# Higher wages in exporting firms: self-selection, export effect, or both? First evidence from linked employer-employee data

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# Higher wages in exporting firms: self-selection, export effect, or both? First evidence from linked employer-employee data

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**Abstract** While it is a stylized fact that exporting firms pay higher wages than non-exporting firms, the direction of the link between exporting and wages is less clear. Using a rich set of German linked employer-employee panel data we follow over time plants that start to export. We show that the exporter wage premium does already exist in the years before firms start to export, and that it does not increase in the following years. Higher wages in exporting firms are thus due to self-selection of more productive, better paying firms into export markets; they are not caused by export activities.

**Keywords** Exports · Wages · Exporter wage premium · Germany

**JEL Classifications** F10 · D21 · J31

## 1 Motivation

Exporting firms pay higher wages than firms that serve the national market only. This is one of the stylized facts from the emerging literature on the micro-econometrics of international firm activities. It was pointed out by Bernard and Jensen (1995) in their pioneering *Brookings Paper*, and it has been confirmed in a

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large number of studies (surveyed in Schank et al. 2007) with firm level data from many different countries. Some recent studies using linked employer-employee data have demonstrated that this positive link between export activities and the level of wages paid by a firm can even be found after controlling for observed and unobserved characteristics of both the employer and the employees.[1]

An issue that, to the best of our knowledge, has not been investigated empirically with linked employer-employee data is the sequencing behind the correlation of export activities and higher wages at the firm level. Does exporting lead to a wage premium? Or did exporting firms pay a wage premium even before they started to export? Theoretical considerations point to possible links in both directions that are by no means mutually exclusive:

*Hypothesis 1* (*H1*): *The observed exporter wage premium reflects self-selection of more productive firms with higher wages into export markets*. The recent literature on exporting by heterogeneous firms, pioneered by Melitz (2003) and surveyed by Greenaway and Kneller (2007), argues that only the more productive firms in an industry can bear the extra costs of entering foreign markets. In these models, exporters are more productive than non-exporters, and we observe self-selection of more productive firms into export activities, with the ex ante more productive firms becoming exporters. If wages are higher in more productive firms—due to higher profits and rent-sharing, or because higher (efficiency) wages cause higher productivity (see Akerlof and Yellen 1986)[2]—and if more productive firms self-select into export markets, we expect that these future exporters already paid a wage premium to the workers ex ante, i.e. before they started to export.

[1] See Munch and Skaksen (2008) for Denmark, Alcalá and Hernández (2007) for Spain, and Schank et al. (2007) for Germany. Note, however, that Breau and Rigby (2006) find no wage difference between exporting and non-exporting plants after controlling for worker characteristics for the Los Angeles Consolidated Metropolitan Statistical Area.

[2] Egger and Kreikemeier (2009) develop a model that incorporates workers' fair wage preferences into a general equilibrium framework à la Melitz (2003). They modify the original Akerlof and Yellen (1990) fair-wage effort mechanism by introducing a rent-sharing motive as a determinant of workers' fair-wage preferences, assuming that the wage considered to be fair depends, among others, on the productivity level and thus on the performance of the firm. Identical workers then earn different wages in equilibrium, and higher wages are paid to employees working in more productive firms. They refer to Fehr and Gächter (2000) who point out that the idea of gift exchange which is central to the fair-wage effort hypothesis implies exactly this. The theory of a positive correlation between productivity levels, profits and wages is well in line with empirical findings on rent-sharing in firms, as pointed out by Egger and Kreikemeier (2009). A different approach of introducing efficiency wages into heterogeneous firms models of the Melitz (2003) type is followed by Davis and Harrigan (2007) who argue that heterogeneity in the ability of firms to monitor effort leads to different wages for identical workers in equilibrium, following the variant of the efficiency wage theory put forward by Shapiro and Stiglitz (1984). If export starters are larger than non-exporters in the years before the start, and if monitoring costs are systematically higher in larger firms, this might lead to ex ante wage differentials for identical workers in future export starters and non-exporters. Furthermore, Amiti and Davis (2008) introduce a fair-wage effort model into the Melitz framework and, in addition, provide some evidence for their theoretical hypotheses using Indonesian data. Also notable in this respect is a recent paper by Helpman et al. (2008) which produces wage differentiation across firms in a variant of the Melitz model in which labor market imperfections arise due to search frictions. This model generates a pure exporter wage premium even though productivity stays constant when a firm starts exporting. A similar result can be derived from a recent paper by Egger and Kreikemeier (2008).

*Hypothesis 2* (*H2*): *Exporting makes firms more productive and leads to higher wages*. This hypothesis found in the literature on exports and productivity points to the role of learning-by-exporting (see Bernard and Jensen 1999; Bernard and Wagner 1997; Baldwin and Gu 2003). Knowledge flows from international buyers and competitors help to improve the post-entry performance of export starters (see Crespi et al. 2008). Furthermore, firms participating in international markets are exposed to more intense competition and must improve faster than firms which only sell their products domestically. Exporting thus makes firms more productive. If wages are higher in more productive firms due to higher profits and rent-sharing, we may expect that exporting leads to higher wages. More specifically, this hypothesis predicts that after a firm has started to export, the wages of its employees increase stronger than the wages of employees who work in firms that continue to produce for the national market only, leading to an ex post exporter wage premium.[3]

Mainly due to a lack of suitable data at the level of individuals, these two hypotheses have not been convincingly investigated for wages.[4] Since empirical studies of exporter wage differentials must control for observed and unobserved characteristics of both employers and employees that might determine wages besides exporting, they have to use linked employer-employee (LEE) panel data. To investigate the relevance of both the self-selection hypothesis and the learning-by-exporting hypothesis in explaining exporter wage differentials, LEE data are needed which cover a period that is long enough to follow cohorts of firms over a couple of years before and after they start to export, and which can be used to test for ex ante and ex post wage differentials. Apparently, such LEE data were not available until recently.

Using suitable LEE data for Germany, a leading actor on the world market for goods, this paper contributes to the literature by testing the two hypotheses mentioned above on the direction of the link between exporting and wages.[5] For the period 1994–2006, we show that the exporter wage premium does already exist in the years before firms start to export, and that it does not increase in the years after exporting started. According to our findings, higher wages in exporting firms are due to self-selection of more productive, better paying firms into export markets, but they are not caused by export activities.

[3] Note that profits play a role in both *H1* and *H2*. Profits, however, cannot be directly controlled for in the empirical analysis here due to lack of information in the data. Using German firm level data Fryges and Wagner (2010) find no evidence for self-selection of more profitable enterprises into exporting and a positive but small causal effect of exporting on profits.

