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This study uses LIAB QM2 9319 data. The access to the LIAB data was provided via remote data from the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) (Ruf et al., 2021). Additionally, the analysis uses data from the 8th Vintage of the CompNet Dataset provided by the Halle Institute for Economic Research (IWH) Research Centre (CompNet, 2021).

Does skill shortage pay off for nursing staff in Germany? Estimating wage premiums for hiring problems, industrial relations, and profitability with linked-employer-employee data.

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Abstract

This study investigates the impact of hiring problems, industrial relations at the workplace and profitability on compensation and wage premia for nursing staff in Germany. Based on Mincer-type earnings functions and a large linked-employee dataset, regressions with unobserved individual and firm-specific fixed effects are estimated. The econometric analysis shows that firms with staffing problems pay a wage premium of about 4 to 5% for nurses. However, this only holds for firms that do not have a works council and/or are not profitable. Here, the wage premium for staffing is paid at the expense of previous premiums for co-determination at the workplace or rent sharing. These premiums are significantly reduced or eliminated due to better outside options. Overall, the pay increases for nurses in firms with staffing problems. Nevertheless, this does not apply to all skilled workers in Germany.

I. Introduction

Due to the demographic development in aging societies, the nursing sector is gaining importance not only in Germany but in almost all industrialized societies. The World Health Organization (WHO) forecasts a worldwide increase in demand for health and social care workers and the creation of 40 million new jobs by 2030. Professionally trained nurses are, numerically, the largest occupational group of caregivers in most countries and account for about half of the global health care workforce. In 2014, the WHO and the World Bank calculated a global shortage of nine million nurses and midwives (World

Health Organization, 2016). According to data from the German Federal Employment Agency (Bundesagentur für Arbeit, 2021), around 1.7 million employees subject to social security contributions work in nursing and geriatric care in Germany (June 2020). Compared to 2019, this represents an increase of around 40,000 jobs or approximately 2%. Four out of every five employees are female and only 40% of these workers are employed full-time. The share of foreigners among employed caregivers increased from about 7% in 2016 to almost 13% in 2021. This is equivalent to an increase of 108,000 employees to a total of 218,000. Moreover, employees in nursing professions are exposed not only to high physical but also to considerable mental workloads and psychological work demands, reflected in the severe stress experience and health complaints of the nursing staff (Schmucker, 2020).

The labor market for nursing staff is also characterized by above-average wage trends (Carstensen et al., 2020), which is apparently not only the result of increased demand for nursing staff but may be exacerbated by a shortage of trained nursing staff. Analyses by the German Federal Employment Agency (Bundesagentur für Arbeit, 2021) indicate that there is a significant additional demand for skilled nursing staff and based on several factors, such as the vacancy time of open jobs, the jobseeker-job ratio, or the occupation-specific unemployment rate, the tight situation in the labor market for nursing staff becomes clear. These results correspond with findings from international studies (Ariste et al., 2019; Drennan & Ross, 2019; Winter et al., 2020; Xu et al., 2020). Hence, the increased search for workers could also reflect the higher wage offers. In the following, the analysis investigates whether nursing professionals in companies with difficulties filling vacancies receive higher wages than comparable employees in companies without a shortage of skilled workers, all other things being equal. Here, not only the individual characteristics of the employees, but also firm-, industry- and occupation-specific fixed effects are investigated using a large linked-employer-employee panel data set for Germany from 2008 to 2018.

The subsequent study contributes to the existing literature in two ways. First, it can be shown that wage competition can be a common way to fill vacancies, especially in the nursing sector. In addition,

it can be shown that wage premiums do not necessarily add up but are capped by the firms' productivity.

The rest of the study is structured as follows: Section two describes the situation of nursing jobs in Germany, followed by an overview of theoretical and empirical findings on intra-company wage formation and the handling of difficulties in filling vacancies in section two, and hypotheses formulated from these findings. Section three describes the data used in detail and presents the empirical estimation strategy. Section four presents the results of the regressions. A summary concludes the analysis.

II. Stylized Facts, Theory and Review of Literature

In Germany, firms employing nursing staff are finding it increasingly difficult to fill their vacancies. According to analyses by the German Federal Employment Agency (Bundesagentur für Arbeit, 2021), the demand for workers in the care professions is at a high level overall. In a 5-year comparison, the number of reported jobs for care workers in 2020 rose more than twice as fast as the number of jobs overall (+7%). The increase in nursing care for the elderly, at 13%, is significantly lower than that of non-specialized nursing care, at around 28%. In both geriatric and nursing care, most job openings are for trained workers (64 and 77%, respectively). At the same time, however, only 10% of the unemployed in geriatric care and 45% in nursing have qualifications as trained caregivers. For geriatric care, 100 vacancies reported to the Federal Employment Agency in 2020 were matched by just 26 unemployed people. In 2014, 100 vacancies were matched by 38 unemployed people, and in the year before the Corona pandemic, there were only half as many. Similarly, in the nursing sector, an average of 100 vacancies were matched by 47 unemployed nurse specialists in 2020. From 2014 to 2019, the ratio fell from 80 to 39 unemployed persons per 100 vacancies. Compared to all employees in Germany, trained nurses earn marginally more than an average skilled worker in 2019 (3,547 vs. 3,401 euros per month). By contrast, skilled workers in geriatric care earn significantly less on average, at 3,032 euros per month. Between 2012 and 2019, the remuneration in geriatric care and nursing

increased by 27.8% and 19.9% compared to the remuneration of all full-time employees, which increased by 18.3% in the same period (Carstensen et al., 2020).

In principle, besides higher wage offers (e.g., Banfi & Villena-Roldan, 2019; Kaas & Kircher, 2015; Marinescu & Wolthoff, 2020; Schaal, 2017), there are other ways to fill a vacancy (faster). For example, the firm could increase its search intensity (e.g., Gavazza et al., 2018; Leduc & Liu, 2020), substitute capital for labor if production capabilities allow it to replace factors of production that have become relatively expensive with relatively cheaper ones (e.g., Andrews et al., 2008; Ehrenfried & Holzner, 2019). Further, the position could be filled by a worker who does not (yet) have the necessary skills to fill the position (Barron et al., 1997; Brenčič, 2010; Lochner et al., 2021; Sedláček, 2014). All options are more likely to be long-term and associated with lower productivity or higher costs. There are additional search, training and/or adjustment costs. Another option is to stop systematically searching for a suitable candidate and leave the position open. In particular, this leads to opportunity costs from the lost profit from the position. In the short run, with other things being equal, wage competition is probably the fastest way for a firm to fill a vacancy.

