Ownership and Wages:
Estimating Public-Private and Foreign-Domestic Differentials with LEED from Hungary, 1986–2003

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Abstract

Studies of public-private and foreign-domestic wage differentials face difficulties distinguishing ownership effects from correlated characteristics of workers and firms. This paper estimates these ownership differentials using linked employer-employee data (LEED) from Hungary containing 1.35mln worker-year observations for 21,238 firms from 1986 to 2003. We find that ownership type is highly correlated with characteristics of both workers (education, experience, gender, and occupation) and firms (size, industry, and productivity), suggesting ownership type is systematically selected along these dimensions. The large unconditional wage gaps (0.24 for public-private and 0.40 for foreign-domestic) in the data are little affected by conditioning on worker characteristics, but controlling for industry reduces the public and foreign premia (to 0.16 and 0.34, respectively), and controlling for employment size further reduces them (to 0.07 and 0.28). We also exploit the presence of 3,700 switches of ownership type in the data to estimate firm fixed-effects and random trend models, accounting for unobserved firm characteristics affecting the average level and trend growth of wages. These controls have little effect on the conditional public-private gap, but they reduce the estimated foreign premium (to 0.07). The results imply that the substantial unconditional wage differentials are mostly, but not entirely, a function of differences in worker and firm characteristics, and that linked panel data are necessary to take these correlated factors into account.

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1. Introduction

Wages in the transition economies of Eastern Europe have changed dramatically in the 15 years since the collapse of central planning. Average wages tended to decline in the first few years of transition and to rise more recently.[1] At the same time, the economies of the region have experienced massive organizational changes, most prominently large-scale privatization and opening to the global economy, including foreign direct investment.

These rapid changes provide a useful context for investigating the relationship between firm ownership and the level of wages. The transfers from the state to new domestic and foreign owners took place not only quickly but broadly across nearly all sectors. The tightly controlled wages of the centrally planned systems were abruptly liberalized, permitting organizations to set their own wages and to increase skill differentials, which were compressed under socialism (e.g., Kornai, 1992). But how these changes might be related is unclear a priori. If firms maximize profits, labor markets are perfectly competitive, there are no differences in fixed costs of employment, and the wage equals the full value of the job to workers, then wages should be correlated with ownership only through compositional differences in types of employees. Shifts in labor demand may lead to temporary wage differentials for the same type of worker, but these should disappear as workers move from lower to higher return activities. However, if ownership is associated with different objectives, fixed costs, fringe benefits, or other work conditions, then differences in wages across these types may persist even beyond the time required for workers to overcome mobility frictions.

In this paper, we estimate the relationship between the level of wages and ownership using linked employer-employee panel data for Hungary. Hungary is a particularly appropriate

[1] Commander and Coricelli (1995) and World Bank (2005) document average real wage changes in a number of transition economies.

country for the analysis, not only because it underwent sweeping ownership changes, similar to some of its neighbors, but also because its privatization policies tended to result in ownership structures more akin to those in market economies, with more outside investor control and with much more foreign involvement than other transition economies. Moreover, the available data for Hungary are exceptional in size and quality. The data include observations on some 1.35 mln worker-years at 21,238 employers that we follow over a long time period, from 1986 to 2003. The worker characteristics in the data are useful for controlling for the composition of employment at each firm, and the firm-side information permits us to measure ownership changes, control for firm characteristics, and control for some types of selection bias into ownership type. However, the data allow us to distinguish only three types of ownership: state (public), domestic private, and foreign. They also do not enable us to follow individual workers over time, nor do they include information on working hours, nonmonetary benefits, and other work conditions. We thus cannot control for unobserved differences across workers, nor can we rule out the possibility that observed wages reflect compensating variations with respect to differences along other dimensions of the employer-employee relationship.

Nevertheless, these data help overcome a number of drawbacks in previous research. Studies relying on firm-level data usually have small samples, short time series, and no worker characteristics, and they sometimes lack a comparison group. Identification may depend on observing ownership changes, but few studies analyze the effects of privatization on wages.[2] Haskel and Szymanski (1993) is the earliest systematic study, and it analyzed 14 British publicly owned companies, of which only 4 were actually privatized. Martin and Parker (1997) study 14 large British privatizations, while Kikeri (1998) and Birdsall and Nellis (2003) summarize a number of case studies and small sample surveys of privatization effects on labor in several developing economies. La Porta and Lopez-de-Silanes (1999) analyze 170 privatized firms in Mexico, although the post-privatization information is limited to a single year. The small sample size problem is overcome in Brown et al. (2005), who study nearly comprehensive panels of manufacturing firms in Hungary, Romania, Russia, and Ukraine, finding a zero or very small negative effect of privatization.[3] But a fundamental problem with all of this work using firm-level data is the inability to measure worker characteristics and thus to control for composition of the workforce, particularly if changes in composition are correlated with changes in ownership.

A similar problem is evident with most studies of relative wages at foreign-owned firms. For example, Feliciano and Lipsey (1999) study wage differentials between foreign and domestically owned establishments in the United States. Aitken et al. (1996) analyze the same topic but extend the analysis with wage spillovers between foreign and domestic firms. Conyon et al. (2002) study wage changes following foreign acquisitions in manufacturing firms in the United Kingdom. Lipsey and Sjöholm (2004) study these wage differentials in Indonesian manufacturing, although in this case they do control for the composition of workforce at the firm level. Brown et al. (2005) analyze the wage effects of privatization to foreign intervention. All these studies tend to find a wage premium in foreign firms.

However, a second, equally serious problem is that most studies do not account for ownership selection effects. If firms experiencing an ownership change are not randomly selected with respect to their wage behavior and the researcher does not take this into account,

[2] The lack of research on the wage impact of privatization contrasts with the large literature on firm performance, already the subject of multiple survey articles (e.g., Megginson and Netter, 2001; Djankov and Murrell, 2002).

