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International trade and collective bargaining outcomes

Evidence from German employer-employee data

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International Trade and Collective Bargaining Outcomes: Evidence from German Employer-Employee Data

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Abstract

In theoretical trade models with variable markups and collective wage bargaining, export exposure may reduce the exporter wage premium. We test this prediction using linked German employer-employee data from 1996 to 2007. To separate the rent-sharing mechanism from assortative matching, we exploit individual worker information to construct profitability measures that are free of skill composition. We find that rent-sharing is less pronounced in more export intensive firms or in more open industries. The exporter wage premium is highest for low productivity firms. In line with theory, these findings are unique to the subsample of plants covered by collective bargaining.

Zusammenfassung

In theoretischen Handelsmodellen mit variablen Aufschlägen auf die Grenzkosten, kann eine Ausweitung der Exporte den Exportlohnaufschlag verringern. Wir überprüfen diese Aussage anhand von verknüpften Arbeitnehmer-Arbeitgeber Daten für den Zeitraum 1996-2007. Um den Rent-Sharing Mechanismus vom Assortative-Matching Argument zu trennen, nutzen wir individuelle Arbeitnehmerinformationen um ein Profitabilitätsmaß zu generieren, welches frei von der Qualifikationsstruktur ist. Wir finden, dass Rent-Sharing in exportintensiven Betrieben oder offeneren Branchen weniger ausgeprägt ist. Der Exportlohnaufschlag ist in Betrieben mit niedrigerer Produktivität am stärksten. Entsprechend der Theorie betrifft dieses Ergebnis Betriebe, die unter Tarifvereinbarungen fallen.

JEL classification: F16, J51, E24, J3

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1 Introduction

Over the last decades, wage inequality has increased strongly in most OECD countries (OECD, 2011). Much of the increase takes place within worker groups defined by education, age, or experience and is therefore of the "residual" type. Globalization, technological change and institutional reforms are often cited as the determinants of this evolution. In this paper, we shed light on the importance of firms' international activities and its interaction with collective bargaining in shaping the distribution of residual wages across workers. Germany is an ideal laboratory for this exercise since it is Europe's largest economy, a major exporter nation, and it has seen a strong increase in wage inequality over the last decades.[1]

International activities of firms can have effects on the wage distribution through various channels. The one most relevant for our study works through rent-sharing between firms and workers. If international activities affect rents, and if firms and workers bargain about the distribution of these rents, exporting or outsourcing can affect wages. Recent theoretical contributions based on Melitz (2003) show that different firms are affected differently by trade liberalization, with lower trade costs typically resulting in a more unequal distribution of *ex post* profits (quasi-rents). In the presence of rent-sharing, more variation across firms in terms of rents yields more variation in terms of wages.

In this paper we investigate how firms' international activities affect rent-sharing and wages in the presence of different bargaining regimes.[2] The empirical analysis draws on linked employer-employee data for German manufacturing industries between 1996 and 2007. This rich data set is well suited for our purposes as it contains information on the export participation and the type of bargaining regime. While the existence of the exporter wage premium is well documented in the literature[3], the interaction between rent-sharing, collective bargaining, and export behavior has not received much attention so far.

Rent sharing on the firm or plant level can arise for various reasons, the leading being collective bargaining. Other mechanisms include fair wage concerns or convex adjustment costs. The first study to model residual wage inequality in a Melitz environment is the *fair wage* model of Egger/Kreickemeier (2009). The authors show that exporters pay a wage premium and lower trade costs increase inequality. Egger/Egger/Kreickemeier (2011) use firm-level data from several countries to structurally estimate that model. They find that the exporter wage-premium is about 10 percent. Trade accounts for a 15 to 25 percent increase in wage dispersion. Cosar/Guner/Tybout (2011) use a search-and-matching framework with *convex adjustment costs*. In their model, individual bargaining yields residual inequality since expanding firms are more strongly constrained due to convex recruitment costs and, so, face higher rents. They estimate their model using Colombian data and find that trade had only a very modest effect on residual wage inequality.

[1] Dustmann/Ludsteck/Schönberg (2009) document the evidence for Germany. They find that at least two thirds of the increase in inequality between 1974 and 2004 is due to a rise in within-group inequality.

[2] In the remainder of this paper we use the terms *firm* and *plant* interchangeably, since the majority of plants in our empirical analysis are single unit firms.

[3] See the seminal work of Bernard/Jensen/Lawrence (1995) and the studies surveyed in Schank/Schnabel/Wagner (2007)

However, in the Melitz (2003) model, *collective bargaining* does not lead to wage dispersion; see Felbermayr/Prat/Schmerer (2011a) or Helpman/Itskhoki/Redding (2010). With constant markups, productivity variation is absorbed by employment adjustment. Allowing for endogenous markups and collective bargaining, Egger/Etzel (2009) or Montagna/Nocco (2011) show that exporting may lead to lower wages as tougher competition in export markets leads to lower per worker rents of firms. Such a prediction does not arise in the models of Egger/Kreickemeier (2009) or Cosar/Guner/Tybout (2011) where wages are not bargained by a union.

To explore the role of rent-sharing, we propose a plant-level profitability proxy which is free from composition effects. Using spell fixed-effects to control for unobserved worker ability, our Mincerian wage regressions show that wages are higher in more profitable plants; this holds regardless whether a firm is covered by collective bargaining and is consistent with all three sources of wage dispersion discussed above. However, only in the subsample of plants under collective bargaining do we find that the export exposure of a plant negatively affects the extent of rent-sharing–a result that is consistent with the endogenous markups and collective bargaining framework. At average profitability, the wage premium paid by a firm achieving 40% of its sales on foreign markets over a purely domestic firm is close to zero. The exporter wage premium is substantial (about 3.9%) in plants with profitability levels two standard deviations below the mean, while it becomes negative (-2.5%) for plants two standard deviations above the mean.

Related literature. Our paper is related to at least four strands of literature. First, it relates to work on collective bargaining and rent-sharing. In Germany, as in other countries, collective agreements still play an important role in the wage determination process. Collective agreements are conducted either at the plant-level or at the industry-level. Plant-level agreements are typically better suited to account for plant-specific economic conditions, such as a plant's stance on international markets.[4] We expect that plants covered by local agreements can respond to firm-level changes, whereas for industry-level bargaining both parties have to meet the needs for all or most of their members. Gürtzgen (2009b) supports this view by showing that wages in plants covered by firm-level agreements are positively associated with quasi-rents, which may be furthermore interpreted as evidence for rent-sharing. In addition, Gürtzgen (2009a) shows that wages are lower in industries characterized by stronger plant-heterogeneity if wages are bargained at the industry-level.

Second, our work relates to the papers on exporter wage premia. Consistent with that literature, we document an unconditional positive correlation between wages and exports at the plant-level. However, controlling for observed and unobserved worker and workplace characteristics, the (residual) exporter wage premium decreases significantly (see also Schank/Schnabel/Wagner, 2007), indicating that the positive premium is to a large extent

[4] In Germany, industrial relations are based on a dual system of representation by unions and work councils. For a brief description of the German system see Schnabel/Zagelmeyer/Kohaut (2006). Addison et al. (2010, 2011) provide an overview of the structure and developments in the German collective bargaining system.

driven by assortative matching.[5,6] In other words, differences in wages are at least partly driven by differences in workforce characteristics.[7]

Third, we build on theoretical work linking export behavior of firms and the determination of wages. Egger/Etzel (2009) use an oligopolistic competition trade model with unions to analyze the effect of international competition on bargained wages. Intensified competition due to the opening up of the country to international trade negatively affects wages in their framework. Firms in industries with higher labor productivity always pay higher wages. Intensified trade however reduces the bargaining position of the union, which has a negative effect on wages. The intuition behind that result is that there are three conflicting effects. As standard in oligopolistic models, going from autarky to free trade increases firms' profits and output, which has a positive impact on the wage rate demanded by the union. However, Egger/Etzel (2009) show that this positive effect is outweighed by lower per worker profits due to more competition, and a higher labor demand elasticity. A higher labor demand elasticity implies that unions are more cautious about the negative employment effects and therefore moderate their wage demand. The authors also extend their model by showing that centralized bargaining at the industry-level yields qualitatively similar results. We allow for this possibility by accounting for industry-level openness. According to Egger/Etzel (2009) we expect that industries with higher average productivity should pay higher wages but increased competition due to international trade weakens the union wage claims.[8]

Similar effects obtain in the study by Montagna/Nocco (2011). Their model extends the Melitz/Ottaviano (2008) framework by allowing for collective bargaining. One of the crucial points in their model is the distinction between domestic and export profit-centers within a firm. Due to higher competition, exporting plant's price elasticity is higher than that of domestic suppliers, which reduces their monopoly price setting power in the foreign market. Hence, unions in exporting plants have to settle for lower wages than unions in non-exporting plants. Montagna/Nocco (2011) allow for heterogeneous producers, but the mechanisms at work are similar to Egger/Etzel (2009).

Eckel/Egger (2009) or Skaksen (2004) both focus on the consequences of outsourcing on collective bargaining outcomes. The possibility to outsource parts of the production chain to foreign affiliates reduces the bargaining position of the union by improving the firm's fallback profit in case of disagreement during wage negotiations. Higher union power raises the multinational firm's incentive to invest abroad as reaction to higher union's wage claims.

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[5] Differences in the workforce composition are also in line with the models of, e.g. Helpman/Itskhoki/Redding (2010), Davidson/Matusz/Shevchenko (2008), or Yeaple (2005). Krishna/Poole/Senses (2011) and Davidson et al. (2010) also find empirical evidence for matching effects and sorting. In a similar context Krishna/Poole/Senses (2011) show for Brazil that the impact of trade openness on wages turns insignificant if match effects are simultaneously considered.

[6] Klein/Moser/Urban (2010) provide robust evidence on the existence of a negative exporter wage premium for low skilled workers for Germany. Based on the same data Schmillen (2011) demonstrates that the exporter wage premium shows up only in plants that export to more remote markets.

[7] This is in stark contrast with Frias/Kaplan/Verhoogen (2009) who find that only one-third of the Mexican exporter wage premium can be explained by unobservable differences in the workforce composition.

[8] From an empirical perspective our study is also closely related to Blien et al. (2009). The authors propose to take the type of wage regime into account when testing the wage curve. Based on the same data as our study, they find point estimates in line with Blanchflower/Oswald (1994) for firms that bargain wages collectively on the firm-level.

