Reassessing the Foreign Ownership Wage Premium in Germany

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Abstract

This paper evaluates the effect of foreign takeover on wages of workers in German establishments, using rich linked employer-employee data from 2003 to 2014. To identify a causal effect of foreign takeover, we combine propensity-score matching with a difference-in-difference estimator. We find that a takeover by a foreign investor leads to a wage premium of 4.0 log points in the year after ownership change, which further increases to 6.3 log points three years after acquisition. The wage premium is largest for high-skilled workers and higher for managers than for non-managers. We also show that the wage premium does not pick up an exporter effect due to a platform investment of the foreign owner, that it takes four to five years before it fully develops, and that the wage increase is specific to foreign acquisition instead of ownership change per se.

JEL-Classifications: F14, F16, F23

Keywords: Foreign ownership wage premium, Impact vs. adjustment effects, Propensity-score matching, Difference-in-difference estimation

1 Introduction

Empirical evidence reported by Aitken et al. (1996) that foreign direct investment leads to higher wage payments has sparked a lot of interest among economists and has started a new strand of empirical research in international trade, documenting the existence of a foreign ownership wage premium (Girma et al., 2001; Velde and Morrissey, 2003; Lipsey and Sjöholm, 2004). With access to detailed firm-level data, the causal relationship between foreign ownership and wage premia has become an important topic in this strand of research over the last decade (Girma and Görg, 2007; Heyman et al., 2007; Balsvik, 2011). This paper provides new evidence for a foreign ownership wage premium in Germany.

We contribute to the literature by using a longitudinal linked employer-employee data set covering an observation window spanning the years 2003 to 2014 and thus more than one business cycle. Considering a long time span is important in order to distinguish the impact effect of foreign takeover in the period of ownership change from lagged adjustment effects in subsequent years. This long observation period allows us to isolate the impact of foreign takeover on German wages from effects of macroeconomic turmoil over the last two decades (such as the accession of China to the WTO, the Eastern enlargement of the EU, or the financial crisis). Moreover, compared to previous research, the richness of our data allows to investigate more profoundly whether the wage premium differs by skill group and whether managers, who supervise an acquisition, benefit most. Finally, detailed information on foreign activity of German producers enables us to investigate to what extent the wage premium picks up an exporter effect due to platform investment of the foreign owner.

To estimate a causal effect of foreign takeover on wages paid by German establishments, we combine propensity-score matching with a difference-in-difference estimator. We associate the probability of a worker in our sample to be treated – defined by staying in an establishment acquired by a foreign investor – with the product of two probabilities: the probability that the employer is target of a foreign takeover and the probability of the worker to remain employed in the same establishment. As both, worker and establishment characteristics, matter for the treatment, we follow Martins (2004) and Hijzen et al. (2013) and combine establishment information with data on worker characteristics in the propensity-score matching. To construct our control group, we match to each treated worker the nearest observational neighbours from establishments that are not subject to foreign takeover.

Using a difference-in-difference approach we then shed light on the effect of treat-

ment on wages distinguishing between an impact effect in the year after takeover and a lagged adjustment effect arising in the second and the third year after takeover. We use data from the year prior to acquisition to determine the control group and build our analysis on a four-year window around the takeover. Because we rely on takeover events from different years, choosing the same four-year observation window for all acquisitions is important (see Egger et al., 2008). In our baseline specification, we estimate an average wage premium from foreign takeover of 4.0 log points, which further grows to 6.3 log points three years after ownership change. This lagged wage increase is compatible with two interpretations: First, it takes time before the full effect of foreign takeover on the wages of stayers materialises. Second, foreign takeover affects not only the wage level but also the wage growth of workers in German plants. To investigate which of the two interpretations is valid, we expand the observation window around the takeover events to six years in an extension. The results indicate that the growth of wages observed after ownership change is temporary and washes out after four years.

When analysing the impact of ownership change for different skill groups, we find that the wage premium due to foreign acquisition is larger for high-skilled than for low- and medium-skilled workers. We also provide evidence that foreign takeover exerts a lagged adjustment effect particularly on the wages of medium- and high-skilled workers. Moreover, estimations based on a six-year window around the takeover event show that reaching the full effect of foreign takeover on wages takes longer for high-skilled workers.

The theoretical literature provides two main arguments for the existence of a foreign ownership wage premium immediately after takeover. First, establishments in foreign ownership use better technology. This technology advantage gives an incentive for offering a wage premium to reduce worker turnover and the risk of technology dissipation (see Glass and Saggi, 2002). Second, profitable multinational firms share rents with their foreign subsidiaries, which allows establishments in foreign ownership to pay higher wages (see Budd et al., 2005; Egger and Kreickemeier, 2013).[1] To explain a lagged adjustment effect, Fosfuri et al. (2001) and Görg et al. (2007) argue that foreign parents install new technology upon takeover, which requires workers to adjust their productivity. To the extent that the training of workers takes time, this theory provides a rationale for our observation that the wage premium of medium- and high-skilled workers further increases two years after takeover. Another expla-

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[1]Relying on Chinese data, Greaney and Li (2017) find support for both rent sharing and the incentive to reduce worker turnover.

nation for an adjustment effect can be derived from Gumpert (2018) who studies the organisation of knowledge in firms and argues that multinational parents pay higher wages in their foreign subsidiaries to compensate the workforce for lower support with headquarter services. Wage growth after a foreign takeover would be consistent with such a model if the adjustment of knowledge organisation takes time. However, so far there is no theory which simultaneously explains an immediate wage premium in the year after takeover and a lagged adjustment effect in consecutive periods.

To ensure that we estimate a foreign ownership premium and not simply the effects of rent appropriation by managers, we separately estimate the impact of a foreign takeover on the remuneration of managers and non-managers, thereby tackling an issue that has received considerable media attention in recent years. We find an additional wage premium from foreign takeover for managers in the pooled sample – as well as for the subgroup of medium-skilled workers – indicating that concerns about rent appropriation of managers in the context of foreign acquisition may be justified.

Furthermore, our results could be inflated if the main motive for takeovers of German establishments was not market access to Germany but market access to new members of the Single Market in Eastern Europe through platform investment. In the case of platform investment, the estimated wage effects may not pick up a foreign ownership wage premium but instead reflect an exporter premium associated with an expansion of trade with Eastern Europe after the millennium (cf. Dauth et al., 2014).[2] To examine whether the platform motive drives our results, we add a dummy for initial export status and interact it with our treatment variable. Our regression results indicate that the estimated wage premium from foreign takeover does not differ for initial exporters and non-exporters.