[4] In contrast to wages, there is ample empirical evidence on the relationship between productivity and exporting, showing substantial exporter productivity premia and many findings in favor of the self-selection hypothesis but much fewer results in favor of the learning-by-exporting hypothesis. See Wagner (2007) for a survey, and International Study Group on Exports, Productivity (ISGEP) (2008) for recent comparable results for 14 countries.

[5] In contrast to Schank et al. (2007), where the size of the exporter wage premium is estimated using similar data (albeit for a shorter time period), we focus on export starters and the evolution of this wage premium before and after exports start. This allows us to explicitly investigate the direction of the link between exporting and wages and test two alternative hypotheses.

The rest of the paper is organized as follows: Sect. 2 describes the LEE data. Section 3 presents the results of our empirical investigation, and Sect. 4 concludes.

## 2 The German linked employer-employee data

The data set used in the subsequent empirical analyses is the German LIAB, i.e. the linked employer-employee data set of the Institute for Employment Research (Institut für Arbeitsmarkt- und Berufsforschung, IAB). The LIAB combines the Employment Statistics of the German Federal Employment Agency (Bundesagentur für Arbeit) with plant level data from the IAB Establishment Panel. For detailed information on the LIAB, see Alda et al. (2005).

The employee side of our data set is the Employment Statistics, covering all employees and trainees subject to social security. They exclude, among others, the self-employed, family workers, a subgroup of civil servants ("Beamte"), students enrolled in higher education, and those in marginal employment. The employment statistics cover nearly 80% of all employed persons in western Germany and about 85% of employees in eastern Germany. They are collected by the social insurance institutions for their purposes according to a procedure introduced in 1973 and are made available to the Federal Employment Agency. Notifications are prescribed at the beginning and at the end of a person's employment in a plant. In addition, an annual report for each employee is compulsory at the end of a year. Misreporting is legally sanctioned. The employment statistics contain information on an employee's occupation, the occupational status, and gross earnings up to the contribution assessment ceiling,[6] as well as on individual characteristics like sex, age, nationality, and qualification. Each personnel record also contains the establishment identifier, the industry, and the size of the plant.

The employer side of our data set is given by the IAB Establishment Panel, a random sample of establishments that is drawn from a stratified sample of the plants included in the Employment Statistics, where the strata are defined over industries and plant sizes (large plants are oversampled). In 1993, the panel started with 4,265 plants, covering 0.27% of all plants in western Germany (2 million) and 11 percent of total employment (29 million). In 1996, the establishment panel also started in eastern Germany with 4,313 establishments representing 1.1% of all plants (391,000) and 11% of total employment (6 million). The IAB Establishment Panel has been set up for the needs of the Federal Employment Agency to provide further information about the demand side of the labor market. Therefore, detailed information on the composition of the workforce and its development through time constitutes a major part of the questionnaire. Further questions include information on training and further education, wages, working time, business activities, establishment policies, and general information about the plant.

[6] For daily gross wages, the ceiling in 2000, for example, is at € 143.92 for western and at € 118.81 for eastern Germany. In our regression sample, 9.0 (4.5) percent of the wage observations in western (eastern) Germany are censored. In order to cope with a potential bias due to censoring, we also conducted analyses not reported here (but available on request) which show that restricting the sample to uncensored observations does not change our conclusions.

The LIAB is created by linking the Employment Statistics and the IAB Establishment Panel through a plant identifier which is available in both data sets.[7] Because the Employment Statistics is spell-based (one record for each employment spell), the combined data is potentially complex. To simplify, we select all (full-time) workers in the employment statistics who are employed by the surveyed plants on June 30th in a year. This yields an unbalanced annual panel of workers together with detailed information on the plants in which they work, which is unique for Germany. We are able to use the years 1994–2006, and we focus on the private sector. Finally, in order to avoid that the individual level estimates may be driven by a few very large plants we keep only plants which employ less than 1,000 workers in the first year they are observed.[8]

## 3 Empirical investigation

The core of our empirical strategy to test for the validity of the two hypotheses on export activities and higher wages consists in comparing over time wages in plants that start to export with wages in plants that continue to produce for the national market only. We start at a point in time when both groups of plants did not export, and end at a point in time when some of these firms have exported for a while. Using observation periods of 6 years, we define *export starters* as plants that do not export in the first 3 years ($t = 1, 2, 3$), but start to export in year $t = 4$ and continue to export in the years $t = 5$ and $t = 6$; *non-exporters* are plants that do not export in any of the years $t = 1, \ldots, 6$.

### 3.1 Descriptive statistics

Using the LIAB data described in Sect. 2 above, the 6-year windows considered here are 1994–1999, 1995–2000,…, 2001–2006. Data for export starters and non-exporters were pooled over these eight cohorts, and wages and sales were deflated. Table 1 reports descriptive statistics for both groups of plants and each year $t = 1, \ldots, 6$.

Since the design of our investigation requires establishments to be observed in six consecutive years and to show particular patterns of export behavior, the sample available for our empirical investigation reduces to 70 export starters and 3,517 non-exporters. A comparison of plants from both groups with regard to size (number of employees), labor productivity (sales per employee) and wages paid (average daily wage) reveals that export starters are on average larger, more productive, and better paying in each year. Compared to non-exporters, export starters have on average

[7] The LIAB data are confidential but not exclusive. They are available for non-commercial research by visiting the research data center of the German Federal Employment Agency at the IAB in Nuremberg, Germany. Researchers interested in replications or extensions of our work may contact the first author (e-mail: thorsten.schank@wiso.uni-erlangen.de) for a copy of the Stata do-files used to produce the results reported here.

[8] This reduced our regression sample by 4 export starters and 72 non-exporters. When we kept all plants as a robustness check in the sample, the overall picture did not change substantially, but matching became more difficult (results are available upon request).

