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Andrews, Martyn; Bellmann, Lutz; Schank, Thorsten; Upward, Richard

Postprint / Postprint
Zeitschriftenartikel / journal article

Empfohlene Zitierung / Suggested Citation:
Andrews, M., Bellmann, L., Schank, T., & Upward, R. (2009). The takeover and selection effects of foreign-owned establishments: an analysis using linked employer–employee data. *Review of World Economics*, *145*(2), 293-317. https://doi.org/10.1007/s10290-009-0016-3

Rev World Econ (2009) 145:293–317
DOI 10.1007/s10290-009-0016-3

ORIGINAL PAPER

The takeover and selection effects of foreign-owned establishments: an analysis using linked employer–employee data

Martyn Andrews · Lutz Bellmann · Thorsten Schank · Richard Upward

Published online: 1 July 2009

Abstract We provide the first estimates of the effect of foreign ownership on wages in Germany, controlling for the observed and unobserved characteristics of workers and plants. We also test whether the wage gains from joining a foreign-owned firm are subsequently lost when leaving that firm, and we examine whether wage gains vary across the sample. We find large selection effects in terms of worker and plant components of wages. Once the selection effect is taken into account, the takeover effect is small and in some cases insignificantly different from zero.

Keywords Foreign-owned firms · Wages · Linked employer–employee data

JEL Classification F23 · J31 · C23

1 Introduction

There is now an extensive literature which suggests that foreign-owned plants outperform domestic plants and pay higher wages. A common finding is that the

M. Andrews
University of Manchester, Manchester, UK

L. Bellmann
Institut für Arbeitsmarkt- und Berufsforschung and Friedrich-Alexander-Universität Erlangen-Nürnberg, Nürnberg, Germany

T. Schank
Friedrich-Alexander-Universität Erlangen-Nürnberg, Nürnberg, Germany

R. Upward (✉)
School of Economics, University of Nottingham, Nottingham NG7 2RD, UK
e-mail: richard.upward@nottingham.ac.uk

wage differential is partly explained by differences in other characteristics which are themselves correlated with foreign ownership. For example, foreign-owned plants tend to be larger and operate in sectors of the economy which are inherently more productive. It is therefore important to control for plant size and sector when comparing the wages and productivity of foreign- and domestic-owned plants. Since these characteristics are often observable in plant-level data, controlling for these differences is straightforward in a regression framework.

Foreign and domestic plants might also differ in their unobservable characteristics. In particular, plants which are taken into foreign ownership might already be outperforming plants which are not taken over. With repeated observations at the plant level, it is possible to remove the influence of any time-invariant difference between plants 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 time-varying differences in the quality of the workforce, which may explain some of the apparent foreign-ownership wage differential.

More recently, the availability of linked employer–employee data (hereafter LEED) has allowed analysis at the worker-level which includes both plant- and worker-level controls. In this paper we present the first estimates of the foreign-ownership wage effect in Germany using LEED.

Our estimation methods allow us to investigate a number of other important issues in this literature. First, we can examine whether the wage gain from ownership status is lost when workers move from foreign-owned to domestic plants. The standard estimation techniques used in the literature generally impose an equal and opposite effect on wages of movement into and out of foreign-owned plants. But if wage gains are the result of, for example, human capital accumulation, we would expect that the wage gains of joining a foreign-owned plant would not be lost on leaving that plant.[1]

Second, we can investigate whether there are any distributional consequences of ownership status. For example, foreign-owned plants may implement a steeper wage-tenure profile, or they may change relative rewards to different skill groups. Third, we can directly estimate whether movers and stayers experience equal benefits from foreign ownership.

Finally, data from the former East Germany provides an interesting test-bed, because we observe plants acquired by both West German and foreign firms. This allows us to see whether the (presumed) technological advantage of overseas firms applies within as well as between countries. For example, it has been argued that foreign-owned firms face a higher fixed entry cost, and so only relatively high productivity foreign-owned firms will enter the overseas market.

We find evidence of large selection effects both in terms of worker and plant unobserved components of wages: plants which get taken over by foreign firms have higher wages before they are taken over. The selection effect is larger for plants in

[1] Blomstrom and Kokko (1998) note that the movement of workers from foreign-owned to domestic plants might be a source of so-called "spillovers". Fosfuri et al. (2001, p. 206) argue that "... evidence on spillovers due to workers' mobility is scarce and far from conclusive."

