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IZA Policy Paper No. 145

The German Statutory Minimum Wage and Its Effects on Regional Employment and Unemployment

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ABSTRACT

The German Statutory Minimum Wage and Its Effects on Regional Employment and Unemployment*

This paper studies the effects of the introduction of Germany's statutory minimum wage in 2015 on employment and unemployment on the level of regional labor markets. Using variation in the regional exposure to the new wage floor, we employ a difference-in-differences approach that compares the evolution of employment and unemployment between regions with varying minimum wage bites. Overall, we find no statistically significant effect of the introduction of the German minimum wage on regular employment subject to social insurance, but a statistically significant negative effect on marginal employment. The reduction is not accompanied by a proportional increase in unemployment.

JEL Classification: J21, J31, J38

Keywords: minimum wage, employment, unemployment, labor market regions, Germany

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* The results presented in this paper are based on a study conducted on behalf of the German Minimum Wage Commission (Bonin et al., 2018), which served as a basis for the Commission's Second Report on the Effects of the Statutory Minimum Wage (Mindestlohnkommission, 2018). The authors would like to thank two anonymous referees for their helpful comments and suggestions.

1 Introduction

On January 1, 2015, a general statutory minimum wage of 8.50 EUR gross per hour worked became effective in Germany. This reform, widely acknowledged as one of the most significant institutional changes to the German labor market since the "Hartz" reforms in 2003–2005, triggered controversial debates about the potential employment impact of a national wage floor.[1] Proponents advocate for wage floors primarily on social and distributional grounds. A minimum wage is considered a suitable tool to raise labor income at the bottom of the wage distribution and hence to reduce income poverty and inequality in earned incomes (see Bosch, 2007; Kalina and Weinkopf, 2014). By contrast, critics of minimum wages argue that a statutory minimum wage may distort the price formation on labor markets and thus cause economic inefficiencies, which may lead to lower employment and higher unemployment (see SVR, 2013, 2014 or Knabe et al., 2014).

From a theoretical perspective, the effect of a minimum wage on employment is ambiguous. Neoclassical models of the labor market predict that minimum wage effects on employment depend upon the employers' degree of market power. Negative employment effects – and thus higher unemployment – may be expected in perfect labor markets where firms are price takers. On the other hand, a minimum wage may have positive employment effects if firms exert wage-setting power in a given labor market (Manning, 2003). In addition, the introduction of a minimum wage may further increase incentives for individuals outside the labor force to seek and take up work. From a Keynesian perspective, the employment effects of a minimum wage are indeterminate; in case of homogeneous work, only nominal wages should be affected, while real wages – and thus aggregate demand – are predicted to remain unchanged (Herr et al., 2009). Thus, in light of the ambiguous theoretical predictions, the impact of minimum wages on the labor market remains an empirical question.

This study analyzes the effects of the introduction of the German statutory minimum wage on January 1, 2015 on employment and unemployment at the level of regional labor markets in the short and medium run. To estimate the causal effect of this nationwide reform, we follow earlier work by Card (1992), Dolton et al. (2015) and Caliendo et al. (2018a) and exploit differences in the bite of the minimum wage across regional labor markets to apply a difference-in-differences approach that compares the evolution of aggregate employment

[1] While there has been no statutory minimum wage in Germany before 2015, some sector-specific minimum wages had been in place before. See Fitzenberger and Doerr (2016) for an assessment of studies investigating the effects of these sector-specific policies.

and unemployment for labor market regions with different minimum wage bites. For each labor market region, we compute the bite of the minimum wage based on information from the Structure of Earnings Survey and link differences in the regional bite to administrative information on local employment and unemployment over the period 2013–2016.

The main finding of this paper is that the introduction of Germany's statutory minimum wage did not have pronounced effects on aggregate regional employment levels in the short to medium run, i.e., over the period 2015 to 2016. While our estimates imply statistically significant negative effects of the minimum wage on total employment, they are small in magnitude. Moreover, we do not find statistically significant effects on regional regular employment subject to social security contributions. The small overall effects on employment are primarily driven by a significant reduction of marginal employment, i.e., the number of so-called *"mini-jobs"*.[2] Finally, our results do not indicate any effect on the level of regional unemployment. One explanation for this finding may be a discouragement effect of the minimum wage. The new wage floor may have decreased labor force participation (Boffy-Ramirez, 2019).

Overall, this paper contributes to the literature evaluating the employment effects of the German minimum wage (see Caliendo et al. (2018b) for an overview). Our findings are consistent with Caliendo et al. (2018a) who also report moderate negative effects on overall employment in the short run until 2015, which are mainly driven by a sharp decline in marginal employment. However, we extend the period of investigation to the medium run until the fourth quarter of 2016 and explicitly study the effects of the minimum wage on regional unemployment levels (also see Ahlfeldt et al. (2018)). Moreover, we exploit variation in the minimum wage bite at a finer regional level, focusing on 257 labor market regions. Our paper is further related to studies looking beyond effects of the minimum wage on employment *levels*. Bossler (2016, 2017) and Bossler and Gerner (2016) find negative effects on employment transitions, in particular hirings. These findings are corroborated by Bellmann et al. (2016), who show that companies rarely responded to the minimum wage introduction by laying off workers but rather reduced hiring. Bellmann et al. (2017a) replicate this result for the federal

[2]Marginal employment refers to the legal regulation that monthly labor income of up to 450 EUR is exempt from the income tax and is only subject to limited social security contributions for the employee. This form of employment was particularly affected by the minimum wage introduction. First, marginal employment jobs were characterized by particularly low hourly wages, with a share of almost 40% below the level of 8.50 EUR (Mindestlohnkommission, 2016, p. 41). Second, for given working hours, *"mini-jobs"* with an hourly wage below 8.50 EUR and a monthly pay just below the threshold of 450 EUR may have been shifted above the threshold by the minimum wage reform and, hence, become subject to higher taxes and contributions and therefore less attractive. Third, the Minimum Wage Act stipulates that for all marginal jobs employers have to document working hours (which is not the case for most regular jobs, see Mindestlohnkommission, 2018, p. 13), which may increase the cost of administration.

state of Saxony, where the bite of the minimum wage was particularly high.

2 Empirical design

2.1 The minimum wage bite

To measure the regional bite of the minimum wage we use the Structure of Earnings Survey 2014 (SES 2014) of the Federal Statistical Office. The SES 2014 is a nationally representative mandatory survey, which provides data on earnings from payroll accounts of around 71,000 firms and roughly one million jobs as of April 2014, i.e., around three months before the legislation of the minimum wage was passed by the German parliament. The individual-level data contain comprehensive information on hours worked and gross earnings, which enables us to precisely determine the bite of the minimum wage for a given worker. In detail, we calculate a worker's hourly wage by dividing the monthly income (net of overtime and bonus payments) by the number of paid monthly hours (excluding overtime hours). Employees exempted from the minimum wage, i.e., apprentices, interns and employees under the age of 18 without vocational training, are excluded from these calculations.

Based on these hourly wage rates, we compute the *regional wage gap* to measure the minimum wage bite at the level of German labor market regions. The wage gap is defined as the average difference between the hourly wage rate and the statutory minimum wage for all hourly wages below the new wage floor (zero for wages above 8.50 EUR). The wage gap quantifies the relevance of the minimum wage with respect to both the number of affected employees and the pre-reform wage level. Hence, this measure of the minimum wage bite should adequately quantify the size of the cost shock (and the implied adjustment costs) faced by employers in a specific region.

