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FDI versus Exports: Multiple Host Countries and Empirical Evidence

Harald Oberhofer and Michael Pfaffermayr

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Harald Oberhofer[a] and Michael Pfaffermayr[b]

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Abstract

There are two main options for companies to serve foreign markets: exports and foreign direct investment (FDI). Based on the Helpman, Melitz and Yeaple (2004) model for multiple host countries this paper derives a clear theoretical prediction for the decision between both strategies. A bivariate probit model is estimated using a large data set of European companies to analyze the probability of using one or the other strategy. The empirical evidence indicates that more productive firms less (more) probably use the export (FDI) strategy to serve foreign markets. Moreover, a considerable number of companies use a combination of both strategies to serve foreign markets, which is in line with a multiple country model.

JEL Codes: C35, D22, F12.

Keywords: Heterogeneous Firms, Exports, Foreign Direct Investment, Multiple Host Countries, Bivariate Probit Estimation.

[a]Department of Economics and Social Sciences and Salzburg Centre of European Union Studies (SCEUS), University of Salzburg, Kapitelgasse 5-7, 5010 Salzburg, Austria. E-mail address: harald.oberhofer@sbg.ac.at.

[b]Department of Economics, University of Innsbruck, Universitaetsstrasse 15, 6020 Innsbruck, Austria. Austrian Institute of Economic Research, Vienna and CESifo, Munich. E-mail: michael.pfaffermayr@uibk.ac.at.

1 Introduction

In recent years more and more companies have started to operate in international markets.[1] In doing so, companies can choose between two major strategies to serve the foreign markets and to participate in the global economy. The more traditional mode is to export the produced goods to foreign markets. The other strategy is to engage in horizontal FDI and duplicate an existing production facility in foreign countries through foreign direct investment (FDI) and serve foreign demand locally.

The aim of this paper is to bring more light into the question of the relationship between these two strategies. Earlier research has found some evidence for a substitutional relationship while other arguments support the hypothesis of a complementary relationship between exports and foreign production.[2]

Brainard (1997) analyzes the location decision of multinational companies by a trade-off between proximity to customers and concentration of production stages to achieve scale economies. This has led to the knowledge capital model as analyzed by Markusen and Venables (2000) and Markusen (2002). Recent research focuses on productivity differences that determine the preferred strategy in models with heterogeneous firms. More productive firms will do FDI to serve foreign markets while the less productive firms will trade their goods (see, e.g, Melitz 2003; Helpman, Melitz and Yeaple 2004; Baldwin 2005). In these models the decision on how to serve foreign markets is explained by a trade-off between fixed plant setup costs and variable transportation costs, the latter including trade costs. The FDI (export) strategy causes higher (lower) fixed costs but lower (higher) variable costs.

Helpman et al. (2004) emphasize that only the most productive firms are able to afford the additional facility duplicating fixed costs and gain through less variable costs. Consequently, less productive firms have to use the export strategy and accept higher variable costs triggered by barriers to trade. Hence, the Helpman et al. (2004) model suggests the hypothesis that the more productive companies substitute their exports through FDI.

This paper shows that the optimal mode of serving foreign markets can (for a given firm) differ across host countries. Hence, in a multi-country

[1] See Helpman (2006) for a comprehensive survey on the trade and FDI literature.

[2] Head and Ries (2004) summarize earlier research and provide arguments for both possible relationships. Greenaway and Kneller (2007) provide and overview on the empirical evidence with regard to heterogeneous firms and their export and FDI behavior.

setting one can observe that some firms do both, exporting and investing abroad. For example, at high transportation costs and fixed plant setup costs that are unrelated to distance, large and distant markets are served via FDI, while small and nearby markets tend to be served by exports. In this model, multinational enterprises (MNEs) are horizontally integrated and the decision between FDI and export depends on the 'critical' market size which is determined by the firm's market power, the distance to the market and the fixed plant setup costs in the foreign market.[3]

Empirical research in this field mainly focuses on evidence for productivity differences between foreign direct investors and exporting firms (Head and Ries 2003; Girma, Kneller and Pisu 2005). Here, a different question is addressed, namely, how productivity (and of course other firm characteristics) influence the probability of using one or the other strategies or both of them. Furthermore, how big is the impact of marginal changes in productivity and other firm characteristics on the probability of exports and FDI?

To estimate the productivity effects on the probability of investing abroad or exporting we use a bivariate probit model that allows for both modes. With respect to productivity we find some evidence for a substitutional relationship between exports and FDI at the firm level. However, our data suggest that the majority of firms use both strategies complementarily.

The paper proceeds as follows: in Section 2 we briefly present the Helpman et al. (2004) model in a general multiple country form. Subsequently we establish an empirical model in Section 3 and present the data used in Section 4. The estimation results are reported in Section 5. Finally we conclude in Section 6.