Intra-firm wage formation is usually based on various factors (Cahuc et al., 2014, 287pp.). However, in general, the worker's reservation wage rate and his marginal productivity for the firm can be identified as the lower and upper limits of pay. A wage rate lower than the reservation wage rate is not accepted by workers and they reject such a job offer. An average wage rate above marginal productivity will not be offered by the firm, even if the firm operates in imperfect product markets and shares the accruing profits with the employed.

The wage rate agreed upon depends on the negotiating skills or bargaining power of employers and employees. If there are more applications than vacancies, the individual bargaining power will be low, and the companies can try to employ the workers at the individual reservation wage rate (Cahuc et al., 2006). Intra-firm wage differentials thus arise solely from individually varying reservation wages and experience if there is no established pay for workers (cf. Hornstein et al., 2011). The workers'

bargaining power can increase if, for example, they can form unions and enforce collective wage bargaining, and if the bargaining power is strong, the wage rate can be equal to the marginal product (Cahuc et al., 2014, 435pp.). In Germany, in the context of industrial relations, besides trade unions negotiating collective agreements at the company and supra-company level, there is also a strong position of works councils negotiation, particularly for working conditions at the local level (cf. Addison et al., 2017; Oberfichtner & Schnabel, 2019). The Works Constitution Act provides that works councils can be established to represent employees' interests in all establishments that exceed a size threshold of five permanent employees. The size of the works council is set by law and increases with the number of employees in a company. Works councils have extensive information (on all matters related to the performance of their statutory duties) and consultation rights (e.g., on planned structural changes in the company and on personnel planning), as required by law. In addition, German works councils have co-determination rights regarding pay regulations, occupational health and safety measures, and the regulation of working hours. Unlike unions, they are not allowed to call strikes and are also precluded from reaching agreements with employers on wages or working conditions, which are normally governed by collective agreements between unions and employers' associations at the industry or firm level.

Unions and works councils create collective bargaining power, but not individual bargaining power. This seems to arise only when employees have a fallback position through job offers and wage posting that is better than the current pay in the company (Abowd et al., 1999; Burdett & Mortensen, 1998). Such a situation also arises, especially when the labor market is tight (Brenzel et al., 2014). Considering a model in which such an on-the-job search for a new job is allowed and the employer can respond with a counteroffer (Cahuc et al., 2006; Dey & Flinn, 2005; Postel–Vinay & Robin, 2002), the workers' fallback position improves significantly, and they can negotiate a significant wage premium due to the shortage of skilled workers. Cahuc et al. (2006) describe a sorting process triggered by wage competition where the most productive firms pay the highest wages to the most productive workers, which could lead to higher wages being paid not because of a shortage of skilled workers but because

of the productivity of the worker in each firm. Therefore, the independent effect of the shortage of skilled workers in wage formation may not be identified. Consequently, firms with low productivity will not be able to fill their vacancies and keep up with wage competition (Abowd et al., 1999; Cahuc et al., 2006), , and may complain that wages are too high (Leifels, 2018). This leads to the following hypothesis:

i. Nurses in firms that have problems filling vacancies have a better bargaining position and therefore receive higher wages than in firms without hiring problems.

A number of studies support the positive effects of firms' profits (e.g., Card et al., 2018), collective bargaining agreements (e.g., Bryson, 2014), and works councils (e.g., Addison et al., 2010) on earnings. However, due to sorting processes where firms pay higher wages to highly productive workers, newer studies for Germany suggest that a wage premium is not always established in companies bound by collective agreements, even though the companies pay a significantly higher average wage compared to non-bound companies (Hirsch & Mueller, 2020; Mueller & Neuschaeffer, 2021). In Germany, the care sector is bound by collective agreements that focus on both working conditions and wages. Reference can be made here to the regulation of Sunday work in the collective agreements regarding Employees in municipal hospitals, long-term care, and other public care facilities[1], which applies to more than 500,000 care workers in Germany. According to this collective agreement, employees who are required to work on Sundays and public holidays shall receive two days off within a two-week period. One of these days off shall fall on a Sunday, which means in fact at least every second Sunday should be free. The minimum legal regulations in the German Working Hours Act only require that 15 Sundays should not be for work[2]. Another example is the strikes at university hospitals in the German state of North Rhine-Westphalia in the summer of 2022. These lasted 11 weeks and were the longest in the history of collective bargaining in this sector, and the negotiations were mainly about better

[1] The collective agreement is called TVöD-B; https://www.vka.de/tarifvertraege-und-richtlinien/tarifvertraege/tvoed

[2] Arbeitszeitgesetz (ArbZG), https://www.gesetze-im-internet.de/arbzg/BJNR117100994.html

working conditions rather than pay increases[3]. On the other hand, firms' revenue and productivity is often limited through flat rate per case payments in hospitals and care rates in nursing homes according to the rules of the German social health respectively nursing insurance (Brücher & Deufert, 2019). Moreover, only 38.5% (2020) of the hospitals and 43% (2022) of the nursing facilities are profit-oriented or run by private owners[4]. A considerable proportion of are operated by religious communities or non-profit institutions, which may have different pay policies. Although these are then not-for-profit operations, remuneration through flat rates per case and nursing rates leads to high cost pressure on the entities (Greer et al., 2013). Nevertheless, it is useful to check whether the results differ for non-profit enterprises. Based on these arguments, one can formulate the following hypothesis:

ii. Establishments with a works council pay higher wages to nurses than other entities.

Since the total wage premium is capped by marginal productivity in the company, it may also be the case that a premium paid to employees in companies complaining about a shortage of skilled workers is offset against or replaces other wage-increasing factors (Kölling, 2022). Since the "union rent" is defined as the product of the collective bargaining power and the difference between marginal productivity and the reservation wage, respectively, the outside wage offers, an increase in the reservation wage through a better individual bargaining power would decrease the "union rent" for a given collective bargaining power (Cahuc et al., 2014, 427):

(1) $r_{union} = \beta(mp_l - w^o)$,

with r_{union} as the "union rent", β as the collective bargaining power created by unions and works councils, mp_l as the marginal productivity of labor, and w^o as the wage offer from other firms. This supports observations that the union wage premium develops countercyclically assuming that the

[3] Press release of the Ministry of Labor, Health and Social Affairs of the State of North Rhine-Westphalia from July 19, 2022, https://www.mags.nrw/pressemitteilung/land-begruesst-tarifeinigung-unikliniken-entlastung-fuer-pflegekraefte-wird

[4] https://www.pflegemarkt.com/2016/10/28/anzahl-und-statistik-der-altenheime-in-deutschland/ Destatis (2022): Fachserie 12, Reihe 6.1.1

individual negotiating position deteriorates in a recession and vice versa (Blanchflower & Bryson, 2004; Bratsberg & Ragan Jr, 2002). This argument can also be applied analogously to individually paid bonuses that are not negotiated within the framework of collective agreements, e.g., some kind of voluntary rent sharing. The mark-up on wages decreases if better outside opportunities occur. Therefore, based on the theoretical considerations and the evaluation of the existing literature, the following hypothesis can now be derived:

iii. Wage premiums for a works council or rent sharing decrease when firms like to fill vacancies increasing the nurses' salaries.

