baua:

Federal Institute for Occupational
Safety and Health

What does the German minimum wage do?
The impact of the introduction of the statutory minimum wage on the composition of low- and minimum-wage labour

Matthias Dütsch, Orkun Altun, Luisa Grundmann, Ralf Himmelreicher[1]

baua: Preprint

Content

Abstract

In this article, we examine structural changes in minimum-wage and low-wage labour after the introduction and first increase of the German minimum wage. Changes in the risks workers face of earning gross hourly wages below the minimum-wage or low-wage thresholds are identified by comparing individual, company-level and sectoral characteristics based on the Structure of Earnings Surveys (SESs) 2014 and 2018. The SES is a mandatory survey of companies that provides information on wages and working hours for approximately 1 million jobs and nearly 70,000 companies from all industries. Using these rich data, we present the first systematic analysis of how structural changes in individual-, company-, and industry-level determinants affect minimum- and low-wage workers. Using a descriptive analysis, we first summarize the changing pattern in jobs, companies, and industries after the minimum wage introduction. Second, we use random intercept-only models to estimate the explanatory power of the individual, company, and industry levels in the years 2014 and 2018 respectively. Third, we perform logistic and linear regression estimations to assess the changing risks of having a minimum- or low-wage job and the distance between a worker's actual earnings and the minimum and low-wage thresholds. We conclude that the minimum wage had an elevator effect regarding minimum-wage labour. However, compositional effects regarding the minimum-wage and low-wage workforce were evident in terms of individual and company factors. There was a selective redistribution of minimum-wage employees into slightly higher wage ranges. Furthermore, convergence seems to have occurred predominantly among sectors, as their explanatory power for lower wages declined.

JEL Classification: J310, J830

1   Corresponding author: Matthias Dütsch, Coordination and Information Office Minimum Wage Commission, Nöldnerstr. 40-42, 10317 Berlin, Germany, email: *matthias.duetsche@geschaeftsstelle-mindestlohn.de*; Orkun Altun, Coordination and Information Office Minimum Wage Commission; Luisa Grundmann, Coordination and Information Office Minimum Wage Commission; Ralf Himmelreicher, Coordination and Information Office Minimum Wage Commission, email: *ralf.himmelreicher@geschaeftsstelle-mindestlohn.de*. The article reflects exclusively the opinion of the authors.

1   Introduction

Labour markets are composed of various segments that vary regarding their working conditions. With a view to the national wage distribution, the bottom end – also denoted as the low-wage segment – is often the main focus of interest. Low-paid employees are generally perceived as having comparatively little power to act and negotiate (Dütsch and Bruttel 2021; Bruttel et al. 2017). Therefore, the low-wage segment is regarded as risk-generating and sociopolitically problematic (Gautié and Schmitt 2010; Kalleberg 2011), with the size of the low-wage sector providing an indication of the opportunity and risk structures in national labour markets. From a sociopolitical perspective, measures to reduce the low-wage sector as a whole and prevent low wages are widely discussed (Bosch 2018). In this context, minimum wages are considered a key instrument of labour market policy for intervening in the low-wage sector (Kalleberg 2011).

In the empirical literature, there exist thus far several qualitative and quantitative descriptions of minimum wage or low-wage employees (Dütsch and Himmelreicher 2020; Gallie 2007; Kalleberg 2011; Kalina and Wein-kopf 2015, 2017, 2018). However, to our knowledge, there is no systematic analysis of the determinants of convergence in wages or of structural changes in minimum-wage or low-wage employment after the introduction or increase in a minimum wage. From a conceptual point of view, various individual and company response patterns affect low-wage labour, which can lead to similar or even contradictory developments. Convergence can occur due to wage increases for employees affected by the minimum wage (Burauel et al. 2020; Cengiz et al. 2019; Phelan 2019). Noncompliance, by contrast, reduces such wage increases and, thus, convergence (Low Pay Commission 2021; Mindestlohnkommission 2018). Compositional changes can be the consequence of employment effects and can be both negative and positive (Borjas 2015; Manning 2003), affecting low-wage labour and consequently its sociodemographic composition. Furthermore, regarding compositional effects, institutionalist and behavioural theories predict changes in work intensity and productivity, or reductions in special payments and nonwage benefits (Hirsch et al. 2015; Lester 1960, 1964; Schmitt 2015). This can result in the replacement of (lower-skilled) minimum-wage employees by higher-wage (and better-skilled) employees, as well as in the mobility of employees between companies (Dustmann et al. 2021). Thus, structural shifts in the low-wage sector are likely to depend on individual determinants but also, in line with Coleman (1990) and Esser (1996), on companies and industries as relevant contextual factors.

Against this backdrop, we examine structural changes associated with the German statutory minimum wage and raise the following question: Did the introduction and first uprating of the minimum wage in Germany lead to convergence or compositional changes in low-wage employment? In an international comparison, the introduction of the minimum wage represents a strong intervention in the lower range of the wage distribution (Bruttel et al. 2018; Mindestlohnkommission 2016): Approximately 4 million jobs or 11.3 percent of all jobs were previously paid below 8.50 euros. We aim to explore individual and structural determinants that had an impact on the risk of earning wages below the minimum-wage and low-wage threshold in 2014, the year prior to the introduction of the statutory minimum wage, and 2018, the year after the first increase in the minimum wage, which constitutes a medium-term period.

For a valid measurement of composition changes, we use rich and representative datasets from 2014 and 2018, each containing information on approximately 1 million jobs and approximately 70,000 companies from all industries. These data allow us to assess the significance of not only individual determinants but also company-level and industry-level determinants, which we present here in detail for the first time. In the empirical part, we describe in the first step the respective determinants and the risk of being employed in the minimum-wage and low-wage sector in 2014 and 2018. In the second step, random intercept-only models are estimated to assess the explanatory power of the individual, company, and industry levels in 2014 and 2018 regarding minimum-wage and low-wage labour. Third, changing correlations between the determinants at those three levels and the risk of being employed in the minimum-wage and low-wage sector between the two years are determined in regression analyses.

In the next section, we provide a comprehensive review of the current state of research on this topic, present theoretical assumptions, and derive two hypotheses. Data and the estimation strategy are described in section 3. Section 4 contains the empirical results, and section 5 presents the findings and conclusion.

2   State of research and theoretical assumptions

To understand minimum- and low-wage employment and its implications for individual careers, recent research has focused on 4 topics. The first addresses the determinants of being in a low-wage job or the individual characteristics that are typical for low-wage employment (Bosch and Kalina 2008; Bruttel et al. 2017; Kalina and Weinkopf 2015, 2017). The second topic addresses the question of how long employees remain in low-wage positions and whether they successfully make the transition into regular employment (through the stepping stone effect) or become unemployed and end up in the 'low-pay, no-pay cycle' (Fok et al. 2015; Most-haf et al. 2011; Knabe and Plum 2013; Schnabel 2016). The third topic is the body of studies examining the consequences of low-wage employment for employees' well-being, labour intensity and health (Appelbaum 2010; Gallie 2007; Kalleberg 2011; Fedorets and Himmelreicher 2021). The fourth topic is possible alternatives to taking up a low-wage job or remaining in the low-wage sector through strategies such as searching longer and more intensely for better paid employment or participating in further training (Schnabel 2016). Our paper contributes to the first strand of research and extends it with an analysis of structural changes following the introduction of a minimum wage. Such changes are often described as a general shift in the working population or are traced back to individuals and their characteristics. However, structuralist theories of action incorporate contextual factors and show that they influence individual opportunities and risks (Coleman 1990; Esser 1996). Consequently, theoretical explanations should account for actors and corresponding framework conditions.

A minimum wage is a labour market institution that raises the wages of employees having earned less than the new minimum. Since the minimum-wage segment represents a substantial part of the low-wage segment, the low-wage segment and, thus, the probability of low wages can potentially be decreased by a minimum wage introduction or hike. Beyond the effect for minimum-wage earners, a reducing effect on the low-wage probability is likely to be stronger the more pronounced the compression effects of the minimum wage are (Burauel et al. 2020; Cengiz et al. 2019; Phelan 2019). This is because the low-wage threshold is a relative measure that refers to the median wage. The higher the minimum wage is in relation to the median wage and the stronger the compression effects are, the more pronounced the reduction in the low-wage sector due to the minimum wage. In Germany, the introduction of the minimum wage in 2015 led to a significant wage compression (Mindestlohnkommission 2016), while spillover effects could not be found (Burauel et al. 2020). Both findings indicate a convergence at the bottom of the income distribution; this implies a concentration of wages at and just above the minimum wage, also called the ripple effect of a minimum wage (Phelan 2019). As a result, the minimum wage became the going rate for many low-paid employees (Brown 1999). Therefore, the function of minimum wages is primarily to raise wages at the bottom of the wage distribution. Overall, this development is likely to lead to a convergence of individual-, company- and industry-specific risks of earning low wages and, in particular, minimum wages. This means that groups of employees, companies and sectors that had the highest incidence of earning below 8.50 euros prior to the introduction of the minimum wage in Germany, such as women, those younger than 35 years old and older than 55 years old, foreigners, low-skilled workers, temporary and fixed-term employees, mini-jobbers, those working in small companies, without collective bargaining obligations or in the service sector (Dütsch and Himmelreicher 2020; Kalina and Weinkopf 2015), are assumed to continue to exhibit a similar risk but at an even lower level. Thus, with regard to the groups mentioned above, the probability of low wages should decrease. Additionally, it is important to consider that a minimum wage can be effective only if there is compliance with it. Noncompliance reduces the positive wage effects (Low Pay Commission 2021; Mindestlohnkommission 2018). Nevertheless, convergence should be evident, albeit to a lesser extent than with full compliance.

Hypothesis 1: Individual, company-specific and sectoral risks of being paid in the minimum-wage and low-wage segment declined between 2014 and 2018 due to convergence.

In the discussion on the impact of minimum wages, compositional effects are a further issue. They first refer to the composition of the workforce regarding characteristics such as gender, age or education. Changes in such characteristics of low-wage labour can occur in the case of disemployment (Borjas 2015; Manning 2003). Thus, workers who receive a minimum wage that is higher than their marginal productivity are laid off according to the approach of a perfectly competitive labour market. This impacts the composition of the low-wage workforce. After the introduction of the German minimum wage, there were negative employment effects among those in marginal employment in their main job, which are still observable in the medium term (Caliendo et al. 2018; Isphording et al. 2022). Concurrently, findings indicate that some of the formerly marginal employment was converted into

part-time employment subject to social security contributions (Bonin et al. 2018; Pestel et al. 2020). Accordingly, compositional changes should be evident in terms of the form of employment. Furthermore, gender-specific changes are to be expected, as marginal employment was particularly characterized by female workers. Moreover, institutionalist and behavioural theories predict restructuring in low-wage employment as companies seek to compensate for higher wage costs due to a minimum wage. Changes in work intensity and productivity measures (Hirsch et al. 2015; Lester 1960, 1964; Schmitt 2015) can result in the replacement of (lower-skilled) minimum-wage employees by higher-wage (and better-skilled) employees. Reductions in special payments and fringe benefits, by contrast, can lead to voluntary withdrawals from companies (ibid.). Second, compositional effects are assumed to stem from changing framework conditions within which individuals act and operate. Differences in company structure result from the type of production and corresponding productivity (Card et al. 2018), the size of the company (Struck 2006) and the collective bargaining agreement of companies (Fitzenberger and Seidlitz 2020). In this regard, Dustmann et al. (2022) found that the German minimum wage increased the company wage premium, suggesting a compositional shift towards more productive and higher-paying companies. Furthermore, small companies are generally considered less able to adapt to changing market conditions than their larger counterparts. Large companies, for example, are better able to cope with profit losses than small companies because they can compensate for revenue shortfalls or higher expenses (Struck 2006). Indeed, studies have shown a decrease in the number of small businesses due to the minimum wage in Germany (De Monte et al. 2022; Dustmann et al. 2022; Isphording et al. 2022). Third, the industries in which jobs are performed are significant contextual factors. The industry to which a company belongs is strongly associated with its employees' wages. This correlation is confirmed by several studies focusing on Germany (Bispinck 2017; Mindestlohnkommission 2018). While the creation of value and thus the scope of profit distribution is comparatively high in the manufacturing industry, this is less the case in the service sector. Accordingly, the average wage level is higher in the manufacturing industry than in other sectors, especially the service sector (Dütsch and Himmelreicher 2020). Consequently, the different extents to which sectors are affected by the minimum wage are likely to lead to a shift in the size and composition of industries in the low-wage sector. For example, in the hospitality industry, there were collective agreements with earnings groups below 8.50 euros prior to the introduction of the minimum wage. The range of wages between the highest and lowest collectively agreed wages fell most sharply there between December 2014 and June 2017, at 7.2 percent (Statistisches Bundesamt 2017). Against this background, a second hypothesis can be derived as a counterhypothesis to the first.

Hypothesis 2: Between 2014 and 2018, the introduction of the minimum wage led to a shift in the composition of the minimum-wage and low-wage sectors in terms of individual and company characteristics and sectors.

