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**Conference Paper**

## Women's Managerial Representation and the Gender Pay Gap

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# Women’s managerial representation and the gender pay gap\*

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**Preliminary – please do not quote**

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## **Abstract**

This paper analyzes the impact of women’s managerial representation on the gender pay gap among subordinates on the establishment level using German Linked-Employer-Employee-Data. For identification of a causal effect we employ a panel model with establishment fixed effects as well as industry-specific time dummies. We find evidence for the women’s share in management to decrease the gender pay gap in a panel fixed-effects model with the effect being larger for second- than first-level management. We further analyze robustness of estimates to heterogeneous treatment effects.

**Keywords:** Gender pay gap, women managers

JEL Classification: J16, J31, J71

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# 1 Introduction

Women remain underrepresented in management positions across countries and most industries. Policies that aim at increasing the representation of women in these roles are discussed controversially in business, politics, public institutions and other parts of society. In part, such measures are motivated by the idea that they may not only increase gender equality in the targeted leadership position but also involve spillover effects that help decrease other gender gaps such as in pay, hiring and promotions among subordinates in the respective entity. These spillover effects could work through channels such as women managers being more concerned with, thus implementing policies to decrease gender gaps and promoting a more gender-equal organisational climate. Also, women managers may provide role models and mentoring to women employees thereby increasing their productivity, negotiation skills and likelihood to climb up the career ladder. The presence of women managers may furthermore constitute a stereotype-disconforming experience to all employees, thereby decreasing prejudices and implicit biases that perpetuate existing gender gaps.

To increase representation of women in supervisory and executive boards, legislative quotas have been introduced in many jurisdictions. Studies exploiting the introduction of these policies to estimate spillover effects of a higher share of women at the top executive and supervisory level to women employees' labor market outcomes at lower ranks have not found clearcut evidence yet (Bertrand et al., 2019; Maida and Weber, 2019). In part, this may be due to relatively short time horizon under consideration. Company-wide policies implemented by top management may take time to be agreed on, implemented and take effect at different levels of the hierarchy.

Managers that are in closer contact in day-to-day business with employees and make personnel decisions on hiring, salaries and promotions at lower levels of the company hierarchy or as leaders of small firms may have a more direct and immediate impact on pay and career progression of their subordinates. Therefore, an increased share of women in these positions may prove to be effective to reduce gender gaps among subordinates also in the shorter run. Using personnel data of a large manufacturing firm, Drechsel-Grau and Holub (2020) find gender gaps in bonus payments of subordinates to be smaller for women than for men managers. Cardoso and Winter-Ebmer (2010) find that woman leaders of small-sized Portuguese firms reduce the gender pay gap among their employees. Similarly Bhide (2020) finds a man-to-woman change of top executive to reduce the gender pay gap relative to a man-to-man change in a sample of small German establishments. Hirsch (2013) finds that increasing the women's share in first- and second-level management decreases the gender pay gap in a cross section of German companies.

In this paper, we use the Linked-Employer-Employee-Data (LIAB) of the German Institute of Employment Research to study the impact of women’s managerial representation on the gender pay gap among subordinates on the establishment level. We extend the existing literature by using an establishment panel that is representative of the German economy both in terms of establishment sizes and industries and that contains information on women’s representation both on the highest first-level and second-level management. Therefore, we do not need to focus on small establishments with a single executive and furthermore can explicitly take into account the proximity of managers to their subordinates.

For identification of a causal effect, we exploit the panel structure of the dataset which allows us determine the impact of a higher share of women in first- and second-level management on the wages of men and women within an establishment in a fixed-effects regression framework including both establishment fixed effects as well as industry-specific time fixed effects. In this way, we control for unobserved time-constant establishment heterogeneity and thus selection of women into lower-paying firms as well as differences in industry-wide trends of addressing gender gaps.

Section 2 introduces the data and presents descriptive statistics on gender gaps and women’s managerial representation in the sample. Section 3 outlines our empirical strategy to estimate the causal effect of women’s managerial representation on the gender pay gap. Section 4 presents estimation results. Section 5 analyzes robustness of our estimates to heterogeneous treatment effects. Section 6 concludes.

## 2 Data

For our analysis, we use the Linked-Employer-Employee-Data (LIAB Cross-Sectional Model 2 9317) of the German Institute of Employment Research (IAB). The dataset combines the yearly survey of German establishments (Establishment Panel) with administrative data from social security records of individuals employed at the respective establishments.

