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# The Impact of Minimum Wages on Well-Being: Evidence from a Quasi-Experiment in Germany

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# **The Impact of Minimum Wages on Well-Being: Evidence from a Quasi-Experiment in Germany**

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To analyze well-being effects of minimum wages, the introduction of a minimum wage in Germany in 2015 is used as a quasi-experiment. Based on the representative SOEP data, a difference-in-differences design compares the development of life, job, and pay satisfaction between those who are affected by the reform according to their pre-intervention wages and those who already have marginally higher wages so that they are not directly affected. The results show that the minimum wage has significantly positive effects on all considered dimensions of well-being, on average, with an increase in life satisfaction by 0.10 standard deviations (0.15 points on a ten-point Likert scale). Positive effects last at least until one year after the reform. Life satisfaction tends to increase particularly in the region that is overall economically less developed (East Germany). The results hold if those who are not employed anymore after the reform are included in the analysis.

*Keywords:* Minimum wage; natural experiments; well-being; satisfaction

*JEL classification:* I31; J28; J30; J31; J38; J60

## 1. Introduction

Minimum wages aim at securing an income that allows for the satisfaction of basic needs. A main criticism is that minimum wages reduce employment. A large body of literature has investigated the effects of minimum wage reforms on employment (e.g., Linneman, 1982; Neumark and Wascher, 2004). The results are mixed, with most studies finding no negative effects (Card, 1992; Dickens et al., 1999; Dube et al., 2010; Garloff, 2016; Katz and Krueger, 1992; Machin and Manning, 1994; Stewart, 2004a, 2004b) or negative effects that are modest or hold within specific groups (Bossler and Gerner, 2016; Burkhauser et al., 2000; Caliendo et al., 2017a; Gittings and Schmutte, 2016; Lopresti and Mumford, 2016; Machin et al., 2003; Neumark and Wascher, 1992; Rama, 2001; Sabia et al., 2016; Schmitz, 2017; Sturn, 2018; Zavodny, 2000). Until today it remains disputable whether minimum wages reduce employment (Dolton et al., 2015; Meer and West, 2016; Neumark et al., 2014; see also the review by Neumark and Wascher, 2007). Minimum wages are associated with positive effects on redistribution in favor of low earners, in particular when hourly wages are considered (Caliendo et al., 2017b; Fedorets and Schroeder, 2017). They have also been found to improve mental health outcomes (Reeves et al., 2017).

Only few studies, however, have analyzed the effects of minimum wages on well-being (Bossler and Broszeit, 2017; Pusch and Rehm, 2017).<sup>1</sup> The present study investigates how the introduction of a minimum wage influences different dimensions of well-being: life satisfaction, job satisfaction, and pay satisfaction of those who earned less than the minimum wage before. This understanding is necessary to evaluate the impact of minimum wages more

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<sup>1</sup> For the purpose of this study, well-being is understood as a combination of different dimensions of satisfaction (see also Clark et al. (2009a); Di Tella et al., 2003; Ferrer-i-Carbonell, 2005; Gardner and Oswald, 2007; Powdthavee, 2010; Van Praag et al., 2003).

comprehensively. To this aim, the minimum wage reform implemented in Germany on January 1, 2015, which introduces a minimum wage for the first time in the country and requires a gross hourly wage of at least €8.50 in whole Germany, is used as a quasi-experiment.

Previous literature investigating the effect of minimum wages on well-being finds that the introduction of a minimum wage has positive effects on job and pay satisfaction (Bossler and Broszeit, 2017; Pusch and Rehm, 2017). We contribute to the existing research by including a broader set of well-being measures, namely, by considering life satisfaction in addition to job and pay satisfaction. This analysis helps to understand whether minimum wages have positive effects on overall well-being, beyond the work domain. We additionally explore whether the effects of the minimum wage are different in two differently developed regions. This investigation is mainly based on the expectation that the wage increase due to the minimum wage is different across regions due to different wage levels before the reform. In particular, we distinguish between the effects of the minimum wage in East Germany and West Germany, which are – overall – two differently developed regions (e.g., Easterlin and Plagnol, 2008; Frijters et al., 2004; Van Praag et al., 2003). We also check whether the results change if those individuals who do not remain employed after the introduction of the minimum wage are included in the analysis. Thereby, we approximate the effects of the minimum wage on well-being among the group of low earners more comprehensively and consider not only the “winners”, who earn more than before, but also potential “losers” of the reform who lose their job.

From a theoretical point of view, there are several arguments why the minimum wage is expected to increase average well-being among the affected low earners. One argument is based on the positive relationship between absolute income and well-being (e.g., Diriwaechter and Shvartsman, 2018; Frijters et al., 2004; Gardner and Oswald, 2007), in

particular at low levels of income (e.g., Ferrer-i-Carbonell, 2005; McBride, 2001). Although detrimental social comparison processes might likely persist after the reform, because earnings of other individuals also tend to increase in the economic upswing (e.g., Corazzini et al., 2012; Kingdon and Knight, 2007; Senik, 2009), the minimum wage reduces the extent of income inequality, in particular among low earners, and is therefore expected to reduce experiences of relative deprivation (e.g., Boyce et al., 2010; Card et al., 2012). The minimum wage might also lead to the fulfillment of income aspirations (Knight and Gunatilaka, 2012; McBride, 2010; Stutzer, 2004).

The empirical analysis is based on the German Socio-Economic Panel (SOEP), a large, representative, and longitudinal data set of the population in Germany. In our baseline model, we observe gross hourly wages and satisfaction measures in the year prior to the introduction of the minimum wage (2014) and in the year after (2015). A difference-in-differences design is used to approximate the causal effect of the minimum wage on well-being in the next year. We compare the satisfaction development of those to whom the minimum wage reform applies (wages below €8.50 in 2014; see also Pusch and Rehm, 2017) to the satisfaction development of other low earners who are not affected because their wages are just above the threshold in 2014 (between €8.50 and 50% more, that is, up to €12.75; compare Pusch and Rehm, 2017). We include biographical, educational, and job-related control variables. In several robustness checks, we further restrict the treatment group (excluding cases of large wage increases, which are likely not due to the minimum wage reform) and extend the considered time span both in the pre-intervention period (using data from 2013) and in the post-intervention period (using data from 2016).

The results show that the minimum wage leads to a significant increase in well-being with respect to life, job, and pay satisfaction. For life satisfaction we estimate an average increase by approximately 0.10 standard deviations (0.15 points on the original ten-point Likert scale),

while the estimated increases in job and pay satisfaction are larger (0.14 and 0.16 standard deviations, on average). The results are robust with respect to the specification of the treatment group, and the results for life and pay satisfaction are robust to increasing the considered time span. Although average wages of low earners do not increase more in East Germany than in West Germany, East German workers' well-being is more strongly affected by the minimum wage than West German workers' well-being, in particular with regard to life satisfaction. There are different possible explanations for this result, including detrimental social comparison effects within West Germany due to a higher general income level, lower income aspirations in East Germany, and the reduction of perceived relative deprivation of East German workers in comparison to West Germany because of the nationwide fixed minimum wage. The percentage of employees who stop working or become unemployed after the reform is much larger among affected employees than in the control group (14.3% versus 7.1%), but the inclusion of these individuals in the analysis does not change the main results. This indicates that the minimum wage tends to have positive effects on well-being in a more comprehensive manner.

The remainder of the paper is organized as follows. In section 2, we outline theoretical arguments for well-being effects of the minimum wage. Section 3 describes the method, which includes the data set, the variables, the sample with treatment and control group, and the econometric model. Section 4 presents the descriptive statistics, the main results, the results of the robustness checks, and the exploratory results. Section 5 concludes.

## **2. Theoretical considerations**

Traditional economic theory implies that utility depends on the absolute level of income (e.g., Diriwaechter and Shvartsman, 2018). Accordingly, increases in income have been found to be associated with increases in well-being (Di Tella et al., 2003; Frijters et al., 2004; Gardner and Oswald, 2007; Grund and Sliwka, 2001; Pouwels et al., 2008; Van Praag et al.,

2003), particularly at low levels of income (e.g., Ferrer-i-Carbonell, 2005; McBride, 2001). As the introduction of a minimum wage is associated with an increase in income for those individuals who earned less before, are affected by the reform, and remain employed, this reasoning speaks in favor of positive minimum wage effects on well-being.

Behavioral theory suggests that well-being often depends on relative comparisons to other individuals. Consequently, many studies have determined positive associations between relative income and well-being (Corazzini et al., 2012; Luttmer, 2005), including life satisfaction (e.g., Blanchflower and Oswald, 2004; Easterlin and Plagnol, 2008; Ferrer-i-Carbonell, 2005; Kingdon and Knight, 2007; Senik, 2009; Vendrik and Woltjer, 2007), job satisfaction (e.g., Brown et al., 2008; Card et al., 2012; Clark et al., 2009b; Clark and Oswald, 1996; Grund and Rubin, 2017; Ravid et al., 2017), and pay satisfaction (e.g., Brown et al., 2008; Bygren, 2004; Godechot and Senik, 2015; Groot and Van den Brink, 1999; Rees, 1993; Shapiro and Wahba, 1978; Sweeny et al., 1990). This phenomenon can be explained by the reference-income hypothesis (Duesenberry, 1949), which predicts that utility from income depends on comparisons to a social reference group.<sup>2</sup>

As the introduction of a minimum wage is often conducted during an economic upswing, the earnings of those who are not directly affected by the minimum wage also tend to increase. The relative income of those who are affected then remains rather low, and they still have the lowest rank in the income distribution. In particular if individuals mostly care about their ordinal rank in comparison to others (Boyce et al., 2010; Brown et al., 2008; Card et al.,

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<sup>2</sup> At a later stage, Easterlin utilized Duesenberry's model to determine the so-called "Easterlin paradox", which inter alia states that if the whole society grows and earns more, individual well-being might not increase (Easterlin, 1974, 1995, 2001).