3 Data and method

For our empirical analysis, we use the last two survey waves in 2014 and 2018 of the Structure of Earnings Survey (SES). The SES is a mandatory cross-sectional survey of companies in Germany, which is collected every 4 years (Statistisches Bundesamt 2020). The use of the earnings surveys (VE) conducted in 2015, 2016 and 2017, whose participation was not mandatory but voluntary in contrast to the SES, is waived. This is partly because of the potential selection problem and partly because the significantly smaller number of cases does not promise any additional insight (Caliendo et al. 2022). Although it is companies that are surveyed, the statistical unit of the survey is employment relationships, encompassing individual-, company- and sector-level information; this provides a unique opportunity to examine our hypotheses. The primary source of the SES data is the payroll accountings of the surveyed companies, which are subject to internal and external audits (Statistisches Bundesamt 2016). Thus, the information on wages is highly accurate. This is not always the case for information regarding working hours, which are partially estimated by the reporting companies. Nevertheless, all information is extensively checked by the statistical offices of the federal states, improving reliability considerably (Statistisches Bundesamt 2016). Starting with 2014, the SES was broadened to include companies with fewer than 10 employees, and its sampling scheme was changed to increase overall representativeness. With these improvements, the SES covers nearly all sectors with the exception of private households and exterritorial organizations and corporations fulfilling the prerequisites for evaluating the minimum- and low-wage segments. Moreover, the changes in the 2014 SES were exactly preserved in the 2018 SES, allowing us to directly compare the two surveys, which was only partially possible for previous waves of the SES. Also noteworthy is that the data on earnings refer only to the month of April in the respective survey years. Thus, the SES 2014 and 2018 let us compare the situation just before the introduction of the minimum wage and 4 years thereafter.

We restricted our sample to employees older than 18 years of age and excluded those who were partially retired as well as apprentices, trainees, and interns. This left us with a sample of 978,817 jobs in 70,303 companies in 2014 and 969,477 jobs in 70,512 companies in 2018. Our main dependent variable is gross hourly wages. It was computed by taking gross monthly earnings and subtracting any overtime earnings as well as allowances for shift, night, Sunday and holiday work. We then divided wages by monthly paid working hours (without overtime). In addition, we use two indicator variables for minimum-wage and low-wage jobs throughout our analysis, which rely on the computed gross hourly wages. For 2014, the minimum-wage threshold was set at the level of 8.50 euros, equal to the rate introduced in 2015. The low-wage threshold, which is defined as two-thirds of the median wage, amounted to 10.33 euros in 2014. Similarly, for 2018, we used 8.89 euros as the minimum-wage threshold, which is 5 cents higher than the minimum wage applicable at the time to account for measurement errors. This procedure has been frequently adopted in other studies on the minimum wage (Bachmann et al. 2022; Bruckmeier and Schwarz 2022; Mindestlohnkommission 2020). The low-wage threshold in that year was 11.05 euros. This procedure left us with a total of 4 dummy variables indicating whether or not a job was paid below or above the minimum- and low-wage threshold at both observation dates. Additionally, in some of the analyses, we use distance variables, which were calculated by subtracting the gross hourly wage a job is paid from the respective minimum-wage and low-wage thresholds.

The central explanatory variables are various individual and company characteristics as well as information on the industrial sector. Individual characteristics include sex, age, the highest educational degree obtained, tenure, employment status (full-time, part-time, or marginal employment)[2], type of contract (fixed-term or permanent), and whether the employment is temporary. Company-level characteristics include information on whether the company is bound by sectoral collective or company collective agreements, the size of the company (<5, 5-49, 50-249, and 250 or more employees), gender distribution, and the region where the company is located (northwest including Berlin, northeast, west and south). Industrial sectors are classified according to the sections of the Statistical Classification of Economic Activities (NACE, Rev. 2), excluding the categories 'Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use' and 'Activities of extraterritorial organizations and bodies' because they are not part of the sample.

Regarding the empirical procedure, first, descriptive analyses give an overview of low-paid workers and low-wage companies as well as minimum-wage workers and minimum-wage companies in 2014 and 2018. In a second step, random intercept only models are estimated to assess the explanatory power of the individual, company, and industry levels in 2014 and 2018 regarding minimum-wage and low-wage labour. Third, logistic and linear regressions are performed considering individual, company- and industry-specific characteristics for pooled data of the survey years 2014 and 2018. Specifically, we assess compositional changes between the two years by introducing interaction terms for the four-year comparison and the explanatory variables.

The multivariate analyses are based on three-level data. This data structure is an important aspect when choosing an estimation procedure. Moulton (1986, 1990) noted that the inclusion of meso- and macrolevel variables in a standard regression analysis in which observations are assumed to be independent leads to inefficient coefficients and biased standard errors. Therefore, in the first step, multilevel models are estimated because they allow a grouping of jobs i within companies j nested in industries k by considering residuals at the company and industry levels. These residuals represent unobserved characteristics that cause correlations between outcomes for jobs from the same company and industry. The empirical analyses are performed with the following three-level random intercept-only model (Rabe-Hesketh and Skrondal 2008):

$$y_{ijk} = \beta_0 + \zeta_{jk}^{(2)} + \zeta_k^{(3)} + \varepsilon_{ijk}$$

where β_0 represents the regression constant; $\zeta_{jk}^{(2)}$ and $\zeta_k^{(3)}$ denote the random effects that are assumed to be independent not only of each other but also across clusters. $\zeta_{jk}^{(2)}$ is also assumed to be independent across units. ε_{ijk} is the error term. In the third and fourth steps, we estimate logit models for binary variables and linear OLS models with cluster-robust standard errors (Wooldridge 2012).

---

2   Marginal employment (minijobs) refers to jobs with maximum earnings of 450 euros gross per month, which are exempt from social security contributions for employees. For midijobs see Herget and Riphan (2022).

4   Empirical findings

4.1   Descriptive statistics

In Germany in 2018, after the introduction and the first increase of the national minimum wage to 8.84 euros, approximately 4 percent of jobs were paid at or below the minimum-wage threshold of 8.89 euros, and approximately 22 percent were paid below the low-wage threshold of 11.05 euros.[3] Com-pared with the situation in 2014, before the introduction of the minimum wage in Germany, the minimum-wage incidence decreased by 7 percentage points, and the low-wage incidence rose by approximately 1 percentage point (table 1). The average gross hourly wage amounted to 18.97 euros in 2018. In the minimum-wage and low-wage ranges, the mean wages were 8.55 euros and 9.68 euros, respectively. In both wage brackets, the average hourly wages increased between 2014 and 2018 by approximately 1.5 euros. These developments, although merely descriptive, point to a convergence of earnings in the minimum-wage sector but to a still widespread and even slightly increasing low-wage sector.

Overall, in 2018, approximately 49 percent of workers were female; approximately 5 percent of women earned less than 8.89 euros, and approximately 28 percent earned less than 11.05 euros. The share of women and men in minimum-wage jobs was similar, while the low-wage incidence was 10 percentage points higher for women. Compared with 2014, in 2018, the minimum-wage incidence of women decreased by 9 percentage points, and the low wage incidence rose by approximately 1 percentage point. Thus, after the introduction of the minimum wage in Germany, more women than men left the minimum-wage segment. Regarding age, higher risks of earning low or minimum wages could be observed for younger workers aged 18 to 24 and those 65 years and older. Approximately one in ten of the younger and older employees were located in the minimum-wage segment, and nearly half were in the low-wage segment. Over time, the share of younger and older minimum-wage earners strongly declined by approximately 15 percentage points; their share in the low-wage segment rose by 5 percentage points. Approximately 8 percent of employees did not complete vocational training; in comparison with other education groups, they showed the largest shares in the minimum-wage (8 percent) and low-wage segments (41 percent). The minimum-wage incidence of unskilled workers fell by more than 11 percentage points by 2018 compared with 2014, while the low-wage incidence increased by 5 percentage points. Nevertheless, approximately 16 percent of employees with a vocational qualification received low pay. Regarding the type of employment, approximately 58 percent of jobs were full time, 27 percent were part time, and 15 percent were marginal in 2018. Among the workers with marginal employment, 14 percent were paid below the minimum wage and 71 percent below the low-wage threshold. They earned significantly lower average hourly wages (11.06 euros) than part-time (17.06 euros) or full-time workers (21.86 euros). Furthermore, the average wages of the marginally employed who were paid in the minimum-wage or low-wage segments amounted to only 8.68 euros and 9.58 euros, respectively. The introduction of the minimum wage led to a shrinking share of marginal jobs paid below the minimum-wage threshold by 23 percentage points but a 7 percentage point increase in the share of marginal jobs paid below the low-wage threshold. The marginally employed often earned less than the minimum wage, even in companies with higher sectoral or company collective agreements (see table A1).

Six percent of workers with fixed-term contracts were in minimum-wage employment and 34 percent in low-paid employment in 2018 (table 1). These were significantly higher shares than those for permanent employees. Approximately 37 percent of temporary work was low paid, while the share among regular work was 22 percent. However, the proportion of temporary jobs below the minimum-wage threshold amounted to 3 percent and was thus very similar to regular employment. Compared to 2014, the share of temporary workers earning less than minimum or low wages disproportionately declined by 9 and 4 percentage points after the introduction of the minimum wage. This may be due to sectoral collective agreements negotiated for this industrial sector (Personaldienstleiter 2019). Additionally, job tenure seems to be an important factor regarding minimum- and low-wage employment: The share of minimum-wage jobs (7 percent) and low-wage jobs (36 percent) among employees working at most four years in their jobs clearly exceeded the percentage of employees with a longer employment history. With regard to individual-level determinants, the descriptive results show two different trends. First, the importance of individual characteristics for earning the minimum wage decreased, especially

---

3   The results presented here are broadly consistent with the results of other studies, despite different samples and perspectives (employer vs. employee): Based on data from the German Socio-Economic Panel (GSOEP), it can be shown that employees whose main job was in the low-wage sector represented 21.7% of all employees in Germany in 2018, with the low-wage threshold at 11.40 euros gross per hour (Grabka and Göbler 2020).

for women, marginally employed, unskilled, fixed-term and employees with a short period of employment. Second, the importance of individual characteristics for earning a low wage increased slightly, especially for unskilled employees and for those in marginal employment. Accordingly, there seems to be an elevator effect, since at the bottom of the income distribution, the risks of very low wages decreased. Concurrently, there was obviously a selective redistribution of minimum-wage employees into only slightly higher wage ranges and, thus, a shift in the composition of minimum-wage and low-wage labour after the introduction of the minimum wage.

Tab. 1: Description of the individual-level characteristics of jobs in Germany in 2018 and comparison to 2014

		All jobs	Minimum-wage jobs < 8.89 euros	Low-wage jobs < 11.05 euros	Change regarding minimum-wage jobs to 2014 in percentage points or euros	Change regarding low-wage jobs to 2014 in percentage points or euros
	Percentage of all workers	100%	3.88%	22.29%	-7.13pp	1.27pp
	Mean wage in euros	18.97	8.55	9.68	1.54	1.69
	Median wage in euros	16.27	8.83	9.78	1.43	1.48
Gender	Women	48.35%	4.51%	27.59%	-9.26pp	1.21pp
	Mean wage in euros	*16.83*	*8.60*	*9.70*	*1.54*	*1.68*
	Men	51.65%	3.30%	17.33%	-5.02pp	1.54pp
	Mean wage in euros	*20.97*	*8.48*	*9.63*	*1.53*	*1.69*
Age	18-24 years old	6.01%	11.65%	48.27%	-14.73pp	5.28pp
	Mean wage in euros	*12.50*	*8.46*	*9.46*	*1.58*	*1.75*
	25-34 years old	20.64%	3.46%	20.56%	-6.86pp	0.69pp
	Mean wage in euros	*17.14*	*8.51*	*9.70*	*1.48*	*1.70*
	35-44 years old	21.24%	2.81%	18.21%	-5.66pp	0.65pp
	Mean wage in euros	*19.79*	*8.60*	*9.74*	*1.52*	*1.62*
	45-54 years old	27.33%	2.83%	18.39%	-5.62pp	1.13pp
	Mean wage in euros	*20.74*	*8.60*	*9.75*	*1.20*	*1.64*
	55-64 years old	21.39%	3.45%	20.70%	-7.50pp	0.02pp
	Mean wage in euros	*20.19*	*8.58*	*9.69*	*1.54*	*1.69*
	65 years and older	3.40%	10.55%	53.72%	-18.54pp	4.61pp
	Mean wage in euros	*14.60*	*8.68*	*9.60*	*1.89*	*1.89*
Highest educational degree	No vocational training	8.11%	7.60%	40.89%	-10.78pp	4.95pp
	Mean wage in euros	*13.77*	*8.46*	*9.63*	*1.50*	*1.64*
	Voc. training, craftsman	54.45%	2.33%	15.62%	-5.31pp	0.40pp
	Mean wage in euros	18.19	8.63	9.76	1.48	1.65
	Polytechnic, university	16.86%	0.58%	3.18%	-0.89pp	0.45pp
	Mean wage in euros	*29.86*	*7.35*	*9.49*	*0.51*	*1.62*
	unknown	20.58%	9.24%	48.28%	-15.36pp	3.43pp
	Mean wage in euros	*14.16*	*8.59*	*9.63*	*1.67*	*1.74*