**Table 1** Descriptive statistics for export starters and non-exporters, all plants

| | Export starters ($N = 70$) Mean | Non-exporters ($N = 3{,}517$) Mean | Prob-value for $H_0$: Diff. of means = 0 |
|---|---|---|---|
| Plant size (number of persons) | | | |
| $t = 1$ | 108.31 | 60.08 | 0.01 |
| $t = 2$ | 107.90 | 59.36 | 0.00 |
| $t = 3$ | 106.93 | 58.47 | 0.00 |
| $t = 4$ | 108.04 | 57.95 | 0.00 |
| $t = 5$ | 110.33 | 56.79 | 0.00 |
| $t = 6$ | 110.52 | 55.63 | 0.00 |
| Yearly sales per employee (in thousands of €) | | | |
| $t = 1$ | 144.66 | 117.56 | 0.27 |
| $t = 2$ | 151.58 | 122.03 | 0.28 |
| $t = 3$ | 129.22 | 119.07 | 0.56 |
| $t = 4$ | 124.29 | 121.13 | 0.83 |
| $t = 5$ | 114.30 | 118.44 | 0.76 |
| $t = 6$ | 136.58 | 124.50 | 0.63 |
| Average daily wage (in €) | | | |
| $t = 1$ | 73.73 | 60.39 | 0.00 |
| $t = 2$ | 73.83 | 60.54 | 0.00 |
| $t = 3$ | 75.42 | 61.22 | 0.00 |
| $t = 4$ | 75.26 | 61.36 | 0.00 |
| $t = 5$ | 74.30 | 60.82 | 0.00 |
| $t = 6$ | 74.24 | 59.85 | 0.00 |
| Growth rates between $t = 3$ and $t = 6$, in % | | | |
| Plant size (number of persons) | 23.48 | −0.63 | 0.20 |
| Yearly sales per employee (in thousands of €) | −0.68 | 7.40 | 0.16 |
| Average daily wage (in €) | −1.77 | −1.52 | 0.84 |

Sample is lower for sales per employee due to missing values. Export starters are plants which do not export in the first 3 years ($t = 1, 2, 3$), but export in the last 3 years ($t = 4, 5, 6$). Non-exporters do not export in any year. Wages and sales are deflated by the aggregate consumer price index. $t = 1,\ldots, 6$ refers to a specific year in the 6-year window a plant is observed. Start (end) years for these windows vary across plants between 1994 (1999) and 2001 (2006)

almost twice the number of employees, and pay wages that are more than 20% higher.

The descriptive statistics reported in Table 1 are in line with the first hypothesis (*H1*) according to which higher wages in exporting firms are due to self-selection of more productive and better paying firms into export markets—labor productivity and daily wages are higher in future export starters compared to non-exporters even in the years before the start (although the difference in average productivity is not statistically significant at any conventional level). In contrast, we find no evidence to support the second hypothesis (*H2*) which argues that exporting increases productivity and thus wages due to learning-by-exporting. Changes in labor productivity and in the daily wage between $t = 3$ and $t = 6$ do not differ in a statistically significant way between export starters and non-exporters.

## 3.2 Plant level regressions

While providing interesting information, the descriptive statistics reported in Table 1 cannot be considered as a basis for a convincing test of the two hypotheses *H1* and *H2*. Since an exporter wage premium is a positive difference between the wages paid to employees in exporting and non-exporting firms after controlling for differences in other variables than exporting that determine wages, the rest of the empirical investigation is concerned with controlling for these influences on wages.

As a first step, we look at the difference in the plant average of daily wages between export starters and non-exporters over time, controlling for plant characteristics that can be expected to be related to the average wage level of a plant (including plant size, the presence or not of a works council, the use of new production technology, location in western or eastern Germany, various measures for the average qualification of the workforce, and dummies for industries, regions, and years). Results based on data for 3,587 plants are reported in column 1 of Table 2.

The coefficient of the exporter starter dummy variable captures any time-invariant (unobserved) differences between export starters and non-exporters and reflects the selection effect into export activity. It shows that the average daily wage paid by export starters is 7.2% higher than in comparable non-exporting plants in $t = 1$, i.e. 3 years before exports start (see row 1 of Table 2). This difference is both statistically significant and of a relevant order of magnitude from an economic point of view.[9] Results reported in column 3 of Table 2 show that the same holds for labor productivity. Controlling for all plant characteristics used in the wage regression, the estimated productivity premium for export starters 3 years before the start is 20.4%. The statistically insignificant coefficients of the interaction terms of the export starter dummy variable and the dummy variables for $t = 2$ to $t = 6$ show that neither the difference in the average wage nor the difference in the average productivity changes over the years $t = 2$ to $t = 6$.

These results are in line with our hypothesis *H1*—plants with higher wages (and a higher productivity) self-select into export markets. Contrary to this, hypothesis *H2*—that wages (and productivity) increase after starting to export due to learning-by-exporting effects—is not supported. All point estimates of the interaction terms of the export starter dummy variable and the dummy variables for $t = 4$ to $t = 6$ are

9 The control variables all have the expected signs, and most of them are statistically significant. Since the focus of this paper is on the exporter wage premium, we do not comment on the results for the control variables here and in other regressions. As a robustness check, we also included average investment per employee as a proxy for the capital stock per head (which reduced the regression sample due to missing information). While the estimated coefficient indicated a positive relationship with wages, the export dummy and the interaction terms of the export starter dummy and the year dummies remained literally unchanged.

very small and statistically not significantly different from zero.[10] These findings are consistent with the results from the descriptive statistics reported in Table 1.

Next, we apply an alternative approach to test for wage (and productivity) enhancing effects of starting to export. This is motivated by the problem that faster wage growth of plants which have just entered the export market (compared to plants that keep selling their products on the domestic market only) would not necessarily reflect a causal effect of exporting on wages. It could well be the case that better paying (and more productive) firms self-select into the export starting group, but would have experienced higher wage growth even without starting to export. However, we cannot observe the latter scenario (i.e. the wage developments of today's export starters if they had not started to export), which is the well-known problem of the missing counterfactual situation.[11]

This closely resembles a situation familiar from the evaluation of active labor market programs (or any other form of treatment of units): If participants, or treated units, are not selected randomly from a population but are selected or self-select according to certain criteria, the effect of a treatment cannot be evaluated by comparing the average performance of the treated and the non-treated. Since each unit (plant or person) either did participate or not, we lack the required information about its performance in the counterfactual situation. A way out is to construct a control group in such a way that every treated unit is matched to an untreated unit that was as similar as possible (ideally, identical) at the time before the treatment. Differences between the two groups (the treated, and the matched non-treated) after the treatment can then be attributed to the treatment (for a comprehensive discussion, see Heckman et al. 1999). The use of a matching approach to search for effects of starting to export on wages (and other dimensions of firm performance, including productivity) has been pioneered by Wagner (2002), and it has been used in a growing number of empirical studies (surveyed in Wagner 2007) ever since.

In the present study, export starters in year $t = 4$ were matched with "statistical twins" from the large group of non-exporters, based on characteristics of the plants in $t = 1$ (3 years before the starters begin to export). Matching was implemented by nearest neighbor propensity score matching.[12] The propensity score was estimated from a probit regression of a dummy variable indicating whether or not a plant is an export starter in year $t = 4$ on a set of variables (all measured at $t = 1$) that are considered as determinants of the probability to start to export and are related to the average wage paid in the firm. Details are given in Table 5 in the "Appendix". The balancing property (which requires an absence of statistically significant differences between the treatment group and the control group in the covariates after matching) is satisfied. The differences in the means of the variables used to compute the

[10] While the insignificance of the interaction terms could be due to the small number of export starters, the very small point estimates found here and in the following regressions should not be a consequence of small sample size.