Intensified international activities by the firm acts as a potential threat which disciplines the union's wage demand.

Finally, there is a growing literature on the role of international trade on unemployment when firms are heterogeneous with respect to productivity. In those models, more productive firms pay the same wages as less productive ones as long as adjustment costs are linear. Using such a framework, Felbermayr/Prat/Schmerer (2011a) highlight a productivity channel through which trade liberalization reduces equilibrium unemployment as unproductive firms are weeded out.[9] That paper is closely related to the two-sector model by Helpman/Itskhoki (2010) who focus more on cross-country differences in labor market institutions and trade patterns. The model by Egger/Kreickemeier (2009), which was the first to relax the full employment condition in the Melitz model, generates residual wage dispersion by incorporating a fair wage constraint which indexes firm-level wages to firm-level profitability. Helpman/Itskhoki/Redding (2010) model the effect of trade when both firms and workers are heterogeneous and focus on wage inequality. Their model features a pattern of assortative matching by which the more efficient firms recruit workers with higher ability.

The structure of the paper is organized as follows. The next section discusses the data used for our empirical analysis; Section 3 outlines the empirical strategy; Section 4 presents the estimation results; and Section 5 concludes.

2 Data

We use German linked employer-employee data (LIAB) provided by the Institute of Employment Research (IAB) to test the link between export intensity and the role of collective wage agreements. The LIAB is a combination of the IAB establishment panel and the employment statistics of the Federal Employment Agency (Alda/Bender/Gartner, 2005). Beginning in 1993, the IAB establishment panel is an annual survey of plants that employ at least one employee. The panel includes a variety of detailed information on the plant's structure and size. Variables include measures of the individual plant's labor force, revenues, usage of intermediate goods, the wage bill, or export intensity.[10] Most important for our research, the survey contains detailed plant-level information about collective agreements. This is a unique feature for matched employer-employee data. Collective agreements are still widely applied and predominantly conducted at the industry- or regional-level but also at the plant- or firm-level. Those agreements constitute a legally binding wage floor between the two bargaining parties. Moreover, firms normally extend this agreement to all workers, even to the non-members. Therefore, for our purposes, the bargaining coverage is a better indicator than union density. Figure 1 shows that, although declining over time, in 2007, about 70% of all employees in German manufacturing are still covered by collective agreements.

The employment statistics cover all employees subject to social security contributions and

[9] We also provide some evidence for that channel in Felbermayr/Prat/Schmerer (2011b). See also Dutt/Mitra/Ranjan (2009).

[10] For further information on the IAB establishment panel see Fischer et al. (2009) and Kölling (2000).

represents about 80% of all employed persons in Western Germany and 86% in Eastern Germany (Bender/Haas/Klose, 2000). Employees with no obligation to pay social security contributions, such as civil servants, workers in marginal employment and family workers, are excluded from the sample. It is compulsory for employers to report data on their and their employees' social security contributions at the end of each year and additionally at the beginning and end of each employment spell. The employment statistics also contain detailed information on several individual characteristics such as age, gender, nationality, tenure and gross wage. Both data sets are merged by a common establishment identifier.

To include both west and east German manufacturing plants we focus on the period 1996-2007.[11] All Euro values are deflated for the base year 2000 using industry-level deflators from the OECD STAN database. To be consistent with the information from individual data we use the total number of employees subject to social security contributions as a plant size control. Establishment output is measured by value added, i.e. total revenues minus intermediate inputs and external costs. The plant's capital stock is constructed using the perpetual inventory method as proposed by Müller (2008, 2010).[12]

Measuring profitability. Our preferred proxy for the potential scope of rent-sharing is total factor productivity (TFP). From a theoretical point of view, rent-sharing is directly linked to productivity through the positive productivity/profits relationship.[13] The total factor productivity measure is superior to alternative proxies such as reported profits since it allows accounting for possible endogeneity problems arising from unobserved productivity shocks and for assortative matching. The endogeneity issue is addressed using the approach of Levinsohn/Petrin (2003), who suggest using intermediate inputs as proxy for those unobserved shocks.[14] Assortative matching poses a more complex problem. Without accounting for work-force composition, one would interpret a link between profits and wages as rent-sharing while the relationship could be simply the result of more efficient plants hiring more productive workers. We follow Iranzo/Schivardi/Tosetti (2008) and tackle this problem by controlling for the plant's workforce composition (the average worker's ability) obtained from Mincerian wage regressions on the worker-level. Moreover, total factor productivity allows estimating the different parameters as input-shares and elasticities simultaneously within one regression.

Measuring international activity. On the plant-level our data comprise information about the export intensity of the plant, measured as the share of sales obtained on export markets. Unfortunately we cannot address outsourcing directly on the plant-level due to missing information about imported intermediates. Moreover, there is no information available about the export destination. We interpret exporting as a valid measure of a plant's broader

[11] 1996 was the first year the survey has been carried out also in Eastern Germany.

[12] Plants in the sample report investment volumes and type of investment, which allows to proxy the capital stock by summing per-period investments and taking investment specific depreciation rates into account.

[13] This standard outcome of heterogeneous firm models as Melitz (2003) can translate into a positive productivity/wage relationship. See Egger/Kreickemeier (2009) for instance.

[14] In particular we use the Stata routine `levpet` provided by Petrin/Poi/Levinsohn (2004) for the estimation of the production function.

international activities that also includes importing. Kasahara/Lapham (2008) have shown that exporting and importing strongly correlate at the firm-level, most likely due to cost complementarities. Moreover, anecdotal evidence suggests that exporting plants may find it easier to outsource parts of the production through foreign affiliates. Besides the plant-level information about exports we also use an industry-level openness measure taken from the OECD in order to tie our analysis closer to Egger/Etzel (2009).[15]

With respect to worker-level data, we focus on full-time employees only, as wages are reported as gross daily wages without any information on working hours. Therefore we exclude all observations for part-time workers, apprentices, interns and persons working at home. As the real gross daily wage will be of particular interest, we also have to deal with an additional issue.[16] Due to a reporting ceiling in the German social security system, wages are right-censored at the contribution limit. As usual (Dustmann/Ludsteck/Schönberg (2009)), we use Tobit regressions to impute wages above the cut-off level. For each year we run a separate regression using age, age squared, tenure, tenure squared, gender, foreign nationality as well as a full set of industry dummies as controls. The censored daily wages are replaced by predicted values obtained from the Tobit regression.[17]

3 Empirical strategy

3.1 Main regression setup

To shed light on the interaction between rent-sharing and international activities of the plant we estimate

$$\begin{aligned}\ln w_{it} = \gamma \ln TFP_{j(i)t} + \xi EXP_{j(i)t} + \kappa \ln TFP_{j(i)t} \times EXP_{j(i)t} \\ + \boldsymbol{\alpha}_1' \mathbf{Z}_{it} + \boldsymbol{\alpha}_2' \mathbf{Z}_{j(i)t} + \nu_t + \theta_i \times \phi_{j(i)} + v_{it}, \end{aligned} \qquad (1)$$

where the index $j(i)$ identifies the plant at which worker i is employed. The dependent variable is the imputed log wage, $\ln w_{it}$, observed for worker i at time t. As variables of interest we include the plant's export share EXP to proxy exposure to international competition and TFP to proxy its profitability. Besides the identification of the exporter wage-premium and the magnitude of rent-sharing between plants and workers, our focus is also on the interaction between both. Controls for individual and plant characteristics purge the data from observable worker and plant heterogeneity. On the individual level we control for the worker's tenure measuring her time of employment within the plant, her age, and her observable level of skill. Unobservable differences in skill or ability are controlled for by including spell fixed-effects $\theta_i \times \phi_{j(i)}$. On the plant-level we include a wide array of

15 Our preferred measure is the world market share by industry reported in OECD STAN database.
16 Further note that due to some reporting inconsistencies by the employer, educational attainment has been adjusted following Fitzenberger/Osikominu/Völter (2006).
17 See Gartner (2005) for details.

controls gathered in the vector $\mathbf{Z}_{j(i)t}$. Controls include for instance the plant's capital intensity, employment as size-control, the share of female and part-time workers, a dummy that takes the value one if the plant has a work-council, and dummies that indicate whether the plant bargains collectively on the plant/firm-level or whether it is subject to centralized industry-level collective agreements. Industry-, time-, and region-dummies are included in all regressions.

In a first step we compare OLS, and spell-fixed effects regressions based on the whole set of observations. Coefficients in the spell-fixed effects regressions are identified using the within-variation in a certain plant-worker combination. A spell ends either because of a successful switch of a worker from one to another plant or due to a layoff. Spell-fixed effects are preferred over person fixed effects as long as the decomposition of the time invariant effect into its worker- and plant-specific component is not a separate object of interest and it has the advantage that the identification is independent of the number of movers.[18] Standard errors are clustered at the plant-level. For the main part of the analysis we also report random-effects regression results. Random-effects have the advantage that identification relies on both the within- and the between variation of the data, which is important for our analysis since the export intensity displays relatively little variation over time.

3.2 Profitability measures

As argued in the introduction we are mainly interested in rent-sharing between employers and workers and to what extent the rent-sharing intensity hinges on the export behavior of the plant. For that purpose we need a profitability measure on the plant-level which is not plagued by workforce composition. Assortative matching implies that more productive employers have workers with a higher ability and that has to be taken into account when analyzing the degree of rent-sharing between plants and workers. We construct the plant's profitability measure according to a method proposed by Iranzo/Schivardi/Tosetti (2008) who suggest using estimated worker fixed effects from Mincerian wage regressions to control for the plant's workforce composition.

