. These are presented in Tables 12A and 12B.

Like in the case of the KK model in Tables 9A and 10A, the estimates for the first step in gravity level and gravity share data are fully identical. This is due to the fact that both represent the likelihood of investment taking place in sector one in general. However estimates obtained for the second step for share in Table 12B, differ considerably from those in 11B.

Table 12A. Gravity (SHARES) Sample Selection

	First Step Probit Results			
	(1)	(2)	(3)	(4)
Regressors	Plain Vanilla	Skill in St 1	Skill in St 1&2	Gvmt Stab.
$\ln(\text{GMTST}\textsc{oth}_{i,t})$				-2.514^{**} (-2.08)
$\ln(\text{SKILL}\textsc{oth}_{i})$		3.326^{***} (2.76)	3.326^{***} (2.76)	4.678^{**} (2.03)
$\ln(\text{Y}_t)$	1.057 (0.30)	2.763 (0.55)	2.763 (0.55)	3.616 (0.51)
$\ln(\text{Y}_{i,t})$	9.162^{***} (4.87)	17.728^{***} (3.40)	17.728^{***} (3.40)	28.870^{*} (1.96)
$\ln(\text{N}_t)$	-20.199^{*} (-1.73)	-22.552 (-1.40)	-22.552 (-1.40)	-52.182 (-1.47)
$\ln(\text{N}_{i,t})$	-8.438^{***} (-4.94)	-17.085^{***} (-3.53)	-17.085^{***} (-3.53)	-27.735^{**} (-2.02)
$\ln(\text{D}_i)$	-1.485^{**} (-2.04)	-1.560 (-1.05)	-1.560 (-1.05)	-3.361 (-0.93)
CONSTANT	-1.650 (-0.17)	38.012^{**} (2.26)	38.012^{**} (2.26)	31.621 (1.09)

Note: Heckman's consistent Z - values are in parenthesis below coefficients.
***, ** and * denote significance levels of 1%, 5% and 10% respectively.

First, it is obvious that although the gravity model variables might help to describe levels of FDI in sector one, they do little to describe the share of FDI in that sector. They do indicate that as the Icelandic GDP grows, FDI is diversified away from sector one. Estimates for distance indicate that once countries overcome the threshold of investing in the power intensive sector, they are more likely to be attracted to sector one than other sectors, with an increase in costs associated with increased distance.

These last results give a nice end to the story, since the power intensive goods are normally shipped and likely to be less distance sensitive than many other products. They might therefore become an increasingly preferable investment option, compared to other investment opportunities, as distance increases.

All considered, it appears as if anything, the gravity model does marginally better than the knowledge-capital approach, since the estimates obtained are slightly more significant than those of the knowledge-capital model.

From Table 12B it can be concluded that a 1% increase in the source country level of skill[31] can be expected to result in about 0.2% increase in sector one share of total FDI. Economically, this corresponds to the situation where if the source country skilled labor (average of 21.35%) would move up by 1% i.e. to 21.56%, then the share of sector one would increase from being 94.14% on average, to being 94.33% (note that the observations in the second step include only the years of investment in sector one, and therefore the mean is very high).

Moreover, estimates indicate that as GDP in Iceland increases by 1%, then the share of sector one in FDI decreases on by about 0.6%. The economic significance of these estimates could be interpreted such that a 1% increase in Iceland GDP from $7 billion[32] to $7.07 billion would affect FDI such that the share of sector one would go down from 94.14% to 93.67%.

As for source country GDP and population, as well as the population of Iceland, coefficient estimates indicate that these economic factors would not effect the share of sector one in overall FDI.

[31] These data are obtained from the International Labor Organization (ILO) as the sum of occupational categories 0/1 and 2; where category 0/1 accounts for professional, technical, and kindred workers, and category 2 for administrative workers. Moreover, the skilled labor ratio is calculated as the sum of categories 0/1 and 2, divided by the sum of all occupational categories. The skilled labor ratio is used as a proxy for relative skilled labor abundance.

[32] GDP values are on an 1995 base.

Table 12B. Gravity (SHARES) Sample Selection

	Second Step OLS Results			
Regressors	(1)	(2)	(3)	(4)
$\ln(\text{SKILL}\textsc{oth}_i)$			0.208^{*} (1.73)	0.112 (1.35)
$\ln(\text{Y}_t)$	-0.563^{***} (-2.54)	-0.617^{***} (-2.77)	-0.561 (-1.32)	-0.722^{**} (-2.15)
$\ln(\text{Y}_{i,t})$	0.066 (0.13)	-0.026 (-0.14)	0.381 (0.95)	0.053 (0.29)
$\ln(\text{N}_t)$	0.073 (0.08)	0.424 (0.65)	0.364 (0.30)	0.287 (0.38)
$\ln(\text{N}_{i,t})$	-0.215 (-0.46)	-0.129 (-0.78)	-0.552 (-1.43)	-0.234 (-1.34)
$\ln(\text{D}_i)$	0.357^{***} (4.70)	0.366^{***} (6.39)	0.447^{***} (3.88)	0.444^{***} (4.05)
Constant	-0.092 (-0.11)	-0.108 (-0.14)	2.229 (1.06)	0.130 (0.07)
Mills Ratio (λ)	0.043 (0.38)	0.031 (0.62)	0.110 (1.17)	0.061 (1.24)
Observations	185	159	159	107
Uncens. Obs.	36	36	36	27

Note: Heckman's consistent Z - values are in parenthesis below coefficients.
***, ** and * denote significance levels of 1%, 5% and 10% respectively.