2012; Clark et al., 2009a; Powdthavee, 2009), this line of reasoning speaks against a positive effect of the minimum wage on well-being.

However, even if relative comparisons are important, the introduction of the minimum wage might still increase well-being. The minimum wage likely reduces the extent of income inequality (Caliendo et al., 2017b; Dolton et al., 2015). In particular, before the minimum wage reform there is a considerable heterogeneity with respect to income even among the group of low earners. After the minimum wage reform, the income of low earners is expected to be more homogenous, as a lower limit is introduced. If income inequality reduces well-being, because people particularly tend to suffer from upward comparisons (Boyce et al., 2010; Card et al., 2012; Duesenberry, 1949; Ferrer-i-Carbonell, 2005; Senik, 2009), then the reduction of inequality due to the introduction of the minimum wage might lead to an increase in well-being.

In addition, people tend to compare their income not only to other individuals' income but also to their own past income (Clark et al., 2008; Senik, 2009; Sweeny et al., 1990; Van de Stadt et al., 1985). This phenomenon has been captured in the literature on income aspirations, which build a subjective reference point (Kahneman and Tversky, 1979) and which depend both on the income of others and on the income of oneself in the past (Knight and Gunatilaka, 2012; McBride, 2010; Stutzer, 2004). As the minimum wage increases the income of the affected low earners relative to their past income, it likely leads to a fulfillment of aspirations, which also speaks in favor of an increase in well-being – at least in the short run, until aspirations are updated.

It may further be expected that positive effects on well-being are more pronounced in East Germany than in West Germany, in particular because wages of low earners in East Germany have presumably been lower, on average, than in West Germany, so that the wage increases due to the minimum wage should be larger in East Germany (Brenke and Müller, 2013; Falck

et al., 2013; Heumer et al., 2013; Kalina and Weinkopf, 2015; Knabe et al., 2014). It may also be expected that although unemployment tends to have large negative effects on well-being (Clark and Oswald, 1994; Di Tella et al., 2001; Romeu Gordo, 2006; Winkelmann and Winkelmann, 1998), the effects of the minimum wage on employment may be modest (e.g., Bossler and Gerner, 2016; Burkhauser et al., 2000; Neumark and Wascher, 1992) so that the minimum wage should increase well-being measures even if those who do not remain employed are included in the analysis.

### **3. Method**

#### **3.1. Data**

The analysis is based on the German Socio-Economic Panel (SOEP)<sup>3</sup>, a longitudinal panel data set that started in 1984 (Wagner et al., 2007). The SOEP comprises a nationally and annually representative sample of nearly 11,000 households and more than 20,000 individuals. This panel provides detailed information on individuals' biographies, employment, earnings, and satisfaction measures over time.

The SOEP has already been used for analyses concerning the minimum wage (Brenke and Müller, 2013; Heumer et al., 2013; Knabe et al., 2014). To analyze well-being effects of the minimum wage, the SOEP has several advantages over alternative data sources that are used in the literature (e.g., Bossler and Broszeit, 2017; Pusch and Rehm, 2017): In particular, the SOEP includes different measures of well-being, including life satisfaction, job satisfaction, and pay satisfaction. It also includes small organizations instead of only focusing on large and medium enterprises (Bossler and Broszeit, 2017), which is an important aspect because small organizations tend to be more strongly affected by the minimum wage (Falck et al.,

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<sup>3</sup> Socio-Economic Panel (SOEP), data for years 1984-2015, version 32, SOEP, 2016, doi:

10.5684/soep.v32.

2013; Heumer et al., 2013; Kalina and Weinkopf, 2015; Pusch and Rehm, 2017). In addition, as a representative data set the SOEP does not oversample particular groups such as those who receive unemployment benefits (Pusch and Rehm, 2017).

We merge data from several SOEP files to construct the sample. We gather information on employment status, monthly gross earnings, actual weekly working hours, education level, employment branch, and basic personal characteristics from the SOEP generated person data. Measures of well-being (life, job, and pay satisfaction) and information on unemployment status are taken from the extensive SOEP person files. Finally, we gather the information about the residential region of the respondents (East versus West Germany) from the SOEP household data file. Our main analysis includes the years 2014 (pre-intervention) and 2015 (post-intervention). To test the common trend assumption (whether treatment and control group develop similarly before the reform; placebo tests) and to explore effects of the minimum wage across a longer time span, we additionally consider the years 2012, 2013, and 2016 (only those individuals who are additionally part of the main sample in 2014 and 2015).

In line with the scope of the minimum wage reform in Germany, we restrict our analysis to those who are employed, working full-time, part-time, or marginally. The main analysis only includes individuals who are employed both in 2014 and 2015. We do not consider apprentices, interns, and self-employed because these groups are not affected by the minimum wage.<sup>4</sup> Respondents who are under 18 years old are also excluded because the minimum wage does not apply to them. Individuals who are above 65 years are likewise excluded because they usually receive pensions (see also Reeves et al., 2017, p. 641).

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<sup>4</sup> Interns must be payed the minimum wage only after graduating but not if the internship is part of their education.

### 3.2. Variables

The dependent variables *Life satisfaction*, *Job satisfaction*, and *Pay satisfaction* are used to approximate individuals' well-being. All three measures are originally on a Likert scale from 0 to 10, ranging from "completely dissatisfied" to "completely satisfied". The items in the SOEP questionnaire are formulated as follows: "How satisfied are you with your life, all things considered?" and "How satisfied are you with your job / personal income?" (see Table 1).<sup>5</sup> Such self-reported satisfaction items are established measures of well-being (e.g., Clark, 1999; Clark and Oswald, 1996; Di Tella et al., 2001; Ferrer-i-Carbonell, 2005; McBride, 2001; Oswald, 1997; Van Praag et al., 2003). Each dependent variable is z-standardized for the analysis (mean = 0 and standard deviation = 1).

The explanatory variable *Hourly wage* captures each respondent's gross hourly wage in € (see Table 1), calculated by dividing the monthly gross earnings by the actual working hours (including overtime) per month.<sup>6</sup> Working hours per month are calculated by multiplying the actual weekly working hours by the constant value of 4.3 (= number of weeks in a month). We hereby follow Brenke and Müller (2013) and Knabe et al. (2014). Another explanatory variable *Group* captures whether the individual belongs to the treatment group (value 1) or the control group (0). The dummy variable *Year* takes on the value 1 in the post-intervention year (2015) and the value 0 in the pre-intervention year (2014). The main explanatory

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<sup>5</sup> In this article, we present the formulations from the English version of SOEP. Both the English and the original German version are accessible at:

[http://www.diw.de/en/diw\\_02.c.222729.en/questionnaires.html](http://www.diw.de/en/diw_02.c.222729.en/questionnaires.html).

<sup>6</sup> Therefore, our measure of hourly wage is based on earnings data. Earnings are assumed to be almost equal to wages, because self-employed workers are excluded from the analysis.

variable *Group x Year* captures the interaction of both variables and is used to estimate the difference-in-difference effect.

The additional variable *East Germany* captures each individual's residential region and takes on the value 1 for East Germany and 0 for West Germany. We further capture the employment status with the variable *Employed*. It takes on the value 1 if an individual is employed at all: full-time, part-time, or marginally/irregularly, as these groups are in general eligible for the minimum wage. It takes on the value 0 if an individual is not employed. We also consider whether an individual is registered unemployed (1=yes, 0=no).

