How did labor demand and wages respond to the German minimum wage introduction in 2015?

Jakob Sturn

April 8, 2022

Abstract

This study investigates effects of the minimum wage introduction in Germany in January 2015 on wages and labor demand by conducting a Difference-in-Differences estimation strategy. I use panel data from the German Socio-Economic Panel (SOEP) and Austrian EU-SILC data to exploit the regional differences in validity of the minimum wage law. While the bulk of literature has not addressed spillover effects of minimum wages on individuals with higher earnings, I find robust evidence that the positive wage effects resulting from the minimum wage introduction reach up far along the wage distribution. Second, the study finds no decline in labor demand neither on the extensive margin (terminate staff) nor on the intensive margin (reducing working hours).

JEL Classification: J31, J38

1. Introduction

Income inequality is a rising concern among Western economies. In Germany the Top 10% income share has increased from 28.6 percent in 1981 to 38.1 percent in 2015. Simultaneously, the Bottom 50% share has decreased from 23.4 percent to 18.3 percent (World Inequality Database, 2021). A dominant reason arguing in favor of a minimum wage is the expected decrease in wage inequality and poverty reduction. The main argument is that a minimum wage directly improves the living conditions of poorer people without the necessity to monitor need-based eligibility, such as government transfers do. And, of course, the distributional effect differs substantially whether firms are forced to pay decent wages, or the government has to reduce poverty with transfers. Therefore, in 2022, four out of five European Union member states have minimum wage laws in force, ranging from EUR 332 per month in Bulgaria to EUR 2,202 per month in Luxembourg (Eurofound, 2022). Member states without a minimum wage law typically have collective bargaining agreements on an industry level, by which most employees are covered, yet not the entire labor force.

In January 2015, Germany introduced its first federal minimum wage of EUR 8.50 per hour, which directly affected 10 - 14% of the German workforce (Caliendo et al., 2019). The general purpose of its introduction was a reduction in wage inequality, decreases in poverty and a social aspiration that human labor should not be rewarded by less than 8.50 EUR per hour. While the latter goal is met by definition and not suitable for an economic evaluation, the former two are such important economic key values, that its evaluation is all the more meaningful. While there is no shortage on economic research contributions investigating minimum wages, their results are conflicting. Some are in line with neoclassic economic theory, which predicts increasing unemployment due to an unjustified rise in wages, which could eventually diminish the initial goals of the minimum wage and may even worsen the pre-intervention status. Other research papers find no such effects, or even increasing employment levels.

This study has two goals. First, it evaluates the German minimum wage introduction regarding wages and labor demand for the whole population. Second, it investigates the heterogenous effects among different income classes. In order to meet these goals, this study combines two micro-level panel data sets, namely German data from the Socio-Economic Panel (SOEP) (2021) and Austrian EU-SILC data from Statistik Austria (2021) and exploits the geographic variation of the minimum wage validity by performing a Difference-in-Differences analysis. German individual characteristics are compared to the Austrian control group, where no statutory minimum wage law is in effect. Hence, all German respondents are considered as affected by the new law and heterogenous effects along the income distribution can be detected. This is also the decisive difference to previous studies on the German minimum wage, which used an inner German estimation setup. Such an inner German setup divides the German population into treatment and control group based on their pre-intervention wage and therefore cannot account for spillover effects the minimum wage may has on individuals on the upper end of the wage distribution.

Since economic theory predicts low-income individuals to be stronger – if not exclusively – affected, the investigation of heterogenous effects is all the more important. Furthermore, the study extends its analysis to a subset of people working in the hairdresser and cosmeticians' industry. This low-wage industry is only insufficiently covered by the Austrian collective bargaining agreement, and therefore is only partly subject to an industry-level minimum wage, which is why it may serve as superior control group with regard to certain dependent variables.

The study finds spillover effects for hourly and monthly wages reaching up high in the income distribution and hence shows positive wage effects for almost all income classes. Furthermore, in contradiction to neoclassic theory, the empirical analysis shows no proof of a consistent adverse employment effect, neither by producing layoffs (extensive margin) nor by reducing the demanded working hours (intensive margin).

The further structure of this work is the following: Section 2 reviews the economic literature on minimum wages and their aftermath. Section 3 describes the data and section 4 the method used in this study in greater detail. Section 5 shows the empirical results. Section 6 provides robustness checks for the former presented results and section 7 addresses limitations of this work. Section 8 concludes.