2 Theoretical Considerations

Recent theoretical research incorporates (exogenously given) productivity differences between firms in standard models of the export versus FDI de-

[3] Another explanation for the use of both strategies would be that MNEs are vertically integrated across borders (Helpman and Krugman 1985) and trade intermediate goods and headquarter services. In this case, the wage differential would be an important determinant. Unfortunately these models cannot be directly tested with firm level data, since export figures are usually not disaggregated by host countries at the firm level. Therefore, in our empirical analysis we exclude vertically integrated MNEs to evaluate the explanatory power of the empirical model for firms with horizontal FDI as examined by the theoretical model.

cision. The consideration of heterogeneity of firms' productivity allows for variation in the foreign market serving decision within industries. The model is embedded in a monopolistically competitive market structure with one production sector, that produces a differentiated product using labor input, where firms face a given wage rates w.

The MNEs considered are integrated horizontally and therefore produce either in the home market and export to foreign markets or serve foreign markets with local production. Foreign production induces additional fixed plant setup costs, while the export strategy increases marginal production costs due to the necessity of transportation. Under the additional assumption of symmetric (production) costs at each location each variety is consumed in the same quantity. Therefore, the demand for a representative variety produced in the home-market i and consumed in a foreign market j is given by:

$$D_{ij} = \frac{p_{ij}^{-\epsilon} E_j}{(N_i p_{ij}^{1-\epsilon} + N_j p_{jj}^{1-\epsilon})} = p_{ij}^{-\epsilon} A_j, \tag{1a}$$

$$\text{with:} \quad A_j = \frac{E_j}{(N_i p_{ij}^{1-\epsilon} + N_j p_{jj}^{1-\epsilon})}$$

and demand for a locally produced brand is:

$$D_{jj} = \frac{p_{jj}^{-\epsilon} E_j}{(N_i p_{ij}^{1-\epsilon} + N_j p_{jj}^{1-\epsilon})} = p_{jj}^{-\epsilon} A_j. \tag{1b}$$

In these models, the countries differ in market size E_j, in the factor price for labor w_j, fixed investment costs f_j and marginal (iceberg) transportation costs from home to the foreign market τ_{ij} see Aw and Lee 2008. Heterogeneity in firm productivity is captured by $\frac{1}{a}$, where the random variable a denotes the labor per unit of output coefficient. The production technology generates marginal production costs $MC = \frac{\tau_{ij} w_i a}{\alpha} = p_{ij}$ in the case of home market production (for the foreign market) and $MC = \frac{w_j a}{\alpha} = p_{jj}$ when production is organized abroad, where α captures the mark-up.

The profits of a representative firm in a foreign market j using the export strategy are given by:

$$\pi_{X_j} = (\tau_{ij} a)^{1-\epsilon} (1-\alpha) A_j \left(\frac{w_i}{\alpha}\right)^{1-\epsilon} - f_{X_j}. \tag{2a}$$

The corresponding profits from local production are given by:

$$\pi_{I_j} = a^{1-\epsilon}(1-\alpha)A_j\left(\frac{w_j}{\alpha}\right)^{1-\epsilon} - f_{I_j}. \tag{2b}$$

Companies' profits in foreign markets depend on firms productivity a, transportation costs τ_{ij}, which reduces productivity in the export functions, demand level A_j, country specific wage rates w_i and w_j, firm specific market power α and the different additional fixed costs f_{X_j} or f_{I_j}. The realizable profits through exports or duplicated production facility for different foreign markets determine the strategy choice. The intersection point of the two profit functions for each country represents a 'cut-off' point where the company switches strategy. In this crucial point the profits of both strategies are equal and so the firm is indifferent between them. The 'cut-off' point is established by equating the additional profit functions for export and FDI for each country, under the assumption of unit wages in all countries:[4]

$$f_{Ij} - f_{Xj} = A_j\left(a^{1-\epsilon}(1-\alpha)\left(\frac{1}{\alpha}\right)^{1-\epsilon} - (\tau_{ij}a)^{1-\epsilon}(1-\alpha)\left(\frac{1}{\alpha}\right)^{1-\epsilon}\right) \tag{3}$$

Rearranging, yields a critical demand level (market size) A_j^* in each country:

$$A_j^* = \frac{f_{Ij} - f_{Xj}}{a^{1-\epsilon}(1-\alpha)\left(\frac{1}{\alpha}\right)^{1-\epsilon}(1-\tau_{ij}^{1-\epsilon})}. \tag{4}$$