[3] A related line of research analyzes effects of all types of ownership change on wages: e.g., Lichtenberg and Siegel (1990) on leveraged buyouts, Gokhale et al. (1995) on hostile takeovers, and McGuckin and Nguyen (2001) on mergers and acquisitions. Our data do not contain information on all ownership changes, but only on transitions between state, domestic private, and foreign ownership types, which are thus our focus in this paper.

the estimated effect of ownership change will generally be biased. Indeed, some recent studies demonstrate this possibility.[4]

Instead of using firm-level data, another category of research has employed individual data that include information on employer ownership as well as wages. There is a sizable literature on public-private wage differentials, surveyed by Gregory and Borland (1999). In the Western context, however, this research amounts to an analysis of interindustry differentials with little possibility of taking into account unobserved differences in ownership types that are correlated with wages. Concerning foreign wage differentials, Peoples and Hekmat (1998) carry out an analysis for the United States, but they use only industry-level ownership information. In the transition context, Brainerd (2002) estimates wage effects of Russian mass privatization using worker-level data. A problem with these studies is possibly inaccurate measures of ownership, which are reported by workers who may not be fully informed about the progress of the privatization process. More importantly, worker-level data do not permit controls for firm selection into ownership type.[5]

The advantages of both firm- and worker-level data can be exploited only if one combines the two data types into linked employer-employee data. But only two previous studies, both of them recent working papers, use linked data for a similar purpose, and both focus on the effects of foreign acquisitions on wages in Portugal: Almeida (2003) estimates the effect of 103 foreign acquisitions and finds higher wages in foreign firms, but Martins (2004), using a dataset with 231 acquisitions, reports a negative effect. These studies share the problem, common to most Western datasets, of relatively few ownership changes, so that the ownership effect is identified

[4] Conyon et al. (2002) employ firm fixed effects to study foreign acquisitions in Britain. Almeida (2003) discusses selection of foreign acquisitions, and Brown et al. (2005, 2006) discuss selection in privatization programs.
[5] An identification approach in analyzing wage differentials across sectors examines wage changes of workers who switch sectors (Krueger and Summers, 1988). Our firm fixed effects and firm-specific trends methods below rely on firms switching sectors.

only on a small sample of firms. In our Hungarian data, by contrast, we observe thousands of ownership changes, including 3550 involving domestic private ownership and 926 involving foreign ownership (some of which overlap). The Hungarian data also contain substantial numbers of observations of each ownership type for each industry, so we can avoid the usual pitfall, particularly common in the public-private wage literature, of attempting to infer ownership differentials from industry differentials. Unlike other transition economies, moreover, the Hungarian ownership structure emerging from the transition process is more similar to developed market economies than elsewhere in Eastern Europe. By contrast with other transition economies of the region, Hungary emerged with very little worker ownership and frequently with strong outside blockholders, particularly foreign investors.

While we believe that our data, context, and methods provide the possibility for significant progress in identifying ownership effects, it is of course still possible that the differentials we estimate may not equal the causal effects of ownership. First, it is likely that selection of firms and workers into ownership types is nonrandom with respect to unobserved factors, such as quality of the firm or the worker. We exploit the longitudinal structure of the firm side of the data to control for fixed and trending differences across firms, but because we do not know the form taken by the heterogeneity we cannot be sure that these methods fully account for selection bias. Moreover, we cannot control for unobserved heterogeneity at the worker-level. A second issue in interpreting our estimates on domestic private and foreign ownership is that we do not observe wage outcomes in state firms under a counterfactual of no privatization and no liberalization of foreign entry into the Hungarian economy. Indeed, wage behavior of each ownership type may well be influenced by each of the others through labor market interactions. Analyzing such spillover effects could be interesting, but we leave it for future research.

The next section describes the construction of the employer and employee components of our data and how we link them into a single database. In Section 3, we briefly explain the changes in the ownership structure during the period studied and summary statistics for all variables. We also provide some initial analysis of the evolution of wage levels. Section 4 describes regression estimates of the impact of ownership on the level and structure of wages, including specifications that control for selection bias into ownership type based on firm-specific time-invariant and time-trending heterogeneity. An important issue in estimating such impacts is the appropriate unit of analysis, and we provide some comparisons of results where the observation is a worker-year with others where the observation is a firm-year. Our data measure wages at both levels, but the worker-year observations permit us to analyze worker heterogeneity in wages and to control for worker characteristics, while the firm-year approach is more closely aligned with our variable of interest, firm ownership. Section 5 concludes with a summary and suggestions for further research.

2. Data Sources and Sample Construction

We study a linked employer-employee dataset from two sources. The first is the Hungarian Wage Survey, which gathers information on individual worker characteristics and wages. The Wage Survey was carried out in 1986, 1989, and annually since 1992, with the last available round in 2003. Our analysis thus uses information on workers from 1986, well before the transition started (in 1990), until 2003, the year just prior to European Union accession. Until 1995, the sampling frame for firms each year includes every tax-paying legal entity using double-sided balance sheets with at least 20 employees; after 1995, the size threshold for inclusion is 10 employees and a random sample of smaller firms is also included. To maintain consistency across years, we restrict attention to firms with at least 20 employees in at least one year.

From this sampling frame, employers are included in the Wage Survey according to whether their employees are selected by a second-level procedure. In 1986 and 1989, workers were selected by using a systematic random design with a fixed interval of selection: in 1986, every 7th production worker and every 5th non-production worker, while in 1989 every 10th worker, regardless of skill; in addition, each manager of the company was included. In these two years, therefore, every Hungarian firm using double-sided accounting should be included, except for nonresponses. From 1992 the worker sampling design changed: production workers were selected if born on the 5th or 15th of any month, while non-production workers were chosen if born on the 5th, 15th, or 25th of any month. In these years, firms are included only if they have employees born on these dates; they are excluded if they do not have such employees, or if they do not respond to the survey. Leaving aside nonresponse, this selection procedure provides a random sample of workers within firms and includes, on average, about 6.5 percent of production workers and 10 percent of non-production workers. Assuming birthdates and nonresponses are randomly distributed across firms, the sample of firms is related to size (the probability of having employees with the given birthdates), but otherwise random.[6]

We constructed two types of weights to reproduce the universe of workers of Hungarian firms with more than 20 employees. The first type of weight adjusts for within-firm oversampling of nonproduction workers and worker nonresponse using separately available information on the number of production and nonproduction workers in each sampled firm,

[6] For example, a firm with 20 production workers has a probability of about 0.11 to be excluded from the sample, while for a similar firm with 100 employees this probability is only 0.012. In addition to weighting to account for the size-probability relationship, we have also estimated all equations restricting the sample to employees of firms with more than 100 workers, with results qualitatively similar to what we report for the larger sample.

available for May of each year. The second set of weights corrects for undersampling of smaller firms and firm nonresponse to the Wage Survey. These weights are constructed using a second database, drawn from the Hungarian Tax Authority, which consists of annual firm-level information between 1992 and 2003 on every firm that used double-entry bookkeeping. The weights are computed for various size classes as the ratio between total employment in this universal data to total employment in the sampled firms in the Wage Survey.[7]

We also use the Tax Authority data to generate some of the firm characteristics in our analysis. The Wage Survey and Tax Authority data are linked using some common variables.[8] The information includes the balance sheet and income statement, the proportion of share capital held by different types of owners, and some basic variables, such as average yearly employment, location, and industrial branch of the firm. We use the share capital variables to construct the ownership structure. For the two early years—1986 and 1989—the Tax Authority data are not available, and for these years we use the firm information from the Wage Survey; ownership in these years is always state, so the share capital variables are not necessary.