2. Literature Review

Since minimum wages are so common in Western economies, the economic literature on their aftermath is extensive, yet discordant. While in some areas the discussion has focused only on the size of the minimum wage effect, in other areas even the direction of the effect, such as the minimum wage's impact on employment, has been discussed controversially.

For instance, current empirical economic research finds a robust relationship between rising wage inequality and decreasing minimum wages (Autor et al., 2016; Lee, 1999). The magnitude of the relationship, however, varies from study to study. Lee (1999) found very large estimates, which almost suggest a 1:1 relationship between rising wage inequality at the lower end of the income distribution and declining minimum wages. In an empirically convincing study Autor et al. (2016) find considerably smaller but all the more robust elasticities of about 0.3 to 0.55. Both studies find wage inequality on the lower end of the income distribution to be remarkably stronger affected.

While the effect of minimum wages on income inequality is well researched, economic theory suggests ambiguous results regarding the effect on employment. In general, recent neoclassical labor market economics predict adverse employment effects. It assumes perfectly competitive labor markets in which every worker is paid his or her marginal productivity (Wachter, 2012). Following this theory, a minimum wage introduction artificially (and unjustifiably) raises the price of labor of workers which earned less than the introduced minimum wage. Then, the crucial variable in determining sign and size of the employment

effect caused by the minimum wage introduction is by how much employers react to the price increase, i.e. the elasticity of labor demand. If labor is considered a normal good, the elasticity of demand is negative and employers react to this price increase by demanding less labor and hence lay off staff, hire less people and reduce working hours of the existing workforce. Neoclassic theory also predicts workers on the lower end of the income distribution to predominantly lose their jobs since it is their marginal productivity which is below its competitive price after the minimum wage was introduced. In such a case, the alleged positive effects of a minimum wage on poverty and income inequality could rapidly turn negative (Stigler, 1946).

However, empirical economic research provides mixed results on whether the neoclassic theory holds in practice, or not. In line with neoclassic theory, Brown et al. (1982) find a decline in employment between one and three percent for low-wage workers due to a 10% minimum wage rise. On the contrary, Card and Krueger (1994) perform a case study with fast-food restaurants in New Jersey and Pennsylvania and find consumer prices to increase but no significant evidence for a decline in employment. The amount of research contributions investigating employment effects of minimum wages have increased so rapidly in the past 20 years, that a substantial meta-analysis research field has emerged. Such meta-analyses summarize the estimates of previous papers and try form a big picture. Wolfson and Belman (2019) analyze 37 U.S. studies published since 2000. They find earlier studies, such as the one by Brown et al. (1982) to slightly overestimate the adverse employment effect, since more recent studies provide a smaller magnitude. Overall, the authors claim to have found a new consensus range among economists of the employment elasticity towards the minimum wage of [−0.13; −0.07]. This range implies, that a one percent increase in a minimum wage reduces employment by 0.07 to 0.13 percent, still resulting in an adverse employment effect. In line with neoclassic economic theory, they find teenagers, which are mostly low-income earners, to be stronger negatively affected.

However, back in 1995, Card and Krueger (1995) drew attention to an issue that would cause the adverse employment estimates may not reflect reality accurately, namely a possible publication bias. The authors argue that empirical economic research suffers from a publication bias, such that reputable journals tend to over-proportionally publish papers with significant outcomes. Such a bias would hinder minimum wage research to falsify negative employment effects, since the presence of a non-effect cannot be statistically proven. In a meta-analysis Doucouliagos and Stanley (2009) investigate 64 studies with a total of 1,474 estimates and try to correct for such a publication bias. Overall, they can verify the hypothesis of Card and Krueger (1995) empirically. Their results indicate a very small, if any, adverse employment effect, which they assess to be “of policy-irrelevant magnitude” (Doucouliagos and Stanley, 2009, p. 423). In addition, Manning (2021) finds the existing negative effects to be not robust towards various labor market specifications. He additionally questions the usefulness of a further investigation of the minimum wage’s employment effects, since the results’ magnitude are very small and are unlikely to be robust (Manning, 2021)