The Establishment Panel contains information on the business and employment situation and expectations of a representative sample of German establishments. The individual-level data of the LIAB Cross-Sectional Model contains information on daily earnings, education, occupation, experience and other characteristics of all individuals employed at the establishments on a specific cutoff date (30 June) in each year.

The Establishment Panel is supplemented with questions on women’s representation in first- and second-level management as part of the modules on women in leadership positions for the years 2004, 2008, 2012, 2014, 2016 and 2018. Based on these years, we construct a panel data set. We impose the following sample restrictions:

- We restrict our sample to private-sector plants only.<sup>1</sup>
- Since we are interested in the impact of women managers on pay of subordinates, we do not include individuals in manager and supervisor roles as identified by the 4th digit of the KldB 2010 Classification of Occupations in our analysis
- We restrict the sample to workers between the ages 20 and 65
- Since the LIAB dataset contains information on daily wages but no details on daily hours worked, we restrict our sample to full-time employees

Daily wages in the LIAB dataset are right-censored at the contribution assessment ceiling, which varies by year and between East and West Germany. This affects 17.2 (6.8) percent of men and 7.4 (4.0) percent of women in West (East) Germany. Wages above the contribution assessment ceiling need to be imputed in order to obtain unbiased estimates (Gartner, 2005). For this wage imputation, we follow the 2-step procedure of Dauth and Eppelsheimer (2020), which uses tobit regressions on observable characteristics (step 1) and leave-one-out-means<sup>2</sup> (step 2) similarly as in Card, Heining, and Kline (2013). We run the regressions separately by year, gender, East and West Germany. Figure A1 shows the gap in the mean and the standard deviation of log daily wages before and after imputation by gender and region. The gaps in mean log wages of 0.02 to 0.04 and in the standard deviation of 0.03 to 0.06 are consistent with those of Card, Heining, and Kline (2013).

## 2.1 Descriptive Statistics

Table 1 presents descriptive statistics of our final dataset separately by employee gender as well as West and East Germany. The table shows that women on average earn less than men in both regions and that they work in smaller establishments. Further, there is considerable gender-based job segregation: on average women employees face a higher share of women coworkers as well as women managers in their establishments than men employees.

Notably, there are also differences between West and East Germany. Both women and men earn less in East Germany, the gender gap, however, is smaller. Further, establishments in the East are smaller and women's share among both employees and managers are higher.

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<sup>1</sup>For this purpose, we follow Dauth and Eppelsheimer (2020) in constructing a 1-digit industry code. We drop observations from the industries Education, Health and Social Work, Non-industrial organizations and public administration. Furthermore, we drop observations from services industries that are public corporations ("Körperschaften des öffentlichen Rechts") or the establishment is mainly or exclusively publicly owned.

<sup>2</sup>These are mean wages over worker and plant without the respective observation under consideration. Thus they function as firm- or worker-fixed effects within the imputation regression.

Table 1: Descriptive Statistics

(a) West

	Men	Women	Difference
Daily wage, imputed	148.2	116.9	31.31***
Age	42.57	40.56	2.005***
College degree	0.175	0.169	0.00608***
12 years highschool or vocational degree	0.744	0.722	0.0217***
Number of days in employment	6786.1	5649.3	1136.8***
Number of days in job	4245.4	3124.6	1120.8***
Number of employees in establishment	9421.3	5651.8	3769.5***
Share of women employees	0.221	0.445	-0.224***
Share of women first level management	0.0572	0.113	-0.0562***
Share of women second level management	0.102	0.209	-0.107***
Observations	4347383		