East Germany. Once the selection effect is taken into account, the genuine takeover effect is small and in some cases insignificantly different from zero in East Germany. The takeover effect is actually slightly *larger* in West Germany.

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

2 Literature review

As noted, there is now a wide range of estimates of the wage impact of foreign affiliates. Earlier studies tend to use industry-level or plant-level data. More recently, the availability of LEED has allowed analysis at the worker-level which includes both plant- and worker-level controls.

The studies can be classified according to the identification of the ownership wage differential. The first method compares wages (or wage growth) between foreign-owned and domestic-owned plants, which is typically carried out by OLS. In this case, one can condition on worker- 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 domestic-owned plants differ in unobserved characteristics. To circumvent this problem, the second method identifies 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 are a panel.

If the analysis is based on a LEED panel, 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 change. 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 (2004) and Heyman et al. (2007) use the former (and explicitly rely on workers staying in the same plant) to identify the ownership differential, the studies of Pesola (2007) and Balsvik (2006) are based on movement of workers.[2] To the best of our knowledge, no study derives (and contrasts) separate estimates of the ownership wage differential based on the two alternative sources of ownership variation.

Some studies only investigate the effect of becoming foreign-owned (Martins 2004; Heyman et al. 2007; Girma and Görg 2007) or restrict the effects of going from domestic to foreign and of going from foreign to domestic as being equal and

[2] Earle and Telegdy (2008) also uses LEED, but in their data workers cannot be tracked over time due to the omission of workers' identification codes.

opposite (Earle and Telegdy 2008). Conyon et al. (2002) is the only study at the plant level which also considers the effect of changing from foreign- to domestic-owned, although their control group comprises plants 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 and movers to multinationals with stayers. The reference group comprises in the first case stayers in non-multinationals, and in the second case stayers in multinationals. Pesola (2007) 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). Almeida (2007) estimates firm-level wage equations, but restricts the sample to those workers who remain in the plant before and after takeover.

All studies report that foreign-owned plants pay higher wages; this is considered a well-established stylized fact. The differential appears to be much larger in less developed countries: the reported (raw) wage differential amounts to 65% for Ghana, ranges between 67 and 90% for Indonesia, but lies somewhere between 10 and 30% for developed countries. In every case the differential reduces significantly after including human capital variables of the workers and/or characteristics of the plant, of which sectoral affiliation and plant 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, those studies which also account for unobserved factors by using fixed-effects methods often find that the differential is even smaller and sometimes insignificantly different from zero. For example, Almeida (2007) finds that the great majority of the wage difference is pre-existing before takeover, and that the wage gains for workers who remain in the firm are insignificantly different from zero.

It is often found that the foreign ownership wage differential rises with skill (Feenstra and Hanson (1997) for Mexico, Earle and Telegdy (2008) for Hungary, Lipsey and Sjöholm (2004) for Indonesia, Velde and Morrissey (2001) for sub-Saharan countries).[3] According to Görg et al. (2007), 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 plants, and whether they receive on-the-job training. Relatedly, Pesola (2007) finds that the positive wage effect of prior experience in foreign-owned plants is driven by the effect on the earnings of highly educated.

In this paper we present the first evidence for the effects of foreign ownership on German plants and workers using LEED. We provide comprehensive evidence consistent with the idea that foreign firms "select" high-wage plants and high-wage

[3] This is not supported, however, by the findings of Buckley and Enderwick (1983) and Girma and Görg (2007) for the United Kingdom.

workers. We also present some evidence that the wage gains from working in a foreign-owned plant are not lost when workers move to domestic firms, consistent with the idea that wage gains are the result of human capital accumulation.

3 Measuring direct wage effects of foreign ownership

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 is all workers who are observed twice. In each period, the identity of a worker's plant is given by $j = J(i, t)$. In words, worker i in period t belongs to plant j. 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:

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

The vector of observable characteristics $\mathbf{z}_{it}$ comprises 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. D_t is a period two dummy; λ measures the change in standard macro effects between $t = 1$ and $t = 2$.

Following Abowd et al. (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. ε_{it} is an idiosyncratic error, and is assumed strictly exogenous, such that $E(\varepsilon_{it}|\mathbf{z}'_{it}, F_{jt}, D_t, \theta_i, \psi_j) = 0$.