Alternative measures of the minimum wage bite, like the share of workers with a wage below 8.50 EUR or the Kaitz index, do not directly measure the increase in labor costs due to the introduction of the minimum wage. For example, two regions with same share of workers below the minimum wage may experience substantially different shocks to total labor costs in case average wages of the affected workers differ across the two regions. This difference is picked up by the wage gap in turn. However, to make sure that our estimates are not driven by the specific measurement of the minimum wage bite, we use the share of affected workers as an alternative measure of the bite in additional specifications below.[3]

[3]Appendix Table A.1 depicts the spread of the minimum wage bite across German labor market

As of April 2014, the average wage gap is around 0.16 EUR per hour with a strong regional disparity between West and East Germany (including Berlin). In East Germany, the wage gap is twice as large with an average of 0.33 EUR.[4] Figure 1 displays the average wage gap for each labor market region of Germany.[5] On average, the wage gap in a labor market region amounts to 0.20 EUR per hour.[6] As before, the average minimum wage bite is higher in East than in West Germany (0.42 EUR vs. 0.15 EUR). But also in the West, there are labor market regions characterized by a relatively large wage gap. Overall, in West Germany the wage gap ranges from 0.02 EUR in the labor market region Dillingen (Bavaria) to 0.34 EUR in Trier (Rhineland-Palatinate). In East Germany, the wage gap ranges from 0.25 EUR in the labor market region Dessau-Roßlau to 0.65 EUR in Mansfeld-Südharz (both situated in Saxony-Anhalt). We exploit this variation in the minimum wage bite for identification below.

[Figure 1 about here]

2.2 Data on regional employment and unemployment

While our measure of the regional minimum wage bite is based on survey data, information on our outcome variables of interest stem from the Federal Employment Agency Statistics (BA Statistics) and cover the period between 2013 to 2016, i.e., two years before and after the introduction of the statutory minimum wage.[7] The data are provided at the county level, which we aggregate to 257 labor market regions.[8] Our data include information on the number

regions using alternative measures of the bite. Figure A.1 further indicates the strong correlation between these measures.

[4]The wage gap is calculated on the basis of the universe of employees. Thus, it explicitly includes employees who received wages exceeding 8.50 EUR per hour in April 2014, whose wages were set to zero for the computation of the wage gap. For those employees with an hourly wage below 8.50 EUR the average difference to the minimum wage is 1.40 EUR (= 0.16 EUR/11.4 percent).

[5]Labor market regions map commuting flows across counties and thus adequately characterize regional labor markets in Germany. For more details, see: `http://www.bbsr.bund.de/BBSR/DE/Raumbeobachtung/Raumabgrenzungen/AMR/Arbeitsmarktregionen.html?nn=443270`, last accessed on 08/10/2018.

[6]The average wage gap at the level of the labor market regions is slightly higher than the one displayed in Table A.1. This is due to the fact that information on the work location of public sector employees is not available in the SES data, which we therefore need to exclude.

[7]The data we use were published in January 2018, i.e., after a correction of initially missing data from the Federal Employment Agency Statistics. For more details, see *Statistik der Bundesagentur für Arbeit, Grundlagen: Methodenbericht-Revision der Beschäftigungsstatistik 2017, Nürnberg, Dezember 2017*: `https://statistik.arbeitsagentur.de/Statischer-Content/Grundlagen/Methodenberichte/Beschaeftigungsstatistik/Generische-Publikationen/Methodenbericht-Revision-der-Beschaeftigungsstatistik-2017.pdf`, last accessed on 04/01/2018.

[8]The BBSR identifies 258 labor market regions by the end of 2015. The district-level data in the BA Statistics refer to the administrative structure as of December 2016. Due to the merger of the

of (i) unemployed individuals by calendar month, (ii) employees subject to mandatory social security contributions on a quarterly basis, and (iii) marginally employed ("mini-jobs") within a given year (as observed at the 30th of June). Information on regional regular employment and unemployment may be broken down by subgroups, allowing a differentiation by gender, age group, nationality (German vs. non-German) and the level of education. For the marginally employed, the data allow differentiating between the total number of marginally employed workers (including workers who work in a mini-job as a second job in addition to a first job in regular employment) and the number of individuals who exclusively work in marginal employment.

2.3 Identification strategy

To analyze the effects of the introduction of the statutory German minimum wage on regional labor markets, we apply two versions of the difference-in-differences (DiD) approach: a standard binary DiD and an extended continuous DiD design.

In a first step, we rely on the **standard DiD** approach that assigns the units of observation – in our case the German labor market regions – into a treatment and control group. It thus allows us to derive the causal effect of the reform by means of a simple before-and-after comparison of the outcomes in these two groups. The causal interpretation of the estimates is subject to the maintained assumption that conditional on covariates the outcome of interest would have developed similarly for the two groups in the absence of treatment ("common trends assumption").

In light of the nation-wide introduction of the minimum wage there is no natural definition of a control and treatment group. While it is possible to precisely assign employees to the treatment and control group (see Stewart, 2004; Stewart and Swaffield, 2008), such a classification is not feasible for more aggregate levels (i.e. firms or regional labor markets). Although exemptions and transitional provisions existed for a limited number of industries and workers, the exemptions provide no meaningful variation to derive estimates at the regional labor market level. To this end, we follow Card (1992), Dolton et al. (2015) and Caliendo et al. (2018a) and classify regional labor markets along the regions' relative bite of the minimum wage. Labor market regions with a wage gap below the median form the control group, while all regions with a wage gap above (or equal to the) median constitute the treatment group.

districts (and former two labor market regions) Göttingen and Osterode am Harz in November 2016, we combine the two into one labor market throughout the period 2013–2016.

Figure 2 shows the corresponding assignment of regional labor markets to either control or treatment group. All 54 East German labor market regions enter the treatment group, along with 74 of the 203 West German labor market regions. As displayed in Appendix Table A.2, the average minimum wage bite in the constructed treatment group (0.30 EUR) is almost three times as high as in the control group (0.11 EUR).