(b) East

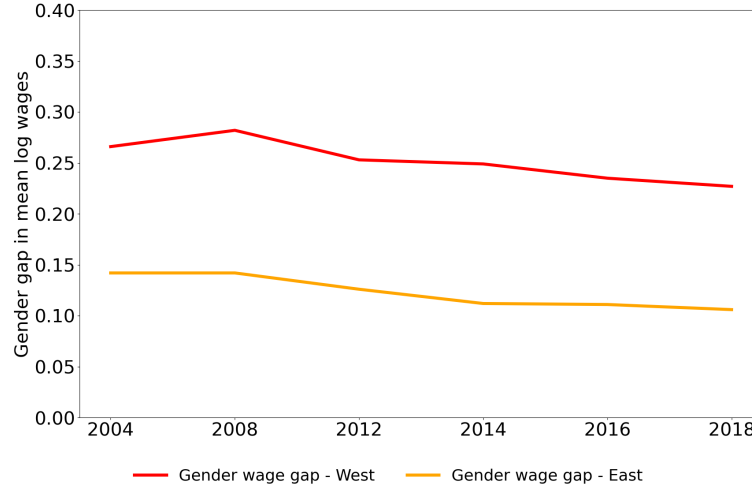
	Men	Women	Difference
Daily wage, imputed	95.48	85.20	10.29***
Age	43.11	43.87	-0.762***
College degree	0.143	0.198	-0.0552***
12 years highschool or vocational degree	0.827	0.770	0.0570***
Number of days in employment	5201.6	5032.7	169.0***
Number of days in job	2919.6	2883.2	36.42***
Number of employees in establishment	815.1	558.1	257.0***
Share of women employees	0.247	0.532	-0.285***
Share of women first level management	0.119	0.222	-0.103***
Share of women second level management	0.204	0.371	-0.166***
Observations	1137858		

### 2.1.1 Gender pay gap

Figure 1 shows the raw gender pay gap in the sample over the time period 2004 to 2018 for both West and East Germany. Overall, in the West the raw gender pay gap decreased from 26.6 percent in 2004 to 22.6 percent in 2018, while in the East the raw gender pay gap decreased from 14.1 to 10.7 percent. The gender pay gap in our dataset is larger than the German Federal Statistical Office's estimation of the raw gender pay gap, which decreased from 24 to 21 percent in West Germany and varied between 6 and 9 percent in East Germany between 2006 and 2018. The main reason for this discrepancy are differences in the underlying dataset. The Federal Statistical Office determines the raw gender pay gap from the structure of

earnings survey ("Verdienststrukturerhebung"), which measures hourly instead of daily wages (Fuchs et al., 2019), therefore accounts for differences in daily working hours between men and women also within the group of full-time employees. Further, we explicitly exclude the public sector in our sample, where a large part of wages are covered by collective bargaining agreements and the gender wage gap is smaller.

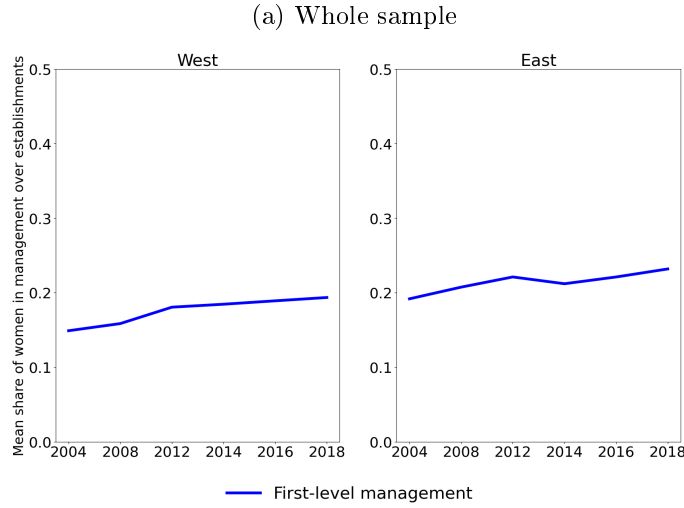
Figure 1: Raw gender pay gap over time



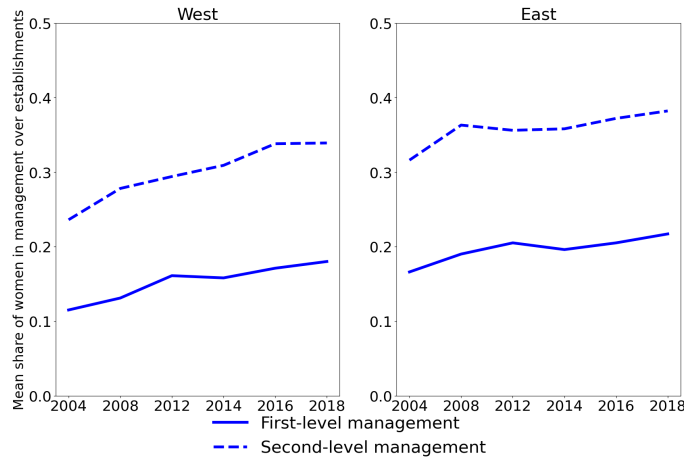
### 2.1.2 Women's managerial representation

Figure 2 presents the average share of women in first- and second-level management over all establishments in our sample by year. As found in Kohaut and Möller (2019), on average, women's managerial representation has increased over time in both East and West Germany, however, at a slow rate. In particular on the first management level women remain substantially underrepresented. Further, representation on both levels is consistently higher in East Germany as compared to West Germany.

