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Effects of the German Minimum Wage on Earnings and Working Time Using Establishment Data

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Abstract: This study examines the short-term effects of the introduction of a statutory minimum wage in Germany on hourly wages, monthly wages and paid working hours. We exploit a novel panel dataset by linking the Structure of Earnings Survey (SES) 2014 and the Earnings Survey (ES) 2015 and apply a difference-in-differences approach at the establishment level. The results indicate an effect of the introduction of the statutory minimum wage on the average hourly wages of employees in minimum wage establishments of up to 5.9 %. Due to negative effects on average working time of approximately minus 3.1 %, the effects on monthly gross earnings are smaller but still amount to up to 2.7 % on average. The results further suggest that the minimum wage effects on earnings were greater among low-wage employees than on average, in eastern Germany than in western Germany, and among part-time employees and marginal employees than among full-time employees.

Keywords: minimum wage; evaluation; hourly wages; earnings; working time

JEL Classification: J08; J30; J31

1 Introduction

The introduction of a general minimum wage in 2015 was a major change to the institutional framework of the labour market in Germany. It had a considerably larger impact on a range of outcomes than subsequent incremental adjustments

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of the minimum wage (Bruttel 2019; Caliendo, Schröder, and Wittbrodt 2019; Mindestlohnkommission 2020). In view of the strong increase in the minimum wage to 12 euros per hour in October 2022, the introduction of the minimum wage provides an important reference for how the minimum wage operates in the German labour market.[1] The effects on hourly wages, monthly wages and working time have been a major focus of interest in previous evaluation studies since these dimensions basically determine whether the reform helps increase the incomes of low-wage earners and hence their welfare.

There has been a lively debate about the size and relation of minimum wage effects on hourly wages, monthly wages and working hours based on different data sources and methodological approaches applied in the literature. Previous research unanimously found a significant positive impact of the minimum wage introduction on hourly wages, but there have been mixed results regarding the impact on monthly wages and working hours based on different data and approaches (see Section 2). In particular, the findings differed between studies based on household survey data on the one hand and administrative data and establishment survey data on the other.

This paper extends previous research by examining the short-term effects of the minimum wage introduction based on novel linked employer–employee panel data for the years 2014 and 2015. To this end, the Structure of Earnings Survey (SES) 2014 and the Earnings Survey (ES) 2015 were linked to form an establishment panel, which also contains observations of a random sample of employees in the surveyed establishments. The SES/ES is one of few large datasets in Germany that allows the calculation of individual hourly wages (Dütsch, Himmelreicher, and Ohlert 2019).

The applied methodology uses a difference-in-differences approach that compares changes in earnings and working time among employees in establishments that were affected by the minimum wage to changes among employees in establishments that were not affected. Affected establishments were defined as those that had at least one employee with an hourly wage below 8.50 euros in the year 2014. Heterogenous effects are considered by putting a focus on low-wage employees and by differentiating between East and West Germany and by type of employment (full-time, part-time, marginal employees). As a robustness check, a weighted control group approach is applied.

1 The introduction of the minimum wage affected approximately four million employees in Germany. The adjustment of the minimum wage to 8.84 euros in 2017 affected approximately 3.3 million employees and the adjustment to 9.19 euros in 2019 affected approximately 2.5 million employees (Mindestlohnkommission 2020). The adjustment of the minimum wage to 12 euros in October 2022 affected approximately 5.8 million employees (Mindestlohnkommission 2023).

The results indicate an effect of the introduction of the statutory minimum wage on the average hourly wages of employees in minimum wage establishments of up to 5.9 %. Due to negative effects on average working time of approximately minus 3.1 %, the effects on monthly gross earnings are smaller but still amount to up to 2.7 % on average. The results further suggest that the minimum wage effects on earnings were greater among low-wage employees than on average, in eastern Germany than in western Germany, and among part-time employees and marginal employees than among full-time employees.

The remainder of the paper is structured as follows. Section 2 provides an overview of previous evidence. Section 3 introduces the data and describes the sample. Section 4 explicates the econometric approach. Section 5.1 presents descriptive results on the distribution and changes in earnings and working time. Section 5.2 examines the effects of the minimum wage. Section 6 provides a robustness check, and Section 7 concludes.

2 Previous Evidence

The literature consistently reports positive effects of the introduction of the minimum wage on hourly wages, which differ only somewhat in size. Several studies used household survey data and reported effects between 4 and 9 % based on the German socioeconomic panel (GSOEP) (Bachmann et al. 2020; Burauel et al. 2020b; Caliendo et al. 2023) and between 5 and 9 % based on the PASS[2] (Hafner and Lochner 2022). Since working hours are not measured in the Integrated Employment Biographies (IEB) except from 2010 to 2014, two studies used approximated hourly wages based on imputed working hours. They reported minimum wage effects on hourly wages of 6 % (Dustmann et al. 2022) and 4 % (Ahlfeldt, Roth, and Seidel 2018). Several studies have pointed to stronger effects on hourly wages in the lower part of the wage distribution (e.g. Ahlfeldt, Roth, and Seidel 2018; Bachmann et al. 2022).

Descriptive evidence based on the Structure of Earnings Survey showed an immediate substantial shift of employment with hourly wages below the minimum wage to the value of the minimum wage and closely above after the introduction of the minimum wage. Changes in the same range of hourly wages were much smaller according to the GSOEP (e.g. Mindestlohnkommission 2020: 52). Additionally, measured noncompliance with the minimum wage is substantially larger based on the GSOEP than based on the SES/ES (Mindestlohnkommission 2018: 62ff.).[3] Estimates

2 The PASS ('Labour Market and Social Security' panel study) is an annual survey of households in Germany with a focus on low-income households.

3 An analysis and discussion of these differences can be found in Bachmann et al. (2020) and Dütsch, Himmelreicher, and Ohlert (2019); see (Fry and Ritchie 2012) for the UK.

of minimum wage effects on hourly wages can thus be expected to be larger in the SES/ES than in the GSOEP. Using the structure of earnings surveys in 2014 and 2018 and regional variation in the minimum wage bite, Biewen, Fitzenberg, and Rümmele (2022) find significant minimum wage effects on hourly wages along the wage distribution and spillover effects up to 20 % above the minimum wage. Bossler, Liang, and Schank (2024) report similar findings along the wage distribution and, on average, attribute an increase in hourly wages of 5.3 % to the minimum wage introduction.

The results regarding the impact of the minimum wage on monthly wages were more mixed. Studies based on the German Socio-Economic Panel (GSOEP) found that there were no increases in monthly wages for affected workers in 2015, and the effect of 6.6 % in 2016 was only statistically significant at the 0.1-level (Bachmann et al. 2020; Burauel et al. 2020a, 2020b). They also showed that the findings on monthly wages resulted from minimum wage-induced reductions in contractual working time. However, other studies did find significant positive minimum wage effects on monthly wages of 3.8–4.3 % using the IAB Establishment Panel (Bossler and Gerner 2020; Bossler et al. 2022) and of 4.4 % in 2015 and 2016 using the Integrated Employment Biographies (IEB) (Bossler and Schank 2023). According to (Bossler and Schank 2023: 14), the effects are largest at the 20th percentile of the distribution of monthly earnings and reach up to the 50th percentile. The authors explain that the effect is small at the 10th percentile because it is located at the upper earnings limit of marginal employment (employees with maximum earnings of 450 euros per month, which are exempt from taxes and social security contributions). For the period from 2014 to 2018, Bossler, Liang, and Schank (2024) find an average effect on monthly wages of approximately 5 % using the SES.

