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MIND THE GAP: EFFECTS OF THE NATIONAL MINIMUM WAGE ON THE GENDER WAGE GAP IN GERMANY

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Mind the Gap: Effects of the National Minimum Wage on the Gender Wage Gap in Germany*

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Abstract

With its introduction in 2015, the statutory minimum wage in Germany intends to benefit primarily low-wage workers. Thus, this paper aims at estimating the effectiveness of the implemented wage floor on gender wage gaps in the lower half of the wage distribution. Using administrative data, distinct regional differences regarding magnitudes of wage differentials and responses to the minimum wage are identified. Overall, wage gaps between men and women at the 10th percentile decrease by 2.46 and 6.34 percentage points respectively in the West and East of Germany after 2015. Applying counterfactual wage distributions, the study provides new evidence that around 60% and even 95% of the decline result from the introduction of the minimum wage in each region. Further, group-specific analyses identify concrete responses on the basis of age, educational level and occupational activity. Having yearly data, the study additionally reveals new results on the impact of the successive minimum wage raises in 2017 and 2019. Counterfactual aggregate decompositions of gender wage gaps finally indicate a decrease in discriminatory remuneration structures in the West of Germany due to the introduced wage floor.

JEL classification: J16, J31, J38, J71, J78
Keywords: Gender Wage Gap, Minimum Wage, Germany

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1 Introduction

With one of the highest observed unadjusted gender wage gaps in the European Union and significant constant values over time, research on wage differentials between men and women in Germany and possible ways to fight against it is still of high importance (Eurostat, 2022). In the existing literature, factors and causes that drive gender wage gaps in Germany have been extensively investigated (see for example Grandner and Gstach (2015) and Antonczyk et al. (2010)). In this context, higher shares of women in the low-paid sector and thus resulting persistent gaps between men and women at lower wage levels arise (see for example Grabka and Schröder (2019) as well as Boll and Lagemann (2019)). The introduction of the national minimum wage in 2015 in Germany should therefore show an impact on observable wage differences between men and women. Thus, to which extent and in which parts of the workforce this policy measure is effective in reducing wage gaps needs to be identified.

The paper contributes to the existing literature in several ways. The study provides first evidence on the effects on the introduced national binding minimum wage in 2015 on the observed gender wage gap in Germany. Further, the effects of subsequent increases in the wage floor in 2017 and 2019 can be observed separately and thus specific results on the effectiveness of the minimum wage at different time points can be provided. Differentiating between the East and the West of Germany allows not only to identify regional-specific conditions before the introduction of the minimum wage but also reveals varied responses in regional gender wage gaps. Most important, the applied method makes it possible to provide new evidence on how decreases in the gender wage gap can be separated into an effect due to changes in the observed characteristics and into an impact resulting from the wage floor. Lastly, decomposition analyses identify implications of changes in the factors that drive the adjusted gender wage gap after 2015.

Using administrative SIAB data provided by the German Institute for Employment Research, enables to provide detailed regional-specific estimates on the eligibility of male and female workers for the introduced wage floor and to conduct counterfactual analyses on the observed change in the gender wage gap after 2015. The applied type of difference-in-differences analysis allows a specific separation of the impact on the gender wage gap resulting from the minimum wage. Here, additionally to the actual observed wage distributions, counterfactual wage distributions introduced by DiNardo et al. (1996) with constant characteristics of workers are estimated.

The presented descriptive statistics reveal on the one hand significantly higher gender wage gaps in the lower half of the wage distribution for the West of Germany compared to the East of Germany. On average, wage differentials between men and women up to the median are 13 percentage points higher in regions of the West. At the same time, descriptive analyses

show significantly higher values of minimum wage bites for the East of Germany, in particular for female workers. On the other hand, varied responses in observed gender wage gaps after 2015 for the two different regions in Germany are identified. Overall, gender differentials at the lowest wages decrease by 2.46 and 6.34 percentage points respectively in the West and East of Germany after the introduction of the minimum wage. Using counterfactual wage distributions with constant characteristics from point in time before the introduction of the binding wage floor, it is possible to identify specific separate effects. While for the West of Germany around 60% in the decrease can be traced back to the minimum wage, even 95% of the change are explained by the wage floor in the East of Germany. Distinguishing further between several groups of workers on the basis of educational levels, age and occupational activities it is possible to identify further regional- and group-specific responses. In addition, the study provides evidence on the effects of the two minimum wage increases in the years 2017 and 2019. Although smaller in size, the impact on wage gaps between men and women is observable as well. Lastly, additional to the analyses of the overall observable unadjusted wage gaps, applying aggregate decomposition estimations, this paper reveals indications for a decrease in discriminatory remuneration between men and women in the West of Germany.

The remainder of this paper is structured as follows: Section 2 describes the minimum wage legislation in Germany and provides an overview on related literature. In Section 3, information on the used data set is provided. General facts on the minimum wage bite and the extent of wage differentials between men and women in Germany as well as descriptive statistics are presented in Section 4. Further, in Section 5 the empirical approaches are specified and finally, the empirical results are presented in Section 6. Discussion and conclusion of the estimated findings are provided in Section 7.

2 Minimum Wage and Related Literature

2.1 Germany's Minimum Wage Legislation

The German government introduced a gross national minimum wage of €8.50 per hour with the primary aim of raising hourly wages in the low-wage sector in January 2015. The introduced Minimum Wage Commission regularly evaluates the value of the wage floor, which should guarantee on the one hand an adequate remuneration of workers and on the other hand functioning market competition without enforcing losses of jobs (see MiLoG §9). Therefore, the minimum wage was steadily increased in the years 2017 (€8.84), 2019 (€9.19) and every year thereafter with a current minimum wage of €12.00 since October 2022. Before 2015, there were several sector-specific minimum wage arrangements, such as the in the mainstream construction industry since 1997, in the property cleaning sector since 2007, the care sector since

2010 and in the meat industry since 2014.[1] With its introduction, the national minimum wage has a legal force across all regions and almost all sectors as well as affected directly around 11% of all jobs in Germany in 2015 (Destatis, 2016). Specific groups that are exempted from the statutory minimum wage are trainees, most interns, volunteers, and long-term unemployed within the first 6 months of employment.[2] For the very few cases of sectoral-specific minimum wage agreements that lie below the initial value of €8.50 in 2015, a special transition period was allowed until 2017.

2.2 Related Literature

After many years of debate about possible threats on the German labour market the national minimum wage was introduced in 2015. The main argument of several critics aimed at predicted decreases in employment with estimated job losses between 200,000 to over one million in the long run, with circa one fourth of job losses in the East of Germany. These predicted job losses were especially seen among marginal as well as low- and semi-skilled full-time workers (Müller and Steiner (2011), Knabe and Schöb (2009) & Bauer et al. (2009)). Further, assumed increases in consumer prices due to the introduction of the minimum wage and a consequential rise of employers' labour costs would have counteracted any positive direct effect on households' net incomes. Thus, opponents of a general wage floor questioned the general effectiveness regarding the aimed fight against poverty and decrease of income inequality (Müller and Steiner (2008), Müller and Steiner (2013) & Knabe et al. (2014)). In contrast to these arguments, supporters of the general minimum wage emphasised the rapid expansion of the low-wage sector in Germany and the resulting social distortions that should be compensated (for example Bosch (2007) and Kalina and Weinkopf (2014)). Studies on labour market responses to the minimum wage after its introduction provide evidence that the general wage floor increases wages with at the same time hardly any or no employment losses (Bossler and Gerner (2020) & Dustmann et al. (2022)). Observed job losses are mainly assignable to establishments in the East of Germany and those that are exposed to strong competitive pressure (Friedrich (2020) & Börschlein and Bossler (2019)). Regarding the main target of achieving higher wages at the lower end of the wage distribution, Bossler and Gerner (2020) reveal average wage increases of around 10% for affected wage earners and a rise in average overall wages between 3.8% and 6.3% using administrative data. Ahlfeldt et al. (2018) support these findings and present evidence on spatial wage convergence. Wages in low-wage regions increase faster than in high-wage areas with at the same time no significant relative job loss in these regions.

[1] For more details see WSI Tarifarchiv,
`https://www.wsi.de/de/mindestloehne-in-deutschland-15302.htm`.

[2] For detailed information on the defined groups see MiLoG §22.

Regarding the overall aim of reducing observed wage disparities among the German workforce, initial studies show that in the short run inequality reduction is not achieved (e.g. Caliendo et al. (2019) and Grabka and Schröder (2018)). Expanding the period of observation until 2017, Bossler and Schank (2020) identify the impact of the minimum wage on the recent decrease of inequality using difference-in-differences estimations. They show that overall inequality measured by the variance decreased by 15% after the minimum wage introduction and the reduction would have been only by around 8.5% with no introduced wage floor. However, by not distinguishing between women and men, there is no evidence on the development of between inequality of these two groups. Ohlert (2018) provides descriptive evidence on wage developments in the low-wage sector after 2015 by gender and region. Whereas in the East of Germany wages of women increased more rapidly than those of men, gender-specific differences in wage growth were not identified in the West of Germany. Overall, they show that from 2014 to 2015 the observed gender wage gap decreases from 22% to 19.3%. However, no causal impact due to the introduction of the minimum wage is provided.

Caliendo and Wittbrodt (2022) identify first effects on the gender wage gap by the minimum wage applying a regional difference-in-differences approach with data from the Structure of Earnings Survey for the years 2014 and 2018. Thus, only joint estimations for the effects resulting from the introduction of the wage floor and its first increase are identified. They show a significant reduction of 4.6 percentage points in the gender wage gap at the 10th percentile in high-bite regions, where female workers are highly impacted by the minimum wage. These results are strongly in line with international empirical literature on the impact of minimum wages on gender wage gaps. Among others, DiNardo et al. (1996), Dex et al. (2000) and Majchrowska and Strawiński (2018) reveal wage gap decreasing effects resulting from introduced or rising minimum wages in the US, in the UK and Poland.

3 Data

The study is based on the weakly anonymous version of the Sample of Integrated Labour Market Biographies (SIAB) with an overall period of observation from 1975 to 2019 (Berge et al., 2021).[3] This administrative data set, provided by the Institute for Employment Research (IAB), is a two percent random sample drawn from the social security records of the Integrated Employment

[3]Berge, Philipp vom; Frodermann, Corinna; Graf, Tobias; Grießemer, Stephan; Kaimer, Steffen; Köhler, Markus; Lehnert, Claudia; Oertel, Martina; Schmucker, Alexandra; Schneider, Andreas; Seth, Stefan (2021): "Weakly anonymous Version of the Sample of Integrated Labour Market Biographies (SIAB) – Version 7519 v1". Research Data Centre of the Federal Employment Agency (BA) at the Institute for Employment Research (IAB). DOI: 10.5164/IAB.SIAB7519.de.en.v1. The data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and subsequently remote data access.

Biographies (IEB) in Germany. The data set consists of mandatory notifications made by employers to social security agencies and thus provides information about all individuals that are covered by the statutory retirement insurance. Therefore, self-employed individuals, civil servants, and family workers are not considered. Overall, the data represent approximately 80 percent of the German workforce.

