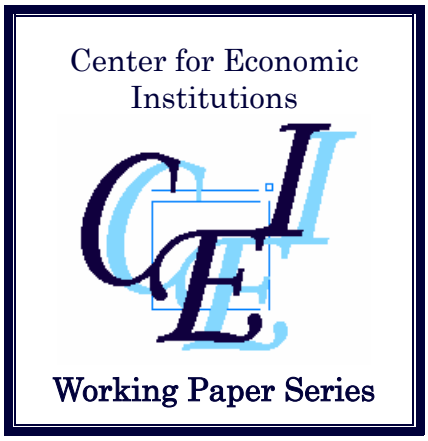
Center for Economic Institutions

Working Paper Series

CEI Working Paper Series, No. 2006-7

"Dissecting FDI"

Jörn Kleinert
Farid Toubal



Institute of Economic Research
Hitotsubashi University
2-1 Naka, Kunitachi, Tokyo, 186-8603 JAPAN
Tel: +81-42-580-8405
Fax: +81-42-580-8333
e-mail: cei-info@ier.hit-u.ac.jp

Dissecting FDI ⋆

Jörn Kleinert [a] and Farid Toubal [b]

[a] *Department of Economics, Eberhard-Karls-University of Tübingen, Germany*

[b] *Centre d'Economie de la Sorbonne, University of Paris 1 Panthéon-Sorbonne, CNRS*

Abstract

This paper investigates the importance of firm heterogeneity for our understanding of the aggregate volume of cross-country multinational sales. Recent theoretical literature points out a sorting out firms with respect to their internationalization strategy according to their productivity. Using the firm level data from German firms' activities, we find a strong effect of firms' size on internationalization pattern. Moreover, we show that most of variation of the aggregate volume of multinational sales is due to variation in the number of firms participating in the market.

Keywords: Gravity equation, multinational firms, heterogeneity.

JEL classification: F23, F12, C21

⋆ This paper has partly been written as Jörn Kleinert was visiting the *Hitotsubashi University* Tokyo, Japan. He thanks *Hitotsubashi University* for the hospitality. We also thank the *Deutsche Bundesbank* for hospitality and access to the firm-level database "Micro Data Direct Investment" (Midi). The project has benefited from financial support through the German Science Foundation under the project Multinational Enterprises: New Theories and Empirical Evidence from German Firm-Level Data (BU 1256/6-1). We are of course solely responsible for any remaining errors.

1 Introduction

Recent empirical papers have documented huge heterogeneity among firms within industries. Firms which differ in productivity and size show pronounced differences in their engagement in international trade. Bernard and Jensen (1995, 1999a, 1999b), Bernard, *et al.* (2005), Clerides, *et al.* 1998, and Eaton *et al.* (2005) showed that the bulk of international trade tends to be conducted by a small number of exporters. Research on firm heterogeneity and firms' international activities has mainly focused on international trade, although few contributions have also considered activities of multinational firms. In an extension of the trade literature, Helpman, *et al.* (2004), Girma, *et al.* (2004), Head and Ries (2003) analyzed multinational firms. They show that the probability that a firm serves foreign market through affiliates' production increases with its productivity. Theoretical and empirical results point to a sorting of firms with respect to their internationalization strategy. The most productive firms engage in production abroad while the least efficient firms operate only in the domestic market. Firms with intermediate level of productivity produce at home and serve the foreign market through exports.

There are however almost no systematic studies on the characteristics of multinational firms' activities. Yeaple (2005) reports evidence from US multinational manufacturers. He uses a confidential survey on multinational manufacturing firms from the United States in 1994. His empirical findings are in line with the theoretical prediction of Helpman, Melitz, and Yeaple (2004). Helpman, Melitz, and Yeaple's theoretical model incorporates heterogeneous firms into a general equilibrium framework. The model allows to examine the huge heterogeneity found in firm-level data. We therefore use a slightly simplified version of this framework in our theoretical analysis.

We derive four propositions from this theoretical model. They are particulary linked with the sorting of firms with respect to their productivity. In addition, we explore the effect of changes in market size and/or trade costs on the activities of multinational firms. Firms might react to exogenous changes through entry and exit (extensive margin) or through the adjustment of sales of existing firms (intensive margin). We then test the predictions using firm-level data on German multinational activities in 2002. The database includes information on all German parent and their foreign affiliates in more than 200 countries. We find strong support for all four propositions.