3.1 Defining the treatment and comparison groups

In the light of the 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 differential 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. Almeida (2007) discusses the possible motivations for foreign acquisitions of domestic firms. She argues that, in a regulated labour market with a high cost of restructuring, foreign firms will wish to select domestic firms which already exhibit desirable characteristics (such as a high-skill, high-productivity workforce). If this is the case, we will find a large selection effect without necessarily any additional takeover effect. The advantage of using LEED is that it allows us to measure selection not only in terms of plant characteristics, but also in terms of characteristics of workers in that plant.

We wish to estimate the effect on average workers' wages in domestic plants in $t = 1$ of becoming foreign owned in $t = 2$. Similarly, we wish to estimate the effect

on average workers' wages in foreign plants 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 that the wage benefits of foreign takeover are not reversed when plants revert to domestic control. This might be the case, if, for example, the wage gain is the result of general human capital accumulation. We therefore consider these two cases separately. To avoid repetition, in what follows we consider only the first case. Thus we 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 $t = 2$.

In the first instance, we estimate both selection and takeover effects. In the literature, the standard model for evaluating policy effects in this case is

$$y_{it} = \mathbf{z}'_{it}\boldsymbol{\beta} + \delta F_{jt} + \gamma T_i + \lambda D_t + \eta_{it}, \quad t = 1, 2. \tag{2}$$

Here the time-invariant dummy variable T_i is equal to one if the worker is in the treatment group and zero otherwise. The error term $\eta_{it} = \theta_i - \gamma T_i + \psi_j + \varepsilon_{it}$ includes ψ_j and ε_{it} from Eq. 1. It is also a function of θ_i because the treatment dummy T_i only controls for the average difference in θ_i between the treatment and control groups. The parameter δ is the *takeover effect*. To see this, note that F_{jt} is the interaction between D_t and T_i, and, when covariates are absent, the OLS estimator of δ is the "raw" difference-in-difference estimator

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

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, $\widehat{\delta}$ is the average wage of workers in foreign-owned plants relative to those in domestic-owned plants in $t = 2$ net of the differential between the same workers in $t = 1$, when they were all in domestic-owned plants.

The parameter γ is the *selection effect* discussed earlier. This is because, when covariates are absent

$$\hat{\gamma} = \bar{y}_{\mathcal{T}1} - \bar{y}_{\mathcal{C}1},$$

which captures the averaged unobserved difference between foreign- and domestic-owned plants prior to and including period $t = 1$. We label $\hat{\delta}$ and $\hat{\gamma}$ as the *Raw DiD* estimators when there are no covariates and the *Conditional DiD* estimators when there are.

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

One could estimate Eq. 2 with pooled cross-section data or with panel data. The raw DiD estimator controls for the average unobserved difference in y_{it} between the treatment and control groups. The conditional DiD estimator additionally controls for observable differences. With panel data one can also sweep out the remaining individual fixed heterogeneity $\theta_i - \gamma T_i$, and one can also control for plant-level heterogeneity.

3.2 Controlling for differences in θ_i

It has been suggested that foreign-owned plants might be more selective in recruitment (e.g. Dale-Olsen 2003), and employ workers with higher θ_i, so that $E(\theta|F=1) > E(\theta|F=0)$. We label this a *worker selection effect*.[4] To remove individual-level fixed effects we difference Eq. 1:[5]

$$\Delta y_i = \Delta \mathbf{z}_i' \boldsymbol{\beta} + \delta F_{j2} + \lambda + (\Delta\psi_j + \Delta\varepsilon_i), \tag{4}$$

where $\Delta y_i = y_{i2} - y_{i1}$, $\Delta \mathbf{z}'_i = \mathbf{z}'_{i2} - \mathbf{z}'_{i1}$, $\Delta F_j = F_{j2}$, $\Delta D_2 = 1$, $\Delta\psi_j = \psi_{J(i,2)} - \psi_{J(i,1)}$ and $\Delta\varepsilon_i = \varepsilon_{i2} - \varepsilon_{i1}$. For workers who do not change plant, $\Delta\psi_j = 0$. Again, if we drop the observable covariates, it is easy to see that the OLS estimator of δ is again the raw difference-in-difference estimator δ given in Eq. 3. 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. With observable covariates, the two estimators of δ no longer coincide. Also note that the selection effect is no longer directly identified, because T_i is time-invariant.[6] We label this estimator *FE*(*i*).

3.3 Controlling for differences in ψ_j

OLS estimates of Eq. 4 will yield unbiased and consistent estimates of δ if F_{j2} 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 correlated with unobservable plant-level determinants of wages. This is because foreign firms might also select into plants which have some unobserved productivity advantage so that $E(\psi|F=1) > E(\psi|F=0)$. 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:

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

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

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

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. Without covariates

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

where now $\bar{y}$ refers to plant-level sample means. Again we cannot directly estimate selection effects. We label this estimator *FE*(*j*).