We cleaned firm ownership data extensively, checking for miscoding and dubious changes (e.g., firms that switch back and forth between ownership types). Our procedures also paid a great deal of attention to longitudinal links, for which we used a dataset from the Central Statistical Office of Hungary providing information on re-registration and boundary changes. As this dataset is not comprehensive, we also tried to find spurious entries and exits by looking for matches of exits among the entries on the basis of headquarter settlement, county, industry, and

[7] The size categories are groups of 10 from 20-100 employees, 101-250, 251-500, 501-1000, and larger than 1,000. The few cases where the sum of sample employment exceeded universal employment were assigned weights of one.
[8] Neither dataset contains firm names, exact addresses, or identification codes, and we constructed the links using an exact one-to-one matching procedure for the following variables: county, detailed industry, employment, and financial indicators such as sales and profits.

employment. Unfortunately, the Wage Survey data do not provide identification codes for workers, so it is not possible to track them across years.

Table 1 shows the number of workers with full information on characteristics, the number of firms with information on ownership, and the total number of employees in these firms.[9] The dataset we work with is a panel of 21,238 firms linked with a within-firm random sample of 1.35 million workers.

3. Evolution of Ownership, Variable Definitions, and Summary Statistics

Compared with its neighbors in Eastern Europe, Hungary began corporate control changes relatively early. Starting with a more relaxed planning regime in 1968, the socialist government gradually permitted state-owned enterprises to operate with increased autonomy, and the decentralization process accelerated during the 1980s (e.g., Szakadat, 1993). Movement of assets out of state ownership began at the very end of the 1980s in the form of so-called "spontaneous privatization," which usually involved spin-offs initiated by managers, who were also usually the beneficiaries, sometimes in combination with foreign or other investors (see, e.g., Voszka, 1993). After the first free elections in May 1990, procedures became more regularized, involved sales of entire going concerns, and generally relied upon competitive tenders open to foreign participation. Unlike the programs in many other countries, the Hungarian policies did not grant workers significantly preferential prices at which they could acquire shares in their companies, with the exception of about 350 management-employee buyouts. Nor did Hungary carry out a mass distribution of shares aided by vouchers, as was common in most other countries of the region. On the other hand, Hungary was much more open to foreign investors than elsewhere. As a consequence, Hungarian privatization resulted in very little worker

[9] Firm-year observations with no information on sales and employment are dropped from the sample.

ownership, very little dispersed ownership, and high levels of blockholdings by managers and both domestic and foreign investors.[10]

Our database provides the ownership shares of the state, domestic, and foreign owners at the end of each year (the reporting date). We define a firm as domestic private if it is majority private and the domestic ownership share is higher than that of foreign ownership. If the foreign share is larger than the domestic, the firm is foreign-owned for the purposes of this paper.[11] The evolution of the ownership structure among the firms in our sample is presented in Figure 1, clearly reflecting the early start and the heavy presence of foreign ownership in Hungarian privatization. Although there was only negligible privatization and new private entry by 1989, already in 1992 about 40 percent of the workers in our sample worked in private enterprises. The share of domestically privatized firms grew steadily until 1998, when 54 percent of the employees worked for domestic owners. Thereafter, it ceased growing and even shrank slightly (because of attrition from the sample). The proportion of employees in foreign-owned firms grows steadily in our sample, reaching 29 percent by 2003. At the same time, about 20 percent of the employees worked for the state. The firm-level figures are different from the worker-level figures, as about three-quarters and one-fifth of the firms are controlled by domestic and foreign owners, respectively, but even by this measure the state has a controlling stake in at least 5 percent of the firms, thus providing a comparison group for the effects of privatization.

Table 2 shows the incidence of various types of changes in ownership type. The transition process resulted in many more changes from state to private than could ever be observed in a nontransition economy, and the number of changes involving foreign ownership in Hungary are

[10] Frydman et al. (1993) and Hanley et al. (2002) contain descriptions of the Hungarian privatization process. Earle et al. (2005) study ownership of firms listed on the Budapest Stock Exchange.

[11] This definition has the advantage over definitions that would involve majority ownership that all privatized firms can be categorized as domestic- or foreign-owned.

probably the largest that could be found in Eastern Europe. In our data, 3,115 ownership changes involve domestic private ownership, and about 600 involve foreign ownership. We will exploit these ownership changes when we control for unobserved heterogeneity in estimating wage differentials, as described below.

The wage variable in our data is gross monthly cash earnings in May plus one-twelfth of previous year's bonuses, which we have deflated by the annual CPI.[12] Figure 1 shows the evolution of real wages from 1986 to 2003: an initial decline of around 10 percent and subsequent rise of about 25 percent.[13] The steady, substantial growth in the Hungarian real wage since the mid-1990s is unusual among the transition economies, and an interesting question is whether Hungary's relatively rapid privatization and large foreign component may have contributed to this performance. The reliability of the real wage measure is of course strongly influenced by the quality of the deflator (in this case, the CPI), and the large changes in quality and availability of goods suggest caution should be exercised when interpreting these figures. When we estimate wage differences by ownership, however, we include year effects, so our comparisons are not influenced by these measurement problems.

Table 3 provides calculations of differences in mean wages by type of owner, presenting information for 1992 and 2003—the first and the last year in our panel when each ownership type is present. In both years, the unconditional mean wage is smallest in domestic private firms, largest in foreign-owned firms, and intermediate under state-ownership. Average worker characteristics also vary, however, with higher rates of female and university employment in

[12] Most studies of wages in Eastern Europe (and many in Western Europe) analyze monthly rather than hourly or weekly earnings; this is because of institutional differences such as the custom of reporting wages on a monthly basis, the lower incidence of part-time employment and greater standardization of full-time hours, and the frequent unavailability of hours information (even for production workers). In our data, hours of work are available only for the most recent years, so we cannot analyze changes using them.
[13] To maintain comparability over time, the evolution of the average real wage is estimated as the year effects in a ln(real wage) equation that controls for firm fixed effects.

foreign-owned firms, higher rates of vocational employment in domestic private firms, and higher rates of high school employment under state ownership.[14] Potential experience tends to be lower in foreign-owned firms, a difference that becomes much more pronounced by 2003. The composition of the workforce by occupation also varies considerably, with a much higher rate of employment of professionals under foreign ownership, and a high rate of skilled manual employment in domestic private firms. Such factors likely influence average wage differentials by ownership type and can be taken into account by multivariate analysis.