III. Data and Empirical Model

The analysis uses linked employer-employee data (LIAB) from the Institute for Employment Research of the Federal Labor Agency, Nuremberg, Germany (Version: LIAB QM 9319), which combines individual data from the official labor statistics data and the IAB-Establishment Panel survey establishment data (Ruf et al., 2021). In addition, aggregate data from the Competitiveness Research Network were used in the regressions (CompNet, 2021).

The establishment data is a sample based on all German establishments with at least one employee subject to social insurance contributions. The Institute for Employment Research began collecting these data in 1993 (West Germany) and 1996 (former East Germany), respectively. The dataset was created to meet the needs of the Federal Employment Agency for improved information regarding the demand side of the labor market based on a stratified random sample. The current strata include 16 industries, 10 employment size classes, and 16 regions (the Bundesländer) for all German establishments with at least one employee covered by social insurance. A detailed description of the data is found in Bellmann et al. (2021).

The administrative data on employees come from the Integrated Employment Biographies (IEB) of the IAB. The IEB contains data on all employed individuals who were subject to social insurance in Germany, marginally employed in Germany (since 1999), received unemployment or basic social

allowances, registered as a jobseeker with the Federal Employment, or participated in labor market policy programs. The IAB Establishment Panel is the starting point for drawing the personal data of the LIAB QM2 9319. First, the establishments are selected from the IAB Establishment Panel with a valid survey in the respective year (1993 to 2019). Then, all persons are drawn from the IEB who were employed in one of these establishments for at least one day on June 30 of the respective survey year. For these individuals, a third step provides all employment histories, including June 30 of the survey year. LIAB QM2 9319 thus includes survey data on all establishments surveyed in the IAB Establishment Panel and of all their employees and contains information of 13,077,307 individuals between 1993 and 2019. For the purposes here, the period is reduced from 2008 to 2018 as some information in the IAB establishment panel is collected since then, and other data only until 2018 (CompNet, 2021). The data used here includes data from all establishments sizes and industries.

Since this analysis focus on nursing staff, only observations on relevant occupations are used for the empirical investigation. These can be identified using the official German occupational classification ("Klassifikation der Berufe" KldB 2010, Paulus & Matthes, 2013). The KldB 2010 is compatible with the international occupational classification (ISCO-08) and takes into account the pronounced occupation-specific structuring of the German labor market. A list of the occupations considered in the estimates is provided in the appendix. Please note that the nursing staff observed in the analysis work in professions that require vocational training in Germany but generally do not require a university degree. Unfortunately, the data does not contain any information on weekly working hours. There is only a variable whether the employee is employed part-time or full-time. Since the extent of part-time employment is not known and varies from establishment to establishment, it is difficult to use the data for pay purposes. Therefore, although approximately 60% of Nurses in Germany are employed part-time, the analysis is limited to full-time Nurses. The appendix contains is a descriptive analysis that shows the differences between the two groups in the data (Table A.5). It seems as if nurses working part-time are older and have a higher experience, while the share with a upper secondary school

degree is lower. Not surprisingly, the proportion of female caregivers is greater among part-time workers than among full-time workers.

Moreover, the LIAB data contains information about the mean daily remuneration of employees. The variable includes special payments, such as holiday pay or 13th monthly salary, but only contains values up to the upper earnings limit for statutory pension insurance contributions. This means that some of the data is censored. However, in the data used here, this applies to less than 0.3% of the observations making it negligible for the wage of nurses. To make the data comparable, only information from full-time employees is used, and the values were discounted using the producer price index. The logarithm of the wage information is used as an endogenous variable.

A number of covariates on the firm level come from the IAB Establishment Panel. An important exogenous variable concerns hiring problems. Establishments in the establishment panel were asked whether they had difficulties filling vacancies. From this information, two dummy variables can be derived. The first dummy variable becomes 1 (and 0 otherwise) if the firm has general problems hiring enough workers, while the second becomes 1 if this applies to skilled workers. Since the results for the two variables differ in only a few areas, the multivariate analyses below focus on general problems with job hiring.

[Table 1 near here]

Table 1 shows the importance of hiring problems in firms employing nurses. In 2008 31% of these firms reported a general hiring problem, while 26.6% express problems to hire skilled workers. Unfortunately, the information refers to the entire firms' workforce, not just the nursing staff. No consistent development emerges during the period of the Great Recession. Since 2013, however, the values have been rising steadily, peaking in 2018 with a share of 0.561 for general staffing problems. The proportion of establishments with problems finding skilled workers rises to 0.502. Although the significance of hiring problems continues to increase over the observation period, not all firms are permanently affected by these problems. According to table 2, the share of firms affected by general

staffing problems for at least 1 year is about 0.407. The share of firms that consistently report such problems for at least 4 years is 0.153. For the remainder, this problem does not appear to be permanent. A similar pattern emerges in the case of problems filling vacancies for skilled workers. Here, the values are 0.357 and 0.129, respectively, which also suggests a share of about 40% of the establishments where the problem occurs on a very long-term basis. This could be an indication that at least some companies are successfully using strategies to combat the shortage of skilled workers.

[Table 2 near here]

The descriptive statistics in Table 3 show that establishments with problems filling vacancies pay lower wages on average, which means that low wages are probably a reason for unfilled open positions. If so, this variable would be endogenous and cannot be used as an exogenous variable in the analysis. Therefore, to solve this problem in the multivariate regressions, we use the information lagged by one year for the establishments where the nurse is actually working rather than the current value. A positive effect of the lagged unsatisfied need for skilled workers on wages could thus be interpreted as a reaction to the shortage of skilled workers.