3.2.1 A generalized production function framework

Using plant-level panel data, we estimate the following production function for plant j

$$Y_{jt} = A_{jt} \cdot K_{jt}^{\alpha} \cdot \tilde{L}_{jt}^{\beta} \ , \tag{2}$$

where the stock of capital is K_{jt}, the composite labor input is $\tilde{L}_{jt}$, and A_{jt} is TFP. The composite labor input is constructed by using consistent estimates of workers' abilities h :

$$\tilde{L}_{jt} = L_{jt} \cdot \left(1/L_{jt} \cdot \sum_{i=1}^{L_{jt}} h_i^{\rho}\right)^{1/\rho} , \tag{3}$$

[18] In column (1) of Table A1 we were primarily interested in the worker component of the spell-fixed effect in order to purge the productivity measures from the work-force composition. Thus, we had to include both person and plant dummies in our Abowd/Kramarz/Margolis (1999) wage regression.

where L_{jt} is total employment, and ρ measures the degree of substitutability across different human capital levels. Using a second-order Taylor series expansion of the production function around the plant's mean ability we obtain

$$\ln Y_{jt} \simeq \alpha \ln K_{jt} + \beta \ln L_{jt} + \beta \ln \left[\bar{h}_{jt} + \frac{1}{2}(\rho - 1) \left(\frac{\sigma^2_{jt}}{\bar{h}_{jt}} \right) \right] + \varepsilon_{jt}. \tag{4}$$

To apply linear estimation techniques, this expression can be further approximated as:

$$\ln Y_{jt} \simeq \alpha \ln K_{jt} + \beta \ln \left(L_{jt} \bar{h}_{jt} \right) + \delta \left(\frac{\sigma_{jt}}{\bar{h}_{jt}} \right)^2 + \varepsilon_{jt} \quad , \tag{5}$$

where $\delta = \beta \frac{1}{2}(\rho - 1)$.[19] The average ability of the workforce, $\bar{h}_{jt}$, and the plant's standard deviation in its workers ability, σ_{jt}, are constructed using the consistently estimated worker productivity measures as explained in the following section.

Olley/Pakes (1996) or Levinsohn/Petrin (2003) stress the importance of controlling for unobservable short-run productivity shocks when estimating total factor productivity. Olley/Pakes (1996) use firms' investment as a proxy, whereas Levinsohn/Petrin (2003) use information about the firms' input of intermediate goods to weed out the simultaneity bias caused by omitting the unobserved productivity shocks. The authors are able to show that the advantage of using intermediate inputs as proxy is that it allows to tackle another bias caused by zero investment flows. At each point in time, employers are more likely to use intermediate inputs than to invest in their capital stock. We use the method suggested by Levinsohn/Petrin (2003) (later denoted LP) and estimate equation (5) in order to obtain ability-free estimates for our profitability proxy.

3.2.2 Measuring human capital

Following Abowd/Kramarz/Margolis (1999) in general, and Andrews et al. (2008) as a particular application to German data, we run a Mincerian wage regression to estimate worker productivity measures. Abowd/Kramarz/Margolis (1999) suggest that the superior identification strategy is "persons first and firms second". We thus estimate

$$\ln w_{it} = \bar{w} + \beta(x_{it} - \bar{x}) + \gamma(y_{j(i)t} - \bar{y}) + \theta_i + \phi_{j(i)t} + \epsilon_{it} \quad , \tag{6}$$

where w_{it} is the imputed daily compensation of individual worker i at time t and $\bar{w}$ is the grand mean of the imputed wage rate averaged over time. Worker and plant characteristics are gathered in the vectors x_{it} and $y_{j(i)t}$, respectively, while θ_i and $\phi_{j(i)t}$ denote worker and plant fixed effects.

The auxiliary model (6) differs from our main specification (1) for two reasons. First of all we have to decompose the spell-fixed effect into its plant- and its worker component. Moreover, we also use a different set of control variables in order to maximize the number

[19] The approximation makes use of $ln(x + y) = lnx + ln(1 + y/x)$ and $ln(1 + y/x) \approx y/x$.

of movers in the sample. The identification of the plant fixed-effect hinges on the number of movers between plants. The sample size decreases rapidly in the number of plant-controls. The higher the total number of plants in the sample, the more likely it gets that plants are connected through workers switching jobs between two plants that are both observed in the sample. In order to reduce the number of plants that drop out of the sample we follow Abowd/Kramarz/Margolis (1999) by treating small plants as one group.

The plant dummy absorbs some of the unobserved heterogeneity on the plant-level. Not controlling for plant fixed effects would yield a biased estimator of the person fixed effects including both person and establishment time-invariant components.[20]
As Abowd/Kramarz/Margolis (1999) demonstrate, neglecting the plant fixed effect would yield estimates for $\phi_{j(i)t}$ which would also include the "employment-duration weighted average plant effect ϕ_j", provided that the other assumptions are not violated.[21]

Results for the human capital estimates. Results of the estimation of equation (6) are reported in Table A1.[22] The human capital index is constructed as

$$\hat{h}_{it} = \hat{\eta} x_{it} + \hat{\theta}_i. \quad (7)$$

The index thus comprises time-varying and time-constant characteristics related to the worker. The predicted $\hat{h}_{it}$ allows constructing the first and second moments of the human-capital distribution within the plant, which facilitates the estimation of equation (5).

3.2.3 Plant-level profitability estimates

Table 1 reports the results of estimating equation (5) using LP's semi-parametric method. Only the regressions in the lower panel control for workforce composition. In both panels, column (1) is the benchmark specification including all plants. Regressions reported in columns (2) and (3) estimate the production function separately for non-exporters and for exporters. P-values from t-tests on constant returns to scale are reported in squared brackets. The tests do not reject the null that the coefficients on labor and capital sums up to unity. Our profitability measure TFP is constructed as the predicted residuals from column (1) including the workforce composition controls. All regressions yield reasonable coefficients for capital between 0.2 and 0.4, and for labor between 0.7 and 0.75.

[20] Especially for our application we have to disentangle the worker from the plant effects in order to test for assortative matching between employers and workers.

[21] Andrews et al. (2008) use their estimation strategy and analyze the importance of a sufficient number of movers between employers to increase the quality of the estimated plant fixed effect. Their focus lies on identifying the plant fixed effects in Abowd/Kramarz/Margolis (1999), which allows them to maximize the number of movers by using the full-sample of workers. Our sample is smaller and relies on information about the plant. We thus need matched employer-employee data, which also reduces the number of movers. We therefore also propose a different identification strategy which relies more on the plant-level information when we estimate the plant-component.

[22] In particular we use the Stata routine `felsdvreg` provided by Cornelißen (2008).

Table 2 compares the standard Levinsohn/Petrin (2003) productivity measure and the skill-free Iranzo/Schivardi/Tosetti (2008) productivity measure for the years 1996, 2002, and 2007. As expected, on average, exporters have higher levels of productivity.[23] Moreover, the gap between exporting and non-exporting plants is smaller when controlling for work force composition. However, the gap between non-exporter and exporter productivity increases over time and across different percentiles of the productivity distribution. This productivity gap between exporters and non-exporters decreases when controlling for the work force composition in the lower Panel B, where the gap declines by 3 to 6 percent on average.Following Del Gatto/Ottaviano/Pagnini (2008) we also test whether TFP is Pareto-distributed. However, the estimated shape-parameter is at a rather low $k = 1.14$ and the R-squared is lower than the proposed threshold reported in Del Gatto/Ottaviano/Pagnini (2008).[24]

4 Regression results

Exporter Wage Premium and Rent-Sharing, Direct Effects. Table 3 reports results obtained from estimating equation (1). The key variables of interest are the share of exports in total sales, and the natural log of TFP as our measure of profitability. The benchmark specification includes controls for worker characteristics as tenure, age, a white-collar dummy, and the level of skill attained by the respective employee. Our standard establishment controls are log-employment to capture plant size, capital intensity measuring the relative capital to labor ratio on the plant-level, and the shares of females and part-timers, variables indicating whether a plant is covered by a collective agrement at the plant- or industry-level, and whether it has a work council. All regressions also include region-, sector-, and time-dummies. Worker and plant controls other than the variables of interest are omitted in the regression tables to save space.[25] We compare standard OLS models in the first column and models with spell-fixed effects in the second column. The latter controls for both plant- and person fixed effects, which will be the standard in the remaining analysis.

Column (1) confirms the general perception that plants more exposed to trade pay higher wages. An increase in the export share by 10 percentage points is associated to an average increase of the wage rate by 0.43 percent. The magnitude of this effect is comparable to what has previously been found in the literature; see Schank/Schnabel/Wagner (2007). Quite strikingly, when adding spell fixed-effects to the model in column (2) the exporter wage premium vanishes. This suggests that the premium may be driven by unobserved ability such that exporters have the more productive labor force, resulting in a spurious correlation between export intensity and wages. Clearly, the spell fixed-effects approach is

[23] Kernel density plots on the productivity distribution, reported in Figure A1, Web Appendix, reveal the well-known stylized fact that exporting plants are more productive.

[24] See Table A3 in the Web Appendix for details.

[25] Detailed output is provided in Table B1, Web Appendix. The variables denoted by CA are dummy variables that indicate whether a plant is subject to collective agreements conducted. Council is a dummy that takes the value one if the plant has a worker-council. Results are very standard. Education has the expected positive effect on log wages. The low-skill dummy is the reference group and thus omitted in all regressions. Age and tenure are associated to higher wages. Collective bargaining increases wages.

demanding as identification is based solely on variation within a worker-firm match, for example, time variation of the export share. However, as shown in Table B1 (Web Appendix), spell effects matter for all estimated coefficients in the model, but the bias from omitting them may be positive or negative, depending on the variable.

Columns (3) and (4) add the logarithm of our profitability measure ($\ln TFP$) to the regression and drop the export share. In the OLS exercise, a 10 percent increase in TFP leads to an increase of the wage by 0.25 percent on average. Adding spell effects reduces the magnitude to 0.11 percent but improves the precision of the estimate. Holding worker and firm effects fixed, the effect of profitability on wages is indicative of rent-sharing: more productive (i.e., more profitable) firms pay higher wages. However, rent-sharing is rather unimportant quantitatively, if compared, e.g., with the effect of capital intensity which has an estimated elasticity four times bigger than that of TFP.

Columns (5) and (6) feature both the profitability measure and the export share in the same regression. In the OLS model, exporters again pay higher wages, even conditional on profitability. When adding spell effects, the separate effect of exporting again vanishes. Results in column (6) are essentially identical to those obtained in (4) in the absence of the export share variable.

Note that, taking the Melitz (2003) model literally, one exporting is directly related to productivity, making simultaneous inference on either difficult.[26] However, in our data, TFP is only a very noisy indicator of exporter status; see figure A1 as the productivity distributions strongly overlap.[27]

Exporter Wage Premium and Rent-Sharing, Interactions. Table 4 presents our core result. The conjecture is that the exporter wage premium is smaller in more profitable firms,[28] or, equivalently, that rent-sharing is less important in more strongly internationalized firms. To test this link between the export-status of the establishment and its profitability, we include the interaction between both variables.