Firm characteristics also vary by ownership, as Table 4 documents. Measured by employment size, state-controlled firms are the largest, with an average size of 284 employees in 1992 and 400 in 2003. Foreign-owned firms are also quite large, on average over 150 employees in 1992 and 220 in 2003, while domestic firms are much smaller, with an average size under 100 in both years. Labor productivity (measured as the value of real sales over the average number of employees) varies dramatically by ownership type: the least productive firms were domestically owned in 1992, followed by state-owned firms. The productivity difference between these two ownership types is quite small, at least compared to the productivity of foreign-owned firms, which were about twice as productive as state-owned firms, and three times as productive as the domestically owned ones. The productivity of both types of private firms increased greatly by 2003, and remained practically unchanged for state-owned firms.[15] Finally, the industrial composition of firms in the sample also varies by ownership. In both years presented in the table, foreign firms had a high presence in manufacturing, while the share of

[14] Wages and educational composition for the categories never privatized and eventually domestic and foreign privatized firms are much more similar in 1986 than in Table 2, indicating that the different composition and wages in 1992 are probably due at least partly to privatization.

[15] These results should be treated with caution, as the sample within each ownership type varies considerably. For a multivariate analysis of the productivity effects of domestic and foreign privatization in four transitional countries (among them Hungary) see Brown et al. (2006).

state-owned firms in this sector dropped dramatically. Energy and water supply was mostly controlled by the state, and domestic firms had a large proportion of firms in agriculture. The presence of state ownership in all sectors of the economy helps in identifying the wage effect of state ownership, which is often confused with interindustrial wage differentials when data from developed countries are analyzed.

To summarize the discussion of selection of workers into different ownership types, we ran multinomial logit regressions, where we test how individual characteristics influence the ownership type of the employer. As shown in Table 5, longer potential experience and only basic education (8 years or less) make it more likely that the worker is employed in a firm controlled by the state; vocational education increases the probability that the employer is a domestic private owner; females and more-educated workers are more likely to work for foreign owners.

In the next step toward the analysis of wages and ownership, Table 6 contains calculations of mean wages by ownership type and educational attainment in 1992 and 2003. For both years and all four educational categories, the ownership types are clearly ranked in wage levels, with foreign highest, state second, and domestic private lowest. At this level of analysis, there are clearly large differences among the three ownership types in both the level and the structure of wages they pay. It is interesting that the mean wages of the two types of private ownership—domestic and foreign—are much more different from each other than from state ownership.

4. Regression Estimates

To estimate the systematic impact of ownership on wages, we turn to regressions. We are interested not only in controlling for worker characteristics in various combinations—and in assessing the robustness of our results to such controls—but also in attempting to remove some types of selection bias in the determination of ownership type. For example, if state-owned enterprises that already pay higher wages are more likely to be purchased by foreigners (perhaps because of higher unobserved skill, better technology, or indeed for any reason), then the foreign wage premium we have documented may be due to the systematic selection of high-wage firms into foreign ownership. The privatization process involving domestic owners may also have biases, as politicians, frequently together with employees, choose whether a firm is privatized. Politicians may prefer to retain firms with the worst prospects in state ownership in order to protect workers from layoffs and wage cuts, and the employees themselves may work to prevent privatization in such cases. If the privatization process is corrupt, then exactly the opposite may be true: politicians may prefer to sell the best firms quickly in order to collect bribes.

Of course, we cannot entirely eliminate all possibility of such biases, but the large number of ownership changes together with the longitudinal dimension of our data permit us to at least check whether the differentials implied by our analysis so far are robust to some simple attempts to account for selection bias. For this purpose, we employ methods developed for the evaluation of training programs in the United States. The first method is the standard correlated effects model that controls for time-invariant unobserved heterogeneity at the firm level. A second is the random growth model, which includes a firm-specific linear time trend.[16] Such a model may be appropriate if, for example, foreign investors are more likely to acquire firms that for some intrinsic reason (unobservable to the researcher but not caused by ownership) are raising their wages or increasing the premia paid to more highly educated workers. Higher-order parameterizations of heterogeneity are of course possible, but we do not take them into account,

[16] Ashenfelter and Card (1985) and Heckman and Hotz (1989) use random trend models to evaluate training, while Jacobson et al. (1993, 2005) apply it to the wage effects of job displacement and community colleges. Brown et al. (2005, 2006) use the model to estimate the impact of privatization on employment, wages, and productivity at the firm level. Our paper is the first to our knowledge that uses firm-level trends in any analysis of worker-level wages, and it is the first that uses firm fixed effects in a study of ownership and worker-level wages.

and identification of the effect of ownership in our analysis assumes that any other heterogeneity is uncorrelated with either ownership or wages. Both of these estimators rely on ownership changes to identify the coefficients of interest; indeed, the random growth model measures changes in the growth rate before and after an ownership change. A resulting disadvantage is that the results pertain to firms that experience such changes, not to the broader sample.[17] Finally, we use some specification tests to evaluate the performance of the estimators.

All equations control for year of observation and region of the establishment. We report standard errors in all cases permitting general within-firm correlation of residuals using Arellano's (1987) clustering method, so that our test statistics are robust to both serial correlation and heteroskedasticity.[18] Standard errors are also adjusted for loss of degrees of freedom in specifications when the data are demeaned and detrended.

Table 7 displays estimates by pooled OLS, firm fixed effects estimations (FE), and firm fixed effects and trends (FE&FT). The first OLS column includes no controls beyond year and region, and the estimates demonstrate that the raw ownership differences are large (0.24 for state and 0.40 for foreign), and they are precisely estimated. The next column adds standard worker characteristics—education, experience, and gender—to construct a Mincer earnings function, but with little qualitative change in the results: a slight decline in the estimated foreign coefficient and somewhat larger decline for state ownership (to 0.39 and 0.20, respectively). The small difference between the unconditional estimates and those controlling for worker characteristics is

[17] Another potential disadvantage is that these estimators may raise the noise-to-signal ratio, eliminating relevant between-firm variation while exacerbating the effects of measurement error in ownership. On the other hand, misclassification error is unlikely to be a problem in our case of official firm reports to the Tax Authority on the firm's ownership—a clear, measurable concept reported by professional accountants. This contrasts with the standard cases studied by economists of changes in industry of employment, union membership, or labor force status. In these cases, switching is usually measured in a household survey context by differing answers over time from (potentially different) family members who happen to be home and who are asked questions about one family member's job search, availability, union status, and other employment-related activities.