[Figure 2 about here]

When comparing observable characteristics for regional labor markets in the treatment and control group, labor market regions with a high minimum wage bite can be characterized by a rather low population density (see Appendix Table A.2), which is why the average wage gap across the whole country is smaller than the average gap across regions. Apart from this, differences with regard to regions' employment and population structure are small. Labor market regions with a relatively large bite of the minimum wage have a slightly higher share of employees in the public sector, while regions with a relatively lower bite are characterized by a higher share of employees in the manufacturing sector. In the regression analysis, we identify effects using variation with regional labor markets while flexibly controlling for different trends across regions by geographic and sectoral structure in order to rule out that estimated effects of the minimum wage bite are driven by these structural differences. In our preferred specifications, we further weight observations by the pre-reform population in each labor market region to account for the fact that sparsely populated regions experienced larger shocks to production costs.[9]

Based on the preceding definition of our control and treatment group, we define the estimation equation in the simple DiD approach as:

$$\ln Y_{it} = LMR_i + Time_t + \beta(Wage\,Gap^{high}_{i,2014} \times I_{t>06/2014}) + \sigma_{it} + \epsilon_{it}. \tag{1}$$

The left-hand side variable $\ln Y_{it}$ indicates the (logarithmic) outcome in labor market region i at time t, which – depending on the outcome of interest – refers to either quarters or years. LMR_i indicates the set of labor market fixed effects, which control for unobservable but time-constant region-specific factors, while $Time_t$ denotes the set of time (quarter or year) fixed effects that absorb all common shocks over time. $Wage\,Gap^{high}_{i,2014} \times I_{t>06/2014}$ is our variable of interest: a binary variable that indicates the treatment group, i.e. labor market regions with a relatively high minimum wage bite, after June 2014 (see below). Coefficient β hence measures

[9] We show below that unweighted and weighted regressions yield very similar estimates.

the average treatment effect of the minimum wage introduction on the respective outcome. Given the set of region and year fixed effects in the empirical model, the coefficient picks up differences in the evolution of the outcome variable in the treatment relative to the control group. Last, σ_{it} denotes a flexible control for heterogeneous time trends that can vary between labor market regions. We will discuss the robustness of our parameter of interest β to different parametrization of σ_{it}. ϵ_{it} describes the i.i.d. error term.

We consider all observations after June 2014 as treated in our empirical model. While the statutory minimum wage came into effect on January 1, 2015, the Minimum Wage Act was passed in July 2014. Against this background, it appears reasonable to assume that firms and employees started to adapt to this reform right after the legislation was passed (*anticipation effects*); for example, by adjusting their hiring or dismissal behavior. Therefore, we treat outcomes observed in the third and fourth quarter of 2014 as post-treatment observations.

As indicated before, identification of the effect of interest in the simple DiD approach rests upon the assumption that the specific outcome under consideration would have developed similarly over time for control and treatment group in the absence of the minimum wage introduction ("common trends assumption"). We will assess the validity of this assumption by examining the evolution of the outcomes for both groups before the reform in some detail below. Evidence of parallel trends in the outcome for treatment and control group may serve as suggestive evidence in favor of the identifying assumption.

The **extended DiD approach** allows us to further corroborate the identifying assumption through the inspection of pre-trends in the estimates, i.e., by considering the effect of the minimum wage bite on the outcomes prior to the introduction of the minimum wage. In this model, the treatment variable is now interacted with all time periods $t \neq 06/2014$. In addition to observing potential dynamics in the treatment effect after the reform, this specification allows us to explicitly test the identifying assumption of the DiD model. Significant effects of the minimum wage bite on the outcome before the introduction of the wage floor would invalidate the research design and indicate that low and high bite labor market regions already faced different trends in the outcome variable before the minimum wage introduction.

In addition to allowing for a treatment effect for all periods relative to $t = 06/2014$, which serves as the reference period, we further exploit the full variation in the regional minimum wage bite across space in the extended version of the DiD approach.[10] We therefore interact

[10] Using the extended DiD approach along with our previous binary definition of treatment and control group yields very similar, yet less precisely estimated effects.

the region-specific wage gap with the vector of time periods, $I_{t=\tau,\tau\neq 06/2014}$. Hence, this specification allows for testing both the dynamics of the minimum wage effects rather than just comparing treatment and control regions before and after the reform and exploits the full variation in the minimum wage bite rather than just relying on a binary indicator. The augmented specification thus reads:

$$\ln Y_{it} = LMR_i + Time_t + \sum_{\tau=01/2013}^{12/2016} \beta_\tau (Wage\,Gap_{i,2014} \times I_{t\neq 06/2014}) + \sigma_{it} + \epsilon_{it}. \qquad (2)$$

Here, β_τ now indicates the set of treatment effects for all periods $t \neq 06/2014$. These indicate the treatment effect relative to the last time period – quarter or year – before the the Minimum Wage Act was passed.

In both versions of the DiD approach, we cluster standard errors at the level of the labor market regions to account for correlated error terms at the regional level. Moreover, we weight our regressions by the population of each labor market region prior to the reform (as of December 31, 2013).

3 Effects on regional employment and unemployment

3.1 Corroborating the identifying assumption

We first compare the evolution of our outcome variables of interest for regional labor markets in the treatment and control group over time. Evidence of parallel trends in the outcomes for the two groups before the minimum wage introduction may serve as suggestive evidence in favor of the identifying assumption. Moreover, a comparison of the evolution of the outcomes after treatment may provide first insights about the potential effects of the minimum wage introduction.

Figure 3 shows the evolution of our three main outcome variables – the regional (logarithmic) level of regular employment, marginal employment and unemployment – over the period of 2013 to 2016 for treatment and control group. In panel (a), we show trends in average regular employment for the two groups. While labor market regions in the control group are characterized by a higher average number of employees, trends have been very similar prior to the adoption of the minimum wage law. We take this as suggestive evidence in favor of the identifying assumption of our DiD design. Besides this visual evidence in favor of "common trends", panel (a) suggests that the introduction of the minimum wage did not have a strong impact on regional employment levels as trends appear to be largely unaffected.

[Figure 3 about here]

Panel (b) of Figure 3 illustrates the evolution of the (log) average number of marginal employment in control and treatment group over time. Here, only annual data are available. As for regular employment, we find that labor market regions in the control group are characterized by a higher level of marginal employment than regions in the treatment group. Moreover, we again observe that levels of marginal employment prior to the adoption of the minimum wage evolve quite similar for the two groups. After treatment, the graph yet suggests a diverging trend in the level of marginal employment for the two groups: labor market regions in the treatment group show a stronger decline in marginal employment than regions in the control group. Below we assess whether this effect may be causally linked to the minimum wage, or whether other factors may explain this pattern.

Last, panel (c) depicts the evolution of regional unemployment for treatment and control group over time. We first observe that – in contrast to panels (a) and (b) – the (log) number of unemployed individuals shows some strong seasonal fluctuations. Moreover, we find that unemployment levels are systematically higher in labor market regions with a larger minimum wage bite. However, despite these differences in levels, trends appear similar for treatment and control group before the introduction of the statutory minimum wage. The graph further suggests that the introduction of the minimum wage had no strong positive effect on regional unemployment levels. In fact, we rather observe a decline in the level of regional unemployment for regions with a strong minimum wage bite. In Section 3.3, we test whether this observation may be causally linked to the minimum wage or may rather be explained by other factors.

3.2 Effects on employment

We next turn to our regression results for the effect of the minimum wage bite on regional employment. Table 1 shows the corresponding estimates using the simple DiD approach. As highlighted before, our coefficient of interest (β) picks up differences in the evolution of the outcome variable between treatment and control group before and after the minimum wage law was passed.

[Table 1 about here]

Panel A shows estimation results for the effect of the minimum wage bite on (log) regular employment. The specification in column (1) contains no control variables other than

the labor market region and quarter fixed effects. The estimated treatment effect is close to zero and not statistically significant. We therefore do not find empirical support for a negative or positive effect of the minimum wage on the level of regular employment. This is supported by our estimates in columns (2) to (4) which include different sets of control variables. The estimated treatment effect is hardly affected by the additional controls and not statistically different from zero in any specification. At most, the estimated treatment effect becomes smaller (in absolute terms) when including our control variables.