**Table 1: Operationalization of main variables**

Variable	Item	Scale
<b><u>Dependent variables</u></b>		
Life satisfaction	<ul style="list-style-type: none"> <li>How satisfied are you with your life all things considered? (0 = completely dissatisfied – 10 = completely satisfied)</li> </ul>	Ordinal (0–10)
Job satisfaction	<ul style="list-style-type: none"> <li>How satisfied are you with your job? (0 = completely dissatisfied – 10 = completely satisfied)</li> </ul>	Ordinal (0–10)
Pay satisfaction	<ul style="list-style-type: none"> <li>How satisfied are you with your personal income? (0 = completely dissatisfied – 10 = completely satisfied)</li> </ul>	Ordinal (0–10)
<b><u>Explanatory variables</u></b>		
Hourly wage	<ul style="list-style-type: none"> <li>Gross hourly wage including overtime (in €)</li> </ul>	Metric
Group	<ul style="list-style-type: none"> <li>1 = treatment group; 0 = control group</li> </ul>	Dummy
Year	<ul style="list-style-type: none"> <li>1 = 2015; 0 = 2014</li> </ul>	Dummy
Group x Year	<ul style="list-style-type: none"> <li>Interaction of Group and Year</li> </ul>	Dummy
<b><u>Additional variables</u></b>		
East Germany	<ul style="list-style-type: none"> <li>1 = East Germany; 0 = West Germany</li> </ul>	Dummy
Employed	<ul style="list-style-type: none"> <li>Are you currently employed? Which one of the following applies best to your status? 1 = employed full-time, part-time, or marginally/irregularly; 0 = not employed</li> </ul>	Dummy
Registered unemployed	<ul style="list-style-type: none"> <li>Are you officially registered unemployed at the Federal Employment Agency (Agentur für Arbeit)?</li> </ul>	Dummy

We finally include the following control variables: age in years, age<sup>2</sup>, gender (dummy), marital status (dummy), education (six dummies for type of secondary school degree, e.g., lower secondary school, upper secondary school), vocational training degree (dummy), college degree (dummy), part-time employment (dummy), and branch dummies (six groups based on the NACE branch codes and classified according to the Federal Statistical Office of Germany). Our choice of the control variables largely follows the existing literature (see, e.g., Bossler and Broszeit, 2017; Reeves et al., 2017). More information on the control variables is given in Table A1 in the Appendix.

### **3.3. Treatment and control group**

*Main groups:* The treatment group consists of the employees who receive hourly wages below €8.50 prior to the intervention (2014), so that they are in principle affected by the minimum wage reform that is introduced in 2015 (see also Pusch and Rehm, 2017). In our baseline model we do not make any restriction with regard to the actual post-intervention wages, because this might lead to a biased sample (e.g., ‘weaker’ individuals might tend to receive lower wages and might be more probable not even to receive the minimum wage in 2015; see also Reeves et al., 2017, p. 642). As the descriptive statistics indicate (Figure 1), wages of employees overall come close to the minimum wage in 2015. The control group consists of individuals who receive wages just above the threshold in 2014: between the minimum wage and 50% more, that is, between €8.50 and €12.75. Hereby we largely follow the study by Pusch and Rehm (2017), which even uses a control group with wages up to €13.00 when studying well-being effects of the German minimum wage. In our final sample, the treatment group consists of 1,057 individuals and the control group consists of 1,887 individuals.

*Robustness check:* Large wage increases in the treatment group, which go far beyond €8.50, are likely not due to the minimum wage reform (compare Reeves et al., 2017, p. 642).

Indeed, we find that wages within the treatment group are relatively heterogeneous in 2015 compared to 2014 (see Table A2), which is surprising after a reform that introduces a fixed minimum wage. We therefore perform a robustness check where we exclude all individuals from the treatment group whose wages are more than 50% higher than the minimum wage in 2015 (that is, above €12.75). In all other respects, the groups are identical to the main groups. The resulting treatment group comprises 974 individuals, while the control group still includes 1,887 individuals.

*East and West Germany:* For analyzing potential differences between East and West Germany, we split the sample into East German workers and West German workers and conduct the difference-in-differences analysis separately, to account for the possibility that various coefficients differ between the two regions. To facilitate the interpretation of the results, in this analysis we only consider individuals who remain in East Germany or in West Germany over the timespan 2014–2015, which reduces the sample slightly. The resulting groups have the following sizes. In East Germany, the treatment group consists of 390 individuals and the control group of 568 individuals. In West Germany, the treatment group comprises 666 individuals and the control group 1,317 individuals.

*Inclusion of those who do not remain employed:* We build groups where we additionally consider those individuals who are not employed anymore following the minimum wage reform. Treatment and control group are first generated in the same way as the main groups (see above). In addition, those individuals are considered who do not report to be employed in 2015. That is, while we only consider individuals who are employed in 2014 (as above), we make no restriction anymore with respect to the employment status in 2015. In a first step, these groups are built for whole Germany. The treatment group comprises 1,236 individuals and the control group 2,031 individuals. Of all individuals in the treatment group, 14.3% are not employed in 2015 (0.2% have missing employment status). A share of 8.2% of the

treatment group is not employed and additionally registered unemployed in 2015. In the control group, 7.1% are not employed in 2015, and 3.0% are not employed and additionally registered unemployed.

In a last step, we split these two groups (treatment and control group including those who do not work in 2015) into East and West German workers, only including those who remain in East or West Germany in the time span 2014–2015. For East Germany, this leads to a sample of 450 individuals in the treatment group and 609 individuals in the control group. For West Germany, the final sample includes 785 individuals in the treatment group and 1418 individuals in the control group.

### 3.4. Econometric model

To approximate the causal effect of the reform on well-being, we estimate how the satisfaction measures of the treatment group change in comparison to the control group. The result is a difference-in-differences estimate (Angrist and Pischke, 2009; Lechner, 2011) and captures the difference between the satisfaction development of the treatment group and the satisfaction development of the control group between 2014 and 2015. The model includes:

- A z-standardized satisfaction measure as the dependent variable,  $y_{it}$ , where  $i$  denotes the individual and  $t$  denotes the time (year 2014 or 2015).
- A dummy for the group,  $d(group)_i$  (1 = treatment group, 0 = control group), and the effect of this dummy captured by the coefficient  $\beta_1$ . In this way, time-independent differences between the groups are captured.
- A dummy for the year,  $d(year)_t$  (1 = 2015, 0 = 2014), and the effect of this dummy captured by the coefficient  $\beta_2$ . In this way, general time trends that are independent of the group are captured.



- The interaction of group and year,  $d(\text{group})_i * d(\text{year})_t$ , with the main coefficient of interest  $\beta_3$ . This coefficient indicates how the treatment group changes in comparison to the control group over time. If the common trend assumption holds, then  $\beta_3$  identifies the average treatment effect on the treated (ATT) (Abadie, 2005).

To increase the precision of the estimates, we additionally include personal controls. We only use control variables that are plausibly not affected by the reform, so that they do not belong to the effect that we want to estimate (see section 3.2). The effects of the control variables are captured by the vector of coefficients  $B$ . In addition, the model includes a constant  $\beta_0$  and an error term  $\varepsilon_{it}$ .

$$y_{it} = \beta_0 + \beta_1 * d(\text{group})_i + \beta_2 * d(\text{year})_t + \beta_3 * d(\text{group})_i * d(\text{year})_t \\ + B * \text{controls}_{it} + \varepsilon_{it}$$

We use heteroscedasticity-robust standard errors, as the assumption of homoscedasticity is rejected with a Breusch-Pagan/Cook-Weisberg test for heteroscedasticity ( $p < .01$ ). The standard errors are clustered at the individual level to account for the fact that the same individual is observed over several years.

To draw convincing conclusions about the causality of the observed associations, the difference-in-differences method depends on the assumption that the difference between the development of the treatment group and the development of the control group is only due to the intervention (reform). This assumption means that the development of the two groups is similar in the absence of the reform (common trend assumption) (see Angrist and Pischke, 2009; Lechner, 2011). To test whether this assumption can be sustained, we observe the development of the treatment versus control group in the years before the reform. First, we apply the difference-in-differences method to the years 2013–2014 (first placebo test) among the main groups, as presented above. Because the determination and announcement of the

minimum wage might have influenced the survey responses already in 2014, we additionally examine the common trend assumption in the years before, 2012–2013 (second placebo test) among these individuals.

Anticipation effects are also a possible threat to our main results. Anticipation of the minimum wage might affect well-being already in the pre-intervention year 2014, in which the reform was announced (Diriwaechter and Shvartsman, 2018). To exclude such effects and to arrive at a cleaner measure of minimum wage effects, we perform a robustness check where 2013 is used as the pre-intervention year, while 2014 is not considered.

Another question is whether well-being effects last or are rather a spontaneous reaction. To find evidence on well-being effects of minimum wages beyond one year, we perform a robustness check where 2016 is used as the post-intervention year, while 2015 is not considered. We also analyze the development from 2013 to 2016 (without 2014 and 2015) to exclude anticipation effects and to consider a slightly longer time span at the same time.

## **4. Results**

### **4.1. Descriptive statistics**

We now demonstrate the development of the wages and our dependent variables from the pre-intervention year (2014) to the post-intervention year (2015). Figure 1 depicts the mean hourly wage in the treatment and in the control group in 2014 and 2015. Following the minimum wage reform, the average wage of the treatment group increases considerably from €6.46 per hour to €8.44 per hour. In the control group, the average wage increases from €10.65 per hour to €11.53 per hour. Thus, the increase in gross wages amounts to approximately two euros per hour in the treatment group and to less than one euro per hour in the control group, on average.