Figure 2: Average share of women among first- and second-level management positions over establishments by year



(b) Restricted sample of establishments with second-level management

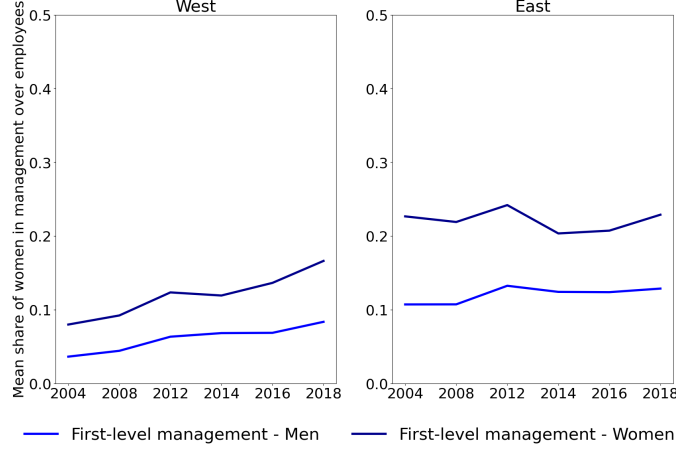


A similar picture arises when looking at the average managerial representation of women in establishments across our sample with employees as the unit of observation, which is presented in Figure 3 by employee gender in East and West Germany. In comparison to Figure 2 the shares in this figure accordingly are weighted by the number of employees in each establishment. Figure 3 shows that women employees in our sample on average face a higher share of women managers in their establishment than men employees for both first- and second-level management. This again is in line with gender-based employment segregation in the German labor market.

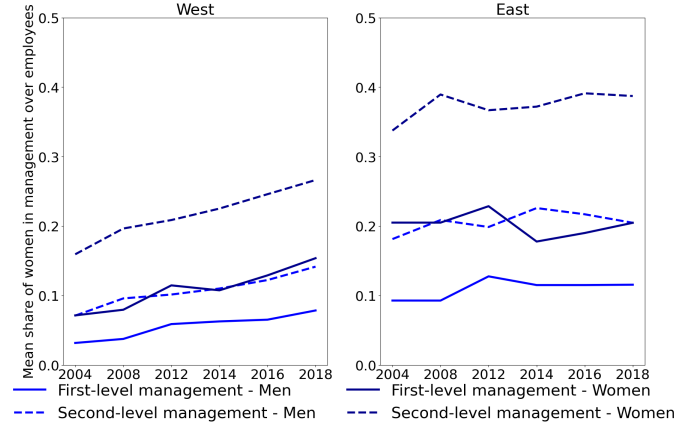


Figure 3: Average share of women among first- and second-level management positions faced by employees by gender

(a) Whole sample



(b) Restricted sample of establishments with second-level management



### 3 Empirical Strategy

We exploit the panel structure of the LIAB dataset to estimate the effect of women's representation in both first- and second-level management on the gender pay gap among subordinates. The representation of women in management may be correlated with unobserved establishment characteristics, such as the importance of gender-equality in the workplace culture, that also affect the gender pay gap in the respective establishment. By including establishment fixed effects, we can control for time-constant unobserved heterogeneity in our regression equation. Thus, identification in this model comes from changes in the share of women managers within each establishment over time. The resulting regression model the impact of women's

representation in first-level management is of the form

$$(1) \quad w_{ijt} = \beta_0 + \beta_1 wom_i + \beta_2 wom\_fl_{ijt} + \beta_3 wom\_fl_{ijt} \times wom_i \\ + X_{it}(\gamma + \gamma_{wom}wom_i) + Y_{jt}(\delta + \delta_{wom}wom_i) + c_j + \lambda_{ind,t} + \lambda_{wom,ind,t}wom_i + \epsilon_{ijt},$$