In more detail, column (2) includes additional dummy variables that allow for different seasonal effects in the outcome for East and West Germany. In column (3), we further control for different trends in outcomes by labor market type (sparsely populated rural region, rural region with some population centers, urban region) and geographic location (East/West). Among others, these dummy variables absorb time-varying differences in outcomes due to structural differences across regions. Column (4) shows our preferred specification. Here, we additionally control for differences in the industrial structure of labor market regions before the introduction of the minimum wage. For this purpose, we allow for different time trends subject to the industrial composition of a labor market region (the share of employees in agriculture, public services, and manufacturing) and its location (East/West Germany).[11] As a final robustness test, specification (5) – subject to the same control variables as the empirical specification in column (4) – excludes those labor market regions characterized by a particularly high or a low minimum wage bite.[12] By excluding these specific regions, we compare even more similar labor markets in the DiD approach. However, the estimated treatment effect is hardly affected by this sample selection.

Panels B and C of Table 1 present the corresponding results for the regional (log) level of marginal employment. While the first measure includes individuals who hold a *mini-job* as secondary employment, the latter relates to the number of individuals who only hold marginal employment. Irrespective of the specific measure, we find statistically significant negative effects on marginal employment in regional labor markets with a higher minimum wage bite. According to our leanest specification displayed in column (1) of panels B and C, the higher minimum wage bite for labor market regions in the treatment than control group reduces the level of marginal employment by around 3.0%. While decreasing in size, this effect

[11] The classification of labor market regions by agglomeration type follows the definition of the BBSR. Information on employment statistics by sector for 2013 and data on population levels are taken from the Regional Statistics of the Federal Statistical Office (Destatis).

[12] We exclude all labor market regions in which the wage gap lies in the highest or lowest decile of the distribution.

remains statistically significant when adding controls (see columns (2) to (4)) and restricting the sample along the minimum wage bite distribution (column (5)). According to our preferred specification displayed in column (4), the introduction of the minimum wage caused regional marginal employment to decrease by around 1.9% in regional labor markets with a relatively higher minimum wage bite compared to regions with a lower bite.

Last, we show the corresponding results for total employment (regular + marginal) in panel D of Table 1. Irrespective of the set of controls we find small but statistically significant effects of the minimum wage bite on total employment levels. According to our preferred specification displayed in column (4), a higher minimum wage bite caused overall employment to decrease by around 0.5% in the treatment relative to the control group; a result which appears to be mainly driven by a reduction in marginal employment. According to Appendix Table A.2, total employment in labor market regions in the treatment group before the introduction of the minimum wage was about 115,000 workers. Hence, a back-of-the-envelope calculation results in an absolute negative employment effect of about 76,500 jobs *relative* to labor market regions in the control group.[13]

Appendix Table A.3 indicates that these general findings do not appear to be driven by the specific measure of the minimum wage bite. When using the share of affected workers to define treatment and control group, estimates for regular, marginal and total employment are very similar to our baseline results. Moreover, effects remain similar when not weighting our results according to regional population figures before the reform (see Appendix Table A.4).

The results of the extended DiD approach further corroborate these general findings. Based on our continuous measure of treatment intensity, the results displayed in panel (a) of Figure 4 point to negative but statistically insignificant effects of the minimum wage bite on regular employment in the aftermath of the reform; thus mirroring the estimates of the simple DiD (see panel A of Table 1). Important for identification, we find no evidence of diverging pre-trends, reporting statistically insignificant and economically small effects of the minimum wage bite on regional employment prior to the announcement of the reform.

[Figure 4 about here]

[13]Note that this result is rather a lower bound for the overall employment impact as we cannot rule out that control labor market regions have also experienced employment losses. Our estimate is slightly higher than comparable results ranging between 45,000 and 60,000 by Bossler and Gerner (2016) and Bossler et al. (2018). Other studies have estimated the overall employment impact for all labor market regions to range between 140,000 and 250,000 jobs (Garloff, 2016; Schmitz, 2017; Caliendo et al., 2018a).

Panel (b) of Figure 4 provides the corresponding results of the extended DiD approach for regional marginal employment. Again, results support the findings of the simple DiD model as displayed in panel B of Table 1. A higher bite of the minimum wage led to a significant reduction in the level of regional marginal employment after the reform.[14] By contrast, we detect no systematic relationship between the minimum wage bite and the level of marginal employment before the reform, which supports the causal interpretation of our findings. Last, panel (c) of Figure 4 depicts the corresponding results for total employment, again mirroring the findings from the simple DiD model (see panel D of Table 1).

3.3 Effects on unemployment

Table 2 summarizes the estimation results for different specifications of our simple DiD model on regional unemployment. Based on our leanest specification of the model as displayed in column (1) we find that a higher bite of the minimum wage caused regional levels of unemployment to fall. However, when gradually moving to a more restrictive specification, the effect fades towards zero and becomes statistically insignificant; suggesting the presence of other systematic differences between treatment and control regions that drive the result displayed in column (1). Thus, when including our preferred set of controls for heterogenous time trends (see column 4) we find no effect of a higher minimum wage bite on regional unemployment. This result remains when we exclude labor market regions in the upper and lower decile of the minimum wage distribution to make treatment and control group more comparable (column 5).

[Table 2 about here]

Results of the extended DiD approach confirm those from the simple DiD design. As displayed in Figure 5 we find no persistent effect of the minimum wage bite on the regional level of unemployment. Point estimates vary around zero and are not statistically significant in most cases.[15] Insignificant pre-trends support the causal interpretation of this null effect.

[Figure 5 about here]

[14] The point estimate indicates that an (hypothetical) increase in the wage gap by 0.1 EUR decreases the log level of marginal employment by around 2.0% compared to the employment level in Q2/2014.

[15] The point estimates suggest a negative effect on unemployment right after the announcement of the reform in the third quarter of 2014 and in the third quarter of 2016. However, as we do not see any consistent time pattern in the estimated unemployment effects, we refrain from giving these two outliers too much weight.

4 Conclusion

This paper investigates the effects of the introduction of the statutory minimum wage in Germany in 2015 on regional employment and unemployment over the short and medium run until late 2016. Due to the institutional setting – a nationwide policy reform with a very limited number of exemptions – an ideal experimental standard yielding clear treatment and control groups for identification is not given. Therefore, we follow Card (1992), Dolton et al. (2015) and Caliendo et al. (2018a) and exploit variation in the bite of the minimum wage across labor market regions to set up difference-in-differences approaches. We use the region-specific average gap between hourly wages and the new wage floor prior to the minimum wage reform to construct a measure of regional exposure to the new minimum wage.

Overall, we find that the introduction of the minimum wage led to a significant reduction in marginal employment in the first two years after the reform. However, we find no evidence that the minimum wage caused regular employment to significantly decline over the respective period. This is in line with previous findings in the literature. Despite the negative effects on marginal employment, we further find no evidence of higher levels of unemployment. One potential explanation for this finding is that former mini-jobbers now operate as freelancers or self-employed, i.e., run business with earnings exempt from minimum wage legislation. A second potential explanation is that individuals with diminished employment prospects because of the minimum wage get discouraged and withdraw from the labor force. Such a response has been observed, for example, by Boffy-Ramirez (2019) who evaluates the impact of various state minimum wage changes in the United States over the period from 1990 to 2017 on participation rates.