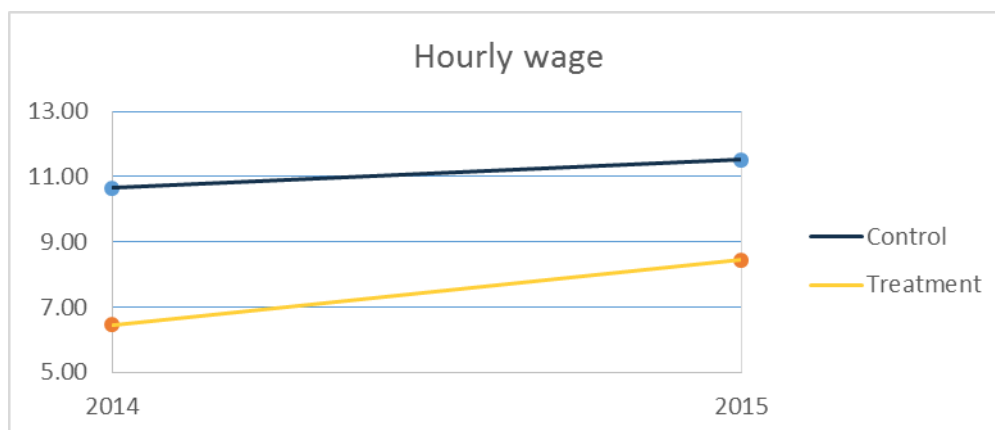
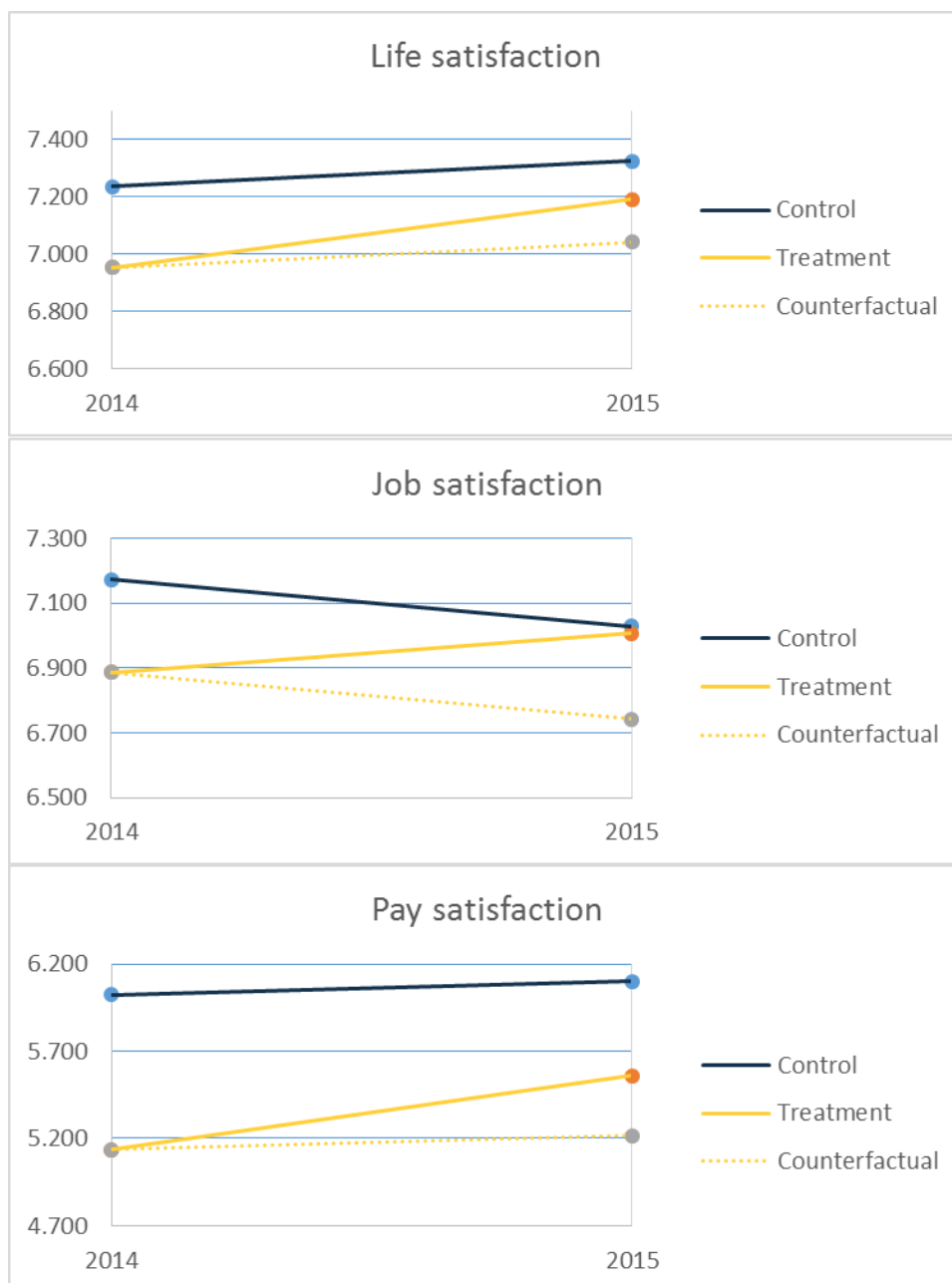


Figure 1: Mean gross hourly wages of treatment and control group before and after the reform (in €).

Figures 2–4 depict the means of the dependent variables (well-being measures) in the treatment group and the control group before and after the intervention. In addition, we display how the treatment group would have developed if the trend was equal to the trend of the control group (“Counterfactual”).

In 2014, the control group has higher average scores in life, job, and pay satisfaction than the treatment group. For life and pay satisfaction, the control group shows a slight increase from 2014 to 2015, while the treatment group improves much more strongly, on average. For job satisfaction, the control group shows a decrease and the treatment group an increase, so that the treatment group catches up with the control group in 2015.

The means and standard deviations of all variables for the treatment and control group in 2014 and 2015 are provided in Table A2 in the Appendix.



Figures 2–4: Average well-being measures of treatment and control group before and after the reform (Likert scales from 0 to 10).

When the descriptive changes displayed in Figures 1–4 are considered separately for East and West Germany, it turns out, first, that the increase in the average wage in East Germany is not larger than in West Germany (from €6.49 to €8.17 in East Germany, from €6.43 to €8.59 in West Germany; see Figures A1–A2 in the Appendix). This may be surprising because the economic situation in large parts of East Germany is less developed, which may have led to considerably lower wages before the reform and hence to a stronger reform effect

on wages.<sup>7</sup> Second, although wages do not increase more in East Germany than in West Germany, average well-being of the treatment group increases more in East Germany compared to West Germany – in particular with respect to life satisfaction and pay satisfaction (see Figures A3–A8). We come back to this topic in the statistical test results (section 4.5) and the conclusion (section 5).

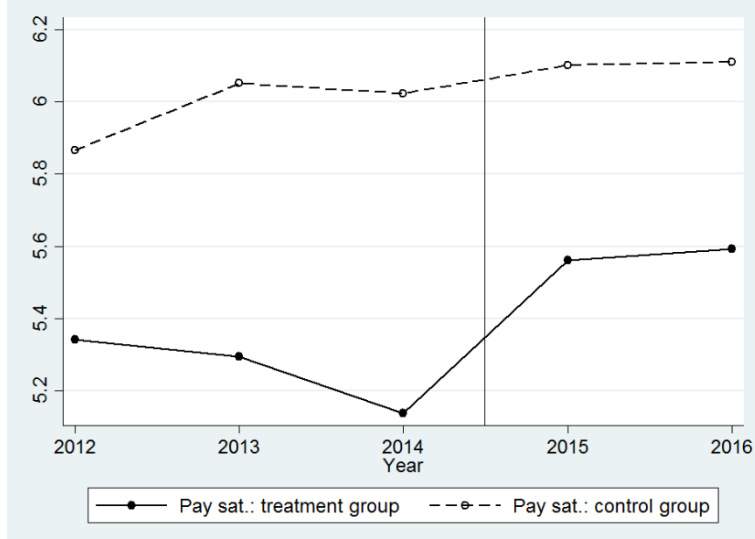
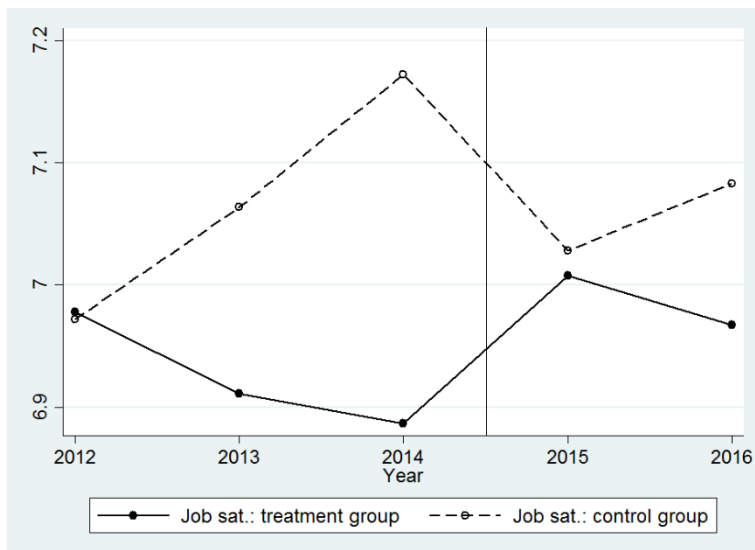
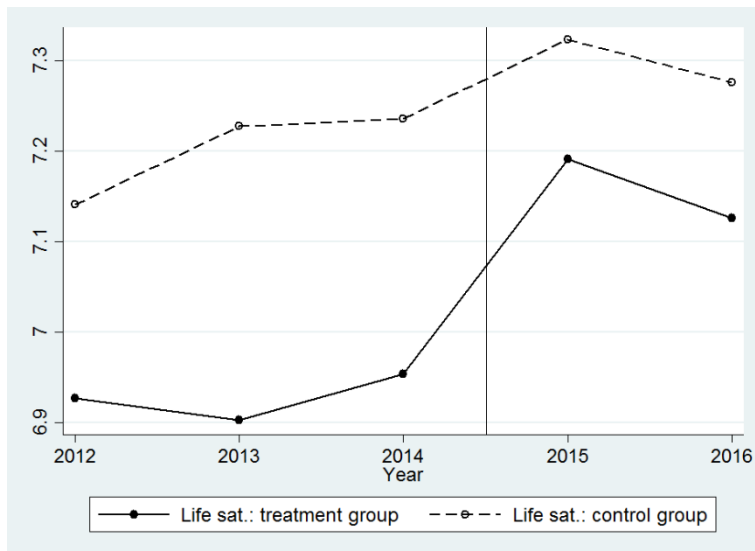
In Figures 5–7, we present the well-being development in a longer time span, from 2013 to 2016 (for the whole country). These descriptive results indicate that the treatment and control group mostly develop similarly before the reform. Job satisfaction apparently tends to increase in the control group and to decrease in the treatment group prior intervention.

