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The takeover and selection effects of foreign ownership in Germany: an analysis using linked worker-firm data

by

Martyn Andrews, Lutz Bellmann, Thorsten Schank and Richard Upward

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Abstract

We use a linked employer-employee data set from Germany to estimate the wage effect of foreign-affiliates in (the former) East and West Germany. In addition, the wage effects of the large number of West German affiliates which are located in East Germany are also considered. The implemented techniques allow us to control both for worker- and plant-level unobserved components of earnings. We find large selection effects both in terms of worker- and firm unobserved components of wages. The selection effect is larger for East German plants. Once the selection effect is taken into account, the genuine takeover effect is small and in some cases insignificantly different from zero. In contrast to the selection effect, the takeover effect is slightly larger in West Germany, where it amounts to 2.7%.

JEL classification: F23, J31, C21

Keywords: Foreign ownership, wages, linked employer-employee data

Outline

Non-Technical Summary

On average, workers in foreign-owned firms are paid higher wages than workers in firms which are domestically owned. This is a well-known fact, and appears to be true in developed and developing countries across the world. Why is this? It might be that foreign-owned firms have some genuine advantage over domestic firms which allows them to pay higher wages. If this were the case, it might be worth encouraging foreign firms to buy domestic firms and pass on those higher wages. We call this explanation the "takeover effect".

On the other hand, it is possible that the difference in wages is really just an illusion. Perhaps foreign firms buy those domestic firms which already pay higher wages, for example by investing in sectors of the economy which pay well. Or perhaps foreign-owned firms buy firms which already employ more productive workers. We call this explanation the "selection effect".

How can we distinguish between these two explanations? In this paper we measure the wage changes of workers who move between firms, and we measure the wage changes which occur when firms change from being domestically owned to being foreign-owned. We do this for a large sample of firms and workers in Germany between 2000 and 2004. We find that most of the difference in wages is due to the selection effect. In fact, in many cases we find that the true boost to wages (the takeover effect) is close to zero.

Does this mean that governments should stop clamouring to attract foreign firms? Not necessarily. First, foreign firms probably offer many other benefits to the host economy, even if these benefits are not in the form of higher wages. Second, we find that even though the true wage effects are small, some of those benefits may be retained by workers when they move on to other employers. Finally, it may be that the true takeover effect can only be measured in the long run.

1 Introduction

There is now an extensive literature which suggests that affiliates of foreign-owned firms outperform domestic firms and pay higher wages. However, as often noted (e.g. Girma, Greenaway & Wakelin 2001) much of this difference may be due to differences in other characteristics of firms which are correlated with foreign ownership. For example, affiliates of foreign-owned firms tend to be larger and operate in sectors of the economy which are inherently more productive. It is therefore important to control for firm size and sectoral distribution when comparing the wages and productivity of foreign and domestic firms. Since these characteristics are often observable in plant- or firm-level data, controlling for these differences is straightforward in a regression framework.

A potentially more difficult problem is that foreign and domestic firms might differ in their unobservable characteristics. In particular, firms which are taken into foreign ownership might already be outperforming firms which are not taken over. With repeated observations at the plant-level, it is possible to remove the influence of any fixed difference between firms which become foreign-owned and those which remain domestic by using difference-in-differences (DiD) or fixed effects (FE) techniques. However, it is difficult with plant-level data to control for differences in the quality of the workforce which may explain some of the apparent foreign-ownership wage premium.

In this study we use a large linked employer-employee data set for Germany for the years 2000 and 2004, and provide estimates of the wage effects of foreign-affiliates in (the former) East and West Germany. In addition, the wage effects of the large number of West German affiliates which are located in East Germany are also considered. The implemented techniques allow us to control both for worker- and plant-level unobserved components of earnings.

In the light of the recent literature on policy evaluation, we think of a change in ownership as a "treatment" which potentially affects the wage paid to workers in the plant. This allows us to partition the wage gap between different types of plant in terms of "selection" and "takeover". Selection reflects the fact that plants are not randomly selected into their ownership status. Takeover measures any additional wage gain which a change in ownership status yields.

This framework is also helpful in investigating whether any wage gain from ownership status is internalised within the firm, or whether there are spillovers to the domestic economy. We can do this by examining the wage changes of workers who move from foreign-owned to domestic plants, and by examining the wage changes of plants which revert to domestic control.

The use of data on workers and firms also allows us to investigate whether there are any distributional consequences of ownership status. For example, foreign-owned firms may implement a steeper wage-tenure profile, or they may change relative rewards to different skill groups.

We find evidence of large selection effects both in terms of worker and firm unobserved components of wages: plants which get taken over by foreign firms have higher plant-level wages and higher

individual-level wages before they are taken over. The selection effect is larger for plants in East Germany. Once the selection effect is taken into account, the genuine takeover effect is small and in some cases insignificantly different from zero. The takeover effect is slightly larger in West Germany.

The paper is structured as follows. We summarise previous estimates of the wage effect in Section 2, and we present a framework for measuring wage effects in Section 3 which explores the different empirical issues which may arise. Section 4 briefly describes the data we use, and our estimates are presented in Section 5. Section 6 concludes.

2 Previous estimates

As noted, there is now a wide range of estimates of the wage impact of foreign affiliates. As always, it is difficult to make direct comparisons across these studies because of differences in methods, samples, data and so on. Nevertheless, Appendix Table A.1 attempts to draw together the relevant comparisons for as many studies as possible.

As can be seen, the 18 studies have been carried out for various developed and developing countries. They have been conducted either at the industry- or firm-level and more recently — as employer-employee data have become available — at the individual-level. The studies can also be broadly classified according to the identification of the ownership wage premium. The first group compares wages (or wage growth) between foreign-owned and domestically-owned plants, which is typically carried out by OLS. In this case, one can condition on human-capital and plant-characteristics available in the respective data-set, but not on unobservables. Hence, the obtained ownership effect may be confounded by a selection effect if foreign- and domestically-owned firms differ in unobserved characteristics. To circumvent this problem, some studies identify the wage differential by comparing the change in wages of plants which change ownership and the change in wages of plants which do not. This is achieved by fixed-effects or difference-in-difference methods, by which unobserved time-invariant differences between both plant-types are swept away. Obviously, this is only possible if the data covers more than one period in time.

By analogy, if the analysis is based on a panel of linked employer-employee data (LEED), one can compare the wage growth of workers who experience a change in their employer's ownership status with the wage growth of workers whose employer's ownership status does not switch. A reported change in ownership status at the individual-level can occur for two reasons. First, the plant for which an individual works changes its nationality. Second, the individual moves to another plant with a different ownership status. While Martins (2006) and Heyman, Sjöholm & Tingvall (2004) use the former (and explicitly rely on workers staying in the same firm) to identify the ownership differential, the studies of Pesola (2006) and Balsvik (2006) are based on movement of workers.[1] To the best of

[1] Earle & Telegdy (2006) also uses LEED data, but in their data workers cannot be tracked over time due to the omission of workers' identification codes.

our knowledge, no study derives (and contrasts) separate estimates of the ownership wage differential based on the two alternative sources of ownership variation.

Some of these studies only investigate the effect of becoming foreign-owned (Martins (2006), Heyman *et al.* (2004), Girma & Görg (2006*a*)) or restrict the effects of going from domestic to foreign and of going from foreign to domestic as being equal and opposite (Earle & Telegdy (2006)). Conyon, Girma, Thompson & Wright (2002) is the only study at the plant level which also considers the effect of changing from foreign- to domestically owned, although their control group comprises firms of both ownership types not changing their status. Balsvik (2006) looks separately at both directions of movement at the individual-level. In separate regressions, she compares movers to non-multinationals (MNE) and movers to MNE with stayers. The reference group comprises in the first case stayers in non-MNE and in the second case stayers in MNE. Pesola (2006) specifies a regression model which includes a foreign ownership dummy and its interaction with tenure and which allows the impact of previous experience to vary with the ownership of the previous and the current employer (such that there are four groups: domestic-domestic; domestic-foreign; foreign-domestic and foreign-foreign).

There is a common consent from all studies that foreign-owned firms pay higher wages. The premium appears to be much larger in less developed countries (the reported (raw) wage differential amounts to 65% for Ghana and ranges in Indonesia even between 67 and 90%), but lies for developed countries at least somewhere between 10 and 30%. We can also regard it as a stylized fact that the differential reduces after including human capital variables of the workers and/or characteristics of the firm (of which sectoral affiliation and firm size seem to be the most important). Nevertheless, if unobserved factors are not taken into account, a positive foreign wage differential remains. This is typically around 10% and the difference between developed and less-developed countries is much less pronounced. There is, of course, some variation between countries, but this may at least partly reflect different sets (or qualities) of control variables. However, studies which also account for unobserved factors often find no or only a very small wage premium.

It is often found that the foreign ownership wage differential rises with skill (Feenstra & Hanson (1997) for Mexico, Earle & Telegdy (2006) for Hungary, Lipsey & Sjöholm (2004) for Indonesia, Velde & Morrissey (2001) for sub-Saharan countries).[2] According to Görg, Strobl & Walsh (2002), one explanation for this is that firm specific training is more productive in foreign firms. Using data for Ghana, the authors can provide evidence for their hypothesis by distinguishing between whether individuals work in domestic or foreign-owned firms, and whether they receive on-the-job training. Relatedly, Pesola (2006) obtains that the positive wage effect of prior experience in foreign-owned firms is driven by the effect on the earnings of highly educated.