[Table 3 near here]

Of course, a dummy variable is only a rough measure of a shortage of skilled workers. A variable that indicates how long it takes to fill a vacancy or how many vacancies cannot be filled after a certain period would be much more meaningful. Such information is contained, for example, in the IAB Job Vacancy Survey (Bossler et al., 2022). However, a lot of further company-specific information is missing here, e.g. on works councils or collective agreements. Therefore, the data from the Establishment Panel are used in the following, although the information on vacancies may be less precise.

Moreover, the dataset provides information on industrial relations existing at the establishment level. In addition to using industrial and company collective agreements, establishments also stated the existence of works councils. Three dummy variables are derived from this information. Table 3 shows that in establishments with a collective bargaining agreement or with a works council, wages are paid

at a significantly higher rate than those without a collective bargaining agreement or a works council. However, it is not clear from the descriptive analysis whether this is actually a premium due to the existence of works councils respectively collective bargaining agreements or a sorting process by which more productive workers work in these establishments. The information about profitability, the state of machinery, and competition is based on self-reporting by the companies in the establishment survey, which was prepared either as ordinal scales (profitability: high, average, low / state of machinery: state-of-the-art, average, outdated) or as a dummy (strong competition: 1, otherwise: 0). The estimation outcomes of the variable indicating profitability is probably related to rent sharing. If the empirical model controls for other reasons like a higher productivity and the impact of profitability on payments is positive, we can assume that the source of higher payments is associated with higher profits. However, the descriptive statistics in table 3 hardly indicate any differences in compensation. To identify the differences between establishments with and without problems hiring suitable staff, all the previous variables are multiplied by the corresponding dummy described above and included in the estimation as interaction variables.

Moreover, the regressions used aggregate data about the constitution of the goods and labor market. The Competitiveness Research Network (CompNet) provides information on the Hirschmen-Herfindahl index at a 2-digit industry level or regional NUTS2 level, which depicts the concentration on the goods market (CompNet, 2021). For each establishment, a corresponding concentration measure is calculated as the average of the industry and regional information. A measure of labor market power is derived in the CompNet data as the relation of markups of firms' labor input decision to firms' intermediate input decision (Dobbelaere & Mairesse, 2013; Mertens, 2022). This indicator is also available at the mentioned regional and industrial levels. Again, the mean of both is calculated for each establishment. The Hirschman-Herfindahl-Index and logarithm of the measure of labor market power are used as additional covariates in the regressions.

The estimates are based on a Mincer-type income function. Therefore, in addition to the age, work, occupational, and business experience are included as exogenous information in the regressions.

Besides the levels of these variables, squared values are also used. Moreover, the number of employees in the establishment, the age of the establishment, the share of non-EU foreigners and college graduates, and dummies for whether the observed nurse is German, whether the firm is foreign-owned and whether it is a single-establishment firm are included in the estimates. Separate parameters for women and men and employed persons with and without upper secondary school degrees ("Abitur" or "Fachabitur") are estimated by interactions with specific dummies for the variables mentioned in this paragraph. Finally, the model control for individual, occupational, firm, industrial, local (Nuts3, "Kreis"), and time (year) specific heterogeneities. Therefore, the estimation model becomes:

$$(2)\quad \ln(w_{it}) = \alpha + \beta_i hp_{it} \cdot \left(\sum_m X_{imt} \right) + \gamma_i Z_{it} + \sum_k e_k ,$$

with w as wages, hp as a dummy for hiring problems variables, X as m covariates interacted with hp, Z as other covariates, and e_k as k unobserved heterogeneities corresponding to the previously described variables, including individual and temporal fixed effects. The i indicate the observed individuals, while t specifies the years of observation. β, and γ are the estimated parameters and α is the constant of the model.

IV. Results

Table 4 contains the results of the estimated models. The estimations control for multi-way fixed effects considering several unobserved heterogeneities on the individual and establishment level[5] and the standard errors are robust to heteroskedasticity and serial correlation of the individual data[6]. Since the main aim is to describe the effects of hiring problems on remuneration, the table does not contain the estimated parameters but the corresponding marginal effects for establishments with or without problems in filling vacancies. Significances are shown for the marginal effects in each case. The gray shaded cells indicate the statistically confirmed differences in outcomes in firms with and without

[5] The regressions apply stata's "reghdfe" procedure to control for multi-way fixed effects (Correia, 2019).
[6] Stata's "cluster()" option is used in the regression.

unfilled vacancies on a 5%-level. This is tested using the estimated parameters for the interaction variables of the empirical model. Three different versions of the model are presented. The first two columns (model a) contain the results for the entire nursing workforce of German firms, while model b restricts this sample to for-profit firms. A significant proportion of nursing facilities and hospitals are operated by religious communities or non-profit institutions, which may have different pay policies. As a proof to the previous, the last two columns (model c) describe the results for all employees in Germany, who generally require training but not a university degree for their tasks at work. (Occupations at skill level 2 of the occupational classification ISCO-08). The situation in the nursing sector is probably not comparable to the staffing problems in other industries and will therefore be contrasted with estimates using a more general sample.

[Table 4 near here]

There are only a few differences in the estimates relating to the remuneration of nursing staff in models a and b. Establishments that already complained of staffing problems in the previous year pay a wage premium of 4% to 5% depending whether one considers only significant or all relevant parameters.[7] Although the descriptive statistics indicate otherwise (Table 3), collective bargaining agreements have a significantly negative impact on the pay of nursing staff in both types of establishments. This thus confirms the results of previous analyses (Hirsch & Mueller, 2020; Mueller & Neuschaeffer, 2021). This negative effect becomes even more significant when unfilled demand for staff occurs. Although the effects now become significant for firm-level collective bargaining agreements, the differences between companies without a shortage of skilled personnel are not statistically significant for all forms of collective bargaining agreements. The situation is different for works councils. Here, we find a wage premium of 2.1% for all care workers and 2.9% for nurses in

[7] Estimations of models with unlagged variables for unfilled positions always show insignificant outcomes. This probably indicates that paying higher wages to nurses can solve these staffing problems. Please see table A.6 in the appendix.

profit-oriented companies. Again, the wage premium decreases when shortages of skilled workers occur, and the effect becomes insignificant when all firms with care workers are considered.

In for profit firms without problems filling their vacancies (model b), employees may experience some kind of rent sharing. The compensation increases by more than 3% in establishments that describe themselves as highly profitable while in establishments with average profitability, the wage premium is almost 2.5%. In establishments with shortage of skilled workers, these premiums almost vanish, and the parameters are insignificant or close to zero. Even more so than in the case of the works council, rent sharing seems to be replaced by a premium for scarce skilled labor.