The rest of the paper is organized as follow. In section 2, we present descriptive firm-level statistics of German firms' foreign affiliates. In section 3, we derive the propositions from a model with heterogenous firms. We test these propositions in section 4. We conclude in section 5.

2 Descriptive Statistics

2.1 Data

This paper exploits a confidential firm-level database which provide information on German multinational activities. The *MIDI (MIcro data base Direct Investment)* dataset of the *Deutsche Bundesbank* provides a detailed breakdown of the foreign assets and liabilities of German multinational firms abroad (Lipponer, 2006). German foreign direct investment is defined as the direct or indirect ownership or control by a single German entity of at least ten percent of the voting securities of an incorporated foreign firm or the equivalent interest in an unincorporated foreign firm. The database comprise information on all foreign affiliates of German multinational firms.

The comprehensive database holds the balance sheets data of German foreign affiliates, including their sales, employment and total assets in each of over 200 country destinations. It also includes information on the sector of activity of parent firm and affiliate at NACE rev-1 two-digit level. The data covers foreign affiliates activities between 1989 and 2002. However, information for the parent company is only available for 2002.

Some multinational firms own more than one affiliate in a particular sector of a particular country. To come closer to theory which models single-affiliate firms and make activities of many-affiliates parents more comparable to single-affiliates parents, we aggregate the affiliate level data sales and employment for each (*i*) parent company, (*ii*) sector, (*iii*) country and (*iv*) year but keep the information about the number of affiliates of each parent firm.

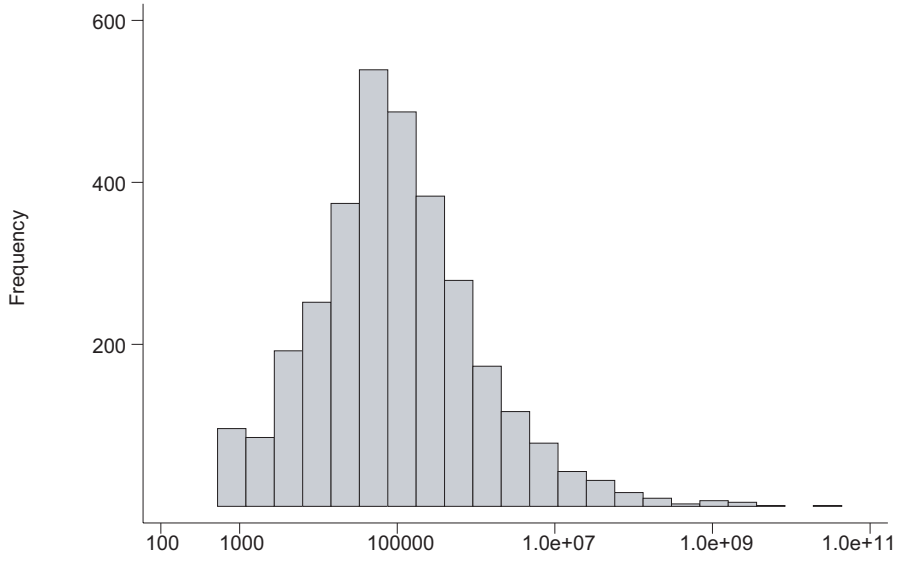
2.2 Size and International Activities

The database includes 6,178 German parent firms with total sales in Germany of 1,150 Billion Euro in 2002. The sample counts 1,748 parent firms in manufacturing with sales in Germany of 954 Billion Euro. While only 0.21% of all German firms are multinational firms, they account for about 27% of total sales in Germany. Multinational firms are large firms, at least on average.

One might expect a priori little heterogeneity within the group of multinational firms because multinational firms are not randomly drawn from a distribution of all firms. Instead, firms select themselves into this group. Thus the within group heterogeneity might be expected to be small. However, as shown in Figure 1, we find huge heterogeneity within the group of multinational firms. German multinational firms' distribution is right skewed. While it is often argued in the literature that large firm are Pareto distributed, the shape shown

in Figure 1 shows that the distribution is not too far from log-normal. From this very crude inspection, the distribution of German multinational firms does not differ from other firm size distributions (Sutton 1997, Cabral and Mata 2003).

Fig. 1. German Multinational Firms' Turnover, (2002, in Thousand Euro)



Source: MIDI, authors' computation.