		All jobs	Minimum-wage jobs < 8.89 euros	Low-wage jobs < 11.05 euros	Change regarding minimum-wage jobs to 2014 in percentage points or euros	Change regarding low-wage jobs to 2014 in percentage points or euros
Type of employment	Full-time employment	58.08%	1.28%	9.17%	-2.91pp	-0.16pp
	Mean wage in euros	*21.86*	*8.15*	*9.77*	*0.88*	*1.51*
	Part-time employment	27.25%	3.86%	24.25%	-6.16pp	2.90pp
	Mean wage in euros	*17.06*	*8.58*	*9.74*	*1.34*	*1.51*
	Marginal employment	14.66%	14.24%	70.63%	-23.18pp	7.37pp
	Mean wage in euros	*11.06*	*8.68*	*9.58*	*1.86*	*1.85*
Type of contract	Permanent contract	84.85%	3.55%	20.11%	-6.68pp	0.85pp
	Mean wage in euros	*19.69*	*8.59*	*9.67*	*1.57*	*1.69*
	Fixed-term contract	15.15%	5.77%	34.49%	-10.62pp	1.42pp
	Mean wage in euros	*14.96*	*8.42*	*9.68*	*1.44*	*1.64*
Temporary work	Regular work	98.09%	3.91%	22.00%	-7.09pp	-0.66pp
	Mean wage in euros	*19.07*	*8.56*	*9.67*	*1.56*	*1.70*
	Temporary work	1.91%	2.60%	37.11%	-9.19pp	-4.24pp
	Mean wage in euros	*14.19*	*8.26*	*9.82*	*0.55*	*1.23*
Job tenure	0-4 years	43.49%	6.51%	35.64%	-11.96pp	1.12pp
	Mean wage in euros	*15.63*	*8.57*	*9.65*	*1.59*	*1.70*
	5-9 years	18.14%	3.30%	20.78%	-6.85pp	0.91pp
	Mean wage in euros	*18.43*	*8.62*	*9.72*	*1.54*	*1.66*
	10 and more years	38.36%	1.18%	7.88%	-2.28pp	-1.06pp
	Mean wage in euros	*23.02*	*8.36*	*9.73*	*1.25*	*1.59*
Number of observations, n =		969,464	36,586	190,204	-	-
Number of observations, N =		37,856,400	1,470,543	8,438,893	-	-

Source: Research data centres of the statistical offices of the Federation and the Länder, SES 2014, SES 2018; all indications are population weighted; own calculations.

In table 2, company-level characteristics of jobs in Germany are described. It becomes obvious that the larger the company is, the smaller the proportion of jobs below the minimum-wage and low-wage thresholds. Small companies with fewer than 5 employees had the highest shares of minimum-wage (8 percent) or low-wage employment (46 percent). After the introduction of the minimum wage, the share of small companies paying wages below the minimum-wage threshold shrank by 15 percentage points, and the share of low-wage workers grew by 4 percentage points. Approximately 42 percent of all jobs were in companies not bound by a collective agreement. Of these jobs, 31 percent were paid below the low-wage threshold, and 6 percent were paid even below the minimum-wage threshold. Compared to 2014, the share of minimum-wage workers declined by 12 percentage points and the share of low-wage-workers remained almost the same. In comparison, employees in companies bound by sectoral or company collective agreements were much better protected against wages be low the low-wage or minimum-wage thresholds. This becomes also evident in Pen's Parades in figure 1, which depicts the distribution of hourly wages according to collective bargaining coverage in 2014 and 2018. Accordingly, low wages rose sharply after the introduction of the minimum wage, especially for employees not covered by collective agreement: Employees in companies not bound by collective bargaining agreements in the lowest wage bracket were able to record wage increases of almost 4 euros gross per hour, and the

minimum wage is the going rate for the lower third of employees in companies not bound by collective bargaining agreements. However, in total, sectoral and company collective agreements lead to higher wages in the entire wage distribution.

Regarding the internal gender distribution (see table 2), low-wage jobs were observed more often in female-dominated companies (28 percent) than in male-dominated companies (17 percent). Thus, obviously, the gender composition of the workforce determines the overall company wage setting. Furthermore, companies located in the northeastern part of Germany had the greatest shares of minimum-wage (6 percent) and low-wage employment (31 percent); they also paid below-average wages. Between 2014 and 2018, a convergence in regional differences can be observed because the share of employees paid below the minimum-wage threshold levelled off considerably. However, there is still a strong south-north divide in terms of low wages, with significantly lower shares in the south of Germany. Overall, descriptive results on company-level characteristics mostly point to decreased company risks of receiving minimum or low wages due to a compression of wages on the lower end of the wage scale: The incidences decreased, especially concerning small, nonbounded companies located in northeastern Germany.

Tab. 2: Description of company-level characteristics of jobs in Germany in 2018 and comparison to 2014

		All jobs	Minimum-wage jobs < 8.89 euros	Low-wage jobs < 11.05 euros	Change regarding minimum-wage jobs to 2014 in percentage points or euros	Change regarding low-wage jobs to 2014 in percentage points or euros
	Percentage of all workers	100%	3.88%	22.29%	-7.13pp	1.27pp
	Mean wage in euros	*18.97*	*8.55*	*9.68*	*1.54*	*1.69*
Size of company	Fewer than 5 empl.	7.32%	8.09%	45.84%	-15.39pp	3.98pp
	Mean wage in euros	*13.82*	*8.66*	*9.63*	*1.71*	*1.70*
	5-49 employees	32.91%	5.66%	31.36%	-10.71pp	2.23pp
	Mean wage in euros	*15.93*	*8.62*	*9.64*	*1.52*	*1.48*
	50-249 employees	24.84%	3.43%	20.94%	-5.94pp	1.01pp
	Mean wage in euros	*18.38*	*8.49*	*9.73*	*1.37*	*1.57*
	250 and more empl.	34.92%	1.65%	9.77%	-3.10pp	-1.27pp
	Mean wage in euros	*23.35*	*8.33*	*9.74*	*1.55*	*1.62*
Collective agreement	Company not bound	41.80%	6.13%	30.89%	-12.09pp	-1.10pp
	Mean wage in euros	*16.89*	*8.58*	*9.62*	*1.60*	*1.75*
	Sectoral agreement	29.65%	1.13%	10.29%	-4.01pp	-3.18pp
	Mean wage in euros	*21.82*	*8.41*	*9.78*	*1.13*	*1.36*
	Company agreement	3.69%	1.26%	7.34%	-2.05pp	0.35pp
	Mean wage in euros	*21.88*	*8.31*	*9.75*	*1.47*	*1.71*
	unknown	24.86%	3.77%	24.36%	-3.62pp	10.49pp
	Mean wage in euros	*18.65*	*8.54*	*9.75*	*1.61*	*1.83*
Gender distribution	More men in company	52.00%	3.19%	16.82%	-5.64pp	0.55pp
	Mean wage in euros	*20.65*	*8.49*	*9.64*	*1.61*	*1.78*
	More women	48.00%	4.64%	28.22%	-6.72pp	6.45pp
	Mean wage in euros	*17.15*	*8.60*	*9.70*	*1.57*	*1.69*

		All jobs	Mini-mum-wage jobs < 8.89 euros	Low-wage jobs < 11.05 euros	Change regarding minimum-wage jobs to 2014 in percentage points or euros	Change regarding low-wage jobs to 2014 in percentage points or euros
Region	North-east, excl. Berlin	13.06%	5.79%	30.82%	-16.75pp	-3.23pp
	Mean wage in euros	*15.97*	*8.75*	*9.64*	*1.88*	*2.03*
	North-west, incl. Berlin	20.04%	4.40%	23.89%	-6.43pp	2.36pp
	Mean wage in euros	*18.53*	*8.53*	*9.66*	*1.48*	*1.61*
	West	34.84%	3.92%	21.66%	-5.75pp	1.83pp
	Mean wage in euros	*19.32*	*8.53*	*9.65*	*1.45*	*1.55*
	South	32.06%	2.75%	18.50%	-4.90pp	2.10pp
	Mean wage in euros	*20.09*	*8.44*	*9.74*	*1.36*	*1.59*
Number of observations, n =		969,464	36,586	190,204	-	-
Number of observations, N =		37,856,400	1,470,543	8,438,893	-	-

West = North Rhine-Westphalia, Hesse, Rhineland-Palatinate, Saarland; South = Baden-Wuerttemberg, Bavaria.

Source: Research data centres of the statistical offices of the Federation and the Länder, SES 2014, SES 2018; all indications are population weighted; own calculations.
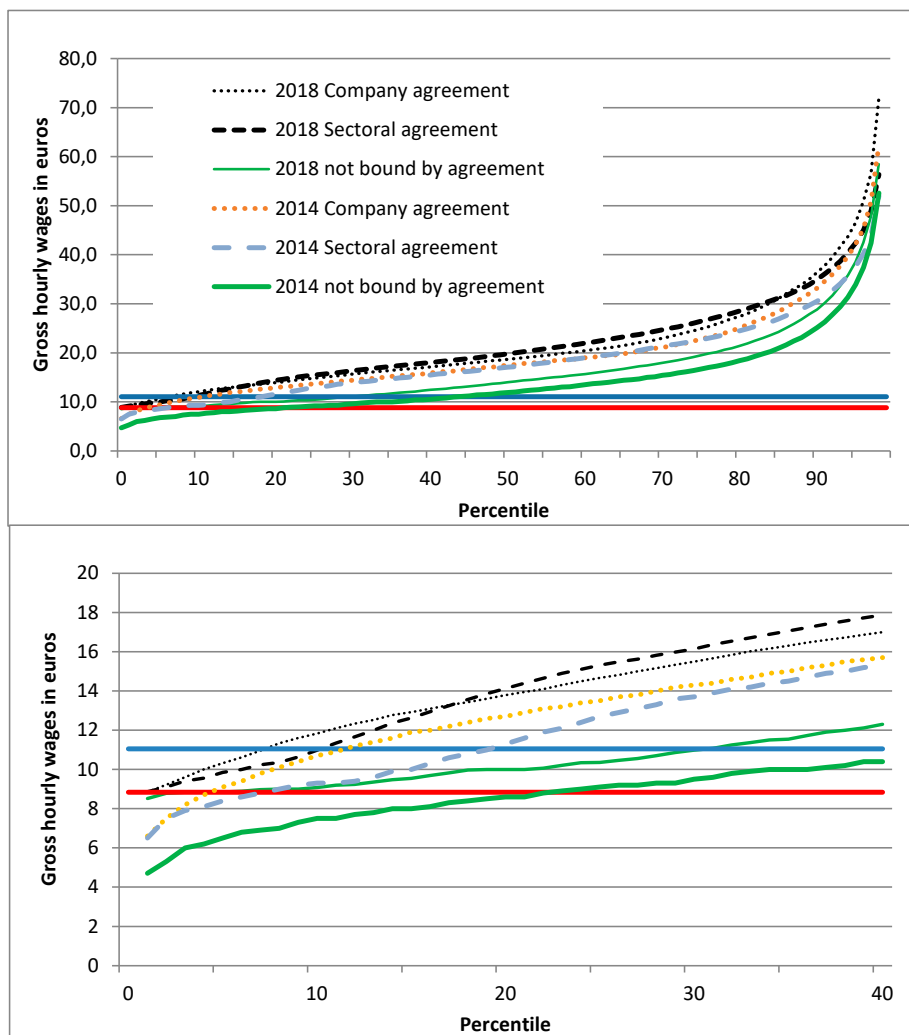
Notes: The red line denotes the minimum-wage threshold, the green line the low-wage threshold.
Source: Research data centres of the statistical offices of the Federation and the Länder, SES 2014, SES 2018; all indications are population weighted; own calculations.

Fig 1: Distribution of hourly wages differentiated by collective bargaining coverage (Pen's Parade)

Minimum-wage and low-wage incidences were very differently distributed across industrial sectors (table 3). Jobs paid below the low-wage threshold could rarely be found in the sectors 'Public administration and defence as well as compulsory social security', 'Mining and quarrying', 'Electricity, gas, steam and water supply', 'Financial and insurance activities', and 'Education'. However, there are comparatively large proportions of low-wage and minimum-wage jobs in the sectors 'Transportation and storage', 'Administrative and support service activities', 'Agriculture, Forestry and Fishing', 'Arts, entertainment and recreation', and 'Accommodation and food service activities'. In the last sector, the share of employees with wages below the low-wage threshold amounted to over 70 percent in 2018, but the proportion of employees earning minimum wages decreased by 30 percentage points to 14 percent between 2014 and 2018.

Thus, the industry-specific risks of receiving minimum wages fell by more than 7 percentage points after the introduction of the minimum wage, but the risks of receiving low wages increased somewhat overall, especially in retail trade and accommodation and food service. One additional and notable point is that in the sectors with large proportions of low-wage or minimum-wage workers, the share of marginally employed workers was also high (see table A1). Generally, there was great heterogeneity among industrial sectors regarding the risk of low pay.