The evidence on minimum wage effects on working time has previously relied strongly on household survey data from the GSOEP (Bachmann et al. 2020; Burauel et al. 2020a) and the PASS (Hafner and Lochner 2022; Pusch, Seifert, and Santoro 2020) and was complemented by findings based on the IAB Establishment Panel (Bossler and Gerner 2020), all indicating a reduction in working time due to the introduction of the minimum wage. The results of Burauel et al. (2020a) indicated a significant negative effect on contracted working time of approximately minus 5 % in the one-year period but no significant effect on working time in the two-year period. Interestingly, negative effects were found only regarding contractual working time but not regarding actual working time. However, recent evidence based on SESs from 2014 to 2018 by Biewen, Fitzenberg, and Rümmele (2022) and (Bossler, Liang, and Schank 2024) does not confirm significant minimum wage effects on working time on average. Bossler, Liang, and Schank (2024), however, noted a reduction in the working hours of minijobbers.

Burauel et al. (2020a, 2020b) also examined heterogeneous short-term effects of the minimum wage by type of employment. They find that the minimum wage had the greatest positive impact on the hourly wages of marginal workers (15.5 % points), while the effect on full-time workers amounted to 7.8 % points, and no significant effect on part-time workers was found. Despite the positive effects on the hourly wages of full-time and marginal workers, no significant impact on monthly earnings was found. Regarding working time, they reported a significant and robust reduction in contractual working hours among employees who are subject to social security contributions but not among marginally employed workers.

3 Data and Sample Description

This study constructs a panel dataset by linking the structure of earnings survey (SES) of 2014 and the earnings survey (ES) of 2015 at the establishment level.[4] Based on these data, I examine the short-term impact of the introduction of a general minimum wage in Germany. The SES is a large mandatory survey among establishments that the Federal Statistical Office conducts every four years (Statistisches Bundesamt 2016, 2017). It collects information on the characteristics of the establishment and a random sample of employees within each covered establishment.[5] The focus of the survey is earnings and hours of work. The ES 2015 is a special survey, which is mostly identical to the SES 2014 regarding its content and procedure but has a smaller sample size, and establishments' participation is nonmandatory. It was initiated with the specific aim of obtaining information on the impact of the minimum wage in the years following the introduction of the minimum wage.[6] Both the SES and the ES cover establishments of all sizes and the entire spectrum of industries, except employment in private households and extraterritorial organizations.

Sampling of the SES and ES was carried out in two stages. In the first stage, a sample stratified by industry, region, and establishment size is drawn at the establishment level from the Firm Register (URS) of the Federal Statistical Office. The realized establishment sample from the SES 2014 was used as the sampling base for the ES 2015 (Statistisches Bundesamt 2017: 15 ff.), which allows us to link the same establishments in both years based on an establishment identifier. In the second

4 Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, DOI: 10.21242/62111.2014.00.00.1.1.1 and 10.21242/62112.2015.00.00.1.1.0.

5 Employees can be in a main job or a side job. Therefore, strictly speaking, the data represents employment relationships held by employees.

6 The ES has been conducted for the years 2015–2017 and 2019.

stage, a simple random selection of employees is independently drawn within establishments in each year. While all employees are covered in small firms, the share of covered employees decreases with firm size.[7]

The minimum wage in Germany is subject to several exemptions for specific groups. It does not apply to self-employed persons, to persons under 18 years old without a vocational degree, individuals in vocational training, individuals in particular internships, long-term unemployed individuals in the first six months after taking up employment or, until 2017, employees in particular industries with sectoral minimum wages (Mindestlohnkommission 2020: 20). Consequently, individuals younger than 18 and individuals in vocational training were excluded from the sample. Other exemptions could not be clearly delimited in the SES/ES data because they would require detailed information on industries and employment trajectories, which was not available. Hence, the same sample delineation as in previous minimum wage examinations based on the SES or ES was applied (Bachmann et al. 2020; Dütsch and Himmelreicher 2020; Dütsch, Himmelreicher, and Ohlert 2019; Mindestlohnkommission 2020). Retaining exempted employees (with wages below the minimum wage) in the sample may lead to an overestimation of the relevance of the minimum wage and to an underestimation of the size of minimum wage effects among eligible employees.

The SES/ES data have crucial advantages but also several limitations. They provide very reliable information on monthly earnings because firms usually transfer this information directly based on their accounting data. The SES/ES data also provide a relatively large sample of employees and establishments, which allows for the differentiation of analyses by subgroup. The main limitation of these data is that they usually do not have a panel structure but rather consist of repeated cross-sections with distinct samples. The years 2014 and 2015 are an exception to this, which is explained in detail below.

Because the SES/ES is an establishment survey, a presumed tendency of employers not to disclose hourly wages below the effective minimum wage may be relevant for the quality of the data (Garnero, Kampelmann, and Rycx 2015). The SES/ES does not measure unpaid working time and is therefore not designed or expected to measure noncompliance with the minimum wage. According to qualitative research and information from custom agencies actual evasions of the minimum wage law are mainly related to unpaid and undocumented working time

7 Establishments with 1–9 employees: every employee; 10–49 employees: every second employee; 50–99 employees: every third employee; 100–249 employees: every sixth employee; 250–499 employees: every 10th employee; 500–999 employees: every 20th employee; 1,000 and more employees: every 40th employee.

(Mindestlohnkommission 2020: 69).[8] Nevertheless, it is of interest that software tools for wage accounting usually indicate when wages and working hours result in an hourly wage that is below the minimum wage (Dütsch, Himmelreicher, and Ohlert 2019: 273). While such tools obviously help employers comply with the minimum wage regarding hourly wages resulting from documented and paid working time, it is unknown how accurate working time documentation is and whether there is unpaid working time. Furthermore, the supposed tendency not to disclose wages below the effective minimum wage may find its way into survey responses both in the SES and the ES at specific instances, such as the reporting of working time for the survey when working time has not been properly documented or the required random sampling of employees within larger establishments for the survey, the implementation of which is left to the establishments.