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

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

[6] The selection effect can be recovered after estimating Eq. 4, as illustrated in Sect. 5.

3.4 Controlling for differences in both θ_i and ψ_j

The problem with aggregating the data to the plant level to difference out plant-level fixed effects is that estimates of δ from Eq. 5 will now be biased and inconsistent if $\Delta\bar{\theta}_j$ is correlated with F_{j2}. This is so-called aggregation bias, caused by the selection effect we cannot control for with plant-level data.

One advantage of LEED 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. In other words, 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 et al. (2006)):

$$\Delta y_i = \Delta \mathbf{z}_i' \boldsymbol{\beta} + \delta F_{j2} + \lambda + \Delta \varepsilon_i \quad i \in \{J(i,1) = J(i,2)\}. \tag{6}$$

Note that, when estimating Eq. 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, in fact, essentially the same method suggested by Martins (2004), which we label *FE*(s).

Because Eq. 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 Eq. 4 but include a full set of (differenced) plant 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 Andrews et al. (2006). It forms a restricted estimator for $\boldsymbol{\beta}, \delta, \lambda$ and ψ from estimating two models separately. These are Eq. 6, using stayers, and Eq. 4, using movers, where differenced plant dummies are added to the latter.[7] The CMD estimator allows us to recover estimates of both θ_i and ψ_j so that we can analyse selection effects.

To summarise, if the population version of Eq. 1 represents the true process by which wages are generated, one can obtain unbiased and consistent estimates of the foreign ownership on wages using: Eq. 4 if ownership and θ_i are correlated; Eq. 5 if ownership and ψ_j are correlated; and Eq. 6 if ownership is correlated with 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

[7] See Wooldridge (2002, ch. 14.6) and Andrews et al. (2006) for further details. Because the plant dummies are only necessary in the movers regression this method is computationally feasible.

8,250 plants[8] located in former West Germany and an additional 7,900 plants in 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 toward larger plants. The sample covers all industries. 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 sector.[9] Complete information on plant ownership is available for all plants only in 2000 and 2004, so we restrict our analysis to those years. A disadvantage of our data is therefore that we are unable to precisely date the year of acquisition. A detailed description of the IAB Establishment Panel can be found in Kölling (2000).

Table 1 summarises the basic sample which we use for the analysis.[10] 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. 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 workers 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.[11] 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%. Because of this, the wage effects of West German–owned plants in East Germany (compared with those that are East German–owned) 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 workers or trainees registered by the social insurance system. The register covers about 80% of workers in West Germany and about 85% in East Germany. Information on workers 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 et al. (2000).

[8] Note that we have information on plants (or establishments) rather than firms. We are not able to determine whether individual plants in the survey belong to the same firm, although we do know whether the plant is one of several plants within a firm.

[9] The relevant question is: "Is the establishment mainly or solely in: (a) West German ownership (b) East German ownership (c) Foreign ownership (d) Public sector ownership (e) No single owner which holds majority?" Our analysis considers only plants under (a)–(c). We are not therefore able to measure the share of foreign ownership in a plant.

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

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

Table 1 Incidence and coverage of different forms of ownership (percentages)

	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

Source: IAB Establishment Panel; 2000 and 2004; weighted figures

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 workers in the employment register who are employed by the surveyed plants on June 30th each year. This yields an unbalanced annual panel of workers 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.[12] Using wage data without any correction would generally yield estimates which are biased toward 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 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).[13]

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 4. We have rather less information on workers, shown in Table 5.

[12] 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.

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

5 Results

All our estimates can be thought of as variants of the basic difference-in-differences estimator described in Sect. 3, where we control for observables, and worker-level and plant-level unobserved heterogeneity.