Tab 3: Description of the sectoral characteristics of jobs in Germany in 2018 and comparison to 2014

	All jobs	Minimum-wage jobs < 8.89 euros	Low-wage jobs < 11.05 euros	Change regarding minimum-wage jobs to 2014 in percentage points or euros	Change regarding low-wage jobs to 2014 in percentage points or euros
Percentage of all workers	100%	3.88%	22.29%	-7.13pp	1.27pp
Mean wage in euros	*18.97*	*8.55*	*9.68*	*1.54*	*1.69*
Agriculture, Forestry, and Fishing	0.82%	9.24%	55.56%	-24.18pp	1.77pp
Mean wage in euros	*12.37*	*8.60*	*9.60*	*1.52*	*1.79*
Mining and quarrying	0.13%	0.69%	5.95%	-0.43pp	2.23pp
Mean wage in euros	*21.73*	*8.25*	*9.88*	*0.83*	*1.28*
Manufacturing	18.07%	1.80%	11.50%	-3.52pp	0.20pp
Mean wage in euros	*22.23*	*8.44*	*9.71*	*1.34*	*1.62*
Electricity, gas, steam, water supply	1.28%	0.47%	7.13%	-1.53pp	-0.39pp
Mean wage in euros	*23.18*	*8.27*	*9.89*	*1.19*	*1.41*
Construction	4.83%	1.26%	11.12%	-3.33pp	0.78pp
Mean wage in euros	*16.75*	*8.49*	*9.87*	*1.50*	*1.69*
Wholesale and retail trade; repair of motor vehicles and motorcycles	13.63%	6.05%	29.21%	-9.10pp	2.99pp
Mean wage in euros	*16.60*	*8.67*	*9.62*	*1.55*	*1.68*
Transportation and storage	5.42%	9.52%	32.05%	-11.56pp	0.07pp
Mean wage in euros	*15.39*	*8.61*	*9.46*	*2.00*	*2.02*
Accommodation and food service	4.62%	14.49%	70.22%	-30.27pp	2.38pp
Mean wage in euros	*18.65*	*8.54*	*9.75*	*1.61*	*1.83*
Information and communication	3.06%	2.86%	10.64%	-5.05pp	-1.82pp
Mean wage in euros	*26.22*	*8.33*	*9.44*	*1.72*	*1.94*

	All jobs	Mini-mum-wage jobs < 8.89 euros	Low-wage jobs < 11.05 euros	Change regarding minimum-wage jobs to 2014 in percentage points or euros	Change regarding low-wage jobs to 2014 in percentage points or euros
Financial and insurance activities	2.46%	0.82%	6.40%	-1.78pp	0.94pp
Mean wage in euros	*26.48*	*8.25*	*9.72*	*1.21*	*1.62*
Real estate activities	1.26%	5.10%	33.09%	-10.20pp	1.92pp
Mean wage in euros	*17.12*	*8.67*	*9.68*	*1.74*	*1.69*
Professional, scientific, and technical activities	6.03%	2.67%	13.27%	-4.40pp	0.02pp
Mean wage in euros	*23.19*	*8.27*	*9.59*	*1.61*	*1.81*
Administrative and support service activities	7.90%	4.47%	50.18%	-11.81pp	0.92pp
Mean wage in euros	*13.59*	*8.53*	*9.92*	*1.11*	*1.35*
Public administration and defence; compulsory social security	6.50%	0.07%	2.57%	-1.29pp	-0.16pp
Mean wage in euros	*22.12*	*8.87*	*9.90*	*2.02*	*1.90*
Education	6.23%	0.94%	7.96%	-1.99pp	1.41pp
Mean wage in euros	*21.96*	*8.51*	*9.85*	*1.76*	*1.81*
Human health and social work	13.48%	2.18%	16.51%	-5.07pp	0.04pp
Mean wage in euros	*18.37*	*8.40*	*9.87*	*1.22*	*1.62*
Arts, entertainment, and recreation	1.27%	12.55%	47.67%	-18.35pp	3.66pp
Mean wage in euros	*14.67*	*8.36*	*9.36*	*1.60*	*1.94*
Other service activities	3.00%	6.73%	33.39%	-10.88pp	1.94pp
Mean wage in euros	*16.65*	*8.71*	*9.59*	*1.67*	*1.68*
Number of observations, n =	969,464	36,586	190,204	-	-
Number of observations, N =	37,856,400	1,470,543	8,438,893		

Source: Research data centres of the statistical offices of the Federation and the Länder, SES 2014, SES 2018; all indications are population weighted; own calculations.

In summary, the factors that were associated with a high share of employees with wages below the minimum-wage threshold in 2014 were associated with high shares of employees in the low-wage segment in 2018, with the gross hourly wage increasing by approximately 2 to 3 euros. We referred to this increase as the elevator effect, which, however, brought hardly any compositional changes for low-wage companies or employees. In the next section, the significance of the individual, company, sectoral and regional levels regarding their power to explain low-wage and minimum-wage employment in 2018 are assessed.

4.2 Examination of the variance components

We use estimates for 3-level logistic random intercept models to analyse the probability of being employed in the low-wage or minimum-wage sector and to assess the distance to both thresholds. In models without explanatory variables (intercept-only models), the variance in the outcome variable can be decomposed into proportions associated with the individual level, the company level, and the industry level. For this purpose, the random part of the 3-level models is explored by considering the estimated residual intraclass correlation ρ of the latent responses. It is assumed that in models on the risk of earning minimum wage or low wages, the

level-1 error variance is equal to $\pi^2/3$ for the logistic link function, while $\psi^{(2)}$ is the variance between companies and $\psi^{(3)}$ is the variance between industrial sectors (Rabe-Hesketh and Skrondal 2008). We thus obtain for the similarity of employees i within the same industrial sector k:

$$\rho(\text{sector}) = \frac{\psi^{(3)}}{\psi^{(2)} + \psi^{(3)} + \pi^2/3}.$$

Within the same company j (and the same industrial sector k), we obtain:

$$\rho(\text{company}) = \frac{\psi^{(2)}}{\psi^{(2)} + \psi^{(3)} + \pi^2/3}.$$

In the linear intercept-only models on the distance between a worker's actual earnings and the minimum- and low-wage thresholds, the level-1 error variance is θ. Thus, the similarity of employees i within the same industrial sector k is:

$$\rho(\text{sector}) = \frac{\psi^{(3)}}{\psi^{(2)} + \psi^{(3)} + \theta}.$$

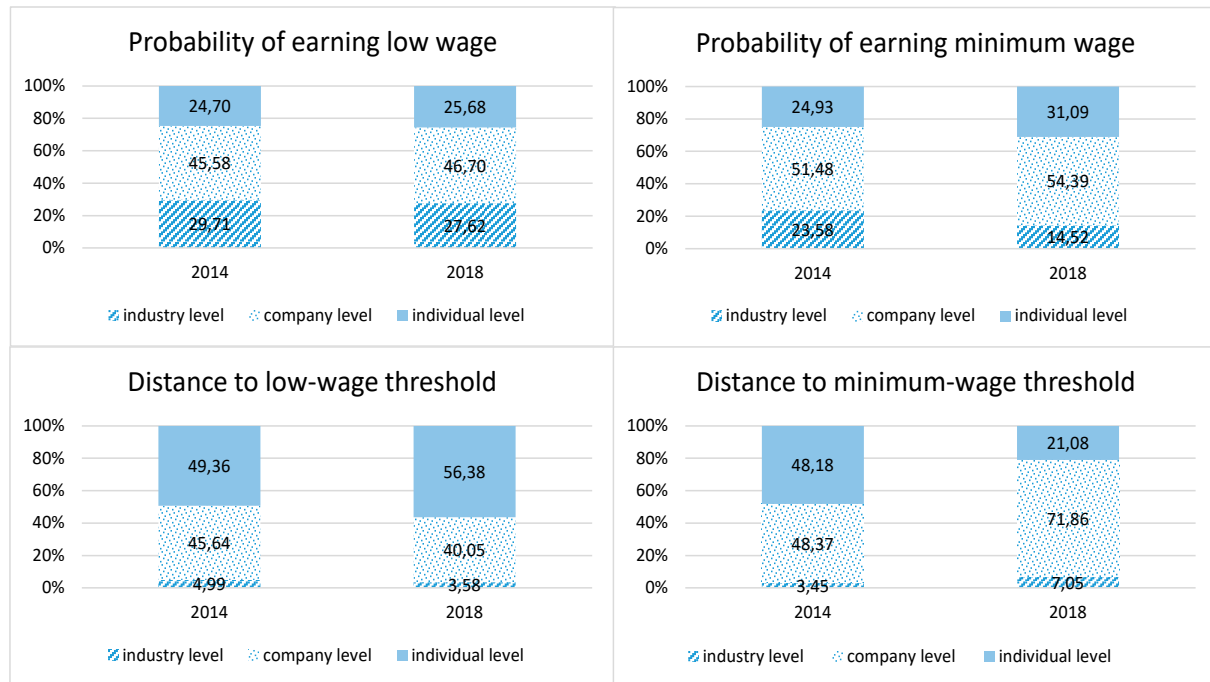Within the same company j (and the same industrial sector k), we obtain:

$$\rho(\text{company}) = \frac{\psi^{(2)}}{\psi^{(2)} + \psi^{(3)} + \theta}.$$

Figure 2 shows random intercept models without explanatory variables.[4] The values of the random part denote that in 2018, 46.70 percent of the differences in the employment situation regarding being employed in a low-wage job or not are explained by the company level, 27.62 percent are explained by the industrial sector level, and 25.68 percent are explained by the individual level. Regarding the employment situation of being employed in a minimum-wage job, 54.39 percent and 14.52 percent of the differences can be attributed to the company level and industrial sector level, respectively; 31.09 percent relate to the individual level. Regarding the differences in the distance between earnings and the low-wage threshold, 40.05 percent can be traced back to the company level, 3.58 percent to the industrial sector level, and 56.38 percent to the individual level. The company level and the industrial sector level account for 71.86 percent and 7.05 percent, respectively, of the differences in the distance to the minimum-wage threshold, and the individual level accounts for the remaining 21.08 percent.

A comparison of the relative explanatory power between 2014 and 2018 highlights that the explanatory power of the levels for the probability of earning low wages remained approximately the same. In contrast, regarding the probability of earning minimum wages, the explanatory power of the individual level in particular increased, while the power of the sectoral level decreased. However, structural conditions still explain more than two-thirds of both probabilities. The importance of the individual level is more pronounced in regard to the distance to the low-wage threshold. It increased even more during the observation period. The formerly high explanatory power of the individual level for the distance to the minimum-wage threshold had decreased very strongly by 2018. There, the relative importance decreased to less than half, while the company level especially gained importance.

These results indicate in line with findings from Card et al. (2013) – strong explanatory power of the company level regarding the risk of being employed in the minimum-wage or low-wage segment of the workforce and regarding the distance to both thresholds in the German labour market. Industrial sectors impact the risk of earning low or minimum wages, but they impact the distance to low- and minimum-wage thresholds to a lesser extent. Individual characteristics explain more variance in the wage gap than in the probability of earning more or less than a low wage or minimum wage, with a considerable drop regarding the latter between 2014 and 2018. We discuss the drivers of the change in the significance of the individual-, company-, and industry level characteristics for being employed in the low-wage and minimum-wage ranges in the next section. Additionally, the two hypotheses derived in section 2 are tested.

---

4   The full estimations are shown in table A2 and A3 in the appendix

Probability of earning low wage

	2014	2018
individual level	24,70	25,68
company level	45,58	46,70
industry level	29,71	27,62

Probability of earning minimum wage

	2014	2018
individual level	24,93	31,09
company level	51,48	54,39
industry level	23,58	14,52

Distance to low-wage threshold

	2014	2018
individual level	49,36	56,38
company level	45,64	40,05
industry level	4,99	3,58

Distance to minimum-wage threshold

	2014	2018
individual level	48,18	21,08
company level	48,37	71,86
industry level	3,45	7,05

Notes: Estimation results for intercept-only models (3-level random intercept models without explanatory variables).
In the intercept-only models, all 44 industries contained in the dataset are used.
Source: Research data centres of the statistical offices of the Federation and the Länder, SES 2014, SES 2018; own calculations.

Fig. 2: Probabilities and distances earning low and minimum wages 2014 vs. 2018

4.3 Estimating compositional changes between 2014 and 2018

To assess changes in the correlation of individual, company and sectoral determinants over time, we perform multivariate regressions. To this end, the explanatory factors shown in tables 1 to 3 are interacted with a dummy variable for the year. Since we are particularly interested in changes, figures 3 to 5 display only the interaction effects.[5] The corresponding coefficients indicate whether and how the relationship between minimum- or low-wage employment and an explanatory variable changed in 2018 compared with 2014. In the left parts of figures 3 to 5 (below), the average marginal effects of logit estimates on the probability of earning below the low-wage threshold (blue dots) and the minimum-wage threshold (red diamonds) are depicted. The right parts of the figures display coefficients from linear OLS regressions indicating the distance between the gross hourly wage and the low-wage threshold (blue dots) and the minimum-wage threshold (red diamonds). Although the results are presented in three figures, they come from one estimation that includes variables at the individual, company, and industry levels.