Columns (1) and (2) investigate the role of plant-level openness to trade, while columns (3) and (4) consider industry-level openness to nudge our analysis closer to the theoretical model of Egger/Etzel (2009). We focus first on columns (1) and (2). Interestingly, allowing for the interaction between TFP and export share, even in the presence of spell effects, both the profitability measure and the export share have positive signs and are statistically different from zero at the 1 percent level. The coefficient on the interaction term is negative in sign and also significant at the 1 percent level. All estimates are algebraically smaller under the spell effects specification. The results provide evidence for an exporter wage premium and for rent-sharing. However, the importance of rent-sharing declines in the

[26] Both measures are positively correlated. However, the correlation is at a rather low 0.11 so that collinearity is not a severe problem in our regressions.

[27] This may be due to time-varying productivity and sunk export fixed costs, as in Impullitti/Irarrazabal/Opromolla (2011).

[28] Employing quantile regressions, Powell/Wagner (2011) show that the exporter productivity-premium is largest at the lowest quantile.

export share of the firm: the elasticity of TFP on the wage is 0.029 in a purely domestic firm but only 0.017 in a firm with an average export share (0.408). The elasticity is zero in a firm exporting all its output. Also, the exporter wage premium is declining in TFP: the wage in an average exporter is about 0.12 percent higher than in an average domestic firm.[29] If a firm with an average export share has a level of TFP two standard deviations above the mean, it pays a wage 1.82 percent lower than a purely domestic firm;[30] if it has a level of TFP two standard deviations below the mean, it pays a wage 2.07 percent higher than a purely domestic firm.[31] A firm exporting its entire output with an average level of TFP has a wage rate about 0.3 percent higher than a similarly profitably purely domestic firm.[32]

Columns (3) and (4) replace the firm-level export share measure with an industry-level variable in order to tie our empirics closer to Egger/Etzel (2009). These regressions confirm that wages in more open industries tend to be higher. Moreover, on the plant-level we also find that the magnitude of rent-sharing tends to be more pronounced in industries which are less open. As a general lesson, due to rent-sharing, it is profitable for a worker to be employed in a highly productive firm; if that firm exports, rent appropriation becomes more difficult for workers.

The role of collective bargaining. A positive link between the distribution of wages and the distribution of firm-level profits is present in theoretical models featuring fair wages (Egger/Kreickemeier (2009)) or search-and-matching with convex adjustment costs (Cosar/Guner/Tybout (2011)) as well as in models featuring collective bargaining. In this section, we test whether the form of wage determination matters for the existence of an exporter wage premium and for the role of internationalization on rent sharing.

Table 5 reports coefficients obtained from regressions either including observations for plants without collective bargaining in columns (1) to (3), or plants that set wages according to plant- or centralized-bargaining agreements in (4) to (6). The upper panel employs the information in the plant-level export share, whereas the lower panel exploits industry-level data as globalization proxy. We compare pooled OLS, spell fixed- and spell random-effects estimators. Both regimes are comparable due to the same number of plants included in both regressions.[33]

Whether wages are bargained collectively or not, we find that more profitable plants pay higher wages. The magnitude of the direct effect is very similar across regressions using plants without or with collective bargaining coverage. Strikingly, however, a direct positive exporter wage premium exists only in the sample of collectively bargained plants. In that sample we also find that rent- sharing is reduced by international activities. Plants not covered by collective bargaining feature an inconsistent and statistically insignificant sign pattern on the export variables. This picture is robust to using an industry-level openness

[29] $100\% \times (0.243 \times 0.408 - 0.029 \times 8.275 \times 0.408) = 0.12342\%$.
[30] $100\% \times (0.243 \times 0.408 - 0.029 \times (8.275 + 2 \times 0.823) \times 0.408) = -1.824127\%$.
[31] $100\% \times (0.243 \times 0.408 - 0.029 \times (8.275 - 2 \times 0.823) \times 0.408) = 2.070967\%$.
[32] $100\% \times (0.243 - 0.029 \times 8.275) = 0.3025\%$.
[33] Though we have different number of observations the results are comparable since we cluster standard errors on the plant-level.

measure instead of the plant-level export share; see the lower panel of Table 5. The results suggest that the pattern in the data is best understood against the background of the model by Egger/Etzel (2009), where collective bargaining and variable markups interact to give rise to a negative interaction between exporting and rent-sharing.

The right-most column in the upper panel of Table 5 suggests that, at average profitability, the wage premium paid by a firm achieving 40% of its sales on foreign markets over a purely domestic firm is close to zero. The exporter wage premium is substantial (about 3.9%) in plants with profitability levels two standard deviations below the mean, while it becomes negative (-2.5%) for plants two standard deviations above the mean.

Robustness checks. As a robustness check we rerun the regressions separately for blue and white collar workers. It can be argued that the wage censoring problem is less severe for blue collar workers. Blue collar workers' income is less likely above the censoring ceiling. Results are reported in Table 6. Again we find estimates that are similar to the results reported in Table 5. The interaction is significant only for plants that set wages collectively and the magnitude of rent-sharing is lower for blue than for the white collar workers. Regressions based on the sample of white collar workers confirm the results from the benchmark regressions that also include spell-fixed effects. Again this could be driven by the wage censoring that results in a more compressed wage profile around the wage ceiling.

Table 7 reports results for different levels of bargaining regimes. Regressions reported in the first panel include the export-share as openness measure, whereas industry-level openness was used in the lower panel. Columns (1) - (3) in each panel focus on plants that indicate the use of firm-level collective agreements, whereas columns (4) - (6) in each panel are based on the subsample of centralized collective bargaining plants. All regressions still reveal a positive relationship between plant profitability and wages paid to the workers. Additionally, the export-share and the interaction between export-share and the plant-level profitability measure are negative and significant for OLS and random-effects.

5 Conclusion

This paper sheds light on the implications of global competition for the wage setting mechanism in the presence of unions. Our results suggest that unions' bargaining positions are weaker in more internationally active plants. Our analysis is motivated by recent theoretical work that shows that the combination of variable markups and collective bargaining implies lower rent-sharing in firms that achieve a higher share of their sales on exports markets where profit margins are lower.

Our preferred measures for rent-sharing is a profitability measure that is purged from the plant's skill-composition. In line with the theoretical predictions outlined in the introduction we are able to show that a surge in collective bargaining plants' export intensity is negatively associated with wages. The well-known exporter wage premium shows up in our regressions when the identification is based on both the within and the between variation of the data and/or if we explicitly allow for interactions between exports and productivity by taking a plant's profitability into account. Moreover, the export-share turns out significant only in plants that either bargain wages collectively or individually on the firm-level. To the best of our knowledge, this paper is the first connecting different wage bargaining regimes to the exporter wage premium based on matched employer-employee data.

Tables and Figures

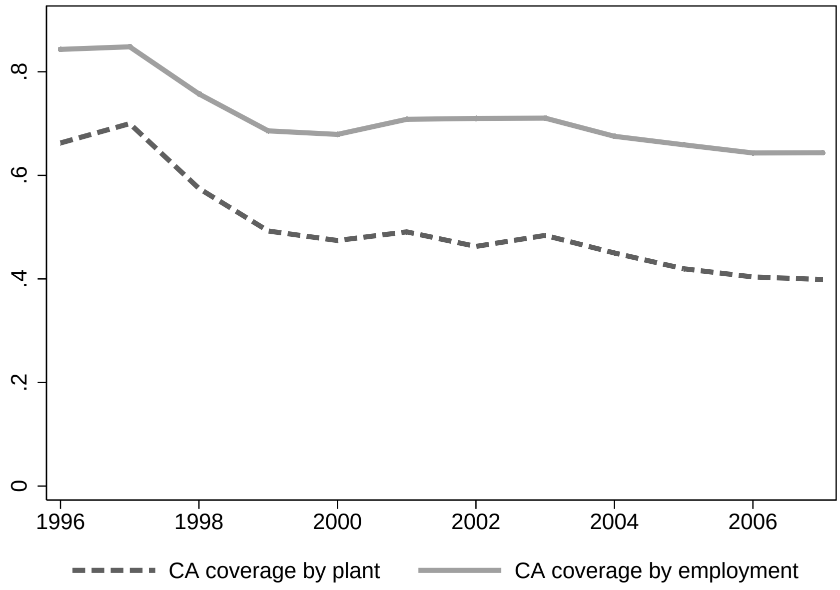

Figure 1: Collective agreement (CA) coverage,
German manufacturing, LIAB 1996-2007

Table 1: Production function estimates

Dependent variable: Value added (ln)			
		Non-exporter	Exporter
	(1)	(2)	(3)
	LP	LP	LP
Panel A: Without controlling for workforce composition			
Employment (ln)	0.698^{***}	0.688^{***}	0.728^{***}
	(0.016)	(0.022)	(0.021)
Capital (ln)	0.200^{***}	0.155^{*}	0.200^{*}
	(0.056)	(0.088)	(0.109)
CRS-Test (p-value)	[0.065]	[0.093]	[0.515]
Panel B: Controlling for the workforce composition			
Employment$\times\bar{h}_{jt}$ (ln)	0.733^{***}	0.727^{***}	0.755^{***}
	(0.017)	(0.022)	(0.017)
Capital (ln)	0.189^{***}	0.153^{*}	0.357^{***}
	(0.061)	(0.091)	(0.094)
VC$(h_{jt})^2$	2.866^{***}	3.237^{***}	1.453
	(0.948)	(0.989)	(1.674)
CRS-Test (p-value)	[0.221]	[0.214]	[0.234]
Observations	20581	9273	11308

Standard errors in parentheses, * significant at 10%, ** significant at 5%, *** significant at 1%. All estimations include industry and time fixed effects. Estimation method: LP refers to Levinsohn and Petrin (2003). Standard errors are bootstrapped in columns (1)-(3). The second panel controls for the plant-level workforce composition by including the mean and the squared variance coefficient of the human capital index. Probability of the sum of parameter estimates on labor and capital to be equal to one in brackets.