The ES 2015 has been subject to one additional concern because, unlike the SES survey, participation in the ES was not mandatory. While the same sampling pool of establishments was contacted for the ES 2015 as for the SES 2014, the participation rate was much lower (12.8 %), which caused the concern that participation in the survey might have been systematically avoided by establishments that were not compliant with the minimum wage after its introduction. Previous empirical evidence does not support this assumption. Most notably, the ascertained rates of employees below the effective minimum wage vary only slightly between the nonmandatory surveys of the years 2015–2017 and the mandatory Structural Earnings survey of the year 2018. Furthermore, the Federal Statistical Office analysed the survey response for the ES 2015 based on the full sample of the SES 2014 and the subsample that participated in the ES 2015. They found that the probability of taking part in the survey declined with establishments' wage level (Frentzen and Günther 2017), which is confirmed by a relatively low mean hourly wage in the ES 2015 (Bachmann et al. 2022: 43). As a consequence, and in line with the aim of the survey to facilitate minimum wage research, the ES is better suited to examining low-wage employment than high-wage employment. Frentzen and Günther (2017) also found that the response rate was marginally lower for establishments that were affected by the minimum wage in 2014 than for establishments that were not affected. This is not necessarily a problem for the analysis of wage effects since it makes the treatment group (of affected establishments) smaller but does not necessarily distort wage changes within the treatment group. However, if there was systematic nonparticipation of establishments that were affected by the minimum wage law and did not react to it (noncompliance), it would lead to an overestimation of wage

8 It is also not measured in contractual working time in the GSOEP. While it is potentially measured by actual working time in the GSOEP, it is unknown if and how the respective actual working hours are remunerated.

effects. In the most comprehensive examination of potential measurement errors to date, Bachmann et al. (2020) concluded that both the SES/ES and the GSOEP are presumably affected by measurement errors that are likely to differ due to different issues in household/employee surveys and establishments surveys. Ultimately, which data come closer to portraying the true distribution of low hourly wages in Germany could not be clarified.

For our analysis, the SES 2014 and the ES 2015 were linked at the establishment level based on an identification number. Linkage is technically not possible for establishments in public service and establishments that exclusively employ marginal employees. Apart from these exceptions, all establishments that participated in the ES 2015 also participated in the SES 2014 and can be followed over time in the data. Information on wages and working time refers to a random sample of employees within each establishment. Importantly, the panel structure of the data is given only at the establishment level but not at the level of individual employees. This means that the composition of observed employees within establishments in the treatment and control groups can change over time. Wage changes therefore can reflect wage increases (or reductions) of workers who stayed at a firm, or entries of employees with specific wage levels, or exits of employees with specific wage levels.

Due to the much smaller sample size of the ES 2015, linking both datasets greatly reduced the number of cases from the SES 2014, resulting in 73,395 employees in 6,594 establishments (see Table 1).[9] A firm is categorized in the treatment group if it had at least one employee earning less than 8.50 euros per hour in 2014 and in the control group otherwise. Approximately 40.5 % and 2,672 establishments in the sample, respectively, are affected by the minimum wage (see also Mindestlohnkommission 2020: 131; Ohlert 2021). Accordingly, the sample comprises the same 6,594 establishments in the ES 2015, but the number of employees deviates somewhat from the data for the previous year due to job changes. Table 1 compares the unweighted wage distributions of the full sample and the panel sample of the SES 2014. This shows that there are no deviations in the lower part of the wage distribution and only small deviations in the upper part, which suggests that the sample of the ES 2015 is not substantially biased regarding the distribution of wages. Additionally, the share of employees below 8.50 is the same in both samples.

9 The sample of the total SES 2014 comprises 60.000 establishments (Dütsch, Himmelreicher, and Ohlert 2019).

Table 1: Summary statistics on the distribution of hourly wages.

	2014		2015
	Cross-section	**Establishment panel sample**	**Establishment panel sample**
Mean	17.04	16.91	18.12
Percentiles			
P5	7.00	6.99	8.50
P10	8.00	8.00	8.67
P25	10.00	10.00	10.40
P50	14.31	14.32	15.00
P75	20.37	20.60	21.86
P90	29.08	29.10	31.25
P95	36.25	35.83	38.41
Share of employees below 8.50€	0.13	0.13	0.02
Number of observations	725,764	73,395	66,782

Source: SES 2014, ES 2015, unweighted data, own calculations. Notes: Observations are employees within establishments. The mean and percentile values are in euros per hour.

4 Econometric Approach

To answer the question of how the introduction of a minimum wage influences the earnings and working time of employees, this study applies a difference-in-differences (DID) approach, in which the factually unobserved situation without a minimum wage is represented by a control group. The central assumption of this approach is that the outcomes in the defined treatment and control groups would develop similarly in the absence of the minimum wage (common trend assumption or CTA). Because there are few exceptions to the minimum wage in Germany, there is no obvious control group of employees who are not covered by the minimum wage. Moreover, the available data in this study do not allow us to follow individual employees but rather to follow establishments over time. Hence, to identify the effects of the introduction of the minimum wage, I divide establishments into those affected by the minimum wage and those not affected to compare the changes in earnings and working time of employees in the two groups of establishments. Establishments' affectedness by the minimum wage is measured based on whether at least one employee with an hourly wage below 8.50 euros per hour was observed in an establishment in 2014.

Since effects of the minimum wage are likely for workers with wages up to and closely above the minimum wage but are increasingly unlikely in higher wage regions (Cengiz et al. 2019), a focus is placed on the group of low-wage employees.

Hence, employees with hourly wages above 10 euros are dropped from the sample in an alternative specification. Further heterogeneity of minimum wage effects is considered by conducting separate estimations for East and West Germany and by interacting treatment effects by type of employment.

The outcomes of interest are hourly wages, monthly earnings and paid working time of employee i in firm j and year t (see equation (1)). Monthly earnings are defined as gross monthly earnings excluding overtime pay, and working time is defined as paid hours of work per month excluding paid overtime.[10] Hourly wages are calculated by dividing monthly earnings by paid working time per month. The logarithm of all three dependent variables is taken for the multivariate analyses.

$$yijt = \text{treated}j * \text{year } 2015t * \delta + \text{year } 2015t * \tau + \theta j + xijt * \beta + \varepsilon ijt \quad (1)$$

The treatment effect on the treated is estimated by δ, which is the coefficient for an interaction of a dummy variable indicating establishments affected by the minimum wage with the year 2015. It shows to what extent the minimum wage changed the average wages and working time of employees in establishments that had at least one employee paid less than 8.50 euros per hour in 2014. Furthermore, I include fixed establishment effects (θj) in the models and thus estimate minimum wage effects based on changes within establishments between 2014 and 2015. The inclusion of establishment fixed effects controls for time-constant differences across establishments and thus also between establishments affected by the minimum wage and those not affected. As only changes within establishments are accounted for, changes in the number of observed employees within establishments over time have no influence on the estimated effect.

Furthermore, control variables that can vary over time are included in the specification. Changes in the composition of employees within establishments could be a driver of changes in earnings and working time, and there is some concern that changes in the composition of employees might deviate between the two groups of establishments, irrespective of the minimum wage introduction, for two reasons: a) there are substantial differences in the employment structure of minimum wage establishments and other establishments (see Table A2), b) it is not known from the data to what extent the same sample of employees was observed within establishments before and after the introduction of the minimum wage (see Section 3). The characteristics of employees within establishments were hence controlled for in the regressions regarding employees' highest educational degree, age and age squared and the type of employment with the categories full-time, part-time and marginal

10 Including overtime in paid working hours and earnings would not change hourly wages strongly. Overtime pay is slightly higher due to overtime surcharges. Unpaid overtime is not included in the data.

employment as well as dummy variables for fixed-term employment and gender. Furthermore, large-scale changes in establishment size are unlikely to be due to the minimum wage but could influence average wages and working time in establishments. Therefore, three categories of establishment size were controlled for (1–10 employees, 11–100 employees, 101 or more employees). It is assumed that the common trend assumption holds conditional on these characteristics.

