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Cross-Border Mergers and Acquisitions of Multinational Firms. New Firm-Level Evidence

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June 2010

FDI is an important channel for productivity spillovers across economies. But productivity and employment effects of cross-border mergers and acquisitions (M&A) on multinational firms are rather unclear and much disputed. We empirically analyze the effects of cross-border M&A on the performance of multinationals in Germany using new data on the firm-level. In order to control for possible selection biases we use a propensity score matching approach.

We find that, first, foreign-owned multinationals are smaller but more productive than their domestic counterparts in the mean. But controlling for differences in the industrial composition and firm size, foreign-owned multinationals are larger in terms of capital, sales, and value added. The difference of total factor productivity amounts to 6 %. Second, multinationals show quite heterogeneous performances after cross-border M&A. Third, we do not find an average causal effect of cross-border M&A on the employment of the acquired multinational firm. But most importantly, the causal effect of cross-border M&A on the multinationals' productivity is positive and significant.

Keywords: FDI, Spillover, foreign ownership, cross-border M&A, productivity, employment effects

JEL classification: F21, F23

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1 Introduction

Cross-border M&A of big multinationals are rare events but typically attract a major interest in the public. They are often accompanied by political action, government interventions or anti-trust regulation. The merger between the french state-owned Gaz de France (GDF) and Suez, a Franco-Belgian utilities group was apparently aimed at impeding an upcoming foreign take-over. The Bavarian state government tried to prevent a merger between the Italian UniCredit and the German HypoVereinsbank. When the French Sanofi took over the German Aventis intensive protests of the employees followed. The employees feared asset stripping, downsizing or massive layoffs. But the economic impact of such cross-border M&A on employment and productivity of multinationals are rather unclear.

Results about the impact of inward FDI have been concentrated on aggregate spillover effects to economies and industries (see the seminal paper of Javorcik, 2004) or the employment and productivity effects for single firms (with or without foreign affiliates, for a survey see e.g. Barba-Navaretti and Venables, 2004). Only few contributions are dedicated to the effects of cross-border M&A on multinational firms, albeit about 19% of German MNEs' total employment was located in multinationals with a foreign parent company in 2004. We contribute to fill this gap and analyze firm data with information about inward and outward FDI linkages of German multinationals.

The contributions regarding the effects of M&A in the case of domestic firms (not multinationals) point out that foreign owned firms outperform domestic firms. They are larger, more productive and pay higher wages than national ones (see Balsvik and Haller, 2006, for Norway, Karpaty, 2004, for Sweden, Crinò and Onida, 2008 for Italy, Conyon et al., 2002, for the United Kingdom, or Mattes, 2010, for German establishments). The impact of a cross-border M&A on these domestic firms' productivity is in general found to be positive. Murakami and Fukao (2006) find that Japanese firms that have been subject to a foreign take-over raise their productivity. Balsvik and Haller (2006) show that foreign owners are able to reverse previously negative trends in productivity and employment. Conyon et al. (2002) estimate that British firms that are acquired by foreign companies exhibit increases of labor productivity of about 13 %. In contrast, the employment effects are mixed. McGuckin and Nguyen (2000) find that ownership changes are not a primary vehicle for cuts in employment and wages in the US. Bandick and Karpaty (2007) find a positive employment effect of foreign take-overs in the case of domestic firms. But Piscitello and Rabbiosi (2005) argue that productivity effects could be due to labor downsizing.

Only little and mixed evidence exists in the case of cross-border M&A of multinationals, though. Doms and Jensen (1998) find for the US that foreign MNEs are less productive than US MNEs. Whereas Bandick and Karpaty (2007) find the above mentioned positive employment effect of take-overs in the case of domestic firms, they do not find any effect on the employment in the case of Swedish multinationals. Pfaffermayr and Bellak (2000) use data for Austrian firms. Whereas they find productivity differences between domestic and foreign owned firms, comparing foreign and domestic owned MNEs does not reveal significant differences in productivity. Hence, they argue that the productivity effect is due the MNE-network. Note that, in the comparison of

foreign owned and domestic MNEs, as in our case, this effect is cancelled out.

We use the only available dataset covering all inward and outward FDI linkages above a certain threshhold on the micro-level in Germany (Microdatabase Direct Investment, MiDi, provided by the *Deutsche Bundesbank*). We enrich these data with more detailed balance-sheet information about German firms from Dafne, supplied by the Bureau van Dijk. Thereby, we link panel data about FDI, making it possible to identify all cross-border M&A from 1997 to 2003 in Germany.

Spearot (2007) models cross-border M&A within a heterogeneous firms framework. In his model the least productive firms ("lemons") are acquired. Likewise, very well performing firms ("cherries") could face a systematically higher probability of take-over. Similar selection mechanisms might be at work also in the case of multinationals. In order to control for possible selection bias, we use a difference-in-differences estimator using a propensity-score matching technique and estimate the average treatment effect on the treated (ATT). The treatment, in our case, is the cross-border M&A.

We find that foreign owned multinationals (FMNEs) are smaller and more productive than their domestic counterparts. With regard to employment, FMNEs are about 15 % smaller than domestic multinational enterprises (DMNEs). If we use the term domestic multinationals we refer to multinationals with affiliates abroad, that themselves are not an affiliate. But FMNEs show significantly higher levels of total factor productivity (TFP), about 6.4 % higher than DMNEs. The gap in the case of labor productivity amounts to 37 %. Cross-border M&A of previously domestic multinationals are rare events. In total, using our full-coverage data, we identify 158 cross-border M&A from 1997 to 2003 in Germany. Performance after ownership change of multinationals is quite heterogeneous. While employment stays rather unchanged in the mean, the middle 50 % of multinationals all show positive developments of total factor productivity. More specifically, while the average causal effect of ownership change on employment is insignificant, the effect of ownership change on productivity is positive and significant.

The paper proceeds as follows. In section 2 we discuss possible transmission channels for productivity and show how we operationalize cross-border M&A and their effect on multinationals. In section 3 we describe our data and our measures for productivity. In section 4, we compare key characteristics of DMNEs and FMNEs. In section 5, we have a closer look at the performance of MNEs before and after ownership change with descriptive methods. In section 6, we measure the average treatment effect of cross-border M&A on the acquired multinationals. Section 7 concludes.

2 Transmission Channels and Identification

2.1 Transmission Channels

Productivity may spill over to the acquired multinational firm (then an affiliate itself) through different transmission channels, such as management, synergy, competitiveness, market power, or technology transfers.

Management effects arise when a new management leads to higher productivity. A new foreign owner may impose a new management that matches better to the domestic

MNE. That may cause productivity improvements for the acquired firm. Disciplining effects may arise when the new management faces lower costs of stimulating or controlling the work force. Likewise, employees might raise their efforts because dismissals are feared. Finally, the corporate governance system of the investor's country may be superior: This competitiveness may relate to the tax system, the corporate law or accounting principles in the investor's country (see e.g. Javorcik et al., 2004).