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

$E_{J(i,t)t} = 1$ if worker i is in an East German-owned plant in period t, 0 otherwise
$W_{J(i,t)t} = 1$ if worker i is in an West German-owned plant in period t, 0 otherwise
$F_{J(i,t)t} = 1$ if worker i is in a foreign-owned plant in period t, 0 otherwise

For West German plants, we do not distinguish between East German-owned and foreign-owned plants because we have so few of the former. Therefore we have only two treatment and control groups, defined by the following dummies:

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

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

The basic model is Eq. 2, which allows us to directly estimate both the selection effect and the takeover effect. This is now written as

$$y_{it} = \alpha + \mathbf{z}'_{it}\boldsymbol{\beta} + \delta_F F_{jt} + \gamma_{WF} T_{WF} + \lambda D_t + \eta_{it} \tag{7}$$

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

$$y_{it} = \alpha + \mathbf{z}'_{it}\boldsymbol{\beta} + \delta_W W_{jt} + \gamma_{FW} T_{FW} + \lambda D_t + \eta_{it} \tag{8}$$

for plants which are foreign-owned at $t = 1$. There are analogous versions of Eqs. 4–6 which estimate δ_F using $FE(i)$, $FE(j)$ and $FE(s)$ respectively.

For plants in East Germany there are six treatment and three 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 variants of (2) for East Germany are therefore

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

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

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

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

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

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 1 Tables 6 and 7, which also

stratify between plant-stayers and movers. Consider Table 6, for West German plants. Each row represents a separate sample since we split between plants based on their ownership status in 2000. The columns represent those treated/not treated. Table 7 has the same structure, but for East Germany, where there are three possible treatment groups.

The dummy variable T_{WF}, for example, takes on the value of zero for the control group of 146,482 workers 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 both 2000 and 2004, this is not necessarily the case for movers. The group of the 6,624 movers worked for 1,238 plants which are observed in either 2000 or 2004, and for 122 plants which are observed 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

Results for West Germany are summarised in Table 2. Row (1) shows the raw difference-in-difference (DiD) estimates of both the selection and takeover effects. Our first basic result is that domestic plants which are taken over pay significantly higher wages *before* they are taken over. This selection effect is the coefficient on T_{WF}, γ_{WF}, estimated at 0.115 log-points. Similarly, foreign-owned plants which become domestic pay lower wages (−0.061) before they become domestic, but this effect is insignificantly different from zero (p-value 0.325). Then, for domestic-owned plants, there is an additional boost to wages of $\hat{\delta} = 0.043$ log-points after foreign takeover. This takeover effect is almost mirrored by plants which switch from foreign to domestic (−0.038 log-points). In the raw data therefore, foreign firms appear to take over higher-paying domestic plants, but also boost wages after takeover. Foreign-owned plants which revert to domestic ownership do not pay significantly lower wages, but wages do drop significantly afterwards.

The raw DiD estimate of the selection effect captures 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 worker and plant characteristics. For example, plants which get taken over may be larger or in higher-paying industries. Incorporating a full set of controls in the conditional DiD regression (as expected) reduces the estimate of γ_{WF} from 0.115 to 0.056, shown in Row (2). 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 plants switch from foreign

Table 2 Results for plants in West Germany

	Domestic in 2000			Foreign in 2000	
	Individual level	Plant level		Individual level	Plant level
(1) Raw DiD					
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)
(2) Conditional DiD					
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)
(3) Conditional DiD, 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)
(4) Conditional DiD, 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)	
(5) Conditional 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)
(6) Conditional *FE*(*i*)					
δ_F	0.029 (0.008)***		δ_W	−0.008 (0.009)	
(7) Conditional *FE*(*j*)					
δ_F		0.037 (0.011)***	δ_W		0.003 (0.017)
(8) Raw *FE*(*s*)					
δ_F	0.041 (0.017)**		δ_W	−0.014 (0.010)	
(9) Conditional *FE*(*s*)					
δ_F	0.027 (0.009)***		δ_W	−0.011 (0.010)	
(10) Conditional CMD					
δ_F	0.027 (0.009)***		δ_W	−0.011 (0.010)	

Notes: reports estimates of Eqs. 7 and 8 plus versions of Eqs. 4–6. Robust standard errors in parentheses, clustered at the plant level. All conditional estimates include all covariates listed in Appendix 1 Tables 4 and 5

Key: *** indicates $p \leq 0.01$, ** indicates $0.01 < p \leq 0.05$, * indicates $0.05 < p \leq 0.1$

to domestic. But this is due to differences in $\mathbf{z}_{it}$. 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.

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 movement and ownership status are correlated, 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, shown in Row (3). This reduces the takeover effect for plants which switch from domestic to foreign slightly (0.021 log-points), while the effect is larger for

movers (0.055 log-points).[14] 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 plants pay higher wages because they provide greater investment in human capital. If this human capital was general, the wage effects of foreign-ownership should be maintained when workers move from foreign-owned to domestic-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, shown in Row (4). Movers to foreign plants gain 0.055 log-points, while the loss for those who move to domestic plants is smaller and insignificantly different from zero.