[18] Kézdi (2003) contains a detailed analysis of autocorrelation and the robust cluster estimator in panel data models.

somewhat surprising given that worker characteristics are highly correlated with both wages and ownership, as we documented in the previous section.[19]

Adding firm-specific intercepts, however, greatly diminishes the magnitude of both coefficients, while hardly affecting the estimated wage structure by worker characteristics. The state coefficient estimate is 0.07 and the foreign is 0.14. Further adding firm-specific trends increases slightly the state effect, but halves the foreign coefficient. Both coefficients in the FE&FT specification have similar standard errors to those in the other specifications, so the issue is not one of precision. Evidently, the estimates are not at all robust to these controls for selection bias into ownership type. The hypothesis that the state and foreign effects are equal is rejected in OLS and FE specifications, but not in the FE&FT, where the point estimates (0.078 for state and 0.073 for foreign) are strikingly similar.

Table 8 provides additional estimates that include controls for occupational group of the worker. The estimated coefficients on worker characteristics are somewhat affected by these variables, but they matter little for the estimated impacts of state and foreign ownership. At the same time, the ownership coefficients are highly sensitive to the controls for selection bias, but the worker characteristic coefficients are not. The wage structure by worker characteristics that we described in the previous section appears not to result from systematic sorting of workers across firms that pay different wage levels, because any time-invariant firm heterogeneity in wage levels is controlled for in the FE specification, while any time-trending heterogeneity across firms is controlled for in the FE&FT.

In Table 9 we further exploit the nature of our data and control for firm characteristics (industry, size, and productivity) in addition to worker characteristics. The coefficient on log

[19] These results are little changed by adding interactions between education categories and experience, by estimating separately by gender, or by employing a number of other alternative approaches to estimating earnings functions.

employment is highly significant and positive in OLS and FE, showing that wages increase by 0.5 percent for each 10 percent increase in the size of the OLS. This effect is only 0.2 percent in FE, and negative and insignificant when firm-specific trends are controlled for. The wage effect of average labor productivity is always highly significant and positive, with a magnitude of 0.11 in OLS, 0.07 in FE, and 0.035 in FE&FT.

Concerning the ownership type coefficients in Table 9, including industry controls in the OLS specification decreases the state coefficient to 0.16 and the foreign coefficient to 0.34. Further addition of labor productivity slightly increases the estimated state effect and further diminishes the estimated foreign effect. Controlling for employment size (but not productivity) has a large effect on the state coefficient (decreasing it to 0.07) a smaller effect on the foreign coefficient (decreasing it to 0.28). These observable characteristics of firms thus account for more of the raw state-private gap than of the foreign differentials. By contrast, the FE and FE&FT estimates are unaffected by the addition of firm size or productivity.[20] Once we control for selection into ownership, these estimations show that inclusion of firm characteristics do not change the main results.

An important and somewhat neglected issue in analyzing the relationship between worker wages and firm characteristics such as ownership is the question of the appropriate unit of observation: the worker or the firm. Analyzing workers exploits the variation in wages among workers and allows their characteristics to be controlled for, so that the composition of employment is held constant. Analyzing firms is appropriate because ownership is an attribute of the firm, and it may be advantageous if the firm-level wage is better measured than wages at the individual level. Table 10 presents a comparison of some alternative approaches along a

[20] As firms rarely change industry in our data, we do not control for industry in the FE and FE&FT specifications.

number of dimensions: unit of observation (firm or worker), source of dependent variable (firm reports to the Tax Authority, average firm wage constructed from worker data, and individual worker data), and weights on workers when constructing firm-level average wages. The last row in Table 10 reproduces our results from Table 7 for comparison purposes. The other rows show the results of various changes in the specification and sample. Regardless of the choice of specification, the coefficients on state and foreign are always positive and statistically significant (except in one case), and the estimates are highly sensitive to the selection control method applied, similar to our previous results. The magnitude of the estimated effects, however, varies relatively little by the choice of unit of observation, wage measurement, controls for composition of workforce, and weighting.[21]

Because the FE and FE&FT specifications produce such different results from the OLS, it is useful to carry out some specification tests. First, we assess the joint statistical significance of the fixed effects, and then, conditional on including the fixed effects, of the firm-specific trends. The F tests in each case reject the exclusion of the FE and the FT at significance levels of 0.0001. Next, we carry out Hausman tests of the vector of coefficients of the FE model relative to the OLS, and of the FE&FT relative to the FE. Again, these χ^2 tests reject the restricted model in each case.

5. Conclusion

Do foreign-owned and state-owned organizations pay higher wages than domestic private firms? Economists have devoted considerable attention to estimating these wage differentials,

[21] A similar issue about the appropriate level of observation arises in research on union wage differentials, as discussed by Pencavel (1991), who notes that the few establishment-level studies tend to find lower differentials than those based on individual data. See also DiNardo and Lee (2004), who find no union wage differential using firm-level data on union elections. Although there has been much more research on union than ownership wage differentials, apparently no study of unions uses linked employer-employee data to investigate such differences.

usually finding positive foreign and state (public) premia. But the existing research suffers from profound difficulties. In the foreign-ownership literature, estimates are usually identified from cross-sectional variation across firms of different types. Few studies use worker-level data on wages and characteristics, so they cannot control for observable worker heterogeneity, and still fewer analyze firms that change ownership type, so they cannot control for unobserved firm-level heterogeneity. In research on state-private differentials, usually referred to as the literature on the public sector wage premium, estimation is typically at the worker level, and sometimes identification uses worker switching across organizations. But the state and private organizations in these studies typically operate in very different industries, so that the estimation essentially concerns interindustry differentials, which may be conflated with differences in work conditions and other unobservables. In both cases, there is reason to doubt that the causal effect of ownership has been identified.

In this paper, we have analyzed linked employer-employee data available for a long panel of firms during the unusual context of economic transition in Hungary, and we have applied new econometric methods that exploit the context and data to try to make progress on estimating foreign and state ownership wage differentials. The data cover nearly every tax-paying entity of at least 20 employees in Hungary from 1986 to 2003, and they include many more switches of ownership type than in previous research: nearly 1000 involving foreign firms and nearly 3500 involving state-owned organizations. The employee side of the data enables us to measure individual worker wages (rather than rely on a firm-level average as in some previous research) and to control for individual worker characteristics and changes in the composition of employment that may be correlated with ownership. The employer side of the data allows us to measure ownership reliably and to control for firm characteristics, and the longitudinal linking of employers facilitates some controls for selection bias into ownership type.

We find that simple OLS models imply substantial ownership effects in our data: an approximately 0.39 premium for working in a foreign-owned firm compared to a domestic private company, and a 0.20 premium for state enterprise employees versus those under domestic private ownership. These results control for other worker characteristics, including gender and experience, and for region and year fixed effects, but they assume no biased selection into ownership types, consistent with much of the literature.

We also estimate models that control for selection based on unobserved heterogeneity through firm-fixed effects and firm-specific trend growth in wages. The latter specifications (usually referred to as "random trend models") permit not only idiosyncratic wages at each firm (as in the fixed-effects model) but also allow wages to evolve independently at each firm in a way that is correlated with ownership and with worker characteristics. For example, they permit compensating differentials due to fringe benefits or other work conditions not only to vary across firms as a fixed fraction of total compensation, but also to evolve over time according to an idiosyncratic trend for each firm.