In this paper we clarify the appropriate methodology for estimating the wage effect of foreign ownership when one has access to linked employer-employee data. We provide more comprehensive evidence consistent with the idea that foreign-owned firms "select" high-wage plants and high-wage

[2]This is not supported, however, by the findings of Buckey & Enderwick (1983) and Girma & Görg (2006*a*) for the UK.

workers. We also present some evidence consistent with the idea that wage gains in foreign-owned plants may "spill over" to workers' subsequent jobs.

3 Measuring direct wage effects of MNEs

Let y_{it} be worker i's wage in period t. There are only two waves, $t = 1$ (namely 2000) and $t = 2$ (2004). The sample for these models is all workers who are observed twice. In each period, the identity of a worker's plant is given by $j = J(i, t)$. Note that the ownership status of worker i's current plant may change either because the worker moves from one plant to another of different ownership status, or because the plant itself changes status.

The simplest framework in which to consider the wage effects of ownership is a standard linear two-way error components model:

$$y_{it} = \mathbf{z}'_{it}\boldsymbol{\beta} + \delta F_{jt} + \lambda_t + \theta_i + \psi_j + \varepsilon_{it}, \qquad t = 1, 2. \tag{1}$$

The vector of observable characteristics $\mathbf{z}$ could be partitioned into those which vary across individual workers, and those which vary across individual plants. The variable F_{jt} is unity if the worker's plant is foreign-owned and zero otherwise. λ_1 and λ_2 are standard macro effects.

Following Abowd, Kramarz & Margolis (1999), θ_i and ψ_j represent unobserved components of wages which are time-invariant at the individual- and plant-level respectively. θ_i might be thought of as "unobserved ability", while ψ_j might be related to the unobserved fixed productivity of a particular plant, if we think that more productive plants pay higher wages. As both might be correlated with foreign ownership, we have a two-way fixed-effects model.

Defining the treatment and comparison groups

A natural interpretation of a foreign ownership takeover is that of a "treatment". In other words, we wish to estimate the effect on average workers' wages in domestic firms in $t = 1$ of becoming foreign-owned in $t = 2$. Similarly, we wish to estimate the effect on average workers' wages in foreign firms in $t = 1$ of becoming domestically-owned in $t = 2$. Some models (such as a standard fixed-effects model) suggest that these two effects should be equal and opposite, in which case we could pool the two types of takeover. But we do not wish to impose this restriction because it is possible, for example, that the wage benefits of foreign takeover are not reversed when plants revert to domestic control. We therefore consider these two cases separately.

Thus define the first treatment group to be those workers which are in domestic plants at $t = 1$ and which are in foreign-owned plants at $t = 2$. The comparable control group are those workers which remain in domestic plants at $t = 1$ and $t = 2$. There are analogous treatment and control groups

consisting of those workers in foreign-owned plants at $t = 1$. In what follows we consider only the first comparison.

Controlling for differences in θ_i

Keeping only those individuals who are in domestic plants at $t = 1$, if we difference Equation (1) we can remove the individual-level fixed effects:[3]

$$\Delta y_i = \Delta \mathbf{z}_i' \boldsymbol{\beta} + \delta F_{j2} + \lambda + (\Delta \psi_j + \Delta \varepsilon_i), \tag{2}$$

where $\Delta y_i = y_{i2} - y_{i1}$, $\Delta \mathbf{z}_i' = \mathbf{z}_{i2}' - \mathbf{z}_{i1}'$, $\Delta F_{jt} = F_{j2}$, $\lambda = \lambda_2 - \lambda_1$, $\Delta \psi_j = \psi_{J(i,t)} - \psi_{J(i,t-1)}$ and $\Delta \varepsilon_i = \varepsilon_{i2} - \varepsilon_{i1}$. For workers who do not change plant, $\Delta \psi_j = 0$. Now drop the observable covariates and it is easy to see that the OLS estimator of δ is the "raw" difference-in-difference estimator,

$$\delta = \Delta \bar{y}_{\mathcal{T}} - \Delta \bar{y}_{\mathcal{C}}, \tag{3}$$

where $\Delta \bar{y}_{\mathcal{T}}$ is the change in average wages of workers who are in the treatment group (those that become foreign-owned) and $\Delta \bar{y}_{\mathcal{C}}$ is the change in average wages in the control group. Equivalently, δ is the average wage of workers in foreign-owned plants relative to those in domestic-owned plants in $t = 2$ net of the gap between the same workers in $t = 1$, when they were all in domestically-owned plants. In these models δ is identified by those workers whose F_{jt} changes. As noted, this occurs either if a plant changes ownership status or if a worker moves to a plant of another status.

It has been suggested that foreign-owned firms might be more selective in recruitment (e.g. Dale-Olsen 2003), and employ workers with higher θ_i, so that $E(\theta \mid F = 1) > E(\theta \mid F = 0)$. We label this a *worker selection effect*.[4] As just shown, with panel data on individuals it is straightforward to control for θ_i by differencing.

To actually obtain an estimate of the differential $\bar{y}_{\mathcal{T}} - \bar{y}_{\mathcal{C}}$ at $t = 1$, an alternative formulation of the differences-in-differences estimator is given by:

$$y_{it} = \mathbf{z}_{it}' \boldsymbol{\beta} + \delta F_{jt} + \gamma T_i + \lambda_2 + \psi_j + \nu_{it}, \qquad t = 1, 2. \tag{4}$$

Here the time-invariant dummy variable T_i is equal to one if the worker is in the treatment group and zero otherwise. When covariates are absent, this gives an identical estimate of δ above, but has the advantage that γ gives an estimate of the selection effect discussed above.[5]

[3] With $T = 2$, differencing and mean-deviating are identical methods.

[4] Equivalently, workers might have been more productive already before they move to a foreign-owned plant.

[5] While workers observed once would not contribute to the identification of the parameters in (2), we could (additionally) utilize these observations to estimate (1). However, using repeated cross-sections to obtain a difference-in-difference estimate relies on stronger assumptions (Lee & Kang 2006).

A variant of this model is to fix covariates at their $t = 1$ values, because one might argue that some observables might themselves respond to potential foreign ownership effects.

Controlling for differences in ψ_j

OLS estimates of (2) will yield consistent estimates of δ if $F_{J(i,t)t}$ is uncorrelated with $\Delta\psi_j$. However, although we have a rich set of covariates (particularly at the plant level), and we can difference out θ_i, it seems likely that foreign ownership is non-random with respect to unobservable plant-level determinants of wages. This is because foreign-owned firms might also select into plants which have some unobserved productivity advantage so that $E(\psi_j \mid F = 1) > E(\psi_j \mid F = 0)$. With panel data on plants one can eliminate the ψ_j in the same way as we did for θ_i by collapsing the individual-level data to a plant-level panel, and estimate:

$$\bar{y}_{jt} = \bar{\mathbf{z}}'_{jt}\boldsymbol{\beta} + \delta F_{jt} + \lambda_t + \bar{\theta}_{jt} + \psi_j + \bar{\varepsilon}_{jt}.$$

$\bar{y}_{jt}$ is the average wage paid in plant j at time t etc. Now take first differences to get:

$$\Delta\bar{y}_j = \Delta\bar{\mathbf{z}}'_j\boldsymbol{\beta} + \delta F_{j2} + \Delta\lambda_t + \Delta\bar{\theta}_j + \Delta\bar{\varepsilon}_j, \tag{5}$$

where, for example, $\Delta\bar{y}_{jt} = \bar{y}_{jt} - \bar{y}_{jt-1}$. By analogy with the above, having controlled for observables, δ is the difference-in-difference estimator

$$\delta = \Delta\bar{y}_{\mathcal{T}} - \Delta\bar{y}_{\mathcal{C}},$$

where now $\bar{y}$ refers to plant-level sample means.

Controlling for both selection effects

The problem with aggregating the data to the plant-level to difference out plant-level fixed effects is that estimates of δ from (5) will now be biased if $\Delta\bar{\theta}_j$ is correlated with F_{jt}. This is so-called aggregation bias, caused by the selection effect we cannot control for with plant-level data.

One advantage of linked employer-employee data is that one can eliminate both θ_i and ψ_j together. To do this, define a *spell*, denoted s, as a unique worker-plant pair. So a worker who changes plant between 2000 and 2004 has two separate spells. Within a spell both θ_i and ψ_j are constant (because both i and j are constant) and so one can eliminate both using "spell-fixed effects" (see Abowd *et al.* (1999) and Andrews, Schank & Upward (2006)):

$$\Delta y_i = \Delta\mathbf{z}'_i\boldsymbol{\beta} + \delta F_{j2} + \lambda + \Delta\varepsilon_i. \tag{6}$$

Note that, when estimating Equation (6), individuals who change plant are not included in the regression and therefore do not contribute to the estimates of δ. Therefore one way of thinking about spell-fixed effects is that it controls for plant-level unobservables by only looking at "stayers". This is why Equation (2) contains the term $\Delta\psi_j$ whereas Equation (6) does not. This is, in fact, essentially the same method suggested by Martins (2006).[6]

Because (6) ignores information on movers, it is not the most efficient estimate of δ (or any other parameter). In addition, one cannot recover separately estimates of θ_i or ψ_j. An alternative method would be to estimate (2) but include a full set of (differenced) firm dummies to control for non-random selection on ψ_j. However, this method is likely to be computationally infeasible since we have many thousands of plants. A solution to this problem is to use the Classical Minimum Distance (CMD) estimator outlined in in Andrews *et al.* (2006). It forms a restricted estimator for $\boldsymbol{\beta}$, δ, λ and ψ from the parameters of (2) and (6) estimated separately.[7]

To summarise, if (1) represents the true process by which wages are generated, one can obtain consistent estimates of the foreign-ownership on wages using: (2) if ownership is non-random with respect to θ_i; (5) if ownership is non-random with respect to ψ_j; and (6) if ownership is non-random with respect to θ_i and ψ_j. More efficient estimates can also be obtained using a CMD estimate which combines both movers and non-movers.