Figure 3 shows that the risk of being employed in low-wage and minimum-wage jobs significantly decreased for women in 2018 compared to 2014. In addition, the distance to the low-wage threshold narrowed. Regarding the highest educational degree, findings are ambiguous. While the risk of earning below the low-wage threshold slightly increased in 2018 for unskilled employees, the risk of earning below the minimum-wage threshold remained almost unchanged. However, the distance to the minimum wage and the low wage declined. Employees with a polytechnic or university degree had a higher probability of working low- or minimum-wage labour in 2018 than they had four years before. Furthermore, the distance to both thresholds rose. With regard to age and tenure, there were no changes over time. Distinct shifts between 2014 and 2018 can be found regarding employment status. While the probability of earning below the minimum- and low-wage thresholds increased for part-time workers in 2018, it decreased for marginal workers. However, both forms of employment saw a reduction in the distance to the minimum-wage and low-wage thresholds. This change was particularly pronounced in the case of marginal employment. A slight decline in the risk of working minimum- or low-wage work occurred regarding fixed-term employment; no change between 2014 and 2018 could be observed regarding temporary work. However, the distance to the low-wage threshold in temporary employment fell.

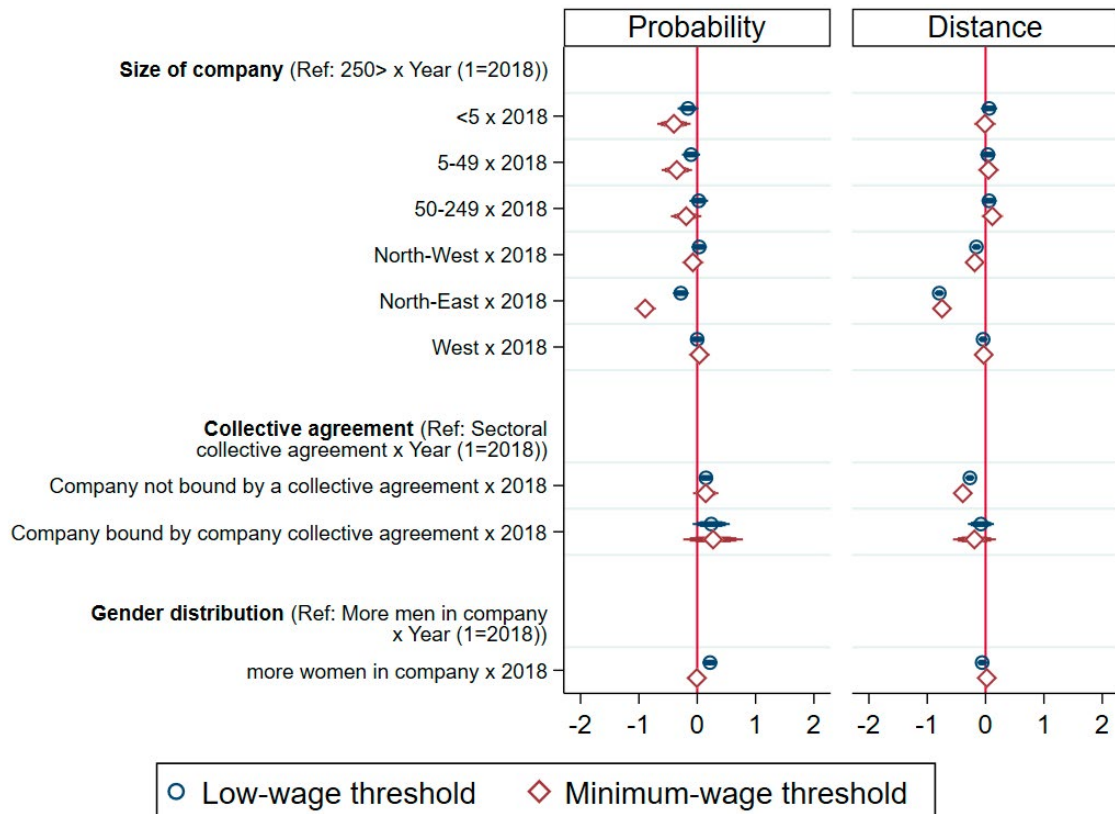5   The full estimation is shown in table A4 in the appendix.
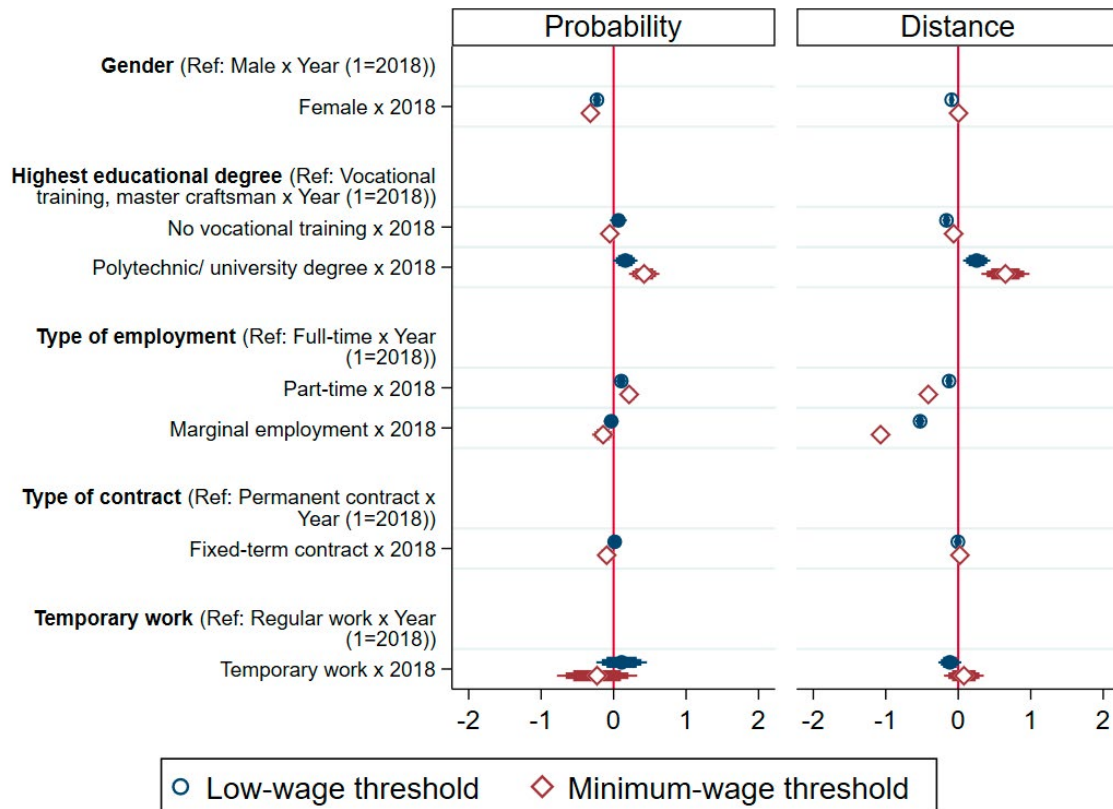
Notes: *Standard errors are clustered at the company level. The dependent variables 'probability' are coded as dummy variables. The value 1 represents a job paying less than 10.33 euros (low-wage threshold) or 8.50 euros (minimum-wage threshold); the dependent variable 'distance' is a metric and denotes the gap between the hourly wage and the low or minimum wage. In the case of binary logit estimates, the average marginal effects are shown. Although the results are presented in figures 3-5, they come from one estimation that included individual-, company-, and industry-level variables. Spikes are drawn for 99.9%, 99%, and 95% confidence intervals. Source: Research data centres of the statistical offices of the Federation and the Länder, SES 2018; own calculations.*

Fig. 3: Changes in the relationship between low-wage and minimum-wage labour and individual characteristics between 2014 and 2018

In the case of company-level determinants, the probability of employment in the minimum-wage and low-wage sector significantly diminished between 2014 and 2018 for smaller companies with fewer than 5 or 5 to 49 employees. However, there are no effects on the distance to either threshold.

Regarding the region where a company is located, a significantly decreased risk of earning below the low-wage and especially the minimum-wage level in the northeast of Germany is observed. In this region, the distance between employees' wages and the minimum-wage and low-wage thresholds also fell significantly. The risk of being employed in the minimum-wage or low-wage segment increased in companies that were not bound by a collective wage agreement. At the same time, however, the wage gap to the minimum wage and low-wage threshold decreased. Finally, for individuals working in companies with a higher share of female employees, the low-wage risk increased significantly in 2018, while the minimum-wage risk did not change.
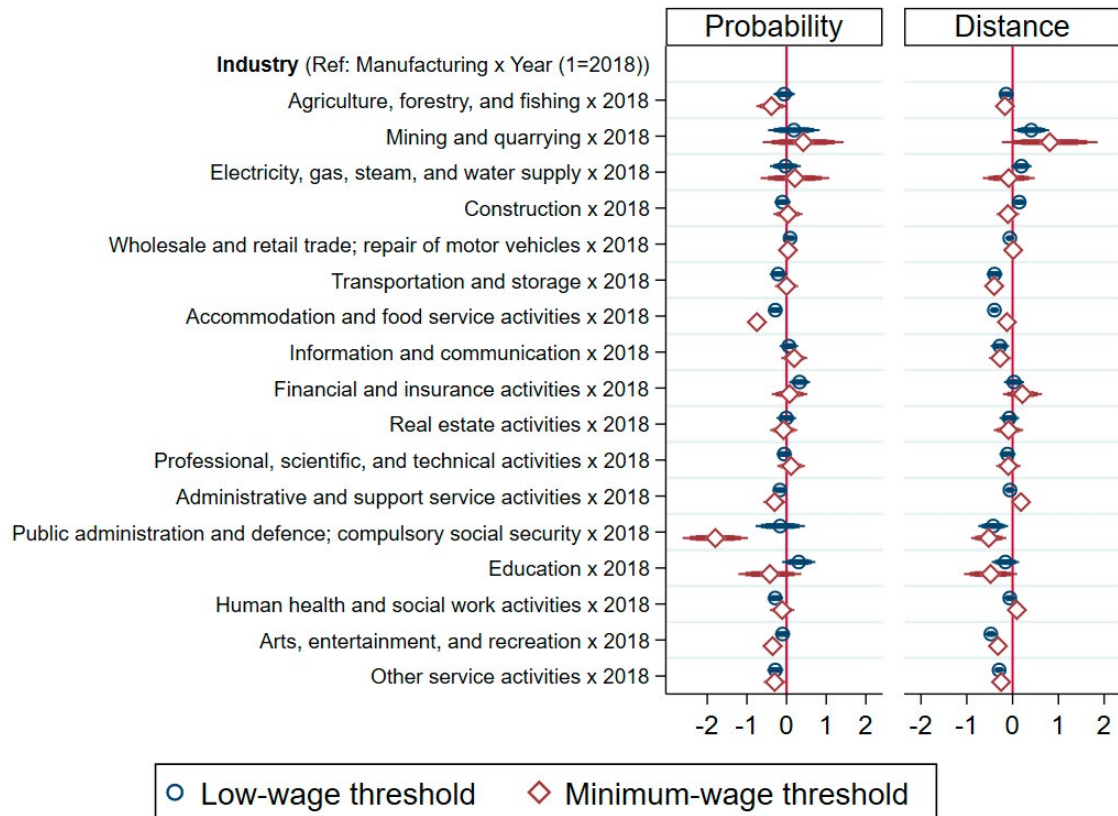
Notes: Standard errors are clustered at the company level. The dependent variables 'probability' are coded as dummy variables. The value 1 represents a job paying less than 10.33 euros (low-wage threshold) or 8.50 euros (minimum-wage threshold); the dependent variable 'distance' is a metric and denotes the gap between the hourly wage and the low or minimum wage. In the case of binary logit estimates, the average marginal effects are shown. Although the results are presented in figures 3-5, they come from an estimation including individual-, company-, and industry-level variables. Spikes are drawn for 99.9%, 99%, and 95% confidence intervals.
Source: Research data centres of the statistical offices of the Federation and the Länder, SES 2018; own calculations

Fig. 4: Changes in the relationship between low-wage and minimum-wage labour and company-specific characteristics between 2014 and 2018

Regarding industrial sectors, there were generally only small changes in the relationship with low- or minimum-wage labour between 2014 and 2018. The strongest reductions in low-wage or minimum-wage risks occurred in the sectors 'Accommodation and food service activities', 'Administrative and support service activities', 'Public administration and defence; compulsory social security', 'Arts, entertainment, and recreation', and 'Other service activities'. With respect to the 'Financial and insurance activities' and 'Education' industries, the low-wage risk significantly increased. Except for 'Public administration and defence; compulsory social security', 'Real estate activities', and 'Human health and social work activities', the distance to both thresholds also dropped significantly. The latter also applied to the 'Transportation and storage' industry. In contrast, the distance to the minimum-wage and low-wage thresholds increased in the sector 'Mining and quarrying'.

Notes: Standard errors are clustered at the company level. The dependent variables 'probability' are coded as dummy variables. The value 1 represents a job paying less than 10.33 euros (low-wage threshold) or 8.50 euros (minimum-wage threshold); the dependent variable 'distance' is a metric and denotes the gap between the hourly wage and the low or minimum wage. In the case of binary logit estimates, the average marginal effects are shown. Although the results are presented in figures 3-5, they come from an estimation including individual-, company-, and industry-level variables. Spikes are drawn for 99.9%, 99%, and 95% confidence intervals. Source: Research data centres of the statistical offices of the Federation and the Länder, SES 2018; own calculations.