M&A of multinationals may have an impact on the structure of the domestic market, raise the market power of the acquired multinational firm, and thereby lower the level of competition in the market (see e.g. Bellak et al., 2006, pp. 32-33, or Barba-Navaretti and Venables, 2004, pp. 151-185). Higher product prices, or higher turn-over, and productivity improvements can be achieved.

Compared to domestic firms, MNEs already have an above-average productivity due to ownership advantages that stem from firm specific knowledge („knowledge capital") or other assets like a worldwide known brand name. Additionally, MNEs may exploit international differences in factor costs more easily. These *synergy and competitiveness effects* are driven by advantages from the multinational structure of the firm, but may arise in the case cross-border M&A, too.

In the heterogenous firms framework of Kendall and Ryan (2007) firms that are opting for FDI have the choice between greenfield investment and M&A. If a firm's technological advantage is only partly transferable, firms with the highest productivity would supply the foreign market with greenfield investment. But with perfectly transferable technology, a merger or a acquisition is always more profitable than greenfield FDI. Hence, the transferability of technology apparently is a prerequisite for cross-border M&A (see also Murakami and Fukao, 2006).

2.2 Identification of the Ownership Effect and a Possible Sample Selection Bias

Regarding the impact of cross-border M&A Pfaffermayr and Bellak (2000) have distinguished between the ownership and the network effect. Our results also contribute to this strand of the literature.

Figure 3 in the appendix shows that if a previously purely domestic firm (PDE) is taken over by a foreign parent firm (and thereby becomes a foreign owned firm, FOF), two things happen simultaneously. First, the ownership structure changes allowing the above mentioned *management* and *synergy* effects. Second, through the cross-border M&A the previously independent PDE changes its firm structure from national to multinational. The new cross-border firm linkage may cause *network* effects that have an impact on the firm's productivity.

Figure 4 in the appendix shows that in the case of cross-border M&A of MNEs, parts of the multinational structure stay unchanged. Hence, in the comparison of FMNEs and DMNEs, as in our case, a part of the network effect is cancelled out. This is one reason for the finding of small impacts of M&A on the firm performance of MNEs in the literature, so far.

Very well performing firms ("cherries") or the least productive firms ("lemons") could face a systematically higher probability of take-over, selection mechanisms might be at

work. In order to control for a possible selection bias, we use a difference-in-differences estimator using a propensity-score matching technique and estimate the average treatment effect on the treated (ATT).

3 Data Issues and Productivity Estimation

3.1 Data

We merge two datasets on the firm-level. First, we use the Micro-database Direct Investment (MiDi), collected and maintained by the Deutsche Bundesbank. It contains all FDI links (on the investment-level) above certain thresholds in Germany since 1989 (see also Lipponer, 2006). From 1996 onwards, MiDi allows to trace each investment record over time on the investment- and on the firm-level (micro-panel structure). Therefore, we can trace companies holding FDI stocks (investors, DMNEs) as well as each single investment enterprise (FOFs and FMNEs). Therefore, MiDi allows us to distinguish FMNEs and DMNEs. But due to its focus on the investment enterprises, MiDi contains far less detailed knowledge, e.g. about employment and sales, of the investor (DMNE). Therefore, we have matched MNEs from MiDi to German firm-level data from Dafne, supplied by the Bureau van Dyjk. Dafne contains balance sheet information for about 140,000 German companies for the entire time span observed in MiDi. To the best of our knowledge this novel dataset has been used before only by Kleinert and Toubal (2006).

We cleaned the data from several outliers. Among these were firms with negative sales (7 observations), negative fixed capital (10 observations), and negative wage (4 observations). In these cases we did not only drop the critical observations but removed the corresponding *firm* from our sample for all time-periods. Some firms reported astonishingly high mean wages. Therefore, we dropped all firms that reported a mean wage over 500,000 EURO. In the end we removed 26 firms from our data.

We define a MNE as foreign owned (FMNE) if the foreign capital share exceeds 20 %. As figure 5 in the appendix shows, the majority of the foreign owned firms in our sample have shares of foreign participation rights of more than 50 % and the largest part of our firms is under full foreign control.

3.2 Productivity Estimation

Our main productivity measure is the total factor productivity (TFP). This enables us to account for different optimal factor input compositions in various industries. In order to control for a possible bias that may stem from sample selection and endogeneity, we employ the estimation technique proposed by Olley and Pakes (1996) and use investment in order to control for correlation between input levels and the unobserved firm-specific productivity process. We estimate sector-specific coefficients of the production function. Given the lack of information on fuel and electricity consumption in the data we are not able to use intermediate inputs as proxies for investment, as has been proposed by Levinsohn and Petrin (2003). We also use OLS estimates of TFP as well as labor

Table 1: **Comparison of DMNE and FMNE**

	Sales	TFP	Labor productivity	Value added	Employment
DMNE	136.89	3.03	5890.53	107.28	2112.67
FMNE	41.62	2.97	5398.10	20.78	1060.23

Arithmetic mean, pooled over the sample period from 1997 to 2004. Firms subject to a foreign takeover excluded.

Source: Own calculations, MiDi-Dafne datatset

productivity, measured as value added over employment, in order to check the robustness of our results.

4 Do FMNEs and DMNEs differ?

In this section, we first give an overview over the relevance of foreign owned MNEs in our data. Then, we compare DMNEs and FMNEs with regard to their performance and present "foreign ownership premia" for German MNEs. We adapt the seminal approach of Bernard et al. (2007) who show "export premia" in the United States. Additionally, we will compare the distribution of TFP for FMNEs and DMNEs.

4.1 Relevance of Foreign Owned Multinationals

Table 10 in the appendix shows the relevance of FMNEs relative to MNEs in Germany. We find that about 30 % of MNEs are foreign owned, but only about 15 % of the total MNE-employment is located within foreign owned MNEs. Furthermore, FMNE sales account for only about 9 % of total MNE sales.

We find considerable differences in the relevance of FMNEs across industries (see Table 9 for our industry definitions). In the case of wholesale trade, light industries as well as machinery, electronics and automobiles, more than 30 % of the MNEs are foreign owned. In contrast, in the finance sector, which is traditionally very well protected in Germany, this is only true for about 6 % of the MNEs. Especially in the light industries FMNE sales account for a large part of total sales (52 %).