Comparing the results for nurses with all trained professionals without a university degree reveals the differences. Due to the much higher number of cases, the calculated values should be much more precise. The estimated parameters are remarkably smaller, indicating greater heterogeneity of the sample. In addition, many of the estimated values and differences are statistically significant, which could possibly be attributed to the very large sample (over 2.1 mill. observations). The premium paid by firms for skilled labor shortages is only one-tenth of the value paid in nursing occupations. Although the wages of skilled workers are only increasing by less than 1%, collective bargaining agreements are now having a positive effect on wages, contrary to previous estimates for care workers. The differences between companies with and without a shortage of skilled workers are significant but also very small, so one should be cautious about interpreting them. The same applies to works councils. For the other variables, the results are basically the same as for the wage of nurses. Therefore, looking carefully at these results, the situation in the nursing sector seems unique and not comparable to the staffing problems in other industries.

The results for variables not reported in the table, especially information about the age and work experience, or their squared values, which are typical for wage estimates, are in line with expectations and do not show any other peculiarities. Comparing the results with the previously stated hypotheses, we can note the following:

First, establishments with staffing problems pay nurses a wage premium of about 4 to 5%, indicating that hypothesis i is supported. However, this situation for nurses cannot be generalized to all occupations with a shortage of skilled workers.

Second, establishments with a works council pay higher wages than those without a works council. This is in line with previous results in the literature, appearing that the rights to negotiate pay structures and payments above formal wage schedules set under collective bargaining are being used (Addison et al., 2010). Therefore, hypothesis ii becomes valid.

Finally, the payment of a premium seems to "offset" the payment of previous wage premiums when skilled labor shortages exist. In particular, the bonuses paid by the existence of a works council and those paid in firms with higher profitability are significantly lower or are no longer paid at all. This means that other companies without works councils or with low profitability have to raise their pay significantly. Assuming that a positive impact of profitability on wages is associated with rent sharing, then firms with profit-sharing benefit because they have already paid a higher wage before and, accordingly, do not have to adjust their pay as much. This conclusion then also applies to companies with a works council and is consistent with hypothesis iii.

V. Summary

This study examines the impact of skill shortages on the wages of nurses in Germany. To this end, a Linked Employer-Employee dataset from 2008 to 2018 is used to estimate the Mincer-type wage equations for trained nurses without a university degree that account for the unobserved individual-, occupation-, and firm-specific heterogeneities. The results of the regressions suggest that firms with hiring problems pay a wage premium of about 4 to 5% for educated nurses, while firms without hiring difficulties pay 2% to 3% higher wages if a works council exists in the firm. In addition, a similar wage premium is granted if the company has very high profitability, which is assumed to indicate rent sharing. In firms with hiring problems, these wage premiums are largely eliminated, i.e., the wage premium to hire staff for unfilled vacancies is paid at the cost of rent sharing and/or the rent of worker

co-determination at the workplace. Hence, companies that do not have a works council or have low profitability have to increase their wages significantly more to fill vacancies. In this respect, it is not possible to reject the three hypotheses introduced in the text.

In terms of economic policy, it can be concluded that shortages of skilled workers and related complaints about excessively high wages (Leifels, 2018) are particularly voiced by firms that already pay low wages or have low productivity. Here, the question arises whether economic policy interventions that help these firms fill vacancies may not lead to higher labor market efficiency since the allocation of care workers to the most productive firms is thereby prevented. Although we have seen strong wage growth for nurses in Germany in recent years, the situation in the German nursing sector is very specific, and government regulation of compensation through social security for hospitals and nursing homes, as well as statutory employment standards, probably constrain employers in paying higher wages.

As a caveat, it is important to note that the results cannot necessarily be generalized, as only very small effects can be estimated for all workers with a comparable skill level, and some of these effects are opposite. Another limitation is establishments only generally report problems with filling vacancies. While it seems obvious that establishments in the care sector are particularly in need of care workers, this conclusion cannot be drawn directly from the data. In addition, only full-time employees are included in the analysis, although the majority of employees work part-time. It, therefore, seems necessary to repeat the study for other sectors that frequently complained about shortages of skilled workers.

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Tables

Table 1: Share of firms with nursing staff reporting hiring problems (Mean, standard deviation and observations)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Hiring problems	0.310 (0.463, 748)	0.300 (0.459, 730)	0.350 (0.477, 677)	0.371 (0.483, 761)	0.369 (0.483, 871)	0.321 (0.467, 860)	0.364 (0.481, 873)	0.422 (0.494, 842)	0.469 (0.499, 848)	0.550 (0.498, 863)	0.561 (0.497, 888)
Hiring problems with skilled labor	0.266 (0.442, 748)	0.268 (0.443, 730)	0.307 (0.462, 677)	0.330 (0.470, 761)	0.317 (0.466, 871)	0.286 (0.452, 860)	0.304 (0.460, 873)	0.348 (0.477, 842)	0.423 (0.494, 848)	0.496 (0.500, 863)	0.502 (0.500, 888)

Source: LIAB 2008 – 2018. Mean of daily remuneration, standard deviation, and number of firms in parenthesis.

Table 2: Share of firms with nursing staff reporting hiring problems in consecutive years.

	Number of years			
	1	2	3	4
Hiring problems	0.407 (0.491, 10,583)	0.273 (0.445, 6,839)	0.204 (0.403, 4,687)	0.153 (0.360, 3.285)
Hiring problems with skilled labor	0.357 (0.479, 10,583)	0.235 (0.424, 6,839)	0.173 (0.378, 4,687)	0.129 (0.335, 3.285)

Source: LIAB 2008 – 2018. Mean of daily remuneration, standard deviation, and number of firms in parenthesis.