Future research on the impact of Germany's statutory minimum wage should look more closely at induced changes in type of employment or labor force status, in order to obtain a deeper understanding concerning the empirical role of the self-employment and participation margins.[16] In addition, the analysis should be extended beyond the two-year period 2015–2016 covered by this study to investigate (i) effects in the longer run and (ii) the subsequent increases in the minimum wage to 8.84 EUR per hour in 2017 (and the planned future increases to 9.19 EUR and 9.35 EUR in 2019 and 2020, respectively).

While the controversial debate preceding the introduction of the statutory minimum

[16] Recently, a study focusing on the incidence of solo self-employed work has indeed been commissioned by the German minimum wage commission (*Auswirkungen des gesetzlichen Mindestlohns auf die Solo-Selbständigkeit*, see `https://www.mindestlohn-kommission.de/DE/Forschung/Projekte/Laufend_node.html`, last accessed 26/02/2019).

wage in Germany largely focused on potentially large negative employment effects, our findings suggest that the minimum wage reform did not considerably affect the extensive margin of employment. This result may appear surprising given that the high bite of the minimum wage in a large number of German labor market regions indicates that *ceteris paribus* firms' labor costs in high-bite areas should have increased strongly. However, it needs to be acknowledged that the stock of labor is not the only potential margin of adjustment to a statutory minimum wage (Belman and Wolfson, 2014). For example, a minimum wage may only affect labor costs if it is actually implemented by employers. While wages at the bottom of the distribution have been increased after the introduction of the minimum wage, there is still evidence for non-compliance with respect to the minimum wage (Burauel et al., 2018). Further, even if hourly wages are adjusted according to the minimum wage, labor earnings may only increase when hours worked remain unaffected. However, there is strong evidence that affected workers' working time was significantly reduced in response to the minimum wage (Bonin et al., 2018). Moreover, Koch et al. (2018) provide qualitative evidence that parts of the compensation packages other than the regular wage (e.g., holiday and Christmas allowances, bonus payments, etc.) were systematically reduced for workers whose hourly wage had to be raised to the minimum wage level. Bellmann et al. (2017b) further find that the intensity of employer-financed training was reduced at establishments treated by the minimum wage. Finally, the incidence of increased labor costs may have also been passed on to firm owners and consumers through lower profits and higher output prices (Bossler et al., 2018).

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Tables and Figures

Table 1: Local employment effects (simple DiD approach)

	(1)	(2)	(3)	(4)	(5)
Panel A: Regular employment					
Treatment effect	-0.0045	-0.0044	-0.0033	-0.0010	-0.0010
	(0.0034)	(0.0033)	(0.0025)	(0.0021)	(0.0022)
Observations	4112	4112	4112	4112	3296
R^2	0.891	0.892	0.910	0.934	0.939
Panel B: Marginal employment (total)					
Treatment effect	-0.0299***	-0.0187***	-0.0184***	-0.0180**	-0.0157**
	(0.0063)	(0.0059)	(0.0068)	(0.0071)	(0.0072)
Observations	1028	1028	1028	1028	824
R^2	0.251	0.309	0.331	0.436	0.411
Panel C: Marginal employment (exclusively)					
Treatment effect	-0.0318***	-0.0189***	-0.0176**	-0.0194**	-0.0174*
	(0.0070)	(0.0073)	(0.0087)	(0.0093)	(0.0093)
Observations	1028	1028	1028	1028	824
R^2	0.528	0.566	0.575	0.633	0.617
Panel D: Regular and (exclusively) marginal employment					
Treatment effect	-0.0085**	-0.0079***	-0.0081***	-0.0056**	-0.0052**
	(0.0036)	(0.0022)	(0.0024)	(0.0022)	(0.0022)
Observations	1028	1028	1028	1028	824
R^2	0.862	0.862	0.882	0.915	0.920
West/East Time FE		X			
LMR type/Time/Region FE			X	X	X
Sector-specific time trends				X	X

Source: BA Statistics and SES (2014).
Notes: Standard errors (in parentheses) are clustered at the labor market level. All specifications include labor market region and time fixed effects. West/East time FE: dummy variables that allow for different seasonal effects in East and West Germany. LMR type/Time/Region FE: time-specific dummy variables that allow for different effects by labor market region type (sparsely populated rural region, rural region with population concentrations, urban region) in East and West Germany. Sector-specific time trends: linear time trends for East and West Germany interacted with the share of employees in (i) agriculture, (ii) public services and (iii) manufacturing in 2013. In column (5), we exclude those labor market regions characterized by a particularly high or low minimum wage bite. The usual confidence levels apply: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 2: Effects on regional unemployment (simple DiD approach)

	(1)	(2)	(3)	(4)	(5)
Treatment effect	-0.053***	-0.049***	-0.011*	-0.007	-0.006
	(0.007)	(0.007)	(0.006)	(0.006)	(0.007)
Observations	4112	4112	4112	4112	3296
R^2	0.540	0.565	0.712	0.737	0.712
West/East Time FE		X			
LMR type/Time/Region FE			X	X	X
Sector-specific time trends				X	X

Source: BA Statistics and SES (2014).
Notes: Standard errors (in parentheses) are clustered at the labor market level. All specifications include labor market region and time fixed effects. West/East time FE: dummy variables that allow for different seasonal effects in East and West Germany. LMR type/Time/Region FE: time-specific dummy variables that allow for different effects by labor market region type (sparsely populated rural region, rural region with population concentrations, urban region) in East and West Germany. Sector-specific time trends: linear time trends for East and West Germany interacted with the share of employees in (i) agriculture, (ii) public services and (iii) manufacturing as of 1/2013. In column (5), we exclude those labor market regions characterized by a particularly high or low minimum wage bite. The usual confidence levels apply: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