Fig. 5: Changes in the relationship between low-wage and minimum-wage labour and industry-specific characteristics between 2014 and 2018

The multivariate results point to different implications with regard to the two hypotheses derived for the three levels of individuals, companies, and economic sectors. With respect to hypothesis 2, there seems in fact to be a shift in composition within the minimum wage and low-wage sectors at the individual level due to increases in minimum-wage and low-wage risks with respect to the highest level of education and part-time employment. This also applies to the company level because employees' minimum-wage and low-wage risks grew depending on the presence of collective agreements and the gender distribution within a company. In contrast to hypothesis 2, but in line with hypothesis 1, a convergence appears to have taken place between 2014 and 2018 with regard to the risk of being paid in the minimum-wage and low-wage segment as far as the sectoral level is concerned. This is also evident from the variance component analyses, as the explanatory power of the sectoral level declined for the most part.

5   Discussion of results and conclusions

Minimum wages are considered a key instrument of labour market policy for preventing low wages (Kalleberg 2011). Thus, the introduction or increase of a minimum wage makes it reasonable to assume that it causes changes not only in the size but also in the composition of the minimum-wage or low-wage labour segment. However, due to a number of potential side effects of minimum wages described in labour market theories, from a theoretical point of view, the effects of minimum wages on the size and composition of low-wage labour remain undetermined. Empirically, to our knowledge, there are no studies offering a systematic characterization of structural changes in minimum-wage or low-wage employment after the introduction or increase of a minimum wage but only cross-sectional studies for a specific year (Dütsch and Himmelreicher 2020; Gallie 2007; Kalleberg 2011; Kalina and Weinkopf 2015, 2017, 2018).

Against this backdrop, we used the introduction of the statutory minimum wage in Germany, which represented a strong intervention in the lower range of the wage distribution (Bruttel et al. 2018; Bruttel et al. 2017; Mindestlohnkommission 2016), as an analytic framework and compared minimum-wage and low-wage labour in 2014 and 2018. The research question was whether the introduction of the minimum wage in Germany led to convergence or compositional changes in low-wage employment. The year 2014 represented the situation immediately before the introduction of the minimum wage, and the year 2018 represented the situation after the introduction and first increase of the minimum wage. For a valid measurement of compositional changes, we used rich and representative datasets from 2014 and 2018, each containing information on approximately 1 million jobs and approximately 70,000 companies from all industries. These data, in which individuals are clustered into firms and these in turn into industries, allowed us to estimate the explanatory power of these three levels as well as determinants at these three levels.

Empirically, we first show that after the introduction and the first increase of the German minimum wage, the incidence of minimum-wage employment fell by 7 percentage points to approximately 4 percent, while the low-wage incidence rose by approximately 1 percentage point to approximately 22 percent. In the minimum-wage and low-wage sectors, mean wages amounted to 8.55 euros and 9.68 euros, respectively, in 2018, an increase of approximately 1.5 euros in both wage groups. These developments point to an elevator effect. Earnings in the minimum-wage sector converged due to wage compression at the lower end of the wage distribution – despite the existence of noncompliance (Mindestlohnkommission 2020) – but wage compression did not affect the entire low-wage segment, which actually grew slightly. This is consistent with the results of causal analyses that found wage compression due to the introduction of the German minimum wage (Mindestlohnkommission 2016). However, wage compression in the minimum-wage range failed to pass over to the low-wage range. For this, the ratio between the minimum wage and the median wage would have had to be stronger, since the low-wage threshold is a relative measure.

Second, the variance component analysis revealed for both 2014 and 2018 a strong explanatory power of the company level regarding the risk of being employed in the minimum-wage or low-wage sector and regarding the distance to both thresholds in the German labour market (see also Dütsch and Himmelreicher 2020). This finding is in line with research on the importance of company opportunity structures for workers' employment prospects and risks (Card et al. 2013; Fitzenberger and Seidlitz 2020; Struck 2006) but also with the fact that minimum wage-induced employment fluctuations in the minimum-wage segment depended on company features (Dustmann et al. 2022). Furthermore, industrial sectors explained to a greater extent the risks of earning low wages than minimum wages. This risk declined between 2014 and 2018. This can be attributed to the fact that the minimum wage raised low-end wages, especially in industries in the German labour market that were not covered by collective agreements (Mindestlohnkommission 2020), and reduced the wage differential in industrial sectors that were covered by collective agreements (Statistisches Bundesamt 2017). Individual characteristics accounted for more variance in the wage gap than in the likelihood of earning low or minimum wages. Between 2014 and 2018, the explanatory power regarding the distance to the minimum wage decreased significantly. These results reliably confirm the conceptual considerations of Coleman (1990) and Esser (1996) that structural determinants are highly important when assessing individual behaviour. This consideration can be transferred to the labour market and to research on employment situations in general.

Third, concerning the specific determinants of minimum wage and low-wage labour, the significance of individual characteristics for the receipt of a minimum wage decreased, especially for women and marginally employed and fixed-term employees. These were the groups of employees that could be found with above-average probability below the minimum-wage threshold in 2014 (Dütsch and Himmelreicher 2020; Kalina and Weinkopf 2015). The low-wage risk declined only for women. The previously mentioned groups still had an increased minimum-wage or low-wage risk but at a lower level. Additionally, there was a very sharp decline in the distance to the minimum wage and low-wage threshold among marginal and part-time employees. Those employees were obviously able to benefit from the introduction of the minimum wage by means of an elevator effect. In contrast, the probability of earning low wages slightly increased, especially for part-time workers (Beckmannshagen and Schröder 2022). This can be explained by an increase in transitions from marginal employment to part-time employment after the introduction of the minimum wage (Isphording et al. 2022; vom Berge et al. 2016). With regard to the company level, the minimum wage and low-wage risk for smaller companies and those in northeastern Germany decreased in terms of convergence; consequently, there was also an elevator effect for the companies most affected prior to the introduction of the minimum wage. However, it must be noted that, as shown descriptively, there is still a strong north-south divide in low wages, with significantly higher shares in the northeast (see also Caliendo et al. 2022). No elevator effect but even an increase in minimum-wage and low-wage risks was observed for companies not bound by collective bargaining agreements. Thus, the introduction of minimum wages seems to have increased the pressure on wages in these companies. At the sectoral level, the sharpest decline in low or minimum wages was observed in a number of service sectors that were characterized by low wage levels before the introduction of the minimum wage, such as 'Accommodation and food service activities', 'Administrative and support service activities', and 'Other service activities' (Kalina and Weinkopf 2015). In these low-wage sectors, which often also represent areas not covered by collective bargaining agreements (Kohaut and Ellguth 2022), there appears to have been an elevator effect.

From these findings, we can conceptually conclude that although current research points to the significance of individual determinants in explaining low wages (Bosch and Kalina 2008; Bruttel et al. 2017; Kalina and Weinkopf 2015, 2017), the company and sectoral framework conditions determine different employment opportunities and risks and, therefore, also significantly impact the likelihood of earning low or minimum wages. The implications of the results in terms of content are that the minimum wage led to an elevator effect regarding minimum-wage labour. However, compositional effects with regard to the minimum-wage and low-wage workforce were evident in terms of individual and company factors. There was obviously a selective redistribution of minimum-wage employees into slightly higher wage ranges (Himmelreicher 2020). Accordingly, groups of employees were able to benefit unevenly from the introduction of the minimum wage. Furthermore, convergence seems to have taken place predominantly among sectors, as their explanatory power for low wages declined.

Our study has some limitations, particularly regarding the data used. The SES data from both years contain information on jobs, not on workers; thus, main and side jobs could not be distinguished. Furthermore, the SES 2014 and 2018 provide only cross-sectional data and cannot be used in a panel design. Panel analyses will be possible in the future with the newly designed earnings survey, which has been conducted since January 2022. Furthermore, subjective indicators, such as the family context, household size, and earnings of other members of the household, were not assessed.

References

Appelbaum, Eileen (2010), Institutions, firms and the quality of jobs in low wage labor markets, in: Jérôme Gautié und John Schmitt (Hrsg.), Low-wage work in the wealthy world, New York, NY: Russell Sage Foundation, 185–210.

Bachmann, Ronald, Bernhard Boockmann, Myrielle Gonschor, René Kalweit, Roman Klauser, Natalie Laub, Christian Rulff and Christina Vonnahme (2022), Auswirkungen des gesetzlichen Mindestlohns auf Löhne und Arbeitszeiten. Studie im Auftrag der Mindestlohnkommission, RWI Projektbericht, RWI – Leibniz-Institut für Wirtschaftsforschung.

Beckmannshagen, Mattis and Carsten Schröder (2022), Earnings inequality and working hours mismatch, Labour Economics, Volume 76.

Bispinck, Reinhard (2017), WSI Niedriglohn-Monitoring 2017, WSI Informationen zur Tarifpolitik. Elemente qualitativer Tarifpolitik 83, Wirtschafts- und Sozialwissenschaftliches Institut in der Hans-Böckler-Stiftung, Düsseldorf.

Bonin, Holger, Ingo Isphording, Annabelle Krause, Andreas Lichter, Nico Pestel, Ulf Rinne, Marco Caliendo, Cosima Obst, Malte Preuss, Carsten Schröder and Markus G. Grabka (2018), Auswirkungen des gesetzlichen Mindestlohns auf Beschäftigung, Arbeitszeit und Arbeitslosigkeit, Studie im Auftrag der Mindestlohnkommission, Forschungsinstitut zur Zukunft der Arbeit, Evaluation Office Caliendo, Deutsches Institut für Wirtschaftsforschung, Bonn u.a.

Borjas, George J. (2015), Labor economics, New York: McGraw-Hill Education.

Bosch, Gerhard (2018), The making of the German minimum wage: a case study of institutional change, Industrial Relations Journal, 49(1), 19-33.

Bosch, Gerhard and Thorsten Kalina (2008), Low-wage work in Germany: an overview, in: Gerhard Bosch und Claudia Weinkopf (Hrsg.), Low-wage work in Germany, New York, NY: Russell Sage Foundation, 19-112.

Brown, Charles (1999), Minimum wages, employment, and the distribution of income, in: Orley C. Ashenfelter und David Card (Hrsg.), Handbook of labor economics, Amsterdam u.a.: North-Holland, 2101-2163.

Bruckmeier, Kerstin and Stefan Schwarz (2022), Auswirkungen des gesetzlichen Mindestlohns auf den Bezug von Sozialleistungen. Studie im Auftrag der Mindestlohnkommission, IAB, Nürnberg.

Bruttel, Oliver, Arne Baumann and Matthias Dütsch (2018), The new German statutory minimum wage in comparative perspective: Employment effects and other adjustment channels, European Journal of Industrial Relations, 24(2), 145-162.

Bruttel, Oliver, Arne Baumann and Ralf Himmelreicher (2017), Der gesetzliche Mindestlohn in Deutschland: Struktur, Verbreitung und Auswirkungen auf die Beschäftigung, WSI-Mitteilungen, 70(7), 473-481.

Burauel, Patrick, Marco Caliendo, Markus G. Grabka, Cosima Obst, Malte Preuss, Carsten Schröder and Cortnie Shupe (2020), The impact of the German minimum wage on Individual wages and monthly earnings, Journal of Economics and Statistics, 240(2-3), 201–231.

Caliendo, Marco, Alexandra Fedorets, Malte Preuss, Carsten Schröder and Linda Wittbrodt (2018), The short-run employment effects of the German minimum wage reform, Labour Economics, 53, 46-62.

Caliendo, Marco, Rebecca Olthaus and Nico Pestel (2022), Auswirkungen des gesetzlichen Mindestlohns auf Beschäftigung und Arbeitslosigkeit. Studie im Auftrag der Mindestlohnkommission, Evaluation Office, Berlin.

Card, David, Ana Rute Cardoso, Jörg Heining and Patrick Kline (2018), Firms and labor market inequality: Evidence and some theory, Journal of Labor Economics, 36(1), 13-70.

Card, David, Jörg Heining and Patrick Kline (2013), Workplace heterogeneity and the rise of West German wage inequality, Quarterly Journal of Economics, 128(3), 967-1015.

Cengiz, Doruk, Arindrajit Dube, Attila Lindner and Ben Zipperer (2019), The effect of minimum wages on low-wage jobs, Quarterly Journal of Economics, 134(3), 1405-1454.

Coleman, James (1990), Foundations of Social Theory, Cambridge, MA: Harvard University Press.

De Monte, Enrico, Alexander Kann, Moritz Lubczyk and Simona Murmann (2022), Auswirkungen des gesetzlichen Mindestlohns auf die Wettbewerbsbedingungen. Studie im Auftrag der Mindestlohnkommission, ZEW, Mannheim.

Dustmann, Christian, Attila Lindner, Uta Schönberg, Matthias Umkehrer and Philipp vom Berge (2022), Reallocation effects of the minimum wage, The Quarterly Journal of Economics, 267-328.

Dütsch, Matthias and Oliver Bruttel (2021), Working conditions in minimum wage jobs, Economia & Lavoro, 54(3), 31-51.

Dütsch, Matthias and Ralf Himmelreicher (2020), Characteristics contributing to low- and minimum-wage labour in Germany, Journal of Economics and Statistics, 240(2-3), 161–200.

Esser, Hartmut (1996), Soziologie: Allgemeine Grundlagen, Frankfurt: Campus.