In the event that employment responds minimally, if at all, to a minimum wage, the burden of such must be borne by someone else than the employees. Two groups can be considered for this purpose. Either consumers bear the burden by paying higher consumer prices as suggested by Card and Krueger (1994), or employers bear the burden by accepting profit losses, such as described by Draca et al. (2011). The question cannot be answered uniformly since its answer crucially depends on the elasticity of demand of the certain product or service. In sectors in which the elasticity of demand is high, businesses cannot easily pass on the cost increase to their customers and will therefore have to accept profit losses. Harasztosi and Lindner (2019) use a minimum wage increase in Hungary to investigate the burden of such an increase. They find consumers to bear 3/4 of the minimum wage increase by paying higher consumer prices, while business owners only bear 1/4. In such a case, inflation may reduce, yet not destroy the original goal of a minimum wage, namely poverty reduction. However, relative wages of low-income earners still benefit, since higher prices are paid by all consumers, including wealthier ones.

Besides laying off staff (extensive margin), employers have another channel to reduce their demand for labor, namely reducing the amount of demanded working hours (intensive margin). Such adverse effects could then as well restrain the beneficial wage increasing effect of a minimum wage, since monthly wages may stagnate or even decline despite rising hourly wages. This economic theory has been challenged early on by Katz and Krueger (1992) who found an increase in full-time employment concomitant with a decrease in part-time employment in the Texas fast food industry. Likewise, Zavodny (2000) finds no significant effect of the minimum wage to reduce working hours while investigating rich individual level US panel data. The minimum wage introduction in the UK in 1999 led to a new wave of research papers investigating the minimum wage's effect on working hours. Connolly and Gregory (2002) find no significant short-term reduction in working hours by low-paid women due to the minimum wage. On the contrary, Stewart and Swaffield (2008) estimate a negative long-term effect for low wage workers. Their results are in line with neoclassic economic theory and suggest a decline in working hours by one to two hours caused by the new minimum wage. Once again empirical economic research provides mixed results in assessing the aftermath of a minimum wage introduction.

A study by Dube (2019) focuses on the question if the minimum wage is poverty decreasing after all. He finds family incomes to be positively affected by minimum wages and poverty to be reduced significantly. In detail, he finds a 1 percent increase of the minimum wage to lower poverty rates by 0.22 to 0.46 percent. In addition, the study finds the reduction in poverty to be smaller if the family receives government transfers.

The mechanical application of the standard competitive market model and its corresponding standard results are not only empirically in doubt but also theoretically. In addition to Marxist and Ricardian traditions of thought, there exist several more recent theoretical approaches that analyze this relationship in a more differentiated way, for instance interlocking markets, price-setting, monopsony, or efficiency wage-like correlations that imply that job rents do not necessarily have to be bad in terms of efficiency theory. Behavioral economics has different views on concepts, such as "fair pay". However, I will not go into these concepts in detail, because it would clearly go beyond the scope of this paper.

2.1 Minimum Wage Literature in Germany

Since Germany is a country with a relatively strong social security net, a minimum wage could affect the German workforce differently than the one of the United States. This subchapter, therefore, provides an overview over the minimum wage literature in Germany.

Bossler and Schank (2020) investigate the 2015 introduced German minimum wage and its effect on wage inequality. German pre-redistribution wage inequality has experienced a rapid increase between 2000 and 2010 but is decreasing ever since. In 2017 its level was as low as in 2000. Moreover, Bossler and Schank (2020) find the German minimum wage introduction to account for up to 50 percent of the recent decline. These results are in line with Autor et al. (2016) and further show, that the strong social security net in Germany does not weaken the positive income effects of the minimum wage to an extent that its overall effect is negative.

Bossler and Gerner (2020) use survey data on businesses to investigate employment effects caused by the German minimum wage introduction in 2015. The authors find an adverse employment effect of roughly 1.7 percent, which would imply a labor demand elasticity with respect to the minimum wage of -0.2 to -0.4. These estimates are outside the consensus range formed by Wolfson and Belman (2019) for US studies. Furthermore, according to Bossler and Gerner (2020) the reason for the adverse employment effects are not layoffs due to arisen costs but rather a reduced hiring activity of firms. In an empirically very convincing study, likewise on the German minimum wage introduction in 2015, Dustmann et al. (2021) find no adverse employment effects at all. Moreover, the authors find workers at the lower end of the wage distribution to reallocate their employment from smaller, worse paying, and lower quality firms to larger, better-paying,

high quality firms. Furthermore, they provide a coherent explanation why their results contradict the findings of Bossler and Gerner (2020). In detail, Dustmann et al. (2021) suggest that the negative employment effects identified by Bossler and Gerner (2020) partly captures the reallocation effects of workers towards better paying businesses. Both studies agree on the wage-increasing effect of the minimum wage.