We complement our empirical analysis by conducting a placebo test and estimating the wage effects of takeover of German establishments by German investors. For low- and medium-skilled workers, we find negative and mostly insignificant effects. For high-skilled workers, we only document insignificant estimates. Thus, a wage premium from takeover only exists in our data if the investor comes from abroad.

The remainder of this paper is organised as follows. In Section 2 we introduce

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[2]The platform argument has been put forward by Motta and Norman (1996), Yeaple (2003), Ekholm et al. (2007) and Neary (2009) as an important motive for foreign investment. It has been used to explain the finding that foreign investment increased in times of falling trade costs. Bernard and Jensen (1995, 1999) were the first providing evidence that exporters pay higher wages than non-exporters. The existence of an exporter wage premium has been empirically confirmed by Schank et al. (2007) and Wagner (2007).

the data set and present descriptive statistics. In Section 3 we describe our empirical methodology and in Section 4 we present and discuss our estimation results. Section 5 shows the robustness of our results and Section 6 concludes.

2 Data Input And Descriptive Statistics

For our empirical analysis, we rely on two data sources provided by the Institute for Employment Research (IAB). The first data set is the IAB Establishment Panel, which consists of a stratified one percent random sample of establishments that employ at least one employee covered by the social security system at June 30 of a year. Since 1993, the IAB Establishment Panel surveys the same establishments from all industries in West Germany and since 1996 in East Germany. Response rates of repeatedly interviewed establishments – which account for about seven percent of the German workforce – are above 80 percent. From the survey questions, we use information about (change in) plant size, industry affiliation, exporting share, location and profitability. Crucial to our analysis, the IAB Establishment Panel also provides information on majority ownership of establishments, differentiating between East German, West German, foreign and public owners as well as a residual group, for which no majority owner is found. Relying on this information, we identify foreign takeover as a change in the majority ownership from German to non-German in two subsequent years.

As a second data set we use the Integrated Employment Biographies (IEB) of the IAB which covers about 80 percent of the German workforce. This data set contains administrative data on all employees who are subject to social security contributions. The IEB provides information about age, gender, nationality, tenure, occupation, education and the daily wage of workers employed in the plants of the IAB Establishment Panel.

The IEB can be linked to the IAB Establishment Panel by a unique identifier, which allows constructing a linked employer-employee data-set (LIAB) with highly reliable information on workers, wages and establishments.[3] The IEB does not contain detailed information on hours worked. In addition, since worker information comes from social security records, wages are top-coded at the social security contribution ceiling. To deal with these drawbacks, we use only full-time workers aged 16–65 years in our analysis and impute wages above the social security contribution

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[3]For further details on the LIAB, see Alda et al. (2005) and Klosterhuber et al. (2016).

ceiling using Tobit regressions (see, e.g. Schafer, 1997; Gartner, 2004; Baumgarten, 2013; Dustmann et al., 2014).[4] Furthermore, we have information on the education level, which is missing or inconsistent for some workers. To mitigate this problem, we impute missing or implausible information on education, relying on information from previous periods.

Due to the low number of takeovers prior to 2003, we use establishment and worker information for the years 2003 to 2014. Furthermore, we concentrate on establishments located in West Germany, because economic conditions and wages in East Germany still differ substantially from those in West Germany. Another reason for focusing on West Germany only is that we want to avoid attributing the effects of foreign takeover to more general (wage) adjustments during the ongoing transition and catch-up process of East Germany. We also drop establishments, which we do not observe over four consecutive years around the takeover. We use information from the year prior to takeover to match workers and the three years afterwards to distinguish the impact effect in the year after ownership change from lagged adjustment effects of foreign acquisition. Because we are interested in the wage impact of foreign takeover over a time span of three years, we only keep workers employed at an establishment over the four-year time horizon (stayers). We also drop workers changing their education over time or employees with a monthly wage below the social security threshold.[5] Finally, we drop one percent of workers with the highest wages in each year to avoid that outliers influence our results.

Table 1 reports descriptive statistics of the key variables used when matching workers from acquired to workers in non-acquired establishments. We identify 152 foreign takeovers and 24,946 stayers in the acquired establishments over our sample period. The descriptive statistics are in line with previous findings that establishments acquired by foreign investors differ from non-acquired establishments in various dimensions (see Gelübcke, 2013). Targeted establishments are bigger, more prevalent in manufacturing and less prevalent in services than in other industries. Moreover, foreign takeover targets exhibit better profits. At the worker level, Table 1 shows that acquired and non-acquired establishments differ slightly with regard to gender and skill composition and that employees in establishments that are target of foreign takeover receive higher wages. Overall, the descriptive statistics suggest that foreign investors do not choose establishments and their workforce randomly,

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[4]In 2003, the social security contribution ceiling was 167.67 Euro for daily wages and 12.5 percent of the wages of full-time workers are top-coded.

[5]The limit was 400 Euro per month from 2003 to 2012 and 450 Euro in 2013 and 2014.

Table 1: Descriptives of Key Covariates

	Acquired	(S.D.)	Non-Acquired Domestic	(S.D.)
(a) Plant-Characteristics				
Plants	152		6,219	
Plant-Years	608		56,052	
Log Employment	4.485	(1.726)	3.400	(1.580)
ΔLog Employment	-0.013	(0.207)	0.014	(0.179)
Agriculture and Energy	0.018	(0.133)	0.031	(0.173)
Manufacturing	0.479	(0.500)	0.276	(0.447)
Construction	0.033	(0.179)	0.107	(0.310)
Retail and Repair	0.192	(0.395)	0.185	(0.388)
Services and Finance	0.278	(0.448)	0.400	(0.490)
Profitability	0.493	(0.500)	0.413	(0.492)
(b) Worker-Characteristics				
Workers	24,946		489,686	
Worker-Years	99,784		3,502,568	
Log Wage	4.851	(0.463)	4.810	(0.504)
Age	42.8	(9.1)	42.8	(9.5)
Female	0.187	(0.390)	0.197	(0.398)
Low-skilled	0.142	(0.349)	0.123	(0.329)
Medium-skilled	0.744	(0.436)	0.759	(0.427)
High-skilled	0.114	(0.317)	0.117	(0.322)