[11] Although the regression results discussed above do not show a difference in wage growth between export starters and non-exporters, these estimates may be biased due to the self-selection of export starters.

[12] Alternative matching procedures have also been carried out (using three and five nearest neighbors, kernel matching), but the (unreported) results were similar to those discussed in the next section.

**Table 2** Plant level regressions of wages and labor productivity (OLS); Germany

| Dependent variable: | Logarithm of (plant average of) daily wage | | Logarithm of sales per employee | |
|---|---|---|---|---|
| Explanatory variables | Full sample | Matched sample | Full sample | Matched sample |
| Export starter (dummy: 1 = yes) | 0.072 (3.02)*** | 0.041 (1.30) | 0.204 (2.78)*** | 0.120 (1.12) |
| Dummy ($t$ = 2) × export starter | 0.001 (0.12) | −0.005 (0.30) | 0.033 (0.65) | −0.023 (0.34) |
| Dummy ($t$ = 3) × export starter | −0.001 (0.12) | −0.007 (0.34) | −0.009 (0.13) | 0.007 (0.07) |
| Dummy ($t$ = 4) × export starter | 0.004 (0.33) | −0.021 (0.83) | −0.005 (0.08) | 0.007 (0.07) |
| Dummy ($t$ = 5) × export starter | 0.006 (0.41) | −0.012 (0.49) | −0.022 (0.28) | −0.043 (0.41) |
| Dummy ($t$ = 6) × export starter | 0.015 (0.98) | −0.002 (0.08) | 0.035 (0.35) | −0.041 (0.34) |
| Plant size dummies (number of employees; reference: 1–9) | | | | |
| 10–19 | 0.094 (10.48)*** | 0.015 (0.34) | 0.003 (0.10) | −0.249 (1.62) |
| 20–49 | 0.119 (12.08)*** | −0.012 (0.20) | 0.002 (0.07) | −0.254 (1.37) |
| 50–99 | 0.105 (8.78)*** | −0.022 (0.32) | −0.101 (2.54)** | −0.085 (0.43) |
| 100–199 | 0.115 (7.66)*** | −0.036 (0.51) | −0.146 (2.64)*** | −0.442 (2.28)** |
| 200–499 | 0.141 (8.89)*** | 0.006 (0.08) | −0.207 (3.13)*** | −0.139 (0.52) |
| 500–999 | 0.134 (6.22)*** | −0.145 (1.67)* | −0.263 (3.02)*** | −1.228 (3.22)*** |
| 1,000 and more | 0.126 (1.69)* | | 0.135 (0.37) | |
| Works council (dummy: 1 = yes) | 0.098 (9.85)*** | 0.091 (2.65)*** | 0.252 (7.08)*** | 0.216 (1.55) |
| Collective agreement (reference: no collective agreement) | | | | |
| At sectoral level (dummy: 1 = yes) | 0.062 (8.70)*** | 0.027 (0.98) | 0.038 (1.75)* | 0.082 (0.86) |
| At firm level (dummy: 1 = yes) | 0.054 (5.77)*** | 0.055 (2.30)** | 0.040 (1.17) | −0.016 (0.18) |
| Plant belongs to a larger unit (dummy: 1 = yes) | 0.119 (10.15)*** | 0.140 (4.10)*** | 0.363 (8.49)*** | 0.407 (2.87)*** |
| New production technology (dummy: 1 = yes) | 0.047 (8.57)*** | 0.043 (2.54)** | 0.127 (7.37)*** | 0.164 (2.14)** |
| Eastern Germany (dummy: 1 = yes) | −0.257 (9.12)*** | −0.265 (2.66)*** | −0.175 (1.91)* | 0.353 (1.07) |

**Table 2** continued

| Dependent variable: | Logarithm of (plant average of) daily wage | | Logarithm of sales per employee | |
|---|---|---|---|---|
| Explanatory variables | Full sample | Matched sample | Full sample | Matched sample |
| Average age of employees (in years) | 0.001 (0.16) | 0.042 (1.11) | 0.011 (0.71) | 0.072 (0.86) |
| Average age squared (divided by 100) | 0.001 (0.19) | −0.043 (0.93) | −0.019 (0.96) | −0.082 (0.76) |
| Average tenure of employees (in years) | 0.025 (7.86)*** | 0.026 (1.87)* | 0.058 (7.27)*** | 0.092 (1.97)* |
| Average tenure squared (divided by 100) | −0.098 (5.07)*** | −0.141 (2.04)** | −0.236 (5.96)*** | −0.527 (2.26)** |
| Proportion within total workforce of plant | | | | |
| Female workers | −0.310 (16.62)*** | −0.306 (3.59)*** | −0.188 (3.63)*** | −0.738 (3.24)*** |
| Non-German workers | −0.104 (2.41)** | −0.286 (1.95)* | −0.155 (2.02)** | 0.152 (0.37) |
| Workers with apprenticeship, no *Abitur* | 0.100 (3.80)*** | 0.090 (0.84) | 0.139 (1.88)* | −0.046 (0.11) |
| Workers without apprenticeship, with *Abitur* | 0.086 (0.66) | 3.329 (4.05)*** | 0.279 (1.69)* | 5.050 (1.60) |
| Workers with apprenticeship and *Abitur* | 0.323 (5.70)*** | 0.302 (1.39) | 0.325 (2.18)** | −1.038 (1.58) |
| Workers with technical college degree | 0.592 (10.69)*** | 0.406 (2.27)** | 0.825 (4.38)*** | −0.780 (1.28) |
| Workers with university degree | 0.604 (12.28)*** | 0.434 (1.95)* | 0.816 (5.16)*** | 1.183 (1.98)** |
| Workers with unreported education | 0.095 (3.40)*** | 0.116 (1.18) | 0.193 (2.48)** | 0.232 (0.55) |
| Master craftsman, foreman | 0.131 (2.62)*** | 0.658 (2.07)** | −0.032 (0.20) | −0.237 (0.24) |
| Constant | 3.685 (34.39)*** | 2.969 (3.86)*** | 11.143 (37.49)*** | 9.703 (5.09)*** |
| Observations | 21,103 | 708 | 18,342 | 634 |
| Plants | 3,587 | 118 | 3,444 | 118 |
| $R^2$ | 0.63 | 0.85 | 0.45 | 0.75 |

Regressions also include 37 sectoral dummies, 9 urbanisation dummies, 15 regional dummies, 12 year dummies as well as 5 dummies for the respective periods $t$. $|t|$-statistics in parentheses, based on robust standard errors adjusted for clustering at the plant level. ***,**,* denote significance at the level of 1, 5, and 10%, respectively. *Full sample* refers to all observations with no missing values in the covariates. *Matched sample* refers to observations from plants which have been selected via nearest neighbor propensity score matching, where the propensity score has been obtained from a probit on export starting propensity score were never statistically significant between the starters and the matched non-exporters (see Table 6 in the "Appendix"). The common support condition (which requires that the propensity score of a treated observation is neither higher than the maximum nor less than the minimum propensity score of the controls) was imposed by dropping export starters whose propensity score is higher than the maximum or lower than the minimum propensity score of the non-exporters.