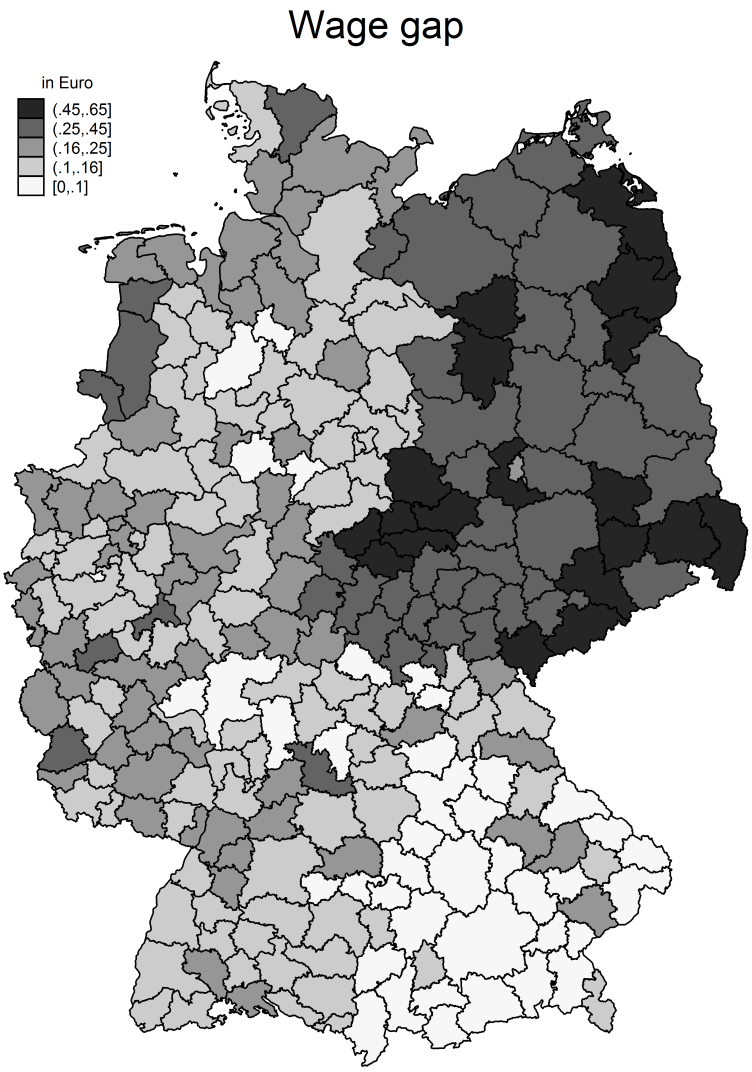
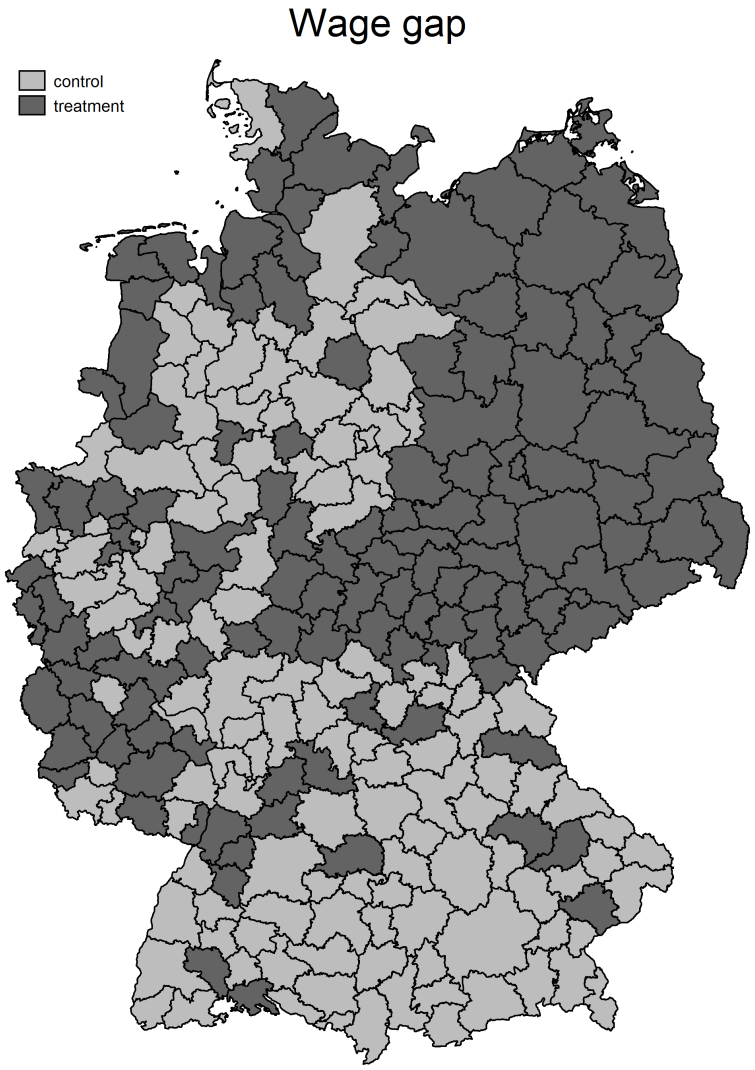


Figure 1: Average wage gap by labor market region (2014, in EUR)

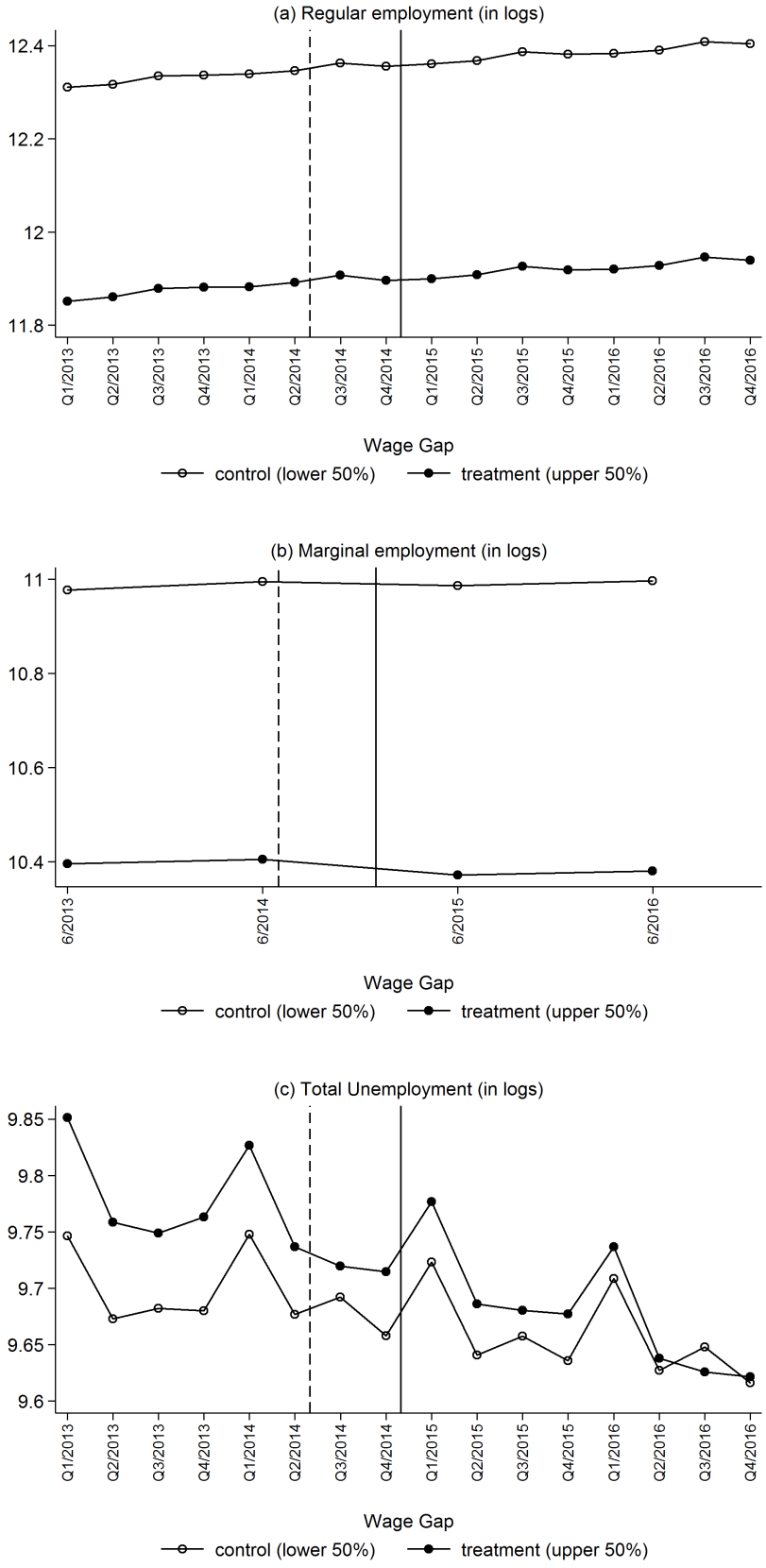
Source: SES (2014), own calculations.