Our results imply statistically significant wage premia under both state and foreign ownership, relative to domestic private. The estimated magnitudes of the differentials vary little with controls for observable worker and firm characteristics, and there is relatively little variation with the unit of observation (firm or worker). But the magnitudes vary considerably with the controls for unobserved firm heterogeneity. We find that inclusion of firm fixed effects more than halves the state-domestic and foreign-domestic wage differential implied by the OLS estimates and that inclusion of firm-specific trends further reduces the estimates. While we find significant differences of both state and foreign wages relative to domestic private, it is striking that these differentials are quite similar in magnitude, particularly when we add firm fixed effects, and even more so with firm-specific trends. Taken at face value, this last specification implies there may be no difference in the wage behavior of foreign-owned and state-owned firms.

The large variation in estimated coefficients across specifications with different controls for unobserved firm heterogeneity motivates us to carry out specification tests. F tests on the firm fixed effects and firm-specific trends are always highly significant, and Hausman tests reject the more parsimonious models in each case. These results imply that the fixed-effects specification is strongly preferred to the OLS, and the specification with trends to the one without trends.

The results also carry implications for the nature of systematic selection of organizations into ownership types. The finding that the OLS estimate of the foreign premium is reduced substantially when firm fixed effects and trends are added suggests that foreign investors may systematically acquire firms already paying relatively high and more quickly growing wages. The estimated state-private premium also falls with these controls, but it is smaller under OLS, implying a similar direction of selection bias but one that is smaller in magnitude compared to foreign ownership. For domestic private firms, on the other hand, the estimates imply selection of firms with relatively low and more slowly growing wages. More broadly, the results demonstrate that taking into account possible selection biases of firms into different ownership types can be essential for estimating differences in their behavior.

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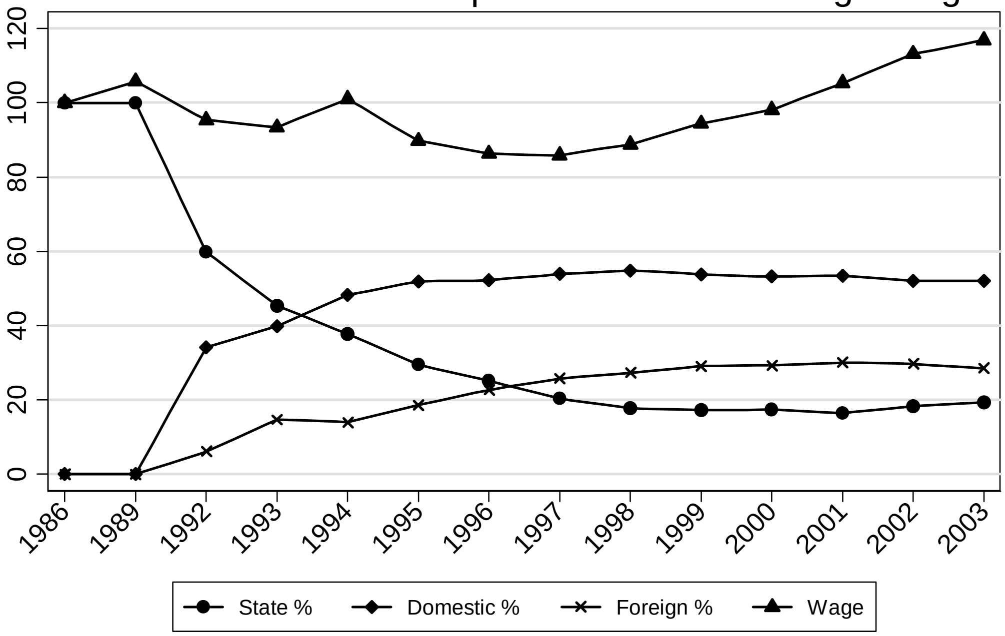
Figure 1:
Evolution of the Ownership Structure and Average Wages



Notes: Number of observations = 1,342,158. State % = percent of employees of firms majority state owned. Domestic % = percent of employees of firms majority private where domestic is the largest private employer type. Foreign % = percent of firms majority private where foreign is the largest private owner type. The evolution of the average real wage is presented as estimated year effects from a regression including firm fixed effects to control for sample changes (dependent variable = log real wage, normalized at 100 in 1986). Data are weighted by the numbers of blue-collar and white-collar workers within each firm, and each firm is weighted using total employment by firm size category.

Table 1: Sample Size by Year

Year	Number of Workers	Number of Firms	Total Employment
1986	100.5	3,236	2,633.5
1989	106.3	3,946	2,268.2
1992	64.8	4,393	1,198.4
1993	67.8	5,158	1,096.9
1994	95.7	7,128	1,351.4
1995	99.2	7,428	1,369.6
1996	97.6	7,421	1,292.1
1997	88.0	7,476	1,258.0
1998	99.0	7,459	1,282.2
1999	99.4	8,020	1,220.8
2000	109.5	9,149	1,257.6
2001	107.7	9,138	1,222.0
2002	102.8	5,630	1,049.2
2003	103.8	5,106	997.0

Notes: Number of workers = thousands of workers in the sample with information on education, experience, and gender. Number of firms = number of firms with information on ownership and with at least one worker in the given year with information on education, experience, and gender. Total employment = total employment of firms in the sample in thousands (i.e., including nonsampled workers).

Table 2: Firms by Ownership Type and Switches

		Number of Firms
Non-Switchers		17,295
of which:	Always State	3,167
	Always Domestic	11,844
	Always Foreign	2,284
Ownership Switchers		3,694
of which:	State – Domestic	2,768
	State – Foreign	144
	Domestic – Foreign	435
	Foreign – Domestic	347

Notes: Total number of firms = 21,238. State = 1 if the firm is at least 50 percent owned by the state in *t*-1. Domestic = 1 if the firm is majority private and domestic owner shareholding is larger than foreign in *t*-1. Foreign = 1 if the firm is majority private and foreign owner shareholding is larger than domestic in *t*-1. The numbers of switchers and non-switchers do not sum to the number of firms as 201 firms have multiple changes in ownership type.