The studies of Bossler and Gerner (2020) and Dustmann et al. (2021) are also interesting to analyze from an econometric point of view. Whereas both studies use an inner-German Difference-in-Difference estimation strategy, they set the treatment determining threshold differently. Bossler and Gerner (2020) consider all individuals in their sample affected by the law, whose wages were below the minimum wage prior to its introduction and therefore neglect possible spillover effects. The strategy by Dustmann et al. (2021) allows for spillover effects since they also assign treatment based on a regional approach. In detail, they assume individuals who work in wealthier German regions to be less affected by the minimum wage and assign them to the control group. Individuals in poorer regions are assigned to the treatment group regardless of their actual wage. Such a strategy allows for spillover effects, but since the minimum wage law was enacted on a federal level, some individuals in wealthier regions were directly affected by the law and hence wrongly assigned to the control group and vice versa.

The study by Bossler and Gerner (2020) also analyzes the minimum wage's impact on working hours and find a small but significant reduction of 0.4%. However, despite their analysis only covers two post-intervention periods, they already find time-varying effects. Whereas the reduction in working hours was found to be 0.6% in 2015, the effect is no longer significant in 2016. Likewise, Burauel et al. (2020) find the contractual working hours to be significantly reduced by 5% in 2015, while the effect turns insignificant as soon as the post-intervention period gets extended by the year 2016. Hence, both papers provide evidence for a negative short-term effect, which magnitude diminishes with further time periods being considered in the analysis. In addition, Burauel et al. (2020) find actual working hours to decrease less strongly than contracted working hours, providing evidence for non-compliance of the minimum wage.

In conclusion, minimum wages have been researched extensively over the past 25 years and will continue to be so. Neoclassical economic theory predicts adverse employment effects and a reduction in working hours to an extent that the minimum wage's initial goals - poverty reduction and wage convergence - are not met but worsened. Empirical economic research has at least partly falsified this prediction since it finds minimum wages indeed to decrease wage inequality and reduce poverty. In addition, there is increasing evidence that overall employment responds - if at all - very weakly. Latest research by Dustmann et al. (2021) could add a new dynamic to the minimum wage literature since they find the adverse employment effects of other studies to be partly capturing the frictional unemployment of workers while they sign on better-paying jobs. Likewise, evidence for a reduction in working hours is scarce and, if present, barely holds significant in the long-term. Most minimum wage studies use a Difference-in-Differences estimation setting, those who only assign treatment based on their pre-intervention wage neglect possible spillover effects.

3. Data

This study analyzes the aftermath of the German minimum wage introduction in 2015 by using a Difference-in-Difference approach. In the main model specification, German survey data from the Socio-Economic Panel (SOEP) (2021) form the treatment group, whilst Austrian EU-SILC (European Union Statistics of Income and Living Conditions) survey data from Statistik Austria (2021) are used as the control group. The German Socio-Economic Panel is among the largest panel surveys worldwide an includes roughly 30,000 participants each year. On the contrary, EU-SILC data combine both, panel and cross-sectional data. Each year contains roughly 11,000 Austrian observations. In this context, it is worth noting that wage data from EU-SILC is derived from register data using the tax statistics rather than survey data. Overall, the data used in the analysis ranges from 2010 to 2019 and hence contains five pre-intervention

years as well as five post-intervention years. In its minimum wage analysis this work focuses on labor demand, represented by unemployment and working hours, as well as wages, represented by hourly and monthly wage. Since the study uses micro data, unemployment is a dummy variable on the individual level indicating if a person is being registered as unemployed or not. Working hours represent the number of hours worked per week each respondent has stated in the questionnaire. In order to minimize the influence of different income tax schemes, all wages are gross wages. Since Austrian labor contracts typically include a 13th and 14th monthly wage, both hourly wages and monthly wages are calculated differently across the two samples. In order to provide appropriate comparability, Austrian monthly wages are calculated by dividing their annual wage by 12. Therefore, the 13th and 14th monthly wage are included in the 12 monthly wages used in this study. Subsequently, Austrian hourly wages are calculated by the yearly wage divided by 50 (working weeks in a year) to obtain weekly wages, which are then further divided through the working hours each individual has stated. On the contrary, German weekly wages are calculated by dividing their 3-month wage (wage monthly * 3) by 13. Afterwards, just as with Austrian data, the German hourly wage is calculated by dividing the weekly wage by the individual's stated weekly workload.