Notes: Plant-characteristics are plant-year averages which are taken from the IAB Establishment Panel survey. Worker-characteristics are worker-year averages which come from the IEB. ΔLog Employment is the difference in log employment before ownership change. We classify workers with no vocational training, no high-school degree (Abitur) or workers lacking education information and conducting simple tasks as low-skilled; workers with a high-school degree and/or vocational training or workers lacking education information and conducting specialised tasks as medium-skilled; workers with a degree from a university or a university of applied sciences or workers lacking education information and conducting highly-complex tasks as high-skilled. The dummy variable profitability is one if a plant evaluates its previous profits as very good or good. Further matching variables (not listed) are eight West German federal state dummies for Schleswig-Holstein (including Hamburg), Lower Saxony (including Bremen), North Rhine-Westphalia, Hesse, Rhineland-Palatinate (including Saarland), Baden-Württemberg, Bavaria and Berlin.

which is why we perform propensity score matching to deal with selection.

3 Estimation Strategy

3.1 Baseline Specification

To estimate the effect of foreign acquisition on wages, we use information from a four-year window around a takeover event. Specifically, to construct our control group, we use data one year prior to the change in ownership, whereas we use information from three years after foreign takeover to distinguish the impact effect of ownership change from lagged adjustment effects. Thus, we consider foreign acquisitions in the years 2004 to 2012. Despite the long observation period, we observe only 152 foreign takeovers. To avoid problems from small sample size, we therefore follow Martins (2004), Heyman et al. (2007) and Hijzen et al. (2013) and build our analysis on individual worker data. All workers in an establishment subject to a foreign takeover are part of the *treatment group* if they are continuously employed in the same establishment over the four-year window around ownership change. Accordingly,

$$D_{ij} = \begin{cases} 1 & \text{if } i \text{ employed in } j \text{ from } t = 0 \text{ to } t = 3 \text{ and } j \text{ foreign-acquired} \\ 0 & \text{if } i \text{ employed in } j \text{ from } t = 0 \text{ to } t = 3 \text{ and } j \text{ domestic \& non-acquired} \end{cases}$$

defines the treatment indicator D_{ij} which is equal to one if worker i from establishment j that has been acquired by a foreign investor between $t = 0$ and $t = 1$ stays in this establishment over the period $t = 0$ to $t = 3$.[6] In contrast, the treatment indicator is zero if worker i's plant j remains domestically owned over the four-year observation window, which defines our *control group.* However, to identify a causal effect of foreign takeover on wages, we have to take into account that acquired and non-acquired establishments differ in several dimensions, including their workforce (see Table 1). Since previous research shows that establishment characteristics and worker characteristics are determinants of both foreign takeover (see Girma and Görg, 2007; Heyman et al., 2007; Bandick and Görg, 2010) and wage payments (Bayard and Troske, 1999; Idson and Oi, 1999; Winter-Ebmer and Zweimüller, 1999), estimates of the effects of foreign takeover that do not account for pre-existing establishment and worker differences are vulnerable to a selection bias.

To overcome the problem of selection bias, we use nearest-neighbour propensity-score matching to define a suitable control group (see e.g. Rosenbaum and Rubin,

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[6]Since we do not know the exact date of ownership change, we refer to period $t = 0$ as the year prior to takeover and to period $t = 1$ as the year after takeover.

1983). We use the variables reported in Table 1 to construct the treatment and control group. To determine the nearest neighbour of a worker in the treatment group, we proceed in two steps. We first estimate the probability that a worker i is employed in plant j in the year prior to foreign takeover ($t = 0$) and stays in the plant until year $t = 3$. We then match workers from the treatment group to workers with the smallest absolute distance in their propensity scores in the control group.

We model the probability of workers to be treated,

$$P(D_{ij} = 1) = \Phi(\beta \cdot \mathbf{X}_{j,0} + \gamma \cdot \mathbf{X}_{i,0}), \tag{1}$$

as a function of a vector of establishment-level covariates, $\mathbf{X}_{j,0}$, and a vector of worker-level covariates, $\mathbf{X}_{i,0}$, measured in period $t = 0$ (with β, γ the respective vectors of coefficients). Establishment-level covariates include the log of employment to control for the plant size, the change in log employment prior to takeover to capture business conditions, as well as a dummy that is one if a plant reports very good or good profits as proxy for profitability, five sector-dummies indicating establishments' industry affiliation and eight federal state-dummies determining establishments' location.[7]

Worker-level covariates include information on log wage, age and gender to control for worker heterogeneity. Conditioning on worker characteristics prior to an ownership change ensures that we compare two workers – one in a foreign-acquired and the other in a domestic establishment – with similar earnings potential before the takeover event. To minimise differences in workers' education level, we also match on workers' skill levels. Finally, we match observations from the same year to minimise the risk that estimates of the foreign ownership wage premium pick up macroeconomic changes that have been quite substantial over the observation period.

Table A.1 in the Appendix reports the mean values of the covariates in the treatment and control group before and after matching. We also show two diagnostics for evaluating the matching quality based on individual covariates (see Girma and Görg, 2007; Hijzen et al., 2013; Balsvik and Saethre, 2016). The first one is the standardised (percentage) bias put forward by Rosenbaum and Rubin (1985). The reduction of the mean standardised bias from 14.8 percent in the unmatched to 4.2 percent in the matched sample indicates a fairly good matching result. As a sec-

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[7]Due to the low number of affected workers in some federal states we assign Bremen (538 stayers) to Lower Saxony, Saarland (11 stayers) to Rhineland-Palatinate and Hamburg (554 stayers) to Schleswig-Holstein.

ond diagnostics, we report the normalised difference of covariate means introduced by Imbens and Wooldridge (2009), who suggest an upper limit of one quarter to consider a variable as sufficiently balanced. This criterion is fulfilled for all of our covariates.