All of the above is repeated for all foreign-owned plants in $t = 1$, some of whom become domestic (the second treatment group) in $t = 2$.

4 The data and descriptive statistics

There are two data sources. The first is the *Institut für Arbeitsmarkt- und Berufsforschung (IAB) Establishment Panel*, an annual survey of approximately 8,250 plants located in the former West Germany and an additional 7,900 plants in the former East Germany. The survey started in 1993 and is ongoing. It covers 1% of all plants and 7% of all employment in Germany, and is therefore a sample weighted towards larger plants. Information is obtained by personal interviews with plant managers, and comprises about 80 questions per year, giving us information on, for example, total employment, bargaining arrangements, total sales, exports, investment, wage bill, location, industry, profit level and nationality of ownership. Ownership is defined as either West German, East German, foreign, or public.[8] Complete information on plant ownership is available for all plants only in 2000 and 2004, so we

[6] Also note that, in the tables below, we decompose the *OLS DiD/FE* estimates into those for *Movers only* and *Stayers only*.

[7] See Wooldridge (2002, ch. 14.6) and Andrews *et al.* (2006) for further details.

[8] The relevant question is: "Is the establishment mainly or solely in: (a) West German ownership (b) East German ownership (c) Foreign ownership (d) Public ownership (e) No single owner which holds majority?" Our analysis considers only plants under (a)-(c).

restrict our analysis to those years. A detailed description of the IAB panel can be found in Kölling (2000).

Table 1 summarises the basic sample which we use for the analysis.[9] Only a small proportion of plants in Germany are foreign-owned: 4% of all plants in West Germany and just 2% of all plants in East Germany are foreign-owned. A higher proportion of plants in the service sector are foreign owned. Turning to the employment shares, foreign ownership becomes more important. Almost one out of eight employees in West German manufacturing works for a foreign-owned plant because foreign-owned plants are on average larger.

As we would expect, there is almost no ownership of West German plants by East German firms.[10] By contrast, there is considerable cross-border ownership of East German plants by West German firms. About 11% of plants in East Germany are West German-owned and the share of workers employed by theses establishments is nearly 30%. In the light of this considerable fraction, wage effects of West German-owned (as compared to East German-owned) plants in East Germany will also be of particular interest in the econometric analysis below.

The second source of data is the employment statistics register of the German Federal Office of Labour (*Beschäftigtenstatistik*), which covers all employees or trainees registered by the social insurance system. The register covers about 80% of employees in West Germany and about 85% in East Germany. Information on employees includes basic demographics, start and end dates of employment spells, occupation and industry, earnings, qualifications (school and post-school), and a plant identification number. A detailed description of the employment data can be found in Bender, Haas & Klose (2000).

By using the plant identification number we can associate each worker with a plant in the panel. We therefore observe approximately 80% of all workers in about 14,000 plants each year. Because the employment register is spell-based (one record for each employment spell), the combined data is potentially complex. To simplify, we select all employees in the employment register who are employed by the surveyed plants on June 30th each year. This yields an unbalanced annual panel of employees together with detailed information on the plants in which they work. We refer to the linked data as the Linked IAB panel, or LIAB.

Reported daily gross wages are censored at the social security contribution ceiling.[11] Using wage data without any correction would generally yield estimates which are biased towards zero. One way to circumvent this problem is to apply a single imputation procedure, i.e. to impute all censored wages with estimated wages. Assuming that daily gross wages have a log-normal distribution, first a Tobit model is estimated, where the dependent variable is log daily gross wage and the independent variables are those included in further analyses. Then, for every censored observation a random value

[9] We exclude plants in agriculture, banks and insurances, education, health and the public sector.

[10] In our analysis we therefore exclude East German-owned plants in West Germany.

[11] The ceiling is in 2000 at € 143.92 for West and at € 118.81 for East Germany. In 2004, the respective figures are € 166.10 and € 114.30. In our regression sample, 12.1 (5.5) % of the wage observations from 2000 in West (East) Germany are censored, while in 2004 10.9% (4.5%) of workers are affected.

	West Germany			*East Germany*		
	Manuf.	Services	All	Manuf.	Services	All
Share of plants						
West German-owned	97.9	95.0	95.8	9.1	12.6	11.4
East German-owned	0.1	0.2	0.2	89.7	85.0	86.5
Foreign owned	2.1	4.8	4.0	1.3	2.5	2.1
Total	100.0	100.0	100.0	100.0	100.0	100.0
Share of workers						
West German-owned	87.8	92.7	90.5	28.7	27.2	27.9
East German-owned	0.1	0.2	0.1	63.0	69.1	66.3
Foreign-owned	12.1	7.1	9.4	8.3	3.7	5.8
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 1: Incidence and coverage of different forms of ownership (percentages). Source: IAB Establishment Panel; 2000 and 2004; weighted figures

is drawn from a normal distribution which is left-truncated at the social security contribution ceiling (with predicted log wage as its mean and standard deviation as estimated from the Tobit model).[12]

Because the plant-level information in our data come from a survey, rather than an administrative source, we have a large number of measurable covariates, shown in Table B.1. We have rather less information on workers, shown in Table B.2.

5 Results

All our estimates can be thought of as variants of the basic difference-in-differences estimator described in Section 3. The basic model is an extension of Equation 4, which allows us to directly estimate both the selection effect and the takeover effect.

Define the following dummy variables to measure the ownership status of a worker's plant in period t:

$$E_{J(i,t)t} = 1 \text{ if worker } i \text{ is in an East German-owned plant in period } t\text{, 0 otherwise}$$

$$W_{J(i,t)t} = 1 \text{ if worker } i \text{ is in an West German-owned plant in period } t\text{, 0 otherwise}$$

$$F_{J(i,t)t} = 1 \text{ if worker } i \text{ is in a foreign-owned plant in period } t\text{, 0 otherwise}$$

In West Germany we ignore $E_{J(i,t)t} = 1$, and therefore we have only two treatment and control groups defined by the following dummies:

$$T_{WF} = \begin{cases} 1 \text{ if } F_{J(i,1)1} = 0 \text{ and } F_{J(i,2)2} = 1 \\ 0 \text{ if } F_{J(i,1)1} = 0 \text{ and } F_{J(i,2)2} = 0 \end{cases}$$

[12] See Gartner (2005) for further details.

$$T_{FW} = \begin{cases} 1 \text{ if } F_{J(i,1)1} = 1 \text{ and } F_{J(i,2)2} = 0 \\ 0 \text{ if } F_{J(i,1)1} = 1 \text{ and } F_{J(i,2)2} = 1 \end{cases}$$

Our two DiD estimators for West Germany are therefore obtained from the following equations

$$y_{it} = \mathbf{z}'_{it}\boldsymbol{\beta} + \delta_F F_{jt} + \gamma_{WF} T_{WF} + \lambda_2 + \varepsilon_{it} \tag{7}$$

for plants which are domestic at $t = 1$, and

$$y_{it} = \mathbf{z}'_{it}\boldsymbol{\beta} + \delta_W W_{jt} + \gamma_{FW} T_{FW} + \lambda_2 + \varepsilon_{it} \tag{8}$$

for plants which are foreign-owned at $t = 1$.

For plants in East Germany there are six possible treatment and control groups. For example, T_{EW} defines the group of plants who are domestic at $t = 1$ and become West German, while T_{EF} defines the group who become foreign. Similarly we have T_{WE} and T_{WF} for plants which are West-German at $t = 1$ and T_{FE}, T_{FW} for plants which are foreign at $t = 1$. The three DiD equations for East Germany are therefore

$$y_{it} = \mathbf{z}'_{it}\boldsymbol{\beta} + \delta_W W_{jt} + \delta_F F_{jt} + \gamma_{EW} T_{EW} + \gamma_{EF} T_{EF} + \lambda_2 + \varepsilon_{it} \tag{9}$$

for plants which are domestic at $t = 1$,

$$y_{it} = \mathbf{z}'_{it}\boldsymbol{\beta} + \delta_E E_{jt} + \delta_F F_{jt} + \gamma_{WE} T_{WE} + \gamma_{WF} T_{WF} + \lambda_2 + \varepsilon_{it} \tag{10}$$

for plants which are West German-owned at $t = 1$ and

$$y_{it} = \mathbf{z}'_{it}\boldsymbol{\beta} + \delta_E E_{jt} + \delta_W W_{jt} + \gamma_{FE} T_{FE} + \gamma_{FW} T_{FW} + \lambda_2 + \varepsilon_{it} \tag{11}$$

for plants which are foreign-owned at $t = 1$

The number of workers and plants for the different treatment and control groups in our regression sample is shown in the Appendix Tables C.1 and C.2, which also stratify between plant-stayers and movers. Each row in Table C.1 represents a control group and the associated treatment group for West Germany, while each row of Table C.2 comprises information on a control group and the corresponding two treatment groups for East Germany.