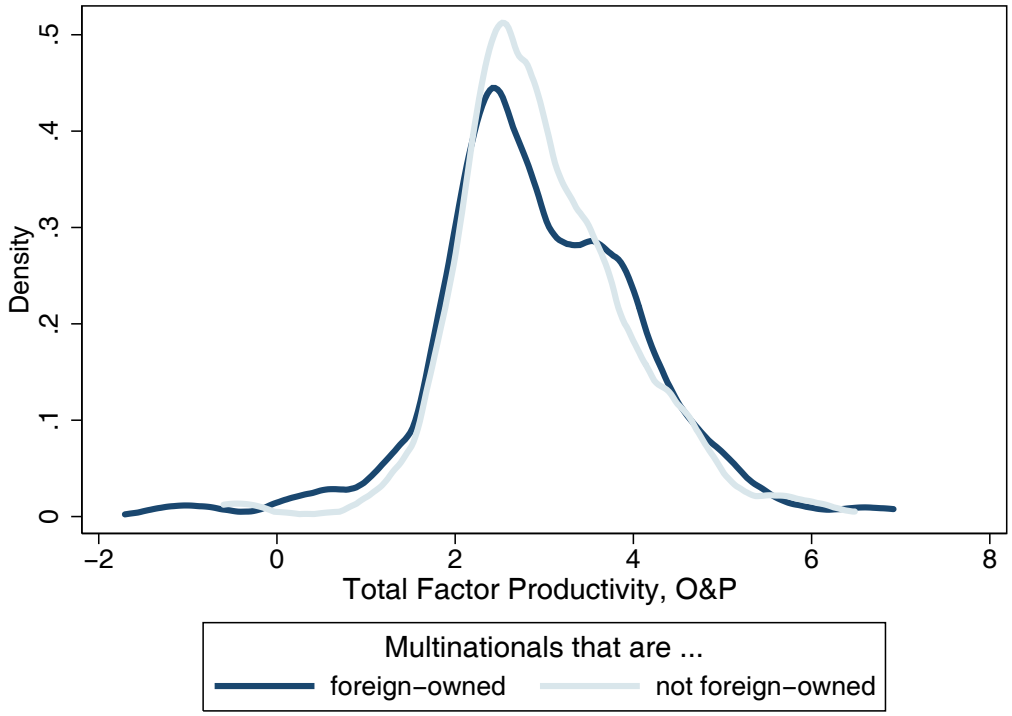
4.2 Comparing the Performance of DMNEs and FMNEs

A first look at the performance measures show that, in the mean, domestic MNEs are larger and slightly less productive than their foreign owned counterparts. Table 1 shows that mean sales of DMNEs are more than three times as high as mean sales of FMNEs. The average employment of DMNEs doubles the mean employment of FMNEs. Further, foreign-owned MNEs are slightly less productive than domestic MNEs.

4.3 The Distribution of TFP for FMNEs and DMNEs

Figure 1 shows kernel-density estimates of TFP for FMNEs (dark line) and for DMNEs (light line). The mode of TFP is in both cases virtually equal. We do not find statistical

Figure 1: **Productivity distribution of domestic and foreign-owned multinationals**



Source: Own calculations, MiDi-Dafne merge.

dominance for any of the two distributions. For density estimations of OLS-estimated TFP, labor productivity and employment see Figure 6 in the appendix. But note that, in order to infer ceteris paribus effects, the large differences in industrial composition have to be taken into account.

4.4 Foreign Ownership Premia for Multinationals

In the following we control for industry and firm size effects and regress the selected performance measures on a dummy variable that indicates foreign ownership, as well as on control variables. We use a set of industry dummies and the employment level (see e.g. Bernard et al., 2007):

$$\log y_{it} = \alpha + \beta \cdot \mathrm{FDI}_{it} + \gamma \cdot \mathrm{ind}_i + \delta \cdot \log L_{it} + u_{it}, \tag{1}$$

where y_{it} are different performance measures (employment, capital, TFP, labor productivity etc.) and L_{it} is employment (omitted in the employment regression). FDI_{it} is a dummy variable that indicates FMNEs, hence is 1 for FMNEs and 0 for DMNEs. By this definition, $\hat{\beta}$ gives us the estimated relative difference in the dependent variable for

Table 2: **Foreign Ownership Premia, pooled estimation (1996-2003)**

	Foreign Ownership Premium		
$\hat{\beta}$	[1]	[2]	[3]
Log Employment	0.081	-0.015	n/a
	(8.44%)	(-1.49%)	n/a
Log Capital	0.324**	0.445***	0.102**
	(38.26%)	(56.05%)	(10.74%)
Log Sales	0.553***	0.484***	0.320***
	(73.85%)	(62.26%)	(37.71%)
Log TFP	-0.004	0.059***	0.062***
	(0.4%)	(6.08%)	(6.4%)
Log Labor productivity	0.285***	0.306***	0.312***
	(32.98%)	(35.8%)	(36.62%)
Log Value added	0.521***	0.502***	0.312***
	(68.37%)	(65.2%)	(36.6%)
Additional control variables	None	Industry dummies	Industry dummies and log employment

DMNE: Domestic Multinational Enterprises, FMNE: Foreign Multinational Enterprises. Sample from 1996 - 2003, **indicates significance on the 1 % level, * on the 5 %, and * on the 10 % level. Exact difference in percentage points in parantheses.

Source: Own calculations, MiDi-Dafne dataset

FMNEs compared to DMNEs controlling for industry-fixed effects (ind_i) and firm size. We estimate equation (1) in three different versions: First, only with the FMNE dummy, second, with additional industry-fixed effects and third, with additional industry-fixed effects and log employment. Since the dependent variable is in logarithmic form and FDI_{it} is a dummy variable, $\hat{\beta}$ is a semi-elasticity. However, the immediate interpretation of $\hat{\beta}$ as an approximate percentage difference is only possible for small values of $\hat{\beta}$. Therefore, we calculate the percentage difference as $\Delta\% = 100[\exp(\hat{\beta}) - 1]$.

The results for $\hat{\beta}$ and $\Delta\%$ in Table 2 differ from the descriptive evidence in Table 1. It shows that, controlling for the industrial composition, FMNEs do not differ significantly from DMNEs in terms of the number of employees. Further, in contrast to the results in Table 1, controlling for industry effects and firm size, foreign-owned MNEs are larger than DMNEs in terms of capital, sales and value added. The difference between FMNEs and DMNEs in terms of sales amounts to 38%. Likewise, FMNEs are more productive: They have higher TFP values (significant on the 1%-level) and higher labor productivity (again significant on the 1%-level). Note, that the difference in terms of labor productivity is, controlling for the industrial composition and firm size, comparatively large (about 37%).

This section provided evidence on the importance of FMEs in the domestic economy and showed that domestic and foreign owned MNEs differ in terms of size and productivity. In the next section we analyze the dynamic impact of cross-border M&A on domestic MNEs.

Table 3: **Number of ownership changes in Germany (1997 - 2003)**

Year	Ownership Changes
1997	16
1998	7
1999	25
2000	23
2001	24
2002	34
2003	29
Total	158

Source: Own calculations, MiDi-Dafne merge.

5 Pre and Post Cross-Border M&A Performance

Table 3 shows the number of cross-border M&A of previously domestic multinationals in Germany in the years from 1997 to 2003. The total of 158 ownership changes indicates that cross-boder M&A of previously domestic multinationals are rather rare events. We find a minimum of activity of cross-border M&A in the year of economic slowdown (1998). Afterwards, the number of ownership changes increases. It correlates with the development of aggregate FDI in Germany. In the remainder of this section we analyze the development of performance indicators of DMNEs that are subject to a cross-border M&A with descriptive means.