From equation (4) it immediately follows that the firm specific productivity influences the country specific 'cut-off'. A higher productivity $a^{1-\epsilon}$ decreases the critical market size. The difference in additional fixed costs $(f_{Ij} - f_{Xj})$ reflects differences in initial expenditures before one single unit of the brand is sold. If there is a huge difference, the foreign market has to be larger to earn higher profits through direct investment. An increase in transportation costs lowers the critical foreign demand level, indicating that smaller foreign markets might be served more profitably through local production.[5]

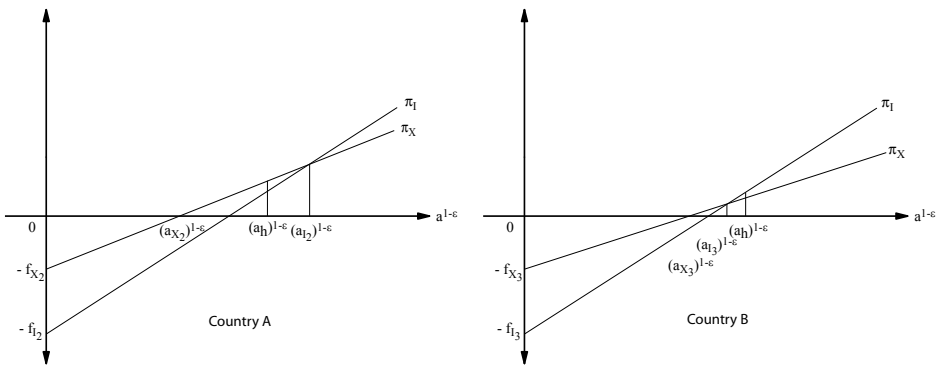
One can, for example, think of two exactly identical foreign countries with the only difference of one being farther away from the home country. In this case the best strategy, for a firm with given productivity, say $a_h^{1-\epsilon}$, could be to serve one market through exports and the other through FDI.

[4]Since export destination is not observed, we set $w_i = w_j = 1$ for simplicity.

[5]Note that equation (4) looks very similar to critical market size equations without heterogeneous firms see Head and Ries 2004, for an example.

Figure 1 illustrates the case where the export profit functions are different as a result of unequal distance and consequently different transportation costs. The profits from FDI are assumed to be equal in both. In this case the firm will decide to export its product to Country A and will build up a new production facility in Country B. Similar conclusions hold with respect to country size, or country specific fixed costs.

Figure 1: Profit Functions for Country A and Country B



3 Empirical model

The empirical analysis uses a bivariate probit model. The analysis is based on a large company data set (AMADEUS) for European firms, which provides information on whether a firm exports or not, and whether it runs foreign affiliates abroad. However, as in almost all firm level data sets, it remains unknown to which countries a firm exports. A company's turnovers through exports are not broken down into countries in the balance sheets. For this reason the empirical analysis is limited to testing the influence of firm and industry characteristics on the market serving strategies.

We apply an empirical model which is closely related to the above described theoretical model. Moreover, we check the robustness of the results using other empirical specifications which are able to capture other explanations for the foreign market serving strategy choice of companies. The first equation of the (parsimonious) baseline bivariate probit model specifies the probability that a firm i in industry k exports (ex) into foreign markets:

$$\begin{aligned}\text{ex}_{ik} = \beta_0 + \beta_1 \text{ log employees}_{ik} + \beta_2 \text{ productivity}_{ik} + \beta_3 \text{ herfindahl index}_k \\ + \beta_4 \text{ consolidated}_k + \beta_5 \text{ independence1}_{ik} + \beta_6 \text{ independence2}_{ik} \\ + \beta_7 \text{ independence3}_{ik} + \sum_{i=1}^{7} \beta_{7+i} \text{ industry dummy variables}_k + \epsilon_{ik}.\end{aligned} \tag{5}$$

The second specification measures the influence of the same explanatory variables on the probability, that a company becomes a MNE:

$$\begin{aligned}\text{mne}_{ik} = \gamma_0 + \gamma_1 \text{ log employees}_{ik} + \gamma_2 \text{ productivity}_{ik} + \gamma_3 \text{ herfindahl index}_k \\ + \gamma_4 \text{ consolidated}_k + \gamma_5 \text{ independence1}_{ik} + \gamma_6 \text{ independence2}_{ik} \\ + \gamma_7 \text{ independence3}_{ik} + \sum_{i=1}^{7} \gamma_{7+i} \text{ industry dummy variables}_k + \nu_{ik}.\end{aligned} \tag{6}$$

The first variable in the baseline specification of the empirical model is the number of employees in a company. This is a proxy for firm size and, therefore, proxies for the ability to cover fixed costs. Larger companies have more liquid funds and a higher collateral which allow for additional fixed costs to serve foreign markets.