where  $w_{ijt}$  is the natural logarithm of the wage of individual  $i$  at time  $t$  in establishment  $j$ ,  $wom_i$  indicates whether individual  $i$  is a woman,  $wom\_fl_{ijt}$  is the share of women first-level managers in establishment  $j$  at time  $t$ .  $X_{it}$  is a set of individual characteristics such as experience, tenure and education.  $Y_{jt}$  is a set of establishment characteristics such as size, industry, the presence of a trade union wage agreement.  $c_j$  is a set of establishment fixed effects and  $\lambda_{ind,t}$  are industry-specific time dummies.  $\epsilon_{ijt}$  is the error term, which we cluster at the establishment level. The coefficient of interest is  $\beta_3$  capturing the effect of women's managerial representation on the gender pay gap through the interaction of  $wom\_fl_{ijt}$  and  $wom_i$ . In order to interpret  $\beta_1$  as the average unexplained gender pay gap in the sample, we center all regressors around their means. The corresponding regression model for second-level management includes two additional regressors  $wom\_sl_{ijt}$  and  $wom\_sl_{ijt} \times wom_i$

## 4 Estimation results

In the following, we present the results for estimating the impact of women's managerial representation on the gender pay gap for both first- as well as second-level management.

### 4.1 First-level management

Table 2 presents the results of estimating equation 1 separately for East and West Germany. In Model (1) we control for observable establishment characteristics but do not include establishment fixed effects. We find a negative relation between the share of women in first-level management of 12.6 (8.2) log points in West (East) Germany, which however is partly offset for women employees through a positive interaction effect of 9.3 (7.4) log points, suggesting that women managers decrease the gender pay gap by paying all employees but particularly men less than women. This finding is in line with the cross-sectional analysis of the 2008 LIAB data in Hirsch (2013). However, looking at the results of Model (2)-(4), we see that the negative relation of the share of women managers on the wages of employees disappears when including establishment fixed effects, thus seems to be driven by time-constant unobserved establishment heterogeneity. On the other hand, the coefficient of interest  $\beta_3$  decreases but remains substantial in size and highly significant in Models (2)-(4) including establishment fixed effects, a linear time trend or industry-specific time dummies. In our preferred spec-

ification including industry-specific time dummies the estimate of  $\beta_3$  amounts to 4 (2) log points.

Table 2: First-level management estimation results

(a) West				
	(1)	(2)	(3)	(4)
Woman	-0.177** (-39.10)	-0.158** (-43.91)	-0.159** (-46.44)	-0.160** (-44.82)
Share of women first-level management	-0.126** (-6.70)	0.00630 (0.60)	-0.00962 (-0.88)	0.0222 (1.93)
Woman * Share of women first-level management	0.0927** (5.61)	0.0596** (8.51)	0.0594** (8.44)	0.0398** (5.40)
Control for individual and firm covariates	Yes	Yes	Yes	Yes
Firm-fixed effects	No	Yes	Yes	Yes
Time trend	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	2770165	2770165	2770165	2770165
<i>t</i> statistics in parentheses				
* $p < 0.05$ , ** $p < 0.01$				
(b) East				
	(1)	(2)	(3)	(4)
Woman	-0.119** (-21.07)	-0.0921** (-25.32)	-0.0926** (-26.84)	-0.0932** (-28.88)
Share of women first-level management	-0.0818** (-6.29)	0.000761 (0.05)	-0.00702 (-0.55)	0.00983 (0.66)
Woman * Share of women first-level management	0.0736** (5.11)	0.0370** (4.80)	0.0383** (5.28)	0.0199** (2.90)
Control for individual and firm covariates	Yes	Yes	Yes	Yes
Firm-fixed effects	No	Yes	Yes	Yes
Time trend	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	746915	746915	746915	746915
<i>t</i> statistics in parentheses				
* $p < 0.05$ , ** $p < 0.01$				

## 4.2 Second-level management

Table 3 presents our estimation results of the impact of women’s representation in second-level management on the gender pay gap among subordinates while controlling for representation in first-level management.

We find the women’s share in second-level management to negatively impact the gender pay gap among subordinates within the same establishment in all Models (1) to (4) including individual and establishment covariates, establishment fixed effects, a linear time trend and industry-specific time dummies in turn. We find the effect to be larger in size than for first-level management. In our preferred specification including industry-specific time dummies the estimated coefficient amounts to 6.4 (5.8) log points. The estimation results thus suggest that women on second-level management that are in closer contact with employees on a day-to-day basis are more important for reducing wage inequalities by gender among subordinates.