The dummy-variable T_{WF}, for example, takes on the value of zero for the control group of 146,482 employees in West Germany, working for West German-owned plants in both years. 139,858 of these stay in the same (1,503) plants which are West German-owned in 2000 and in 2004. The remaining 6,624 move between West German-owned establishments. While stayers work for plants which are— by construction— observed in as well in 2000 as in 2004, this is not necessarily the case for movers.

The group of the (6,624) movers worked for 1,238 plants which are either observed in 2000 or 2004 and for 122 plants which are included in the regression sample in both years.

The corresponding treatment group (i.e. $T_{WF} = 1$) consists of 12,426 workers whose employing plant is West German-owned in 2000 and foreign-owned in 2004. The observed change can occur for two reasons: First, 11,976 stayers work for 36 plants which are taken over between 2000 and 2004; and second, 450 workers move from West German-owned to foreign-owned establishments. The estimated selection and takeover effects are identified by both types of workers. In contrast to previous studies, which relied either on stayers or on movers, in the analysis below we compare results based on the two sources of ownership-change.

5.1 West Germany

The first panel shows the raw difference-in-difference (DiD) estimate (Equation 3), which can be estimated either using OLS or fixed effects (FE). Our first basic result is that domestic firms which are taken over pay significantly higher wages *before* they are taken over. This is the coefficient on T_F, estimated at 0.115 log-points. Similarly, foreign-owned firms which become domestic pay lower wages (-0.061) before they become domestic, but this effect is insignificantly different from zero. There is then an additional boost to wages of 0.043 log points after foreign takeover. This result is almost mirrored by firms which switch from foreign to domestic (-0.038 log points). In the raw data therefore, foreign firms appear to take over higher-paying domestic firms, but also boost wages after takeover. Foreign-owned firms which revert to domestic ownership do not pay significantly lower wages, but wages do drop significantly afterwards.

The raw DiD estimate controls for permanent differences in wages between plants which change ownership status and those that do not. These large differences (estimated to be about 10%) may in part be due to differences in observed characteristics, which we call $\mathbf{x}_{it}$ and $\mathbf{w}_{jt}$. For example, firms which get taken over may be larger or in higher-paying industries. Incorporating a full set of time-varying controls in the basic DiD regression (as expected) reduces the estimate of γ_{WF} from 0.115 to 0.056. Interestingly, the estimate of γ_{FW} for plants which change from foreign to domestic changes sign and becomes positive and significant. In the raw data there appears to be negative selection: lower-paying firms switch from foreign to domestic. But this is due to time-varying differences in $\mathbf{x}_{it}$ and $\mathbf{w}_{jt}$. The inclusion of covariates also reduces the takeover effect a lot: it reduces to 0.025 log points for switching from domestic to foreign, and it is virtually zero for plants which become domestic.

As has been noted above, because this is an individual-level wage equation, the estimates of δ_F and δ_W are driven both by plants which change their ownership status and by individuals who switch between plants of different ownership status. If movers are non-random with respect to ownership status, this might bias our DiD estimates. It is straightforward to control for this by looking at wages only of individuals who remain in the same plant. This reduces the takeover effect for plants which switch from

Table 2: Results for plants in West Germany

	Domestic in 2000					*Foreign in 2000*			
	Individual level		*Plant level*			*Individual level*		*Plant level*	
Raw DiD/FE									
γ_{WF}	0.115	(0.044)	0.226	(0.058)	γ_{FW}	−0.061	(0.062)	−0.086	(0.101)
δ_F	0.043	(0.016)	0.040	(0.009)	δ_W	−0.038	(0.020)	−0.000	(0.019)
OLS DiD, conditional on covariates									
γ_{WF}	0.056	(0.020)	0.015	(0.034)	γ_{FW}	0.030	(0.016)	0.006	(0.035)
δ_F	0.025	(0.008)	0.025	(0.013)	δ_W	−0.002	(0.016)	−0.005	(0.021)
OLS DiD, conditional on covariates, Stayers only									
γ_{WF}	0.046	(0.020)	0.010	(0.033)	γ_{FW}	0.030	(0.019)	0.010	(0.035)
δ_F	0.021	(0.009)	0.029	(0.016)	δ_W	0.006	(0.015)	−0.007	(0.021)
OLS DiD, conditional on covariates, Movers only									
γ_{WF}	0.022	(0.017)			γ_{FW}	−0.010	(0.019)		
δ_F	0.055	(0.029)			δ_W	−0.019	(0.027)		
OLS DiD, covariates fixed at $t = 1$,Stayers only									
γ_{WF}	0.043	(0.019)	0.007	(0.033)	γ_{FW}	0.048	(0.018)	0.020	(0.032)
δ_F	0.041	(0.017)	0.045	(0.012)	δ_W	−0.014	(0.010)	0.005	(0.021)
FE(i), conditional on covariates									
δ_F	0.029	(0.008)	0.037	(0.011)	δ_W	−0.008	(0.009)	0.003	(0.017)
FE(s), raw									
δ_F	0.041	(0.017)	0.045	(0.012)	δ_W	−0.014	(0.010)	0.005	(0.018)
FE(s), conditional on covariates									
δ_F	0.027	(0.009)	0.040	(0.013)	δ_W	−0.011	(0.010)	0.003	(0.016)
CMD, conditional on covariates									
δ_F	0.027	(0.009)			δ_W	−0.011	(0.010)		

Notes: reports estimates of (7) and (8). Robust standard errors in parentheses. Further covariates are those listed in Appendix Tables B.1 and B.2.

domestic to foreign slightly (0.021 log-points), while the effect is larger for movers (0.055 log-points). [13] With respect to the change from foreign to domestic, the takeover effect is insignificantly different from zero for both, stayers and movers. However, the positive selection effect is only observed for stayers.

It has been suggested that foreign-owned firms pay higher wages because they provide greater investment in human capital. If this human capital was general, the wage effects of foreign-ownership should "spillover" into the domestic economy when workers move from foreign-owned to domestically-owned establishments. Hence, we would expect to see *smaller* wage losses for movers from foreign to domestic plants than wage gains for movers from domestic to foreign. In fact —keeping in mind the relatively low number of movers— there is evidence for this in the conditional DiD estimates.

The model estimated above allows the covariates to vary between 2000 and 2004. A change in ownership status, however, may cause changes in wages and changes in the observable characteristics of the plant. For example, a plant which becomes foreign-owned may grow larger and pay higher wages. By including $\mathbf{x}_{it}$ and $\mathbf{w}_{jt}$ in the regression we incorrectly "control for" these changes. The alternative is to measure covariates only at $t = 2000$. This of course is only meaningful by looking at individuals who remain in the same plant. The estimated effect of becoming foreign-owned rises again to 0.041 log-points.[14]

A generalisation of the DiD framework allows for individual-specific unobserved permanent components of wages, or unobserved fixed effects, labelled θ_i. As we have a balanced panel (at the individual level) between $t = 1$ and $t = 2$ the average value of θ_i is constant for the treatment and control groups, and so the raw fixed effects estimator gives identical estimates as the OLS DiD.

Using DiD or FE methods we can control for time and person-level fixed effects. In addition, we can control for plant-level fixed effects by using spell-fixed effects (6). In fact, without covariates using spell-fixed effects is equivalent to using information only on stayers because for stayers $\Delta\psi_j = \psi_{J(i,t)} - \psi_{J(i,t-1)} = 0$. So the FE(s) results are identical to the stayers only model. Conditioning on covariates, we find that foreign takeover of domestic firms does boost wages, but only by about 0.027 log-points, or 2.7%. This is smaller than the selection effect for stayers. Domestic takeover of foreign firms appears to have a smaller, negative and statistically insignificant effect of -0.011. However, given the relatively large standard errors on these two estimates, we cannot reject the hypothesis that the effect of takeover is equal and opposite. Thus, some of the effect on wages appears to be an effect which is gained when firms become foreign and is lost when they become domestic.

The final row reports estimates from our Classical Minimum Distance (CMD) method. This method controls for both individual- and plant-fixed effects, and (unlike spell-fixed effects) includes both

[13] The overall DiD estimate is a weighted average of the movers' and non-movers' estimates. As can be seen from Table C.1, only a small fraction of the sample comprise movers (4.6 % of the employees in West Germany working for West German-owned plants in 2000).

[14] In fact, this specification means that $\mathbf{x}_{it}$ is a fixed effect, and so this estimator gives identical estimates of δ_F and δ_W as the raw DiD for plant-stayers.

movers and non-movers. Reassuringly, we find that the CMD estimates are almost identical to the spell-fixed effects estimates, and so our preferred estimates appear robust to the choice of method.

As noted in Section 3, it is also possible to estimate wage effects at the level of the plant. This is useful not least for comparison with the existing literature. Our estimates of the selection effect are generally bigger in the raw data (0.226 and -0.086). Without covariates the individual-level estimates are just a re-weighting of the plant level estimates, with larger plants having a higher weight. This shows that the selection effect is bigger for smaller plants. We would therefore expect that the inclusion of covariates (including firm size) in the plant-level estimates would reduce the selection effect, and this is indeed what happens.

5.2 East Germany

The East German results are more complex because there are three treatment/control groups, and two possible treatments for each group as shown in Equations (9)–(11). In Table 3 we report the two selection effects and the two takeover effects for each possible group at $t = 1$.