As already seen in the previous figures (2–4), the treatment group shows remarkable increases in average well-being with the minimum wage reform. The control group mostly remains stable; an exception is job satisfaction, where the control group shows a clear decrease from 2014 and 2015. This suggests that the control group may have been (negatively) affected by the reform, which would be a violation of the Stable Unit Treatment Value Assumption (SUTVA) and lead to an overestimation of the reform effect, as further discussed in section 5.

The higher well-being measures in the treatment group are mostly sustained until 2016. With respect to job satisfaction, the gap between control and treatment group becomes slightly larger again in 2016, but clearly not as large as before the reform.

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<sup>7</sup> In addition to observing average wages, we also check the distribution of wages in the treatment group prior to the reform. We find that the distribution is remarkably similar between East and West Germany (see Figure A9 in the Appendix).



Figures 5–7: Well-being development (life, job, and pay satisfaction) from 2012 to 2016 (Likert scales from 0 to 10). The minimum wage reform is from 2014 to 2015.

## 4.2. Well-being effects of the minimum wage

Table 2 presents the main results with the difference-in-differences estimation of minimum wage effects on well-being measures. These effects are identified by the coefficient for the interaction *Group x Year*, which captures the difference between the satisfaction development of the treatment group and the satisfaction development of the control group from the pre-intervention year (2014) to the post-intervention year (2015). Assuming that the development of the treatment group would have been parallel to the development of the control group in the absence of the reform, this coefficient estimates the effect that is created by the minimum wage. To increase the precision of the estimates, all control variables are additionally included.

The results indicate that the treatment effects on life, job, and pay satisfaction are all significantly positive, meaning that, on average, well-being of the affected individuals (individuals with wages below the minimum wage in 2014) increases significantly more than well-being of the non-affected individuals (individuals with slightly higher wages in 2014). The minimum wage increases life satisfaction by approximately 0.10 standard deviations, on average, which are about 0.15 points on the original ten-point Likert scale. (The standard deviations are shown in Table A2 in the Appendix.) For job satisfaction we estimate a positive effect of 0.14 standard deviations (0.27 points on the ten-point Likert scale). Pay satisfaction increases by 0.16 standard deviations, on average (0.35 points on the ten-point Likert scale).

The results on job and pay satisfaction are largely in line with the studies by Bossler and Broszeit (2017) as well as Pusch and Rehm (2017), although the effect sizes are somewhat larger in these studies. Our results contribute to this research by finding additional positive effects on life satisfaction.

**Table 2: Difference-in-differences estimation of minimum wage effects on well-being**

	(1) Life satisfaction	(2) Job satisfaction	(3) Pay satisfaction
<b>Group x Year</b>	<b>0.098**</b> (0.039)	<b>0.138***</b> (0.042)	<b>0.162***</b> (0.039)
Group	-0.214*** (0.042)	-0.165*** (0.043)	-0.416*** (0.041)
Year	0.072*** (0.022)	-0.066*** (0.024)	0.045** (0.021)
Observations	5,888	5,888	5,888
R-squared	0.042	0.023	0.043

Dependent variables: z-standardized satisfaction measures.

Explanatory variables: group (1 = treatment group, 0 = control group), year (1 = 2015, 0 = 2014), and interaction of group and year.

All control variables included: age, age<sup>2</sup>, gender, marital status, secondary school degree, vocational training degree, college degree, part-time employment, branch.

Clustered robust standard errors in parentheses. \*\*\* $p < .01$ . \*\* $p < .05$ . \* $p < .10$ .

### 4.3. Tests of common trend assumption

To find out whether changes between the development of the treatment group and the development of the control group can actually be attributed to the minimum wage reform, we test whether the groups develop similarly in the absence of the reform (tests of common trend assumption). To this aim, we apply the difference-in-differences design to the years prior to the reform (placebo tests). The results of these tests are shown in Tables A3–A4 in the Appendix.

The first test uses the years 2013 and 2014. No significant differences are found between the development of the treatment group and the control group (Table A3).

The second placebo test uses the years 2012 and 2013. The results show that in these previous years, life and pay satisfaction of the treatment group develop significantly



negatively in comparison to the control group ( $-0.10$  respectively  $-0.12$  standard deviations), while no significant difference is found with respect to job satisfaction (see Table A4).

Overall, we find no indication that the treatment group has a positive well-being trend compared to the control group in the absence of the reform. Therefore, the positive difference-in-differences estimations found in the main results (section 4.2) can likely be attributed to the minimum wage. Significant differences before the reform only hold in the direction of a relatively negative trend in the treatment group. Therefore, the treatment group would presumably have developed negatively in comparison to the control group in the absence of the reform, and the minimum wage reverses this trend. Making the common trend assumption rather leads to an underestimation of the true minimum wage effects.

#### **4.4. Robustness checks**

We perform four tests to check the robustness of our main results. The detailed results of these robustness checks are shown in Tables A5–A8 in the Appendix.

First, because large wage increases, which go far beyond the introduced minimum wage, are likely not due to the reform (compare Reeves et al., 2017, p. 642), we use an alternative specification of the treatment group, where individuals are not considered if they earn much more than the minimum wage in 2015. In this definition of the treatment group, it includes only those individuals who earn less than €8.50 in 2014 and up to €12.75 in 2015, while the control group still includes those who earn between €8.50 and €12.75 prior to the reform in 2014. Using this newly defined treatment group, the results are qualitatively equal and very similar to our main results (see Table A5).

Second, to exclude anticipation effects that may arise from the fact that the minimum wage reform was announced in 2014, we use data from 2013 instead of 2014 for the pre-intervention period. Now the relative development of the treatment group in comparison to

the control group from 2013 to 2015 is analyzed. The results are equivalent to our main results, except that the effect on job satisfaction is not significant anymore (Table A6).

Third, we check whether the minimum wage affects well-being in a (slightly) longer time span beyond immediate effects. For this reason, we use data from 2016 instead of 2015 for the post-intervention period and analyze the development from 2014 to 2016. The results are equivalent to our main results (see Table A7), which indicates that the effects of the minimum wage last for at least one year after the reform.

Fourth, we aim at excluding anticipation effects and using a longer time frame together, by using data from 2013 (instead of 2014) as the pre-intervention time point and 2016 (instead of 2015) as the post-intervention time point. Except for job satisfaction, which shows no significant effect anymore, the results are equivalent to our main results (see Table A8).

#### **4.5. Well-being effects in East and West Germany**

To explore whether the minimum wage has differential effects on well-being dependent on the development of a region, we perform the difference-in-differences estimation for the pre-intervention and post-intervention year (2014 and 2015) separately for East and West Germany. The results are shown in Table 3 (East Germany) and Table 4 (West Germany). Again our main focus is on the coefficient for the interaction *Group x Year*, which estimates how the satisfaction measures develop in the treatment group in comparison to the control group following the reform.

While the treatment effect on life satisfaction is not significant in West Germany, in East Germany the effect is considerably larger than in the whole group (Table 2). Life satisfaction of affected low earners in East Germany increases by approximately 0.23 standard deviations, on average, compared to those who are not affected. We find significantly positive effects on job satisfaction in East and West Germany, and here the effect sizes are rather comparable

across the two regions. Pay satisfaction apparently increases more strongly in East Germany than in West Germany (0.27 standard deviations versus 0.10 standard deviations).<sup>8</sup>

Overall, we find evidence that well-being – especially life satisfaction – is positively affected by the minimum wage particularly in the region that tends to be economically less developed. We discuss potential reasons for this result in section 5.

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<sup>8</sup> A comparison of the 90% confidence intervals of the effects in East and West Germany indicates that the effect on life satisfaction is actually larger in East than in West Germany, while the confidence intervals of the effects on job and pay satisfaction overlap between East and West Germany.