In order to ease readability of this study, this chapter only includes summary statistics of the dependent variables in the later regression analysis. Summary statistics of all variables, dependent and independent are presented in Tables 7 and 8 in the Appendix in section 9. Note that all summary statistics tables are weighted by the corresponding survey weights.

Table 1 Dependent Variable Summary Statistics: Full Sample

Variable	DE.pre		DE.post		AT.pre		AT.post	
	N	Wt. Mean	N	Wt. Mean	N	Wt. Mean	N	Wt. Mean
unemployment	116323	0.08	115055	0.07	31252	0.09	30210	0.09
hourly wage	70293	16.07	71061	18.28	25420	17.62	24965	19.47
working hours/week	82712	37.92	82642	37.27	26739	36.33	25860	36.28
grossincome/ month	74816	2592.48	74766	2896.82	30110	2408.92	28923	2697.00

Table 1 hence summarizes all four dependent variables in the later regressions of the full data sample grouped by country and period. The pre-treatment period includes all data between 2010 and 2014, whilst data from 2015 to 2019 belong to the post-treatment period. Differences between treatment and control group are minor. The unemployment rate in the Austrian sample is the same in both periods and somewhat higher than in Germany, where unemployment decreases marginally. Individuals in the Austrian sample have a slightly higher hourly wage but work slightly less hours which leads to an overall slightly smaller monthly income. While hourly wages increase in both countries by roughly the same share, working hours hardly change.

Figure 1 and 2 show the density of hourly wages in Germany and Austria respectively before and after the minimum wage introduction. Furthermore, two box-plots ease readability over key figures. Accordingly, the median hourly wage in Germany is smaller than in Austria. Furthermore, the wage distribution in Germany appears slightly more uniformly, while both distributions diverge over time. Moreover, in both countries the median wage increased from pre- (2010-2014) to post-intervention period (2015-2019).

However, the external validity of the regression results estimated by the sample presented above may be flawed since most Austrian employees are covered by an industry wide minimum wage and therefore may

not serve as ideal control group. In order to provide robustness for the results of the main sample, this study extends its analysis to a subset containing only hairdressers and cosmeticians. The hairdressing and other beauty treatment industry is among the worst paid industries in Germany (Statista, 2020). In Austria cosmeticians are one of few jobs not covered by a valid collective bargaining agreement and therefore have no minimum wage at all (Wirtschaftskammer Österreich, 2020). Hairdresser are covered by a collective bargaining agreement and received a gross minimum wage dependent on their work-experience between 8.13 EUR and 9.75 EUR per hour in 2014 (Wirtschaftskammer Österreich, 2014). In 2015 their gross minimum wage rose little to EUR 8.28 and 9.93 EUR per hour (Wirtschaftskammer Österreich, 2015). Thus, the Austrian hairdressing and other beauty treatment industry seems to be unaffected by the German minimum wage introduction. Moreover, economic literature mentioned in section 2, the impact of minimum wages is assumed to be the strongest in low-paid sectors. Therefore, extending the analysis to a subset in low-income industry provides additional insights regarding the heterogeneity effects of the minimum wage

Figure 1 Hourly wages in DE before and after 2015, Full Sample: Density of hourly wages