Table 1 contains information about German parent firms. We report information on the number of German parent firms, the number of foreign affiliates, the volume of German multinational sales and their employees abroad according to the size distribution of German parent firms. We measure this size by their total assets in 2002. Table 1 shows a high concentration of foreign affiliates' activities on few parent firms. Large German multinationals own on average relatively more and larger affiliates. They employ more labor and have higher sales.

In 2002, the largest German multinational parent firms, which represent 1% of the total number of German parents, owns 10% of the number of foreign affiliates. They account for 29.3% of total German multinationals' foreign sales

Table 1
Quantile of German Parent Companies' Total Assets (2002, percent of the total into parentheses)

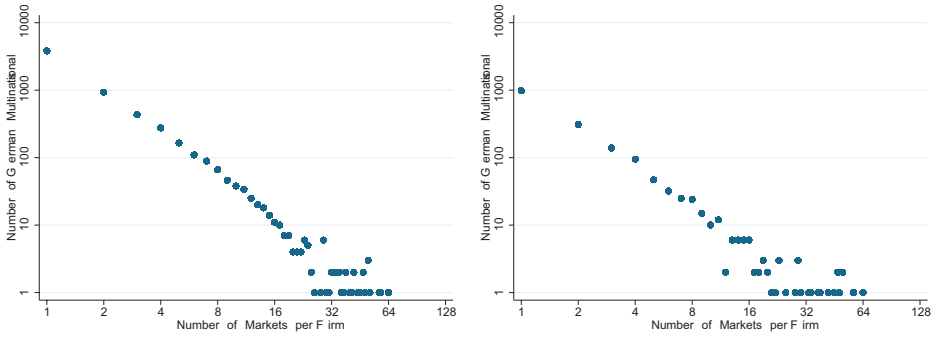
Decile	Parent companies	Foreign affiliates	Foreign Sales (1000 Euro)	Foreign Employment
1	1454	1980	6.75E+07	334151
	(23.5)	(8.8)	(4.6)	(7.0)
2	1352	2282	4.10E+07	267023
	(21.9)	(10.1)	(2.8)	(5.6)
3	981	2188	4.15E+07	220928
	(15.9)	(9.7)	(2.8)	(4.7)
4	739	2313	5.19E+07	282535
	(12.0)	(10.2)	(3.5)	(6.0)
5	605	2307	6.59E+07	373929
	(9.8)	(10.2)	(4.5)	(7.9)
6	382	2335	8.20E+07	348786
	(6.2)	(10.3)	(5.6)	(7.3)
7	315	2302	1.41E+08	501531
	(5.1)	(10.2)	(9.6)	(10.7)
8	201	2337	2.51E+08	770814
	(3.3)	(10.3)	(17.1)	(16.2)
9	87	2290	2.99E+08	805698
	(1.4)	(10.1)	(20.3)	(17.0)
10	62	2262	4.31E+08	845493
	(1.0)	(10.0)	(29.3)	(17.8)
Total	6178	22596	1.47E+09	4750888

Source: MIDI (2002), authors' computation.

abroad, and make up for 17.8% of German multinationals' foreign employment. Table 1 shows moreover that most of German multinational firms are of smaller size. The three first deciles comprise almost 2/3 of the total number of parent firms. These firms account for only 10% of total German multinational sales abroad and 17.3% of German multinationals' foreign employment. The 62 largest German parent firms own on average 36 affiliates. This is much more than the average 1.4 affiliates which are hold by parent firms in the first decile. Table 1 shows that the larger the German firms, the more foreign affiliates they own.

In 2002, about 62% of the total number of German multinational parent firms

own affiliates in exactly one market. The share of the parent firms that own affiliates in two to nine countries amounts about 34%. About 4% for the parents firms that invest in more than 10 markets. Thus, German multinational firms are also heterogenous with respect to their degree of internationalization as shown in Figure 2. We illustrate the degree of internationalization of all German multinationals and those from the manufacturing sectors in this figure.



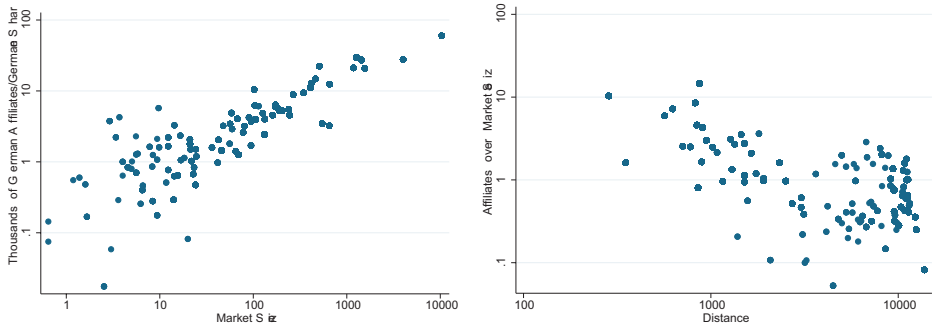
(a) Total (b) Manufacturing

Fig. 2. Market per Firms, 2002

Each panel of Figure 2 represents the frequency with which firms are active in different markets. This frequency decreases. Most firms concentrate their foreign activities in one market while only a few are global players.