Table 2: Total factor productivity distribution by export status

Panel A: Levinsohn and Petrin without workforce-composition controls

	Mean	Std. Dev.	p10	p50	p90
1996					
Non-exporter	74.6	53.2	27.3	63.0	142.3
Exporter	104.0	93.1	44.0	85.7	170.5
2000					
Non-exporter	82.8	86.7	19.9	66.9	140.9
Exporter	103.4	89.4	31.8	86.2	176.0
2007					
Non-exporter	75.4	63.6	28.4	58.0	139.3
Exporter	102.6	92.3	42.1	81.5	163.8

Panel B: Levinsohn and Petrin including workforce-composition controls

	Mean	Std. Dev.	p10	p50	p90
1996					
Non-exporter	78.3	53.2	31.4	65.9	131.9
Exporter	101.5	69.0	48.3	84.3	171.7
2000					
Non-exporter	83.3	77.3	21.5	67.7	145.4
Exporter	98.9	69.9	36.9	85.9	159.9
2007					
Non-exporter	78.5	60.7	34.3	63.0	139.8
Exporter	102.3	90.0	44.2	81.4	166.8

TFP is constructed following Levinsohn and Petrin (2003). The means, standard deviations, 10th, 50th, and 90th percentile of TFP are separately reported for non-exporters and exporters in the years 1996, 2002, and 2007. All values are expressed as percentage of the yearly-industry average, weighted by inverse drawing probability weights.

Table 3: The export wage-premium and the role of TFP (I)

Dependent variable: Logarithm of individual daily wage						
	(1) OLS	(2) FE-Spell	(3) OLS	(4) FE-Spell	(5) OLS	(6) FE-Spell
Exports (share)	0.043^{***}	-0.016			0.049^{***}	0.001
	(0.014)	(0.018)			(0.014)	(0.016)
TFP (ln)			0.025^{**}	0.011^{***}	0.026^{***}	0.011^{***}
			(0.010)	(0.003)	(0.009)	(0.004)
R^2	0.618	0.177	0.620	0.180	0.621	0.180
Plants	5040	5040	5040	5040	5040	5040
Observations	4658595	4658595	4658595	4658595	4658595	4658595

Standard errors in parentheses clustered at plant-level, * significant at 10%, ** significant at 5%, *** significant at 1%. Controls included but not reported are age, age squared, tenure, tenure squared, medium-,high-skill and white-collar dummies, plant size, capital intensity, the share of females and part timers and dummies for the existence of a worker council and collective agreements at the firm- or industry-level. Additionally, all estimations include a full set of region-, sector-, and time-dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table 4: The export wage-premium and the role of TFP (II)

Dependent variable: Logarithm of individual daily wage				
	(1) OLS	(2) FE-Spell	(3) OLS	(4) FE-Spell
TFP (ln)	0.071^{***}	0.029^{***}	0.108^{***}	0.053^{**}
	(0.007)	(0.006)	(0.011)	(0.021)
Exports (share)	0.785^{***}	0.243^{***}		
	(0.111)	(0.074)		
Exports $\times$ TFP	-0.089^{***}	-0.029^{***}		
	(0.013)	(0.009)		
Openness			0.056^{***}	0.033
			(0.018)	(0.021)
Openness $\times$ TFP			-0.005^{***}	-0.002^{**}
			(0.001)	(0.001)
R^2	0.623	0.181	0.622	0.188
Plants	5040	5040	5003	5003
Observations	4658595	4658595	4654547	4654547

Standard errors in parentheses clustered at the plant-level in (1)-(2) and at the industry-level in (3)-(4), * significant at 10%, ** significant at 5%, *** significant at 1%. Controls included but not reported are age, age squared, tenure, tenure squared, medium-,high-skill and white-collar dummies, plant size, capital intensity, the share of females and part timers and dummies for the existence of a worker council and collective agreements at the firm- or industry-level. Additionally, all estimations include a full set of region-, sector-, and time-dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table 5: The role of collective agreements

Dependent variable: Logarithm of individual daily wage

	No collective agreement			Collective agreement		
	OLS	FE-Spell	RE-Spell	OLS	FE-Spell	RE-Spell
TFP (ln)	0.083***	0.031***	0.045***	0.066***	0.028***	0.041***
	(0.010)	(0.010)	(0.010)	(0.008)	(0.008)	(0.007)
Exports (share)	0.287	−0.100	0.018	0.726***	0.244***	0.423***
	(0.207)	(0.183)	(0.164)	(0.124)	(0.088)	(0.079)
Exports × TFP	−0.037	0.008	−0.004	−0.081***	−0.029***	−0.049***
	(0.026)	(0.023)	(0.020)	(0.015)	(0.011)	(0.009)
R^2	0.590	0.126		0.597	0.192	
Plants	2626	2626	2626	3302	3302	3302
Observations	491828	491828	491828	4166767	4166767	4166767

	No collective agreement			Collective agreement		
	OLS	FE-Spell	RE-Spell	OLS	FE-Spell	RE-Spell
TFP (ln)	0.101***	0.058	0.078**	0.104***	0.050**	0.073***
	(0.027)	(0.044)	(0.039)	(0.013)	(0.020)	(0.014)
Openness	0.053	0.048	0.055	0.052**	0.030	0.039**
	(0.037)	(0.042)	(0.040)	(0.018)	(0.020)	(0.018)
Openness × TFP	−0.003	−0.002	−0.003	−0.005***	−0.002**	−0.004***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)
R^2	0.592	0.152		0.596	0.196	
Plants	2594	2594	2594	3284	3284	3284
Observations	489410	489410	489410	4165137	4165137	4165137

Standard errors in parentheses clustered at the plant-level in the upper panel and the industry-level in the lower panel, * significant at 10%, ** significant at 5%, *** significant at 1%. Controls included but not reported are age, age squared, tenure, tenure squared, medium-,high-skill and white-collar dummies, plant size, capital intensity, the share of females and part timers and a dummy for the existence of a worker council. Additionally, all estimations include a full set of region-, sector-, and time-dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table 6: Differential effects according to skill-type?

Dependent variable: Logarithm of individual daily wage

	Blue collar workers					
	Non-collective agreements			Collective agreements		
	OLS	FE-Spell	RE-Spell	OLS	FE-Spell	RE-Spell
TFP (ln)	0.073***	0.030***	0.042***	0.053***	0.030***	0.039***
	(0.010)	(0.010)	(0.010)	(0.008)	(0.008)	(0.007)
Exports (share)	0.037	−0.205	−0.150	0.529***	0.269***	0.379***
	(0.230)	(0.233)	(0.202)	(0.132)	(0.093)	(0.082)
Exports × TFP	−0.007	0.022	0.016	−0.057***	−0.032***	−0.043***
	(0.028)	(0.030)	(0.025)	(0.016)	(0.011)	(0.010)
R^2	0.536	0.118		0.493	0.188	
Plants	2512	2512	2512	3238	3238	3238
Observations	344930	344930	344930	2692308	2692308	2692308

	White collar workers					
	Non-collective agreements			Collective agreements		
	OLS	FE-Spell	RE-Spell	OLS	FE-Spell	RE-Spell
TFP (ln)	0.104***	0.028***	0.049***	0.082***	0.020***	0.044***
	(0.011)	(0.011)	(0.010)	(0.010)	(0.008)	(0.007)
Exports (share)	0.854***	0.022	0.297**	0.974***	0.175**	0.482***
	(0.220)	(0.136)	(0.126)	(0.129)	(0.084)	(0.086)
Exports × TFP	−0.103***	−0.007	−0.038**	−0.110***	−0.020**	−0.055***
	(0.027)	(0.017)	(0.016)	(0.016)	(0.010)	(0.010)
R^2	0.477	0.168		0.479	0.212	
Plants	2246	2246	2246	3046	3046	3046
Observations	146898	146898	146898	1474459	1474459	1474459

Standard errors in parentheses clustered at the plant-level in the upper panel and the industry-level in the lower panel, * significant at 10%, ** significant at 5%, *** significant at 1%. Controls included but not reported are age, age squared, tenure, tenure squared, medium-,high-skill and white-collar dummies, plant size, capital intensity, the share of females and part timers and a dummy for the existence of a worker council. Additionally, all estimations include a full set of region-, sector-, and time-dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table 7: Firm-level versus industry-level agreements

Dependent variable: Logarithm of individual daily wage

	Firm-level agreement			Industry-level agreement		
	OLS	FE-Spell	RE-Spell	OLS	FE-Spell	RE-Spell
TFP (ln)	0.068***	0.019**	0.039***	0.055***	0.032***	0.043***
	(0.013)	(0.010)	(0.009)	(0.009)	(0.010)	(0.008)
Exports (share)	0.789***	0.129	0.399***	0.347**	0.186	0.248**
	(0.157)	(0.142)	(0.113)	(0.164)	(0.135)	(0.123)
Exports × TFP	−0.089***	−0.017	−0.047***	−0.037*	−0.022	−0.029**
	(0.018)	(0.015)	(0.012)	(0.020)	(0.016)	(0.015)
R^2	0.685	0.156		0.584	0.206	
Plants	845	845	845	2804	2804	2804
Observations	654761	654761	654761	3512006	3512006	3512006

	Firm-level agreement			Industry-level agreement		
	OLS	FE-Spell	RE-Spell	OLS	FE-Spell	RE-Spell
TFP (ln)	0.109***	0.033	0.070*	0.075***	0.041*	0.050***
	(0.034)	(0.034)	(0.038)	(0.015)	(0.021)	(0.016)
Openness	0.072***	0.032	0.050*	0.032	0.024	0.023
	(0.024)	(0.032)	(0.030)	(0.019)	(0.021)	(0.020)
Openness × TFP	−0.005***	−0.001	−0.003*	−0.003**	−0.001	−0.001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
R^2	0.684	0.160		0.584	0.210	
Plants	838	838	838	2790	2790	2790
Observations	654524	654524	654524	3510613	3510613	3510613

Standard errors in parentheses clustered at the plant-level in the upper panel and the industry-level in the lower panel, * significant at 10%, ** significant at 5%, *** significant at 1%. Controls included but not reported are age, age squared, tenure, tenure squared, medium-,high-skill and white-collar dummies, plant size, capital intensity, the share of females and part timers and a dummy for the existence of a worker council. Additionally, all estimations include a full set of region-, sector-, and time-dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

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WEBAPPENDIX

to

"International Trade and Collective Bargaining Outcomes: Evidence from German Employer-Employee Data"

by

Gabriel Felbermayr, Andreas Hauptmann and Hans-Joerg Schmerer

March 2012

Appendix A: Additional Tables–Not for Publication

Table A1: FELSDV results

Dependent variable: Logarithm of individual daily wage *Variables of interest: Firm and person fixed effects*			
	(1)	(2)	(3)
Age	0.076***	0.075***	0.073***
	(0.001)	(0.001)	(0.001)
Age^2/100	−.084***	−.082***	−.079***
	(0.001)	(0.001)	(0.001)
Age^3/1000	0.003***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)
Employment (ln)		0.039***	0.034***
		(0.001)	(0.001)
Capital intensity (ln)			0.023***
			(0.001)
Observations	10107425	10107382	7611812

Rubust standard errors in parenthesis, * significant at 10%, ** significant at 5%, *** significant at 1%. Person, firm, year, and industry dummies included in all regressions. Person fixed effects of specification (2) are used to construct human capital measures consisting of observed and unobserved characteristics. These human capital measures are in turn used to construct firm-level human capital index variables such as the mean $\bar{h}_{jt}$ and the standard deviation σ_{jt}.