This matching approach leads to 59 (out of 70) export starters for which a non-exporting twin-plant could be found. These 59 pairs constitute our so-called matched sample made up of 118 plants. The plant level regressions of average daily wages and of sales per employee discussed above were repeated for data from this matched sample; results are reported in columns 2 and 4 of Table 2. By construction (due to the successful matching) neither wages nor productivity differ significantly between export starters and non-exporting plants in $t = 1$, and the same holds for the other years before the export start in $t = 4$.

In the matched sample, the estimated regression coefficients of the interaction terms of the export starter dummy variable with the dummy variables for the years $t = 4$, $t = 5$ and $t = 6$ turn out to be statistically insignificant at any conventional level in both the wage and the productivity regression. Therefore, in line with the findings from the descriptive statistics reported in Table 1 and from the regressions using the full sample of plants reported in columns 1 and 3 of Table 2, we find no evidence for hypothesis *H2* which argues that exporting increases productivity and thus wages due to learning-by-exporting.

### 3.3 Individual level wage regressions

The plant level estimations presented in Sect. 3.2 may suffer from aggregation bias since individual heterogeneity which influences wages cannot be controlled for. Therefore, we replicate the empirical investigation for wages using data at the individual level, controlling for both observed employer and employee characteristics.[13] Like in the plant level analysis we consider two samples of plants—the full sample of all plants, and the matched sample made up of export starters and matched non-exporters.

Results for the full sample of 3,587 plants and all 242,879 employees, meaning a total of 819,076 observations, are reported in column 1 of Table 3. The estimated coefficient of the export starter dummy variable is positive and highly statistically significant. It is also large from an economic point of view, pointing to an export starter wage differential of 6.9% in $t = 1$ (i.e. 3 years before the start) which does not significantly change in the following 2 years ($t = 2$ and $t = 3$). These results are strongly in favor of hypothesis *H1* according to which higher wages in exporting firms are due to self-selection of better paying firms into export markets.[14]

[13] Due to the lack of information for productivity at the individual level this replication is possible for the wage equations only.

[14] As before, the control variables all have the expected signs, and most of them are statistically significant.

**Table 3** Individual level wage regressions (OLS); all employees; Germany (Dependent variable: logarithm of daily wage)

| Explanatory variables | Full sample | | Matched sample | |
|---|---|---|---|---|
| Export starter (dummy: 1 = yes) | 0.069 (2.37)** | 0.036 (1.54) | −0.028 (1.04) | −0.031 (1.29) |
| Dummy ($t = 2$) × export starter | −0.008 (0.88) | −0.006 (0.70) | −0.020 (1.50) | −0.025 (1.57) |
| Dummy ($t = 3$) × export starter | −0.016 (0.80) | 0.017 (0.77) | 0.001 (0.07) | −0.005 (0.31) |
| Dummy ($t = 4$) × export starter | −0.005 (0.32) | 0.020 (0.95) | −0.006 (0.31) | −0.018 (1.03) |
| Dummy ($t = 5$) × export starter | 0.014 (0.96) | 0.030 (1.25) | −0.018 (0.77) | −0.027 (1.22) |
| Dummy ($t = 6$) × export starter | 0.030 (1.88)* | 0.061 (2.53)** | 0.006 (0.24) | −0.006 (0.35) |
| Logarithm of sales per employee | | 0.095 (11.35)*** | | 0.073 (4.48)*** |
| Plant size dummies (number of employees; reference: 1–9) | | | | |
| 10–19 | 0.100 (4.52)*** | 0.091 (4.64)*** | 0.125 (1.98)** | 0.145 (2.56)** |
| 20–49 | 0.085 (4.92)*** | 0.081 (5.27)*** | 0.131 (2.03)** | 0.131 (2.33)** |
| 50–99 | 0.079 (4.04)*** | 0.076 (4.25)*** | 0.108 (1.60)* | 0.077 (1.32) |
| 100–199 | 0.086 (3.78)*** | 0.085 (4.15)*** | 0.121 (1.79)* | 0.111 (1.93)* |
| 200–499 | 0.112 (4.74)*** | 0.110 (5.24)*** | 0.176 (2.42)** | 0.152 (2.46)** |
| 500–999 | 0.105 (3.80)*** | 0.111 (4.55)*** | −0.001 (0.01) | −0.074 (0.95) |
| 1,000 and more | 0.062 (0.82) | 0.077 (1.37) | | |
| Works council (dummy: 1 = yes) | 0.105 (7.37)*** | 0.076 (5.65)*** | 0.071 (1.78)* | 0.064 (2.14)** |
| Collective agreement (reference: no collective agreement) | | | | |
| At sectoral level (dummy: 1 = yes) | 0.019 (1.35) | 0.022 (1.78)* | 0.005 (0.23) | 0.015 (0.69) |
| At firm level (dummy: 1 = yes) | 0.003 (0.22) | 0.006 (0.46) | 0.001 (0.04) | 0.003 (0.21) |
| Plant belongs to a larger unit (dummy: 1 = yes) | 0.072 (5.79)*** | 0.043 (3.53)*** | 0.096 (3.57)*** | 0.072 (3.21)*** |
| New production technology (dummy: 1 = yes) | 0.037 (4.53)*** | 0.020 (2.70)*** | 0.028 (2.15)** | 0.016 (1.34) |
| Eastern Germany (dummy: 1 = yes) | −0.283 (4.04)*** | −0.277 (4.35)*** | −0.363 (5.05)*** | −0.385 (6.22)*** |
| Age of employee (in years) | 0.026 (29.28)*** | 0.025 (29.19)*** | 0.035 (11.43)*** | 0.035 (11.73)*** |