We estimate the causal effect of foreign takeover on the wages of stayers using a difference-in-difference (DID) approach. We estimate the treatment effect separately for the year after a foreign takeover and the two subsequent years using a baseline DID model of the following form:

$$w_{ijt} = \alpha_i + \lambda_t + \sum_{s=1}^{3} \nu_s \cdot d_t^s \cdot D_{ij} + \epsilon_{ijt}, \tag{2}$$

where w_{ijt} is the log daily wage of worker i in plant j and year t after ownership change, α_i is a worker fixed effect to control for time-invariant unobserved heterogeneity and λ_t is a time-fixed effect.[8] Furthermore, d_t^s is a time dummy equal to one if $t = s$ and D_{ij} is the treatment indicator equal to one for each stayer, whose plant j has been acquired between $t = 0$ and $t = 1$, and zero otherwise. Parameters ν_s are the coefficients for the interaction term of the time dummies with the treatment indicator. Finally, ϵ_{ijt} is the error term. Since the estimates of ν_s represent the wage premium s periods after a worker experiences a foreign takeover, Equation (2) allows to estimate the effect of ownership change at three points in time. Hence, we can determine if the effect of foreign takeover on wages is immediate or takes time to develop (see Balsvik and Haller, 2010; Hijzen et al., 2013).

The coefficients ν_s capture a causal average treatment effect of foreign takeover on workers if the following three assumptions hold. The first one is the *Conditional Independence Assumption* (CIA), which states that conditional on the covariates in Table 1 the assignment of workers into treatment and control group is random. We take the CIA into account by matching on establishment characteristics, such as establishment size, employment growth, industry, establishments' location and profitability, as well as worker characteristics, such as age, gender, skill dummies and the log daily wage.

The second assumption is the *Stable Unit-Treatment Value Assumption* (SUTVA). In our context, this assumption requires that untreated workers' wages are not affected by other workers staying in a foreign acquired establishment. We are confident

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[8]Since all workers in our sample are stayers, we cannot estimate a separate establishment fixed effect. Put differently, the average worker fixed effect within an establishment is the establishment fixed effect.

that the SUTVA holds because the number of foreign takeovers compared to the to-
tal German establishment population is small (see Table 1). Thus, we do not expect
an effect of a foreign takeover on the wages of untreated workers, e.g. due to an
increase in equilibrium wages for all workers.

Third, in the absence of treatment, the wages of both treated and untreated
workers have to follow the same path, which is referred to as the *Common Trend
Assumption* (CTA). With data from only one pre-acquisition period, it is not possible
to test if the CTA holds prior to takeover (see e.g. Mora and Reggio, 2012). However,
our matching approach ensures that workers in the treatment and control group are
similar in their skills as well as their wages prior to acquisition. To the extent that
wages of workers with similar characteristics follow a common trend in a competitive
labour market, it is likely that our matching approach does not violate the CTA. As
suggested by Pischke (2005), we investigate pre-treatment trends graphically. Since
examining a pre-trend requires at least two observations for each worker prior to
a foreign takeover, we restrict the sample to all matched worker-pairs, which we
observe from period $t = -1$ to period $t = 3$. This decreases the sample to 15,581
stayers in 117 foreign-acquired plants.

Figure 1: Average Wages in Treated and Matched Control Group
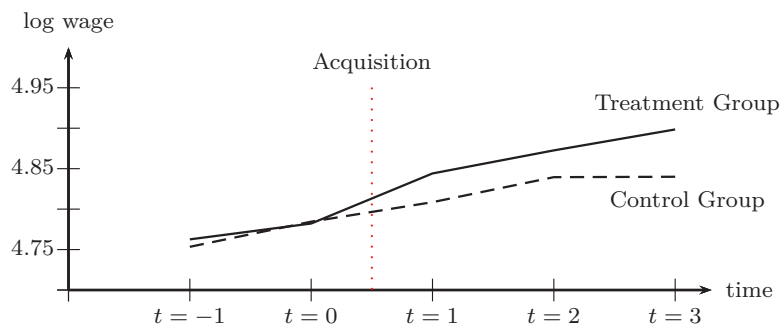
Figure 1 depicts the wage trend of treated and untreated workers. The graph
shows that wages grow similarly prior to foreign acquisition and that our matching
is successful in eliminating differences in average wages between treated and control
group. A test on the equality of means confirms that average wages in period $t = 0$
do not differ significantly between groups. Finally, a simple linear regression of the
wage increase between $t = -1$ and $t = 0$ additionally shows that the growth in
wages prior to acquisition is similar. These results suggest that the wage premium
from foreign takeover does not pick up pre-existing differences in the compositions of

11

treatment and control group. As illustrated by Figure 1, workers in establishments that are subject to foreign takeover experience, however, a considerably steeper wage profile after ownership changes.

3.2 Heterogeneity of the Foreign Wage Premium

Combining propensity-score matching with a difference-in-difference approach allows to estimate a causal effect of a foreign takeover on wages. However, if the wage premium from foreign takeover differs between heterogeneous workers or plants, estimates from the pooled sample are less informative. From a policy perspective, heterogeneity in the wage premium is particularly relevant if some workers benefit from a foreign investment while others lose. There are two approaches to analyse if the wage premium varies across workers. First, we can split the sample by observable differences of workers and estimate the model in Equation (2) separately for the sub-samples. We follow this approach to analyse if pooling over skill groups is justified in our model.

Second, we can include interaction terms in the difference-in-difference regression and estimate a model of the following form,

$$w_{ijt} = \alpha_i + \lambda_t + \sum_{s=1}^{3} \nu_s \cdot d_t^s \cdot D_{ij} + \sum_{s=1}^{3} \eta_s \cdot d_t^s \cdot I_i + \sum_{s=1}^{3} \pi_s \cdot d_t^s \cdot D_{ij} \cdot I_i + \rho_{ijt}, \quad (3)$$

where I_i is an indicator variable for worker i, which is one if worker i belongs to a certain sub-group and zero otherwise, and ρ_{ijt} is an error term. Accordingly, coefficients η_s measure the wage differential s years after ownership change for workers with $I_i = 1$ compared to workers with $I_i = 0$. π_s is the additional wage gain s years after acquisiton from foreign takeover between years $t = 0$ and $t = 1$ for workers from this group. In general, I_i can vary across workers differing in individual characteristics within an establishment (such as the manager status) or can be the same for all workers from the same establishment but differ between establishments (such as the export status of the employer).

4 Results

This section presents results from our difference-in-difference estimation for the matched sample of treated and untreated workers. The estimates reported in Table 2 rely on the baseline specification in Equation (2). In the first column, we report

our finding for the pooled sample of all workers. The estimates show that workers receive a wage premium of 4.0 log points in the year after ownership change, with the wage premium further increasing to 6.3 log points after three years. A simple Wald test, which compares the equality of coefficients, shows that the differences between the premia in $t = 3$ and $t = 1$ are significant. These results are similar in size to previous estimates for Germany (see Andrews et al., 2009; Hijzen et al., 2013) and in line with findings from other studies arguing that the impact of ownership change takes time to develop (see Balsvik and Haller, 2010; Hijzen et al., 2013).