5.1 Development with Respect to the Status quo ante

In Figure 2 we show the distribution of the growth rates $(y_t - y_{-1})$ / y_{-1} of our main variables of interest (employees, labor productivity, and employment). We set the firm-specific years τ_i, in that the cross-border merger or aquisition of a previously domestic multinational firm i takes place to $t = 0$. Note, that we show the growth rates for $t = 0, 1, 2$, i.e in the year of takeover and afterwards *relative to the year before ownership-change* ($t = -1$) and pool the observations for the total of 158 cross-border M&A with regard to t. Due to confidentiality restrictions we do not depict outside values. The shaded box in the center of each plot marks the interquartile range from the first to the third quartile of the distribution. The horizontal line in the box is the median. The additional solid line behind the box depicts the mean. The dashed line behind the box marks the mean *weighted by the number of employees in each firm*, and hence can be interpreted as the growth rate of each variable *from the perspective of the employee*.

Figure 2 shows that the development of TFP is mainly positive after ownership change. We find more volatility (as measured by the interquartile range displayed in the boxplots) than in the development of labor productivity. But in all three time points the median growth rate is positive (and reaches a maximum in the second year $t = 2$ after the cross-border M&A). Again, the mean is higher in each single year, reaching a maximum of 0.06 in the second year after ownership change ($t = 2$). TFP development from the perspective of an employee is somewhat lower than the unweighted

mean. Finally, it is not only the big firms that increase TFP, but also a big part of middle productive firms: nearly 50 % of the "middle" firms all show a positive TFP development. For labor productivity, we find a very similar picture. The volatility is higher, though. Again, the median as well as the unweighted and the weighted mean are positive for $t = 1$ and $t = 2$.

In the case of employment, the boxplots in figure 2 shows a decreasing average number of employees for the year of ownership change and two years afterwards. The median and therefore the majority of the firms display a negative development of employment in all observed three time periods. Only if the firm size is taken into account and look from the perscpective of an employee, we find small positive numbers.

The descriptive analysis in this section gives a first impression of the development of performance indicators after an ownership change. While we find positive effetcs for productivity, we have, on average, a negative effect on employment. But the descriptive analysis could be inaccurate due to a possible selection bias. Hence, in the following section we present a matching estimator approach that controls for the possible bias.

6 The Effect of Foreign Ownership Change

In this chapter we analyze the causal effect of a cross-border M&A. More specifically, we ask how a DMNE that was subject to a cross-border M&A would have had developed if it had not been taken over. Since that counterfactual situation cannot be observed, we construct a hypothetical one using matching estimator techniques. See Caliendo (2006) for a comprehensive description of the methodology.

6.1 Matching Estimator Approach

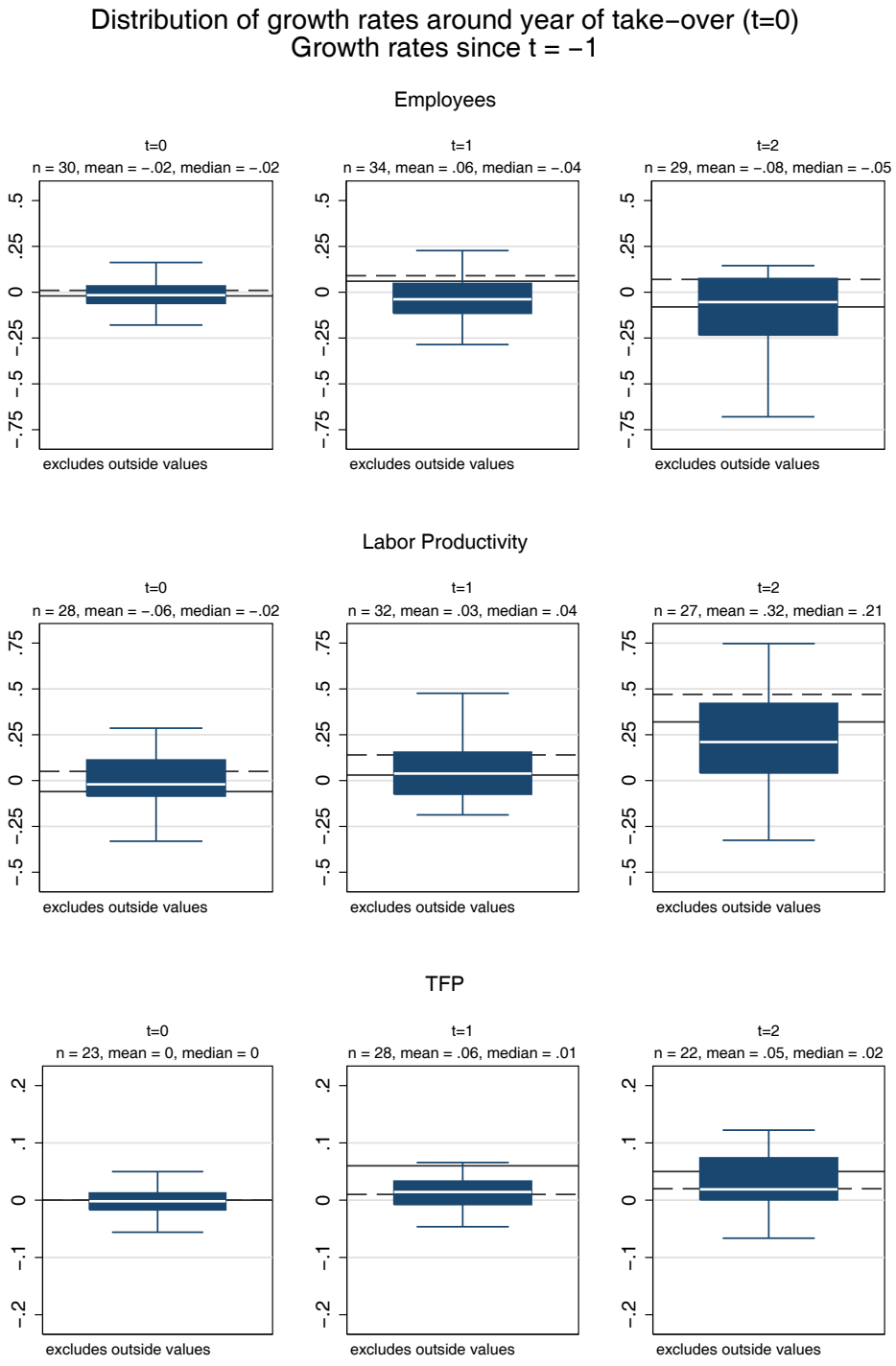
The matching estimator approach starts from the simple idea of comparing the performance of a DMNE that has been subject to a cross-border M&A (the treated subpopulation) to the performance of DMNEs that stayed in domestic ownership (the untreated subpopulation). We define treatment as a cross-border M&A and a treatment indicator w_t with $w_t = 1$ for the firms in foreign ownership in year t ($w_t = 0$ for the firms in domestic ownership in a given year t).