**Table 3** continued

| Explanatory variables | Full sample | | Matched sample | |
|---|---|---|---|---|
| Age squared (divided by 100) | −0.029 (28.54)*** | −0.027 (27.78)*** | −0.037 (10.56)*** | −0.037 (10.67)*** |
| Tenure of employee (in years) | 0.024 (13.46)*** | 0.022 (15.60)*** | 0.017 (5.52)*** | 0.015 (5.34)*** |
| Tenure squared (divided by 100) | −0.057 (10.13)*** | −0.051 (11.49)*** | −0.033 (3.47)*** | −0.029 (3.05)*** |
| Female (dummy: 1 = yes) | −0.156 (18.10)*** | −0.150 (19.07)*** | −0.155 (9.92)*** | −0.146 (10.22)*** |
| Non-German (dummy: 1 = yes) | −0.074 (7.38)*** | −0.073 (7.28)*** | −0.111 (4.55)*** | −0.111 (4.31)*** |
| Without apprenticeship or *Abitur* (ref. group) | | | | |
| Apprenticeship, no *Abitur* (dummy: 1 = yes) | 0.139 (13.60)*** | 0.136 (14.26)*** | 0.152 (5.87)*** | 0.159 (6.32)*** |
| No apprenticeship, with *Abitur* (dummy: 1 = yes) | 0.181 (7.85)*** | 0.152 (6.49)*** | 0.295 (6.29)*** | 0.300 (6.69)*** |
| Apprenticeship and *Abitur* (dummy: 1 = yes) | 0.335 (26.10)*** | 0.319 (25.53)*** | 0.315 (7.71)*** | 0.315 (7.60)*** |
| Technical college degree (dummy: 1 = yes) | 0.486 (32.35)*** | 0.463 (35.11)*** | 0.474 (16.13)*** | 0.480 (16.74)*** |
| University degree (dummy: 1 = yes) | 0.568 (31.76)*** | 0.534 (34.30)*** | 0.491 (14.21)*** | 0.494 (14.68)*** |
| Education unknown (dummy: 1 = yes) | 0.099 (3.35)*** | 0.111 (4.16)*** | 0.111 (2.53)** | 0.134 (3.36)** |
| Master craftsman, foreman (dummy: 1 = yes) | 0.195 (26.25)*** | 0.193 (26.37)*** | 0.143 (7.77)*** | 0.156 (9.09)*** |
| Constant | 3.165 (41.29)*** | 2.122 (19.78)*** | 3.519 (28.35)*** | 2.726 (13.72)*** |
| Observations | 819,076 | 714,093 | 48,879 | 44,414 |
| Employees | 242,879 | 222,144 | 13,134 | 12,763 |
| Plants | 3,587 | 3,444 | 118 | 118 |
| $R^2$ | 0.580 | 0.607 | 0.601 | 0.620 |

*All employees* comprise *stayers* (workers which work for the respective plant in all 6 years of the data window) as well as employees which join/leave the plant during the observed 6 years. Regressions also include 37 sectoral dummies, 9 urbanisation dummies, 15 regional dummies, 11 year dummies as well as 5 dummies for the respective periods *t*. $|t|$-statistics in parentheses, based on robust standard errors adjusted for clustering at the plant level. ***,**,* denote significance at the level of 1, 5, and 10%, respectively. *Full sample* refers to all observations with no missing values in the covariates. *Matched sample* refers to observations of employees from plants which have been selected via nearest neighbor propensity score matching, where the propensity score has been obtained from a probit on export starting

In contrast, hypothesis *H2* (according to which wages and productivity increase after starting to export due to learning-by-exporting effects) is hardly supported by our data. In the full sample, only the interaction term for $t = 6$ is positive and (albeit weakly) significant, indicating that the wage change of export starters exceeds the wage change of non-exporters by 3%. However, turning to the results of the matched sample (column 3), we do not find any evidence in favor of a wage increase after starting to export because all interaction terms are insignificant.

In order to see whether the covariation between wages and exports differs when conditioning on plant productivity, we have repeated the regressions for the full and the matched sample with the logarithm of sales per employee included as an additional regressor (see columns 2 and 4 of Table 3). While this robustness check does not change the results in the matched sample, in the full sample the magnitude and statistical significance of the export starter dummy is reduced. This is further evidence that the observed export wage premium (largely) reflects self-selection of more productive firms into export markets (as proposed by hypothesis *H1*).

We also take into account that the selection effect only controls for time-invariant differences between export starters and non-exporters and their employees. Any changes in the workforce (due to hirings and separations) are by definition not absorbed by the selection effect. If quitters and joiners are non-random with respect to the introduction of the export activity, we may obtain a biased estimate of our hypothesis *H2*. We control for this by (additionally) looking only at wages of individuals who remain in the respective plant in all 6 years observed (*stayers*), the results of which are reported in Table 4.

The findings for stayers closely resemble those for all employees. We find an export starter wage premium of 5.9% (column 1). However, neither in the estimations based on all plants nor in the regressions including stayers in matched plants only the interaction terms of the export starter dummy and the dummy variables for the years $t = 4$, $t = 5$ and $t = 6$ are ever statistically significant. Higher wages in exporting plants thus do not seem to be induced by export activities.[15]

## 4 Conclusions

Using a rich set of German linked employer-employee panel data, we have demonstrated that the exporter wage premium does already exist in the years before plants start to export, and that it does not increase in the years after exporting started. According to our results, higher wages in exporting plants that are found after controlling for observed and unobserved employer and employee characteristics are due to self-selection of more productive, better paying plants into export markets. This empirical finding is in accordance with the recent theoretical literature on exporting by heterogeneous firms (pioneered by Melitz 2003) which postulates

[15] In a further regression for stayers, we conditioned on covariates fixed at $t = 1$ because one could argue that some observables might themselves respond to the start of the export activity. However, the results of this estimation did not alter our conclusions.