It is common practice to test the CTA based on the trends of both groups prior to the respective policy intervention. This is not possible based on the available data in this study, as the panel dataset at the establishment level can only be compiled for the years 2014 and 2015. Pretrends presented by Bossler and Gerner (2020) imply that the common trend assumption is not problematic for the analysis of working time effects. According to this study, which is based on the IAB Establishment Panel, the development of standard working hours did not differ significantly between minimum wage establishments and other establishments in the year before the introduction of the minimum wage (ibid.: 14). The same study shows that wage trends from 2013 to 2014 were slightly lower (approximately 2.1 %) in establishments affected by the minimum wage than in unaffected establishments (ibid.: 11). It can therefore be assumed that the DID model described above tends to overestimate the minimum wage effect on earnings to a small extent. The effects on hourly wages and monthly earnings are therefore interpreted as an upper bound.

A robustness check of the results was conducted based on the notion that similar pretreatment means in the outcome variables in the treatment and control groups are indicative of a good comparison group (Lechner 2010: 191). To this end, I applied a synthetic (weighted) control group approach (entropy balancing) that balances the pretreatment means and distributions of the respective outcome variables and a set of covariates (Hainmueller 2012; Hainmueller and Xu 2013). The approach is similar to matching on pretreatment outcomes, which is only possible with panel data and requires weaker assumptions than the parallel trend assumption in DID. For this purpose, the data are fully aggregated at the establishment level, which allows us to apply the obtained balancing weights to establishments in both observed years to retain a fixed treatment and control group. The approach has been applied frequently in minimum wage evaluation at the establishment level (e.g. Bossler and Gerner 2020).

The results on the effects of the minimum wage on earnings and working hours could in principle also be influenced by employment effects of the minimum wage. However, the employment effects of the introduction of the minimum wage were relatively small overall according to previous findings (Caliendo, Schröder, and Wittbrodt 2019). The presumably minimum wage-related additional conversions from marginal employment to employment subject to social security contributions

comprised approximately 100 thousand employment relationships in 2015 (vom Berge and Weber 2017: 4). For the analyses presented, these findings suggest a low quantitative relevance of selection into employment.

5 Results

5.1 Descriptive Results

Between 2014 and 2015, hourly wages increased by 11.6 % in establishments affected by the minimum wage and by 3.7 % in other establishments, on average (Table 2). The difference in this change between the treatment and control groups therefore amounts to approximately 8 % points. While the growth of hourly wages was clearly greater at the bottom of the distribution of affected establishments than among other establishments, it was also fairly high in the upper half of the wage distribution, where an impact of the minimum wage is rather unlikely (Figure 1). In establishments that were not affected by the minimum wage, there was almost no growth in hourly wages at the 5th and 10th percentiles and slightly greater wage growth at higher percentiles, which resembles the usual pattern of wage growth observed in the years prior to the minimum wage introduction (Burauel et al. 2018: 34).

Table 2: Means and changes in outcome variables by treatment status.

	Employees in establishments affected by the minimum wage			Employees in other establishments		
	2014	2015	Change	2014	2015	Change
Hourly wages						
Mean	14.1	15.7	11.6 %	19.0	19.7	3.7 %
Monthly wages						
Mean	1,996.3	2,236.0	12.0 %	2,933.1	3,035.8	3.5 %
Working time						
Mean	29.9	30.3	1.3 %	34.4	34.3	–0,2 %
Number of observations	31,421	26,654		41,974	40,128	

Source: SES 2014, ES 2015, unweighted data, own calculations. Notes: Establishments affected by the minimum wage are those that had at least one employee paid less than 8.50 euros per hour in 2014. The results from a regression without any control variables show that the changes from 2014 to 2015 in the control group are significantly different from zero for hourly wages and monthly wages but not for working time. Changes from 2014 to 2015 in the treatment group are significantly different from the changes in the treatment group for hourly wages and monthly wages but not for working time.

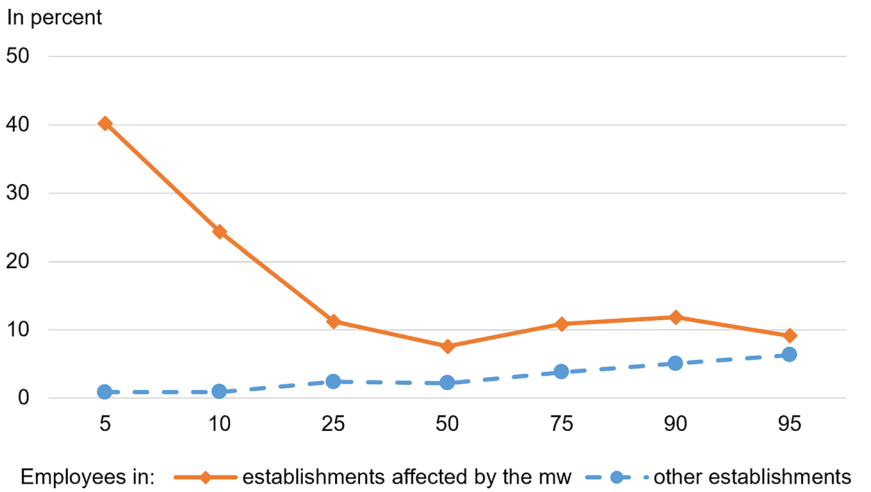

Figure 1: Changes in hourly wages by treatment status along the wage distribution. Source: SES 2014, ES 2015, unweighted data, own calculations. Notes: The *y*-axis shows changes in percentages. The *x*-axis shows percentiles of the distribution of hourly wages. The establishments affected by the minimum wage are those that had at least one employee paid less than 8.50 euros per hour in 2014.

On average, monthly wages increased by 12 % in establishments affected by the minimum wage and by 3.5 % in other establishments (Table 2). Monthly wage growth was thus approximately as high as the mean hourly wage growth. The difference between the treatment and control groups regarding monthly wage growth amounts to approximately 8.5 % points. A comparison of the changes across the distribution of monthly wages shows that the increase in monthly wages was greatest at the 25th percentile, where the monthly wage increased from approximately 600 euros to approximately 870 euros (without figures). These descriptive findings suggest that the growth of monthly wages was greater for part-time workers who are liable to social security than for marginal workers and full-time workers with higher earnings (see also Himmelreicher 2020). For marginal workers, the growth of monthly wages is limited by definition due to the upper limit of earnings of 450 euros in this employment form.

On average, working time increased by approximately 1 % in establishments affected by the minimum wage and remained unchanged in other establishments (Table 2). Hence, the difference between the treatment and control groups regarding changes in working time amounts to approximately 1 % point. In the treatment group, working time also increased most at the 25th percentile of the working time distribution, from approximately 17 h per week to approximately 20 h per week.

5.2 Results from Difference-in-Differences Analysis

5.2.1 Main Results

The results from difference-in-differences regressions with control variables show that the introduction of the minimum wage raised the mean hourly wages of employees in minimum wage establishments by up to 5.9 % (Table 3). The effect on the average wage of low-wage employees in minimum wage establishments is considerably greater, amounting to up to 13.7 %.[11] Although the overall minimum wage effect of approximately 6 % is similar in size to the estimated effects in previous studies, the result implies that the measured impact on affected low-wage workers is more than twice as large based on the SES/ES data. Studies based on the GSOEP conducted comparisons of workers who earned less than the minimum wage in 2014 to workers with earnings just above the minimum wage (Bachmann et al. 2020; Burauel et al. 2018; Caliendo et al. 2023). They found a positive effect of the minimum wage introduction on hourly wages amounting to approximately 6 %.