In an unfeasible experimental setting one would want to compare the performance y (productivity, employment) of the same firm i with $(y_i|(w_t = 1) = y_{i1})$ and without treatment $(y_i|(w_t = 0) = y_{i0})$. This experiment would deliver the Average Treatment Effect on the Treated

$$ATT = E[y_{i1} - y_{i0}|w_t = 1] = E[y_{i1}|w_t = 1] - E[y_{i0}|w_t = 1].$$

In other words, this is the average effect of a foreign takeover on the performance of a firm that has undergone an ownership change. Unfortunately, we cannot observe y_{i1} and y_{i0} for any firm in our sample at the same time. $E[y_{i0}|w_t = 1]$ is not observable. Neither can we assume that treatment is distributed randomly among firms, that is, we have to assume that international M&As are correlated with firm performance (e.g. cherry picking). Hence, unconditional and conditional expectations of firm performance

Figure 2: **Heterogeneity of growth rates of TFP and employment after ownership change**



This figure shows the heterogeneity of growth rates $\frac{y_{t=\tau}-y_{t=-1}}{y_{t=-1}}$ of employment, TFP and labor productivity in the two subsequent years with respect to the year before ownership change of foreign owned multinationals (FMNEs). n is the number of observations. The outer dashed lines depict the mean, the outer bold line depicts the mean of the respective performance measure, weighted by the firm-specific number of employees. Outside values are excluded for reasons of nondisclosure.

Source: Own calculations, MiDi-Dafne merge.

are not equal, $E[y_{i0}|w_t = 1] \neq E[y_{i0}] = E[y_{i0}|w_t = 0]$ and $1/N \sum_{i=1}^{N}(y_{i1} - y_{i0})$ as a naive measure of the foreign takeover effect is biased.

At this point, the "conditional independence assumption" (CIA) is introduced.[1] It states that given a set of observable covariates X, foreign takeovers happen randomly, or in other words, conditional on the observable covariates X, w and (y_{i1}, y_{i0}) are independent, and

$$E[y_{i0}|X, w_t = 1] = E[y_{i0}|X, w_t = 0] = E[y_{i0}|X]$$

(see e.g. Wooldridge, 2002, p. 607). X must contain all relevant variables for both, the foreign takeover and the outcome variable y, for the CIA to hold.[2]

Once we partial out the observables in X, w and (y_{i1}, y_{i0}) are uncorrelated. Then

$$ATT = E[y_{i1} - y_{i0}|X].$$

However, matching on a high number of firm characteristics creates a dimensionality problem and is not feasible. Rosenbaum and Rubin (1983)show that it is not necessary to match on all covariates. Instead, it is possible to aggregate the firm characteristics into a single score, the propensity score. The alternative but equivalent formulation is

$$ATT = E[y_{i1} - y_{i0}|p(X)]$$

where $p(X)$ is called the propensity score. $p(X) = Pr(w = 1|X)$ is the probability of a foreign takeover given the covariates X. For an estimate of ATT we would simply have to average treated and untreated firms with the same $p(X)$, respectively. To cope with the problem, that in general we will find no firms with exactly identical score $p(X)$, different matching strategies have been proposed in the literature (see, e.g., Caliendo 2006). We apply nearest neighbor matching with n nearest neighbors, where each treated firms (switcher) is assigned to n untreated twins with the most similar absolute value with respect to the propensity score, as far as the difference in propensity score is below a certain threshold. For reasons of robustness we apply different numbers of nearest neighbors and present the results for 5 and 10 nearest neighbors. We also apply kernel matching, which assigns all firm from the control group as twins to a switcher, but weights these twins by the absolute difference with respect to the propensity score. Note, that we restrict all matches to observations of firms in the same year and the same 1-digit-industry.

The standard matching estimator for the ATT is given by

$$\widehat{ATT}_M = \frac{1}{n_1} \sum_i \left\{ y_{i1,t} - \hat{E}[y_{i0,t}|w = 1, p(X)] \right\} \tag{2}$$

with $n_1$as the number of treated firms. The validity of the matching estimator approach depends crucially on the validity of the conditional independence assumption.

[1] Synonyms are "selection on observables" or "ignorability of treatment" (given the observed covariates).

[2] The choice of these variables is not trivial and not to test for. Therefore, I will apply different specifications as robustness checks.

This means that the observable covariates X contain all relevant variables that determine the foreign takeover and the outcome. However, there may be unobserved factors that matter as well. In order to account for time-invariant (unobserved) effects at least, we apply a difference-in-difference approach. This is, we do not compare the absolute value of an outcome variable y between the group of switchers and the assigned twins after the takeover. Instead, we compare the absolute change from the year t of the foreign ownership change and the year $t+\tau$ ($y_{t+\tau} - y_t$) between switchers and assigned twins. The resulting difference-in-difference matching estimator is given by

$$\widehat{ATT}_{DiD} = \frac{1}{n_1} \sum_i \left\{ [y_{i1,t+\tau} - y_{i1t}] - \hat{E}[y_{i0,t+\tau} - y_{i0t} | w = 1, p(X)] \right\}. \tag{3}$$

It may take one or two years for a foreign ownership change to affect the characteristics of the target firms. Therefore, we calculate the ATT for $\tau = 1, 2$, that is one and two years after the ownership change. A further requirement for the validity of the propensity score matching estimator is that $0 < Pr(w = 1|X) < 1$, thus ruling out the perfect predictability of foreign takeovers and ensuring that the firms from the control group fall within the propensity score distribution of the acquired firms. This is the so called common support condition.

6.2 Estimation of the Propensity Score

6.2.1 Hypotheses about the Observable Covariates

Table 4 contains an overview over our hypotheses concerning the observable covariates X for the propensity score estimation as well as their empirical operationalization. We include profits into the probit regression. Possible market access motives are captured by domestic sales and the domestic market share. Regarding profits and sales we also consider non-linear effects and include squared terms. A very high turnover could indicate a very high firm value which would make a takeover expensive and therefore less probable. Access to foreign markets is addressed by the number of foreign affiliates that a MNE has to offer to the foreign acquirer. Firm size effects are captured by the number of employees. We expect a reversly U-shaped effect, because very small firms may be less probable to be known abroad and very large firms tend to be too big and too costly for M&A. Firm value is operationalized by the domestic capital stock and the value of foreign direct investment abroad. Finally, financial burdens like the debt equity ratio may affect the propensity score. Finally, we add firm age to the list of our observable covariates.

6.2.2 Probit Estimation Results

We estimate the propensity score using a pooled probit model. We take the means of the observable covariates X of the firms that are not subject to a foreign takeover across *all years* in the data. In the case of MNEs that face a cross-border M&A in the observation period we take the means of the observations for all the years up to the year of the M&A. That means, we exclude the observations after the cross-border

Table 4: **Hypotheses about the observable covariates**

Hypothesis		Variables	Sign
Lemons vs. cherries		Profits	+ / - / U-shaped
Market access	in Germany	Sales	+
		Market Share	+
	to foreign markets	Number of foreign affiliates	+
Firm size		Enployees	-
Firm value	in Germany	Capital	reverse U
	abroad	Volume of FDI abroad	reverse U
Financial burdens		Debt equity ratio	+ / -
Age			+/ -

Source: Own presentation

M&A. Note, that we thereby reduce the dataset to a cross-section for the purpose of the propensity score estimation. In Appendix 2 we present the balancing characteristics of our sample.