A positive impact on wages in the first year after foreign takeover seems well in line with two strands of theoretical research. The first one emphasises that multinational firms pay workers a wage premium to reduce turnover and thus the risk of technology dissipation (see Glass and Saggi, 2002). The second one argues that workers in establishments owned by a foreign parent with high profitability receive higher wages due to international rent sharing (see Budd et al., 2005; Egger and Kreickemeier, 2013). The finding of a further wage increase even three years after takeover is consistent with the argument that foreign investors introduce new technology and that workers have to be trained before using new technology productively (see Fosfuri et al., 2001; Görg et al., 2007). Our finding of a positive impact and a lagged adjustment effect suggests that arguments from both strands of the theoretical literature must be combined to explain the wage effects of foreign takeover in German plants.

Columns (2) to (4) of Table 2 show the estimates of foreign takeover by skill groups. We find that the immediate wage impact in the period of ownership change with 3.1 log points is less pronounced for low- and medium-skilled workers than for high skilled workers, who obtain a sizeable wage premium of 11.3 log points right after a foreign takeover. This indicates that rent sharing and worker turnover aversion are more important motives for paying a wage premium if workers are better educated. The wage premium of low-skilled workers is positive but insignificantly different from zero in $t = 2$ and reaches 2.6 log points in the third year after takeover. The wage premium for medium skilled workers increases to 5.2 log points while the wage premium for high skilled workers noticeably rises to 18.1 log points after 3 years. The differences in the wage premia between periods $t = 3$ and $t = 1$ for medium- and high-skilled workers are significant. Thus, wages even grow stronger after the ownership change – particularly for workers with higher skill levels.

To investigate to what extent the skill bias in the foreign takeover effect reported in Table 2 captures differences in the positions of workers with different skill levels

Table 2: The Foreign Ownership Wage Premium

	All workers	Low-skilled	Med.-skilled	High-skilled
	(1)	(2)	(3)	(4)
Acquisition $t = 1$	0.040***	0.031***	0.031***	0.113***
	(0.010)	(0.011)	(0.009)	(0.022)
Acquisition $t = 2$	0.042***	0.008	0.030***	0.167***
	(0.012)	(0.014)	(0.010)	(0.028)
Acquisition $t = 3$	0.063***	0.026*	0.052***	0.181***
	(0.014)	(0.016)	(0.012)	(0.030)
Constant	4.780***	4.641***	4.763***	5.062***
	(0.004)	(0.005)	(0.004)	(0.009)
Observations	199,384	28,368	148,352	22,664

Notes: Dependent variable is the log daily wage. The estimation includes time dummies and worker fixed effects. Standard errors in parentheses are clustered at the establishment-level. ***, ** and * denote significance at the 1, 5 and 10 percent levels, respectively.

in a plant's hierarchy, we estimate the model outlined in Equation (3), in which we additionally interact the treatment indicators with the manager status of workers. For this purpose, we use occupation codes from the German nomenclature in 1988 (KldB 1988) available in the LIAB.[9] We convert these codes into the international standard classification of occupations (ISCO-88 COM) and assign employees to three hierarchical layers *workers*, *supervisors* and *managers or directors*, following Caliendo et al. (2015). We then refer to *managers or directors* simply as *managers*.[10] Of course, formal education and hierarchical position in a plant are highly correlated. Still, distinguishing between skill groups and management status is not the same, because low-skilled workers can be managers of an establishment, while high-skilled university graduates can end up working in the production process. In our sample, about 13.6 percent of workers are managers, with the fraction varying between 1.3 percent among low-skilled workers, 7.9 percent among medium-skilled workers and 63.4 percent among high-skilled workers. Table 3 summarises the estimation results when additionally taking into account the manager status of workers.

Column (1) in Table 3 shows that the wage premium of 3.1 log points for non-managers is considerable lower than for managers who receive a wage premium of 10.3 log points in the year after acquisition. Similar to the baseline results in Table

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[9]The occupation codes capture the job a worker currently performs.

[10]Accordingly, our manager category comprises workers from ISCO-88 COM codes 111-131 and 211-247.

Table 3: The Foreign Ownership Wage Premium for Managers

	All workers	Low-skilled	Med.-skilled	High-skilled
	(1)	(2)	(3)	(4)
Acquisition $t=1$	0.031***	0.027**	0.028***	0.100***
	(0.009)	(0.011)	(0.008)	(0.028)
Acquisition $t=2$	0.032***	0.008	0.030***	0.140***
	(0.010)	(0.013)	(0.009)	(0.031)
Acquisition $t=3$	0.051***	0.027*	0.049***	0.154***
	(0.012)	(0.015)	(0.012)	(0.029)
Manager·Acquisition $t=1$	0.072***	0.060*	0.035*	0.015
	(0.019)	(0.036)	(0.020)	(0.034)
Manager·Acquisition $t=2$	0.087***	0.033	0.015	0.039
	(0.021)	(0.032)	(0.018)	(0.039)
Manager·Acquisition $t=3$	0.097***	0.023	0.036*	0.043
	(0.026)	(0.039)	(0.022)	(0.046)
Constant	4.780***	4.641***	4.763***	5.062***
	(0.004)	(0.005)	(0.004)	(0.009)
Observations	199,384	28,368	148,352	22,664

Notes: Dependent variable is the log daily wage. The estimation includes time dummies and worker fixed effects. Standard errors in parentheses are clustered at the establishment-level. ***, ** and * denote significance at the 1, 5 and 10 percent levels, respectively.

2, the wage premium increases for non-managers to 5.1 log points and for managers to 14.8 log points three periods after the ownership change. This result is well in line with the widespread concern that managers use events of foreign takeover for rent appropriation. Incentives for rent appropriation exist in particular if performance-based contracts stipulate higher remuneration upon completion of an acquisition.