The data set provides a rich set of information on several individual- and occupation-specific characteristics. In particular, it contains information on gender, the year of birth, the educational attainment, the type of contract (whether full-time or part-time employment) and the region of work (federal state and district levels). Further, relevant information on the employment related characteristics such as the type of occupation, the occupational activity, as well as the number of days in employment and job is presented. Details on the classification of economic activities, total number of employees and region of activity of establishments are included as well.

The SIAB data is structured by employment spells, which means that there are two identifier-variables indicating the start date and the end date of the observation. Using only the respective job spells referring to June 30 a yearly panel is created. If a worker has more than one job at the point of observation, the following analyses only keep the main job of the individual, which is defined as the job with the highest daily wage. Observations with a wage of zero are as well not considered in the analysis. The sample is restricted to women and men that are between 25 and 55 years old.[4] Using the Consumer Price Index provided by the German Federal Statistical Office, wage information are converted into constant 2015 Euros.

Several advantages of administrative data, such as a high number of observations, no interviewer effects or survey bias as well as yearly data information, qualify the SIAB data set particularly for the underlying study. Nevertheless, the data set has two shortcomings that have to be kept in mind. First, the underlying data on wage earnings is right-censored at the contribution assessment ceiling of the social security system. In order to circumvent this issue, the wage imputation method following the approach by Gartner (2005) can be applied.[5] However, since the analysis focuses only on wage information of the lower half of the wage distribution, no impact resulting of this characteristic is expected. Second, there is no precise information on the number of hours worked per month or week. Thus, the study is restricted to full-time working individuals, which follows common procedure in existing literature on minimum wage and gender wage gap research in Germany (see Caliendo and Wittbrodt (2022); Weyh et al.

[4]Following existing literature the age is restricted in order to circumvent possible gender-specific differences in period of education and retirement, see for example Schrenker and Zucco (2020) and Selezneva and Van Kerm (2016).

[5]Using this method in order to impute wages, yearly tobit estimations by gender above the social security threshold are estimated controlling for standard factors such as age, education, tenure and occupational field.

(2022) and Blömer et al. (2018)).[6]

The study considers the following individual explanatory factors. Workers are classified in age groups[7], groups in accordance with their educational level (three dummy variables[8]) and by nationality. Regarding the individual work experience, groups for days in employment and days of job tenure are considered[9]. Further, 14 different occupational segments based on the 2-digit Classification of Occupations 2010 (Klassifizierung der Berufe 2010, KldB 2010) as well as four different groups of occupational activities[10] are taken into account to control for occupation related effects. Firm-specific properties such as the economic sector (19 groups based on the Classification of Economic Activities, WZ 2008) and the firm size (six dummy variables[11]) augment the explanatory factors. Regional-specific effects are controlled by dummy variables indicating the federal state. For descriptive statistics information on the district of employment is used.[12] In order to increase the regional number of observations on a yearly and district-level basis, the regional-specific data is aggregated at the level of German spatial planning regions, „Raumordnungsregionen“ (ROR).[13] This aggregation summarizes districts defined by the NUTS (Nomenclature of Territorial Units for Statistics) classifications that belong to a specific economic center and its surrounding areas (BBSR Bonn, 2019).[14]

4 Descriptive Evidence

The following section presents descriptive evidence on regional and gender-specific minimum wage bites as well as gender wage gaps in Germany. Further, the descriptive statistics are presented and characteristics of minimum wage workers are identified.

Minimum wage bite. With the introduction of the national minimum wage in Germany, it is necessary to show who and which regions are especially affected by the defined wage floor. Therefore, in Figure 1 the minimum wage bite at the level of German spatial planning regions is

[6]Workers in part-time employment, which is defined as working less than 30 hours per week, are excluded in order to increase comparability.

[7](1) 25-34 years, (2) 35-44 years and 45-55 years.

[8](1) Low: lower/middle secondary without vocational training; (2) Medium: lower/middle secondary with vocational training or upper secondary with or without vocational training; (3) High: university of applied sciences or traditional university.

[9](1) $<$ 2 years, (2) 2-4 years, (3) 4-8 years (4) 8-16 years (5) $>$ 16 years.

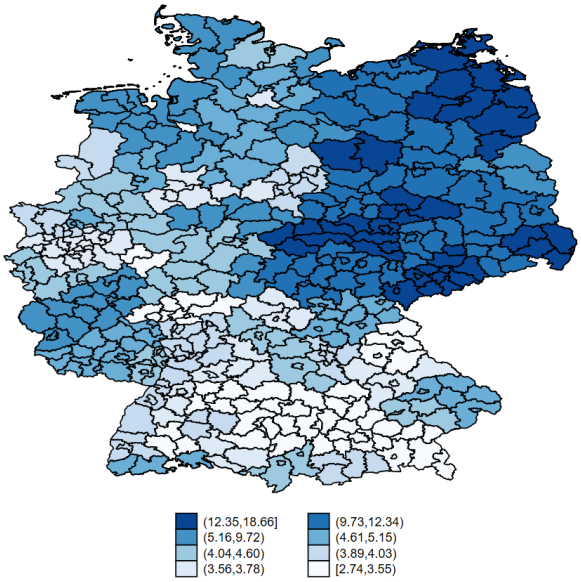
[10](1) unskilled activities, (2) specialist activities, (3) complex activities, (4) highly complex activities.

[11](1) 1-9 employees; (2) 10-49 employees; (3) 50-199 employees; (4) 200-999 employees; (5) 1000-4999 employees; (6) $\geq$5000 employees.

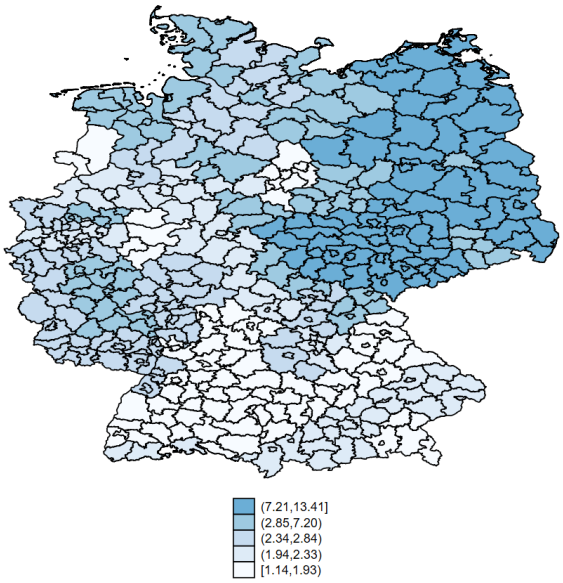
[12]Due to its particular sensitivity with regard to data protection legislation, this variable is only available on application, see Berge et al. (2021).

[13]The German spatial planning regions are called ROR-regions thereafter.

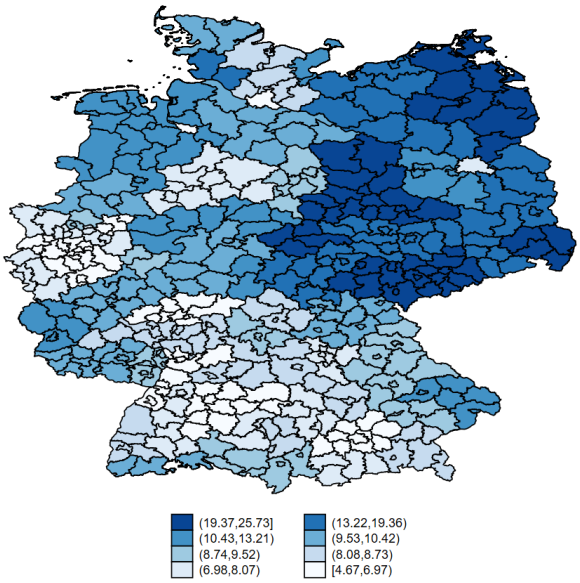
[14]A detailed graphical depiction of the defined ROR-regions with their respective districts is provided by the BBSR Bonn (2019).



(a) Minimum wage bite, overall sample



(b) Minimum wage bite, men



(c) Minimum wage bite, women

Figure 1: Estimated minimum wage bite for different groups, 2013/14

Source: SIAB7519, own calculations.
Notes: The different subfigures present the estimated results of the overall minimum wage bite as well as for men and women separately at the level of ROR-regions.

presented.[15] [16] In detail, the shares of male and female workers that earn less than the specified

[15]The minimum wage bite is estimated on the basis of hourly daily wages. Considering only full-time employed individuals, the information on hours worked separately by gender provided by Dustmann et al. (2022) are used to transform daily wages.

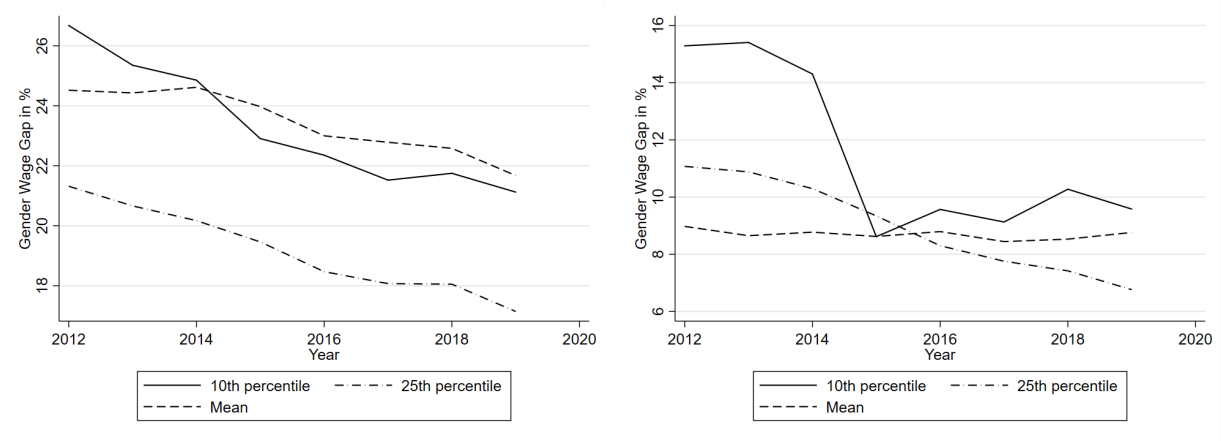
[16]German spatial planning regions summarize districts defined by the NUTS (Nomenclature of Territorial Units for Statistics) classifications that belong to a specific economic centre and its surrounding areas (BBSR Bonn, 2019).

minimum wage in the pooled time point 2013/14 are presented.[17] In Figure 1 (a) the average minimum wage bite for both men and women, ranging between 2.74% and 18.66%, is revealed. Overall, it can be seen that there is a significant trend towards higher wage bites in the East of Germany. Further, distinguishing between men and women in Figures 1 (b) and (c) a more varied picture emerges. While still higher fractions of wage bites for men are observable in the East and also the North of Germany, overall higher values are revealed for women. Female workers are highly affected by the implemented national minimum wage especially in the East of Germany with minimum wage bites being on average three times higher than their male counterparts. In addition, in the West of Germany there are specific regions, where women as well are stronger influenced by the wage floor. These regions are in the North and centre of Germany as well as near to the border. Additional to the usual procedure in existing literature to separate between the East and the West of Germany, due to different characteristics of the regional labor markets, the identified differences regarding the observed minimum wage bite result in subsequent analyses that are conducted separately.