Table 3: Average daily remuneration for nursing staff in Germany 2008 – 2018 (Mean, standard deviation and observations)

Variable	All nurses		Nurses in for profit firms		All employees with qualified job tasks (usually without degree from university)	
	Existent	Not existent	Existent	Not existent	Existent	Not existent
Hiring problems	84.539 (33.043, 56,926)	89.664 (34.775, 29,539)	84.558 (33.000, 48,584)	86.890 (32.428, 19,730)	98.477 (41.050, 682,190)	104.207 (40.925, 2,091,165)
Hiring problems with skilled labor	84.228 (33.033, 53,357)	89.613 (34.572, 33,108)	84.488 (32.932, 46,716)	86.840 (32.624, 21,598)	98.862 (41.190, 588,455)	103.858 (40.922, 2,184,900)
Collective bargaining agreement	88.273 (34.565, 70,822)	77.279 (27.953, 15,702)	87.230 (33.850, 54,046)	77.625 (27.477, 14,308)	109.814 (40.017, 2,105,384)	80.933 (36.167, 676,388)
Works Council	88.278 (33.418, 73,058)	75.427 (33.345, 13,466)	86.471 (32.864, 59,050)	77.275 (31.647, 9,304)	110.075 (39.531, 2,218,190)	74.123 (33.594, 563,582)
High competition	86.083 (33.449, 32,896)	86.398 (33.900, 53,628)	84.900 (31.928, 29,164)	85.457 (33.523, 39,190)	105.785 (42.066, 1,501,924)	99.279 (39.495, 1,279,848)
State-of-the art machinery	86.604 (33.373, 9,824)	86.236 (33.775, 76,700)	82.870 (28.718, 8,256)	85.542 (33.368, 60,098)	113.300 (43.221, 707,091)	99.210 (39.626, 207,4681)
Highly profitable	85.683 (34.388, 45,677)	86.944 (32.966, 40,847)	84.446 (33.905, 38,431)	86.212 (31.423, 29,923)	105.560 (41.729, 1,498,643)	99.558 (39.959, 1,283,129)

Source: LIAB 2008 – 2018. Mean of daily remuneration, standard deviation, and number of observed employees in parenthesis.

Table 4: Marginal effects of wage regressions for nursing staff in Germany (Fixed effects regression, 2008 – 2018)

Variables	(a) All Nurses		(b) Nurses in for-profit firms		(c) All employees with skilled job task[#]	
	wo. hiring problems	w. hiring problems	wo. hiring problems	w. hiring problems	wo. hiring problems	w. hiring problems
Reported hiring problems (yes = 1)	-	0.040** (0.013)	-	0.045** (0.015)	-	0.004* (0.001)
Collective bargaining agreements (ref.: no agreement)						
Regional or industry Collective bargaining agreements	-0.013* (0.006)	-0.020** (0.005)	-0.012* (0.006)	-0.023** (0.006)	0.006** (0.001)	0.004** (0.001)
Company collective bargaining agreements	-0.008 (0.007)	-0.017** (0.006)	-0.009 (0.009)	-0.024** (0.007)	0.004** (0.001)	0.007** (0.001)
Works council (yes = 1)	0.021** (0.007)	0.007 (0.007)	0.029** (0.009)	0.021* (0.010)	0.004** (0.002)	0.003 (0.002)
High competition (yes = 1)	-0.002 (0.003)	-0.003 (0.003)	-0.007 (0.004)	-0.002 (0.003)	-0.004** (0.000)	-0.005** (0.001)
Overall technical state of machinery (ref.: out-of-date)						
State-of-the-art	0.027** (0.006)	0.021** (0.005)	0.028** (0.007)	0.026** (0.006)	0.003** (0.001)	0.005** (0.001)
Average	0.016** (0.005)	0.005 (0.003)	0.012* (0.005)	0.005 (0.003)	0.003** (0.001)	0.001 (0.001)
Profiability (ref.: low)						
High	0.020** (0.005)	0.005 (0.004)	0.031** (0.008)	0.005 (0.005)	0.013** (0.001)	0.010** (0.001)
Average	0.019** (0.006)	-0.001 (0.004)	0.024** (0.008)	0.001 (0.005)	0.005** (0.000)	-0.001 (0.001)
Log. of labor market power	-0.093** (0.032)	-0.059 (0.031)	-0.159** (0.038)	-0.123** (0.037)	0.003 (0.003)	-0.002 (0.004)
Herfindahl-Hirschman-Index	-0.096 (0.105)	-0.003 (0.111)	0.040 (0.117)	0.114 (0.122)	0.029* (0.014)	0.012 (0.016)
Fixed effects:						
Individuals	yes		yes		yes	
Establishments	yes		yes		yes	
Area (“Kreis”)	yes		yes		yes	
Occupations	yes		yes		yes	
Industries	yes		yes		yes	
Years	yes		yes		yes	

Cont. table 4

Adjusted R-squared	0.8880	0.8809	0.8975
F-test (df1, df2)	71.83** (100, 26984)	63.60** (100, 21017)	1330.06** (94, 739783)
Observations (no. of persons, no. of establishments)	86,524 (26,985; 616)	68,354 (21,018; 420)	2,781,772 (739,784; 12,595)

Note: LIAB 2008 – 2018. The regression controls for unobserved heterogeneity because of occupations, counties, industries, establishments, individuals, and years. Grey shaded cells indicate significant differences between individuals in firms with respectively without reported hiring problems. The model also includes the following additional variables: dummies for females, highest level of school/university graduation, and German nationality, age, years in employment, job, and establishment, the squares of age and experience variables, shares of workers with university degree and non-EU workers in establishments, dummies whether the entity is a single establishment firm and whether the firm has a foreign ownership. The model also contains interaction variables of being a female worker respectively highest level of school/university graduation and human capital variables. Standard errors are adjusted for clustering on individuals. ** and * denote significance at the .01, and .05-level, respectively. # Corresponds to occupations at skill level 2 of the occupational classification ISCO-08.

Appendix

Table A.1: Mean and Standard Deviation of Variables of used Sample (Individual Data)