When investigating the effect of takeover by skill group, Columns (2) to (4) show that for non-managers the initial ranking of wage gains from our baseline specification is unaffected with the wage premia ranging from 2.7 to 10.0 log points in the first and 2.7 to 15.4 log points in the third year after ownership change. Moreover, we find an additional and immediate wage gain of 3.5 log points for medium-skilled managers, which stays fairly stable over the three-year, post-treatment observation window. Our results for the low-skilled group indicate that in the first year after ownership change low-skilled managers receive an additional positive wage premium of 6.0 log points. In the second and third year after takeover for low-skilled workers and over the whole post-treatment observation window for the group of high-skilled

workers, we estimate a positive effect of manager status on the foreign ownership wage premium, which is, however, not statistically significant. Summing up our results, we find that after separating the wage gain by manager status, wage premia for non-managers decrease in all skill groups – with high-skilled workers still receiving the largest wage increase – but remain economically and statistically significant. This differentiates our results from Heyman et al. (2011) who, using Swedish linked employer-employee data, report that the foreign ownership wage premium of high-skilled workers disappears when investigating the wage gain by manager status.

In a next step, we include the initial exporter status of establishments and interact it with the treatment indicator. The exporter dummy is one if the plant generated positive revenues abroad in the year prior to acquisition. Adding this dummy allows to analyse to what extent the wage premium attributed to foreign takeover actually captures a wage premium from exporting (see Bernard and Jensen, 1995; Schank et al., 2007). We conduct this analysis because one motive for the acquisition of a foreign establishment is platform investment, whose main purpose is entrance in nearby export markets.[11]

To investigate whether our results capture a wage premium because foreign investors target exporting establishments, Table 4 displays the wage effects for workers employed by initial exporters and non-exporters. Our results indicate that the wage premium is not significantly different between workers employed by exporters and non-exporters. Dividing the sample by skill groups shows that we observe the same ranking of wage premia as in our baseline specification, i.e. high-skilled workers receiving the highest premium and low-skilled workers the lowest one. From the results in Table 4, we therefore conclude that the estimated wage premium does not pick up an exporter effect.

5 Robustness

Section 4 documents a sizeable effect on wages in the year after foreign takeover as well as evidence for a lagged adjustment effect, suggesting additional wage growth in later years for medium- and high-skilled workers. There are two possible interpretations of the lagged adjustment in wages. On the one hand, additional positive wage effects may arise because it takes some time before the full effect of ownership change materialises – for instance, due to increased training in the period right after

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[11]The literature points to the opening up of Eastern Europe as a historic event providing evidence for platform foreign investment (see Motta and Norman, 1996; Ekholm et al., 2007; Neary, 2009).

Table 4: The Foreign Ownership Wage Premium for Exporters

	All workers	Low-skilled	Med.-skilled	High-skilled
	(1)	*(2)*	*(3)*	*(4)*
Acquisition $t = 1$	0.057***	0.038*	0.049**	0.132***
	(0.021)	(0.023)	(0.023)	(0.028)
Acquisition $t = 2$	0.053***	0.010	0.045**	0.157***
	(0.017)	(0.016)	(0.018)	(0.041)
Acquisition $t = 3$	0.064***	0.036*	0.055**	0.157***
	(0.021)	(0.019)	(0.023)	(0.031)
Exporter·Acquisition $t = 1$	-0.023	-0.010	-0.025	-0.029
	(0.024)	(0.026)	(0.025)	(0.040)
Exporter·Acquisition $t = 2$	-0.015	-0.002	-0.022	0.012
	(0.023)	(0.025)	(0.021)	(0.053)
Exporter·Acquisition $t = 3$	-0.002	-0.013	-0.005	0.033
	(0.028)	(0.028)	(0.027)	(0.048)
Constant	4.780***	4.641***	4.763***	5.062***
	(0.004)	(0.005)	(0.004)	(0.009)
Observations	199,384	28,368	148,352	22,664

Notes: Dependent variable is the log daily wage. The estimation includes time dummies and worker fixed effects. Standard errors in parentheses are clustered at the establishment-level. ***, ** and * denote significance at the 1, 5 and 10 percent levels, respectively.

ownership change (see Fosfuri et al., 2001; Görg et al., 2007). On the other hand, the lagged adjustment in wages is also consistent with the idea that foreign takeover does not only increase the level but also the growth rate of wages.

To investigate, which of these two interpretations is supported by our data, we expand the time window around the ownership change to six years. Expanding the observation window reduces the number of takeover events to 50 and the number of treated stayers to 9,289. It also somewhat increases the mean standardised bias of matching. Still, this exercise has the advantage of showing a more long-run perspective of wage adjustments due to ownership change. Table 5 reports the results and shows that – despite the reduction in the number of observations – the general picture regarding the effects of foreign takeover on the wages in the first three years after ownership change remains by and large unaffected. Furthermore, looking at periods four and five after ownership change reveals that the wage growth is temporary and washes out after four to five years. For low-skilled and medium-skilled workers we even observe a decline in the estimated wage premium after four

Table 5: The Foreign Ownership Wage Premium Over Five Years

	All workers	Low-skilled	Med.-skilled	High-skilled
	(1)	(2)	(3)	(4)
Acquisition $t = 1$	0.055***	0.060***	0.043**	0.135***
	(0.017)	(0.019)	(0.017)	(0.032)
Acquisition $t = 2$	0.062***	0.041*	0.047***	0.219***
	(0.017)	(0.022)	(0.015)	(0.043)
Acquisition $t = 3$	0.095***	0.065***	0.080***	0.251***
	(0.022)	(0.021)	(0.022)	(0.038)
Acquisition $t = 4$	0.117***	0.071**	0.103***	0.300***
	(0.026)	(0.029)	(0.025)	(0.037)
Acquisition $t = 5$	0.100***	0.050	0.081**	0.323***
	(0.035)	(0.040)	(0.034)	(0.067)
Constant	4.799***	4.679***	4.786***	5.075***
	(0.009)	(0.010)	(0.009)	(0.017)
Observations	111,468	15,468	85,188	10,812

Notes: Dependent variable is the log daily wage. The estimation includes time dummies and worker fixed effects. Standard errors in parentheses are clustered at the establishment-level. ***, ** and * denote significance at the 1, 5 and 10 percent levels, respectively.

years. High-skilled workers receive a higher wage premium in $t = 5$ as compared to $t = 4$, but the estimates do not differ significantly, indicating that the wage premia for high-skilled workers also stop increasing after four to five years. This suggests that foreign takeover affects the level and not the growth rate of wages, with the level effect requiring four to five years before materialising fully.