About 20% of the total number of German parent firms own affiliates in France, which is a large and close-by market. The literature using gravity equation states that the number of affiliates in a foreign market increases in the size of this market and decreases in bilateral distance. We show this relationships in Figure 3. We present in panel (a) the correlation between the number of firms weighted by their market share in a particular market and the size of this market. We illustrate in panel (b) the correlation between the number of affiliates weighted by the market size against distance from Germany.

Fig. 3. Number of German firms' foreign affiliates in 2002 and the effect of



(a) Market Size (b) Distance

We show in panel (a) a positive correlation between the number of firms weighted by their market share in a particular market and the size of this market. Their results can thus be generalized to multinational firms. The number of German firms normalized by German market share increases systematically with market size, but with an elasticity less than one. Panel (b) shows a negative correlation between the number of affiliates weighted by the market size and distance from Germany. The picture looks very similar to Eaton *et al.* (2005) results in their study on French exporters.

3 Firm Heterogeneity in a Proximity-Concentration Model

Productivity differences are the most likely candidate causing this huge heterogeneity within the group of multinational firms. Helpman *et al.* (2004) were first to incorporate productivity differences in a model of multinational firms. In their model, each firm has a specific level of productivity that the firm draws at entry from a common distribution. In our theoretical part, we follow the notation of Helpman *et al.* and define the productivity level as $1/a_k$ where a_k denotes the marginal cost of production of a firm k. Market structure is monopolistic competitive. Profit maximization leads therefore to a price that is a fixed markup over marginal cost. Thus, a firm k sets its firm-specific pro-

ducer price to $p_k = a_k/\rho$, where ρ is the degree of differentiation between products. ρ is assumed to be equal for all firms. Equation (1) described the optimal quantity x_{kij} sold in the sector i of the foreign country j by firm k.

$$x_{kij} = (p_{kj}^h)^{-\sigma} Y_{ij} P_{ij}^{\sigma-1} \tag{1}$$

where $\sigma = 1/(1-\rho)$. P_{ij} denotes the price index in sector i of country j. Y_{ij} denotes total demand in sector i of country j. p_{kj}^h is the price of firm k selling in market j. The superscript h, $h = Ex, MNE$, indicates respectively whether a firm is an exporter or produces abroad. A firm can choose between both channel. Consumer prices of good k that is exported from a firm in another country l, p_{kj}^{Ex} include bilateral iceberg trade costs, τ_{lj}, between the home country l and sales market j. Because the same wage prevails in all countries and labor is the only factor of production, firms produce abroad at the same marginal costs as at home. Hence, the prices of good k produced abroad are the same as in the home country. Thus, firm k's good's price in country j are higher if the firms exports it goods from l than if firm k produces in country j. The decision between exporting and producing abroad depends therefore on the distance costs between j and l. Yet, the decision depends also on firm's productivity level $1/a_k$. Substitute the price in equation (1), to see that more productive firms have higher sales in the foreign market.

Proposition 1: *A more productive firm owns a foreign affiliate that has larger sales.*

Each firm compares the profit related to each mode of entry in market j. The firms that have a higher productivity level than $1/a_j^{Ex}$ are active in this market and earn positive profit. Firms that have a productivity level equal to $1/a_j^{MNE}$ are indifferent between exporting and producing abroad because both strategies yield the same profit. Firms with a productivity level higher

than $1/a_j^{MNE}$ produce in country j and have higher profits than firms with a lower productivity level that export to j. We use the zero-profit conditions to derive the critical marginal cost levels (a) for a firm that produces only for the home market (b) for an exporting firm and (c) for a firm that produces abroad. This is given in equation (2).