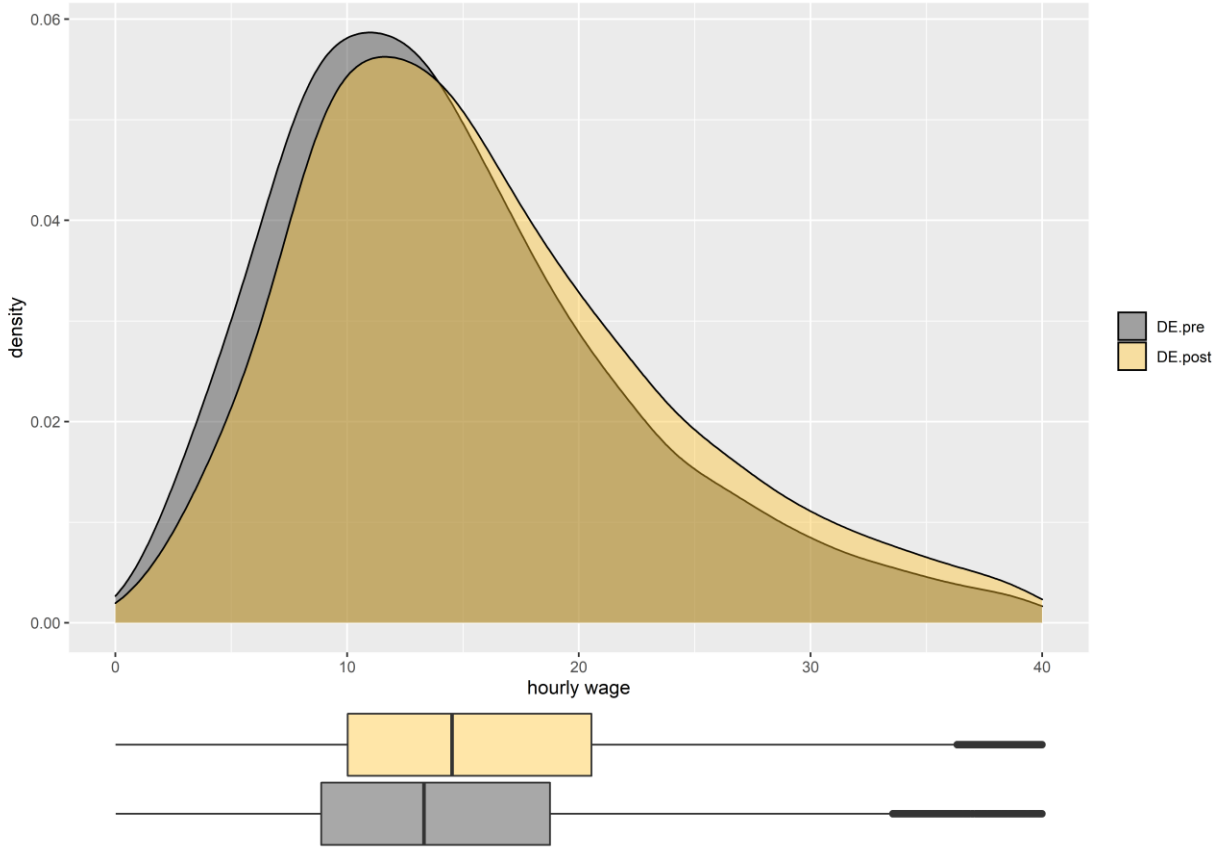


Figure 2 Hourly wages in AT before and after 2015, Full Sample: Density of hourly wages