As mentioned in Section 2, there is a higher probability for more productive firms investing directly abroad than for less productive firms. We measure labor productivity in terms of revenue per employee. According to theory we would expect that higher labor productivity increases the probability of using the direct investment possibility and decrease the probability of companies choosing only to export. Following Helpman et al. (2004), the marginal effect of the productivity variable should be positive for the FDI strategy and negative for the export strategy.

The last variable of special interest is market concentration. Market concentration provides information about the market power of companies and proxies the size of the mark-up. We measure market concentration using the Herfindahl index. Thereby, we assume that all countries in the sample share a common market.. It is derived from the firms in the sample, and thus, is only a proxy of the true market concentration and ranges from $\frac{1}{n}$ to 1. According to the model, companies in concentrated industries with high mark-ups will find it easier to pay the additional fixed costs for a direct investment.

Lastly, we add eight dummy variables for different industries to control for other unobserved industry specific effects.[6] We also control for differential effects between consolidated and unconsolidated companies and different levels of autonomy of companies. Hereby, we apply Bureau van Dijk's independence indicator , which characterizes a company's degree of independence with regard to its shareholders. Bureau van Dijk classifies all firms according to four different independence levels, namely very independent, independent, not independent and unknown.

The present model of horizontal MNEs is not the only one that explains the relationship of exports and FDI at the firm level. Saggi 1998 and Rob and Vettas 2003 show that in a given market, uncertainty about demand could also lead to a complementary use of both strategies in horizontally integrated MNEs. In this case, FDI under lower variable costs is used to satisfy proven demand and exports to satisfy uncertain demand. These models suggest that MNEs should be older than exporters on average as they gained experience in foreign markets. In turn, exporters are expected to be older on average compared to purely national firms. A positive impact of age on FDI activity has also been found by Pradhan 2004, who explains the positive age effect by an increasing stock of intangible assets in the course of a firm's growth process. Therefore, we include firm age as an additional control variable where its marginal effect is expected to be positive (negative) for the probability of the FDI (export) strategy.

As an additional robustness check we include a variable that measures a company's relationship to other companies. It takes on the value 1 if a company is an affiliate of another and 0 otherwise. We expect that an affiliate will not become a multinational company itself and will use the export strategy to serve foreign countries (export platform FDI; see Baltagi, Egger and Pfaffermayr 2007 and Ekholm, Forslid and Markusen 2007 for example).

As described in the introduction, vertical division of production might also lead to a complementary use of both strategies. Venables (1996, 1999) and Markusen and Venables (1998) show that companies will use both strategies if there are increasing returns in the production of each component of the final good.

For these reasons and to strengthen the empirical evidence from our baseline specification we additionally include company's age and its relationship

[6] The dummy variables are related to the NACE Revision 1.1 classification.

to other companies in the base model described by (5) and (6) and exclude potentially vertically integrated MNEs from our sample.[7]

4 Data

Our data set contains a large set of European companies and allows to analyze the export and FDI decisions at the firm level. The 'AMADEUS Top 250,000' database offers financial statements, profit and loss accounts and information of a company's organizational structure for the largest surviving companies in Europe. The quality of reported data varies intensely and so we can collect information on the export and MNE status for 70,471 firms.

We only include firms which report their exporter status to avoid misclassification of missing volumes. Multinational companies are defined by being a shareholder of at least one foreign subsidiary. Table 1 shows the chosen market serving strategies of companies in the data set.[8]

Table 1: MNEs and Exporters

	Multinationals		
Exporter	No	Yes	Total
No	4,366	2,754	7,120
Yes	17,800	45,551	63,351
Total	22,166	48,305	70,471

The companies in our data set are located in 10 European countries. The spectrum ranges from the United Kingdom and France as leading economic areas to the thirty thousand resident princedom Liechtenstein. Table 2 reports the quantity of companies per country. The vast majority are located in the United Kingdom or France. Together these make up approximately 91.5% of the data set.

An analysis of variances and Kruskal-Wallis tests for the log values of the variables age, number of employees and productivity are reported in Table 3. Companies which use both strategies build the reference category for the variance analysis. According to the Kruskal-Wallis tests the four

[7] According to the inclusion of firms age, Aw and Lee (2008) in a recent empirical study, incorporate company's age in a Helpman et al. (2004) type model 'since anecdotal evidence suggests that firms first enter global markets by exporting and then become multinationals later'.

[8] For example, 4,366 companies only serve their home markets in our sample.