$$\left(a_{il}^{Dom}\right)^{1-\sigma} \frac{Y_{il}(1-\rho)}{P_{il}^{\sigma-1}\rho^{1-\sigma}} = f_i^{Dom} \tag{2a}$$

$$\left(a_{ij}^{Ex}\tau_{lj}\right)^{1-\sigma} \frac{Y_{ij}(1-\rho)}{P_{ij}^{\sigma-1}\rho^{1-\sigma}} = f_{ij}^{Ex} \tag{2b}$$

$$\left(a_{ij}^{MNE}\right)^{1-\sigma} \left(1-\tau_{lj}^{1-\sigma}\right) \frac{Y_{ij}(1-\rho)}{P_{ij}^{\sigma-1}\rho^{1-\sigma}} = f_{ij}^{MNE} - f_{ij}^{Ex} \tag{2c}$$

We define $A = \frac{Y_{ij}(1-\rho)}{P_{ij}^{\sigma-1}\rho^{1-\sigma}}$ and insert (2b) in (2c). Rearranging terms yields equation 3, which shows that the most productive firms produce abroad.

$$\left(a_{ij}^{MNE}\right)^{1-\sigma} A - f_{ij}^{MNE} = \left(\left(a_{ij}^{MNE}\tau_{lj}\right)^{1-\sigma} - \left(a_{ij}^{Ex}\tau_{lj}\right)^{1-\sigma}\right) A \tag{3}$$

To see this, note that the left hand side must be non-negative, because it expresses the profits of the multinational firm. Profits cannot be negative because we assume free exit. Thus, the right-hand side must be non-negative as well which requires $a_{ij}^{MNE} \leq a_{ij}^{Ex}$.

Proposition 2: *(a) a firm from country l that exports to country j is less productive than a firm from country l that produces in country j, (b) country j sales of an exporter from country l are smaller than country j sales of an affiliate from a l- based multinational firm that produces in country j.*

Proposition 2 deals with differences between exporters and multinational firms from the same home country which are active in the same host country. Next we turn to the decision of one particular firm concerning its optimal strategy for different host countries. If fixed costs f_{ij}^{MNE} and f_{ij}^{Ex} in (2) differ between countries, the decision of firm k differs between countries. Yet, more productive

firms are more likely to establish a foreign affiliate in any country. Thus, adding up the foreign affiliates of firm k over all countries, we have that more productive firms are likely to produce in more foreign countries.

Proposition 3: *A more productive firm owns a larger number of foreign affiliates.*

From the critical marginal cost levels given in equations (2), we can also derive the effect of country characteristics on the internalization decision of firms. All else equal, a larger foreign market Y_{ij} increases the minimum marginal cost levels of exporters and firms producing abroad. Thus, they are more firms active in a larger foreign country. Trade costs reduce the critical marginal cost level of exporters. Thus, less firms are active in countries further away. If fixed costs are independent of trade costs, trade costs reduce the critical marginal cost level of a multinational firm. Among the firms from country l active in a foreign country j, the share of multinational firms increase with trade costs.

Proposition 4: *The number of firms that are active in a foreign country j increases in the foreign country market size and decreases with bilateral trade costs between l and j.*

4 Empirical Results

4.1 Size

In this section, we test each of the proposition using information on manufacturing German parent firms. The sample includes information on 1,748 parent firms classified in manufacturing and their 6,930 foreign affiliates in 2002.

Our test strategy is based on the theoretical model which establishes a direct link between productivity and the size of the parent firm. We therefore use the

size of the parent as measure of productivity. We know that productivity is not the only determinant of size. Yet, we are confident that the size of a firm is a good proxy for productivity even in a world where firms are not symmetric with respect to consumer preferences and vertical differentiation also exists. We rely on size because we can not estimate firm-level productivity since we lack data on value added.