**Table 4** Individual level wage regressions (OLS); stayers only; Germany (Dependent variable: logarithm of daily wage)

| Explanatory variables | Full sample | | Matched sample | |
|---|---|---|---|---|
| Export starter (dummy: 1 = yes) | 0.059 (2.05)** | 0.031 (1.26) | −0.028 (1.03) | −0.036 (1.41) |
| Dummy ($t$ = 2) × export starter | 0.001 (0.20) | −0.011 (0.97) | −0.006 (0.67) | −0.011 (0.96) |
| Dummy ($t$ = 3) × export starter | 0.003 (0.32) | 0.026 (1.26) | 0.006 (0.47) | 0.010 (0.77) |
| Dummy ($t$ = 4) × export starter | 0.006 (0.58) | 0.024 (1.28) | 0.004 (0.31) | −0.002 (0.14) |
| Dummy ($t$ = 5) × export starter | 0.012 (1.09) | 0.019 (0.86) | −0.007 (0.41) | −0.010 (0.56) |
| Dummy ($t$ = 6) × export starter | 0.017 (1.39) | 0.040 (1.56) | 0.001 (0.07) | 0.012 (0.66) |
| Logarithm of sales per employee | | 0.084 (10.02)*** | | 0.072 (4.09)*** |
| Plant size dummies (number of employees; reference: 1–9) | | | | |
| 10–19 | 0.103 (7.76)*** | 0.098 (7.69)*** | 0.119 (1.60)* | 0.124 (1.91)* |
| 20–49 | 0.137 (10.33)*** | 0.134 (10.42)*** | 0.171 (2.22)** | 0.159 (2.31)** |
| 50–99 | 0.135 (8.84)*** | 0.132 (8.92)*** | 0.160 (2.02)** | 0.120 (1.68)* |
| 100–199 | 0.163 (8.90)*** | 0.153 (8.65)*** | 0.177 (2.24)** | 0.152 (2.14)** |
| 200–499 | 0.178 (9.29)*** | 0.167 (9.12)*** | 0.243 (2.91)*** | 0.203 (2.75)*** |
| 500–999 | 0.180 (8.12)*** | 0.173 (8.44)*** | 0.139 (1.41) | 0.152 (1.86)* |
| 1,000 and more | 0.126 (1.87)* | 0.134 (2.63)*** | | |
| Works council (dummy: 1 = yes) | 0.083 (6.06)*** | 0.062 (7.76)*** | 0.046 (1.14) | 0.036 (1.09) |
| Collective agreement (reference: no collective agreement) | | | | |
| At sectoral level (dummy: 1 = yes) | 0.036 (2.54)** | 0.040 (3.21)*** | −0.002 (0.10) | 0.006 (0.29) |
| At firm level (dummy: 1 = yes) | 0.028 (1.75)* | 0.019 (1.21) | −0.011 (0.63) | −0.007 (0.42) |
| Plant belongs to a larger unit (dummy: 1 = yes) | 0.056 (4.04)*** | 0.035 (2.60)*** | 0.091 (3.50)*** | 0.067 (2.91)*** |
| New production technology (dummy: 1 = yes) | 0.030 (4.39)*** | 0.019 (2.99)*** | 0.017 (1.37) | 0.001 (0.12) |
| Eastern Germany (dummy: 1 = yes) | −0.198 (4.26)*** | −0.215 (5.28)*** | −0.259 (3.80)*** | −0.405 (6.26)*** |
| Age of employee (in years) | 0.020 (16.02)*** | 0.019 (16.10)*** | 0.031 (8.70)*** | 0.031 (8.85)*** |

**Table 4** continued

| Explanatory variables | Full sample | | Matched sample | |
|---|---|---|---|---|
| Age squared (divided by 100) | −0.021 (14.92)*** | −0.021 (14.78)*** | −0.033 (8.28)*** | −0.033 (8.27)*** |
| Tenure of employee (in years) | 0.012 (6.10)*** | 0.013 (6.36)*** | 0.018 (5.27)*** | 0.016 (4.75)*** |
| Tenure squared (divided by 100) | −0.019 (3.16)*** | −0.020 (3.42)*** | −0.038 (3.66)*** | −0.033 (3.06)*** |
| Female (dummy: 1 = yes) | −0.149 (17.61)*** | −0.143 (19.09)*** | −0.129 (7.25)*** | −0.129 (7.10)*** |
| Non-German (dummy: 1 = yes) | −0.069 (8.06)*** | −0.070 (8.13)*** | −0.097 (3.58)*** | −0.090 (3.27)*** |
| Without apprenticeship or *Abitur* (ref. group) | | | | |
| Apprenticeship, no *Abitur* (dummy: 1 = yes) | 0.129 (12.58)*** | 0.129 (12.10)*** | 0.160 (6.74)*** | 0.162 (7.30)*** |
| No Apprenticeship, with *Abitur* (dummy: 1 = yes) | 0.255 (10.37)*** | 0.231 (9.01)*** | 0.291 (4.00)*** | 0.307 (4.29)*** |
| Apprenticeship and *Abitur* (dummy: 1 = yes) | 0.323 (21.80)*** | 0.314 (20.53)*** | 0.320 (7.24)*** | 0.316 (7.19)*** |
| Technical college degree (dummy: 1 = yes) | 0.460 (28.60)*** | 0.450 (28.67)*** | 0.488 (16.60)*** | 0.490 (17.88)*** |
| University degree (dummy: 1 = yes) | 0.516 (28.97)*** | 0.497 (29.90)*** | 0.483 (15.28)*** | 0.479 (15.40)*** |
| Education unknown (dummy: 1 = yes) | 0.079 (4.03)*** | 0.096 (5.27)*** | 0.106 (2.09)** | 0.105 (2.33)** |
| Master craftsman, foreman (dummy: 1 = yes) | 0.182 (21.92)*** | 0.180 (21.63)*** | 0.139 (7.27)*** | 0.151 (8.53)*** |
| Constant | 3.218 (54.68)*** | 2.261 (19.73)*** | 3.585 (26.77)*** | 2.835 (13.22)*** |
| Observations | 417,222 | 367,584 | 28,092 | 25,491 |
| Employees | 69,530 | 67,118 | 4,682 | 4,682 |
| Plants | 3,046 | 2,925 | 116 | 116 |
| $R^2$ | 0.568 | 0.588 | 0.622 | 0.630 |

*Stayers are* workers which work for the respective plant in all 6 years of the data window. Regressions also include 37 sectoral dummies, 9 urbanisation dummies, 15 regional dummies, 11 year dummies as well as 5 dummies for the respective periods $t$. $|t|$-statistics in parentheses, based on robust standard errors adjusted for clustering at the plant level. ***,**,* denote significance at the level of 1, 5, and 10%, respectively. *Full sample* refers to all observations with no missing values in the covariates. *Matched sample* refers to observations of employees from plants which have been selected via nearest neighbor propensity score matching, where the propensity score has been obtained from a probit on export starting that only the more productive firms in an industry can bear the extra costs of entering foreign markets.

Our empirical results imply that the so-called exporter wage premium is labeled misleadingly since it may not be caused by export activities. At least in the case of Germany, one of the major exporting countries in the world, exporting does not seem to make firms more productive or lead to higher wages. One may, however, argue that it takes some time before the positive effects of exporting are fully realized, and that the period of 2 years after starting to export observed here is too short for investigating the presence or not of wage effects. Future research that can use data for a longer period will be able to provide empirical evidence on this. Furthermore, it would be interesting to see whether our finding can be replicated for other countries using linked employer-employee panel data. This sort of data provides information that should be tapped more intensively in order to gain additional insights in international firm activities.