Figure 2: Binary classification of labor market regions according to minimum wage bite



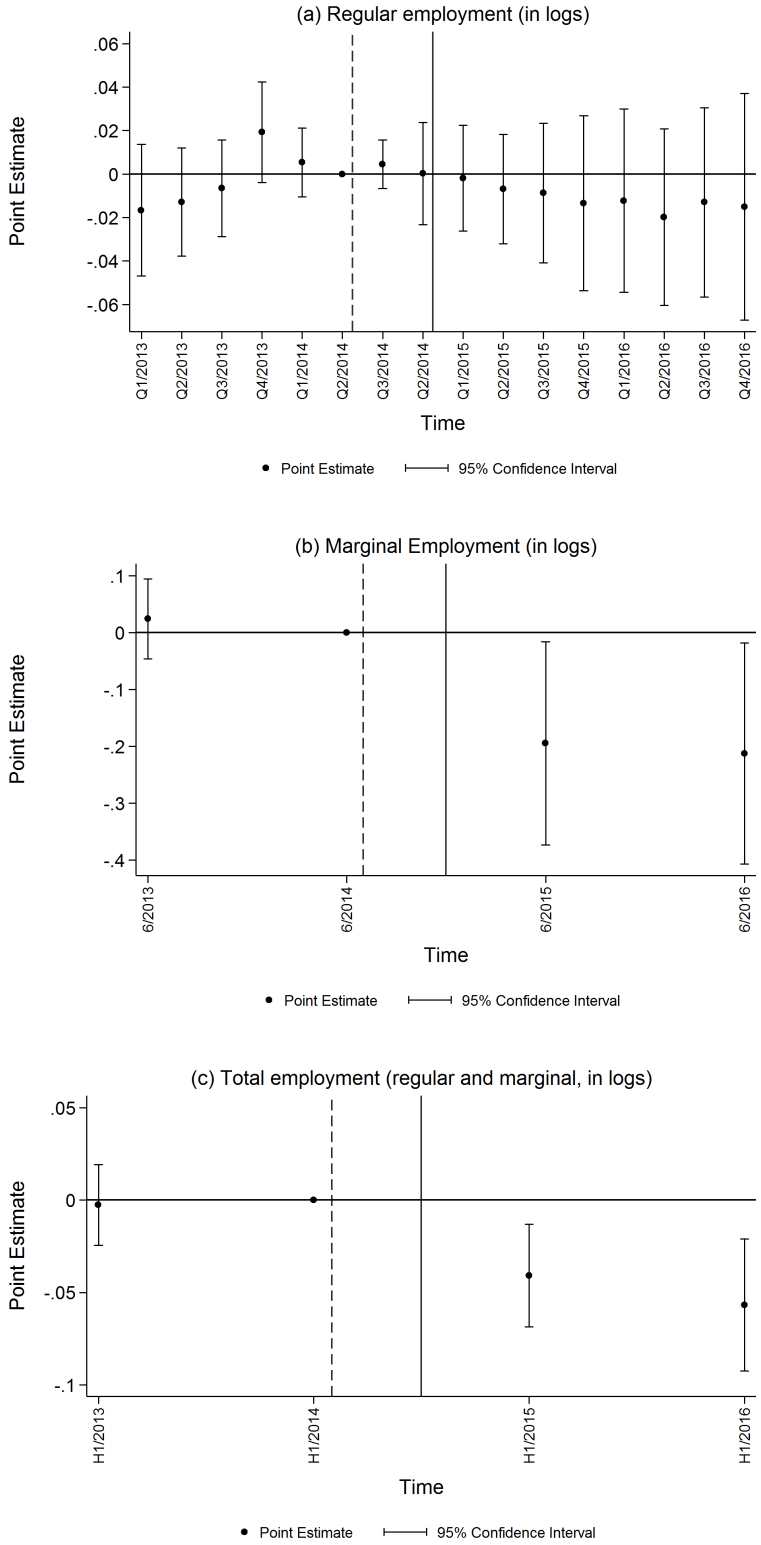
Source: SES (2014), own calculations.
Notes: The classification of labor market regions is based on the average wage gap (Control: below the median, Treatment: above the median). The median of the wage gap on level of labor market regions is 0.16 EUR.

Figure 3: The evolution of regional employment and unemployment between 2013–2016



Source: BA Statistics and SES (2014), own calculations.
Notes: The dashed vertical line indicates the time of the passing of the law (July 2014) and the solid vertical line the time of the introduction of the minimum wage (January 2015). Note that data on regular employment is available at the quarterly level, information on marginal employment at the annual level.

Figure 4: Effect of the minimum wage bite on regular and marginal employment (extended DiD)



Source: BA Statistics and SES (2014), own calculations.
Notes: The dashed vertical line indicates the time of the passing of the law (July 2014) and the solid vertical line the time of the introduction of the minimum wage (January 2015). Point estimators and confidence intervals refer to vector β in equation (2). The specification includes labor market region and time fixed effects. West/East quarter FE: dummy variables for seasonal effects (quarters) in East and West Germany. LMR type/Time/Region FE: time-specific dummy variables indicating the type of labor market regions (sparsely populated rural region, rural region with population concentrations, urban region) for East and West Germany. Sector-time-trends: linear time trends interacted with the share of employees in agriculture, public service and manufacturing in 2013 in East and West Germany. Note that data on regular employment is available at the quarterly level, information on marginal employment at the annual level. Total employment refers to the sum of regular and marginal employment.

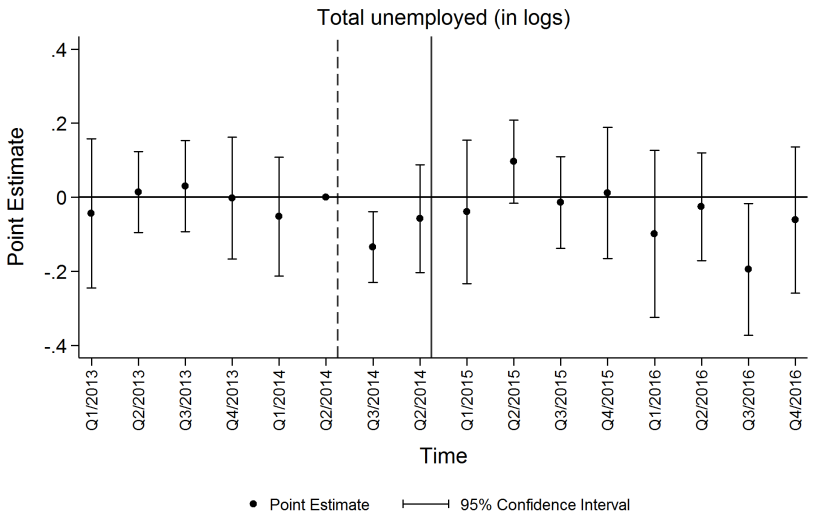


Figure 5: Effects on unemployment (extended DiD-approach)

Source: BA Statistics and SES (2014), own calculations.
Notes: The dashed vertical line indicates the time of the passing of the law (July 2014) and the solid vertical line the time of the introduction of the minimum wage (January 2015). Point estimators and confidence intervals refer to vector β in equation (2). The specification includes labor market region and time fixed effects. West/East quarter FE: dummy variables for seasonal effects (quarters) in East and West Germany. LMR type/Time/Region FE: time-specific dummy variables indicating the type of labor market regions (sparsely populated rural region, rural region with population concentrations, urban region) for East and West Germany. Sector-time-trends: linear time trends interacted with the share of employees in agriculture, public service and manufacturing in 2013 in East and West Germany. Observations: 824, R^2 (within): 0.084.