To ensure that the wage premia reported in Table 2 are due to foreign takeover and not the result of a general acquisition effect, we additionally conduct a placebo test, in which we consider takeovers of West German plants by East or West German investors. For this purpose, we use the IAB Establishment Panel to identify whether the majority owner of an establishment is from West or East Germany and classify a German takeover as an event, in which ownership in two consecutive years switches from West German to East German or vice versa. We identify 81 intra-German takeovers with 2,721 stayers over our sample period. The matching for this placebo is similarly successful as for our main specification. Table 6 presents the results.

To the extent that our estimates so far only capture a general takeover effect, stayers in domestic-acquired establishments should experience a wage increase similar to stayers in foreign-acquired establishments. However, Table 6 shows that this is

Table 6: The Wage Premium from Intra-German Takeovers

	All workers (1)	Low-skilled (2)	Med.-skilled (3)	High-skilled (4)
Acquisition $t=1$	-0.004	-0.003	-0.009	0.023
	(0.012)	(0.018)	(0.012)	(0.025)
Acquisition $t=2$	-0.022*	-0.017	-0.027**	-0.003
	(0.012)	(0.023)	(0.013)	(0.033)
Acquisition $t=3$	-0.050	-0.088	-0.047	0.003
	(0.036)	(0.070)	(0.031)	(0.027)
Constant	4.366***	4.298***	4.351***	4.581***
	(0.005)	(0.010)	(0.005)	(0.009)
Observations	21,736	4,424	14,896	2,416

Notes: Dependent variable is the log daily wage. Estimation includes relative time dummies and controls for worker fixed effects. Standard errors in parentheses are clustered at the establishment-level. ***, ** and * denote significance at the 1, 5 and 10 percent levels, respectively.

clearly not the case. For low- and high-skilled workers we find no significant effect of a German takeover. Medium-skilled workers even lose from a takeover by a German investor after two years. Summing up these results, the insignificant and negative coefficients in Table 6 suggest that the wage premia in Table 2 do not capture a general takeover, but rather a genuine foreign takeover effect.

To ensure that our results are robust to changing the set of covariates used for matching, we control for three additional variables in the propensity-score estimation. The first one is a dummy variable that is one if the establishment has already existed prior to 1990. This dummy controls for selection of older targets by foreign investors, which can pay higher wages because they are already well-established in the market (see Heyman et al., 2007). As a second matching variable, we add a dummy that is one if wages paid by the establishment are subject to collective labour agreements. Accounting for this dummy helps ruling out a selection bias because foreign investors aim to avoid wage pressure from unions.[12]

As a final control variable, we add the share of female workers because recent research by Vahter and Masso (2018) suggests that foreign investors require stronger commitment and higher flexibility from workers, which potentially leads to selection of establishments with fewer women, who might be less flexible due to family responsibilities. We compute the share of female workers in $t=0$ as the share of

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[12]The turmoil after the takeover of the German automotive supplier Grohmann Engineering by Tesla is a prominent example in this case.

females among the total workforce in an establishment.

If foreign investors acquire establishments, which are older, covered by collective agreements and/or employ an below-average share of women, our matching would suffer from omitted variable bias when not controlling for these covariates.[13]

Table 7: Additional Matching Covariates

	All workers	Low-skilled	Med.-skilled	High-skilled
	(1)	(2)	(3)	(4)
Acquisition $t = 1$	0.037***	0.028**	0.028***	0.107***
	(0.010)	(0.011)	(0.009)	(0.022)
Acquisition $t = 2$	0.038***	0.011	0.024**	0.165***
	(0.012)	(0.015)	(0.010)	(0.028)
Acquisition $t = 3$	0.060***	0.027*	0.049***	0.174***
	(0.014)	(0.015)	(0.012)	(0.030)
Constant	4.757***	4.626***	4.740***	5.031***
	(0.004)	(0.005)	(0.004)	(0.009)
Observations	199,496	28,400	148,432	22,664

Notes: Nearest-neighbour propensity-score matching includes a dummy indicating if the plant has already existed prior to 1990, a dummy for workers under collective labour agreements and the establishment share of females in addition to baseline covariates in Table A.1. The dependent variable in the difference-in-difference estimation is the log daily wage. The estimation includes time dummies and worker fixed effects. Standard errors in parentheses are clustered at the establishment-level. ***, ** and * denote significance at the 1, 5 and 10 percent levels, respectively.

Table 7 shows the results after adding the three additional matching variables and confirms our initial findings. Thus, selection by firm age, coverage by collective agreements or gender composition does not drive our results. Matching with a more extensive set of covariates leaves the initial ranking of wage premia unaffected. Moreover, the wage premia are similar in size, ranging from 2.8 to 10.7 log points in the period after takeover and 2.7 to 17.4 log points after three years.

In a further robustness check, we refine our matching approach by introducing a caliper of 0.05. This implies that stayers are matched to controls only within a range of 0.05 of their respective propensity scores and excludes observations for which no

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[13]Despite adding three new covariates, matching is similarly successful as in our main specification. The mean standardised bias slightly increases to 6.5 percent, while normalised differences are smaller than one quarter for all covariates.

match is found within this range.[14]

Table 8: The Foreign Ownership Wage Premium with Caliper Matching

	All workers	Low-skilled	Med.-skilled	High-skilled
	(1)	(2)	(3)	(4)
Acquisition $t = 1$	0.036***	0.021*	0.024**	0.122***
	(0.010)	(0.011)	(0.010)	(0.030)
Acquisition $t = 2$	0.035***	-0.005	0.020**	0.173***
	(0.011)	(0.010)	(0.009)	(0.035)
Acquisition $t = 3$	0.057***	0.015	0.043***	0.187***
	(0.013)	(0.013)	(0.012)	(0.037)
Constant	4.752***	4.611***	4.735***	5.033***
	(0.004)	(0.004)	(0.004)	(0.012)
Observations	174,856	25,240	128,704	20,912

Notes: Propensity-score matching is conducted with a caliper of 0.05. The dependent variable in the difference-in-difference estimation is the log daily wage. The estimation includes time dummies and worker fixed effects. Standard errors in parentheses are clustered at the establishment-level. ***, ** and * denote significance at the 1, 5 and 10 percent levels, respectively.