Gender wage gap. The second factor that is observed in this study is the gender wage gap and its development in Germany during recent years. First of all, the developments of differences in pay between men and women from 2012 until 2019 at different parts of the wage distribution are presented in Figures 2 (a) and (b) for the West and East of Germany.[18] Overall, a general trend of decreasing wage gaps between men and women in the West of Germany is observable, ranging between 26.68% and 17.14%. Wage differentials at the 10th percentile visibly decrease further after 2014 with the introduction of the minimum wage in 2015. In addition, with the subsequent increases of the minimum wage in 2017 and 2019, there are visible kinks in the development of the gender wage gap at the lowest wages. Regarding wage differences at the 25th percentile and the mean similar trends are revealed, albeit to a smaller extent. For the East of Germany, a significant drop of the wage gap at the 10th percentile is identified in 2015. Further, visible kinks that are more pronounced compared to the West of Germany are observable resulting from minimum wage increases. Looking at wage differences at the 25th percentile, an overall downward sloping trend is revealed. In contrast to this, the mean wage gap remains more or less constant over time. Comparing both figures, overall smaller differences in wages in the East of Germany are identified. On average, gender wage gaps in the lower half of the wage distribution are 12.3 percentage points smaller in the East compared to the West of Germany.

[17] Pooled time point are used since in 2014 already an increase in wages in anticipation to the introduced wage floor in 2015 is observable. Thus, this results in higher sampling precision in order to draw valid conclusions on the overall effect.

[18] The gender pay gap is estimated as the difference between gross daily wages of men and women expressed as a percentage of gross daily earnings of men.



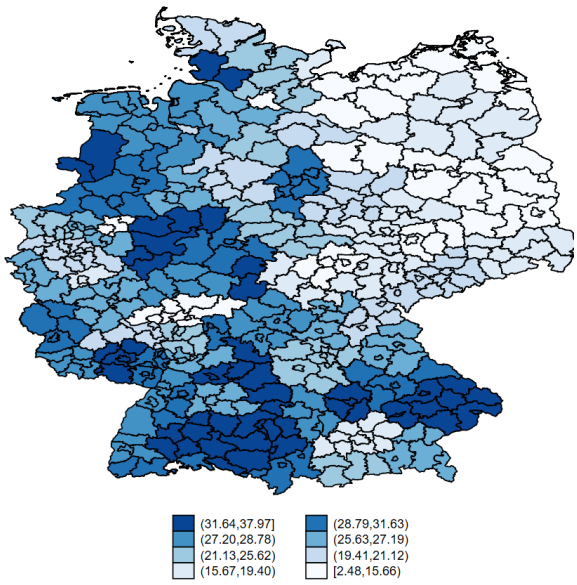
(a) West of Germany (b) East of Germany

Figure 2: Gender wage gap at the 10th, 25th percentile and mean, 2012-2019

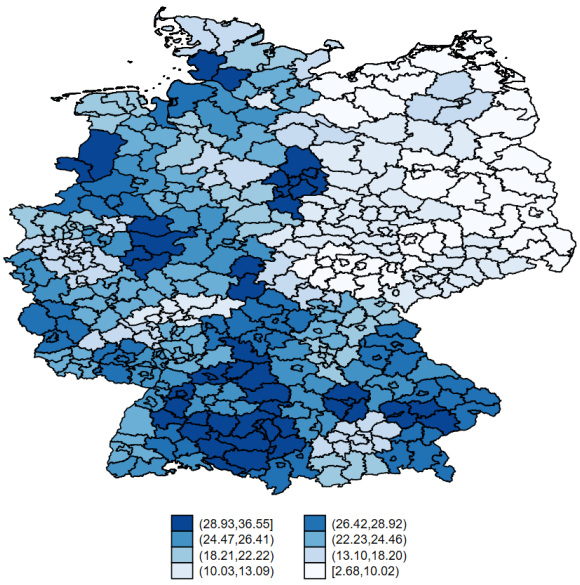
Source: SIAB7519, own calculations.
Notes: The figure presents the overall estimated gender wage gap at 10th, 25th percentile and mean between 2012 and 2019.

Since the introduced wage floor most likely primarily affects lowest wages, regional gender pay gaps at the 10th percentile are presented in Figures 3 (a) and (b) before and after the introduction. On average, significant higher wage gaps between men and women are present in the West of Germany, especially in the middle and south, in both time points. However, looking at the change of observed wage differentials between 2013/14 and 2015/16 in Figure 3 (c) the highest decreases are observed in the East of Germany. The overall values in this area are very similar across all regions with the exception of Berlin and its surroundings. In contrast to this, the results for the West of Germany show a more diverse picture. There is a mix between regions, where gender wage gaps on the one hand stay rather constant or even increase between 2013/14 and 2015/16. On the other hand, there are also regions, where observed differences in wages between men and women decrease over time.

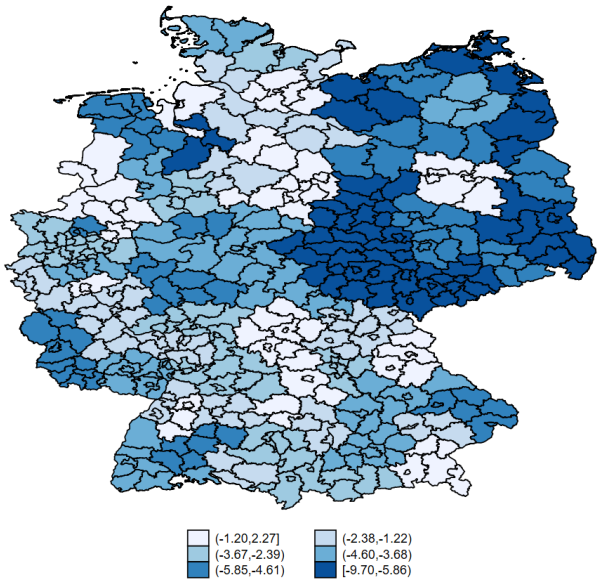
Descriptive statistics. Table 1 presents the descriptive statistics for selected pooled time points 2013/14 and 2015/16 by gender and region. On average, there are significant lower wage levels in the East of Germany compared to the West of Germany. Further, wage differentials between men and women are identified as well, with higher values in the West of Germany. Regarding the age of the workforce no major differences are presented, except slightly younger women in the West of Germany compared to their male counterparts. In the East of Germany, there are on average fewer workers in the lowest educational level with at the same time higher fractions in the medium educational level. Overall, no distinct differences in educational attainment between men and women are identified. However, in the East of Germany an observable higher fraction of women exhibits the highest level of education. Regarding the share of workers



(a) Gender wage gap, 10th percentile, 2013/14



(b) Gender wage gap, 10th percentile, 2015/16



(c) Change in the Gender wage gap after the introduction of the minimum wage

Figure 3: Regional differences, gender wage gap

Source: SIAB7519, own calculations.
Notes: The different subfigures present the estimated gender wage gaps on the level of ROR-regions for the pooled time points 2013/14 and 2015/16. Further, the corresponding change over time in the gender wage gap is presented.

with a foreign nationality higher values in the West and among men are presented. This group of workers also shows an on average higher number of days in employment and job. Women in the West of Germany and workers in the East have similar days of tenure and no changes over time are revealed. In general, there are more men exercising unskilled activities. Women

in the West of Germany are predominantly located in the group of specialist activities with at the same time lower shares in the upper two occupational levels compared to men. In contrast to this, women in the East of Germany show higher fractions in higher occupational activities compared to men. On average, men in the West of Germany work in firms with higher numbers of employees, whereas the opposite holds true for the East of Germany albeit with overall smaller values.

Characteristics of minimum wage workers. In advance to the empirical analyses, information on workers that are eligible to the wage floor before its introduction is presented in the following. Results of this analysis provide insights in groups of workers that are particularly affected by the introduction of the minimum wage. Estimating logit regression frameworks, where the dependent variable is a dummy variable being one if the observed worker earns less than the introduced minimum wage, several characteristics are taken into account. Table A.1 in the Appendix summarizes the resulting average marginal effects of the whole sample and two subsamples differentiating between men and women.

The estimated effects of the overall sample provide evidence of a higher probability to be affected by the introduced minimum wage if workers are located in the East of Germany and are female. These results support the inference drawn from the descriptive statistics analyses before. For workers with a foreign nationality in the overall sample no clear effect is revealed. Regarding school education and the age of workers a clear trend towards a higher risk for less educated and older individuals is identified. Less tenure in the practised profession and few years of work experience as well increase the probability being a minimum wage worker. The practiced requirement level has a significant effect deteriorating the remuneration possibilities, especially being a worker exercising unskilled activities. Economic industries that noticeably increase the probability of being a minimum wage worker are in the field of food and hospitality, craft/trade, security, traffic and logistic as well as in the security sector. The plant size shows that the smaller the number of employees the higher the risk to be rewarded with the wage floor.

Having a look at men and women separately, overall similar results regarding the general trends can be seen. However, regarding the size of the respective effects differences emerge. For women in the East of Germany it is more likely to be affected by the wage floor than for their male counterparts. While there was no clear effect for foreign workers in the overall sample, the effects have opposing trends for women and men separately. However, both effects are relatively small. It also seems that lower educated women and older men are exposed to higher risk earning the introduced wage floor. Whereas the effects of years of job experience are more or less the same between men and women, it can be seen that fewer years of overall