Table 3: Minimum wage effects on hourly wages, monthly wages and working time.

	All employees	Low-wage employees
Panel A: hourly wages		
Year 2015	0.026[a]	−0.009[b]
Treatment 2015	0.059[a]	0.137[a]
Panel B: monthly wages		
Year 2015	0.018[a]	−0.019
Treatment 2015	0.027[a]	0.079[a]
Panel C: working time		
Year 2015	−0.008[a]	−0.011
Treatment 2015	−0.031[a]	−0.057[a]
Observations	140,177	34,496
Establishment FE	Yes	Yes
Control variables	Yes	Yes

Source: SES 2014, ES 2015, unweighted data, own calculations. Notes: OLS estimation including fixed establishment effects. The outcome variables are presented in logarithmic form. Treatment refers to a dummy variable indicating establishments that had at least one employee paid less than 8.50 euros per hour in 2014. The included control variables are employees' highest educational degree, age, age squared, type of employment in the full-time, part-time and marginal employment categories, a dummy for fixed-term employment and a dummy for female gender. Confidence level: [a]$p < 0.001$, [b]$p < 0.01$, [c]$p < 0.05$.

11 A fixed low-wage threshold of hourly wages lower than 10.05 euros has been applied to include employees with a round value of 10 euros per hour. The low-wage thresholds reported by the Federal Statistical Office are close to 10 euros in 2014 and 2015.

In contrast to the same studies, I find significant positive effects of the minimum wage introduction on the monthly wages of employees in minimum wage establishments. It amounts to up to 2.7 %, on average, and to up to 7.9 % for low-wage employees in minimum wage establishments. These findings are therefore in line with (Bossler and Schank 2023), who found positive effects of approximately 4.4 % on monthly wages.

I find negative effects of the minimum wage on working time of approximately −3.1 % in total and approximately −5.7 % for low-wage employees. Other studies found similar effects on working time of approximately −5 % (Bachmann et al. 2020; Bonin et al. 2018; Bossler and Gerner 2020; Caliendo et al. 2023). I find that the relative reductions in working time are smaller than the relative increases in hourly wages. The results thus confirm that in the short term, working time adjustments have diminished increases in monthly earnings compared to increases in hourly wages. However, working time reductions did not entirely offset the positive impact of the introduction of the minimum wage on monthly earnings.

There are distinct differences in the bite of the minimum wage between East Germany and West Germany. Approximately 21 % of employees in East Germany and approximately 9 % of employees in West Germany had an hourly wage below 8.50 euros in 2014 (Mindestlohnkommission 2020: 56). Accordingly, a larger impact of the minimum wage could be expected in East Germany.

Separate estimations for East and West Germany show that the effects of the minimum wage on wages and working time were indeed clearly greater in East Germany (see Table 4). Relative to employees in establishments without minimum wage workers, average hourly wages increased by approximately 4.0 % more in minimum wage establishments in West Germany and by approximately 10.2 % more in East Germany. Furthermore, the minimum wage introduction raised the mean wage of low-wage employees in minimum wage establishments by approximately 11.2 % in West Germany and by approximately 16.0 % in East Germany.

The measured additional increase in average monthly wages in minimum wage establishments in West Germany amounts to 1.4 % but is statistically insignificant. In East Germany, average monthly wages increased by approximately 5.8 % due to the minimum wage. The measured impact on the monthly wages of low-wage employees is again larger than on average for all employees in minimum wage establishments. It amounts to approximately 6.0 % in West Germany and approximately 9.9 % in East Germany. Since earnings are lower, on average, in East Germany than in West Germany, the observed minimum wage effects cause some convergence of the wage level between regions.

The impact of the minimum wage introduction on working time is also somewhat stronger in East Germany than in West Germany. In West Germany, working

Table 4: Minimum wage effects in East Germany and West Germany.

	All employees		Low-wage employees	
	West Germany	**East Germany**	**West Germany**	**East Germany**
Panel A: hourly wages				
Year 2015	0.026[a]	0.023[a]	−0.012[a]	0.006
Treatment 2015	0.040[a]	0.102[a]	0.112[a]	0.160[a]
Panel B: monthly wages				
Year 2015	0.018[b]	0.017[b]	−0.022	−0.012
Treatment 2015	0.014	0.058[a]	0.060[b]	0.099[a]
Panel C: working time				
Year 2015	−0.008[b]	−0.006	−0.010	−0.018
Treatment 2015	−0.026[a]	−0.043[a]	−0.051[b]	−0.061[a]
Observations	106,097	34,080	21,911	12,585
Establishment FE	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes

Source: SES 2014, ES 2015, unweighted data, own calculations. Notes: OLS estimation including fixed establishment effects. The outcome variables are presented in logarithmic form. Treatment refers to a dummy variable indicating establishments that had at least one employee paid less than 8.50 euros per hour in 2014. The included control variables are employees' highest educational degree, age, age squared, type of employment in the full-time, part-time and marginal employment categories, a dummy for fixed-term employment and a dummy for female gender. Confidence level: [a]$p < 0.001$, [b]$p < 0.01$, [c]$p < 0.05$.

time decreased, on average, by approximately 2.6 % more among employees in minimum wage establishments than among those in other establishments. In East Germany, the respective estimate is −4.3 %. Working time reductions were slightly stronger among low-wage workers than on average in minimum wage establishments. There was a decrease in working time of approximately 5.1 % among low-wage employees in West German minimum wage establishments and of approximately 6.1 % in East German minimum wage establishments. Since contractual working time is, on average, greater in East Germany than in West Germany, the observed minimum wage effects contribute to some convergence in working time between the regions.

5.2.2 Heterogeneity Results by Type of Employment

The effects of the minimum wage on the average hourly wages of different groups of workers are usually greater for groups with a higher bite of the minimum wage, i.e. groups with a greater share of affected workers. Additionally, workers may experience differential minimum wage effects by type of employment if there are differences by group a) in the distance to the minimum wage for affected workers,

b) regarding differential spillover effects on hourly wages above the minimum wage, or c) concerning remaining employees below the minimum wage due to noncompliance or exceptions from the minimum wage.

Table 5 shows that the bite of the minimum wage was greater for part-time workers and substantially greater for marginally employed workers than for full-time employees. Approximately 43 % of employees in marginal employment received an hourly wage below 8.50 euros in 2014. Additionally, the average wages of employees who were affected by the minimum wage were lower for marginal employees than for part-time or full-time employees. Hence, the impact of the minimum wage introduction can be expected to be the largest among employees in marginal employment.

Reductions in working time are particularly likely to occur among marginal employees since their monthly gross earnings had to be below the administered threshold of 450 euros, despite rising hourly wage rates. According to surveys on working time preferences, part-time workers in Germany wish to increase their working hours, while full-time employees wish to reduce their working hours (Harnisch, Müller, and Neumann 2018). Therefore, the effects of the minimum wage on working time are likely to differ between part-time and full-time workers.