Exporter vs. non-exporter. Our analysis hinges on the constructed total factor productivity measure which is our preferred proxy for firm profitability. The kernel density plot in A1 indicates that, in our sample, exporters are on average more productive. Moreover, the plot also reveals that productivity is normally distributed around the mean and the two distributions strongly overlap. Thus, there is no clear cutoff as predicted by Melitz (2003) and as indicated by the density plot and the test statistics presented in Table A1, firm profitability is not Pareto distributed.

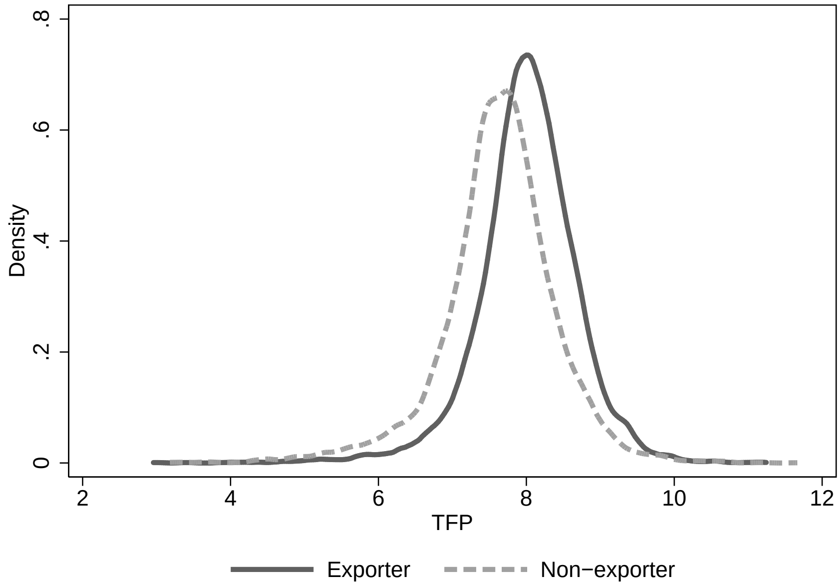

Figure A1: Kernel density plot of the profitability measure

Summary statistics. Table A2 reports further information about the variables used in the regressions covering unweighted and weighted means and standard deviation measures. The former are for interpretation of the regression results reported in the text and the latter are weighted by an inverse drawing probability, which increases the representation-power of the data. The weighting matrixes have to be treated with caution. We refrain from using them in the main regressions because of the matched employer-employee setup, where the firm dimension is inflated due to the matching of the person data. We also distinguish between individual- and establishment-level, where variables are collapsed to the establishment-year dimension for the establishment-level summary reports.

Table A2: Summary statistics - unweighted

	Individual level		Plant level	
	Mean	Std. Dev.	Mean	Std. Dev.
Individual characteristics				
Daily imputed wage (ln)	4.585	0.390	4.214	0.377
Daily non-imputed wage (ln)	4.562	0.353	4.206	0.369
Female worker (dummy)	0.176	0.381	0.251	0.225
Foreign worker (dummy)	0.102	0.302	0.051	0.095
White-collar worker (dummy)	0.344	0.475	0.293	0.230
Low-skilled worker (dummy)	0.173	0.378	0.130	0.182
Medium-skilled worker (dummy)	0.701	0.458	0.789	0.202
High-skilled worker (dummy)	0.126	0.332	0.081	0.126
Age (years)	41.413	10.075	41.391	4.231
Tenure (years)	11.340	8.164	7.823	4.216
Experience (years)	16.830	8.335	13.996	4.852
Establishment characteristics				
Exporting plant (dummy)	0.890	0.313	0.549	0.498
Exports (share of total sales)	0.408	0.271	0.182	0.250
TFP (ln)	8.275	0.823	7.843	0.748
Labor productivity (ln)	11.160	0.861	10.785	0.788
Employment (ln)	7.359	1.858	4.063	1.807
Value added (ln)	18.518	2.132	14.848	2.170
Capital intensity (ln)	11.385	0.930	10.641	1.279
Female workers (share)	0.206	0.154	0.270	0.213
Part-time workers (share)	0.046	0.059	0.079	0.125
CA, industry-level (dummy)	0.762	0.426	0.465	0.499
CA, firm-level (dummy)	0.133	0.340	0.094	0.292
Existence worker council (dummy)	0.930	0.255	0.463	0.499
Industry-level characteristics				
Export orientation (dummy)	0.920	0.271	0.829	0.376
Sectoral trade openness (share)	13.448	3.802	11.812	3.706

Note: German matched employer-employee data (LIAB), 1996-2007, manufacturing industries. All monetary variables are expressed in real terms using a two-digit industry value added deflator. All industry-level variables are taken from the OECD STAN database.

Pareto test for the TFP estimates. Del Gatto/Ottaviano/Pagnini (2008): "Formally, consider a random variable X (e.g., our TFP) with observed cumulative distribution F(X). If the variable is distributed as a Pareto with shape parameter ks, then the OLS estimate of the slope parameter in the regression of ln(1 - F(X)) on ln (X) plus a constant is a consistent estimator of - ks and the corresponding R^2 is close to one."

Table A3: Is TFP Pareto distributed?

	k-parameter	R^2	Obs.
	Pooled sample		
Total	1.144	0.734	20580
	By year		
1996	1.204	0.741	955
1997	1.114	0.724	936
1998	1.059	0.692	1093
1999	1.130	0.714	1309
2000	1.103	0.718	2008
2001	1.128	0.724	2213
2002	1.058	0.700	2145
2003	1.079	0.700	2158
2004	1.138	0.734	2134
2005	1.119	0.740	1990
2006	1.307	0.820	1839
2007	1.309	0.808	1789
	By industry		
Textiles	1.032	0.698	664
Printing	1.036	0.695	1093
Wood	1.225	0.779	1138
Chemicals	1.134	0.766	1198
Plastic	1.083	0.596	1122
Non-metallic	1.192	0.725	1116
Metallic	1.199	0.695	1636
Recycling	1.073	0.766	178
Steel	1.273	0.678	2599
Machinery	1.206	0.695	2947
Vehicles a	1.076	0.722	1124
Vehicles b	1.066	0.733	324
Electronic	1.179	0.758	1730
Optic	1.229	0.712	1190
Furniture	1.006	0.627	570

Appendix B: Detailed regression output

Table B1: The export wage-premium and the role of TFP (I)
(Details to Table 3)

Dependent variable: Logarithm of individual daily wage						
	(1) OLS	(2) FE-Spell	(3) OLS	(4) FE-Spell	(5) OLS	(6) FE-Spell
Exports (share of total sales)	0.043***	−0.016			0.049***	0.001
	(0.014)	(0.018)			(0.014)	(0.016)
TFP (ln)			0.025**	0.011***	0.026***	0.011***
			(0.010)	(0.003)	(0.009)	(0.004)
Employment (ln)	0.027***	0.024	0.028***	0.033	0.026***	0.033
	(0.004)	(0.025)	(0.004)	(0.026)	(0.004)	(0.026)
Capital intensity (ln)	0.024***	0.033	0.026***	0.045**	0.024***	0.045**
	(0.004)	(0.020)	(0.004)	(0.020)	(0.004)	(0.020)
Female workers (share)	−0.334***	−0.072**	−0.322***	−0.069**	−0.319***	−0.068**
	(0.027)	(0.033)	(0.026)	(0.032)	(0.026)	(0.032)
Part-time workers (share)	−0.063	0.059	−0.068	0.047	−0.067	0.047
	(0.061)	(0.056)	(0.055)	(0.062)	(0.055)	(0.062)
Worker council (dummy)	0.103***	0.003	0.100***	0.002	0.098***	0.002
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Age (years)	0.025***	0.027***	0.025***	0.027***	0.025***	0.027***
	(0.001)	(0.006)	(0.001)	(0.006)	(0.001)	(0.006)
$Age^2/100$	−0.026***	−0.035***	−0.026***	−0.034***	−0.026***	−0.034***
	(0.001)	(0.005)	(0.001)	(0.005)	(0.001)	(0.005)
Tenure (days)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tenure^2/100$	−0.000***	−0.000*	−0.000***	−0.000*	−0.000***	−0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.120***	0.004	0.120***	0.000	0.120***	0.000
	(0.004)	(0.007)	(0.004)	(0.006)	(0.004)	(0.006)
High-skilled (dummy)	0.357***	0.072***	0.358***	0.059***	0.356***	0.059***
	(0.011)	(0.019)	(0.011)	(0.019)	(0.011)	(0.019)
White-collar (dummy)	0.257***	0.079***	0.256***	0.079***	0.256***	0.079***
	(0.007)	(0.008)	(0.007)	(0.008)	(0.007)	(0.008)
CA, industry-level (dummy)	0.066***	−0.003	0.063***	−0.003	0.063***	−0.003
	(0.011)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)
CA, firm-level (dummy)	0.043***	−0.006	0.046***	−0.006	0.047***	−0.007
	(0.013)	(0.011)	(0.012)	(0.011)	(0.012)	(0.011)
R^2	0.618	0.177	0.620	0.180	0.621	0.180
Plants	5040	5040	5040	5040	5040	5040
Observations	4658595	4658595	4658595	4658595	4658595	4658595

Standard errors in parentheses clustered at plant-level, * significant at 10%, ** significant at 5%, *** significant at 1%. All estimations include a full set of region-, sector-, and time-dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table B2: The export wage-premium and the role of TFP (II)
(Details to Table 4)