Table 3: Characteristics of Workers in the Sample, 1992 and 2003

	State		Domestic		Foreign	
	1992	2003	1992	2003	1992	2003
Real Wage	102.6	130.9	79.2	111.2	122.3	189.6
	(64.5)	(99.0)	(54.9)	(109.8)	(96.3)	(210.4)
Female (%)	37.9	33.7	36.3	38.7	44.4	47.1
Education (%)						
Elementary or less	31.8	19.9	35.7	22.2	30.3	17.0
Vocational	30.3	30.9	38.3	39.6	36.3	30.9
High school	30.2	40.9	20.3	28.6	24.5	33.6
University	7.8	8.2	5.7	9.6	8.9	18.5
Potential experience (yrs.)	22.2	26.1	22.5	25.4	20.5	21.8
	(10.6)	(10.6)	(10.5)	(11.5)	(10.7)	(11.3)
Occupation (%)						
Managers	5.2	9.3	6.9	8.8	4.5	7.9
Professionals	7.0	3.2	5.0	3.5	7.5	8.9
Assoc. professionals	14.9	18.1	7.8	11.1	9.4	18.2
Skilled non-manual	6.9	6.5	6.9	5.9	6.1	5.9
Service	10.5	16.1	7.9	9.2	8.3	5.4
Skilled manual	44.5	39.1	53.9	50.5	53.4	47.8
Unskilled	11.0	7.7	11.6	11.1	10.8	5.9
Observations	42,089	17,119	17,773	60,134	4,093	26,544

Notes: Real wage measured in thousands of 2003 HUF, deflated by CPI. State = 1 if the firm is at least 50 percent owned by the state in *t*-1. Domestic = 1 if the firm is majority private and domestic owner shareholding is larger than foreign in *t*-1. Foreign = 1 if the firm is majority private and foreign owner shareholding is larger than domestic in *t*-1. Standard deviations are shown in parentheses for continuous variables. Data are weighted by the numbers of blue collar and white collar workers within each firm, and each firm is weighted using total employment by firm size category.

Table 4: Characteristics of Firms in the Sample, 1992 and 2003

	State		Domestic		Foreign	
	1992	2003	1992	2003	1992	2003
Employment	284.0	401.4	85.9	61.8	155.8	224.2
	(2076.5)	(2899.9)	(101.7)	(152.6)	(301.0)	(904.0)
Labor Productivity	9.8	10.0	7.8	20.7	18.8	39.4
	(21.7)	(42.1)	(17.4)	(172.7)	(53.6)	(86.3)
Industry (%)						
Agriculture	6.1	9.4	25.1	13.1	2.0	2.6
Mining	0.7	0.2	0.2	0.5	0.6	1.2
Manufacturing	32.5	7.2	33.7	34.5	64.5	55.2
Energy and water supply	1.4	24.7	0.0	0.6	0.0	1.1
Construction	8.8	8.9	16.2	10.4	5.3	2.3
Trade	22.1	1.9	16.4	18.2	18.8	17.4
Hotels and restaurants	5.1	0.4	3.0	3.4	4.0	2.7
Transportation	5.6	7.7	1.2	3.6	0.2	3.3
Telecom	0.1	0.4	0.0	0.4	0.0	0.8
FIRE	13.1	20.6	3.7	13.3	4.6	11.4
Other services	4.5	18.4	0.4	2.1	0.0	2.1
Observations	1,538	346	2,572	3,701	276	1,057

Notes: Labor productivity is measured as the value of sales (in millions of 2003 HUF) over average number of employees. State = 1 if the firm is at least 50 percent owned by the state in *t*-1. Domestic = 1 if the firm is majority private and domestic owner shareholding is larger than foreign in *t*-1. Foreign = 1 if the firm is majority private and foreign owner shareholding is larger than domestic in *t*-1. FIRE = Finance, Insurance, and Real Estate. Standard deviations are shown in parentheses for continuous variables. Data are weighted by the numbers of blue-collar and white-collar workers within each firm, and each firm is weighted using total employment by firm size category.

Table 5: Selection into Forms of Ownership

	State	Domestic	Foreign
Vocational	-0.168**	0.125**	0.043**
	(0.008)	(0.007)	(0.007)
High school	-0.070**	0.012	0.058**
	(0.016)	(0.012)	(0.013)
University	-0.157**	0.009	0.148**
	(0.014)	(0.018)	(0.017)
Experience	-0.000	0.003**	-0.002**
	(0.000)	(0.000)	(0.000)
Female	-0.046*	0.004	0.042**
	(0.020)	(0.015)	(0.008)
Predicted probability	0.455	0.380	0.165

Notes: N = 1,342,158. Multinomial logit estimates, marginal effects reported. The dependent variable is ownership type: State if the firm is majority state in *t*-1; Domestic if the firm is majority private and domestic shareholding is larger than foreign in *t*-1; Foreign if the firm is majority private and foreign shareholding is larger than domestic in *t*-1. Standard errors (corrected for firm clustering) are shown in parentheses. ** = significant at 0.01; * = significant at 0.05. The regressions are weighted by the numbers of blue-collar and white-collar workers within each firm, and each firm is weighted using total employment by firm size category.

Table 6: Average Real Wages by Ownership Type and Education

	State		Domestic		Foreign	
	1992	2003	1992	2003	1992	2003
Elementary or less	78.7	92.4	63.4	76.9	86.4	96.4
	(34.2)	(43.9)	(32.7)	(33.7)	(37.3)	(41.4)
Vocational	91.2	112.0	72.0	88.2	103.2	122.1
	(41.8)	(43.3)	(34.8)	(43.4)	(48.7)	(61.1)
High school	114.3	132.6	95.6	121.3	137.8	174.1
	(57.2)	(70.5)	(66.7)	(91.8)	(79.3)	(130.0)
University	199.6	286.6	167.2	256.0	280.0	416.3
	(128.8)	(231.6)	(107.1)	(253.4)	(203.2)	(365.1)
Observations	42,089	17,119	17,773	60,134	4,093	26,544

Notes: Real wage (deflated by CPI) measured in thousands of 2003 HUF. Standard deviations in parentheses. State = 1 if a majority of the firm's shares are owned by the state. Domestic = 1 if the firm is majority private and domestic owner shareholding is larger than foreign in *t*-1. Foreign = 1 if the firm is majority private and foreign owner shareholding is larger than domestic in *t*-1. Data are weighted by the numbers of blue-collar and white-collar workers within each firm, and each firm is weighted using total employment by firm size category.