Table 5 contains the results of the propensity score estimation. We find the following results for the covariates in X which are in line with our hypotheses from Table 4. We find a U-shaped effect of profits, which supports the "cherries" as well as the "lemons" hypothesis. We find the same U-shaped effect for sales. That means either firms with a relatively small or a relatively large volume of sales are typically the target of cross-border M&A. We cannot detect any significant effect of the number of foreign affiliates. We find an inverted U-shaped effect on employment. The average-sized firms are most probable to be subject to a foreign takeover. However, this effect is only significant at the 10%-level. Capital shows a positive, but decreasing effect, which is also the case for the volume of outward FDI. The debt-equity ratio is insignificant. Regarding firm age we find a U-Shaped effect that indicates that it is neither the recently founded firms nor the firms established a long time ago that are subject to cross-border M&A.

To put it in a nutshell, it is the medium-sized (in terms of employees, capital, and outward FDI) DMNE with relatively low *or* relatively high profits and sales as well with a bigger market share that is most probable to be subject to a cross-border M&A.

6.3 Average Performance Effect of Foreign Ownership Change

We apply the difference-in-difference matching estimator as displayed in Equation 3. Instead of one-year-differences, $\Delta y_t = y_t - y_{t-1}$, we use two-year-differences $\Delta_2 y_t = y_t - y_{t-2}$. Thereby, we aim at capturing the expected time lag between cause and effect that has become evident in Figure 2. We calculated the ATT using the statistical software package Stata and the module "psmatch2" provided by Leuven and Sianesi (2003). The matching estimator does not take into account that the underlying propensity scores are estimated values themselves. Therefore, we infer the ATT standard errors using a bootstrap with 200 replications. Further, as robustness checks, we vary the number of nearest neighbors and the caliper. Additionally, we apply kernel matching

Table 5: **Estimation of the propensity score (probit results)**

explaining variable	coefficient of levels	s.e. levels	coefficient of squares	s.e. squares
Profit	-33.889***	(3.24)	0.000***	(3.38)
Sales	-2.668***	(3.54)	0.000***	(3.94)
Market Share	12860473.051***	(3.02)		
Number of foreign affiliates	-9577119896	(0.45)	431282,31	(1.29)
Employment	101,353.363*	(1.68)	-9.816*	(1.67)
Capital	14.434***	(3.61)	-0.000***	(3.69)
Volume of outward FDI	3,320.464*	(1.70)	-0.005**	(2.05)
Debt/Equity ratio	-189757,98	(0.20)	17852	(0.17)
Firm Age	-5820120.953**	(2.00)	30,405.106**	(2.21)
Constant	-1.766***(4.78)			
Observations	1044			

Robust z statistics in parantheses. * significant at 10%; ** significant at 5%; *** significant at 1%
Source: Own calculations, MiDi-Dafne merge.

Table 6: **Specifications of Propensity Score Matching**

	Specification [1]	Specification [2]	Specification [3]	Specification [4]
Matching type	5 nearest neighbors	10 nearest neighbors	10 nearest neighbors	kernel matching
Caliper / kernel	0.02	0.02	0.05	epanechnikov
Perfect matching on	industry and year	industry and year	industry and year	industry and year

(epanechnikov kernel) with a bandwidth of 0.05. See Table 6 for an overview of our four different specifications.

Table 7 contains the estimated ATT on TFP. The results show that there is a positive and significant impact of cross-border M&A on the total factor productivity of DMNEs within two years. All four different specifications of the matching estimator yield positive and significant effects, demonstrating the robustness of our results against variations of the macting procedure.

Table 8 presents the results for the causal impact on employment. The impact on employment is not significant. Also this finding is robust against different specifications of the matching procedure. Therefore, in the mean, cross-border M&A do not cause employment cuts in multinational firms.

7 Conclusions and Outlook

Cross-border M&A of big multinationals are rare events and typically attract a major interest in the public. But the economic impact of cross-border M&A on the employ-

Table 7: **ATT (difference-in-difference) regarding TFP**

Model	Sample	Treated	Controls	Diff.	s.e.	t-value	t-value	p-value
1	Unmatched	0.22	-0.02	0.23	0.07	3.51		
1	ATT	0.21	-0.03	0.24	0.12	2.04	2.16	0.03**
2	Unmatched	0.22	-0.02	0.23	0.07	3.51		
2	ATT	0.21	-0.05	0.27	0.12	2.27	2.2	0.03**
3	Unmatched	0.22	-0.02	0.23	0.07	3.51		
3	ATT	0.21	-0.04	0.25	0.12	2.2	2.09	0.04**
4	Unmatched	0.22	-0.02	0.23	0.07	3.51		
4	ATT	0.21	-0.03	0.25	0.11	2.15	2.34	0.02**

** signifcant on the 5%-level. Bootstrapping with 200 replications.

Source: Own calculations, Midi-Dafne merge

Table 8: **ATT (difference-in-difference) regarding employment**

Model	Sample	Treated	Controls	Diff.	s.e.	t-value	t-value	p-value
1	Unmatched	-89,78	-549,6	459,81	1235,94	0,37		
1	ATT	-42,94	40,1	-83,04	68,9	-1,21	-0,9	0,37
2	Unmatched	-89,78	-549,6	459,81	1235,94	0,37		
2	ATT	-42,94	23,38	-66,33	67,11	-0,99	-0,71	0,48
3	Unmatched	-89,78	-549,6	459,81	1235,94	0,37		
3	ATT	-42,94	-29,32	-13,63	62,72	-0,22	-0,23	0,82
4	Unmatched	-89,78	-549,6	459,81	1235,94	0,37		
4	ATT	-42,94	-163,28	120,34	383,62	0,31	0,02	0,98

Bootstrapping with 200 replications.

Source: Own calculations, Midi-Dafne merge

ment and the productivity of multinational firms are rather unknown because only few empirical evidence has been dedicated to this topic. In this paper, we analyze firm data with information about inward and outward FDI linkages of German multinationals in order to contribute to fill this gap.

We used the only available dataset covering all inward and outward FDI linkages above a certain threshold on the micro-level in Germany (Microdatabase Direct Investment, MiDi, provided by the *Deutsche Bundesbank*) and enriched these data with more detailed balance-sheet information about German firms from Dafne, supplied by the Bureau van Dijk. Thereby, we were able to link panel data about FDI, making it possible to identify all cross-border M&A from 1997 to 2003 in Germany.

We find that foreign owned multinationals (FMNEs) are smaller and more productive than their domestic counterparts. In the mean, FMNEs have about 15 % less employees than domestic multinational enterprises (DMNEs). A large part of these differences is due the different industrial composition of both groups. But FMNEs show significantly higher levels of total factor productivity (TFP), about 6.4 % higher than comparable DMNEs in the same industry and of the same size. The gap of labor productivity amounts to 37 %.

Cross-border M&A of previously domestic multinationals are rare events. In total, using our full-coverage data, we identify 158 cross-border M&A from 1997 to 2003 in Germany. Performance after ownership change of multinationals is quite heterogeneous. While employment stays rather unchanged in the mean, the middle 50 % of multinationals all show positive developments of total factor productivity.