The models estimated above allow 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 $\mathbf{z}_{it}$ in the regression we incorrectly "control for" these changes. One way of dealing with this bias is to measure covariates only at the pre-takeover values in 2000. This of course is only meaningful for those individuals who remain in the same plant. The result, shown in Row (5), is that the estimated effect of becoming foreign-owned rises again to 0.041 log-points.[15]

Exploiting the panel nature of the data, we can control for worker-level fixed effects θ_i using Eq. 4, shown in Row (6). We can control for plant-level fixed effects ψ_j using Eq. 5, shown in Row (7). Both θ_i and ψ_j can be controlled for by using Eq. 6, shown in Rows (8) and (9). Conditioning on covariates, we find that foreign takeover of domestic plants does boost wages, but only by about 0.027 log-points. This is smaller than the selection effect for stayers. Domestic takeover of foreign plants 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.

The final row (10) reports estimates from the classical minimum distance (CMD) method. This method controls for both individual- and plant-fixed effects, and (unlike spell-fixed effects) includes both 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 Sect. 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

[14] The overall DiD estimate is a weighted average of the movers' and non-movers' estimates. As can be seen from Table 6, only a small fraction of the sample comprise movers (4.6% of the workers in West Germany working for West German-owned plants in 2000).

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

that the selection effect is bigger for smaller plants. We would therefore expect that the inclusion of covariates (including plant size) in the plant-level estimates would reduce the selection effect, and this is indeed what happens. Comparing Row (6) with Row (7) we find that the resulting estimates of δ_F are slightly large from plant-level data, but that the estimates are within one standard error. This reflects the fact that our plant-level data includes plant-level averages of worker characteristics. One might conclude therefore that provided one controls for the average quality of the workforce in a plant, plant-level estimates are an adequate way of measuring the takeover effect. Of course, such detailed measures of the workforce are only typically available from LEED.

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 Eqs. 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 in Row (1) 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 0.309 more. Once these large selection effects are taken into account, however, 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-owned or West German-owned 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 (Row 2), but remain substantial.[16]

Rows (3) and (4) 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 plant-fixed effects, labeled $FE(s)$, Row (9). In almost every case we find small and insignificant effects. The only exception is a fall of -0.044 log points for West German-owned plants which become domestic. Thus, we find that while selection is greater in East Germany, there is less evidence that takeover has any additional effect on wages. Larger selection effects in East Germany is consistent with the idea that the base group of plants (those which are not taken over) are less technologically advanced than the equivalent base group in West Germany.[17]

[16] It is also consistent with a model in which the effects of foreign ownership on wages take a long time (more than 4 years) to develop.

[17] Temouri et al. (2008) find that the productivity gap between foreign-owned and domestic plants is greater in the Eastern states.

Table 3 Results for plants in East Germany

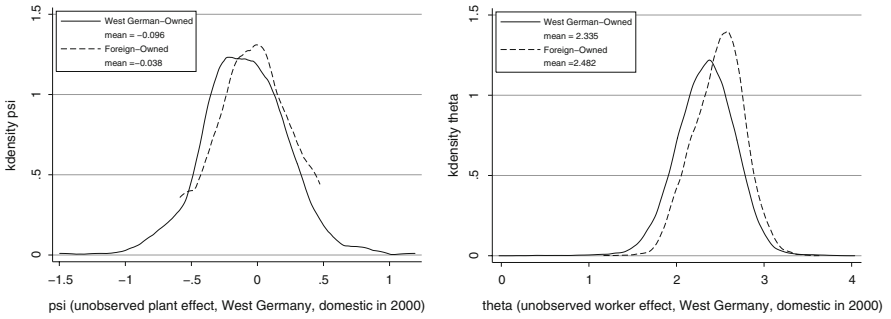
	Domestic in 2000			West German in 2000			Foreign in 2000	
	Individual level	Plant level		Individual level	Plant level		Individual level	Plant level
(1) Raw DiD/FE								
γ_{EW}	0.196 (0.049)***	0.233 (0.039)***	γ_{WE}	−0.086 (0.052)*	−0.043 (0.041)	γ_{FE}	0.026 (0.079)	−0.051 (0.104)
γ_{EF}	0.309 (0.092)***	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)
(2) Conditional DiD								
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)
(3) Conditional DiD, 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)
(4) Conditional DiD, 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)	