Table 2: Number of Companies per Country

Country	Frequency	Percent
Croatia	253	0.004
Cyprus	8	0.000
France	35,244	0.500
Greece	539	0.008
Iceland	62	0.001
Liechtenstein	32	0.000
Slovenia	20	0.000
Sweden	2,203	0.031
Switzerland	2,962	0.042
United Kingdom	29,148	0.414
Total	70,471	100.00

Table 3: Results of the Descriptive Statistics (Selection of Explanatory Variables)

	Employees[a]	Productivity[a]	Age[a]
Domestic	-2.368^{***} (0.032)	0.746^{***} (0.024)	-0.284^{***} (0.130)
Export	-2.017^{***} (0.018)	0.305^{***} (0.014)	-0.393^{***} (0.007)
FDI	-1.617^{***}(0.040)	0.391^{***} (0.030)	-0.207^{***} (0.016)
Both	–	–	–
overall mean	8.125^{***} (0.010)	5.121^{***} (0.007)	3.632^{***} (0.004)
	$\chi^2(3)$	$\chi^2(3)$	$\chi^2(3)$
Kruskal-Wallis[b]	$13,819.467^{***}$ (0.000)	$1,795.671^{***}$ (0.000)	$2,952.940^{***}$ (0.000)
Observations	$70,471$	$70,471$	$70,471$

Notes: Standard errors are given in parenthesis. The symbol *** stands for 1% significant.
[a] Values measured in Logs.
[b] p- values in paranthesis.

groups of companies (only domestically orientated companies, exporters, 'direct investors' and mixed-strategy user) are significantly different. The χ^2 test, for the hypothesis that companies making up one homogeneous group, is strongly rejected for two variables used in the baseline specification (employees and productivity) as well as for company's age. The analysis of variance suggests that companies which use both strategies are the largest and the oldest companies. The youngest seem to be domestically orientated. The analysis of variance for productivity does not provide clear-cut results. The only domestically acting companies seem to be the most productive ones, which clearly contradicts the theoretical model of horizontal MNEs

5 Empirical Estimation

We estimate the baseline bivariate probit model based on equations (5) and (6) using a Maximum Likelihood approach, taking possible correlation between the error terms ϵ_{ik} and ν_{ik} into account (see Maddala 1983 and Greene 2003). Column (1) of Table 4 presents the estimation results for the baseline. The number of employees as a measure of firm size and productivity of companies increase the probability of serving foreign markets through FDI significantly. This is also in line with previous research (see Wagner 2006). The effect of size is positive on both strategies, but larger for the probability of investing abroad.

Finally, the Likelihood-ratio test of $\rho = 0$ rejects the restricted model and approves correlation in the error terms. Hence, the two strategies are not used exclusively, as suggested by the two-country model in Helpman et al. 2004, a bivariate probit is appropriate, rather than a single equation model like the logit model that treats these strategies as exclusive options.

In the next step, we explore the robustness of the baseline estimates and include firms' age and the its relationship to other companies as additional explanatory variables. Age seems to play a crucial role for the market serving strategy. Column (2) of Table 4 shows that older firms more probably serve foreign markets using the FDI strategy, while the export strategy is less likely. Companies which are affiliates themselves tend to use the export strategy and are less likely engaged in FDI, which supports export platform FDI as a mode of serving other foreign markets. However, the estimated parameters of the baseline specification are hardly affected by this model extension although a Wald-test tends to support the model where company's age and the relationship to other companies are included, highlighting its additional explanatory power for the FDI versus export decision.

Since, the results of the theoretical model are only valid for horizontal FDI we exclude potentially vertical MNEs to evaluate the robustness of the empirical results. For this purpose we estimate the full empirical model, only for lone standing firms and corporate groups, where at least 50 percent (75 percent) of all subsidiaries operate in the same nace - 2 digit industry of the parent company and exclude all other national corporate groups and MNEs from the sample. The corresponding results are reported in columns (3) and (4) of Table 4. Even though the data sample decreases to 39,510 (20,616) included companies, the results of the bivariate probit estimation concerning