A Appendix

Table A.1: Measures of the minimum wage bite

Region	Germany	West	East
Average wage gap (in EUR)	0.16	0.12	0.33
Share of workers with hourly wage $<$ 8.50 EUR (in %)	11.4	9.4	20.8
Kaitz index (relative to average wage, in %)	49.9	48.3	58.8
Kaitz index (relative to median wage, in %)	57.7	55.9	69.0

Source: SES (2014), own calculations.

Table A.2: Characteristics of labor market regions prior to the introduction of the minimum wage

Minimum wage bite (wage gap)	**Control**	**Treatment**	**Total**
Average wage gap (2014, in EUR)	0.11	0.30	0.20
Total employment			
2013–2014	155,551	115,028	135,369
2015–2016	161,464	118,404	140,018
Agglomeration type (share in %)			
Sparsely populated, rural	25.6	35.2	30.4
Rural with population centers	20.9	28.9	24.9
Urban	53.5	35.9	44.8
East Germany (share in %)	0.0	42.2	21.0
2013 Employment structure (share in %)			
Agriculture	2.3	2.4	2.4
Services	13.6	13.6	13.6
Manufacturing	30.4	27.7	29.1
Public Sector	29.5	31.8	30.6
Wholesale	24.3	24.5	24.4
Population share 18-64 years (2013, in %)	62.6	62.2	62.4
Number of labor market regions	129	128	257

Source: SES (2014), Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) and Destatis, own calculations.
Notes: The classification of labor market regions by agglomeration type follows the definition of the BBSR. Information on employment statistics by sector for 2013 and data on population levels are taken from the Regional Statistics of the Federal Statistical Office (Destatis).

Table A.3: Robustness Checks: Share of affected employees as alternative bite (simple DiD approach)

	(1)	(2)	(3)	(4)	(5)
Outcome	Regular Empl.	Marginal Empl. (total)	Marginal Empl. (excl.)	Total Empl.	Unemployment
Treatment effect	0.0003	-0.0162**	-0.0150*	-0.0039	-0.0164**
	(0.0024)	(0.0074)	(0.0086)	(0.0025)	(0.0067)
Observations	4112	1028	1028	1028	4112
R^2	0.934	0.426	0.625	0.914	0.739
LMR type/Time/Region FE	X	X	X	X	X
Sector-time-trends	X	X	X	X	X

Source: BA Statistics and SES (2014).
Notes: Standard errors (in parentheses) are clustered at the labor market level. All specifications include labor market region and time fixed effects. LMR type/Time/Region FE: time-specific dummy variables that allow for different effects by labor market region type (sparsely populated rural region, rural region with population concentrations, urban region) in East and West Germany. Sector-specific time trends: linear time trends for East and West Germany interacted with the share of employees in (i) agriculture, (ii) public services and (iii) manufacturing as of 1/2013. The usual confidence levels apply: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.4: Robustness Checks: Non-weighted regressions (simple DiD approach)

	(1)	(2)	(3)	(4)	(5)
Outcome	Regular Empl.	Marginal Empl. (total)	Marginal Empl. (excl.)	Total Empl.	Unemployment
Treatment effect	-0.0015	-0.0118**	-0.0108*	-0.0044**	-0.0047
	(0.0022)	(0.0045)	(0.0059)	(0.002)	(0.0064)
Observations	4112	1028	1028	1028	4112
R^2	0.896	0.412	0.631	0.869	0.691
LMR type/Time/Region FE	X	X	X	X	X
Sector-specific time trends	X	X	X	X	X

Source: BA Statistics and SES (2014).
Notes: Standard errors (in parentheses) are clustered at the labor market level. All specifications include labor market region and time fixed effects. LMR type/Time/Region FE: time-specific dummy variables that allow for different effects by labor market region type (sparsely populated rural region, rural region with population concentrations, urban region) in East and West Germany. Sector-specific time trends: linear time trends for East and West Germany interacted with the share of employees in (i) agriculture, (ii) public services and (iii) manufacturing as of 1/2013. The usual confidence levels apply: * p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01.

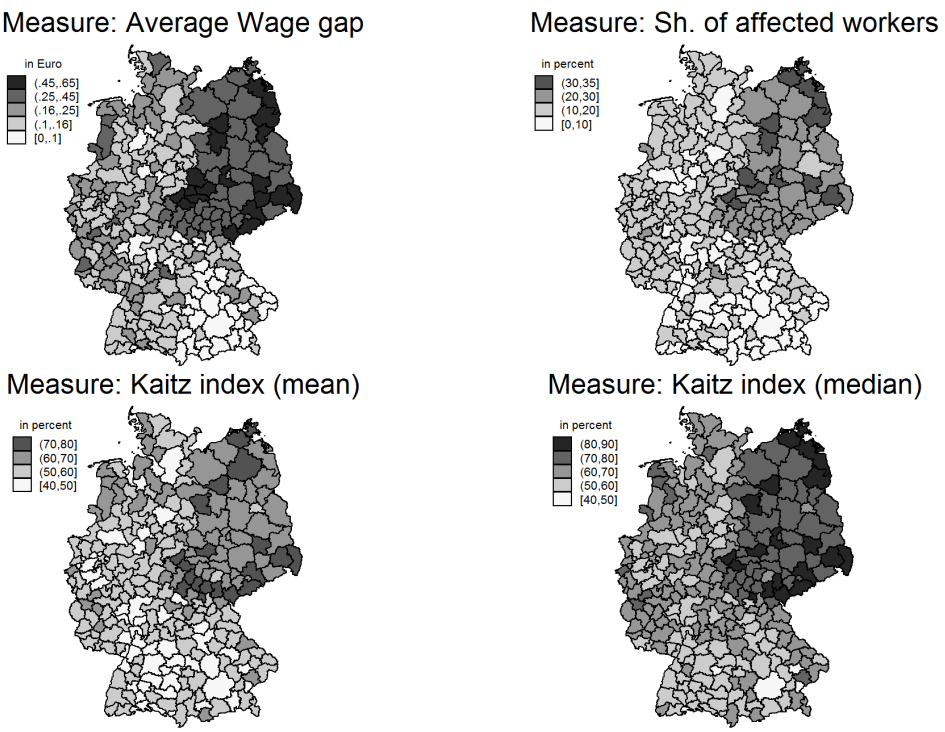


Figure A.1: Geographic spread of minimum wage bite by measure

Sources: SES (2014), own calculations.