Table 3 continued

	Domestic in 2000			West German in 2000			Foreign in 2000	
	Individual level	Plant level		Individual level	Plant level		Individual level	Plant level
(5) Conditional 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)
(6) Conditional *FE*(*i*)								
δ_W	0.010 (0.011)		δ_E	−0.048 (0.015)***		δ_E	0.018 (0.048)	
δ_F	0.031 (0.030)		δ_F	0.023 (0.013)*		δ_W	0.032 (0.028)	
(7) Conditional *FE*(*j*)								
δ_W		0.019 (0.013)	δ_E		−0.015 (0.013)	δ_E		0.118 (0.177)
δ_F		−0.031 (0.036)	δ_F		0.056 (0.017)***	δ_W		0.040 (0.040)
(8) Raw *FE*(*s*)								
δ_W	0.001 (0.011)		δ_E	−0.053 (0.020)***		δ_E	0.056 (0.035)	
δ_F	0.014 (0.021)		δ_F	0.024 (0.014)*		δ_W	−0.012 (0.016)	
(9) Conditional *FE*(*s*)								
δ_W	0.011 (0.012)		δ_E	−0.044 (0.015)***		δ_E	0.060 (0.048)	
δ_F	0.011 (0.037)		δ_F	0.019 (0.014)		δ_W	0.034 (0.030)	

Notes: reports estimates of Eqs. 9–11 plus versions of Eqs. 4–6. Robust standard errors in parentheses, clustered at the plant level. All conditional estimates include all covariates listed in Appendix 1 Tables 4 and 5

Key: *** indicates $p \leq 0.01$, ** indicates $0.01 < p \leq 0.05$, * indicates $0.05 < p \leq 0.1$



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

Fig. 1 Estimated distribution of unobserved fixed wage components, West German plants

5.3 Selection effects at the plant 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 Eq. 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 plant 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 Fig. 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.

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 plant, 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.[18]

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 plants might implement a steeper wage-tenure profile, or might reward highly-skilled workers relatively more. The effects of foreign-owned plants might also vary by characteristics such as size and profitability. A further benefit of LEED is that we can disaggregate the foreign ownership effect by both worker characteristics and plant characteristics.

[18] 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 included.

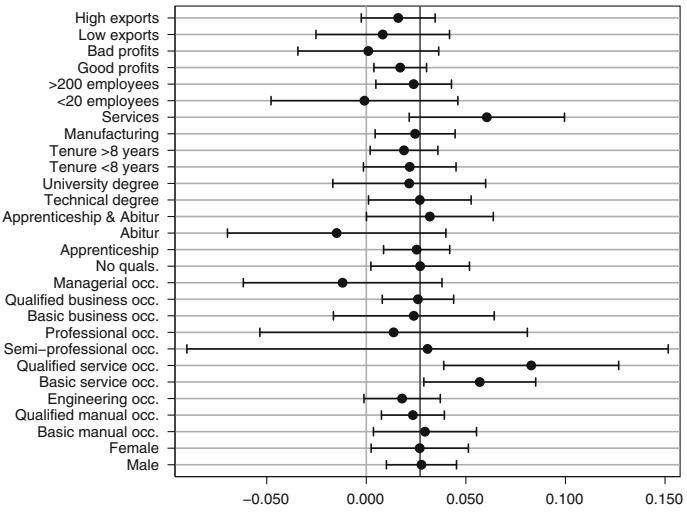


Fig. 2 *FE*(*s*) estimates of δ_F, West Germany, plants which are West German-owned in 2000

To enable comparison of a large number of coefficient estimates, we use graphical methods. In Fig. 2 we plot the estimate of δ_F for each subgroup 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 1 Tables 4 and 5, and include worker and plant characteristics.

Figure 2 enables us to see at a glance that confidence intervals for almost all subgroups 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 plants in the service sector, where there is evidence of larger takeover effects. The coefficient on δ_F for service sector plants, for example, is 0.060. Thus, foreign plants do *not* appear to reward more highly-skilled occupations or more highly qualified individuals more.

In Fig. 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 subgroups have confidence intervals which include zero. Exceptions are workers in engineering and managerial occupations, which have much larger takeover effects, and workers in plants with high levels of exports.

Finally, Fig. 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.