Table 3: Second-level management estimation results

(a) West

	(1)	(2)	(3)	(4)
Woman	-0.176** (-35.50)	-0.160** (-42.51)	-0.161** (-45.58)	-0.161** (-45.73)
Share of women first-level management	-0.101** (-4.65)	0.00770 (0.74)	-0.0107 (-0.92)	0.0212 (1.74)
Woman * Share of women first-level management	0.0723** (3.88)	0.0434** (6.10)	0.0427** (6.04)	0.0306** (4.10)
Share of women second-level management	-0.110** (-6.20)	0.00415 (0.24)	-0.0153 (-1.34)	0.00108 (0.10)
Woman * Share of women second-level management	0.0851** (5.48)	0.0812** (9.43)	0.0851** (10.81)	0.0641** (8.38)
Individual and firm covariates	Yes	Yes	Yes	Yes
Firm-fixed effects	No	Yes	Yes	Yes
Time trend	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	2492152	2492152	2492152	2492152

*t* statistics in parentheses\*  $p < 0.05$ , \*\*  $p < 0.01$ 

(b) East

	(1)	(2)	(3)	(4)
Woman	-0.122** (-20.99)	-0.0973** (-24.59)	-0.0979** (-26.04)	-0.0965** (-28.18)
Share of women first-level management	-0.0656** (-4.82)	-0.000649 (-0.05)	-0.00999 (-1.38)	0.00877 (0.79)
Woman * Share of women first-level management	0.0639** (4.08)	0.0274** (3.41)	0.0285** (4.01)	0.0154* (2.17)
Share of women second-level management	-0.147** (-8.84)	-0.00305 (-0.29)	-0.00878 (-1.00)	-0.0000433 (-0.00)
Woman * Share of women second-level management	0.0961** (6.50)	0.0771** (9.49)	0.0781** (10.27)	0.0575** (7.32)
Individual and firm covariates	Yes	Yes	Yes	Yes
Firm-fixed effects	No	Yes	Yes	Yes
Time trend	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	634389	634389	634389	634389

*t* statistics in parentheses\*  $p < 0.05$ , \*\*  $p < 0.01$

## 5 Robustness of two-way fixed effects estimation under heterogeneous treatment effects

A recent stream of literature (as surveyed in de Chaisemartin and D’Haultfoeuille (2022)) has shown that under heterogeneity of treatment effects over time or between groups two-way fixed-effects estimators are not unbiased for the average treatment effect, i.e. may not identify a convex combination of treatment effects over time and groups weighted by their relative number of observations in the sample. Further, some of the weights attached to each time- and group-specific treatment effect may be negative. The reason for this issue are so-called "forbidden comparisons" (Borusyak, Jaravel, and Spiess, 2021) of outcomes between groups that switch treatment status during the observation period and always-treated groups as well as between groups that are exposed to different intensities of treatment in case of non-binary or non-staggered treatments.

In our application, heterogeneity in the effects of women’s managerial representation on the gender pay gap between establishments and over time may arise for several reasons. First, the effectiveness and implementability of policies that aim to reduce the gender pay gap may depend on the current level of the gender pay gap in an establishment. Second, wages in some establishments maybe be stickier than in others, e.g. due to collective bargaining agreements or differing levels of employee turnover. Third, the ability of women managers to influence wages as a function of their share in management could be non-linear and vary between different levels of representation since a critical mass of supporters may be needed to change a certain policy. Since the treatment variables in our application are non-binary, both of the abovementioned "forbidden comparisons" are relevant for our analysis.

A range of estimators that are heterogeneity-robust but less efficient than the two-way fixed-effects estimators (see Table 1 of de Chaisemartin and D’Haultfoeuille (2022)) as well as methods to calculate the size of negative weights in the two-way fixed-effects estimation have been proposed. In the following, we use these tools to assess the issue of heterogeneous treatment effects in our estimation of the effect of women’s managerial representation on the gender pay gap and robustness of our estimates.