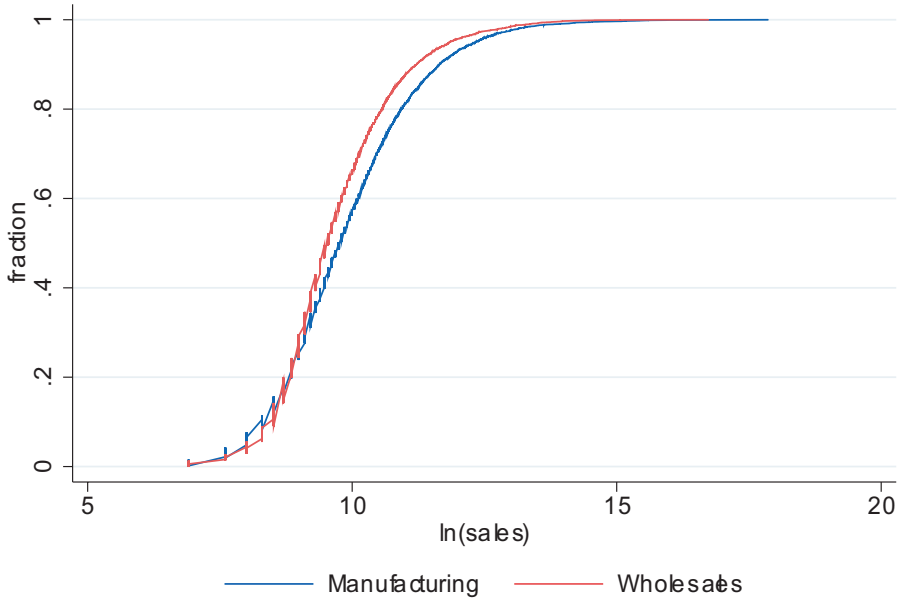
Proposition 1 states that more productive, i.e. larger, firms own foreign affiliates that have larger sales in a foreign country. The empirical test of proposition 1 is thus straight forward. We regress the logarithm of the size of the foreign affiliate on the logarithm of the size of the parent firm. We add country fixed effects and two set of sector dummy variables related to the sector of the affiliate, D_i^a, and to the sector of the parent firm, D_i^p. We control for the fact that a parent firm can own several affiliates by clustering the standard errors around the parent firm identity. Given country and sector fixed effects, we expect a positive impact of the size of the parent firm on the affiliate size.

$$\ln(\text{size affiliate}_{kij}) = \underset{(7.18)}{4.873} + \underset{(12.66)}{0.184} \ln(\text{parent size}_k) + D_i^a + D_i^p + D_j + u_{kij}$$

The R^2 is 0.28. The variation of the parent firm size and the fixed effects explain thus 28% of the variation of the foreign affiliate size. The parent firm size has a positive and significant impact on the size of the foreign affiliate.

Turning to proposition 2, it states that a firm that exports is less productive (i.e. smaller at home) and has smaller sales in country j than a firm that produce in country j. To test this proposition we must first distinguish between exporting firms and firms producing aborad. We do this by using the sector classification of firms and affiliates. In the data, affiliates and parent firms are classified according to the sector they are engaged in. For our analysis, we define a parent firm classified in manufacturing that has affiliates active

Fig. 4. Cumulative Distribution of Foreign Affiliates' Sales (2002)



Source: MIDI, authors' computation.

only in the wholesale sector of a particular country as an exporting firm. We define a manufacturing parent firm which holds affiliates that are active in manufacturing as firm producing abroad. Thus, although we do not have information about exports at the firm level we can distinguish between exporters and firms producing abroad. Unfortunately, many firms own both wholesale affiliates and affiliates in manufacturing, although not necessarily in the same country. We therefore restrain from testing proposition 2a and continue with 2b which states that affiliates in wholesale have smaller sales than affiliates in manufacturing.

Having classified the firms in those which export and those which produce abroad, we first look at the cumulative distribution of the foreign affiliates in wholesale, W, and in manufacturing, M. They are shown in Figure (4). The graph points to a first-order stochastic dominance of manufacturing affiliates with respect to sales. Manufacturing affiliates are larger than wholesale affiliates over the whole distribution.

Next, we analyze systematic differences between both distribution using the non-parametric Kolmogorov-Smirnov test (KS-test). The two-sided KS-test has the advantage of making no assumption about the distribution of data. It determines whether two distributions differ significantly. Therefore it calculate the largest difference between the observed and expected cumulative frequencies, which is called *D-statistics*. This statistics is compared against the critical D-statistic for that sample size. The results of the two-sided KS-test is shown in Table 2. The second line of Table 2 test the hypothesis that affiliates in manufacturing have smaller sales than those in wholesales. The largest difference between the distributions functions is 0.069 which is statistically significant at 1%. Thus, the null hypothesis that affiliates in manufacturing are smaller is rejected. The third line test the hypothesis that manufacturing contains larger values than wholesales. The largest difference between the distributions functions is -0.0275 which is not significant.

Table 2
KS Test of Differences between manufacturing affiliates and wholesale affiliates

Group	Largest Difference	*P-value*	Corrected
Ho: $M - W \leq 0$	0.0696	0.000	
Ho: $W - M \leq 0$	-0.0275	0.157	
Combined K-S-Test	0.0696	0.000	0.000

Source: MIDI (2002), authors' computation.