**Table 3: Difference-in-differences estimation for East Germany**

	(1) Life satisfaction	(2) Job satisfaction	(3) Pay satisfaction
<b>Group x Year</b>	<b>0.233***</b> (0.060)	<b>0.176**</b> (0.072)	<b>0.268***</b> (0.065)
Group	-0.331*** (0.070)	-0.252*** (0.073)	-0.604*** (0.067)
Year	0.018 (0.035)	-0.045 (0.040)	0.032 (0.036)
Observations	1,916	1,916	1,916
R-squared	0.065	0.038	0.090

All control variables included. See description of Table 2.

Clustered robust standard errors in parentheses. \*\*\* $p < .01$ . \*\* $p < .05$ . \* $p < .10$ .

**Table 4: Difference-in-differences estimation for West Germany**

	(1) Life satisfaction	(2) Job satisfaction	(3) Pay satisfaction
<b>Group x Year</b>	<b>0.023</b> (0.051)	<b>0.115**</b> (0.052)	<b>0.103**</b> (0.048)
Group	-0.141*** (0.054)	-0.131** (0.054)	-0.313*** (0.053)
Year	0.097*** (0.027)	-0.078*** (0.030)	0.048* (0.025)
Observations	3,966	3,966	3,966
R-squared	0.035	0.022	0.037

All control variables included. See description of Table 2.

Clustered robust standard errors in parentheses. \*\*\* $p < .01$ . \*\* $p < .05$ . \* $p < .10$ .

#### 4.6. Inclusion of those who do not remain employed

To explore more comprehensive well-being effects of the minimum wage, we now include all individuals irrespective of their employment status in 2015, therefore we include those who remain employed and those who do not work anymore in 2015. As described in section 3.3, about 14.3% of the treatment group and 7.1% of the control group are not employed in 2015. The results using these larger groups are shown in Table 5.

The main results do not change (see the first model of Table 5). There is a significantly positive effect of the minimum wage on life satisfaction, and the estimated effect size (0.08 standard deviations) is almost as large as in the main results with the original groups (Table 2). (Job and pay satisfaction are not considered anymore because these measures do not apply to those who are not employed.) Therefore, we find support that the minimum wage has positive effects on well-being even when those who are rather negatively affected are included.

**Table 5: Difference-in-differences including those who are not employed anymore in 2015**

	(1) Life satisfaction Whole country	(2) Life satisfaction East Germany	(3) Life satisfaction West Germany
<b>Group x Year</b>	<b>0.080**</b> <b>(0.038)</b>	<b>0.235***</b> <b>(0.059)</b>	<b>-0.002</b> <b>(0.049)</b>
Group	-0.217*** (0.040)	-0.351*** (0.065)	-0.144*** (0.050)
Year	0.058*** (0.021)	-0.004 (0.034)	0.085*** (0.027)
Observations	6,534	2,118	4,406
R-squared	0.042	0.051	0.037

All control variables included. See description of Table 2.

Clustered robust standard errors in parentheses. \*\*\* $p < .01$ . \*\* $p < .05$ . \* $p < .10$ .

We additionally include those who are not employed anymore in 2015 separately for East and West Germany (second respectively third model of Table 5). In East Germany, the result does essentially not change compared to the original specification, which only included employed individuals: Life satisfaction of the treatment group tends to increase significantly in comparison to the control group by 0.24 standard deviations. In West Germany, the original result does not change either, as life satisfaction of the treatment group does again not significantly increase in comparison to the control group.

## 5. Conclusion

The present study investigates the effects of minimum wages on different dimensions of well-being (satisfaction with life, job, and pay), using the introduction of the minimum wage in Germany in January 2015 as a quasi-experiment and employing a difference-in-differences design. We find evidence that the minimum wage has positive effects on all three considered dimensions of well-being. These results last at least until 2016. Although East German low earners do not profit more from the minimum wage than West German low earners, on average (the mean wages and distribution of wages in the treatment group are almost equal in the two regions before the reform), the positive effect on well-being, in particular on life satisfaction, is more pronounced in East Germany. When those who do not remain employed following the minimum wage reform are included in the analysis, then the main results do not change, which indicates that the minimum wage tends to have positive well-being effects for low earners in a more comprehensive manner.

Why are the well-being effects of the minimum wage overall stronger in the economically less developed region (East Germany)? Former studies have estimated that the wage increase due to the minimum wage would be larger in East Germany than in West Germany due to lower average wages before the reform (Brenke and Müller, 2013; Falck et al., 2013; Kalina and Weinkopf, 2015). However, we do not find that wages increase more in East than in West Germany, as the wages of the treatment group before the reform are almost equal in both regions (in fact, they are slightly lower in West Germany, on average, with very similar distributions; see Figures A1–A2 and A9 in the Appendix). For this reason, the question remains how the larger well-being gains in East Germany can be explained.

There are different plausible reasons for this phenomenon. First, while the earnings level introduced by the minimum wage might be sufficient for a relatively acceptable living standard in most of East Germany, West German low earners might still experience

considerable relative deprivation due to higher regional income levels (see also Corazzini et al., 2012 for the positive relationship between economic development and social comparison effects). Second, aspiration levels might tend to be lower in East Germany due to lower own income in more distant previous years and due to lower average income in the region (Stutzer, 2004), which would increase the well-being effect of the same minimum wage in East Germany compared to West Germany. Third, before the reform many East German low earners might have perceived relative deprivation in comparison to West German workers, which restricted their well-being, and the nation-wide fixed minimum wage might have reduced this detrimental social comparison effect across regions. Just as the earnings of neighbors can enter the utility function negatively (Luttmer, 2005), satisfaction might be reduced if one region feels relatively deprived within the same country – even if actual wages of low earners are similar across regions. A fourth possible explanation is that income inequality is perceived differently in East and West Germany. If unequal income is regarded as unfair, then it tends to reduce well-being (Bjørnskov et al., 2013). It is reasonable that East Germans accept inequality less than West Germans, on average, considering that parts of the East German culture may still be influenced by experiences in socialism.

As the well-being effects of the minimum wage are positive and considerable, even if the employment effects are taken into account, our study provides arguments in favor of minimum wages. In addition, organizations might profit from more satisfied employees due to the positive relationship between job satisfaction and productivity (e.g., Böckerman and Ilmakunnas, 2012; Judge et al., 2001). Nevertheless, these policy implications should be treated with much caution. While we show that lost job positions do not reverse the positive minimum wage effects, one might argue that the minimum wage decreases new job offers and therefore hinders unemployed individuals from finding a position. This potential effect is

not captured in our study and is beyond its scope (see Bossler and Gerner, 2016 for evidence on this topic).

Another limitation of our study might be seen in the definition of the groups: The treatment group includes all individuals who should be affected by the minimum wage (wages below €8.50 in 2014), but we know that many individuals do actually not receive the minimum wage in 2015, as indicated by Figure 1 (see also Burauel et al., 2017). This can be due to exceptional regulations or due to non-compliance (Reeves et al., 2017). By including all individuals in the treatment group that should be affected, we estimate the intention-to-treat effect and avoid a potential bias from self-selection, because individuals in firms who pay the minimum wage might tend to differ from those who work in less compliant firms or who accept lower wages (Reeves et al., 2017, p. 642). A disadvantage of our design is that the effect of the minimum wage is not precisely estimated. However, because our treatment group includes individuals who do not actually receive the minimum wage, the design can only underestimate – and not overestimate – the true effect of the minimum wage.

A further limitation concerns the precise estimation of the treatment effects. The difference-in-differences model can measure the causal effect of the minimum wage only if the two groups (treatment and control group) would develop equally in the absence of the reform. This is not consistently the case, as there are some differences in the trends already before the reform (see section 4.3 and Figures 5–7). However, the treatment group overall develops negatively in comparison to the control group in these cases, so that the actual effect of the minimum wage – reversing the negative trend and creating a positive trend – may in fact even be larger than estimated by our design. A more serious concern is the sudden negative trend of the control group in job satisfaction from 2014 to 2015 (see Figures 5–7). This trend change in job satisfaction following the minimum wage reform suggests that the control group might be affected by the reform as well. This would be a spill-over effect,



violating the Stable Unit Treatment Value Assumption (SUTVA) (Cox, 1958), and likely lead to an overestimation of the difference-in-differences estimate for job satisfaction in our case. One reason why the control group could be negatively affected by the minimum wage might be that better working conditions of those receiving the minimum wage are compensated by worse working conditions for other employees (Pusch and Rehm, 2017). Judging from the descriptive figures, we argue that the true effect of the reform on job satisfaction may be only half as large as indicated by our main results in Table 2. The possible negative effects on employees with wages slightly above the minimum wage might be a practical concern for employers and policy makers.

Future research might investigate the mechanisms that lead to positive well-being effects of the minimum wage. Concerning job satisfaction, there is evidence that the working conditions of the affected employees have improved in 2015, for example with respect to less working hours, higher job complexity, and more appreciation from superiors and colleagues (Pusch and Rehm, 2017).

### **Acknowledgements**

For valuable ideas, comments, hints, and discussions we thank Liana Bomm, Alina Elrich, René Fahr, Urs Fischbacher, Bernd Frick, Gamze Görel, Daniel Kamhöfer, Martin Kocher, Holger Meyer, Irene Palnau, Christian Pfeifer, Kerstin Pull, Valentin Schiele, Hendrik Schmitz, Martin Schneider, Caren Sureth-Sloane, Dirk van Straaten, Matthias Westphal, Svenja Winkler, Philip Yang, and participants of the Colloquium on Personnel Economics (COPE), Munich 2018.