Table 7: Estimated Impacts of State and Foreign Ownership

	OLS	**OLS**	**FE**	**FE & FT**
State	0.238**	0.197**	0.065**	0.078**
	(0.024)	(0.017)	(0.015)	(0.016)
Foreign	0.398**	0.386**	0.137**	0.073**
	(0.020)	(0.014)	(0.015)	(0.013)
Vocational	-	0.127**	0.132**	0.137**
		(0.005)	(0.003)	(0.004)
High school	-	0.373**	0.314**	0.330**
		(0.009)	(0.006)	(0.006)
University	-	0.950**	0.840**	0.872**
		(0.016)	(0.010)	(0.011)
Experience	-	0.027**	0.027**	0.026**
		(0.001)	(0.000)	(0.000)
Experience$^2 * 100$	-	-0.040**	-0.039**	-0.037**
		(0.001)	(0.001)	(0.001)
Female	-	-0.222**	-0.203**	-0.194**
		(0.006)	(0.005)	(0.005)
Firm-specific intercepts (FE)	no	no	yes	yes
Firm-specific trends (FT)	no	no	no	yes
R^2	0.139	0.413	0.630	0.354

Notes: Observations = 1,342,158. Dependent variable = ln(real gross wage). State = 1 if the firm is majority state in t-1. Foreign = 1 if the firm is majority private and foreign shareholding are larger than domestic in t-1. The regressions are weighted by the numbers of blue-collar and white-collar workers within firm and the total employment by firm-size categories. Elementary is the omitted educational category. FE = specification including firm fixed effects; FT = all variables have been detrended using individual firm trends. All equations include year and region fixed effects. The regressions are weighted by the numbers of blue-collar and white-collar workers within each firm, and each firm is weighted using total employment by firm size category. Standard errors (corrected for firm clustering and for loss of degrees of freedom when detrending) are shown in parentheses. R^2: overall for OLS, within for FE and FE&FT. The difference between the foreign and state effect is statistically significant in OLS and FE, and insignificant in FE&FT. ** = significant at 0.01; * = significant at 0.05.

Table 8: Estimated Impacts of State and Foreign Ownership, with Controls for Occupation

	OLS	FE	FE & FT
State	0.208**	0.068**	0.079**
	(0.016)	(0.013)	(0.016)
Foreign	0.384**	0.139**	0.072**
	(0.014)	(0.015)	(0.013)
Skilled manual	0.219**	0.203**	0.203**
	(0.007)	(0.006)	(0.008)
Service	0.072**	0.111**	0.115**
	(0.022)	(0.019)	(0.023)
Skilled non-manual	0.234**	0.212**	0.220**
	(0.012)	(0.009)	(0.011)
Assoc. professional	0.334**	0.307**	0.321**
	(0.017)	(0.013)	(0.015)
Professional	0.425**	0.393**	0.403**
	(0.011)	(0.008)	(0.009)
Manager	0.650**	0.685**	0.705**
	(0.010)	(0.010)	(0.012)
Firm-specific intercepts (FE)	no	yes	yes
Firm-specific trends (FT)	no	no	yes
R^2	0.462	0.676	0.442

Notes: Observations = 1,342,158. The specifications are the same as in Table 7 except for the addition of occupational categories. Unskilled manual is the omitted occupation. All equations include year and region fixed effects. The regressions are weighted by the numbers of blue-collar and white-collar workers within each firm, and each firm is weighted using total employment by firm size category. Standard errors (corrected for firm clustering and for loss of degrees of freedom when detrending) are shown in parentheses. R^2: overall for OLS, within for FE and FE&FT. The difference between the foreign and state effect is statistically significant in OLS and FE, and insignificant in FE&FT. ** = significant at 0.01; * = significant at 0.05.

Table 9: Estimated Impacts of State and Foreign Ownership, with Firm-Level Controls

	OLS			FE		FE & FT	
	1	2	3	1	2	1	2
State	0.156**	0.162**	0.069**	0.067**	0.063**	0.081**	0.079**
	(0.019)	(0.013)	(0.017)	(0.011)	(0.012)	(0.015)	(0.016)
Foreign	0.341**	0.269**	0.283**	0.126**	0.137**	0.071**	0.072**
	(0.014)	(0.013)	(0.015)	(0.014)	(0.015)	(0.013)	(0.013)
Labor productivity	-	0.108**	-	0.067**	-	0.035**	-
		(0.009)		(0.004)		(0.007)	
Employment	-	-	0.050**	-	0.021**	-	-0.009
			(0.005)		(0.005)		(0.007)
Industry intercepts	yes	yes	yes	no	no	no	no
Firm-specific intercepts	no	no	no	yes	yes	yes	yes
Firm-specific trends	no	no	no	no	no	yes	yes
R^2	0.479	0.511	0.495	0.677	0.676	0.442	0.442

Notes: Observations = 1,342,158. The specifications are the same as in Table 8 except for the addition of firm-level controls. The regressions are weighted by the numbers of blue-collar and white-collar workers within each firm, and each firm is weighted using total employment by firm size category. Standard errors (corrected for firm clustering and for loss of degrees of freedom when detrending) are shown in parentheses. R^2: overall for OLS, within for FE and FE&FT. The difference between the foreign and state effect is statistically significant in OLS and FE, and insignificant in FE&FT. ** = significant at 0.01; * = significant at 0.05.

Table 10: Firm-Level versus Worker-Level Estimates

Dependent Variable	Composition Controls	Employment Weights	State OLS	State FE	State FE & FT	Foreign OLS	Foreign FE	Foreign FE & FT
AW_F	no	no	0.237**	0.040**	0.030**	0.550**	0.093**	0.046**
AW_F	no	yes	0.222**	0.031	0.033	0.486**	0.186**	0.050
AW_F	yes	no	0.194**	0.039**	0.029**	0.486**	0.091**	0.045**
AW_F	yes	yes	0.136**	0.029	0.032	0.399**	0.176**	0.048
AW_I	no	no	0.233**	0.073**	0.159**	0.527**	0.091**	0.082**
AW_I	no	yes	0.278**	0.065**	0.102**	0.471**	0.168**	0.085**
AW_I	yes	no	0.182**	0.069**	0.149**	0.468**	0.082**	0.070**
AW_I	yes	yes	0.198**	0.063**	0.101**	0.396**	0.141**	0.078**
W_I	NA	NA	0.197**	0.065**	0.078**	0.386**	0.137**	0.073**

Notes: These are regression coefficients (standard errors clustered on firms) for alternative specifications in which the unit of observation is the firm in the first 8 and the worker in the last row (which is the reproduction of the coefficients in Table 7), the log wage dependent variable is taken from firm financial reports or the worker survey, region and year controls are added, the methods of estimation are OLS, FE (firm fixed effects), and FE&FT (firm-specific intercepts and trends). AW_F = Average wage constructed from firm-level data (wage bill/number of employees); AW_I = Average wage constructed from individual wages, weighted by production and nonproduction worker weights; W_I = Individual wages. Composition controls are the proportion of females, proportion of workers in different educational groups, average potential experience and its square, weighted by the number of blue- and white-collar workers. All regressions are weighted by firm weights, those where "employment weights" are indicated are in addition weighted by the number of workers. The last row reproduces the results from Table 7, for comparison purposes. NA = not applicable.