Table 8 confirms our baseline results that foreign takeover leads to an immediate wage increase for all workers. The reported coefficients vary between 2.1 and 12.2 log points in $t = 1$ and 1.5 to 18.7 log points in $t = 3$ and are comparable in size to the estimates relying on nearest-neighbour matching without a caliper reported in Table 2. However, the estimated low-skilled wage premium in period $t = 3$ is no longer significant. Overall, we nonetheless conclude that the finding of a significant foreign ownership wage premium is robust to refinements of the matching procedure.[15]

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[14]The standardised bias of caliper matching is 6.1 percent and normalised differences are less than 0.13 for all variables. The number of establishments subject to foreign takeover remains unaffected, whereas the number of treated workers falls to 21,857, which implies a decrease by 3,066 observations.

[15]The finding of a significant foreign ownership wage premium also remains unchanged when conducting matching with replacement, when matching separately for each skill group or after excluding workers lacking reliable education information. Furthermore, the results are robust to including part-time workers or to restricting the sample to establishments with more than ten full-time workers, which is the threshold at which employment protection legislation in Germany limits the scope of establishments to lay off workers.

6 Conclusion

This paper provides new evidence on the foreign ownership wage premium from a large German employer-employee data set. Using information on ownership change of German establishments, we observe 152 foreign takeover events over the period 2003 to 2014. To identify a causal effect of foreign acquisition, we combine propensity-score matching with a difference-in-difference estimator. We then analyse workers' wages in the year after ownership change as well as in two subsequent periods to distinguish impact effects from lagged adjustment effects. Similar to previous studies, we conduct our analysis at the worker level and consider employees staying in the same establishment over a four-year window around ownership change.

Based on this data set, we provide evidence for the existence of a foreign ownership wage premium in the year after takeover. On average, this wage premium amounts to 4.0 log points and varies considerably by skill group. We also find evidence for a lagged adjustment effect, in particular for medium- and high-skilled workers. Moreover, high-skilled workers experience the highest wage stimulus from ownership change over the whole observation period. Additionally, we show that the hierarchical position of workers in a plant explains part of the foreign ownership wage premium because the estimated wage effect of takeover decreases but remains significant when taking into account the manager status of workers. Furthermore, the wage premium is of similar size for initial exporters and non-exporters. Expanding the observation window around takeover events reveals that foreign takeover increases the level but not the growth rate of wages, with the level effect requiring four to five years before materialising fully. In a placebo test, we analyse takeovers by German investors and show that intra-German takeovers – if at all – affect wages negatively. Finally, we also document that our results are robust to changes in the matching procedure.

Drawing a nuanced picture of the foreign ownership wage premium, we think that our results are of interest for policy makers, who set the rules and conditions for foreign investment. In this respect, our finding that workers' position in the hierarchy of establishments explains part of the wage premium is disconcerting, as it suggests that foreign takeover gives the management of acquired establishments scope for rent appropriation. Moreover, we believe that distinguishing immediate impact and lagged adjustment effects of foreign takeover within a single framework is a promising avenue for future research.

A Appendix

Table A.1: Balancing Test for the Matching Procedure

Variable	Sample	Mean		Stand.	Bias	Normal.
		Treated	*Control*	*bias %*	*reduction*	*diff.*
(a) Plant-Characteristics						
Log Employment	Unmatched	6.841	6.982	-8.3		
Log Employment	Matched	6.841	6.569	16.0	-92.3	0.133
ΔLog Employment	Unmatched	-0.012	0.009	-17.3		
ΔLog Employment	Matched	-0.012	-0.013	0.4	97.6	0.002
Profitability	Unmatched	0.580	0.531	9.8		
Profitability	Matched	0.580	0.555	5.0	49.2	0.035
Manufacturing	Unmatched	0.758	0.681	17.1		
Manufacturing	Matched	0.758	0.783	-5.6	67.2	-0.041
Construction	Unmatched	0.005	0.031	-19.2		
Construction	Matched	0.005	0.008	-2.2	88.5	-0.025
Trade and Repair	Unmatched	0.051	0.076	-10.3		
Trade and Repair	Matched	0.051	0.045	2.1	79.3	0.017
Services and Finance	Unmatched	0.180	0.183	-1.0		
Services and Finance	Matched	0.180	0.157	5.9	-498.3	0.041
Lower Saxony	Unmatched	0.173	0.136	10.5		
Lower Saxony	Matched	0.173	0.149	6.8	35.0	0.048
North Rhine-Westphalia	Unmatched	0.094	0.231	-37.9		
North Rhine-Westphalia	Matched	0.094	0.107	-3.6	90.4	-0.031
Hesse	Unmatched	0.217	0.072	42.0		
Hesse	Matched	0.217	0.203	3.9	90.7	0.022
Rhineland-Palatinate	Unmatched	0.042	0.073	-13.5		
Rhineland-Palatinate	Matched	0.042	0.054	-5.2	61.5	-0.040
Baden-Württemberg	Unmatched	0.278	0.137	35.3		
Baden-Württemberg	Matched	0.278	0.312	-8.3	76.5	-0.051
Bavaria	Unmatched	0.104	0.265	-42.5		
Bavaria	Matched	0.104	0.086	4.5	89.4	0.041
Berlin	Unmatched	0.028	0.022	3.9		
Berlin	Matched	0.028	0.021	4.3	-9.5	0.031
(b) Worker-Characteristics						
Log Wage	Unmatched	4.779	4.761	4.1		
Log Wage	Matched	4.779	4.782	-0.5	86.8	-0.006
Age	Unmatched	41.3	41.3	-0.7		
Age	Matched	41.3	41.3	-0.4	43.6	-0.003
Female	Unmatched	0.187	0.197	-2.7		
Female	Matched	0.187	0.180	1.6	40.6	0.012
Medium Skill	Unmatched	0.744	0.759	-3.6		
Medium Skill	Matched	0.744	0.740	1.0	71.5	0.007
High Skill	Unmatched	0.114	0.117	-1.2		
High Skill	Matched	0.114	0.120	-2.1	-73.4	-0.014

Sample				*Mean bias*	*Median bias*	
Unmatched				14.8	10.3	
Matched				4.2	3.9	

Notes: All variables are measured in $t = 0$ and averaged at the worker-level in the treated and control group respectively. Due to the low number of takeovers in small Federal States we assign the city state of Bremen to Lower Saxony, Saarland to Rhineland-Palatinate and the city state of Hamburg to Schleswig-Holstein. The omitted Federal State is Schleswig-Holstein including Hamburg, the omitted sector is agriculture, hunting and forestry.

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