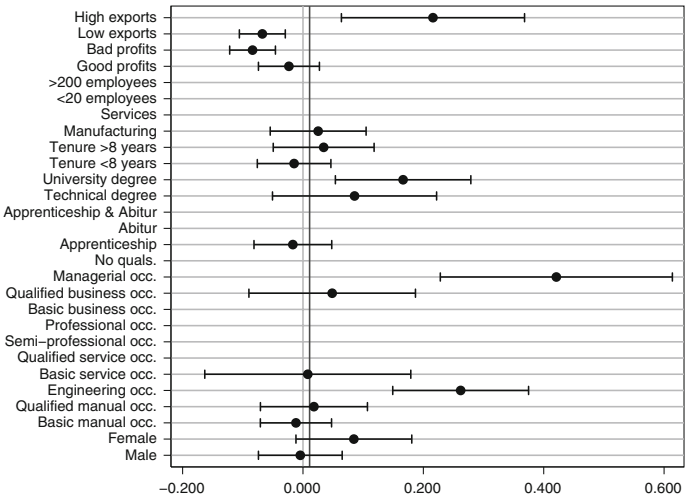


Fig. 3 $FE(s)$ estimates of δ_F, East Germany, plants which are East German-owned in 2000

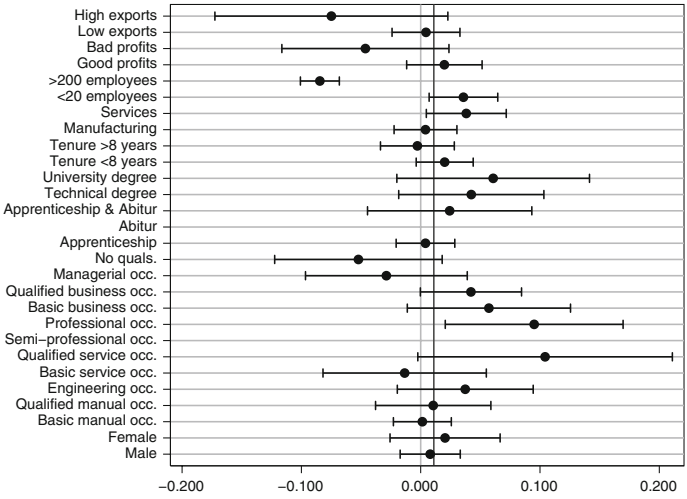


Fig. 4 $FE(s)$ estimates of δ_W, East Germany, plants which are East German-owned in 2000

6 Conclusion

We have shown how the treatment-effects framework can be used to estimate the "selection" and "takeover" components of the wage differential between foreign- and domestic-owned plants. With LEED 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 plant 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 finding that the selection effects account for almost all the wage differences between foreign and domestic plants is consistent with evidence for other European countries which comes from LEED, such as Almeida (2007) and Martins (2004).

The framework we use also distinguishes between plants 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-owned plants. 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 plant 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 workers who leave domestically owned plants and join foreign-owned). Our results also show that the wage gains to workers who move from a domestic to a foreign plant are larger than the wage gains to stayers who remain in a plant which changes ownership status. This sheds light on the process by which foreign-owned plants become high-paying establishments. Rather than paying higher wages to existing workers, they take on new higher-paid workers.

The use of linked data on workers and plants 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-owned plants do not appear to change the reward structure within plants 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. It seems possible that foreign firms find it difficult to change the wage structure of pre-existing German plants. Finally, we would also stress that, in these data, we cannot identify plants which are owned by German multinationals. Recent evidence from Temouri et al. (2008) shows that the productivity advantage of "foreign" firms in Germany disappears if one compares German multinational enterprises with foreign firms.

Acknowledgments The authors thank the Economic and Social Research Council (under grant number RES-000-22-1034) and the Leverhulme Trust (under grant number F/00 114/AM) for financial assistance. We also thank the participants of the following conferences for their comments: 2006 Comparative Analysis of Enterprise Micro Data (CAED) Chicago; 2nd User Conference on the Analysis of BA and IAB Data (2006) Nürnberg; IAB outsourcing workshop (2006) Nürnberg; EALE (2007) Oslo. The data were kindly supplied by the Institut für Arbeitsmarkt und Berufsforschung, Nürnberg.

Appendix 1: Sample means

Table 4 Plant-level sample means by location and ownership status

		West Germany		East Germany		
		West	Foreign	East	West	Foreign
Size	Number of workers	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 and 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 (three-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 5 Individual-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	Qualified 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

Appendix 2: Regression sample

Table 6 West Germany

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

Number of workers (number of plants observed once–twice). All workers included in both years

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

Table 7 East Germany

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

Number of workers (number of plants observed once–twice). All workers included in both years

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

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