The raw DiD estimates show first of all that the selection effect for domestic plants in 2000 is much larger than in West Germany. Plants which change from domestic to West-German pay 0.195 log-points more than those who remain domestic; plants which become foreign even pay 0.310 more. Once these large selection effects are taken into account, the takeover effect on wages is small and insignificantly different from zero. Selection effects for West German-owned and foreign-owned plants in 2000 are much smaller and insignificantly different from zero. Once again, the large selection effects for domestic plants which become foreign or West-German is consistent with the idea that higher-paying plants are those which get taken over. The selection effects reduce when covariates are taken into account (second panel), but remain substantial.[15]

The third and fourth panels show that these selection effects differ widely between stayers and movers. Workers who remain in the same plant have even larger selection effects, while they are insignificantly different from zero for workers who move. Note however that the selection effect is large and negative (albeit poorly determined) for movers from plants which were foreign-owned in 2000.

Our preferred estimates for the takeover effect are those which control for both worker and firm-fixed effects, labelled FE(s). In almost every case we find small and insignificant effects. The only exception is a fall of -0.053 log points for West German-owned plants which become domestic. Thus, we find that while selection is greater in East Germany, there is actually less evidence that takeover has any additional effect on wages.

[15] It is also consistent with a model in which the effects of foreign ownership on wages take a long time (more than four years) to develop.

Table 3: Results for plants in East Germany

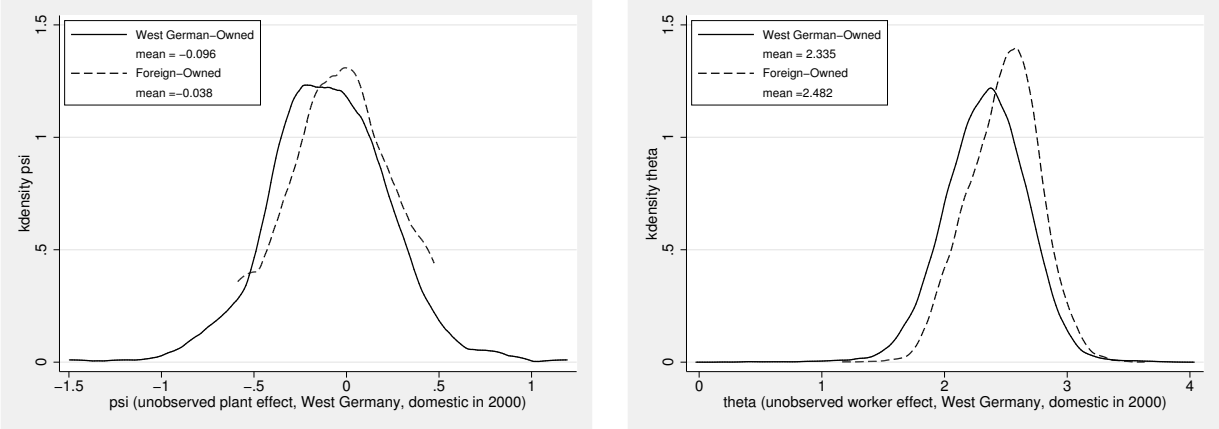
	Domestic in 2000					*West-German in 2000*					*Foreign in 2000*			
	Individual level		*Plant level*			*Individual level*		*Plant level*			*Individual level*		*Plant level*	
Raw DiD/FE														
γ_{EW}	0.196	(0.049)	0.233	(0.039)	γ_{WE}	−0.086	(0.052)	−0.043	(0.041)	γ_{FE}	0.026	(0.079)	−0.051	(0.104)
γ_{EF}	0.309	(0.092)	0.343	(0.104)	γ_{WF}	−0.049	(0.061)	0.132	(0.057)	γ_{FW}	−0.002	(0.049)	0.032	(0.075)
δ_W	0.014	(0.013)	0.020	(0.012)	δ_E	−0.061	(0.020)	−0.013	(0.012)	δ_E	0.038	(0.042)	−0.009	(0.034)
δ_F	0.038	(0.023)	−0.026	(0.031)	δ_F	0.023	(0.030)	0.079	(0.019)	δ_W	−0.017	(0.016)	0.009	(0.028)
OLS DiD, conditional on covariates														
γ_{EW}	0.163	(0.024)	0.147	(0.026)	γ_{WE}	−0.022	(0.026)	0.005	(0.029)	γ_{FE}	−0.103	(0.038)	−0.431	(0.091)
γ_{EF}	0.268	(0.062)	0.202	(0.055)	γ_{WF}	0.034	(0.035)	−0.007	(0.027)	γ_{FW}	0.029	(0.045)	0.131	(0.153)
δ_W	0.000	(0.013)	0.008	(0.016)	δ_E	−0.033	(0.018)	0.001	(0.024)	δ_E	−0.027	(0.045)	0.022	(0.094)
δ_F	−0.032	(0.033)	−0.063	(0.032)	δ_F	0.015	(0.024)	0.089	(0.022)	δ_W	0.078	(0.050)	0.046	(0.051)
OLS DiD, conditional on covariates, Stayers only														
γ_{EW}	0.185	(0.025)	0.148	(0.025)	γ_{WE}	−0.023	(0.027)	0.006	(0.028)	γ_{FE}	−0.086	(0.044)	−0.440	(0.088)
γ_{EF}	0.332	(0.056)	0.203	(0.055)	γ_{WF}	0.045	(0.039)	0.002	(0.028)	γ_{FW}	0.080	(0.063)	0.206	(0.153)
δ_W	−0.004	(0.013)	0.007	(0.016)	δ_E	−0.037	(0.019)	0.000	(0.024)	δ_E	0.007	(0.049)	0.010	(0.085)
δ_F	−0.072	(0.030)	−0.061	(0.033)	δ_F	0.001	(0.021)	0.078	(0.022)	δ_W	0.096	(0.055)	0.017	(0.051)
OLS DiD, conditional on covariates, Movers only														
γ_{EW}	0.039	(0.033)			γ_{WE}	0.052	(0.031)			γ_{FE}	−0.189	(0.150)		
γ_{EF}	−0.017	(0.038)			γ_{WF}	0.040	(0.039)			γ_{FW}	−0.103	(0.126)		
δ_W	−0.048	(0.060)			δ_E	−0.068	(0.054)			δ_E	−0.118	(0.187)		
δ_F	0.072	(0.069)			δ_F	0.087	(0.054)			δ_W	−0.043	(0.180)		
OLS DiD, covariates fixed at $t = 1$, Stayers only														
γ_{EW}	0.185	(0.025)	0.149	(0.027)	γ_{WE}	−0.022	(0.030)	0.009	(0.027)	γ_{FE}	−0.175	(0.042)	−0.364	(0.025)
γ_{EF}	0.320	(0.057)	0.177	(0.064)	γ_{WF}	0.051	(0.040)	−0.017	(0.028)	γ_{FW}	−0.096	(0.094)	1.085	(0.020)
δ_W	0.001	(0.011)	0.019	(0.012)	δ_E	−0.053	(0.020)	−0.013	(0.013)	δ_E	0.056	(0.035)	−0.010	(0.051)
δ_F	0.014	(0.021)	−0.024	(0.033)	δ_F	0.024	(0.014)	0.074	(0.016)	δ_W	−0.012	(0.016)	0.009	(0.041)
FE(i), conditional on covariates														
δ_W	0.010	(0.011)	0.019	(0.013)	δ_E	−0.048	(0.015)	−0.015	(0.013)	δ_E	0.018	(0.048)	0.118	(0.177)
δ_F	0.031	(0.030)	−0.031	(0.036)	δ_F	0.023	(0.013)	0.056	(0.017)	δ_W	0.032	(0.028)	0.040	(0.040)
FE(s), raw														
δ_W	0.001	(0.011)	0.019	(0.012)	δ_E	−0.053	(0.020)	−0.013	(0.012)	δ_E	0.056	(0.035)	−0.010	(0.036)
δ_F	0.014	(0.021)	−0.024	(0.032)	δ_F	0.024	(0.014)	0.074	(0.016)	δ_W	−0.012	(0.016)	0.009	(0.028)
FE(s), conditional on covariates														
δ_W	0.011	(0.012)	0.019	(0.013)	δ_E	−0.044	(0.015)	−0.020	(0.013)	δ_E	0.060	(0.048)	0.182	(0.075)
δ_F	0.011	(0.037)	−0.032	(0.036)	δ_F	0.019	(0.014)	0.060	(0.017)	δ_W	0.034	(0.030)	0.021	(0.048)

Notes: reports estimates of (9), (10) and (11). Robust standard errors in parentheses. Further covariates are those listed in Appendix Tables B.1 and B.2.

5.3 Selection effects at the firm-level and the individual-level

Using the preferred fixed-effects methods, such as FE(s) or CMD, means that the parameter identifying the selection effect is not directly estimated. For example, in Equation (6), the treatment dummy T is swept away by the within-spell transformation. However, using CMD we can recover estimates of both the worker and the firm fixed component of wages, denoted θ_i and ψ_j. This allows us to compare their mean or their distribution between the treatment and control groups of each type.

In Figure 1 we plot the distribution of our estimates of ψ_j and θ_i for the control and treatment groups corresponding to those West German plants which were domestic in 2000.