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## Appendix

See Tables 5 and 6.

**Table 5** Determinants of export starting, probit estimation; Germany (Dependent variable is a dummy for export starters: 1 = yes)

| Explanatory variables | Coefficient | *Z*-value |
|---|---|---|
| Logarithm of average wage | 1.090 | (2.88)*** |
| Logarithm of total sales per employee | 0.101 | (0.84) |
| Plant size dummies (number of employees; reference: 1–9) | | |
| 10–19 | 0.524 | (1.92)* |
| 20–49 | 0.794 | (2.95)*** |
| 50–99 | 1.112 | (3.54)*** |
| 100–199 | 1.619 | (4.94)*** |
| 200–499 | 1.127 | (2.94)*** |
| 500–999 | 1.291 | (2.48)*** |
| Works council (dummy: 1 = yes) | 0.244 | (1.16) |
| Collective agreement (reference: no collective agreement) | | |
| At sectoral level (dummy: 1 = yes) | −0.276 | (1.48) |
| At firm level (dummy: 1 = yes) | −0.005 | (0.02) |
| Plant belongs to a larger unit (dummy: 1 = yes) | −0.181 | (0.83) |
| New production technology (dummy: 1 = yes) | 0.230 | (1.31) |
| Eastern Germany (dummy: 1 = yes) | 0.532 | (2.33)** |
| Average age of employees (in years) | −0.210 | (1.41) |

**Table 5** continued

| Explanatory variables | Coefficient | *Z*-value |
|---|---|---|
| Average age squared (divided by 100) | 0.278 | (1.50) |
| Average tenure of employees (in years) | 0.031 | (0.45) |
| Average tenure squared (divided by 100) | −0.337 | (0.77) |
| Proportion within total workforce of plant | | |
| Female workers | 0.500 | (1.36) |
| Workers with apprenticeship, no *Abitur* | −0.410 | (1.49) |
| Workers without apprenticeship, with *Abitur* | −0.801 | (0.25) |
| Workers with apprenticeship and *Abitur* | 0.600 | (0.72) |
| Workers with technical college degree | −0.406 | (0.41) |
| Workers with university degree | 0.508 | (0.78) |
| Master craftsman, foreman | −0.564 | (0.36) |
| Constant | −9.682 | (.) |
| Number of plants | 2,329 | |
| $\chi^2$ (52) | 177.10 | *** |
| Pseudo-$R^2$ | 0.310 | |

All covariates dated at $t = 1$. Regressions also include sectoral and year dummies. ***,**,* denote significance at the level of 1, 5, and 10%, respectively. Number of plants is lower than the respective figure reported in Table 2 or 3, since the latter also comprise plants which have missing values in the first year (and thus do not enter the probit regression), but with complete information in at least one of the other years

**Table 6** Mean values of variables for export starters and non-exporters

| Variable[a] | All plants | | | Matched plants | | |
|---|---|---|---|---|---|---|
| | Export starters ($N = 68$)[b] | Non-exporters ($N = 3{,}413$)[b] | *p*-value[c] | Export starters ($N = 59$) | Non-exporters ($N = 59$) | *p*-value[c] |
| Logarithm of average wage | 4.272 | 4.041 | 0.00 | 4.248 | 4.264 | 0.79 |
| Logarithm of total sales per employee | 12.243 | 11.818 | 0.00 | 12.251 | 12.467 | 0.21 |
| Establishment size (number of employees) | 105.60 | 60.03 | 0.00 | 106.70 | 92.42 | 0.57 |
| Works council (dummy: 1 = yes) | 0.471 | 0.214 | 0.00 | 0.441 | 0.458 | 0.86 |
| Collective agreement at the sectoral level (dummy: 1 = yes) | 0.500 | 0.491 | 0.89 | 0.475 | 0.407 | 0.46 |
| Collective agreement at the firm level (dummy: 1 = yes) | 0.103 | 0.098 | 0.90 | 0.119 | 0.169 | 0.44 |
| Plant belongs to a larger unit (dummy: 1 = yes) | 0.191 | 0.126 | 0.18 | 0.186 | 0.186 | 1.00 |

**Table 6** continued

| Variable[a] | All plants | | | Matched plants | | |
|---|---|---|---|---|---|---|
| | Export starters ($N = 68$)[b] | Non-exporters ($N = 3{,}413$)[b] | $p$-value[c] | Export starters ($N = 59$) | Non-exporters ($N = 59$) | $p$-value[c] |
| New production technology (dummy: 1 = yes) | 0.809 | 0.704 | 0.04 | 0.797 | 0.831 | 0.64 |
| Eastern Germany (dummy: 1 = yes) | 0.485 | 0.485 | 1.00 | 0.508 | 0.475 | 0.72 |
| Average age of employees (in years) | 40.208 | 38.630 | 0.01 | 40.119 | 39.889 | 0.79 |
| Average tenure of employees (in years) | 5.640 | 4.833 | 0.06 | 5.625 | 5.789 | 0.79 |
| Proportion within total workforce of plant | | | | | | |
| Female workers | 0.251 | 0.381 | 0.00 | 0.262 | 0.252 | 0.82 |
| Workers with apprenticeship, no *Abitur* | 0.663 | 0.731 | 0.05 | 0.672 | 0.661 | 0.84 |
| Workers without apprenticeship, with *Abitur* | 0.006 | 0.004 | 0.42 | 0.004 | 0.004 | 0.83 |
| Workers with apprenticeship and *Abitur* | 0.034 | 0.024 | 0.26 | 0.036 | 0.034 | 0.84 |
| Workers with technical college degree | 0.042 | 0.023 | 0.07 | 0.038 | 0.036 | 0.88 |
| Workers with university degree | 0.063 | 0.027 | 0.07 | 0.050 | 0.060 | 0.67 |
| Master craftsman, foreman | 0.025 | 0.023 | 0.66 | 0.027 | 0.034 | 0.58 |

[a] Information refers to the first year a plant is observed ($t = 1$), i.e. 3 years before the (potential) export start. Sample may be lower for some variables due to missing values

[b] Numbers differ slightly from those reported in Table 1 (70 resp. 3,517) since the latter also include plants which have missing values in covariates in $t = 1$

[c] Two-sample $t$-test (with unequal variance) of the hypothesis that the difference in the mean is equal to zero

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