The following two results are specifically policy relevant: First, the average causal effect of cross-border M&A on the employment of multinationals is insignificant, but, second, the effect of cross-border M&A on the multinationals' productivity is positive and significant.

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Appendix 1: Descriptive Tables and Figures

Table 9: **Definition of industries**

no.	Industry	NACE 2-digit codes									
1	Light industries	15	16	17	18	19	20	21	22	23	36
2	Heavy industries	24	25	26	27	28					
3	Machinery, electronics, automobile	29	30	31	32	33	34	35			
4	Utilities, construction	40	41	45	90						
5	Sales	50	51	52	55						
6	Transport, communication, business services	60	61	62	63	64	72	73	74		
7	Finance	65	67								
8	Real estate	70	71								

Source: Own presentation

Figure 3: **The pure ownership effect**

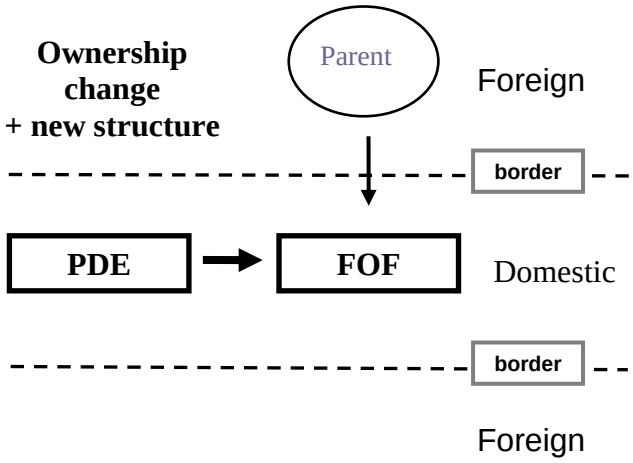


Figure 4: **Effect of ownership and MNE structure**

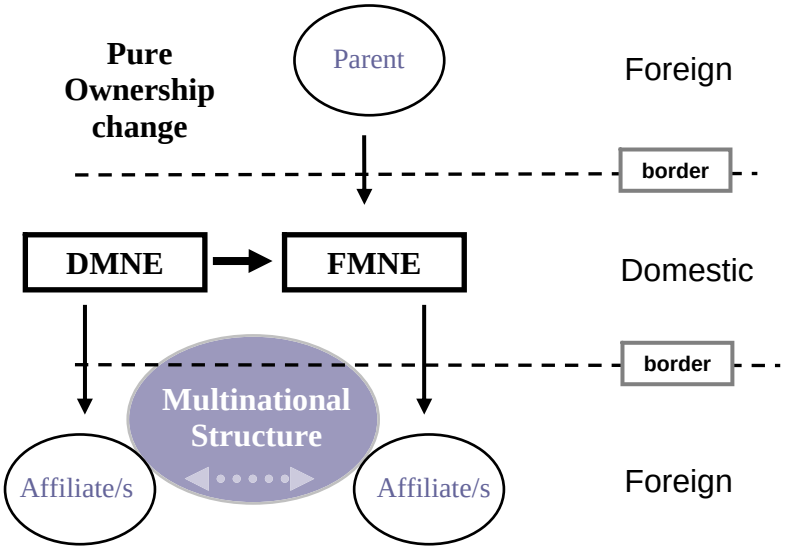
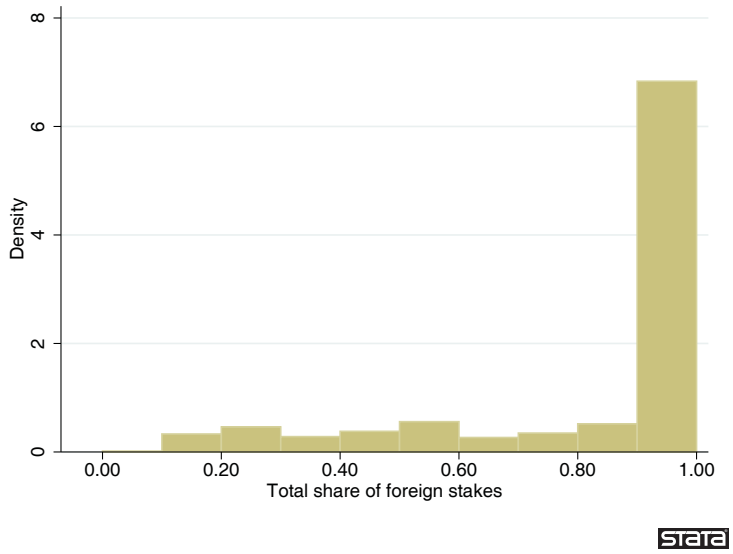
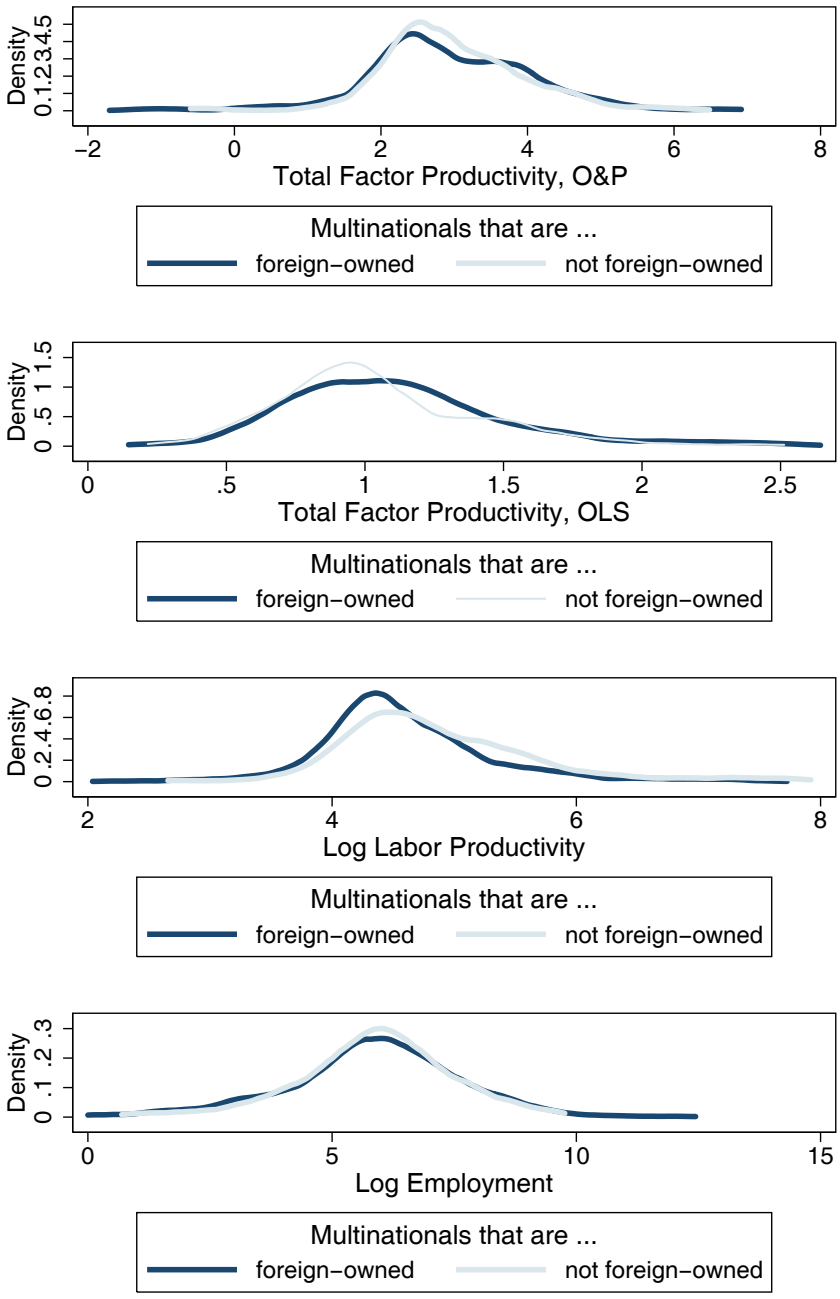