Table 1: Descriptive statistics by gender and region; 2013/14 and 2015/16

	2013/14				2015/16			
	West		East		West		East	
	Men	Women	Men	Women	Men	Women	Men	Women
Daily wage:								
	137.48	103.76	96.28	87.89	141.12	107.98	100.59	91.83
	(91.15)	(55.34)	(61.44)	(47.99)	(94.19)	(58.21)	(62.83)	(47.22)
Age:								
	41.43	39.83	41.13	41.74	41.36	39.75	41.01	41.48
	(8.69)	(9.38)	(8.98)	(9.24)	(8.86)	(9.50)	(8.98)	(9.30)
Education:								
low	6.32	5.92	2.70	2.35	6.61	5.91	3.17	2.51
	(24.33)	(23.60)	(16.21)	(15.15)	(24.84)	(23.58)	(17.51)	(15.63)
middle	72.54	72.49	78.79	73.30	71.56	70.72	77.82	72.01
	(44.63)	(44.65)	(40.88)	(44.24)	(45.11)	(45.50)	(41.55)	(44.89)
high	21.14	21.59	18.51	24.35	21.83	23.37	19.02	25.49
	(40.83)	(41.14)	(38.43)	(42.92)	(41.31)	(42.32)	(39.24)	(43.58)
Foreign nationality:								
	9.65	7.44	2.85	2.56	10.73	8.36	3.89	3.34
	(29.53)	(26.23)	(16.63)	(15.79)	(30.94)	(27.67)	(19.35)	(17.98)
Tenure:								
Days in employment	6132.85	5483.14	5313.47	5314.24	6077.32	5469.17	5406.45	5423.40
	(3263.87)	(3135.73)	(2620.17)	(2536.72)	(3305.11)	(3179.48)	(2811.78)	(2734.45)
Days in job	2942.09	2472.80	2459.13	2543.14	2906.27	2430.50	2463.45	2522.77
	(2819.57)	(2495.70)	(2319.61)	(2379.97)	(2828.08)	(2502.21)	(2386.77)	(2451.16)
Occupational level:								
Unskilled activities	11.51	10.49	10.85	8.51	11.59	10.16	11.14	8.41
	(31.91)	(30.63)	(31.10)	(27.90)	(32.01)	(30.21)	(31.46)	(27.75)
Specialist activities	54.93	61.29	61.11	60.17	54.50	60.84	60.24	60.06
	(49.75)	(48.71)	(48.75)	(48.96)	(49.79)	(48.81)	(48.94)	(48.98)
Complex activities	17.21	14.79	13.92	15.64	17.30	15.08	14.16	15.60
	(37.74)	(35.50)	(34.62)	(36.33)	(37.82)	(35.78)	(34.86)	(36.29)
Highly complex activities	16.35	13.43	14.12	15.68	16.62	13.93	14.47	15.92
	(36.99)	(34.09)	(34.82)	(36.36)	(37.22)	(34.62)	(35.18)	(36.58)
Plant size:								
	1510.04	888.49	402.27	450.38	1577.18	931.25	429.55	482.43
	(5820.64)	(3789.07)	(1193.73)	(1146.79)	(6241.70)	(4040.08)	(1289.02)	(1272.71)
Number of observations	344,204	152,375	70,290	43,084	344,675	152,330	70,954	41,794

Source: SIAB7519, own calculations.
Notes: The table presents descriptive statistics for selected variables in 2013/14 and 2015/16 by gender and region. The wage variable presents information on gross daily wages and shares are multiplied by 100 for convenience.

work experience for women pose a significantly higher risk on being a minimum wage worker. This observation also holds true for the exercised requirement level and especially for the plant size. When it comes to the economic sectors overall similar results are identified.

5 Empirical Approach

This section presents empirical approaches that are applied in the study. First of all, the reweighting procedure introduced by DiNardo et al. (1996) is defined in order to provide difference-in-differences estimations on unadjusted gender wage gaps. Here, actual wage distributions before and after the minimum wage introduction as well as counterfactual wage distributions are estimated. In a second part, a reweighted Oaxaca-Blinder decomposition framework using recentered influence functions regressions is presented, in order to assess the effects on adjusted wage differentials between men and women in Germany.

Counterfactual difference-in-differences analysis. The aim of this empirical analysis is to separate the effect of the minimum wage from the effect due to overall changes in the observed characteristics on decreases in the gender wage gap. Estimating counterfactual wage distributions, it is possible to provide results on the effectiveness of the introduced wage floor in Germany with regards to reducing wage differentials.

First of all, the overall observed change in the gender wage gap, GWG, at a specific percentile, γ, between two points in time, $t = 0, 1$, is defined by:

$$\Delta GWG_{\gamma} = GWG_{\gamma,1} - GWG_{\gamma,0}, \tag{1}$$

where the gender wage gap in each point in time results of $GWG_{\gamma,t} = (w_{\gamma,t,M} - w_{\gamma,t,W})/w_{\gamma,t,M}$ with $w_{\gamma,t,g}$ being the wage of men, $g = M$, or women, $g = W$ at a specific wage percentile and point in time t.

Observed wages of men and women are influenced by numerous factors. In the underlying analyses the estimated wage gaps are therefore a function of several explanatory variables, $X_{t,g}$, by time and gender and a policy measure, P_t, which is the introduced minimum wage in 2015. As a result, equation (1) can be rewritten as:

$$\Delta GWG_{\gamma} = GWG_{\gamma,1}(X_{1,M}; X_{1,W}; P_1) - GWG_{\gamma,0}(X_{0,M}; X_{0,W}; P_0). \tag{2}$$

From this equation it could be argued that if individual characteristics stay constant during the introduction of the minimum wage, the overall estimated change in the gender wage gap can be ascribed to the wage floor. However, due to possible changes in the composition of the workforce over time, this assumption does not hold true. Therefore, counterfactual estimations have to be added to the analysis.

In order to estimate counterfactual wages, $w^C_{\gamma,g}$, by gender and at a specific percentile, the

procedure introduced by DiNardo et al. (1996) is applied. In this case, counterfactual wage distributions are estimated, where observable characteristics of workers are reweighted. To start with, the actual densities of wages, $F(.)$, before and after the introduction of the minimum wage are observed. These are in general divided into a wage function $y(.)$ and a composition function $h(.)$:

$$F(w|t_y = 0, t_h = 0)_g = \int y(w|X, t = 0)_g \; h(X|t = 0)_g \; dx \tag{3}$$

$$F(w|t_y = 1, t_h = 1)_g = \int y(w|X, t = 1)_g \; h(X|t = 1)_g \; dx, \tag{4}$$

where $y(w|X, t = 0, 1)_g$ is the density of wages and $h(X|t = 0, 1)_g$ defines the density of characteristics in a specific year of either men or women.

In order to get a counterfactual wage distribution $F^C(.)$, where the characteristics of point in time $t = 0$ are held constant and only the wage structure changes to point in time $t = 1$, a reweighting function $\hat{\psi}_g$ is applied:

$$F^C(w|t_y = 1, t_h = 0)_g = \int y(w|X, t = 1)_g \; h(X|t = 0)_g dx \tag{5}$$

$$= \int y(w|X, t = 1)_g \; \psi_g(X_g) \; h(X|t = 1)_g dx, \tag{6}$$

where ψ_g is defined as the fraction $h(X|t = 0)_g / h(X|t = 1)_g$.

Applying the Bayes rule, ψ_g can be estimated as follows:

$$\begin{aligned} \hat{\psi}_g(X_g) &= \frac{h(X|t = 0)_g}{h(X|t = 1)_g} \\ &= \frac{Pr(t = 1)}{Pr(t = 0)} \frac{Pr(t = 0|X_g)}{Pr(t = 1|X_g)}, \end{aligned} \tag{7}$$

where $Pr(t = 0)$ and $Pr(t = 1)$ are the shares of the respective observations of one point in time in a pooled sample as well as $Pr(t = 0|x)$ and $Pr(t = 1|x)$ estimated from a logit regression framework. With the estimated counterfactual wage distributions of men and women it is possible to estimate counterfactual wages, $w^C_{\gamma,1,g}$, and thus the counterfactual gender wage gap $GWG^C_{\gamma,1}$.

The combination of the two actual observed gender wage gaps before and after the minimum wage introduction with the estimated counterfactual wage gap leads then to a type of difference-

in-differences estimation. Equation (2) can be thus divided into two parts:[19]

$$\Delta GWG_{\gamma} = \underbrace{GWG_{\gamma,1}(X_{1,M}; X_{1,W}; P_1) - GWG^{C}_{\gamma,1}(X_{0,M}; X_{0,W}; P_1)}_{\textit{Change due to changes in workers' characteristics}} + \underbrace{GWG^{C}_{\gamma,1}(X_{0,M}; X_{0,W}; P_1) - GWG_{\gamma,0}(X_{0,M}; X_{0,W}; P_0)}_{\textit{Change due to minimum wage introduction}}. \quad (8)$$

In the first part, the policy measure is considered in both gender wage gaps estimations and only the characteristics change, which results in the endowment effect. The second part represents the effect that results due to the introduced minimum wage. Since the characteristics are held constant over time, the only part that changes is the status of the policy measure.

Estimating the impact of the introduced wage floor at different parts of the wage distribution enables to reveal specific consequences regarding the change in the gender wage gap for different wage groups. Thus, especially the effects on targeted groups in the low-paid sector, that should benefit from this policy measure, can be identified and quantified. Further, restricting on specific subgroups in the sample, effects depending on the observed region, age group, educational level and occupational activity can be computed.

Counterfactual decomposition of the gender wage gap. On the basis of the standard decomposition method introduced by Oaxaca (1973) and Blinder (1973) the following empirical analysis divides the overall, unadjusted, gender wage gap at the mean, $GWG_{\mu,t}$, into an explained and an unexplained effect.[20]

In a first step, earnings functions are estimated separately for men and women, where several explanatory variables, X_g, are considered. The linear wage setting regression model is defined as follows:

$$ln(\bar{w})_{M,t} = \hat{\beta}^0_M + \hat{\beta}_M \bar{X}_M + v_M \quad (9)$$

$$ln(\bar{w})_{W,t} = \hat{\beta}^0_W + \hat{\beta}_W \bar{X}_W + v_W, \quad (10)$$

where $ln(\bar{w})_{M,t}$ and $ln(\bar{w})_{W,t}$ denote log daily average wages of men and women, respectively. Further, $\hat{\beta}^0_M$ and $\hat{\beta}^0_W$ define the respective constants and v_M and v_W are the residuals.

In a second step, after some transformation, the aggregate decomposition of the gender

[19]Similar estimation procedures are proposed by Majchrowska and Strawiński (2018) and Bargain et al. (2019) using counterfactual distributions in order to show the effect of a minimum wage on the gender wage gap.

[20]In the following, the standard Oaxaca-Blinder decomposition at the mean is presented as a baseline model.

wage gap in point in time t is estimated by:

$$\begin{aligned} GWG_{\mu,t} &= ln(\bar{w})_{M,t} - ln(\bar{w})_{W,t} \\ &= \underbrace{(\bar{X}_{M,t} - \bar{X}_{W,t})\hat{\beta}_{M,t}}_{\substack{explained \\ effect}} + \underbrace{\bar{X}_{W,t}(\hat{\beta}_{M,t} - \hat{\beta}_{W,t}) + (\hat{\beta}^0_{M,t} - \hat{\beta}^0_{W,t})}_{\substack{unexplained \\ effect}}, \end{aligned} \tag{11}$$

where the first component of the equation defines the explained part of the gender wage gap. This effect is also called endowment effect and is the result of differences in observable characteristics between men and women. The second component represents the unexplained effect that arises on the one hand due to differences in remuneration between men and women despite the same endowment and on the other hand due to the constant term. The latter part results from factors that describe the estimated gender wage gap but are not included in the dataset.[21]

In the context of an aggregate decomposition, the change in gender wage gaps between two points in time is then defined by:

$$\begin{aligned} GWG_{\mu,1} - GWG_{\mu,0} = &[(\bar{X}_{M,1} - \bar{X}_{W,1})\hat{\beta}_{M,1} + \bar{X}_{W,1}(\hat{\beta}_{M,1} - \hat{\beta}_{W,1}) + (\hat{\beta}^0_{M,1} - \hat{\beta}^0_{W,1})] \\ - \ &[(\bar{X}_{M,0} - \bar{X}_{W,0})\hat{\beta}_{M,0} + \bar{X}_{W,0}(\hat{\beta}_{M,0} - \hat{\beta}_{W,0}) + (\hat{\beta}^0_{M,0} - \hat{\beta}^0_{W,0})]. \end{aligned} \tag{12}$$