Table 4: Bivariate Probit Estimation Results

	(1)		(2)		(3)		(4)	
Explanatory Variable								
Exporter								
Employees	0.126^{***}	(0.004)	0.132^{***}	(0.004)	0.132^{***}	(0.006)	0.051^{***}	(0.008)
Productivity	-0.017^{***}	(0.005)	-0.016^{***}	(0.005)	-0.020^{***}	(0.006)	-0.114^{***}	(0.010)
Herfindahl	1.641^{**}	(0.807)	1.441^{*}	(0.792)	2.254^{*}	(1.238)	2.674^{**}	(1.318)
Consolidated	0.426^{***}	(0.017)	0.422^{***}	(0.017)	0.362^{***}	(0.021)	0.359^{***}	(0.028)
Age	-		-0.040^{***}	(0.009)	-0.037^{***}	(0.010)	0.061^{***}	(0.016)
Affiliate	-		0.413^{***}	(0.025)	0.321^{***}	(0.029)	0.271^{***}	(0.035)
Industry Dummies[a]	$2,165.350^{***}$	(0.000)	$2,004.230^{***}$	(0.000)	$1,422.950^{***}$	(0.000)	$1,071.670^{***}$	(0.000)
Independence Dummies[a]	850.380^{***}	(0.000)	941.810^{***}	(0.000)	701.310^{***}	(0.000)	338.360^{***}	(0.000)
Multinational								
Employees	0.277^{***}	(0.003)	0.259^{***}	(0.003)	0.260^{***}	(0.005)	0.283^{***}	(0.007)
Productivity	0.089^{***}	(0.004)	0.078^{***}	(0.004)	0.011^{***}	(0.005)	0.107^{***}	(0.008)
Herfindahl	-1.279^{***}	(0.477)	-1.017^{***}	(0.479)	-0.919^{*}	(0.547)	-0.021	(0.551)
Consolidated	0.281^{***}	(0.014)	0.306^{***}	(0.014)	0.331^{***}	(0.018)	0.311^{***}	(0.023)
Age	-		0.162^{***}	(0.007)	0.126^{***}	(0.009)	0.072^{***}	(0.012)
Affiliate	-		-0.303^{***}	(0.017)	-0.180^{***}	(0.021)	-0.350^{***}	(0.026)
Industry Dummies[a]	$2,645.630^{***}$	(0.000)	$2,705.040^{***}$	(0.000)	$1,230.550^{***}$	(0.000)	782.580^{***}	(0.000)
Independence Dummies[a]	$1,524.330^{***}$	(0.000)	$1,233.850^{***}$	(0.000)	958.010^{***}	(0.000)	397.130^{***}	(0.000)
ρ[b]	0.241^{***}	(0.009)	0.267^{***}	(0.009)	0.332^{***}	(0.010)	0.297^{***}	(0.015)
LR- test of $\rho = 0[\chi^2(1)]$[b]	689.921^{***}	(0.000)	792.085^{***}	(0.000)	492.589^{***}	(0.000)	342.800^{***}	(0.000)
Log likelihood	$-52,433.706$		$-51,789.632$		$-33,872.011$		$18,899.189$	
Observations	$70,741$		$70,741$		$39,510$		$20,616$	

Notes: Standard errors are given in parenthesis. The symbols *, ** and *** stand for significant at the 10%, 5% and 1% level. Column (1) shows the results for the baseline estimation, while column (2) corresponds to the extended bivariate probit specification. Columns (3) and (4) report the results for the restricted data sets where at least 50 percent (75 percent) of the subsidiaries operate in the same 2 digit industry as the parent company.

[a] Industry and Independence Dummies are not reported. The influence of industry characteristics and independence of the shareholder firm are tested running two joint tests. Test statistics come from a $\chi^2(8)$ distribution for industry characteristics and a $\chi^2(3)$ distribution for independence. P-values in parenthesis.

[b] P-values in parenthesis.

the variables of most interest (productivity and firm size) remain robust (in terms of significance and direction of influence). The effect of age on the probability of exporting in the most restrictive sample changes, indicating that older horizontally integrated corporate groups and lone standing firms are more likely to serve foreign markets via exports and FDI.

To evaluate the effects of a change in the explanatory variables on the export and/or FDI decisions quantitatively, we estimate marginal effects on the four options to combine the export and FDI decision for all four bivariate probit models. Companies can abstain from using both strategies, can apply the export- or FDI strategy or decide to do both. Table 5 reports our results.

Column (1) shows the results for the baseline estimation, while the marginal effects in column (2) correspond to bivariate probit specification (2) in Table 4. Columns (3) and (4) of Table 5 report the marginal effects for the restricted data sets where at least 50 percent (75 percent) of the subsidiaries operate in the same 2 digit industry as the parent company. A marginal expansion of the number of employees and company's age decreases the probability of solely serving the domestic market. The impact of a marginal increase of productivity on the probability of only serving home markets is mixed. For the baseline specification the effect is negative, but becomes zero, if vertically integrated corporate groups are excluded from the sample.

The marginal effects on the probability of serving foreign countries only through exports supports the substitution hypothesis. A small increase in productivity leads to a lower probability of only doing exports, in all specifications and sample sizes. The negative productivity effect is more pronounced for horizontally integrated corporations supporting the Helpman et al. (2004) results. A rise in the number of employees or age reduces the probability of exporting abroad.