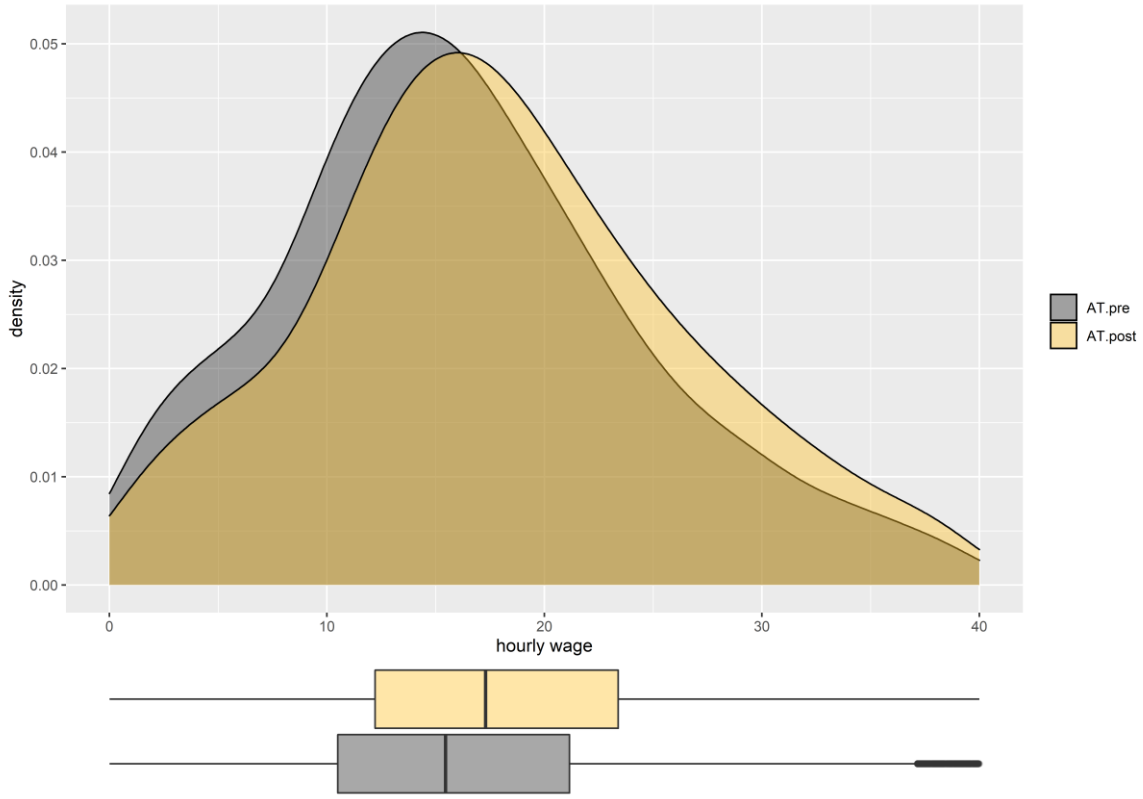


Table 2 : Dependent Variable Summary Statistics Subset: Hairdresser and Cosmeticians

Variable	DE.pre		DE.post		AT.pre		AT.post	
	N	Wt. Mean	N	Wt. Mean	N	Wt. Mean	N	Wt. Mean
unemployment	598	0.03	531	0.02	167	0.24	173	0.13
hourly wage	443	10.79	413	11.59	131	7.81	150	8.6
working hours/week	527	34.06	478	30.9	138	33.75	155	31.84
grossincome/ month	489	1348.48	446	1265.5	138	976.81	157	1038.08

Table 2 therefore shows the data of the dependent variables of the subset of hairdresser and cosmeticians. The eye-catching difference in the unemployment rate is connected to data issues by both German data from Socio- Economic Panel (SOEP) (2021) and Austrian EU-SILC data from Statistik Austria (2021), which are discussed in detail in section 7.

As long as the data issues are constant over the whole period of investigation and are not correlated with the minimum wage introduction, the Difference-in-Differences estimator remains consistent. Apart from the remarkable difference in unemployment, German hourly wages are substantially higher in this subset. Working hours decrease in both countries over time, however the decline is sharper in Germany. Monthly incomes are remarkably higher in Germany, However, monthly incomes decrease in Germany while they increase in Austria from pre- to post-intervention period.

Analogously to Figure 1 and Figure 2, Figure 3 and Figure 4 picture the density of hourly wages for hairdresser and cosmeticians in the pre- and post-treatment period. As well as in the full sample, hourly wages increased in both countries over time. While German wages diverged over time, Austrian wages did, if at all, slightly converge.

Figure 3 hourly wages in DE before and after 2015, Subset Hairdresser: Density of hourly wages