In a final step the counterfactual sample is added. Thus the type of difference-in-differences estimation strategy can be estimated in order to show the effect of the introduced minimum wage on the adjusted gender wage gap:

$$\begin{aligned} GWG_{\mu,1} - GWG_{\mu,0} &= \{GWG_{\mu,1} - GWG^C_{\mu,1}\} + \{GWG^C_{\mu,1} - GWG_{\mu,0}\} \\ &= \{[(\bar{X}_{M,1} - \bar{X}_{W,1})\hat{\beta}_{M,1} + \bar{X}_{W,1}(\hat{\beta}_{M,1} - \hat{\beta}_{W,1}) + (\hat{\beta}^0_{M,1} - \hat{\beta}^0_{W,1})] \\ &- \ [(\bar{X}_{M,0} - \bar{X}_{W,0})\hat{\beta}_{M,1} + \bar{X}_{W,0}(\hat{\beta}_{M,1} - \hat{\beta}_{W,1}) + (\hat{\beta}^0_{M,1} - \hat{\beta}^0_{W,1})]\} \\ &+ \ \{[(\bar{X}_{M,0} - \bar{X}_{W,0})\hat{\beta}_{M,1} + \bar{X}_{W,0}(\hat{\beta}_{M,1} - \hat{\beta}_{W,1}) + (\hat{\beta}^0_{M,1} - \hat{\beta}^0_{W,1})] \\ &- \ [(\bar{X}_{M,0} - \bar{X}_{W,0})\hat{\beta}_{M,0} + \bar{X}_{W,0}(\hat{\beta}_{M,0} - \hat{\beta}_{W,0}) + (\hat{\beta}^0_{M,0} - \hat{\beta}^0_{W,0})]\}. \end{aligned} \tag{13}$$

As in equation (8), the first component of the equation represents the effect due to changes in the composition of characteristics and the second component represents the effect of the minimum wage on the gender wage gap. Using the counterfactual sample, changes in the aggregate decomposition due to the introduction of the minimum wage can be revealed. Differentiating

[21] The initial proposed decomposition analysis by Oaxaca (1973) and Blinder (1973) defines the male wage structure as the non-discriminatory wage structure. However, at the same time the wage structure of women or combined weighted wage structures as proposed by Reimers (1983) and Oaxaca and Ransom (1994) can be used estimating the aggregate decomposition. Thus, the empirical analyses on the decomposition of gender wage gaps in Section 6 provide several robustness checks using alternative wage structures.

between the actual and counterfactual samples, it is possible to make statements how the binding wage floor might influence the unexplained wage gap and the relating thereto trend of discrimination.

In order to estimate gender wage gaps away from the mean, the recentered influence functions (RIF) regressions approach introduced by Firpo et al. (2018) is applied. In this case the standard Oaxaca-Blinder decompositions are estimated using coefficients of unconditional (quantile) partial regression models. The above presented estimation analyses are then adjusted accordingly.[22]

6 Empirical Results

This section presents the results of the estimated type of difference-in-difference analyses using counterfactual wage distributions on the impact of the introduced wage floor on the observed gender wage gap in Germany. Differentiating between various groups of workers, detailed responses of gender wage gaps on the implemented minimum wage can be assessed. Further, estimations on the impact of increases in the wage floor in 2017 and 2019 as well as counterfactual aggregate decomposition results are presented.

6.1 Gender wage gaps of the overall sample

Figure 4 shows the estimated results separately for the West and East of Germany as well as for different percentiles in the lower half of the wage distribution.[23] The gender wage gap at the 10th percentile overall decreased by 2.46 percentage points in the West of Germany and by 6.34 percentage points in the East of Germany between 2013/14 and 2015/16. Using the defined reweighting method in order to fix the distribution of characteristics at the level before the introduction of the wage floor, it is possible to divide the overall change on the one hand into an effect due to the binding minimum wage and on the other hand into an effect due to changes in the observed characteristics. As a result of this estimation strategy, it is revealed that around 60% in the decrease in wage differentials at the 10th percentile in the West of Germany are explainable by the minimum wage introduction. In contrast to this, in the East of Germany even 95% can be traced back to the effect due to the wage floor. A similar picture emerges for wages at the 25th percentile, where the gender wage gaps decrease by around 1.6 percentage points in both regions. However, whereas 72% of this decrease are traceable back

[22]Detailed information on the estimation strategy of RIF-regressions and the relating thereto aggregate decomposition can be found in Fortin et al. (2011).

[23]All detailed results of Figures 4 to 8 are presented in Tables A.2 to A.6 in the Appendix. Since the minimum wage addresses wages in the low-paid sector, the study is restricted to results of the gender pay gap up to the median as similarly done by Caliendo and Wittbrodt (2022).

to the wage floor in the East of Germany, the majority of the decline (59%) is explained by changes in the characteristics of the observed workers in the West of Germany between 2013/14 and 2015/16. Whereas for median wages no changes in the gender wage gap are observable in the East of Germany, wage differentials decrease by one percentage point in the West of Germany during the observed period of time. Again, the majority is explained by changes in characteristics (68%).

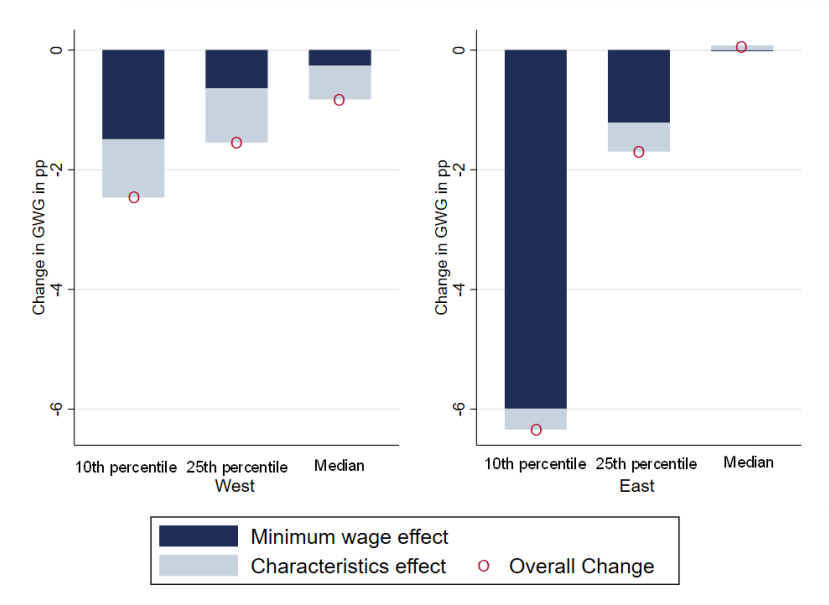
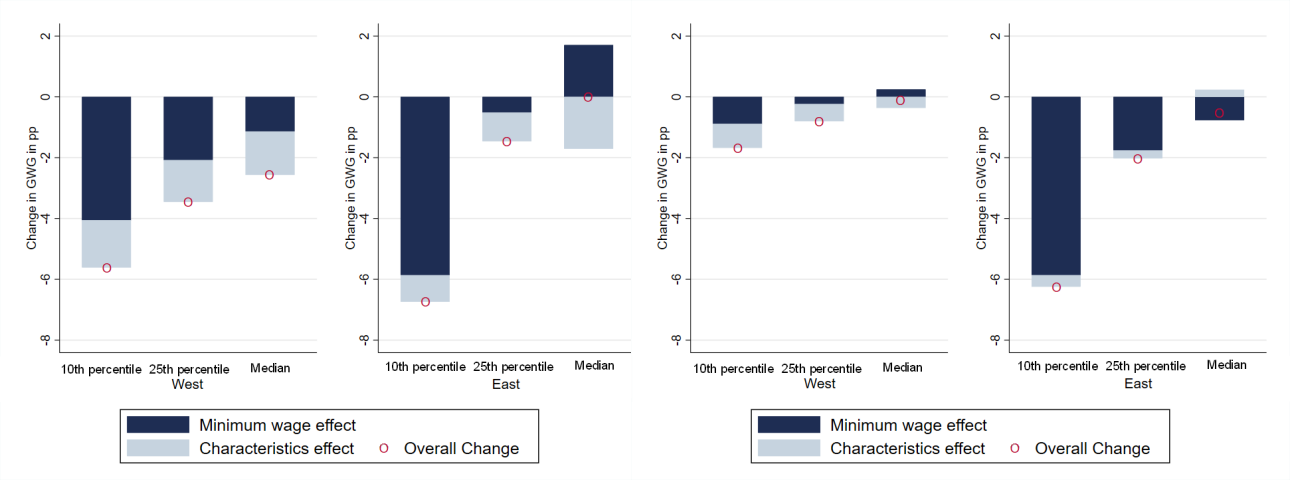


Figure 4: Change in gender wage gaps in the East and West of Germany

Source: SIAB7519, own calculations.
Note: The two subfigures present the estimated results of the difference-in-differences analysis using a reweighted distribution distinguishing between the East and the West of Germany.

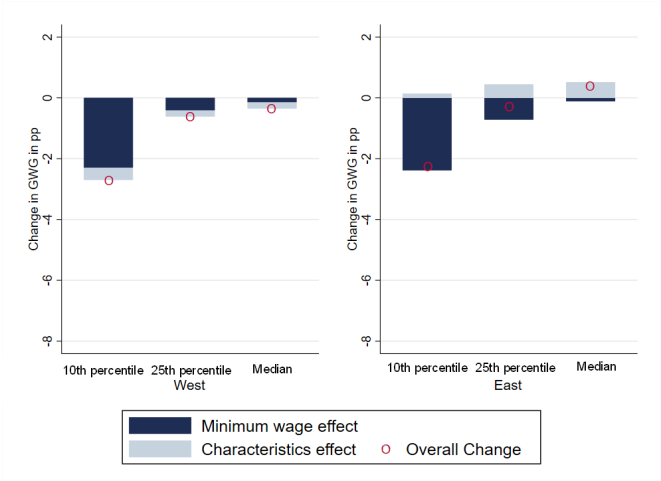
6.2 Gender wage gaps among specific groups

As presented in the descriptive section on the characteristics of minimum wage workers (see Table A.1), there are specific groups of workers that are at higher risk to be influenced by the implemented wage floor. Therefore, the following analyses focus on particular groups of the workforce in order to show possible varied responses. At first, Figure 5 presents the results on the counterfactual estimations separately for workers of three educational levels. Again, it can be seen that the highest overall decreases of wage differentials are observable at the lowest wages. Further, on average, the highest declines are identified for the group of the lowest educational level. In particular, gender wage gaps at the 10th percentile decrease around 6 percentage points in both regions. At higher wages for the lowest educational group wage differentials between men and women decline mainly in the West of Germany, where at the same time the