## Appendix

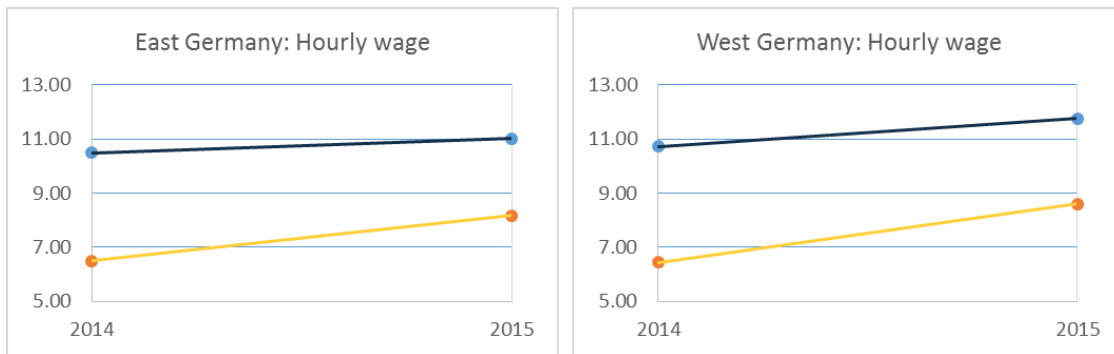
**Table A1: Operationalization of control variables**

Variable	Item	Scale
<b><u>Control variables</u></b>		
Female	<ul style="list-style-type: none"> <li>• Gender of participant (1= female; 0= male)</li> </ul>	Dummy
Age	<ul style="list-style-type: none"> <li>• Age in years (18–65)</li> </ul>	Metric
Age <sup>2</sup>	<ul style="list-style-type: none"> <li>• Age squared</li> </ul>	Metric
Married	<ul style="list-style-type: none"> <li>• Married (1= yes; 0= no)</li> </ul>	Dummy
Secondary school degree	<ul style="list-style-type: none"> <li>• Six dummies for type of secondary school degree, e.g. lower secondary school, upper secondary school</li> </ul>	Dummies
Vocational training	<ul style="list-style-type: none"> <li>• Vocational training degree (1= yes; 0= no)</li> </ul>	Dummy
College degree	<ul style="list-style-type: none"> <li>• College degree (1= yes; 0= no)</li> </ul>	Dummy
Part-time employment	<ul style="list-style-type: none"> <li>• Part-time employment (1= yes; 0= no)</li> </ul>	Dummy
Branches	<ul style="list-style-type: none"> <li>• 6 branch dummies (e.g. agriculture, fabrication, technical professions, service) according to the NACE branch codes, grouped according to the Federal Statistical Office of Germany, the KldB 92 (“Klassifikation der Berufe”)</li> </ul>	Dummies

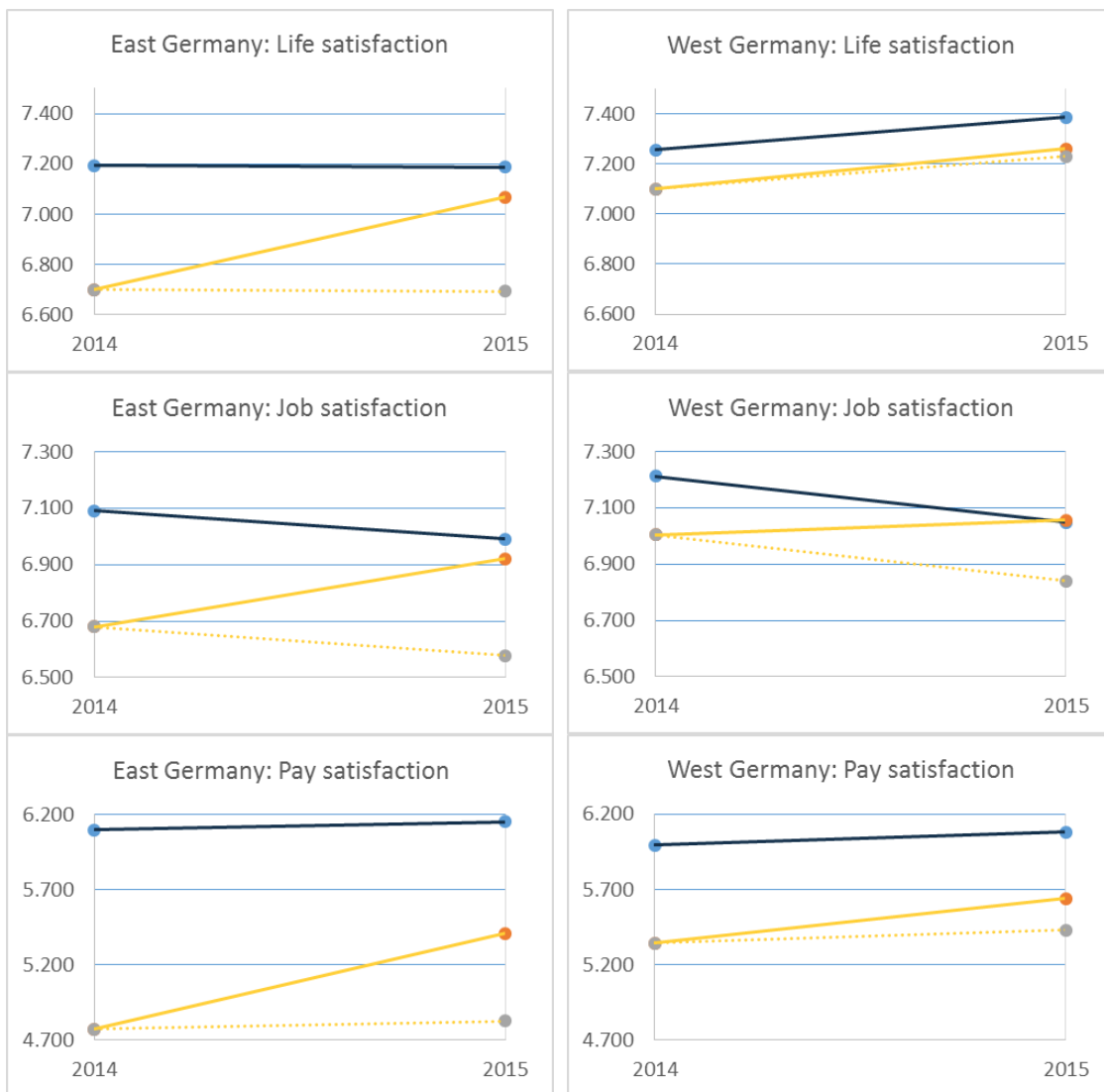
**Table A2: Descriptive statistics of treatment and control group in 2014 and 2015**

	2014				2015			
	Treatment group ( $n_T = 1,057$ )		Control group ( $n_C = 1,887$ )		Treatment group ( $n_T = 1,057$ )		Control group ( $n_C = 1,887$ )	
	mean	sd	mean	sd	mean	sd	mean	sd
Hourly wage	<b>6.457</b>	1.708	<b>10.651</b>	1.233	<b>8.436</b>	4.037	<b>11.525</b>	3.779
Life satisfaction	<b>6.954</b>	1.719	<b>7.236</b>	1.618	<b>7.191</b>	1.637	<b>7.323</b>	1.589
Job satisfaction	<b>6.886</b>	2.169	<b>7.172</b>	1.988	<b>7.008</b>	1.999	<b>7.028</b>	2.066
Pay satisfaction	<b>5.137</b>	2.314	<b>6.023</b>	2.085	<b>5.560</b>	2.245	<b>6.101</b>	2.059
East Germany	<b>0.369</b>	0.483	<b>0.301</b>	0.459	<b>0.369</b>	0.483	<b>0.301</b>	0.459
Employed	<b>1.000</b>	0.000	<b>1.000</b>	0.000	<b>1.000</b>	0.000	<b>1.000</b>	0.000
Age	<b>42.537</b>	11.031	<b>43.111</b>	10.371	<b>43.537</b>	11.031	<b>44.110</b>	10.371
Female	<b>0.761</b>	0.427	<b>0.609</b>	0.488	<b>0.761</b>	0.427	<b>0.609</b>	0.488
Married	<b>0.593</b>	0.491	<b>0.624</b>	0.485	<b>0.584</b>	0.493	<b>0.615</b>	0.487
Secondary school: lower	<b>0.267</b>	0.442	<b>0.245</b>	0.430	<b>0.267</b>	0.442	<b>0.245</b>	0.430
Sec. school: general	<b>0.442</b>	0.497	<b>0.486</b>	0.500	<b>0.441</b>	0.497	<b>0.486</b>	0.500
Sec. school: field-specific	<b>0.039</b>	0.193	<b>0.050</b>	0.218	<b>0.040</b>	0.195	<b>0.050</b>	0.219
Sec. school: upper	<b>0.136</b>	0.343	<b>0.121</b>	0.327	<b>0.137</b>	0.344	<b>0.121</b>	0.327
Sec. school: other	<b>0.096</b>	0.294	<b>0.085</b>	0.279	<b>0.096</b>	0.294	<b>0.085</b>	0.279
Sec. school: no degree	<b>0.021</b>	0.143	<b>0.012</b>	0.110	<b>0.020</b>	0.140	<b>0.012</b>	0.110
Vocational training	<b>0.746</b>	0.435	<b>0.810</b>	0.392	<b>0.749</b>	0.434	<b>0.811</b>	0.392
College degree	<b>0.082</b>	0.275	<b>0.108</b>	0.311	<b>0.096</b>	0.294	<b>0.110</b>	0.313
Part-time employment	<b>0.646</b>	0.478	<b>0.411</b>	0.492	<b>0.636</b>	0.481	<b>0.414</b>	0.493
Branch: agriculture	<b>0.023</b>	0.149	<b>0.020</b>	0.139	<b>0.024</b>	0.152	<b>0.021</b>	0.142
Branch: fabrication	<b>0.098</b>	0.298	<b>0.146</b>	0.353	<b>0.093</b>	0.290	<b>0.142</b>	0.349
Branch: technical	<b>0.073</b>	0.260	<b>0.150</b>	0.357	<b>0.074</b>	0.262	<b>0.153</b>	0.360
Branch: education	<b>0.045</b>	0.208	<b>0.055</b>	0.227	<b>0.041</b>	0.198	<b>0.053</b>	0.224
Branch: medicine	<b>0.162</b>	0.368	<b>0.187</b>	0.390	<b>0.179</b>	0.383	<b>0.192</b>	0.394
Branch: service	<b>0.599</b>	0.490	<b>0.443</b>	0.497	<b>0.590</b>	0.492	<b>0.439</b>	0.496