Variable	All nurses	Nurse in for-profit firms	All trained employees
Log. of daily remuneration	4.226 (0.507)	4.217 (0.497)	4.402 (0.507)
Hiring problems (yes = 1)	0.645 (0.479)	0.687 (0.464)	0.242 (0.428)
Bounded by collective agreement (yes = 1)	0.819 (0.385)	0.791 (0.407)	0.757 (0.429)
Existence of works council (yes = 1)	0.844 (0.363)	0.864 (0.343)	0.797 (0.402)
Female worker (yes = 1)	0.788 (0.408)	0.796 (0.403)	0.238 (0.426)
Upper secondary school degree (“Abitur” oder “Fachabitur”) (yes = 1)	0.311 (0.599)	0.329 (0.617)	0.227 (0.555)
German (yes = 1)	0.970 (0.170)	0.972 (0.166)	0.943 (0.233)
Age	37.444 (12.613)	37.415 (12.536)	41.529 (12.297)
Years of employment experience	12.431 (9.398)	12.339 (9.252)	17.181 (10.463)
Years in establishment	9.373 (7.911)	9.228 (7.709)	11.983 (9.243)
Years of job experience	8.190 (7.620)	8.059 (7.452)	10.967 (9.117)
Log. of employees in firm	6.294 (1.195)	6.283 (1.148)	6.148 (1.852)
Log. of firm age	3.025 (0.546)	2.988 (0.532)	3.190 (0.572)
Share of females in firm	0.764 (0.129)	0.774 (0.113)	0.275 (0.226)
Single establishment company	0.729 (0.444)	0.720 (0.449)	0.481 (0.500)
High competition (yes = 1)	0.380 (0.485)	0.427 (0.495)	0.540 (0.498)
State of machinery:			
State-of-the-art	0.114 (0.317)	0.121 (0.326)	0.254 (0.435)
Average	0.582 (0.493)	0.573 (0.495)	0.536 (0.499)
Profitability:			
High	0.528 (0.499)	0.562 (0.496)	0.539 (0.498)
Average	0.277 (0.448)	0.275 (0.447)	0.265 (0.441)
Number of observations	85,524	68,354	2,781,772
Number of individuals	26,985	21,018	739,784
Number of establishments	2,530	1,751	60,033

Source: LIAB 2008 - 2018

Table A.2: Parameter estimates of wage regressions for nursing staff in Germany (Fixed effects regression, 2008 – 2018)

Variables	(a) All Nurses		(b) Nurses in for-profit firms		(c) All employees with skilled job task[#]	
		Interaction w. hiring problems		Interaction w. hiring problems		Interaction w. hiring problems
Reported hiring problems (lagged, yes = 1)	-	0.040** (0.013)	-	0.045** (0.015)	-	0.004* (0.001)
Collective bargaining agreements (ref.: no agreement)						
Regional or industry Collective bargaining agreements	-0.013* (0.006)	-0.007 (0.006)	-0.012* (0.006)	-0.010 (0.007)	0.006** (0.001)	-0.003** (0.001)
Company collective bargaining agreements	-0.008 (0.007)	-0.009 (0.007)	-0.009 (0.009)	-0.015 (0.009)	0.004** (0.001)	0.003* (0.001)
Works council (yes = 1)	0.021** (0.007)	-0.014* (0.007)	0.029** (0.009)	-0.008 (0.008)	0.004** (0.002)	-0.002 (0.001)
High competition (yes = 1)	-0.002 (0.003)	-0.001 (0.004)	-0.007 (0.004)	0.004 (0.005)	-0.004** (0.000)	-0.001 (0.001)
Overall technical state of machinery (ref.: out-of-date)						
State-of-the-art	0.027** (0.006)	-0.006 (0.007)	0.028** (0.007)	-0.002 (0.008)	0.003** (0.001)	0.002 (0.001)
Average	0.016** (0.005)	-0.011* (0.005)	0.012* (0.005)	-0.007 (0.006)	0.003** (0.001)	-0.002** (0.001)
Profiability (ref.: low)						
High	0.020** (0.005)	-0.015** (0.006)	0.031** (0.008)	-0.026** (0.008)	0.013** (0.001)	-0.004** (0.001)
Average	0.019** (0.006)	-0.020** (0.006)	0.024** (0.008)	-0.024** (0.008)	0.005** (0.000)	-0.007** (0.001)
Log. of labor market power	-0.093** (0.032)	0.033* (0.015)	-0.159** (0.038)	0.036* (0.017)	0.003 (0.003)	-0.004* (0.002)
Herfindahl-Hirschman-Index	-0.096 (0.105)	0.094** (0.031)	0.040 (0.117)	0.075* (0.036)	0.029* (0.014)	-0.018* (0.009)
Fixed effects:						
Individuals	yes		yes		yes	
Establishments	yes		yes		yes	
Area (“Kreis”)	yes		yes		yes	
Occupations	yes		yes		yes	
Industries	yes		yes		yes	
Years	yes		yes		yes	

Cont. table A.2

Adjusted R-squared	0.8880	0.8809	0.8975
F-test (df1, df2)	71.83** (100, 26984)	63.60** (100, 21017)	1330.06** (94, 739783)
Observations (no. of persons, no. of establishments)	86,524 (26,985; 2,530)	68,354 (21,018; 1,751)	2,781,772 (739,784; 60,033)

Note: LIAB 2008 – 2018. The regression controls for unobserved heterogeneity because of occupations, counties, industries, establishments, individuals, and years. The model also includes the following additional variables: dummies for females, highest level of school/university graduation, and German nationality, age, years in employment, job, and establishment, the squares of age and experience variables, shares of workers with university degree and non-EU workers in establishments, dummies whether the entity is a single establishment firm and whether the firm has a foreign ownership. The model also contains interaction variables of being a female worker respectively highest level of school/university graduation and human capital variables. Standard errors are adjusted for clustering on individuals. ** and * denote significance at the .01, and .05-level, respectively. # Corresponds to occupations at skill level 2 of the occupational classification ISCO-08.

Table A.3: Parameter estimates of wage regressions for nursing staff in Germany (Hiring problems with skilled employees, fixed effects regression, 2008 – 2018)

Variables	(a) All Nurses		(b) Nurses in for-profit firms		(c) All employees with skilled job task#	
		Interaction w. hiring problems		Interaction w. hiring problems		Interaction w. hiring problems
Reported hiring problems (lagged, yes = 1)	-	0.037** (0.012)	-	0.036* (0.015)	-	0.002 (0.002)
Collective bargaining agreements (ref.: no agreement)						
Regional or industry Collective bargaining agreements	-0.013* (0.005)	-0.007 (0.006)	-0.013* (0.006)	-0.010 (0.007)	0.006** (0.001)	-0.003** (0.001)
Company collective bargaining agreements	-0.008 (0.007)	-0.009 (0.008)	-0.012 (0.009)	-0.011 (0.009)	0.005** (0.001)	0.002 (0.001)
Works council (yes = 1)	0.016* (0.007)	-0.008 (0.007)	0.028** (0.009)	-0.004 (0.008)	0.004* (0.002)	0.000 (0.001)
High competition (yes = 1)	-0.001 (0.003)	-0.002 (0.004)	-0.006 (0.003)	0.004 (0.005)	-0.004** (0.000)	0.000 (0.001)
Overall technical state of machinery (ref.: out-of-date)						
State-of-the-art	0.017** (0.006)	0.009 (0.007)	0.017* (0.007)	0.014 (0.008)	0.003** (0.001)	0.002 (0.001)
Average	0.014** (0.005)	-0.008 (0.005)	0.010* (0.005)	-0.005 (0.005)	0.003** (0.001)	-0.003** (0.001)
Profiability (ref.: low)						
High	0.021** (0.005)	-0.019** (0.006)	0.032** (0.008)	-0.028** (0.008)	0.013** (0.000)	-0.003** (0.001)