(a) Plant effect $\hat{\psi}_j$ (b) Worker effect $\hat{\theta}_i$

Figure 1: Estimated distribution of unobserved fixed wage components, West German plants

In both cases, as we would expect, we find that the distribution of the fixed unobserved component of wages for the treatment group lies to the right of that for the control group. This is another way of showing the selection effect, but one which decomposes the selection effect into two components: one relating to the firm, and one to the worker. The difference in the mean of $\hat{\theta}_i$ is about 0.16 log-points, while the difference in $\hat{\psi}_j$ is about 0.058. In both cases, foreign takeover is associated with higher fixed worker- and plant-level characteristics, although it seems that the worker-level effect is quantitatively more important.[16]

5.4 Heterogeneity in the foreign ownership effect

Even if the average effect of changing ownership status is small, it might be that this disguises some larger or smaller effects for subgroups in the data. For example, foreign-owned firms might implement

[16]Plant effects are only plotted for establishments which are observed twice. The difference in the distributions of the worker effects does not depend on whether only stayers, only movers or (as in the figure) all workers are inlcuded.

a steeper wage-tenure profile, or might reward highly-skilled workers relatively more. The effects of foreign-owned firms might also vary by firm characteristic, such as size and profitability. A further benefit of linked employer-employee data is that we can disaggregate the foreign ownership effect by both worker characteristics and firm characteristics.

To enable comparison of a large number of coefficient estimates, we use graphical methods. In Figure 2 we plot the estimate of δ_F for each sub-group of the data, together with its 95% confidence interval. For reference we also draw vertical lines showing the FE(s) pooled estimate of $\delta_F = 0.027$ and the null hypothesis $\delta_F = 0$. The subgroups we choose are based on those covariates described in Appendix Tables B.1 and B.2, and include worker and firm characteristics.

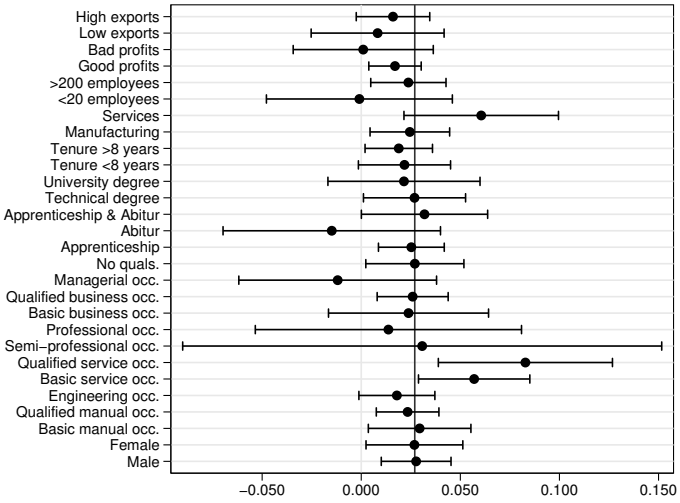


Figure 2: FE(s) estimates of δ_F, West Germany, plants which are West German-owned in 2000

Figure 2 enables us to see at a glance that confidence intervals for almost all sub-groups of the data include the pooled estimate, and most also include zero, which partly reflects the fact that the pooled estimate itself is only 0.027 with a standard error of 0.009. Thus we find little evidence that takeover effects are much larger or much smaller for subgroups of the data. The only notable exceptions are for workers in service occupations and for firms in the service sector, where there is evidence of larger takeover effects. The coefficient on δ_F for service sector firms, for example, is 0.060. Thus, foreign firms do *not* appear to reward more highly-skilled occupations or more highly qualified individuals more.

In Figure 3 we repeat the exercise, but look at the takeover effect from domestic to foreign in East Germany. As Table 3 shows, our preferred pooled estimate for the δ_F is effectively zero (0.011), and most sub-groups have confidence intervals which include zero. Exceptions are workers in engineering and managerial occupations, which have much larger takeover effects, and workers in firms with high levels of exports.

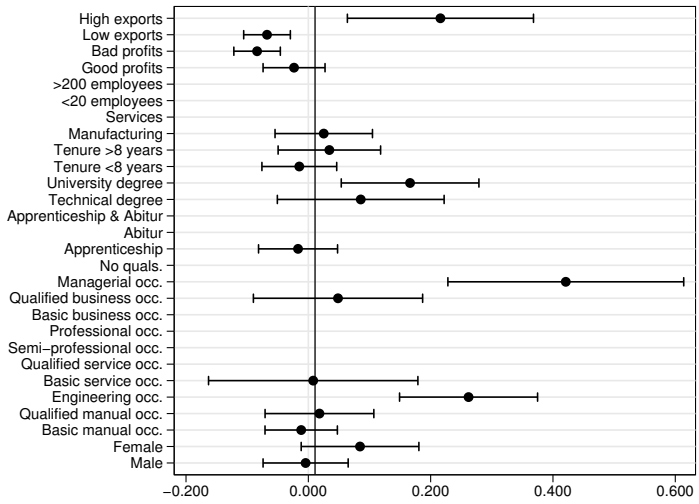


Figure 3: FE(s) estimates of δ_F, East Germany, plants which are East German-owned in 2000

Finally, Figure 4 plots estimates and confidence intervals for the West German takeover effect. Once again, there is very little evidence here that takeover effects are significantly different from zero for any subgroup of the population, with the exception of one occupational group (professionals). Taken as a whole, these results confirm that once selection is taken into account, the true takeover effect is small for most groups.

6 Conclusion

We have shown how the treatment-effects framework can be used to estimate the "selection" and "takeover" components of the wage gap between foreign and domestic firms. With linked worker-firm data it is possible to use this framework to isolate the effects of selection on both plant and worker unobservable components of wages.

We find evidence of large selection effects both in terms of worker- and firm unobserved components of wages: plants which get taken over by foreign firms have higher plant-level wages and higher individual-level wages before they are taken over. The selection effects are larger for East German plants, both for those which change to West German ownership and foreign ownership. Once the selection effect is taken into account, the genuine takeover effect is small and in some cases insignificantly different from zero. In contrast to the selection effect, the takeover effect is slightly larger in West Germany.

The framework we use also distinguishes between firms which change ownership status from domestic to foreign and *vice versa*. Most previous studies impose the restriction that these two effects are equal and opposite, as they would be if there was a simple wage bonus paid to workers in foreign-

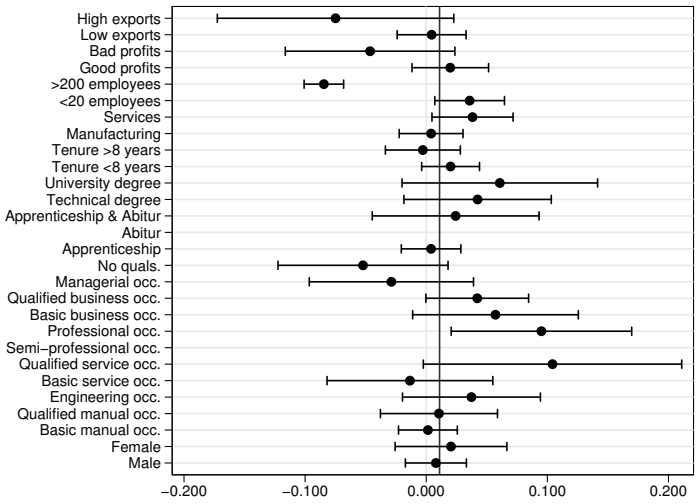


Figure 4: FE(s) estimates of δ_W, East Germany, plants which are East German-owned in 2000

owned firms. In West Germany the takeover effect is 2.7% in one direction and -1.1% in the other direction. However, the latter is insignificantly different from zero, suggesting that workers do not suffer a significant wage loss when their firm reverts to domestic ownership. In addition, workers who leave foreign-owned plants and join domestic plants do not experience wage falls (as opposed to a wage increase of 5.5% for employees who leave domestically-owned plants and join foreign-owned). This evidence is supportive of the idea that foreign-owned firms might offer spillover benefits to the domestic economy.

The use of linked data on workers and firms allows us to investigate whether there are any distributional consequences of ownership status. We split the sample by a number of possibly relevant characteristics and re-estimate the takeover effect. We find little evidence that takeover effects are much larger or much smaller for subgroups of the data. In particular, there is no systematic pattern in terms of skill or occupational groups: foreign-firms do not appear to change the reward structure within firms significantly once selection effects are accounted for.

One interpretation of these results is that the true impacts of ownership structure on the labour market are small, at least in Germany in the 21st century. A second possibility is that wage effects take a long time to manifest themselves. What we call the selection effect is not distinguishable in our data from the long-run effect on wages of foreign-ownership.