(a) Low

(b) Medium



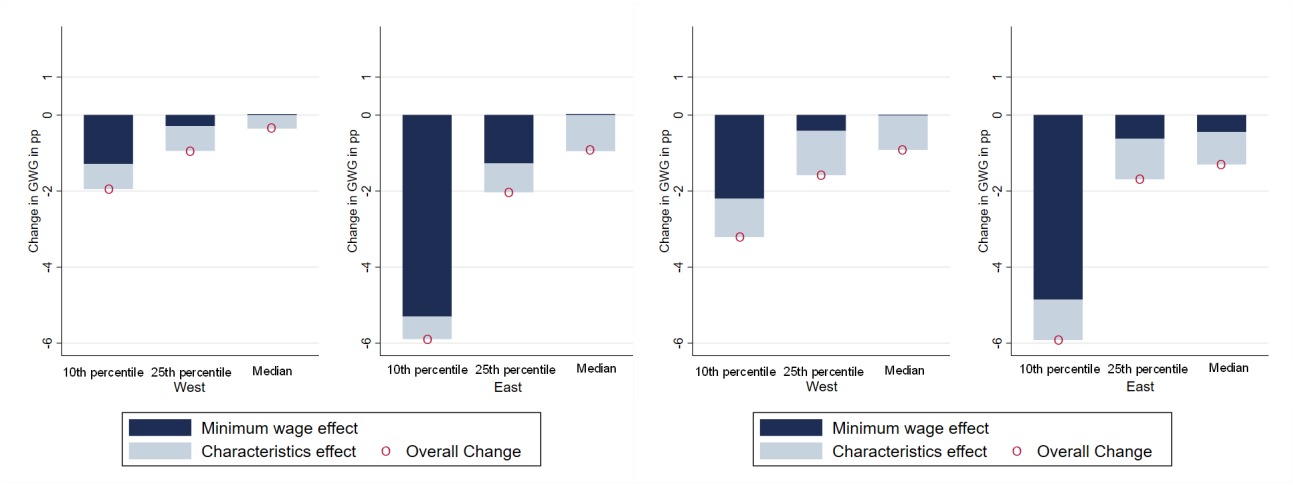
(c) High

Figure 5: Change in gender wage gaps in the East and West of Germany by educational levels

Source: SIAB7519, own calculations.
Notes: The different subfigures present the estimated results of the difference-in-differences analysis using a reweighted distribution distinguishing between different educational levels.

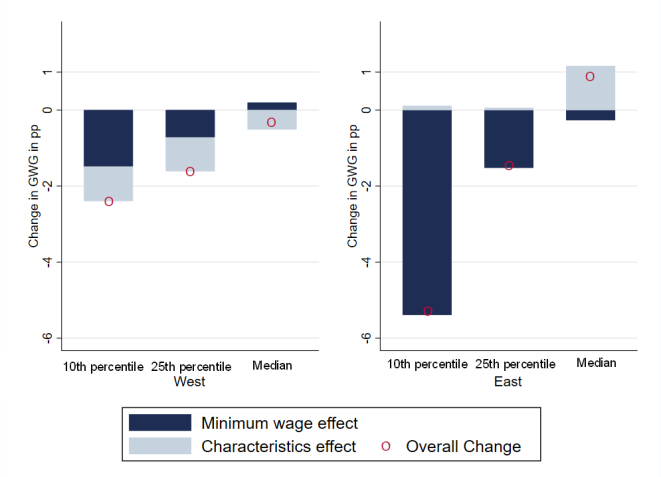
effect due to changes in the characteristics rises. The decrease in wage gaps in the East of Germany is either less or non-existent. At the medium educational level, overall decreases in wage differentials are higher for the East of Germany compared to the West. Regarding the former, the observed gender wage gap decreases by around 6 percentage points at the 10th percentile and around 2 percentage points at the 25 percentile. In both cases, around 90% of the drop is traced back to changes in the wage structure due to the introduced wage floor. Wage differentials at the 10th percentile for the highest educational group decrease by more then 2 percentage point in both regions, which occurs mainly due to the minimum wage effect. Wage gaps at the 25th percentile and median only slightly go back or exhibit no change at all. However, inequality increasing tendencies between men and women are identified resulting

from changes in the observed characteristics in the East of Germany, which are either totally or partly balanced out by the introduced wage floor.



(a) 25-34 Years

(b) 35-44 Years



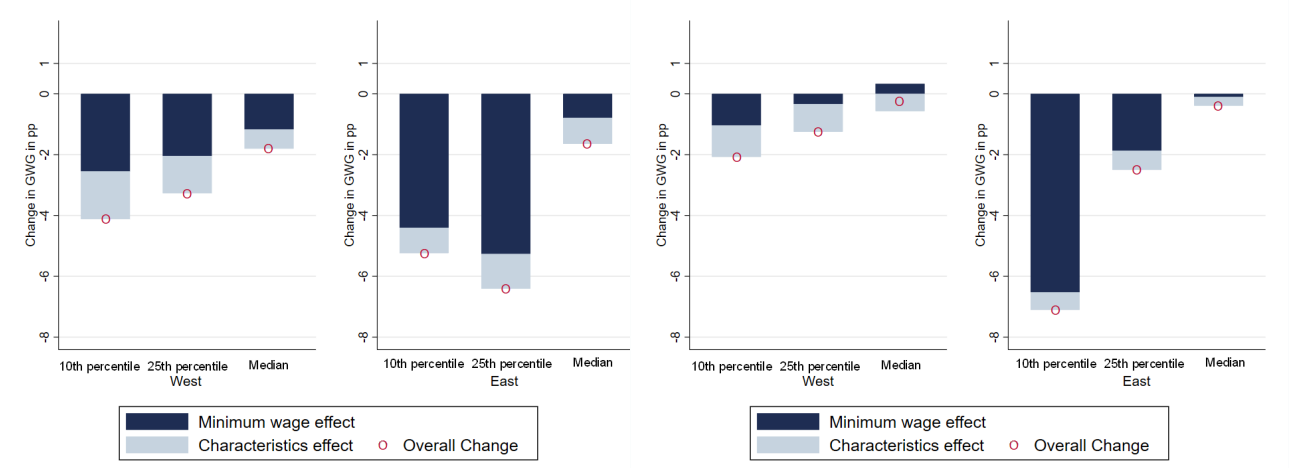
(c) 45-55 Years

Figure 6: Change in gender wage gaps in the East and West of Germany by age groups

Source: SIAB7519, own calculations.
Notes: The different subfigures present the estimated results of the difference-in-differences analysis using a reweighted distribution distinguishing between different age groups.

The next subgroups that are taken into account are workers of different age, divided into three groups: (1) 25-34 years, (2) 35-44 years and (3) 45-55 years. Figure 6 shows that on average the highest decreases in gender wage gaps, around 6 percentage points, are estimated for the lowest wages in the East of Germany, regardless the age. The most significant drop in wage differentials between men and women in the West of Germany is revealed for the medium age group. Decreases by more than 3 percentage points at the 10th percentile, by around 1.6 percentage points at the 25th percentile and 1 percentage point at median wages are estimated. When it comes to the division into the effect due to the minimum wage and the effect resulting

from changes in the characteristics a more diverse picture emerges. Whereas the majority of decreases in the youngest and oldest groups of workers at lower wages in the East of Germany is explained by the effect that comes from the wage floor, large parts of the declines in the West of Germany are explained again by changes in the observed endowments of the workers. The identified development in the median wage gap in the East of Germany for the oldest group shows an overall increase in wage differentials driven by the characteristics effect. For the medium age group, wage gaps at the 25th percentile and the median decrease for both regions mainly due to differences in characteristics between 2013/14 and 2015/16 (between 63% and 99%).



(a) Unskilled activities

(b) Professional activities

(c) Complex activities

(d) Highly complex activities

Figure 7: Change in gender wage gaps in the East and West of Germany by occupational activities

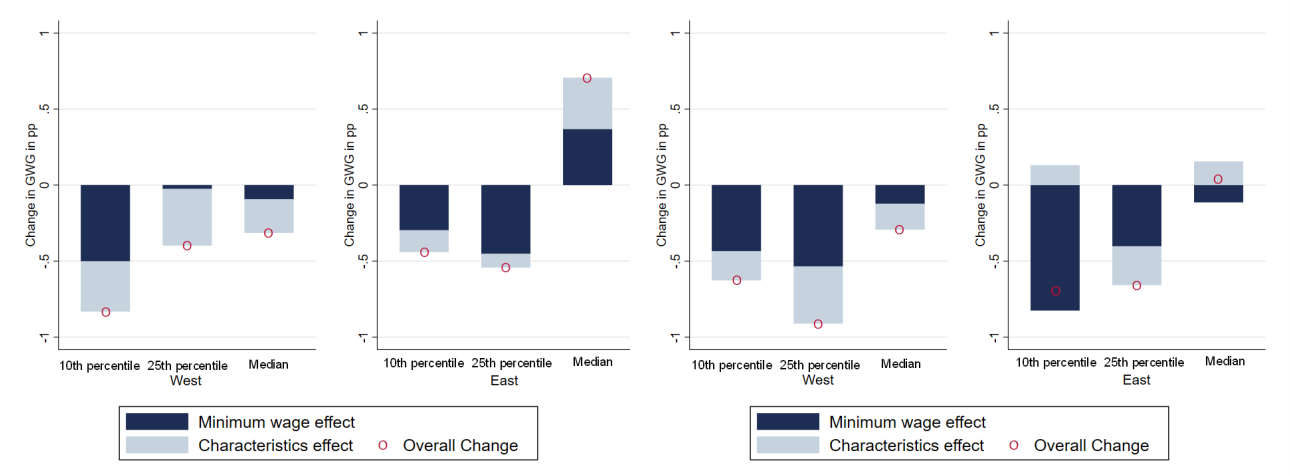
Source: SIAB7519, own calculations.
Notes: The different subfigures present the estimated results of the difference-in-differences analysis using a reweighted distribution distinguishing between different occupational levels.

The last subgroups of workers that are taken into account in more detail are the four occupational levels, (1) unskilled activities, (2) professional activities (3) complex activities and (4) highly complex activities (Figure 7). Overall, wage gaps between men and women are in particular reduced in the lowest two occupational groups. Wage differentials for the most likely affected workers at the 10 percentile decrease in the West of Germany between 2.1 and 4.1 percentage points, whereas in the East of Germany the magnitudes rage between 5.2 and 7.1 percentage points. Again, the proportions of effects due to changes in characteristics have higher values for the West of Germany (38% and 50%) compared to the East (16% and 8%). Looking at wage gaps at the 25th percentile and the median, decreases are on average higher for the lowest occupational level with larger values for the East of Germany. For the second occupational level, declines in these wage gaps mainly occur due to changes in the characteristics in the West of Germany and in the East of Germany due to the wage floor effect. Wage gaps between men and women at the highest occupational levels exhibit either small or no decreases for the West of Germany. If there are any drops in wage differentials in the East of Germany, they mainly result from the minimum wage effect with values between 1.7 and 2.2 percentage points.