From the two-sided test of Table 2, we clearly reject the hypothesis that manufacturing and wholesale affiliates have equal size distribution. We cannot reject the stochastic dominance of manufacturing size distribution over wholesale size distribution. However, we can reject the stochastic dominance of wholesale size distribution over manufacturing size distribution.

4.2 Intensive and Extensive Margins

A new feature of the proximity-concentration model with heterogenous firms is that not only the number of foreign affiliates (extensive margin) but also their average sales (intensive margin) adjust to changes in market size or trade costs. In our multi-unit firm framework, there exist two extensive margins. First, a new firm might enter a foreign market and become a multinational. Second, a multinational firm might set up a new affiliate in a country which it served through exports before.

Proposition 3 refers to the second extensive margin. It states that a more productive firm owns a larger number of foreign affiliates. In order to test this proposition, we regress the number of foreign affiliates on the size of the parent firm from the manufacturing sector and add a set of parent firm's sector specific effects. We estimate a negative binomial regression model since we find overdispersion in the data. When there is overdispersion the poisson estimates are inefficient with standard errors biased downward yielding spuriously large z-values. We control for the fact that a parent firm can own several affiliates by clustering the standard errors around the parent firm identity. Given sector fixed effects, we expect a positive impact of the size of the parent firm on the number of foreign affiliates.

$$\begin{array}{rccc} (\text{number of affiliates})_k = & 1.381 & + & 0.139 \\ & (6.05) & & (2.58) \end{array} \ln(\text{parent size}_k) + D_i^p + u_k$$

The Cragg and Ulher's R^2 is 0.17 meaning that the variation of the parent firm size and the fixed effects explain about 17% of the variation of the number of foreign affiliates. Computing the marginal effects of the parent size on the number of foreign affiliates, we find that a one percent increase in the size of the parent firm, increases the number of foreign affiliate by 0.54%. The size of the parent firm has a positive and significant impact on the number of foreign

affiliates. We interpret this as positive effect of productivity of the parent firm on the number of its foreign affiliates.

In order to analyze more precisely the respective importance of the extensive and intensive margins, we conduct a simple regression analysis similar to Eaton *et al.* (2005) and Yeaple (2005). We use a gravity equation to decompose changes in market size and trade costs into the extensive and intensive margins. The gravity equation states that host country's market size has a positive effect on the volume of affiliates' sales while geographic, regulatory and cultural transaction costs between countries have a negative effect (Kleinert and Toubal, 2005). The different transaction costs can be summarized by the market share of foreign affiliates of German multinational firms in country j, λ_{jl}. This share is calculated as the share of German affiliates' sales S_{jl} in total sales in country j X_j. Yet, total sales of German firms' foreign affiliates in country j S_{jl} can also be decomposed in the number of German firms' foreign affiliates N_{jl} and the average size of a German foreign affiliate in country j $\bar{s_{jl}}$. Thus, sales of all German multinational affiliates in market j, S_{jl} can be expressed as:

$$S_{jl} = N_{jl}\bar{s_{jl}} = \lambda_{jl}X_j \tag{4}$$

Total sales in country j X_j equals country's j absorption defined as gross production plus import minus export. We regress the logarithm of $N_{jl} \equiv S_{jl}/\bar{s}_{jl}$ on the logarithm of German firms' market share in country j and the logarithm of absorption X_j in country j to show how much of the variation in German multinationals' sales is due to variation in the market share of German affiliates and how much to variation in market size of country j. To explore the possibility that aggregate sample masks effects of sectoral variation of multinational sales across countries, we conduct this decomposition using a full set of country specific dummy variables.

Table 3
Intensive and Extensive Margin, (2002)

	Label	Manufacturing Affiliates	Wholesale Affiliates
German Market Share	λ_{jl}	0.64***	0.63***
		(0.04)	(0.04)
Absorption	X_j	0.66***	0.63***
		(0.04)	(0.03)
Constant		-11.02***	-10.85***
		(1.01)	(0.84)
Nb. Obs.		721	685
R^2		90.62	86.50

Robust standard errors into parentheses. Standard errors have been adjusted for clustering around the country's identity.
*** denotes statistical significance at one percent level.