Dependent variable: Logarithm of individual daily wage				
	(1) OLS	(2) FE-Spell	(3) OLS	(4) FE-Spell
TFP (ln)	0.071***	0.029***	0.108***	0.053**
	(0.007)	(0.006)	(0.011)	(0.021)
Exports (share)	0.785***	0.243***		
	(0.111)	(0.074)		
TFP × Exports	−0.089***	−0.029***		
	(0.013)	(0.009)		
Sectoral trade openness (share)			0.056***	0.033
			(0.018)	(0.021)
TFP × Openness			−0.005***	−0.002**
			(0.001)	(0.001)
Employment (ln)	0.024***	0.029	0.025***	0.027
	(0.004)	(0.026)	(0.008)	(0.019)
Capital intensity (ln)	0.026***	0.041**	0.026***	0.040
	(0.004)	(0.020)	(0.004)	(0.023)
Female workers (share)	−0.323***	−0.068**	−0.313***	−0.073
	(0.026)	(0.032)	(0.039)	(0.065)
Part-time workers (share)	−0.017	0.051	−0.053	0.026
	(0.054)	(0.062)	(0.081)	(0.080)
Worker council (dummy)	0.088***	0.001	0.097***	0.002
	(0.010)	(0.010)	(0.010)	(0.007)
Age (years)	0.025***	0.027***	0.025***	0.026***
	(0.001)	(0.006)	(0.002)	(0.006)
Age^2/100	−0.025***	−0.034***	−0.025***	−0.033***
	(0.001)	(0.005)	(0.002)	(0.004)
Tenure (days)	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Tenure^2/100	−0.000***	−0.000*	−0.000***	−0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.120***	0.000	0.120***	0.002
	(0.004)	(0.006)	(0.010)	(0.008)
High-skilled (dummy)	0.357***	0.060***	0.358***	0.063**
	(0.011)	(0.020)	(0.022)	(0.028)
White-collar (dummy)	0.255***	0.079***	0.254***	0.078***
	(0.007)	(0.008)	(0.014)	(0.008)
CA, industry-level (dummy)	0.064***	−0.003	0.064***	−0.001
	(0.010)	(0.009)	(0.009)	(0.009)
CA, firm-level (dummy)	0.044***	−0.007	0.045***	−0.006
	(0.012)	(0.011)	(0.010)	(0.005)
R^2	0.623	0.181	0.622	0.188
Plants	5040	5040	5003	5003
Observations	4658595	4658595	4654547	4654547

Standard errors in parentheses clustered at the plant-level in (1)-(2) and at the industry-level in (3)-(4), * significant at 10%, ** significant at 5%, *** significant at 1%. All estimations include a full set of region-, sector-, and time-dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table B3: The role of collective agreements (Details to Table 5, upper panel)

Dependent variable: Logarithm of individual daily wage						
	No collective agreement			Collective agreement		
	OLS	FE-Spell	RE-Spell	OLS	FE-Spell	RE-Spell
TFP (ln)	0.083***	0.031***	0.045***	0.066***	0.028***	0.041***
	(0.010)	(0.010)	(0.010)	(0.008)	(0.008)	(0.007)
Exports (share)	0.287	−0.100	0.018	0.726***	0.244***	0.423***
	(0.207)	(0.183)	(0.164)	(0.124)	(0.088)	(0.079)
TFP × Exports	−0.037	0.008	−0.004	−0.081***	−0.029***	−0.049***
	(0.026)	(0.023)	(0.020)	(0.015)	(0.011)	(0.009)
Employment (ln)	0.044***	0.075***	0.054***	0.023***	0.028	0.031***
	(0.005)	(0.025)	(0.005)	(0.004)	(0.030)	(0.004)
Capital intensity (ln)	0.031***	0.050***	0.035***	0.025***	0.036	0.027***
	(0.004)	(0.018)	(0.005)	(0.004)	(0.026)	(0.005)
Female workers (share)	−0.344***	−0.015	−0.201***	−0.332***	−0.086**	−0.254***
	(0.029)	(0.035)	(0.028)	(0.031)	(0.042)	(0.028)
Part-time workers (share)	0.023	0.062*	−0.001	−0.024	0.050	0.019
	(0.079)	(0.034)	(0.038)	(0.069)	(0.083)	(0.045)
Worker council (dummy)	0.050***	−0.031*	0.009	0.088***	0.009	0.049***
	(0.011)	(0.017)	(0.013)	(0.012)	(0.011)	(0.008)
Age (years)	0.025***	−0.005	0.027***	0.025***	0.030***	0.030***
	(0.001)	(0.007)	(0.002)	(0.001)	(0.006)	(0.002)
Age^2/100	−0.027***	−0.029***	−0.029***	−0.025***	−0.034***	−0.031***
	(0.001)	(0.006)	(0.003)	(0.001)	(0.006)	(0.003)
Tenure (days)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure^2/100	−0.000***	−0.000	−0.000***	−0.000***	−0.000*	−0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.147***	0.010	0.137***	0.119***	−0.001	0.100***
	(0.010)	(0.012)	(0.011)	(0.004)	(0.006)	(0.010)
High-skilled (dummy)	0.432***	0.052**	0.431***	0.351***	0.058***	0.351***
	(0.012)	(0.022)	(0.012)	(0.011)	(0.022)	(0.025)
White-collar (dummy)	0.239***	0.080***	0.206***	0.255***	0.077***	0.215***
	(0.007)	(0.007)	(0.007)	(0.008)	(0.009)	(0.009)
R^2	0.590	0.126		0.597	0.192	
Plants	2626	2626	2626	3302	3302	3302
Observations	491828	491828	491828	4166767	4166767	4166767

Standard errors in parentheses clustered at the plant-level in the upper panel and the industry-level in the lower panel, * significant at 10%, ** significant at 5%, *** significant at 1%. All estimations include a full set of region-, sector-, and time-dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table B4: The role of collective agreements (Details to Table 5, lower panel)

Dependent variable: Logarithm of individual daily wage	No collective agreement			Collective agreement		
	OLS	FE-Spell	RE-Spell	OLS	FE-Spell	RE-Spell
TFP (ln)	0.101***	0.058	0.078**	0.104***	0.050**	0.073***
	(0.027)	(0.044)	(0.039)	(0.013)	(0.020)	(0.014)
Sectoral openness (share)	0.053	0.048	0.055	0.052**	0.030	0.039**
	(0.037)	(0.042)	(0.040)	(0.018)	(0.020)	(0.018)
TFP × openness	−0.003	−0.002	−0.003	−0.005***	−0.002**	−0.004***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)
Employment (ln)	0.043***	0.090***	0.054***	0.024***	0.025	0.031***
	(0.004)	(0.014)	(0.006)	(0.007)	(0.026)	(0.006)
Capital intensity (ln)	0.029***	0.058***	0.034***	0.025***	0.033	0.026***
	(0.004)	(0.013)	(0.006)	(0.005)	(0.028)	(0.004)
Female workers (share)	−0.343***	−0.010	−0.193***	−0.323***	−0.094	−0.252***
	(0.020)	(0.017)	(0.017)	(0.043)	(0.084)	(0.046)
Part-time workers (share)	0.013	0.040	−0.017	−0.052	0.024	−0.011
	(0.087)	(0.034)	(0.034)	(0.091)	(0.099)	(0.071)
Worker council (dummy)	0.051***	−0.028**	0.009	0.100***	0.009	0.051***
	(0.007)	(0.012)	(0.006)	(0.017)	(0.013)	(0.009)
Age (years)	0.024***	−0.003	0.027***	0.025***	0.029***	0.030***
	(0.002)	(0.008)	(0.002)	(0.003)	(0.007)	(0.002)
$Age^2/100$	−0.027***	−0.028***	−0.029***	−0.025***	−0.033***	−0.030***
	(0.002)	(0.004)	(0.003)	(0.003)	(0.005)	(0.003)
Tenure (days)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tenure^2/100$	−0.000***	−0.000	−0.000***	−0.000***	−0.000***	−0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.148***	0.017*	0.139***	0.119***	0.001	0.101***
	(0.011)	(0.008)	(0.014)	(0.009)	(0.008)	(0.019)
High-skilled (dummy)	0.432***	0.065***	0.433***	0.353***	0.060*	0.352***
	(0.015)	(0.018)	(0.019)	(0.022)	(0.030)	(0.038)
White-collar (dummy)	0.240***	0.081***	0.204***	0.255***	0.076***	0.215***
	(0.014)	(0.007)	(0.011)	(0.014)	(0.007)	(0.015)
R^2	0.592	0.152		0.596	0.196	
Plants	2594	2594	2594	3284	3284	3284
Observations	489410	489410	489410	4165137	4165137	4165137

Standard errors in parentheses clustered at the plant-level in the upper panel and the industry-level in the lower panel, * significant at 10%, ** significant at 5%, *** significant at 1%. All estimations include a full set of region-, sector-, and time-dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table B5: Differential effects according to skill-type? (Details to Table 6, upper panel)

Dependent variable: Logarithm of individual daily wage						
	Blue collar workers					
	Non-collective agreements			Collective agreements		
	OLS	FE-Spell	RE-Spell	OLS	FE-Spell	RE-Spell
TFP (ln)	0.073***	0.030***	0.042***	0.053***	0.030***	0.039***
	(0.010)	(0.010)	(0.010)	(0.008)	(0.008)	(0.007)
Exports (share)	0.037	−0.205	−0.150	0.529***	0.269***	0.379***
	(0.230)	(0.233)	(0.202)	(0.132)	(0.093)	(0.082)
TFP × Exports	−0.007	0.022	0.016	−0.057***	−0.032***	−0.043***
	(0.028)	(0.030)	(0.025)	(0.016)	(0.011)	(0.010)
Employment (ln)	0.038***	0.070***	0.047***	0.026***	0.045	0.035***
	(0.006)	(0.026)	(0.006)	(0.004)	(0.033)	(0.004)
Capital intensity (ln)	0.030***	0.051***	0.034***	0.024***	0.031	0.024***
	(0.004)	(0.019)	(0.005)	(0.004)	(0.027)	(0.004)
Female workers (share)	−0.392***	−0.019	−0.245***	−0.424***	−0.111***	−0.338***
	(0.030)	(0.037)	(0.030)	(0.036)	(0.042)	(0.029)
Part-time workers (share)	0.116	0.063*	0.034	0.058	0.132**	0.072
	(0.092)	(0.036)	(0.039)	(0.069)	(0.065)	(0.047)
Worker council (dummy)	0.051***	−0.039**	0.008	0.064***	0.010	0.034***
	(0.012)	(0.018)	(0.013)	(0.012)	(0.012)	(0.007)
Age (years)	0.018***	0.003	0.020***	0.015***	0.027***	0.021***
	(0.001)	(0.008)	(0.002)	(0.001)	(0.006)	(0.002)
$Age^2/100$	−0.021***	−0.023***	−0.025***	−0.017***	−0.029***	−0.025***
	(0.001)	(0.007)	(0.003)	(0.001)	(0.006)	(0.003)
Tenure (days)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tenure^2/100$	−0.000***	−0.000	−0.000***	−0.000***	−0.000	−0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.139***	0.010	0.132***	0.109***	0.002	0.086***
	(0.010)	(0.013)	(0.011)	(0.003)	(0.006)	(0.010)
High-skilled (dummy)	0.334***	0.015	0.282***	0.218***	0.004	0.160***
	(0.018)	(0.053)	(0.021)	(0.014)	(0.013)	(0.021)
R^2	0.536	0.118		0.493	0.188	
Plants	2512	2512	2512	3238	3238	3238
Observations	344930	344930	344930	2692308	2692308	2692308