To be completed

## 6 Conclusion

To be completed

## A Additional figures and tables

Figure A1: Gap in mean and standard deviation of log wages before and after imputation



## B Further Robustness checks

### B.1 Right-censoring of wages

Daily wages in the LIAB dataset are right-censored at the contribution assessment ceiling and wages above the contribution assessment ceiling need to be imputed. To ensure that our results are not driven by imputed wages, we repeat our analysis while excluding these from the estimation.

Tables A1 and A2 show that the results for the panel model with establishment fixed effects are robust to excluding imputed wages as the estimated coefficients on the interaction of the share of women in first- and second-level management with the gender dummy are only slightly different from those in Tables 2 and 3.

Table A1: First-level management estimation results without imputed wages

(a) West				
	(1)	(2)	(3)	(4)
Woman	-0.147** (-39.68)	-0.133** (-46.20)	-0.134** (-48.36)	-0.158** (-12.31)
Share of women first-level management	-0.118** (-9.15)	0.00318 (0.33)	-0.0133 (-1.83)	0.00238 (0.36)
Woman * Share of women first-level management	0.0886** (7.68)	0.0583** (9.88)	0.0592** (10.41)	0.0297** (5.29)
Control for individual and firm covariates	Yes	Yes	Yes	Yes
Firm-fixed effects	No	Yes	Yes	Yes
Time trend	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	3581679	3581679	3581679	3581679
<i>t</i> statistics in parentheses				
* $p < 0.05$ , ** $p < 0.01$				
(b) East				
	(1)	(2)	(3)	(4)
Woman	-0.107** (-19.51)	-0.0795** (-27.40)	-0.0797** (-28.37)	-0.0411** (-3.67)
Share of women first-level management	-0.0931** (-8.10)	-0.0104 (-0.88)	-0.0202 (-1.80)	-0.000258 (-0.03)
Woman * Share of women first-level management	0.0889** (6.63)	0.0541** (7.70)	0.0574** (8.28)	0.0239** (3.99)
Control for individual and firm covariates	Yes	Yes	Yes	Yes
Firm-fixed effects	No	Yes	Yes	Yes
Time trend	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	1032845	1032845	1032845	1032845
<i>t</i> statistics in parentheses				
* $p < 0.05$ , ** $p < 0.01$				



Table A2: Second-level management estimation results without imputed wages

(a) West

	(1)	(2)	(3)	(4)
Woman	-0.137** (-30.61)	-0.126** (-37.48)	-0.127** (-39.26)	-0.123** (-10.65)
Share of women first-level management	-0.0969** (-5.58)	0.0135 (1.27)	-0.00895 (-1.04)	0.00613 (0.73)
Woman * Share of women first-level management	0.0613** (3.95)	0.0326** (5.22)	0.0313** (5.15)	0.0203** (3.22)
Share of women second-level management	-0.112** (-7.17)	0.00464 (0.32)	-0.0181* (-2.16)	-0.0163* (-2.16)
Woman * Share of women second-level management	0.0709** (4.91)	0.0618** (7.60)	0.0662** (9.00)	0.0533** (7.87)
Control for individual and firm covariates	Yes	Yes	Yes	Yes
Firm-fixed effects	No	Yes	Yes	Yes
Time trend	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	2101812	2101812	2101812	2101812

*t* statistics in parentheses\*  $p < 0.05$ , \*\*  $p < 0.01$ 

(b) East

	(1)	(2)	(3)	(4)
Woman	-0.102** (-16.58)	-0.0808** (-21.67)	-0.0811** (-22.46)	-0.0816** (-7.25)
Share of women first-level management	-0.0582** (-4.26)	0.00597 (0.46)	-0.00536 (-0.77)	0.0137* (1.96)
Woman * Share of women first-level management	0.0545** (3.44)	0.0163* (2.04)	0.0176* (2.48)	0.00512 (0.75)
Share of women second-level management	-0.135** (-8.35)	0.000572 (0.06)	-0.00572 (-0.73)	-0.000394 (-0.05)
Woman * Share of women second-level management	0.0839** (5.69)	0.0682** (8.69)	0.0691** (9.50)	0.0527** (7.25)
Control for individual and firm covariates	Yes	Yes	Yes	Yes
Firm-fixed effects	No	Yes	Yes	Yes
Time trend	No	No	Yes	No
Industry-specific time dummies	No	No	No	Yes
N	599869	599869	599869	599869

*t* statistics in parentheses\*  $p < 0.05$ , \*\*  $p < 0.01$

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