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A Synopsis of Studies on Foreign Ownership Wage Differentials

Table A.1: Previous estimates of foreign ownership wage effects

Study	Country	Data	Estimation method	Measure of ownership	Measure of remuneration	Differential
Aitken, Harrison & Lipsey (1996)	US, Mexico (M), Venezuela (V)	industry-level; manufacturing; 1987(US), 1984–1990(M), 1977–1989(V); 1,091(US), 4,717(M), 10,870(V) industry-states; also plant-level for V	OLS (2SLS); separately for skilled and unskilled in Venezuela and Mexico	employment share at region-industry level of firms with 10% or more (US) resp. with any (M, V) foreign-owned equity	log. averages wages by four-digit industry, region, year	higher levels of foreign investment associated with higher wages for skilled and unskilled workers in Mexico (22 and 3%) and Venezuela (29 and 22 %) and in US (37%) in all enterprises; negative (Venezuela) or no (Mexico) wage spillovers from foreign investment to domestically-owned plants, but positive for US (34%)
Balsvik (2006)	Norway	LEED; manufacturing; 1990–2000; 2,092,413 person-years	OLS on full-data; OLS and plant FE for movers vs. stayers; before moving and after moving regressions	dummies for foreign ownership and alternatively two dummies: foreign multinational (MNE) and domestic MNE	log. real wage	raw differential: 10.7%; + firm char.: 3.3%; + ind. char.: 3.1% (3.4% for foreign MNE and 0.8% for domestic MNE); future movers from MNE to non-MNE are paid no differently than stayers at MNE; future movers from non-MNE to MNE receive a wage premium compared to stayers (and to movers to non-MNE) of 1.2%; movers from MNE to non-MNE (with more than 3 years of experience from MNE) receive a wage premium of 5% compared to stayers in the new plant; movers from non-MNE to MNE are not doing better than similar workers in the same (new) plant
Buckey & Enderwick (1983)	Great Britain	manufacturing; 1980 wave of WIRS; 614 domestically-, 119 foreign-owned establishments	comparison of median wage in domestic and foreign-owned firms, by skill, industry and firm size		typical weekly gross pay by group: semi-skilled manuals, skilled manuals, clerical workers, middle management	no difference in median wage for management employees, 7-8% for other three groups; differential most pronounced in small and very large plant sizes, no impact in intermediate sizes; foreign-owned firms do not invariably pay higher wages across industries
Conyon *et al.* (2002)	UK	manufacturing; private and public companies; 1989–1994; at least two years before and after acquisition; 331 domestic-, 129 foreign-owned acquisitions, 642 firms with no change	(firm) FE	foreign acquisition of existing UK firms (and vice versa) between year t and $t-1$ (controls: firms subject to no ownership change)		3.44% wage premium (4.7% in US-acquired, 3.9% in EU acquisitions and 3.2% in acquisitions from other foreign countries), but when productivity is added, wage premium disappears totally; -2.1% wage reduction after domestic acquisition, which is unaffected by the introduction of productivity; only for US acquisitions significant impact on growth rate of wages of 2.9% (but neither for other foreign or domestic acquisitions), but reduces again when adding labor productivity

Table A.1: Previous estimates of foreign ownership wage effects

Study	Country	Data	Estimation method	Measure of ownership	Measure of remuneration	Differential
Dale-Olsen (2003)	Norway	LEED; manufacturing; 1989–1995; at least two movers and 25 wage-observations per establishment; 1,994,751 observations; 1971 domestic-, 309 foreign-owned firms; 497,214 workers	FEiLSDVj; auxiliary regression of unobserved individual component on foreign ownership; ECM model for minimum ability (average of three lowest individuals)	foreign (domestic private): at least 50 (less than 20) % of capital is under control of foreign investors	log. hourly earnings	foreign-controlled establishments employ stayers with 10.4% higher minimum ability (no difference for mean and maximum ability); long-run relationship between ownership and ability in ECM is 11.5%, but changing ownership yields no short-term impact on any ability measure
Earle & Telegdy (2006)	Hungary	LEED; 1986, 1989, 1992–2003; 1.4 million workers (random sample of workers within firms); 21,831 firms (at least 20 employees in at least one year); 4,437 (293) switch from State to Domestic (Foreign) 383 from Domestic to Foreign, 360 from Foreign to Domestic	OLS; firm FE; firm FE and time trends	dummies for state-owned vs. domestic (if the firm is majority private and domestic shareholding is larger than foreign) vs. foreign (if the firm is majority private and foreign shareholding are larger than domestic)	log real gross wage	pooled OLS: foreign-domestic differential of 44% (with year and regional controls); unchanged after including HK variables; FE: 15 %; FE & FT: 6 %; foreign-owned firms offer high rewards in particular to university graduates; smaller slopes of experience-wage profiles in foreign-owned firms; tests on substantial pre-privatization differences in wages are ambivalent across specifications
Feenstra & Hanson (1997)	Mexico	1975–1988; state-level census data on two-digit industries (32 states, 9 industries), 4 time periods (1975, 1980, 1985, 1988); unbalanced panel of 746 differenced observations	First Differences; IV for ownership variable	regional activities of maquiladoras (foreign assembly plants) as a measure of FDI: ratio of foreign manufacturing establishments to domestic manufacturing establishments	skilled labor-share of total wages; skilled and unskilled labour proxied by non-production and production workers respectively	growth in FDI positively correlated with relative demand for skilled labor: FDI can account for 52.4% of increase in border region's non-production wage share increase
Feliciano & Lipsey (1999)	US	(two-digit SIC) industry-state level; manufacturing and non-manufacturing; 1987–1992; BEA and Census matched data	OLS; (separately for domestically-owned and all plants) growth rate in wages on changes in employment in foreign-owned plants	dummy variable indicating whether industry-state cell is composed of foreign-owned or domestically-owned establishments; spill-over effects: foreign-owned employment share within industry and state	log. annual wage per worker (for foreign-owned and domestically-owned) spill-over effects: log wage in (1) US-owned and (2) all establishments	raw: 29% if employment-weighted; 23% (1987) and 15% (1992) if un-weighted; within-industry: 5-7% in manufacturing, 9-10% outside; within manufacturing: differential disappears after controlling for size, location, labor force (schooling, gender, unionization); non-manufacturing: 8-9% remain; only for non-manufacturing in 1992: significant positive relationship of foreign ownership to domestic establishment wages; no effect of foreign ownership growth on wage growth in domestically-owned plants

Table A.1: Previous estimates of foreign ownership wage effects

Study	Country	Data	Estimation method	Measure of ownership	Measure of remuneration	Differential
Girma *et al.* (2001)	UK	firm-level; manufacturing; 1991–96; 2,343 domestic, 1,408 foreign (525 US, 76 Japanese and 807 others); each firm observed at least three times and without a change of ownership in sample period	Random Effects	dummy; alternatively: three dummies for ownership from US, Japan, others; spillover regressions: sector share of employment in foreign-owned firms	log. wages, wage growth	raw: 13.7%; + controls: 9.51-5.34% ; wage growth not significantly different after productivity is controlled for; differential is highest for US and insignificant for Japanese firms; on average, no wage spillover to domestic firms, neither evidence of linking wage growth and growth in foreign presence; with higher levels of import competition, impact of FDI in sector on wages in domestic firms increases, but higher skill intensity dampens wage effect
Girma & Görg (2006*b*)	UK	plant-level; electronics and food industry; 1980–1994; 203 (100) acquisitions in electronic (food) sector; 108 US, 104 EU, 91 foreign acquisitions by other countries	PSM (control: plants which are always domestic) DID; different post-acquisition periods (1-4 years); by skilled and unskilled	dummies: US-, EU-, other ownership	log. plant-level wage	skilled (8%) and unskilled (9-13%) experience wage increase after US takeover; no effect if acquired by a EU firm; positive unskilled wage effects in the first two years (6.5%) following acquisitions from the rest of the world
Globerman, Ries & Vertinsky (1994)	Canada	plant-level; manufacturing; 1986; 5,553 Canadian-, 458 US-, 112 EC-, 38 Japanese-owned	OLS	dummies: US-, EC-, Japanese-ownership	log. average wage per production employee	raw + industry dummies: 18-29% (differences between source countries insignificant); + other variables: US and EC insignificant, negative differential for Japanese firms (-3.6%)
Görg *et al.* (2002)	Ghana	LEED; manufacturing; 1998; 144 firms (34 with some foreign ownership); 1,365 workers	OLS	degree of foreign ownership (percentage); assumption for regressions of starting wage: foreign ownership has remained constant over time	log. hourly wage; separately: current wage and starting wage in the firm; wage growth	raw differential: 65%; + HK: 38 %; HK + firm-variables: 8.5%; no statistically significant difference in starting wages; no ownership differential in wage growth between workers not receiving training; workers receiving on-the-job training in foreign firms have higher wages (26%) and experience higher wage growth than workers being trained in domestic firms