Standard errors in parentheses clustered at the plant-level in the upper panel and the industry-level in the lower panel, * significant at 10%, ** significant at 5%, *** significant at 1%. All estimations include a full set of region-, sector-, and time-dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table B6: Differential effects according to skill-type? (Details to Table 6, lower panel)

Dependent variable: Logarithm of individual daily wage						
	White collar workers					
	Non-collective agreements			Collective agreements		
	OLS	FE-Spell	RE-Spell	OLS	FE-Spell	RE-Spell
TFP (ln)	0.104***	0.028***	0.049***	0.082***	0.020***	0.044***
	(0.011)	(0.011)	(0.010)	(0.010)	(0.008)	(0.007)
Exports (share)	0.854***	0.022	0.297**	0.974***	0.175**	0.482***
	(0.220)	(0.136)	(0.126)	(0.129)	(0.084)	(0.086)
TFP × Exports	−0.103***	−0.007	−0.038**	−0.110***	−0.020**	−0.055***
	(0.027)	(0.017)	(0.016)	(0.016)	(0.010)	(0.010)
Employment (ln)	0.063***	0.090***	0.073***	0.019***	0.023	0.024***
	(0.005)	(0.024)	(0.006)	(0.004)	(0.026)	(0.004)
Capital intensity (ln)	0.032***	0.048***	0.037***	0.024***	0.045**	0.027***
	(0.005)	(0.019)	(0.006)	(0.004)	(0.023)	(0.005)
Female workers (share)	−0.160***	−0.004	−0.092***	−0.114***	−0.057	−0.108***
	(0.036)	(0.032)	(0.027)	(0.033)	(0.041)	(0.032)
Part-time workers (share)	−0.186***	0.036	−0.095**	−0.225**	−0.064	−0.114**
	(0.058)	(0.036)	(0.047)	(0.094)	(0.087)	(0.054)
Worker council (dummy)	0.036***	−0.010	0.012	0.154***	0.000	0.090***
	(0.013)	(0.015)	(0.012)	(0.019)	(0.008)	(0.016)
Age (years)	0.053***	−0.033*	0.053***	0.061***	0.055***	0.065***
	(0.002)	(0.017)	(0.002)	(0.001)	(0.008)	(0.002)
$Age^2/100$	−0.052***	−0.048***	−0.052***	−0.058***	−0.061***	−0.063***
	(0.002)	(0.006)	(0.003)	(0.001)	(0.006)	(0.002)
Tenure (days)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tenure^2/100$	−0.000***	−0.000	−0.000**	−0.000***	−0.000	−0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.109***	0.014	0.099***	0.108***	0.046***	0.109***
	(0.018)	(0.018)	(0.016)	(0.016)	(0.010)	(0.017)
High-skilled (dummy)	0.376***	0.039	0.353***	0.322***	0.065***	0.316***
	(0.018)	(0.030)	(0.016)	(0.020)	(0.021)	(0.024)
R^2	0.477	0.168		0.479	0.212	
Plants	2246	2246	2246	3046	3046	3046
Observations	146898	146898	146898	1474459	1474459	1474459

Standard errors in parentheses clustered at the plant-level in the upper panel and the industry-level in the lower panel, * significant at 10%, ** significant at 5%, *** significant at 1%. All estimations include a full set of region-, sector-, and time-dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table B7: Firm-level versus industry-level agreements (Details to Table 7, upper panel)

Dependent variable: Logarithm of individual daily wage						
	Firm-level agreement			Industry-level agreement		
	OLS	FE-Spell	RE-Spell	OLS	FE-Spell	RE-Spell
TFP (ln)	0.068***	0.019**	0.039***	0.055***	0.032***	0.043***
	(0.013)	(0.010)	(0.009)	(0.009)	(0.010)	(0.008)
Exports (share)	0.789***	0.129	0.399***	0.347**	0.186	0.248**
	(0.157)	(0.142)	(0.113)	(0.164)	(0.135)	(0.123)
TFP × Exports	−0.089***	−0.017	−0.047***	−0.037*	−0.022	−0.029**
	(0.018)	(0.015)	(0.012)	(0.020)	(0.016)	(0.015)
Employment (ln)	0.044***	0.023	0.046***	0.020***	0.029	0.027***
	(0.004)	(0.034)	(0.005)	(0.004)	(0.033)	(0.005)
Capital intensity (ln)	0.031***	0.025	0.034***	0.024***	0.044	0.026***
	(0.005)	(0.031)	(0.006)	(0.005)	(0.031)	(0.005)
Female workers (share)	−0.374***	−0.005	−0.287***	−0.325***	−0.113**	−0.261***
	(0.055)	(0.074)	(0.046)	(0.034)	(0.051)	(0.031)
Part-time workers (share)	−0.076	−0.027	−0.093	−0.019	0.049	0.026
	(0.101)	(0.109)	(0.074)	(0.066)	(0.102)	(0.052)
Worker council (dummy)	0.058***	−0.011	0.049***	0.092***	0.011	0.048***
	(0.020)	(0.017)	(0.017)	(0.014)	(0.012)	(0.009)
Age (years)	0.023***	0.000	0.025***	0.026***	0.031***	0.031***
	(0.001)	(0.013)	(0.004)	(0.001)	(0.006)	(0.002)
$Age^2/100$	−0.024***	−0.020*	−0.026***	−0.025***	−0.036***	−0.031***
	(0.001)	(0.011)	(0.004)	(0.001)	(0.006)	(0.003)
Tenure (days)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tenure^2/100$	−0.000***	−0.000*	−0.000**	−0.000***	−0.000	−0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.109***	−0.005	0.050***	0.122***	0.003	0.117***
	(0.006)	(0.011)	(0.018)	(0.004)	(0.008)	(0.006)
High-skilled (dummy)	0.298***	0.022	0.224***	0.360***	0.109***	0.383***
	(0.028)	(0.020)	(0.055)	(0.010)	(0.015)	(0.012)
White-collar (dummy)	0.280***	0.060**	0.245***	0.251***	0.077***	0.209***
	(0.016)	(0.023)	(0.006)	(0.008)	(0.010)	(0.009)
R^2	0.685	0.156		0.584	0.206	
Plants	845	845	845	2804	2804	2804
Observations	654761	654761	654761	3512006	3512006	3512006

Standard errors in parentheses clustered at the plant-level in the upper panel and the industry-level in the lower panel, * significant at 10%, ** significant at 5%, *** significant at 1%. All estimations include a full set of region-, sector-, and time-dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

Table B8: Firm-level versus industry-level agreements (Details to Table 7, lower panel)

Dependent variable: Logarithm of individual daily wage						
	Firm-level agreement			Industry-level agreement		
	OLS	FE-Spell	RE-Spell	OLS	FE-Spell	RE-Spell
TFP (ln)	0.109***	0.033	0.070*	0.075***	0.041*	0.050***
	(0.034)	(0.034)	(0.038)	(0.015)	(0.021)	(0.016)
Openness	0.072***	0.032	0.050*	0.032	0.024	0.023
	(0.024)	(0.032)	(0.030)	(0.019)	(0.021)	(0.020)
Openness × TFP	−0.005***	−0.001	−0.003*	−0.003**	−0.001	−0.001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Employment (ln)	0.049***	0.039	0.047***	0.021**	0.026	0.027***
	(0.005)	(0.039)	(0.003)	(0.007)	(0.035)	(0.006)
Capital intensity (ln)	0.031***	0.033	0.033***	0.024***	0.041	0.026***
	(0.005)	(0.034)	(0.008)	(0.005)	(0.038)	(0.004)
Female workers (share)	−0.369***	−0.028	−0.292***	−0.323***	−0.123	−0.263***
	(0.066)	(0.090)	(0.068)	(0.041)	(0.101)	(0.046)
Part-time workers (share)	−0.120	−0.102	−0.155*	−0.028	0.049	0.021
	(0.113)	(0.090)	(0.091)	(0.075)	(0.123)	(0.086)
Worker council (dummy)	0.071***	−0.010	0.052***	0.098***	0.011	0.050***
	(0.013)	(0.024)	(0.015)	(0.026)	(0.017)	(0.014)
Age (years)	0.023***	−0.001	0.024***	0.026***	0.030***	0.031***
	(0.001)	(0.014)	(0.004)	(0.003)	(0.006)	(0.003)
$Age^2/100$	−0.024***	−0.019**	−0.025***	−0.025***	−0.035***	−0.031***
	(0.001)	(0.009)	(0.004)	(0.003)	(0.006)	(0.004)
Tenure (days)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tenure^2/100$	−0.000***	−0.000*	−0.000**	−0.000***	−0.000*	−0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Medium-skilled (dummy)	0.109***	−0.005	0.050*	0.122***	0.002	0.117***
	(0.010)	(0.015)	(0.026)	(0.010)	(0.008)	(0.013)
High-skilled (dummy)	0.299***	0.020	0.223***	0.362***	0.107***	0.384***
	(0.034)	(0.021)	(0.070)	(0.015)	(0.021)	(0.015)
White-collar (dummy)	0.281***	0.059**	0.246***	0.250***	0.076***	0.208***
	(0.015)	(0.025)	(0.011)	(0.015)	(0.007)	(0.017)
R^2	0.684	0.160		0.584	0.210	
Plants	838	838	838	2790	2790	2790
Observations	654524	654524	654524	3510613	3510613	3510613

Standard errors in parentheses clustered at the plant-level in the upper panel and the industry-level in the lower panel, * significant at 10%, ** significant at 5%, *** significant at 1%. All estimations include a full set of region-, sector-, and time-dummies. Total factor productivity (TFP) is constructed following Iranzo et al. (2008). We apply the Levinsohn and Petrin (2003) method to control for unobserved productivity shocks.

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