Finally, estimates for distance indicate that an average increase in distance of 1% would involve an average increase in the share of sector one by about 0.4%. The economic relationship effects of these changes could be interpreted such that if distance would increase from its average by 1%, moving up from and average of 4000 kilometers to 4040 kilometers, then the share of sector one is estimated to go up from 94.14% to 94.52%.

9 Conclusion

This paper presents analysis of foreign direct investment (FDI) allocated to different investment sectors in Iceland. Both levels of FDI and shares of FDI are estimated. When estimated separately, it appears that different forces are driving investment in individual sectors. These results may possibly explain why the Knowledge Capital (KK) model specification of Carr, Markusen, Maskus (CMM) did not perform particularly well for aggregate Icelandic data in my earlier paper (Kristjánsdóttir, 2004c). In order to take a closer look at the dominating investment sector in Iceland, the power intensive sector, the sector is analyzed specifically by applying the Heckman two-step procedure to test for sample selection. Estimates indicate the threshold of overcoming fixed cost does seem to be a critical issue when multinationals choose to invest.

When sample selection is analyzed with a set of KK model variables, the proxy for skill difference endowments is estimated to be negative for FDI levels, but positive in step two for FDI shares. This may indicate that source countries are attracted by the level of skill in Iceland at the beginning stage of operations when faced with fixed threshold cost. Once the plants have overcome fixed costs, there are positive impacts on marginal investment the more skilled the source country is compared to the host. The KK model estimates by the Heckman procedure indicate that it appears as if the KK model analysis helps in explaining why countries are likely to overcome fixed cost. Finally, when a set of gravity model variables are applied in the Heckman procedure, it appears that they do a better job in explaining the incentives for FDI. Estimates for endowments such as the level of skill of the other country becomes more clear in the case of the gravity model, indicating that an increase in the level of skill in the source country tends to positively effect both on the investment undertaken initially and the marginal increase thereafter. Also, source and host country market sizes have a clearer interpretation in the gravity model case, especially the host country estimates. It therefore appears that the gravity model does a better job explaining investment.

10 Appendix A. The Sample Selection Procedure

The sample selection procedure can be described as follows. I start by presenting the equation determining sample selection equation (Greene, 1997, pp. 978) as Equation (5):

$$z_i^* = \gamma' w_i + u_i, \tag{4}$$

Following this I can present the basic model specification as shown in Eq. (6):

$$y_i = \beta' x_i + \epsilon_i. \tag{5}$$

Most of the time, the selection variable z^* is not observed, but only its sign. In our example, I observe only whether a source country invests in Iceland in a particular year or not. This information implies the sign of z^*, but not its magnitude. Because I do not have information on the scale of z^*, it is impossible to estimate the selection equation variance.

Then the selection mechanism, capturing whether investment takes place or not, can be put forward as shown in Eq. (7), where $Prob$ refers to probability.:

$$\begin{aligned} z_i^* &= \gamma' w_i + u_i, \quad z_i^* = 1 \quad if \quad z_i^* > 0 \quad and \quad 0 \quad otherwise; \qquad (6) \\ Prob(z_i &= 1) = \Phi(\gamma' w_i) \quad and \\ Prob(z_i &= 0) = 1 - \Phi(\gamma' w_i). \end{aligned}$$

The regression equation can be presented as follows:

$$\begin{aligned} y_i &= \beta' x_i + \epsilon_i \quad observed \quad only \quad if \quad z_i^* = 1, \qquad (7) \\ (u_i, \epsilon_i) &\sim bivariate \quad normal[0, 0, 1, \sigma_\epsilon, \rho]. \end{aligned}$$

If I then suppose that z_i and w_i are observed for a random sample of observations, and that I only observe y_i when z_i=1, then I can present the model as follows:

$$(E[y_i| \; z_i = 1] = \beta' x + \rho \sigma_\epsilon \lambda(\gamma' w). \tag{8}$$

11 Appendix B. The Kyoto Protocol

Kyoto Protocol to the United Nations framework convention on climate change[33].

Third session Kyoto, 1-10 December 1997[34].

Quantified emission limitation or reduction commitment

(percentage of base year or period)

Australia	108%	Liechtenstein	92%
Austria	92%	Lithuania*	92%
Belgium	92%	Luxembourg	92%
Bulgaria*	92%	Monaco	92%
Canada	94%	Netherlands	92%
Croatia*	95%	New Zealand	100%
Czech Republic*	92%	Norway	101%
Denmark	92%	Poland*	94%
Estonia*	92%	Portugal	92%
European Community	92%	Romania*	92%
Finland	92%	Russian Federation*	100%
France	92%	Slovakia*	92%
Germany	92%	Slovenia*	92%
Greece	92%	Spain	92%
Hungary*	94%	Sweden	92%
Iceland	110%	Switzerland	92%
Ireland	92%	Ukraine*	100%
Italy	92%	United Kingdom of Great Britain	
Japan	94%	and Northern Ireland	92%
Latvia*	92%	United States of America	93%

* Countries that are undergoing the process of transition to a market economy

[33] English conference of the parties.

[34] Source: www.cnn.com/SPECIALS/1997/global.warming/stories/treaty/index4.html

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