Figure 5: **The Distribution of Foreign Shares**



Source: Own presentation

Figure 6: **Productivity and employment distributions of domestic and foreign-owned multinationals**



Source: Own calculations, MiDi-Dafne merge.

Appendix 2: Balancing Characteristics of the Propensity Score

The main purpose of the estimation of the propensity score estimated in section 6.2 is to construct a suitable control group for the switchers, that is for the MNE subject to a foreign takeover. The control group should consist of "twins" that - ex ante - do not differ systematically from the switchers. This means that they should display the same characteristics as the switchers with the only exception that they are *not* subject of a foreign ownership change.

Table [X] shows summary statistics of the observable variable of switchers and their respective twins used for the matching estimator (the balancing properties of the sample). Since the DMNEs used for matching differ between the four different specifications presented in table 6, we also present the balancing properties for the four differnt samples. On the one hand we present descriptive statistics that show that there is *on average* no difference between the switchers and the twins. On the other hand, as second criterion, we consider the Standardized Bias as suggested by Rosenbaum and Rubin (1985) which is calculated as:

$$SB = 100\frac{(\bar{X}_1 - \bar{X}_0)}{\sqrt{0.5[V_1(X) + V_2(X)]}}$$

The statistics show that there is no systematic, significant difference between the switchers and their twins *before* the foreign ownership change. Also, the Standardized Bias is in every case well below X.

Table 10: **Relevance of foreign owned MNE relative to MNEs and total number of firms in Germany, entire period 1996 - 2004**

	FMNEs as share of MNEs			FMNEs as share of all firms in the data		
Sector	Percentage of firms	Employment share	Sales share	Percentage of firms	Employment share	Sales share
Total	29.6%	14.9%	8.7%	1.9%	7.3%	9.7%
Light industries	37.0%	36.6%	52.2%	3.3%	16.8%	49.1%
Heavy industries	27.9%	17.7%	16.2%	3.8%	12.8%	14.0%
Machinery, electronics, automobile	18.0%	11.3%	9.0%	6.3%	12.5%	7.8%
Utilities, construction	21.1%	6.9%	0.0%	0.3%	1.8%	0.3%
Sales	41.1%	23.9%	56.8%	2.2%	6.5%	23.7%
Transport, communication, business services	24.1%	7.6%	0.1%	1.9%	3.6%	1.1%
Finance	6.0%	0.5%	3.5%	0.3%	0.2%	1.3%
Real estate	20.6%	8.2%	16.8%	0.3%	14.0%	0.0%
Utilities, Construction	21.1%	6.9%	0.0%	0.3%	1.8%	0.3%
Manufacturing	31.6%	19.0%	15.5%	4.6%	13.1%	13.0%
Services	28.1%	9.1%	9.6%	1.5%	4.0%	4.9%

DMNE: Domestic Multinational Enterprises, FMNE: Foreign Multinational Enterprises. All values except age in EURO, age in years. 1997 - 2004. Source: Own calculations. MiDi-DAFNE-Merge. The left part of the table contains the number, the levels of employment and sales of FMNEs in relation to the respective measures of all MNEs, $\frac{y^{\text{FMNE}}}{y^{\text{FMNE}}+y^{\text{DMNE}}}$.

Table 11: **Balancing results**

Variable	Sample	Specification [1]				
		arithmetic mean		p > |t|	% bias	% reduct. bias
		switchers	control group			
Sales	all firms	3.10E+08	3.70E+08	0.911	-2.6	
	matched sample	3.40E+05	2.80E+05	0.63	0	99.9
Sales squared	all firms	1.60E+18	6.70E+18	0.66	-11.5	
	matched sample	3.70E+11	1.80E+11	0.48	0	100
Profit	all firms	1.70E+07	2.00E+07	0.959	-1.3	
	matched sample	6920.9	7148.5	0.978	0	100
Profit squared	all firms	8.40E+15	1.00E+17	0.839	-5.3	
	matched sample	1.20E+09	3.90E+08	0.263	0	100
Tangible	all firms	6.60E+07	3.30E+08	0.693	-10.4	
	matched sample	60836	58362	0.949	0	100
Tangible squared	all firms	6.20E+16	1.30E+19	0.724	-9.3	
	matched sample	1.50E+10	2.60E+10	0.824	0	100
Employment	all firms	1636.6	4820.3	0.502	-17.6	
	matched sample	1354.1	1471.4	0.82	-0.6	96.3
Employment squared	all firms	5.70E+06	6.80E+08	0.587	-14.3	
	matched sample	4.40E+06	5.60E+06	0.777	0	99.8
Market Share	all firms	8.8895	6.5057	0.418	12.9	
	matched sample	2.6304	2.9824	0.839	-1.9	85.2
Number of foreign affiliates	all firms	10.038	9.1056	0.769	5.8	
	matched sample	7.7273	8.8682	0.724	-7.1	-22.3
Number of foreign affiliates squared	all firms	350.96	339.94	0.973	0.8	
	matched sample	127.82	222.18	0.563	-6.5	-755.9
Volume of outward FDI	all firms	72294	1.40E+05	0.556	-15.7	
	matched sample	38461	65404	0.439	-6.6	57.7
Volume of outward FDI squared	all firms	2.80E+10	3.20E+11	0.598	-14.6	
	matched sample	6.10E+09	2.40E+10	0.523	-0.9	93.8
Debt / Equity ratio	all firms	3.6047	5.7639	0.799	-6.8	
	matched sample	3.4849	4.4761	0.895	-3.1	54.1
Debt	all firms	2.00E+08	2.90E+08	0.884	-3.7	
	matched sample	80596	83272	0.934	0	100
Firm Age	all firms	40.207	44.823	0.575	-11	
	matched sample	43.333	45.241	0.876	-4.5	58.7
Firm Age squared	all firms	3152.9	3938.8	0.484	-14.8	
	matched sample	3532.8	3766.1	0.871	-4.4	70.3

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