Fedorets, Alexandra and Ralf Himmelreicher (2021), Mindestlohn und Arbeitsintensität - Evidenz aus Deutschland, WSI-Mitteilungen, 74(6), 446-453.

Fitzenberger, Bernd and Arnim Seidlitz (2020), Die Lohnungleichheit von Vollzeitbeschäftigten in Deutschland: Rückblick und Überblick, AStA Wirtschafts- und Sozialstatistisches Archiv, https://doi.org/10.1007/s11943-020-00273-w, online first.

Fok, Yin King, Rosanna Scutella and Roger Wilkins (2015), The low-pay no-pay cycle: Are there systematic differences across demographic groups?, Oxford Bulletin of Economics and Statistics 77(6), 872–896.

Gallie, Duncan (2007): Employment regimes and the quality of Work. Oxford, UK: Oxford University Press.

Gautié, Jérôme and John Schmitt (2010), Low-wage work in the wealthy world, New York, NY: Russell Sage Foundation.

Grabka, Markus M. and Konstantin Göbler (2020), Der Niedriglohnsektor in Deutschland. Falle oder Sprungbrett für Beschäftigte?, Bertelsmann Stiftung, Gütersloh.

Herget, Anna and Regina T. Riphan (2022), The untold story of midijobs, Journal of Economics and Statistics, 242(3), 309-341.

Himmelreicher, Ralf (2020), Mindestlohn und beitragspflichtige Arbeitsentgelte, Deutsche Rentenversicherung, 75(4), 507-521.

Hirsch, Barry T., Bruce E. Kaufman and Tetyana Zelenska (2015), Minimum wage channels of adjustment, Industrial Relations, 54(2), 199-239.

Isphording, Ingo, Marco Caliendo, Robert Mahlstedt, Nico Pestel and Christian Zimpelmann (2022), Auswirkungen des gesetzlichen Mindestlohns auf individuelle Beschäftigungsbewegungen und betriebliche Lohnstrukturen in den Jahren 2015 bis 2020. Studie im Auftrag der Mindestlohnkommission IZA, Evaluation Office, Bonn.

Kalina, Thorsten and Claudia Weinkopf (2015), Niedriglohnbeschäftigung 2013: Stagnation auf hohem Niveau, IAQ-Report 2015-03, Institut Arbeit und Qualifikation, Duisburg.

Kalina, Thorsten and Claudia Weinkopf (2017), Niedriglohnbeschäftigung 2015 - bislang kein Rückgang im Zuge der Mindestlohneinführung, IAQ-Report 2017-06, Institut Arbeit und Qualifikation, Duisburg.

Kalina, Thorsten and Claudia Weinkopf (2018), Niedriglohnbeschäftigung 2016 - beachtliche Lohnzuwächse im unteren Lohnsegment, aber weiterhin hoher Anteil von Beschäftigten mit Niedriglöhnen, IAQ-Report 2018-06, Institut Arbeit und Qualifikation, Duisburg.

Kalleberg, Arne L. (2011), Good jobs, bad jobs. The rise of polarized and precarious employment systems in the United States, 1970s to 2000s, New York: Russell Sage Foundation.

Knabe, Andreas and Alexander Plum (2013), Low-wage jobs - Springboards to high-paid ones?, Review of Labour Economics and Industrial Relations, 27(3), 310–330.

Kohaut, Susanne and Peter Ellguth (2022), Tarifbindung und betriebliche Interessenvertretung : Ergebnisse aus dem IAB-Betriebspanel 2021, WSI-Mitteilungen, 75(4), 328-336.

Lester, Richard A. (1960), Employment effects of minimum wages, Industrial and Labor Relations Review, 13(2), 254-264.

Lester, Richard A. (1964), Economics of labor, New York: Macmillan.

Low Pay Commission (2021), Non-compliance and enforcement of the National Minimum Wage, April 2021, London.

Manning, Alan (2003), The real thin theory: Monopsony in modern labour markets, Labour Economics, 10, 105-131.

Mindestlohnkommission (2016), Erster Bericht zu den Auswirkungen des gesetzlichen Mindestlohns. Bericht der Mindestlohnkommission an die Bundesregierung nach § 9 Abs. 4 Mindestlohngesetz, Berlin.

Mindestlohnkommission (2018), Zweiter Bericht zu den Auswirkungen des gesetzlichen Mindestlohns. Bericht der Mindestlohnkommission an die Bundesregierung nach § 9 Abs. 4 Mindestlohngesetz, Berlin.

Mindestlohnkommission (2020), Dritter Bericht zu den Auswirkungen des gesetzlichen Mindestlohns. Bericht der Mindestlohnkommission an die Bundesregierung nach § 9 Abs. 4 Mindestlohngesetz, Berlin.

Mosthaf, Alexander, Claus Schnabel and Jens Stephani (2011), Low-wage careers: Are there dead-end firms and dead-end jobs?, Journal for Labour Market Research, 43(3), 231–249.

Moulton, Brent (1986), Random group effects and the precision of regression estimates, Journal of Econometrics, 32(3), 385–397.

Moulton, Brent (1990), An illustration of a pitfall in estimating the effects of aggregate variables on micro units, Review of Economics and Statistics, 72(2), 334-338.

Personaldienstleiter, Bundesarbeitgeberverband der (2019), Tarifverträge Zeitarbeit, Berlin.

Pestel, Nico, Holger Bonin, Ingo Isphording, Terry Gregory and Marco Caliendo (2020), Auswirkungen des gesetzlichen Mindestlohns auf Beschäftigung und Arbeitslosigkeit, Studie im Auftrag der Mindestlohnkommission, Forschungsinstitut zur Zukunft der Arbeit, Bonn.

Phelan, Brian J. (2019), Hedonic-based labor supply substitution and the ripple effect of minimum wages, Journal of Labor Economics, 37(3), 905-947.

Rabe-Hesketh, Sophia and Anders Skrondal (2008), Multilevel and longitudinal modeling using stata, College Station, TX: Stata Press.

Schmitt, John (2015), Explaining the small employment effects of the minimum wage in the United States, Industrial Relations, 54(4), 547-581.

Schnabel, Claus (2016), Low-wage employment. Are low-paid jobs stepping stones to higher paid jobs, do they become persistent, or do they lead to recurring unemployment?, IZA World of Labor, 2016(276).

Statistisches Bundesamt (2016), Verdienststrukturerhebung. Erhebung der Struktur der Arbeitsverdienste nach § 4 Verdienststatistikgesetz, VSE 2014 Qualitätsbericht, Wiesbaden.

Statistisches Bundesamt (2017), Mindestlohn verringert Spannweite der Tarifverdienste in einzelnen Branchen, Pressemitteilung 280 vom 16. August 2017, Wiesbaden.

Statistisches Bundesamt (2020), Verdienststrukturerhebung 2018. Erhebung der Struktur der Arbeitsverdienste nach § 4 Verdienststatistikgesetz, VSE 2018 Qualitätsbericht, Wiesbaden.

Struck, Olaf (2006), Flexibilität und Sicherheit: Empirische Befunde, theoretische Konzepte und institutionelle Gestaltung von Beschäftigungsstabilität, Wiesbaden: VS Verlag.

vom Berge, Philipp, Steffen Kaimer, Silvina Copestake, Daniela Croxton, Johanna Eberle, Wolfram Klosterhuber and Jonas Krüger (2016), Arbeitsmarktspiegel. Entwicklungen nach Einführung des Mindestlohns (Ausgabe 2), IAB-Forschungsbericht 12/2016, Institut für Arbeitsmarkt- und Berufsforschung, Nürnberg.

Wooldridge, Jeffrey M. (2012), Introductory econometrics: a modern aporach, Mason, USA: South-Western, Cengage Learning.

Appendix

Tab. A1: Sectoral and marginal job characteristics in Germany, 2018

	All jobs	Share of marginal employed jobs	Share of minimum-wage jobs among marginal employment < 8.89 euros
Percent of all workers	100%	14.66%	14.24%
Mean wage in euros	*18.97*	*11.06*	*8.68*
Agriculture, Forestry, and Fishing	0.82%	25.09%	9.69%
Mean wage in euros	*12.37*	*10.52*	*8.70*
Mining and quarrying	0.13%	4.76%	9.78%
Mean wage in euros	*21.73*	*11.81*	*8.79*
Manufacturing	18.07%	5.62%	12.79%
Mean wage in euros	*22.23*	*11.06*	*8.65*
Electricity, gas, steam, and water supply	1.28%	4.36%	2.75%
Mean wage in euros	*23.18*	*13.32*	*8.64*
Construction	4.83%	11.71%	4.62%
Mean wage in euros	*16.75*	*12.25*	*8.78*
Wholesale and retail trade; repair of motor vehicles and motorcycles	13.63%	18.19%	21.06%
Mean wage in euros	*16.60*	*10.60*	*8.75*
Transportation and storage	5.42%	17.89%	30.98%
Mean wage in euros	*15.39*	*10.19*	*8.65*
Accommodation and food service activities	4.62%	41.55%	19.88%
Mean wage in euros	*11.07*	*9.86*	*8.67*
Information and communication	3.06%	9.27%	20.08%
Mean wage in euros	*26.22*	*11.54*	*8.63*
Financial and insurance activities	2.46%	5.98%	6.55%
Mean wage in euros	*26.48*	*12.10*	*8.58*
Real estate activities	1.26%	42.40%	9.67%
Mean wage in euros	*17.12*	*11.77*	*8.75*
Professional, scientific, and technical activities	6.03%	13.55%	12.22%
Mean wage in euros	*23.19*	*12.35*	*8.70*
Administrative and support service activities	7.90%	24.54%	7.34%
Mean wage in euros	*13.59*	*10.59*	*8.64*
Public administration and defence; compulsory social security	6.50%	3.33%	1.80%
Mean wage in euros	*22.12*	*11.00*	*8.87*
Education	6.23%	10.26%	3.24%
Mean wage in euros	*21.96*	*12.03*	*8.50*

	All jobs	Share of marginal employed jobs	Share of minimum-wage jobs among marginal employment < 8.89 euros
Human health and social work activities	13.48%	11.88%	8.31%
Mean wage in euros	*18.37*	*12.14*	*8.55*
Arts, entertainment, and recreation	1.27%	39.56%	18.66%
Mean wage in euros	*14.67*	*11.08*	*8.70*
Other service activities	3.00%	25.55%	12.33%
Mean wage in euros	*16.65*	*11.69*	*8.75*
Number of observations, n	969,464	118,842	20,250
Number of observations, N	37,856,400	5,551,477	790,605

Notes: All figures are population weighted, which correct for sex, region, type of employment and company size.

Source: Research data centres of the statistical offices of the Federation and the Länder, SES 2018; own calculations.

Tab. A2: Estimation results for intercept-only models 2014 (3-level random intercept models without explanatory variables)

	Probability of earning low wage	Probability of earning minimum wage	Distance to low-wage threshold	Distance to minimum-wage threshold
Residual variance (industrial sectors)	3.762	3.111	0.086	0.055
Residual variance (companies)	6.216	6.791	0.944	0.772
Residual variance (individual level)	3.289	3.289	0.986	0.769
Relative importance of industrial sectors	28.35	24.09	4.26	3.45
Relative importance of companies	46.85	52.06	46.83	48.37
Relative importance of individual level	24.80	23.85	48.91	48.18
Number of industrial sectors	45	45	45	45
Number of companies	70.303	70.303	46.829	28.804
Number of jobs	978.817	978.817	196.851	110.019
LR test vs. logistic model	653.02	430.40	447.70	218.39
Prob > chi²	0.000	0.000	0.000	0.000

Notes: In the intercept-only models, all 45 industries contained in the dataset were used.

Source: Research data centres of the Statistical Offices of the Federation and the Länder, SES, 2014; own calculations.

Tab. A3: Estimation results for intercept-only models 2018 (3-level random intercept models without explanatory variables)

	Probability of earning low wage	Probability of earning minimum wage	Distance to low-wage threshold	Distance to minimum-wage threshold
Residual variance (industrial sectors)	3.537	1.536	0.030	0.095
Residual variance (companies)	5.981	5.753	0.336	0.968
Residual variance (jobs)	3.289	3.289	0.473	0.284
Relative importance of industrial sectors	27.62	14.52	3.58	7.05
Relative importance of companies	46.70	54.39	40.05	71.86
Relative importance of individual level	25.68	31.09	56.38	21.08
Number of industrial sectors	44	44	44	44
Number of companies	70.512	70.512	42.528	13.224
Number of jobs	969.477	969.477	190.204	36.586
LR test vs. logistic model	608.49	163.25	272.99	120.12
Prob > chi²	0.000	0.000	0.000	0.000

Notes: In the intercept-only models, all 44 industries contained in the dataset were used.

Source: Research data centres of the statistical offices of the Federation and the Länder, SES 2018; own calculations.