6.3 Gender wage gaps after minimum wage increases

As presented in the descriptive statistics in Figure 2, the minimum wage increases in the years 2017 and 2019 possibly influence the observed gender wage gaps in the East and West of Germany as well. Thus, the reweighted difference-in-differences analysis is applied for the years 2016 and 2017 as well as 2018 and 2019 in Figure 8.[24] Despite the fact that there are noticeable decreases in wage differentials between men and women in both time points, there is no significant difference between the West and the East of Germany observable. Further, the magnitudes of declines are significantly smaller compared to the effects resulting from the introduction of the minimum wage. Overall, in particular wage gaps at the bottom of the wage distribution are influenced by wage floor rises, where mainly the minimum wage effect is decisive (between 0.5 and 0.8 percentage points). Regarding the division into the wage floor effect and characteristics effect at the 25th percentile and the median, again higher shares for the latter effect in the West of Germany are revealed (between 41% and 94%). For median wage gaps in the East of Germany even increasing tendencies for both effects (2017) or due to the characteristics effect (2019) are identified.

[24]Due to the close consecutive years of minimum wage introduction and minimum wage increases no pooled time points are used in these sub-analyses.



(a) Minimum wage increase 2017 (b) Minimum wage increase 2019

Figure 8: Change in gender wage gaps in the East and West of Germany after minimum wage increases

Source: SIAB7519, own calculations.
Notes: The different subfigures present the estimated results of the difference-in-differences analysis using a reweighted distribution for the minimum wage increases in 2017 and 2019.

6.4 Minimum wage and the decomposition of wage gaps

Until now, the counterfactual type of difference-in-differences analyses identify effects resulting from the introduced minimum wage on the overall unadjusted gender wage gap in Germany. However, decomposing wage differentials between men and women into explained and unexplained effects, as described by the Oaxaca-Blinder decomposition, is a crucial factor in the debate on gender wage gaps. Thus, in Table 2 the Oaxaca-Blinder decomposition results for wage differentials at different percentiles for the West and the East of Germany are presented.

Beginning with the observed subsamples in 2013/14 and 2015/16, the overall decrease in wage differentials over time as well as higher magnitudes of drops for the East of Germany compared to the West of Germany are confirmed. The results of the decomposition analyses reveal that in the underlying data wage gaps are mainly traced back to unexplained effects. Differences in the observed characteristics between men and women reveal positive and highly statistically significant explained effects that account for up to 20% at the 10th percentile as well as around 10% at the 25th percentile and the median in the West of Germany. In contrast to this, in the East of Germany explained effects at the lowest wages are very small and only weakly statistically significant. Further, for higher wages the effects turn negative and provide high statistical significance. These results reveal that for wages at the 25th percentile and the median, women in the East of Germany exhibit better endowments and considering only these characteristics they would earn more than men. When it comes to unexplained effects, these can be further divided on the one hand into the impact due to differences in remuneration for

women, despite the same observed characteristics as men, and on the other hand the constant. The latter summarises all effects resulting from factors that can not be observed in the data. The constant defines between 64% and 83% of the unexplained effect in the West and between 60% and 98% of the unexplained effect in the East of Germany.[25]

In order to show how the introduction of the national minimum wage influenced the decomposition of the gender wage gap, the estimation results of the counterfactual sample are additionally presented in Table 2. When it comes to the aggregate decomposition in the explained and unexplained effect no major differences between the actual observable sample in 2015/16 and the counterfactual sample are revealed. However, having a closer look at the division of the unexplained part observable differences emerge. For wage gaps at the 10th percentile in the West of Germany the constant explains around 64% of the unexplained part in 2013/14. This effect increases up to 72% in 2015/16. For the counterfactual sample in 2015/16 with the distribution of characteristics fixed at the level of 2013/14, the proportion is almost as high as in the actual sample after the introduced wage floor. From this observed trend it can be concluded that the share of the unexplained wage gap, that is traced back to differences in remuneration for women despite the same observed characteristics as men, decreases due to the introduced minimum wage in 2015. In other words, it seems that possible discrimination against women regarding observable characteristics that are available in the underlying data is restricted by the binding wage floor in the West of Germany. For other wage levels, the division of the unexplained effects into the constant and the part, where women earn differently than men despite the same characteristics, either stays constant or the latter effect slightly increases. This holds also true for all wage levels for the East of Germany. However overall, no major changes regarding the shares of explained and unexplained effects in the decomposition of wage gaps are identified after the introduction of the minimum wage in Germany.

As described in Section 5 there are several ways to define the non-discriminatory wage structure estimating the aggregate decomposition. Thus, in Table A.7 in the Appendix robustness checks on alternative wage structures are provided. Applying the weighted wage structure approach by Reimers (1983), where female and male wage structures get the same weight, it can be seen that no major changes arise. The same holds true for the approach proposed by Oaxaca and Ransom (1994), where the two different wage structures are weighted according the actual share of workers in the underlying data. In this case, as well no changes in the relative size of the different components are observable. As a result, the presented results are robust to different estimation strategies of the non-discriminatory wage structure.

[25]Using administrative data with limited availability of explanatory variables in the context of gender wage gap decompositions, these results are confirmed by the existing literature, see for example Weyh et al. (2022) and Fuchs et al. (2019).

Table 2: Actual and counterfactual aggregate decomposition results

	West of Germany			East of Germany		
Percentile	Explained effect	Unexplained effect	Constant	Explained effect	Unexplained effect	Constant
2013/14						
10	5.80***	22.97***	14.70***	0.52*	15.59***	16.97***
25	3.07***	19.84***	16.47***	−2.48***	13.73***	21.08***
50	2.39***	15.47***	12.25***	−10.91***	10.39***	28.58***
2015/16						
10	4.47***	21.21***	15.32***	0.26	8.66***	8.84***
25	2.07***	18.91***	13.04***	−2.74***	12.13***	20.02***
50	2.04***	14.85***	11.60***	−10.13***	9.67***	26.91***
2015/16 counterfactual						
10	4.88***	21.51***	15.26***	0.42*	8.70***	7.90***
25	2.36***	19.19***	13.11***	−2.60***	12.26***	19.84***
50	2.32***	14.61***	11.29***	−10.25***	9.78***	26.68***

Source: SIAB7519, own calculations.
Notes: The table presents the counterfactual aggregate decomposition of gender wage gaps at different percentiles (10th, 25th and 50th percentile) using the RIF-regressions based Oaxaca-Blinder method. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level, respectively.

7 Discussion and Conclusion

This study analyses the effects of the implemented statutory minimum wage in 2015 on the observed gender wage gap in Germany. Descriptive analyses show significant wage differentials between men and women in the West of Germany between 25.11% and 15.53% along the lower half of the wage distribution between 2013/14 and 2015/16. In contrast to this, gender wage gaps in the East of Germany are considerably lower in size with a maximum of 14.87% at the 10th percentile before the introduction of the binding wage floor. At the same time, workers in the East of Germany exhibit a significantly higher probability to be affected by the introduced minimum wage estimated by regional-specific minimum wage bites. In particular, it is revealed that women benefit highly from the defined wage floor in the East of Germany.

Using administrative data provided by the German Institute for Employment Research, the study provides yearly information and thus assessments of the effects resulting from the introduction of the minimum wage but also from its subsequent increases can be estimated separately. The applied estimation strategy with counterfactual wage distributions, where the distribution of characteristics is fixed at the level before the minimum wage introduction, allows divided analyses of different sources of effects.

The results reveal significant decreases of wage differentials between men and women that can be traced back to the introduced statutory wage floor. Among low-paid jobs, wage differentials exhibit on average the highest declines. At the 10th percentile wage gaps decrease by 2.46 percentage points in the West and by 6.34 percentage points in the East of Germany. Thereby,

respectively around 60% and 95% can be explained by the introduction of the minimum wage. For higher wage levels at the 25th percentile and the median decreases in the observed gender wage gaps can be seen as well, although smaller in size. Thus, this separate analysis for the East and the West of Germany reveals two main conclusions. On the one hand, higher impact on wage gaps in regions, where woman are significantly more affected by the minimum wage than their male counterparts, is identified. Thus, the effectiveness of the wage floor and the suitability of this policy measure in reducing wage differentials in these regions are confirmed. On the other hand, it is revealed that for the West of Germany changes in the distribution of characteristics as well play a substantial role. As a result, it seems that in the West of Germany, where in general significantly higher wage gaps are identified, still considerable differences in the endowment between women and men exist and reducing them is decisive in the fight against gender-specific wage differentials. Therefore, it needs further targeted efforts in the West of Germany in order to guarantee equal remuneration for women and men.

The consecutive rises in the level of minimum wages in the years 2017 and 2019 are also considered in the counterfactual difference-in-difference analyses. Although the study reveals smaller gender wage gap decreasing trends, minimum wage increases still have significant impact in both, the East and the West of Germany.

Differentiating between several groups of the workforce by educational level, age and occupational activity the analysis provides detailed information on the effectiveness of the wage floor for different target groups. In particular, at lower wage levels for the least educated and middle aged workers the introduction of the minimum wage is the driving factor that significantly lowers the group-specific gender wage gaps. In the context of increasing wage gaps between men and women after the age of 30, as presented by Schrenker and Zucco (2020), the latter response indicates an effective mechanism of the introduced minimum wage in reducing distinct age-specific wage differentials. Further, looking at occupational levels, it can be seen that in particular wage gaps in the lower half of the distribution among the least demanding occupational activities benefit from the binding wage floor. Again, higher effects due to the minimum wage are identified in the East of Germany, in contrast to higher shares of effects due to changes in characteristics in the West of Germany.

The presented results on the effect of the minimum wage in Germany are in line with literature on the evaluation of the implemented minimum wage in relation to resulting developments in wage inequality. Thus, the wage floor not only considerably leads to a reduction in overall wage inequality in recent years as presented by Bossler and Schank (2020), but also is a valid measure for diminishing wage differentials between men and women as shown by Caliendo and Wittbrodt (2022). Therefore, the underlying study once more supports the importance and effectiveness of the binding minimum wage and its effects on the wage distributions of men and

women in Germany.

The added counterfactual decomposition analyses, where unadjusted wage differentials are divided into an explained and an unexplained effect, provide first evidence on how the introduced minimum wage affects the adjusted gender wage gap. Overall, the estimated results suggest that for the lowest wage level in the West of Germany, the share of differences in wages between men and women, that cannot be traced back to different endowment, decreases due to the introduced wage floor. This means, possible discrimination against women on the basis of observable characteristics in the underlying data seems to be restricted by the minimum wage. For wage gaps in the East of Germany, no major effects can be observed. Further, in general, the shares of the components in the aggregate decomposition are not affected by the introduction of the wage floor. On this basis, it would be interesting to extend the number of factors that explain wage differentials between men and women in order to provide further evidence whether and how the minimum wage possibly limits discriminatory remuneration structures in Germany. Due to data availability restrictions and the applied estimation design, it was not feasible in this study and thus remains an important issue for future research.