Table A.1: Previous estimates of foreign ownership wage effects

Study	Country	Data	Estimation method	Measure of ownership	Measure of remuneration	Differential
Heyman *et al.* (2004)	Sweden	LEED; individual- and plant-level; 1990–2000 (plants) resp. 1996–2000 (workers); 61,520 plant-years; 1,627,908 worker-years (only non-movers)	OLS; Fixed Effects; PSM, DiD; Foreign-Owned vs. rest (alternatively: vs. multinationals vs. locals)	dummy (1 if more than 50% of equity is foreign-owned); foreign takeover vs. greenfield	log. wage per employee (plant-level) resp. log. monthly wage (individual level)	raw + industry dummies: 11% at plant-, 4% at individual-level; all covariates: 12% resp. 2%; important is whether multinational rather than whether foreign-owned; effect of foreign takeover only about half to two third of effect of greenfield investments; zero wage premium on matched sample at individual-level; individual FE yields negative wage premium of -4%, suggests that foreign owners target high-wage firms, but wages increase at lower rate after ownership-change
Lipsey (1994)	US	plant- and industry-level; Census-BEA match data (US Department of Commerce) & BLS data, different years for var. investigations (1987, 1990, 1991, 1992)	OLS	dummy	average annual compensation	raw: 10% in manufacturing, 30% in non-manufacturing, half due to industry distribution; foreign and domestic manufacturing plants of same size pay about the same wage; occupational mix within industries hardly accounts for pay premium within industries; higher level of foreign participation raises domestic establishment wages; wage levels in acquired firms little below those in continuing operations (but above average increases in wages); changes in average compensation negatively correlated with change in employment (new affiliates shedding employees were dropping lower paid and less skilled ones)
Lipsey & Sjöholm (2004)	Indonesia	plant-level census data (more than 20 employees); manufacturing; 1996; 19,911 observations	OLS, separately for blue-collar and white-collar workers	dummy, also dummy for public ownership	log. average plant wage	raw: 67% for blue-collar (bc), 90% for white-collar (wc); HK: 36% (bc), 69% (wc); HK + plant-variables: 12% (bc), 20% (wc); premium for tertiary education is larger in foreign-owned firms, in particular for bc-workers
Martins (2006)	Portugal	LEED; 80% sample of annual census of all firms in manufacturing sector; 1991–1999; 5,409,000 worker-years, 39,783 firms; 231 acquisitions of domestic firms by multinationals	OLS; Quantile Reg.; PSM, DiD (treatment: acquistion of domestic firms by foreign-owned; controls: firms that are always (i) domestic or (ii) foreign; only non-moving workers)	dummy (1 if at least 50% of equity is owned by foreign parties); different dummy variables for share of firm's equity owned by foreign parties	log. real hourly wage (change in ln wages)	raw: 32%; HK: 27%; HK + firm: 11%; no monotonic relationship between wage premia and share of foreign equity; wage premium at 75%-percentile 2-3% larger than at 25% percentile; PSM yields insignificant differences in wage premium; DiD: lower wage growth in firms that are acquired by foreign investors

Table A.1: Previous estimates of foreign ownership wage effects

Study	Country	Data	Estimation method	Measure of ownership	Measure of remuneration	Differential
Pesola (2006)	Finland	LEED; 1994–2002; business sector; approx. 146,700 individuals working for 40,153 different plants; 1,158,789 person-year observations; number of plant-changers: 28,966 (DD), 3,826 (DF), 3,277 (FD), 1,355(FF)	for employees in domestic firms: OLS, FE; previous experience interacted with foreign ownership and university degree; for all employees: previous experience interacted with the ownership of previous and current employer (DD, DF, FD, FF)	dummy (20% treshold)	log real. monthly earnings	prior experience in foreign-owned firms has (over and above the return to other previous experience) a positive effect on earnings for the highly educated; these workers do not pay in form of lower wages for knowledge accumulation; foreign-owned firms do not pay a premium for knowledge that workers bring with them from domestic firms
Velde & Morrissey (2001)	Cameroon, Ghana, Kenya, Zambia, Zimbabwe	LEED; 1990–1993; same firms, but repeated cross-sections of individuals; food, wood, textile and metal industries	OLS	dummy if some foreign ownership (usually by persons, also by firms); interaction with education/occupation and sector	log. individual monthly earnings	controlling for age, education and tenure: 20-37% differential; + firm-specific effects (size, sector, region): 8-23%; skilled workers benefit more from foreign ownership: completing secondary education raises wages in foreign-owned firms by 16-33%; skill-differential does not depend on plant size

B Sample means

		West Germany		*East Germany*		
		West	*Foreign*	*East*	*West*	*Foreign*
size	Number of employees	284.601	590.581	38.237	150.450	236.558
—	Mining, energy	0.012	0.016	0.011	0.019	0.025
ind2	Food	0.044	0.027	0.039	0.041	0.067
ind3	Consumer goods	0.070	0.072	0.035	0.039	0.049
ind4	Producer goods	0.127	0.293	0.162	0.220	0.252
ind5	Investment goods	0.205	0.313	0.212	0.319	0.356
ind6	Construction	0.127	0.025	0.217	0.079	0.092
ind7	Trade	0.196	0.122	0.143	0.159	0.074
ind8	Transport & communications	0.042	0.037	0.033	0.018	0.025
ind9	Catering	0.026	0.019	0.022	0.005	0.006
ind10	Business services	0.125	0.056	0.091	0.084	0.037
ind11	Other services	0.025	0.019	0.035	0.016	0.018
—	Population >500,000 (central)	0.283	0.353	0.097	0.124	0.147
urban2	Population >500,000 (outskirts)	0.060	0.047	0.039	0.062	0.037
urban3	Population 100,000-500,000 (central)	0.189	0.200	0.130	0.175	0.178
urban4	Population 100,000-500,000 (outskirts)	0.141	0.109	0.124	0.117	0.110
urban5	Population 50,000-100,000 (central)	0.022	0.014	0.044	0.037	0.061
urban6	Population 50,000-100,000 (outskirts)	0.063	0.054	0.152	0.127	0.117
urban7	Population 20,000-50,000	0.110	0.113	0.171	0.172	0.153
urban8	Population 5,000-20,000	0.090	0.085	0.122	0.101	0.098
urban9	Population 2,000-5,000	0.027	0.016	0.072	0.045	0.067
urban10	Population <2,0000	0.016	0.010	0.048	0.040	0.031
single	Plant not part of larger firm	0.710	0.282	0.947	0.557	0.503
B1	Sectoral bargaining agreement	0.611	0.691	0.266	0.388	0.534
B2	Firm-level bargaining agreement	0.060	0.080	0.075	0.128	0.123
inv	Investment (relative to median)	148.899	355.623	16.258	81.403	157.100
conc	Herfindahl concentration index (3-digit)	0.005	0.012	0.005	0.009	0.015
—	Profits “very good”	0.047	0.080	0.038	0.048	0.067
profit2	Profits “good”	0.282	0.291	0.283	0.327	0.380
profit3	Profits “Satisfactory”	0.342	0.280	0.370	0.342	0.276
profit4	Profits “Just sufficient”	0.202	0.188	0.191	0.162	0.172
profit5	Profits “Bad”	0.127	0.161	0.118	0.122	0.104
vin	Age of plant (years)	18.371	17.751	8.599	8.361	8.687
exp	Proportion of exports in total sales	0.121	0.354	0.028	0.102	0.267
	No. of observations	4,136	515	2,212	872	163
	No. of plants	2,632	401	1,257	574	117

Table B.1: Plant-level sample means by location and ownership status

		West Germany		*East Germany*		
		West	*Foreign*	*East*	*West*	*Foreign*
wage	Daily wage in €, reported	104.246	114.421	61.572	80.005	83.055
wage	Daily wage in €, imputed	107.288	120.774	61.908	81.616	84.321
female	Female	0.170	0.182	0.269	0.235	0.235
foreign	Foreign	0.098	0.125	0.002	0.006	0.006
age	Age	41.898	41.855	42.772	43.129	43.129
—	Without apprenticeship or Abitur	0.171	0.203	0.020	0.043	0.043
qual2	Apprenticeship, no Abitur	0.671	0.596	0.803	0.759	0.759
qual3	No apprenticeship, with Abitur	0.005	0.006	0.002	0.002	0.002
qual4	With apprenticeship and Abitur	0.028	0.027	0.019	0.022	0.022
qual5	Technical college degree	0.050	0.071	0.044	0.064	0.064
qual6	University education	0.042	0.074	0.050	0.066	0.066
qual7	Education unknown	0.033	0.022	0.061	0.045	0.045
—	Basic manual occupation	0.320	0.378	0.260	0.335	0.335
occ2	Qualified manual occupation	0.220	0.155	0.332	0.218	0.218
occ3	Engineers and technicians	0.160	0.198	0.102	0.126	0.126
occ4	Basic service occupation	0.088	0.051	0.100	0.125	0.125
occ5	Qualfied service occupation	0.014	0.003	0.020	0.005	0.005
occ6	Semi-professional	0.003	0.003	0.001	0.007	0.007
occ7	Professional	0.005	0.006	0.004	0.003	0.003
occ8	Basic business occupation	0.041	0.045	0.039	0.027	0.027
occ9	Qualified business occupation	0.131	0.121	0.111	0.113	0.113
occ10	Manager	0.018	0.041	0.031	0.042	0.042
tenure	Tenure in years	12.444	11.544	7.585	8.097	8.097
	No. of observations	309,889	87,697	27,405	50,056	17,155
	No. of individuals	163,407	52,311	15,628	28,145	10,348

Table B.2: Individual-level sample means by location and ownership status

C Regression Sample

	Ownership in 2004			
	Stayers		*Movers*	
	Domestic	Foreign	Domestic	Foreign
Ownership in 2000				
Domestic	139,858	11,976	6,624	450
	(0–1,503)	(0–36)	(1,238–122)	(397–3)
Foreign	3,754	34,975	745	411
	(0–20)	(0–114)	(366–4)	(161–21)

Table C.1: West Germany. Number of workers (number of plants observed in one year–in two years). All workers included in both years.

	Ownership in 2004					
	Stayers			*Movers*		
	Domestic	West	Foreign	Domestic	West	Foreign
Ownership in 2000						
Domestic	11,533	953	179	244	113	25
	(0–955)	(0–23)	(a)	(215–8)	(152–1)	(40–0)
West	2,077	21,656	1,875	129	255	249
	(0–49)	(0–298)	(0–23)	(143–0)	(174–8)	(61–0)
Foreign	358	797	6,798	17	41	9
	(a)	(a)	(0–46)	(28–0)	(53–1)	(12–0)

[a] Total number of plants in cell too small to report.

Table C.2: East Germany. Number of workers (number of plants observed in one year–in two years). All workers included in both years.