Figure 2 provides a descriptive overview of changes in the respective outcome variables in establishments that were affected by the introduction of the minimum wage compared to other establishments. In establishments affected by the minimum wage, the growth in hourly wages was greater for marginal employment and somewhat greater for full-time employment than for part-time employment (Figure 2). The wage growth of hourly wages was clearly lower for all three types of employment in establishments not affected by the minimum

Table 5: Distribution of hourly wages by type of employment in 2014.

	Full-time	Part-time	Marginal employment
Year	2014	2014	2014
Mean	19.19	14.72	9.19
Percentiles			
P5	8.16	6.90	5.00
P10	9.21	7.69	6.00
P25	11.86	9.31	7.39
P50	16.42	12.98	8.83
Share of employees below 8.50€	0.06	0.16	0.43
Number of observations	48,452	14,841	10,102

Source: SES 2014, unweighted data, own calculations.

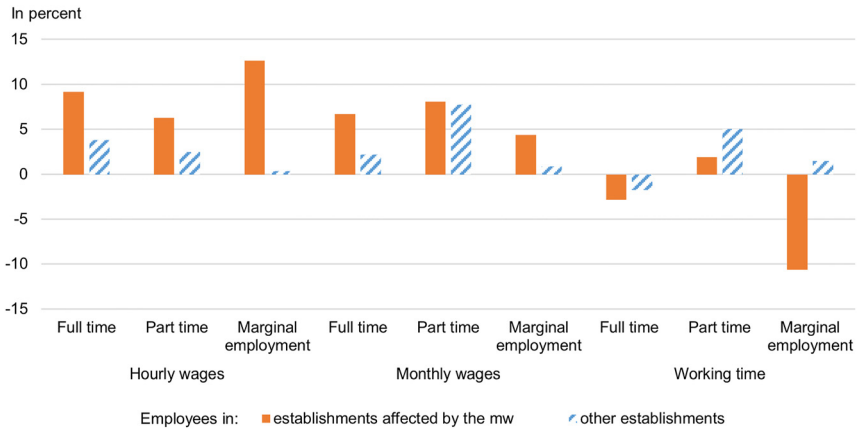

Figure 2: Changes in outcome variables by treatment status and type of employment. Source: SES 2014, ES 2015, unweighted data, own calculations. Notes: Establishments affected by the minimum wage are those that had at least one employee paid less than 8.50 euros per hour in 2014.

wage. Monthly wages increased to a similar extent among full-time employees and part-time employees in establishments affected by the minimum wage. However, in part-time employment, monthly wages also increased in establishments not affected by the minimum wage. In comparison, increases in monthly wages were smaller among marginally employed workers and were present only in establishments affected by the minimum wage. As noted in Section 3, individual transitions between different types of employment cannot be tracked in the SES/ES data. Therefore, minimum wage-induced transitions from marginal employment to part-time employment, which occur by definition when the threshold of monthly earnings of 450 euros is exceeded, are not captured in the changes reported here. Previous studies showed that the total number of transitions between marginal employment and regular employment increased from 52 to 104 thousand between January 2015 and January 2014, which was significantly greater than that in previous years (Mindestlohnkommission 2020: 91 ff.). According to the data of the IAB Labour Market Survey, 85 % of the transitions from marginal employment to employment subject to social security contributions in 2015 were conversions within the same company (vom Berge et al. 2016). In addition, there was a decline in the share of marginally employed versus employees subject to social insurance contributions in the workforce of establishments, which was particularly pronounced in establishments of small and medium-sized enterprises (Bonin et al. 2018; Pestel et al. 2020).

Working hours decreased slightly in full-time employment and more so in establishments affected by the minimum wage. Working hours increased in part-time employment, but the increase was lower in establishments affected by the minimum wage than in unaffected establishments (Figure 2). The number of working hours decreased most clearly among those with marginal employment in establishments affected by the minimum wage, by approximately 11 %. This finding reflects that the minimum wage together with the statutory upper earnings limit of 450 euros per month for marginal employment implies a de facto upper limit in working time.

Difference-in-differences estimates of the minimum wage effects on hourly wages by type of employment show that there is a similar positive impact of the minimum wage on full-time and part-time employees, amounting to approximately 4.8 %, on average (see Table 6, Panel A).[12] Compared to the reference group of full-time employees, the effect on the hourly wages of marginal employees is on average approximately 6.3 % points greater. The effects of the minimum wage are larger for each employment group when only low-wage employees are considered in the analysis. The positive effect on the hourly wages of low-wage employees amounts to approximately 10.8 % for full-time employees, which is 2.4 % points greater among part-time employees and approximately 6.3 % points greater among marginal employees. These results clearly show greater effects of the minimum wage than reported in previous studies based on the GSOEP for all three types of employment. Similar to the GSOEP studies, the effects on hourly wages are greater among marginally employed workers than among regular workers.

The growth of the monthly wages of full-time employees was on average approximately 1.4 % greater for in minimum wage establishments than in other establishments. The difference among part-time workers was not statistically significantly different from that among full-time employees, and it was approximately 5.3 % points greater among marginal employees. The respective measured impact of the minimum wage on monthly wages was greater among low-wage employees. Compared to low-wage full-time workers, it was 7.3 % points greater among low-wage part-time employees and 3.6 % points greater among marginal employees.

On average, reductions in working time amounted to −3 % among full-time employees in minimum wage establishments compared to full-time employees in

12 The effect for full-time employees is given by the coefficient “Treatment 2015”. The effect for part-time and marginal employees is given by the sum of the coefficients “Treatment 2015” and the respective interactions “Part-time × treatment” and “Full-time × treatment”.

Table 6: Minimum wage effects by type of employment.

	All employees		Low-wage employees
Panel A: hourly wages			
Year 2015	0.032[a]		−0.009[b]
Treatment 2015	0.048[a]		0.108[a]
Full time		Reference	
Part time	−0.074[a]		−0.028[a]
Marginal employment	−0.328[a]		−0.104[a]
Full time × treatment 2015		Reference	
Part time × treatment 2015	−0.005		0.024[a]
Marginal employment × treatment 2015	0.063[a]		0.063[a]
Panel B: monthly wages			
Year 2015	0.018[a]		−0.020
Treatment 2015	0.014[c]		0.047[b]
Full time		Reference	
Part time	−0.564[a]		−0.514[a]
Marginal employment	−2.006[a]		−1.669[a]
Full time × treatment 2015		Reference	
Part time × treatment 2015	0.018		0.073[a]
Marginal employment × treatment 2015	0.053[a]		0.036[c]
Panel C: working time			
Year 2015	−0.008[a]		−0.012
Treatment 2015	−0.034[a]		−0.060[a]
Full time		Reference	
Part time	−0.490[a]		−0.486[a]
Marginal employment	−1.677[a]		−1.565[a]
Full time × treatment 2015		Reference	
Part time × treatment 2015	0.023[c]		0.049[b]
Marginal employment × treatment 2015	−0.010		−0.027
Observations	140,177		34,496
Establishment FE	X		X
Control variables	X		X

Source: SES 2014, ES 2015, unweighted data, own calculations. Notes: OLS estimation including fixed establishment effects. The outcome variables are used in logarithmic form. Treatment refers to a dummy variable indicating establishments that had at least one employee paid less than 8.50 euros per hour in 2014. The included control variables are employees' highest educational degree, age, age squared, a dummy for fixed-term employment and a dummy for female gender. Confidence level: [a]$p < 0.001$, [b]$p < 0.01$, [c]$p < 0.05$.

other establishments (see Table 6, panel C). The working time reduction due to the minimum wage is approximately 2.3 % points smaller among part-time employees in minimum wage establishments. The respective coefficient for marginal employees is not significantly different from that for full-time employees. The minimum wage-induced reduction in working time among low-wage employees amounts to

approximately minus 6 % for full-time jobs. It is again of similar size among marginal employees and it is by 4.9 and thus much smaller among part-time employees. The relatively small effect on the working time of part-time workers explains the relatively large positive effect of the minimum wage on the monthly earnings of low-wage part-time workers.