Changes in the core variable productivity has a positive influence on the probability of becoming a direct investor only. However, the marginal effects are considerably smaller for these firms than those for exporters. But as expected, the productivity effect tends to increase if possibly vertically integrated enterprises are excluded from the sample. The marginal productivity effect in column (4) is 2.5 times larger than the corresponding effect in the baseline specification in column (1). However, the impact still remains relatively small. Surprisingly, firm size tends to negatively influence the de-

Table 5: Marginal Effects Estimation after Bivariate Probit

	(1)		(2)		(3)		(4)	
Explanatory Variable								
			Domestic Firm					
Employees	-0.013^{***}	(0.000)	-0.012^{***}	(0.000)	-0.019^{***}	(0.001)	-0.016^{***}	(0.001)
Productivity	-0.001^{***}	(0.000)	-0.001^{***}	(0.000)	-0.002^{***}	(0.001)	0.009	(0.001)
Herfindahl	-0.043	(0.040)	-0.041	(0.040)	-0.145	(0.099)	-0.307^{**}	(0.154)
Age	-		-0.002^{***}	(0.000)	-0.001	(0.001)	-0.010^{***}	(0.001)
			Exporter only					
Employees	-0.075^{***}	(0.000)	-0.069^{***}	(0.001)	-0.079^{***}	(0.002)	-0.097^{***}	(0.003)
Productivity	-0.027^{***}	(0.001)	-0.023^{***}	(0.001)	-0.040^{***}	(0.002)	-0.052^{***}	(0.003)
Herfindahl	0.446^{***}	(0.143)	0.359^{***}	(0.139)	0.492^{**}	(0.206)	0.316^{**}	(0.242)
Age	-		-0.048^{***}	(0.002)	-0.062^{***}	(0.002)	-0.019^{***}	(0.005)
			FDI only					
Employees	-0.003^{***}	(0.000)	-0.003^{***}	(0.000)	-0.001^{**}	(0.000)	0.007^{***}	(0.001)
Productivity	0.004^{***}	(0.000)	0.003^{***}	(0.000)	0.005^{**}	(0.001)	0.010^{***}	(0.001)
Herfindahl	-0.158^{**}	(0.064)	-0.133^{**}	(0.060)	-0.200^{**}	(0.094)	-0.156^{**}	(0.078)
Age	-		0.007^{***}	(0.001)	0.007^{***}	(0.001)	-0.001	(0.001)
			Both Strategies					
Employees	0.090^{***}	(0.001)	0.085^{***}	(0.001)	0.100^{***}	(0.002)	0.106^{***}	(0.003)
Productivity	0.025^{***}	(0.001)	0.021^{***}	(0.001)	0.036^{***}	(0.002)	0.032^{***}	(0.003)
Herfindahl	-0.245	(0.160)	-0.184	(0.156)	-0.147	(0.216)	0.148	(0.220)
Age	-		0.044^{***}	(0.002)	0.041^{***}	(0.003)	0.030^{***}	(0.005)
Observations	70,471		70,471		39,510		20,616	

Notes: Standard errors are given in parenthesis. The symbols *, ** and *** stand for significant at the 10%, 5% and 1% level. Column (1) shows the results for the baseline estimation, while column (2) corresponds to the extended bivariate probit specification. Columns (3) and (4) report the results for the restricted data sets where at least 50 percent (75 percent) of the subsidiaries operate in the same 2 digit industry as the parent company.

cision to only use the FDI strategy, but the effect disappears for horizontal enterprises.

Finally, companies could use both strategies to serve foreign markets. As discussed in the theoretical section, companies might use the best strategy for each foreign market and that might be export in some cases, direct investment in others or a combination of both. The effect of a marginal change in productivity stays positively significant in all four specifications and it has a stronger impact on the probability of using both strategies than on the probability of only investing abroad. Companies which become older or larger are more likely to serve foreign markets through a combination of exports and FDI. Interestingly, competition within industries measured via the Herfindahl index seems to play an ambiguous role for market serving strategies, since it tends to positively (negatively) influence the probability to become an exporter (a MNE) but has no impact on the probability of being a domestic firm or a mixed strategy user.

To sum up, our estimation results provide evidence for the simultaneous use of export and FDI strategies. Nevertheless, the estimates of marginal effects on the likelihood of the exclusive use of only exports or FDI tend to support the Helpman et al. (2004) results concerning a substitutional relationship between both strategies. An increase in productivity negatively influences the probability of only exporting to foreign markets and increases the likelihood of only investing abroad. This is most pronounced for the very restricted sample for only horizontally integrated corporations and lone standing firms.