Cont. table A.3

Average	0.017** (0.005)	-0.019** (0.006)	0.023** (0.007)	-0.023** (0.008)	0.005** (0.000)	-0.004** (0.001)
Log. of labor market power	-0.087** (0.032)	0.031* (0.014)	-0.151** (0.037)	0.024 (0.017)	0.002 (0.003)	-0.006** (0.002)
Herfindahl-Hirschman-Index	-0.076 (0.105)	0.086** (0.030)	0.054 (0.116)	0.068* (0.034)	0.034* (0.014)	-0.025* (0.010)
Fixed effects:						
Individuals	yes		yes		yes	
Establishments	yes		yes		yes	
Area ("Kreis")	yes		yes		yes	
Occupations	yes		yes		yes	
Industries	yes		yes		yes	
Years	yes		yes		yes	
Adjusted R-squared	0.8880		0.8808		0.8975	
F-test (df1, df2)	71.68** (100, 26984)		63.88** (100, 21017)		1328.43** (94, 739783)	
Observations (no. of persons, no. of establishments)	86,524 (26,985; 2,530)		68,354 (21,018; 1,751)		2,781,772 (739,784; 60,033)	

Note: LIAB 2008 – 2018. The regression controls for unobserved heterogeneity because of occupations, counties, industries, establishments, individuals, and years. The model also includes the following additional variables: dummies for females, highest level of school/university graduation, and German nationality, age, years in employment, job, and establishment, the squares of age and experience variables, shares of workers with university degree and non-EU workers in establishments, dummies whether the entity is a single establishment firm and whether the firm has a foreign ownership. The model also contains interaction variables of being a female worker respectively highest level of school/university graduation and human capital variables. Standard errors are adjusted for clustering on individuals. ** and * denote significance at the .01, and .05-level, respectively. # Corresponds to occupations at skill level 2 of the occupational classification ISCO-08.

Table A.4: Nursing professions included in the empirical estimates.

The analysis use data from employees in following occupations (Value of the five-digit-classification of KldB 2010 in parenthesis):

- Occupations in nursing (without specialization) (81302)
- Occupations in nursing specialized in a particular branch of nursing (81313, 81323)
- Surgical and medico-technical assistants (81332, 81333)
- Occupations in geriatric care (without specialization) (82102, 82103)
- Occupations in geriatric care (with specialization, not elsewhere classified) (82182, 82183)

Source: KldB 2010.

Table A.5: Descriptive statistics of Nurses working full- and part-time.

	Nurses working part-time (60,993 obs.)	Nurses working full-time (85,524 obs.)
Female worker (yes = 1)	0.922 (0.267)	0.788 (0.408)
Upper secondary school degree ("Abitur" oder "Fachabitur") (yes = 1)	0.239 (0.547)	0.311 (0.599)
German (yes = 1)	0.976 (0.152)	0.970 (0.170)
Age	43.992 (10.360)	37.444 (12.613)
Years of employment experience	17.030 (8.270)	12.431 (9.398)
Years in establishment	11.732 (8.042)	9.373 (7.911)
Years of job experience	9.095 (7.605)	8.190 (7.620)

Source: LIAB 2008 – 2018

Table A.6: Parameter estimates of wage regressions for nursing staff in Germany (Hiring problems with skilled employees, fixed effects regression, 2008 – 2018)

Variables	(a) All Nurses		(b) Nurses in for-profit firms	
		Interaction w. hiring problems		Interaction w. hiring problems
Reported hiring problems (yes = 1)	-	-0.014 (0.009)	-	-0.019 (0.011)
Collective bargaining agreements (ref.: no agreement)				
Regional or industry Collective bargaining agreements	0.002 (0.005)	-0.012* (0.005)	0.008 (0.005)	-0.021** (0.006)
Company collective bargaining agreements	0.007 (0.006)	-0.014* (0.007)	0.007 (0.007)	-0.016* (0.008)
Works council (yes = 1)	0.014** (0.005)	-0.002 (0.005)	0.020** (0.007)	-0.002 (0.006)
High competition (yes = 1)	-0.007* (0.003)	0.009* (0.004)	-0.009** (0.003)	0.009* (0.004)
Overall technical state of machinery (ref.: out-of-date)				

Cont. table A.6

State-of-the-art	0.013* (0.006)	0.004 (0.007)	0.007 (0.007)	0.013 (0.007)
Average	-0.003 (0.004)	0.005 (0.004)	-0.013** (0.004)	0.015** (0.004)
Profiability (ref.: low)				
High	0.001 (0.005)	0.001 (0.006)	0.004 (0.006)	-0.003 (0.007)
Average	0.000 (0.004)	0.002 (0.005)	0.002 (0.005)	0.000 (0.007)
Log. of labor market power	-0.021 (0.028)	-0.031* (0.013)	-0.061* (0.030)	-0.035* (0.015)
Herfindahl-Hirschman-Index	0.002 (0.102)	0.008 (0.026)	0.095 (0.107)	-0.005 (0.029)
Fixed effects:				
Individuals	yes		yes	
Establishments	yes		yes	
Area (“Kreis”)	yes		yes	
Occupations	yes		yes	
Industries	yes		yes	
Years	yes		yes	
Adjusted R-squared	0.8849		0.8858	
F-test (df1, df2)	76,56** (100, 33314)		71.36** (100, 26762)	
Observations (no. of persons)	108,120 (33,315)		87.802 (26,763)	

Note: LIAB 2008 – 2018. The regression controls for unobserved heterogeneity because of occupations, counties, industries, establishments, individuals, and years. The model also includes the following additional variables: dummies for females, highest level of school/university graduation, and German nationality, age, years in employment, job, and establishment, the squares of age and experience variables, shares of workers with university degree and non-EU workers in establishments, dummies whether the entity is a single establishment firm and whether the firm has a foreign ownership. The model also contains interaction variables of being a female worker respectively highest level of school/university graduation and human capital variables. Standard errors are adjusted for clustering on individuals. ** and * denote significance at the .01, and .05-level, respectively. # Corresponds to occupations at skill level 2 of the occupational classification ISCO-08.