6 Robustness Check

As a robustness check, a weighted control group approach is applied, which balances the pretreatment means of the respective outcome variable and a set of covariates (see Appendix Tables A1–A3). This approach is similar to matching pretreatment outcomes, but it has the advantages of easier implementation and greater functional flexibility (Hainmueller 2012; Hainmueller and Xu 2013). For the robustness check, the data are fully aggregated at the establishment level because this allows to apply the pretreatment weights for establishments in the control group also to the posttreatment data, which retains a fixed treatment and control group.

In the main analysis, minimum wage effects were identified by establishments being affected by the minimum wage or not. Control variables at the employee level were useful for exploiting the available information at the employee level and thus for increasing the precision of the estimated minimum wage effects. They are, however, not relevant for the identification of the minimum wage effect, which is estimated based on variation at the establishment level (Lechner 2010). Hence, the analysis with data aggregated to the establishment level should yield similar difference-in-differences estimates when establishments are weighted by the number of employee observations in each establishment. The respective results are presented in column two of Table 7 and can be compared to the main results (from Table 3) in column one of Table 7. Column three of Table 7 presents the results from balancing pretreatment outcomes prior to the estimation of the DID model (and weighting by the number of employee observations in each establishment).[13] The control variables from the main analysis are also balanced. All variables are aggregated at the establishment level, resulting in the shares of education groups and employment types, etc., in establishments.

13 Results from DID-estimation with and without entropy balancing without weighting the aggregated establishment data by employees per establishment are larger in magnitude for all three outcomes.

Table 7: Robustness check.

	(1) Main results from Table 3 (data on employees in establishments)	(2) Data aggregated to establishment level	(3) Data aggregated to establishment level, balanced control group
		Weighted by employee observations per establishment	
Panel A: hourly wages			
Year 2015	0.026[a]	0.026[a]	0.046[a]
Treatment 2015	0.059[a]	0.059[a]	0.049[a]
Panel B: monthly wages			
Year 2015	0.018[a]	0.011[b]	0.047[a]
Treatment 2015	0.027[a]	0.041[a]	0.009
Panel C: working time			
Year 2015	−0.008[a]	−0.015[a]	−0.025[a]
Treatment 2015	−0.031[a]	−0.019[a]	−0.009
Number of establishments	–	12,789	12,789
Number of observations	140,177	–	–

Source: SES 2014, ES 2015, own calculations. Notes: OLS estimation. The outcome variables are presented in logarithmic form. Balancing of the control group using entropy balancing (see Appendix Tables A2–A4). The covariates included in balancing the control group are the share of employees in the establishment by education, type of employment and gender, a dummy for East/West Germany, three categories of establishment size and a dummy for establishments covered by a collective bargaining agreement. Confidence level: [a]$p < 0.001$, [b]$p < 0.05$, [c]$p < 0.01$.

The results regarding hourly wages show that the difference-in-differences estimates with data aggregated to the establishment level are very similar to the main results when no balancing of the control group is conducted (see Table 7, columns 1 and 2). As expected, balancing the control group results in a slightly lower estimate (by approximately 1 % point) of the measured minimum wage effect on hourly wages. This finding implies that the minimum wage effect on hourly wages from the main model could be overestimated to a small extent due to systematic differences in the composition of the treatment and control group establishments, which have not been captured by control variables and are correlated not only with the pretreatment mean hourly wage but also with its change over time.

The results with respect to working time and monthly wages seem to be less robust according to the balanced control group approach. Regarding working time, the negative minimum wage effect is also reduced in the balancing approach by approximately 1 % point. Because the average effect on working time was too small to begin with, the remaining estimate is not significantly different from zero. This result implies that the minimum wage effect on average working time in minimum wage establishments might be overestimated in the main model.

Regarding monthly wages, the minimum wage effect is relatively strongly reduced by the balancing approach and is approximately 3 % points smaller. The remaining estimate is not statistically significant from zero. This result implies that the minimum wage effect on monthly wages from the main analysis might be overestimated due to systematic differences between the treatment and control groups. As presented in Appendix Tables A1–A3, the pretreatment difference in average monthly earnings between minimum establishments and other establishments is particularly large. Controlling for these differences markedly changes the DID results.

A similar robustness check with balanced control groups was not feasible for most of the subgroups because the entropy balancing estimation did not converge. Consequently, the results for subgroups from the main model must be interpreted more cautiously. It is nevertheless highly reasonable that minimum wage effects are larger than average among subgroups that are affected to a high extent by the minimum wage, as is the case for low-wage employees, employees in East Germany and marginal employees.

7 Conclusion

This study contributes to understanding the short-term effects of the minimum wage introduction in Germany on hourly wages, monthly earnings and working time based on previously unused linked employer–employee panel data, which combines the SES 2014 and the ES 2015. We find that the effect of the introduction of the statutory minimum wage on the average hourly wages of employees in minimum wage establishments is as high as 5.9 %. Due to negative effects on average working time of approximately minus 3.1 %, the effects on monthly gross earnings are smaller but still amount to up to 2.7 % on average.

The effects of the minimum wage introduction on monthly wages and working time have been a topic of debate, with some studies finding no effects (in the short-run) and others finding a significantly positive impact. Our results confirm a significant positive effect on employees' monthly wages in minimum wage establishments, which is greater among low-wage employees. Similar

to other studies, the effects on monthly wages are smaller than the effects on hourly wages because of reductions in working hours. Hence, the finding that the minimum wage effect on monthly earnings has been reduced but not offset by reductions in working time is corroborated. The results regarding the average effects on monthly earnings and working time of employees in minimum wage establishments could, however, not be confirmed in a robustness check with a balanced control group, which calls for a cautious interpretation of these outcomes.

The results further indicate that the minimum wage effects on earnings were greater than average among low-wage employees in eastern Germany compared to those in western Germany and for part-time employees. The positive effect of the introduction of the minimum wage on the hourly wages of low-wage employees amounts to 13 %, which is substantially greater than that found in previous studies based on the GSOEP that focused on employees with hourly wages below 8.50 euros (there is an effect of approximately 6 %). However, these studies cannot be compared directly because they differ in many aspects.

Our results on heterogeneous minimum wage effects by type of employment suggest that the hourly pay of low-wage part-time employees and marginal employees could catch up compared to that of low-wage full-time employees. The gains in monthly gross earnings were largest among part-time workers and therefore benefitted women more than men (also see Ohlert 2023). The results further indicate that part-time employees, particularly marginally employed workers, benefit from the minimum wage due to the possibility of receiving similar earnings with fewer hours of work. The possibility of differentiating results by type of employment based on many observations is an advantage of the applied SES/ES data.