Tab. A4: Changes in the relationship between low-wage and minimum-wage labour and selected individual-, company-, and industry-specific characteristics between 2014 and 2018

	Probability of low-wage job	Probability of minimum-wage job	Distance to the low-wage threshold	Distance to the minimum-wage threshold
Year (Ref.: 2014)				
2018	-0.341***	-0.756***	0.022	0.132
	(0.113)	(0.146)	(0.078)	(0.117)
Gender (Ref.: Male)				
Female	0.562***	0.413***	0.081***	-0.064***
	(0.014)	(0.015)	(0.010)	(0.012)
Interaction: Gender (Ref.: Male x Year (2018=1))				
Female x 2018	-0.229***	-0.321***	-0.0910***	0.00359
	(0.018)	(0.024)	(0.012)	(0.017)
Highest educational degree (Ref.: Vocational training, master craftsman)				
No vocational training	1.046***	0.674***	0.258***	0.130***
	(0.025)	(0.022)	(0.015)	(0.019)
Polytechnic/ university degree	-1.543***	-1.288***	-0.082*	0.176***
	(0.040)	(0.037)	(0.048)	(0.052)
Unknown	0.714***	0.582***	0.251***	0.128***
	(0.016)	(0.020)	(0.014)	(0.016)

	Probability of low-wage job	Probability of minimum-wage job	Distance to the low-wage threshold	Distance to the minimum-wage threshold
Interaction: Highest educational degree (Ref.: Vocational training, master craftsman x Year (1=2018)				
No vocational training x 2018	0.066*	-0.052	-0.162***	-0.064**
	(0.035)	(0.037)	(0.018)	(0.026)
Polytechnic/ university degree x 2018	0.162***	0.422***	0.254***	0.651***
	(0.051)	(0.064)	(0.057)	(0.101)
Unknown x 2018	0.074***	-0.00962	-0.154***	-0.102***
	(0.025)	(0.035)	(0.016)	(0.022)
Age (in years)	-0.100***	-0.098***	-0.044***	-0.018***
	(0.003)	(0.003)	(0.002)	(0.003)
Interaction: Age (in years) x Year (1=2018)				
Age (in years) x 2018	-0.004	0.006	0.015***	-0.003
	(0.004)	(0.005)	(0.003)	(0.004)
Age (in years squared)	0.001***	0.001***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Age (in years squared) x 2018	0.000	-0.000	-0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Tenure (in years)	-0.097***	-0.070***	-0.023***	-0.016***
	(0.002)	(0.003)	(0.002)	(0.002)
Interaction: Tenure (in years) x Year (1=2018)				
Tenure (in years) x 2018	0.011***	0.012***	0.020***	0.025***
	(0.004)	(0.005)	(0.002)	(0.004)
Tenure (in years squared)	0.001***	0.000***	0.000***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Tenure (in years squared) x 2018	-0.000**	-0.000	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Type of employment (Ref: Full-time)				
Part-time	0.750***	0.702***	0.211***	0.085***
	(0.016)	(0.021)	(0.013)	(0.015)
Marginal employment	2.527***	1.921***	0.744***	0.587***
	(0.023)	(0.024)	(0.016)	(0.019)
Interaction: Type of employment (Ref.: Full-time x Year (1=2018))				
Part-time x 2018	0.106***	0.214***	-0.126***	-0.413***
	(0.023)	(0.039)	(0.016)	(0.028)
Marginal employment x 2018	-0.0334	-0.144***	-0.526***	-1.072***
	(0.031)	(0.047)	(0.019)	(0.030)
Type of contract (Ref: Permanent contract)				
Fixed-term contract	0.466***	0.276***	0.0421***	0.0271
	(0.020)	(0.023)	(0.015)	(0.018)
Interaction: Type of contract (Ref: Permanent contract x Year (1=2018))				
Fixed-term contract x 2018	0.015	-0.096**	-0.005	0.024
	(0.028)	(0.039)	(0.018)	(0.026)
Temporary work (Ref: Regular work)				
Temporary work	0.275***	0.260***	0.218***	-0.060
	(0.071)	(0.088)	(0.034)	(0.051)
Interaction: Temporary work (Ref: Regular work x Year (1=2018))				
Temporary work x 2018	0.111	-0.228	-0.116**	0.078
	(0.106)	(0.168)	(0.048)	(0.084)

	Probability of low-wage job	Probability of minimum-wage job	Distance to the low-wage threshold	Distance to the minimum-wage threshold
Size of company (Ref: 250>)				
<5	0.737***	0.373***	-0.0676*	-0.0696
	(0.041)	(0.054)	(0.039)	(0.047)
5-49	0.525***	0.403***	-0.0601*	-0.172***
	(0.036)	(0.049)	(0.036)	(0.045)
50-249	0.282***	0.229***	-0.089**	-0.224***
	(0.036)	(0.050)	(0.036)	(0.046)
unknown	-0.099	0.050	0.049	-0.039
	(0.063)	(0.077)	(0.055)	(0.081)
Interaction: Size of company (Ref: 250> x Year (1=2018))				
<5 x 2018	-0.159***	-0.400***	0.060	-0.011
	(0.054)	(0.087)	(0.043)	(0.057)
5-49 x 2018	-0.106**	-0.350***	0.039	0.050
	(0.047)	(0.079)	(0.040)	(0.054)
50-249 x 2018	0.026	-0.190**	0.060	0.116**
	(0.049)	(0.080)	(0.040)	(0.056)
unknown x 2018	0	0	0	0
	(.)	(.)	(.)	(.)
Region (Ref: South)				
North-West	0.328***	0.377***	0.223***	0.121***
	(0.028)	(0.032)	(0.021)	(0.029)
North-East	1.639***	1.911***	0.979***	0.473***
	(0.029)	(0.032)	(0.022)	(0.027)
West	0.223***	0.262***	0.120***	0.016
	(0.026)	(0.031)	(0.021)	(0.025)
Interaction: Region (Ref: South x Year (1=2018))				
North-West x 2018	0.0335	-0.074	-0.157***	-0.186***
	(0.040)	(0.056)	(0.025)	(0.037)
North-East x 2018	-0.282***	-0.892***	-0.794***	-0.746***
	(0.041)	(0.056)	(0.025)	(0.034)
West x 2018	-0.000	0.037	-0.042*	-0.031
	(0.036)	(0.055)	(0.024)	(0.035)
Collective agreement (Ref: Sectoral collective agreement)				
Company not bound by a collective agreement	0.588***	0.660***	0.351***	0.273***
	(0.024)	(0.031)	(0.020)	(0.024)
Company bound by company collective agreement	-0.779***	-0.610***	0.021	0.292***
	(0.059)	(0.079)	(0.054)	(0.071)
unknown	0.303***	0.491***	0.373***	0.315***
	(0.032)	(0.042)	(0.027)	(0.031)
Interaction: Collective agreement (Ref: Sectoral collective agreement x Year (1=2018))				
Company not bound by a collective agreement x 2018	0.150***	0.145**	-0.268***	-0.389***
	(0.038)	(0.066)	(0.024)	(0.039)
Company bound by company collective agreement x 2018	0.240**	0.272*	-0.079	-0.191*
	(0.097)	(0.156)	(0.068)	(0.112)
unknown x 2018	0.272***	0.154**	-0.324***	-0.439***
	(0.045)	(0.074)	(0.031)	(0.046)

	Probability of low-wage job	Probability of minimum-wage job	Distance to the low-wage threshold	Distance to the minimum-wage threshold
Gender distribution (Ref: More men in company)				
more women in company	0.088***	0.106***	0.036	-0.040
	(0.033)	(0.034)	(0.025)	(0.028)
Interaction: Gender distribution (Ref: More men in company x Year (1=2018))				
more women in company x 2018	0.219***	-0.007	-0.059**	0.021
	(0.039)	(0.050)	(0.027)	(0.034)
Industry (Ref: Manufacturing)				
Agriculture, forestry, and fishing	1.101***	0.909***	0.206***	-0.033
	(0.063)	(0.072)	(0.046)	(0.044)
Mining and quarrying	-1.077***	-1.506***	-0.653***	-0.396***
	(0.134)	(0.190)	(0.086)	(0.130)
Electricity, gas, steam, and water supply	-0.517***	-1.316***	-0.424***	0.048
	(0.082)	(0.101)	(0.053)	(0.109)
Construction	-1.036***	-1.156***	-0.388***	0.113**
	(0.042)	(0.056)	(0.038)	(0.053)
Wholesale and retail trade; repair of motor vehicles	-0.128***	0.089**	0.059**	-0.111***
	(0.031)	(0.039)	(0.025)	(0.032)
Transportation and storage	0.472***	0.733***	0.571***	0.377***
	(0.044)	(0.052)	(0.047)	(0.049)
Accommodation and food service activities	1.454***	1.239***	0.544***	0.126***
	(0.037)	(0.042)	(0.027)	(0.031)
Information and communication	-0.464***	0.120*	0.455***	0.264***
	(0.048)	(0.062)	(0.055)	(0.058)
Financial and insurance activities	-1.256***	-0.918***	-0.123**	-0.029
	(0.060)	(0.078)	(0.059)	(0.069)
Real estate activities	-0.647***	-0.400***	-0.027	0.157**
	(0.059)	(0.073)	(0.061)	(0.079)
Professional, scientific, and technical activities	-0.731***	-0.372***	0.142***	0.290***
	(0.043)	(0.058)	(0.048)	(0.059)
Administrative and support service activities	0.999***	0.290***	-0.132***	-0.259***
	(0.038)	(0.049)	(0.029)	(0.035)
Public administration and defence; compulsory social security	-1.656***	-1.191***	0.117	0.130
	(0.144)	(0.156)	(0.091)	(0.097)
Education	-0.828***	-0.771***	-0.210***	0.098
	(0.085)	(0.098)	(0.075)	(0.125)
Human health and social work activities	-0.425***	-0.428***	-0.090***	-0.022
	(0.041)	(0.049)	(0.032)	(0.038)
Arts, entertainment, and recreation	0.401***	0.849***	0.630***	0.267***
	(0.041)	(0.044)	(0.032)	(0.033)
Other service activities	0.860***	0.914***	0.423***	0.095***
	(0.042)	(0.047)	(0.030)	(0.032)

	Probability of low-wage job	Probability of minimum-wage job	Distance to the low-wage threshold	Distance to the minimum-wage threshold
Interaction: Industry (Ref: Manufacturing x Year (1=2018))				
Agriculture, forestry, and fishing x 2018	-0.059	-0.379***	-0.141***	-0.166***
	(0.082)	(0.116)	(0.050)	(0.062)
Mining and quarrying x 2018	0.185	0.420	0.407***	0.810**
	(0.198)	(0.310)	(0.119)	(0.318)
Electricity, gas, steam, and water supply x 2018	-0.029	0.211	0.192***	-0.084
	(0.118)	(0.263)	(0.068)	(0.173)
Construction x 2018	-0.103	0.036	0.144***	-0.103
	(0.063)	(0.111)	(0.045)	(0.076)
Wholesale and retail trade; repair of motor vehicles x 2018	0.088*	0.035	-0.061**	0.012
	(0.046)	(0.067)	(0.030)	(0.044)
Transportation and storage x 2018	-0.212***	-0.000	-0.395***	-0.402***
	(0.065)	(0.089)	(0.053)	(0.065)
Accommodation and food service activities x 2018	-0.283***	-0.746***	-0.396***	-0.124***
	(0.056)	(0.073)	(0.032)	(0.044)
Information and communication x 2018	0.059	0.195**	-0.278***	-0.273***
	(0.071)	(0.099)	(0.062)	(0.074)
Financial and insurance activities x 2018	0.329***	0.077	0.031	0.215*
	(0.080)	(0.137)	(0.066)	(0.130)
Real estate activities x 2018	-0.006	-0.074	-0.073	-0.089
	(0.075)	(0.103)	(0.065)	(0.098)
Professional, scientific, and technical activities x 2018	-0.056	0.114	-0.112**	-0.093
	(0.060)	(0.106)	(0.054)	(0.081)
Administrative and support service activities x 2018	-0.168***	-0.301***	-0.058*	0.181***
	(0.054)	(0.087)	(0.034)	(0.048)
Public administration and defence; compulsory social security x 2018	-0.161	-1.795***	-0.424***	-0.521***
	(0.189)	(0.251)	(0.099)	(0.117)
Education x 2018	0.308**	-0.420*	-0.157*	-0.482***
	(0.127)	(0.241)	(0.091)	(0.177)
Human health and social work activities x 2018	-0.286***	-0.111	-0.063	0.094
	(0.060)	(0.094)	(0.038)	(0.059)
Arts, entertainment, and recreation x 2018	-0.100*	-0.350***	-0.475***	-0.320***
	(0.059)	(0.079)	(0.037)	(0.046)
Other service activities x 2018	-0.283***	-0.298***	-0.295***	-0.249***
	(0.063)	(0.085)	(0.035)	(0.043)
Constant	-1.096***	-2.448***	1.671***	1.264***
	(0.086)	(0.090)	(0.067)	(0.084)
Observations	**1948111**	**1948111**	**424751**	**146432**

Notes: Standard errors are clustered at the company level. The dependent variable 'probability' is coded as dummy variables. The value 1 represents a job paying less than 10.33 euros (low-wage threshold) or 8.50 euros (minimum-wage threshold); the dependent variable 'distance' is a metric and denotes the gap between the hourly wage and the low or minimum wage. In the case of binary logit estimates, the average marginal effects are shown. Although the results are presented in figures 2-4, they come from an estimation including individual-, company-, and industry-level variables.
Spikes are drawn for 99.9%, 99%, and 95% confidence intervals.
Source: Research data centres of the statistical offices of the Federation and the Länder, SES 2014, SES 2018; own calculations.