6 Conclusion

In this paper the decision of firms on how to serve foreign markets is at issue. We apply a Helpman et al. (2004) type model that explains, in a multi-country setting, why firms both export and run subsidiaries abroad. Distant markets, which imply high transportation costs, may be served by subsidiaries abroad, while markets nearby by exports. We provide empirical evidence for the determining firm characteristics (such as productivity and fixed plant setup costs) of this strategy choice. The estimation results support Helpman et al. (2004) indicating that productivity determines the export versus FDI decision. The estimated marginal effects for the group of horizontally integrated corporations also supports the main result of Help-

man et al. (2004) which is associated with a substitutional relationship between both strategies. Besides this, the empirical estimation results show that firms are more likely to be MNEs the older they are. Our estimates also suggest that the most horizontally integrated enterprises do both, export and produce locally abroad, which can explain a complementary relationship.

References

Aw, B. Y. and Lee, Y. (2008). Firm Heterogeneity and Location Choice of Taiwanese Multinationals. *Journal of International Economics* **75**(1): 167–179.

Baldwin, R. (2005). Heterogeneous Firms and Trade: Testable and Untestable Properties of the Melitz Model. NBER Working Paper 11471. National Bureau of Economic Research, Cambridge, Mass.

Baltagi, B. H., Egger, P. and Pfaffermayr M. (2007) Estimating Models of Complex FDI: Are There Third-Country Effects?. *Journal of Econometrics* **140**(1): 260–281.

Brainard, S. L. (1997). An Empirical Assessment of the Proximity-Concentration Tradeoff between Multinational Sales and Trade. *American Economic Review* **87**(4): 520–544.

Ekholm, K., Forslid, R. and Markusen J. R. (2007). Export-Platform Foreign Direct Investment. *Journal of the European Economic Association* **5**(4): 776–795.

Girma, S., Kneller, R. and Pisu, M. (2005). Exports versus FDI: An Empirical Test. *Review of World Economics/Weltwirtschaftliches Archiv* **141**(2): 193–218.

Greenaway, D. and Kneller, R. (2007). Firm Heterogeneity, Exporting and Foreign Direct Investment. *Economic Journal* **117**(517): F134–F161.

Greene, W. H. (2003). *Econometric Analysis*. Fifth edn. Upper Saddle River: Pearson Prentice Hall.

Head, K. and Ries, J. (2003). Heterogeneity and the FDI versus Export Decision of Japanese Manufacturers. *Journal of the Japanese and International Economies* **17**(4): 448–67.

Head, K. and Ries, J. (2004). Exporting and FDI as Alternative Strategies. *Oxford Review of Economic Policy* **20**(3): 409–423.

Helpman, E. (2006). Trade, FDI an the Organization of Firms. *Journal of Economic Literature* **44**(3): 589–630.

Helpman, E. and Krugman, P. R. (1985). *Market Structure and Foreign Trade. Increasing Returns, Imperfect Competition, and the International Economy*. Brighton: Wheatsheaf Books LTD.

Helpman, E., Melitz, M. and Yeaple, S. (2004). Export versus FDI with Heterogeneous Firms. *American Economic Review* **94**(1): 300–316.

Maddala, G. S. (1983). *Limited - Dependent and Qualitative Variables in Econometrics*. New York: Cambridge University Press.

Markusen, J. R. (2002). *Multinational Firms and the Theory of International Trade*. Cambridge: MIT Press.

Markusen, J. R. and Venables, A. J. (1998). Multinational Firms and the New Trade Theory. *Journal of International Economics* **46**(2): 183–203.

Markusen, J. R. and Venables, A. J. (2000). The Theory of Endowment, Intra-Industry and Multi-National Trade. *Journal of International Economics* **52**(2): 209–234.

Melitz, M. J. (2003). The Impact of Trade on Aggregate Industry Productivity and Intra-Industry Reallocations. *Econometrica* **71**(6): 1695–1725.

Pradhan, J. P. (2004). The Determinants of Outward Foreign Direct Investment: A Firm-level Analysis of Indian Manufacturing. *Oxford Development Studies* **32**(4): 619–639.

Rob, R. and Vettas, N. (2003). Foreign Direct Investment and Exports with Growing Demand. *Review of Economic Studies* **70**(3): 629–648.

Saggi, K. (1998). Optimal Timing of FDI Under Demand Uncertainty. *in* J.-L. Mucchielli, P. J. Buckley and V. V. Cordell (eds.), Globalization and Regionalization: Strategies, Policies and Economic Environments. Binghamton: The Harworth Press.

Venables, A. J. (1996). Equilibrium Locations in Vertically Linked Industries. *International Economic Review* **37**(2): 341–359.

Venables, A. J. (1999). Fragmentation and Multinational Production. *European Economic Review* **43**(4-6): 935–945.

Wagner, J. (2006). Exports, Foreign Direct Investment, and Productivity: Evidence from German Firm Level Data. *Applied Economics Letters* **13**(6): 347–349.