The overall finding of relatively high minimum wage effects on both hourly wages and monthly wages corroborates previous evidence that employees actually receive higher earnings due to the introduction of the minimum wage. Higher gross earnings are important to low-wage earners, even if they still depend on transfer payments due to low working hours or household needs (Baumann and Bruttel 2020; Bruckmeier and Bruttel 2021). Hence, the introduction of the minimum wage in Germany has improved the opportunities for low-wage earners to achieve an independent income.

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Appendix

Table A1: Full regression results from main model (complementing Table 3).

	Hourly wages		Monthly wages		Working time	
	All employees	Low-wage employees	All employees	Low-wage employees	All employees	Low-wage employees
Year 2015	0.0256[a]	−0.00871[b]	0.0182[a]	−0.0194	−0.00750[a]	−0.0113
Year 2015 × treatment group	0.0585[a]	0.137[a]	0.0274[a]	0.0790[a]	−0.0307[a]	−0.0572[a]
Employees with no vocational degree	Reference		Reference		Reference	
Employees with a vocational degree	0.0808[a]	0.0170[a]	0.126[a]	0.0691[a]	0.0450[a]	0.0520[a]
College/university degree	0.326[a]	0.0227[a]	0.374[a]	0.0566[b]	0.0486[a]	0.0339
Unknown vocational degree	0.565[a]	−0.0118	0.614[a]	−0.0503	0.0495[a]	−0.0368
Age	0.0235[a]	0.00387[a]	0.0310[a]	0.0147[a]	0.00748[a]	0.0108[a]
Age^2	−0.000221[a]	−0.0000386[a]	−0.000306[a]	−0.000151[a]	−0.0000849[a]	−0.000112[a]
Full-time employees	Reference		Reference		Reference	
Part-time employees	−0.0747[a]	−0.0200[a]	−0.561[a]	−0.488[a]	−0.486[a]	−0.469[a]
Marginal employees	−0.312[a]	−0.0833[a]	−1.993[a]	−1.657[a]	−1.681[a]	−1.574[a]
Fixed term contract	−0.143[a]	−0.0301[a]	−0.167[a]	−0.0638[a]	−0.0237[a]	−0.0336[b]
Female	−0.0896[a]	−0.0107[a]	−0.111[a]	−0.0304[a]	−0.0212[a]	−0.0192[c]
Establishment size: up to 10 employees	Reference		Reference		Reference	
Establishment size: 11–100 employees	−0.00568	0.00587	−0.0104	0.00157	−0.00447	−0.00427
Establishment size: 101 or more employees	−0.0198	0.0346	−0.0306	−0.0195	−0.0107	−0.0544
Constant	2.121[a]	2.017[a]	7.071[a]	6.858[a]	4.949[a]	4.841[a]
Observations	140,177	34,496	140,177	34,496	140,177	34,496

Source: SES 2014, ES 2015, own calculations. Notes: Confidence level: [a]$p < 0.001$, [b]$p < 0.05$, [c]$p < 0.01$.

Table A2: Pre- and posttreatment balancing statistics of log hourly wages and covariates (means).

	Treated		Controls			
			Without balancing		Balanced	
	2014	2015	2014	2015	2014	2015
Log hourly wage	2.256	2.396	2.708	2.726	2.256	2.295
Establishments in West Germany	0.610	0.610	0.793	0.793	0.610	0.610
Establishment size (categories 1–3)	1.677	1.675	1.680	1.682	1.677	1.641
Establishments covered by collective bargaining	0.154	–	0.297	–	0.154	–
Share of employees with no vocational degree in establishment	0.150	0.128	0.089	0.090	0.150	0.140
Share of employees with vocational degree in establishment	0.723	0.669	0.707	0.670	0.723	0.689
Share of employees with college/university degree	0.125	0.117	0.198	0.188	0.125	0.124
Share of employees with unknown vocational degree	0.003	0.086	0.007	0.051	0.003	0.047
Share of women in establishment	0.567	0.557	0.454	0.453	0.567	0.565
Share of full-time employees in establishment	0.464	0.499	0.618	0.641	0.464	0.470
Share of part-time employees in establishment	0.279	0.291	0.263	0.243	0.278	0.275
Share of marginal employees in establishment	0.258	0.210	0.119	0.115	0.258	0.255

Notes: For dummy variables, the mean reflects the respective share of establishments in the treatment and the control group. The collective bargaining status of establishments was not measured in the ES 2015.

Table A3: Pre- and posttreatment balancing statistics of log monthly wages and covariates (means).

	Treated		Controls			
			Without balancing		Balanced	
	2014	2015	2014	2015	2014	2015
Log monthly wage	6.809	6.963	7.455	7.476	6.809	6.932
Establishments in West Germany	0.610	0.610	0.793	0.793	0.610	0.610
Establishment size (categories 1–3)	1.677	1.675	1.680	1.682	1.677	1.654
Establishments covered by collective bargaining	0.154	–	0.297	–	0.154	–
Share of employees with no vocational degree in establishment	0.150	0.128	0.089	0.090	0.150	0.135
Share of employees with vocational degree in establishment	0.723	0.669	0.707	0.670	0.723	0.686
Share of employees with college/university degree	0.125	0.117	0.198	0.188	0.125	0.121
Share of employees with unknown vocational degree	0.003	0.086	0.007	0.051	0.003	0.058
Share of women in establishment	0.567	0.557	0.454	0.453	0.567	0.556
Share of full-time employees in establishment	0.464	0.499	0.618	0.641	0.464	0.504
Share of part-time employees in establishment	0.279	0.291	0.263	0.243	0.279	0.266
Share of marginal employees in establishment	0.258	0.210	0.119	0.115	0.258	0.229

Notes: For dummy variables, the mean reflects the respective share of establishments in the treatment and the control group. The collective bargaining status of establishments was not measured in the ES 2015.

Table A4: Pre- and posttreatment balancing statistics of log working time and covariates (means).

	Treated		Controls			
			Without balancing		Balanced	
	2014	2015	2014	2015	2014	2015
Log working time	4.545	4.560	4.738	4.742	4.545	4.597
Establishments in West Germany	0.610	0.610	0.793	0.793	0.610	0.610
Establishment size (categories 1–3)	1.677	1.675	1.680	1.682	1.677	1.665
Establishments covered by collective bargaining	0.154	–	0.297	–	0.154	–
Share of employees with no vocational degree in establishment	0.150	0.128	0.089	0.090	0.150	0.129
Share of employees with vocational degree in establishment	0.723	0.669	0.707	0.670	0.723	0.687
Share of employees with college/university degree	0.125	0.117	0.198	0.188	0.125	0.134
Share of employees with unknown vocational degree	0.003	0.086	0.007	0.051	0.003	0.050
Share of women in establishment	0.567	0.557	0.454	0.453	0.567	0.556
Share of full-time employees in establishment	0.464	0.499	0.618	0.641	0.464	0.524
Share of part-time employees in establishment	0.279	0.291	0.263	0.243	0.279	0.270
Share of marginal employees in establishment	0.258	0.210	0.119	0.115	0.258	0.206

Notes: For dummy variables, the mean reflects the respective share of establishments in the treatment and the control group. The collective bargaining status of establishments was not measured in the ES 2015.

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