sd = standard deviation.



Figures A1–A2: Mean wages separately for East and West Germany. Dark lines: control group. Bright lines: treatment group. See description of Figure 1.



Figures A3–A8: Mean well-being measures separately for East and West Germany. Dark lines: control group. Bright lines: treatment group. See description of Figures 2–4.

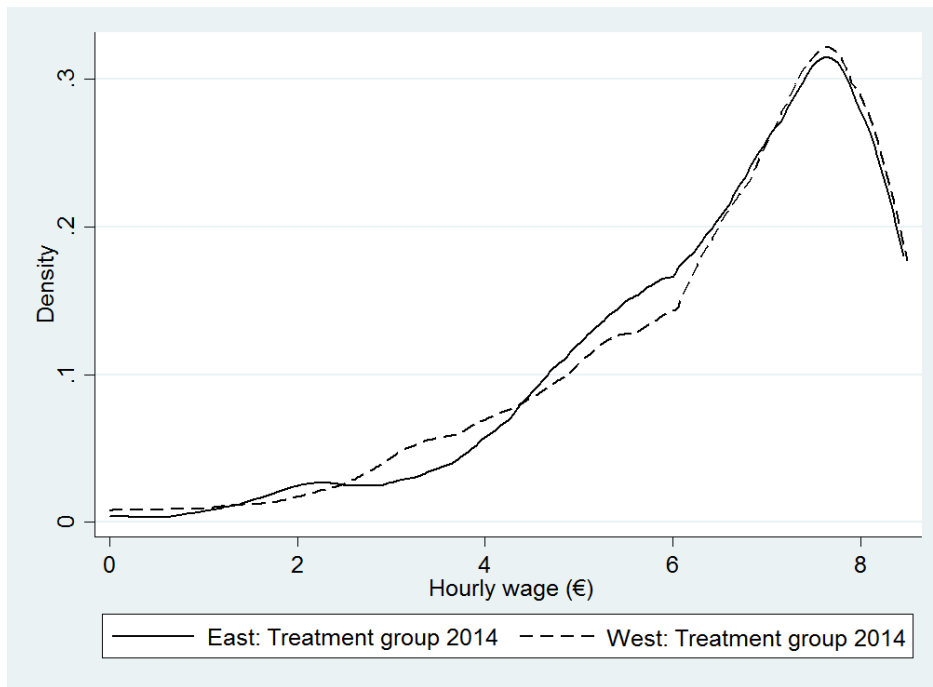


Figure A9: Distribution of wages in the treatment group prior to the minimum wage reform, separately for East and West Germany.

**Table A3: Test 1 of common trend assumption: Well-being development of treatment versus control group prior to the intervention (year 1 = 2014, year 0 = 2013)**

	(1) Life satisfaction	(2) Job satisfaction	(3) Pay satisfaction
<b>Group x Year</b>	<b>0.025</b> <b>(0.053)</b>	<b>-0.069</b> <b>(0.054)</b>	<b>-0.054</b> <b>(0.050)</b>
Group	-0.245*** (0.056)	-0.097* (0.054)	-0.368*** (0.052)
Year	-0.016 (0.028)	0.043 (0.029)	-0.017 (0.027)
Observations	4,671	4,671	4,671
R-squared	0.046	0.020	0.049

All control variables included. See description of Table 2.

Clustered robust standard errors in parentheses. \*\*\* $p < .01$ . \*\* $p < .05$ . \* $p < .10$ .

**Table A4: Test 2 of common trend assumption: Well-being development of treatment versus control group prior to the intervention (year 1 = 2013, year 0 = 2012)**

	(1) Life satisfaction	(2) Job satisfaction	(3) Pay satisfaction
<b>Group x Year</b>	<b>-0.098*</b> <b>(0.058)</b>	<b>-0.084</b> <b>(0.059)</b>	<b>-0.124**</b> <b>(0.057)</b>
Group	-0.145** (0.059)	-0.013 (0.060)	-0.243*** (0.063)
Year	0.060* (0.032)	0.045 (0.033)	0.072** (0.031)
Observations	3,171	3,171	3,171
R-squared	0.042	0.021	0.035

All control variables included. See description of Table 2.

Clustered robust standard errors in parentheses. \*\*\* $p < .01$ . \*\* $p < .05$ . \* $p < .10$ .

**Table A5: Robustness check 1: more restrictive treatment group (hourly wage in 2015 up to €12.75)**

	(1) Life satisfaction	(2) Job satisfaction	(3) Pay satisfaction
<b>Group x Year</b>	<b>0.078**</b> <b>(0.040)</b>	<b>0.114***</b> <b>(0.042)</b>	<b>0.139***</b> <b>(0.039)</b>
Group	-0.204*** (0.043)	-0.143*** (0.044)	-0.430*** (0.042)
Year	0.072*** (0.022)	-0.066*** (0.024)	0.044** (0.021)
Observations	5,722	5,722	5,722
R-squared	0.044	0.024	0.044

All control variables included. See description of Table 2.

Clustered robust standard errors in parentheses. \*\*\* $p < .01$ . \*\* $p < .05$ . \* $p < .10$ .

**Table A6: Robustness check 2: without anticipation effects (year 1 = 2015, year 0 = 2013)**

	(1) Life satisfaction	(2) Job satisfaction	(3) Pay satisfaction
<b>Group x Year</b>	<b>0.119**</b> <b>(0.053)</b>	<b>0.062</b> <b>(0.055)</b>	<b>0.093*</b> <b>(0.051)</b>
Group	-0.234*** (0.055)	-0.086 (0.054)	-0.353*** (0.052)
Year	0.057** (0.029)	-0.024 (0.031)	0.028 (0.028)
Observations	4,703	4,681	4,694
R-squared	0.041	0.022	0.036

All control variables included. See description of Table 2.

Clustered robust standard errors in parentheses. \*\*\* $p < .01$ . \*\* $p < .05$ . \* $p < .10$ .



**Table A7: Robustness check 3: longer time span (year 1 = 2016, year 0 = 2014)**

	(1) Life satisfaction	(2) Job satisfaction	(3) Pay satisfaction
<b>Group x Year</b>	<b>0.119***</b> <b>(0.045)</b>	<b>0.094*</b> <b>(0.050)</b>	<b>0.195***</b> <b>(0.044)</b>
Group	-0.208*** (0.042)	-0.161*** (0.042)	-0.408*** (0.041)
Year	0.063** (0.026)	-0.020 (0.027)	0.084*** (0.024)
Observations	5,345	5,331	5,349
R-squared	0.044	0.019	0.044

All control variables included. See description of Table 2.

Clustered robust standard errors in parentheses. \*\*\* $p < .01$ . \*\* $p < .05$ . \* $p < .10$ .

**Table A8: Robustness check 4: without anticipation effects and longer time span (year 1 = 2016, year 0 = 2013)**

	(1) Life satisfaction	(2) Job satisfaction	(3) Pay satisfaction
<b>Group x Year</b>	<b>0.136**</b> <b>(0.058)</b>	<b>0.015</b> <b>(0.059)</b>	<b>0.126**</b> <b>(0.053)</b>
Group	-0.223*** (0.055)	-0.079 (0.054)	-0.343*** (0.052)
Year	0.047 (0.031)	0.027 (0.032)	0.069** (0.029)
Observations	4,160	4,124	4,155
R-squared	0.043	0.019	0.034

All control variables included. See description of Table 2.

Clustered robust standard errors in parentheses. \*\*\* $p < .01$ . \*\* $p < .05$ . \* $p < .10$ .

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