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Appendix

Table A.1: Characteristics of minimum wage workers - Logit estimations

	Whole sample	**Male sample**	**Female sample**
East Germany	0.040***	0.032***	0.055***
Women	0.041***		
Foreign Nationality	0.001	0.005***	-0.009***
Educational level:			
Low	0.020***	0.015***	0.023***
High	-0.022***	-0.011***	-0.040***
Age:			
25-35 Years	-0.020***	-0.008***	-0.045***
45-55 Years	0.010***	0.012***	0.007***
Job experience:			
0-2 years	0.012***	0.011***	0.013***
4-8 years	-0.002*	-0.002**	-0.003
8-16 years	-0.009***	-0.010***	-0.011***
$\geq$ 16 years	-0.025***	-0.018***	-0.040***
Work experience:			
0-2 years	0.017***	0.007***	0.040***
4-8 years	-0.013***	-0.009***	-0.015***
8-16 years	-0.024***	-0.020***	-0.023***
$\geq$ 16 years	-0.048***	-0.041***	-0.058***
Requirement level:			
unskilled activities	0.033***	0.022***	0.052***
complex activities	-0.028***	-0.020***	-0.045***
highly complex activities	-0.043***	-0.027***	-0.081***
Occupations:			
Food, agriculture and forestry	0.042***	0.021***	0.068***
Manufacturing	0.026***	0.015***	0.031**
Technical production	0.009***	0.005***	0.000
Food and hospitality industry	0.070***	0.054***	0.072***
Health care	0.035***	0.021***	0.023**
Social and cultural service	0.031***	0.039***	0.004

Continued on next page

Table A.1 – *Continued from previous page*

	(1)	**(2)**	**(3)**
Craft/trade	0.051***	0.026***	0.059***
Company organisation	0.027***	0.022***	0.005
Service sector	0.018***	0.022***	-0.016
IT and scientific service	-0.001	0.001	-0.039***
Security	0.058***	0.042***	0.057***
Traffic and logistic	0.050***	0.036***	0.040***
Cleansing service	0.075***	0.042***	0.106***
Plant size:			
1-9 employees	0.084***	0.054***	0.145***
10-49 employees	0.045***	0.027***	0.084***
50-199 employees	0.024***	0.015***	0.038***
1000-4999 employees	-0.025***	-0.017***	-0.042***
$\geq$ 5000 employees	-0.031***	-0.018***	-0.057***
N	304,710	207,204	97,506

Source: SIAB7519, own calculations.

Notes: The table presents the estimated average marginal effects of logit regression frameworks with a dummy variable that is equal to one if the worker earns less than 8.50 EUR as the dependent variable. The base category of the estimation is a male worker in the West of Germany with German citizenship and medium education between 35 and 44 years. The time in employment and in job is between 2 and 4 years exercising specialist activities in a construction occupation at a plant with between 200 and 999 employees. In column (1) estimates on the overall sample are provided, whereas in columns (2) and (3) subsamples differentiating between men and women are used. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level, respectively.

Table A.2: Actual gender wage gaps in 2013/14, 2015/16 and counterfactual 2015/16, whole sample

	West of Germany			East of Germany		
Percentile	Women	Men	Wage Gap	Women	Men	Wage Gap
2013/14						
10	49.57***	66.18***	25.11%	41.59***	48.85***	14.87%
25	68.13***	85.68***	20.48%	53.22***	59.57***	10.66%
50	94.75***	113.28***	16.36%	78.69***	78.29***	−0.51%
2015/16						
10	52.45***	67.81***	22.64%	48.14***	52.63***	8.53%
25	70.88***	87.43***	18.94%	57.28***	62.93***	8.96%
50	98.02***	116.05***	15.53%	82.03***	81.66***	−0.45%
2015/16 counterfactual						
10	52.11***	68.29***	23.61%	48.00***	52.72***	8.87%
25	70.28***	87.72***	19.84%	56.91***	62.87***	9.45%
50	97.32***	116.05***	16.09%	81.67***	81.19***	−5.29%

Source: SIAB7519, own calculations.

Notes: The table presents the results of the counterfactual difference-in-differences analyses between 2013/14 and 2015/16, separately for the East and West of Germany. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level, respectively.

Table A.3: Actual gender wage gaps in 2013/14, 2015/16 and counterfactual 2015/16, by educational groups

	West of Germany			East of Germany		
Percentile	2014/15	2015/16	2015/16 counterfactual	2014/15	2015/16	2015/16 counterfactual
Educational group						
Low						
10	17.45%	11.83%	13.39%	4.29%	−2.45%	−1.57%
25	18.99%	15.54%	16.91%	2.21%	0.76%	1.70%
50	16.10%	13.54%	14.96%	−3.41%	−3.41%	−1.70%
Medium						
10	25.66%	23.98%	24.77%	16.58%	10.34%	10.72%
25	21.07%	20.27%	20.83%	13.66%	11.64%	11.90%
50	15.22%	15.11%	15.47%	3.45%	2.92%	2.69%
High						
10	30.26%	27.56%	27.96%	20.57%	18.32%	18.19%
25	27.50%	26.89%	27.09%	21.19%	20.92%	20.47%
50	28.49%	28.14%	28.34%	20.44%	20.85%	20.33%

Source: SIAB7519, own calculations.

Notes: The table presents the results of the counterfactual difference-in-differences analyses between 2013/14 and 2015/16, separately for the East and West of Germany by educational groups.

Table A.4: Actual gender wage gaps in 2013/14, 2015/16 and counterfactual 2015/16, by age groups

	West of Germany			East of Germany		
Percentile	2014/15	2015/16	2015/16 counterfactual	2014/15	2015/16	2015/16 counterfactual
Age group						
25-34 Years						
10	13.21%	11.26%	11.93%	11.35%	5.50%	6.05%
25	10.71%	9.77%	10.42%	8.06%	6.04%	6.79%
50	7.76%	7.43%	7.79%	0.56%	−0.36%	0.59%
35-44 Years						
10	29.32%	26.11%	27.12%	17.70%	11.79%	12.85%
25	22.54%	20.96%	22.12%	13.99%	12.30%	13.37%
50	16.72%	15.80%	16.71%	4.38%	3.08%	3.93%
45-55 Years						
10	31.89%	29.50%	30.40%	15.79%	10.51%	10.40%
25	26.18%	24.57%	25.46%	10.12%	8.67%	8.61%
50	19.76%	19.45%	19.96%	−3.78%	−2.89%	−4.05%

Source: SIAB7519, own calculations.

Notes: The table presents the results of the counterfactual difference-in-differences analyses between 2013/14 and 2015/16, separately for the East and West of Germany by age groups.

Table A.5: Actual gender wage gaps in 2013/14, 2015/16 and counterfactual 2015/16, by occupational activities

	West of Germany			East of Germany		
Percentile	2014/15	2015/16	2015/16 counterfactual	2014/15	2015/16	2015/16 counterfactual
Occupational level						
Unskilled activities						
10	18.87%	14.76%	16.33%	14.11%	8.87%	9.70%
25	20.93%	17.66%	18.89%	13.63%	7.22%	8.36%
50	22.43%	20.63%	21.27%	15.43%	13.79%	14.64%
Professional activities						
10	24.78%	22.71%	23.75%	17.12%	10.01%	10.59%
25	18.77%	17.53%	18.44%	12.53%	10.03%	10.66%
50	12.06%	11.82%	12.39%	−0.60%	−0.99%	−0.70%
Complex activities						
10	26.49%	25.61%	26.35%	16.46%	14.75%	14.91%
25	23.04%	22.59%	23.01%	18.06%	16.67%	16.73%
50	22.36%	22.89%	22.66%	15.13%	14.97%	14.28%
Highly complex activities						
10	27.87%	26.84%	27.11%	17.34%	14.31%	15.01%
25	24.62%	23.51%	24.18%	14.77%	14.34%	14.50%
50	24.97%	24.37%	24.87%	12.19%	11.82%	12.10%

Source: SIAB7519, own calculations.
Notes: The table presents the results of the counterfactual difference-in-differences analyses between 2013/14 and 2015/16, separately for the East and West of Germany by occupational activities.

Table A.6: Actual and counterfactual gender wage gaps before and after minimum wage increases

	West of Germany			East of Germany		
Percentile	Before	After	Counterfactual	Before	After	Counterfactual
Minimum wage increase						
2017						
10	22.36%	21.52%	21.85%	9.57%	9.13%	9.27%
25	18.47%	18.07%	18.44%	8.30%	7.76%	7.85%
50	15.22%	14.90%	15.12%	−0.57%	0.14%	−0.20%
2019						
10	21.75%	21.12%	21.31%	10.27%	9.58%	9.45%
25	18.05%	17.14%	17.52%	7.42%	6.76%	7.02%
50	14.84%	14.54%	14.71%	0.49%	0.53%	0.37%

Source: SIAB7519, own calculations.
Notes: The table presents the results of the counterfactual difference-in-differences analyses between 2016 and 2017 as well 2018 and 2019, separately for the East and West of Germany.

Table A.7: Actual and counterfactual aggregate decomposition results using alternative non-discriminatory wage structures

	West of Germany			East of Germany		
Percentile	Explained effect	Unexplained effect	Constant	Explained effect	Unexplained effect	Constant
Non-discriminatory wage structure proposed by Reimers (1983)						
2013/14						
10	5.21***	23.56***	14.70***	−0.27	16.38***	16.97***
25	3.11***	19.80***	16.47***	−4.48***	15.73***	21.08***
50	1.93***	15.92***	12.25***	−12.33***	11.82***	28.58***
2015/16						
10	3.43***	22.24***	15.32***	−0.27	9.18***	8.84***
25	2.02***	18.96***	13.04***	−4.29***	13.68***	20.02***
50	1.44***	15.44***	11.60***	−11.47***	11.02***	26.91***
2015/16 counterfactual						
10	3.81***	22.58***	15.26***	−0.09	9.21***	7.90***
25	2.38***	19.17***	13.11***	−4.16***	13.82***	19.84***
50	1.74***	15.49***	11.29***	−11.59***	11.11***	26.68***
Non-discriminatory wage structure proposed by Oaxaca and Ransom (1994)						
2013/14						
10	5.44***	23.33***	14.69***	−0.08	16.18***	16.97***
25	3.10***	19.81***	16.47***	−3.98***	15.23***	21.08***
50	2.11***	15.75***	12.25***	−11.98***	11.46***	25.58***
2015/16						
10	3.83***	21.84***	15.32***	−0.14	9.05***	8.84***
25	2.04***	18.94***	13.04***	−3.90***	13.29***	20.02***
50	1.67***	15.21***	11.60***	−11.14***	10.68***	26.91***
2015/16 counterfactual						
10	4.22***	22.17***	15.26***	0.04	9.09***	7.90***
25	2.37***	19.18***	13.11***	−3.77***	13.43***	19.84***
50	1.96***	15.27***	11.29***	−11.25***	10.78***	26.68***

Source: SIAB7519, own calculations.

Notes: The table presents the counterfactual aggregate decomposition of gender wage gaps at different percentiles (10th, 25th and 50th percentile) using the RIF-regressions based Oaxaca-Blinder method. The non-discriminatory wage structure is calculated using the estimation strategies suggested by Reimers (1983) and Oaxaca and Ransom (1994). ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level, respectively.

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TKID "Transformation der Kommunikation – Integration und Desintegration"
NegoTrans "Negotiation Research – Transformation, Technology, Media and Costs"
INEF "Innovation, Entrepreneurship and Finance"
WDS "Work, Digitalization and Sustainability"

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