Table (3) shows two different specifications corresponding to activities of foreign affiliates. We interpret the coefficient estimates in the manufacturing sectors as follow: given country's market size, a higher German multinational market share is due to a 64% increase in the number of affiliates and a 36% increase in the average sales per affiliate. Further, given the market share of German multinational firms, a larger market reflects 66% more affiliate and 34% more sale per firms. These results are in line with the results found by Yeaple (2005) for foreign affiliates of US manufacturing firms. Much of the variation of German multinational sales across countries is due to variation in the number of firms participating in the market.

The estimated parameters for affiliate in manufacturing are lower as the parameters in Eaton *et al.* (2005) who analyze international trade of French firms. That should be expected if fixed costs of production abroad are higher than fixed costs of exporting. We therefore also estimated the adjustment of wholesale affiliate of German multinational firms. Surprisingly, their adjustment to changes in market size and the German market share does not differ significantly from those of manufacturing affiliates of German multinational firms. Given country's market size, a higher German multinational market

share is due to a 63% increase in the number of affiliates and a 37% increase in the average sales per affiliate. Further, given the market share of German multinational firms, a larger market reflects 63% more affiliate and 37% more sale per firms. The adjustment through the extensive margin is lower as Eaton *et al.*'s estimates for France. We believe that the difference in the results stems from our smaller sample of exporters which is biased towards larger firms. In sum, our results show that adjustment through the extensive margin in our sample is almost twice as large as adjustment through the intensive margin.

5 Conclusion

We examine firm heterogeneity using information from a comprehensive dataset on multinational activities. Therefore, we derive four propositions from a proximity-concentration model with heterogenous firms and test them. The empirical analysis strongly supports all four theoretical predictions.

First, we show that larger firms have larger affiliates. Second, exporters to a particular country are less productive than firms that produce in the this country. The sales of an exporter in a particular country are smaller than the sales of a multinational firm's affiliate that produces there. Third, more productive firms own a larger number of foreign affiliates. The probability of producing in a new country increases with productivity. Hence, the adjustment to changes of market size and/or trade costs through the extensive margin is largely driven by a larger number of affiliates of existing multinational firms. Fourth, we conduct a deeper analysis of the respective importance of the extensive and intensive margins. We show that the extensive margin is twice as important as the intensive margin. This finding supports model with monopolistic competition among heterogenous firms.

References

Bernard, Andrew B. and Jensen, J. Bradford (1995). Exporters, Jobs, and Wages in U.S. Manufacturing: 1976-1987. *Brookings Papers on Economic Activity. Microeconomics*, Vol. 1995: 67-119.

Bernard, Andrew B. and Jensen, J. Bradford (1999a). Exceptional Exporter Performance: Cause, Effect, or Both? *Journal of International Economics*, 47(1): 1-25.

Bernard, Andrew B. and Jensen, J. Bradford (1999b). Exporting and Productivity. NBER Working Paper No. 7135.

Bernard, Andrew B., Jensen, J. Bradford and Peter, K., Schott (2005). Importers, Exporters and Multinationals: A Portrait of Firms in the US that Trade Goods. NBER Working Paper No. 11404.

Clerides, Sofronis, Lach, Saul, and Tybout, James R. (1998). Is Learning by Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico, and Morocco. *Quarterly Journal of Economics* 113(3): 903-947.

Eaton, Jonathan, Kortum, Samuel, and Francis Kramarz (2004). Dissecting Trade: Firms, Industries and Export Destinations. *American Economic Review* 94(2): 150–154.

Girma, Sourafel, Görg, Holger and Erik Strobl (2004). Exports, international investment, and plant performance: Evidence from a non-parametric test. *Economics Letters*, 83(3): 317-324.

Head, Keath and Ries, John (2003). Heterogeneity and the FDI versus Export Decision of Japanese Manufacturers. *Journal of the Japanese and International Economies*, 17(4): 448-467

Helpman, Elhanan, Melitz, Marc J., and Yeaple, Stephen R. (2004). Export Versus FDI with Heterogeneous Firms. *American Economic Review* 94(1): 300–316.

Kleinert, Jörn, and Farid, Toubal, (2005). Gravity for FDI. CEGE Discussion Paper 46, Juni 2005.

Lipponer, Alexander, (2006). Microdatabase Directinvestment– Midi, A Brief Guide. Bundesbank Discussion Paper, March 2006.

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

Yeaple, Stephen R., (2005). Firm Heterogeneity and the Structure of US Multinational Activity: An Empirical analysis. University of Pennsylvania, Mimeo, march 2005.