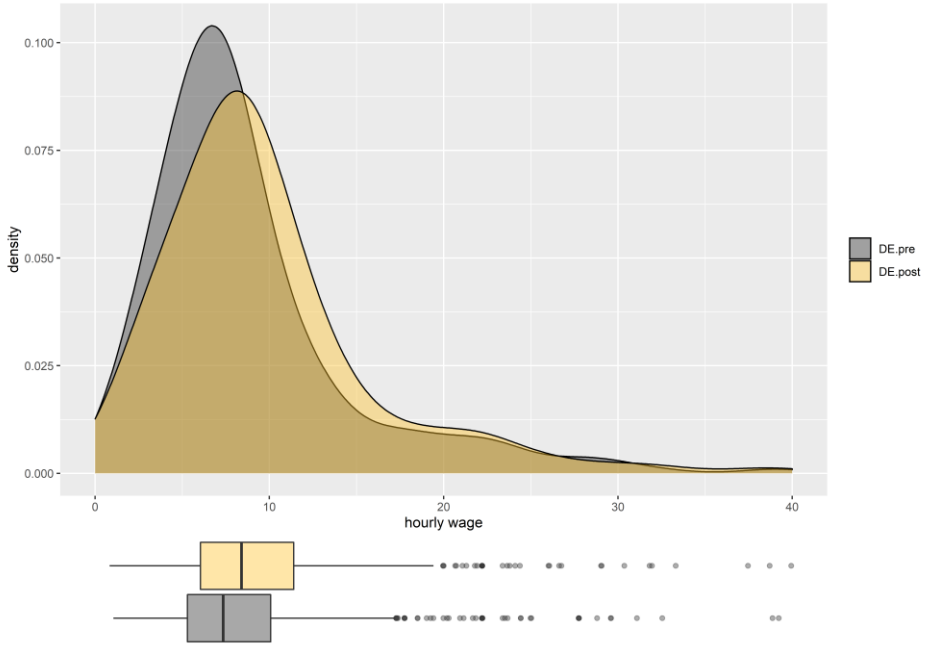
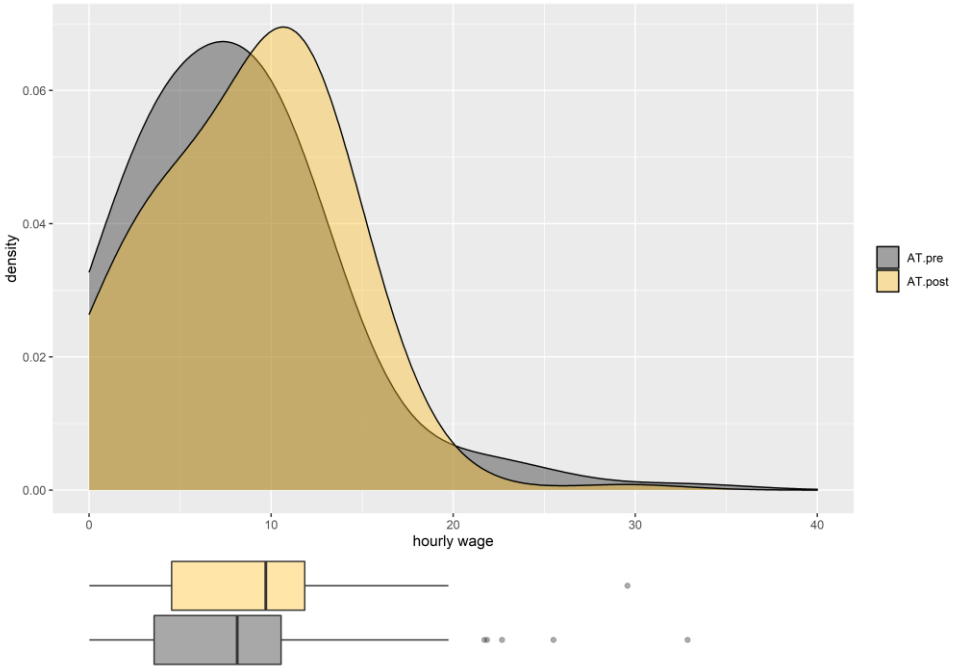


Figure 4 Hourly wages in AT before and after 2015 Subset Hairdresser: Density of hourly wages



4. Method

In order to analyze the aftermath of the German minimum wage introduction, this study uses a Difference-in-Differences (DiD) estimation, in which treatment assignment is based on a regional approach. More specific, all German individuals are considered exposed to the treatment, while all Austrian individuals are not and hence form the control group. Since the study uses a regional approach instead of an inner-German approach, it is able to detect wage effects to spill over towards those not directly affected by the minimum wage.

In the main specification the regression formula then looks like following:

$$Log(Y_{i,j,t}) = \beta_1 * time_t + \beta_2 * treated_j + \gamma_1 * time_t * treated_j + \delta_1 * X_{i,j,t} + \epsilon_{i,j,t}$$

where $Y_{i,j,t}$ is the outcome variable of individual i in country j at year t. As demonstrated in Table 1, four different dependent variables get estimated in this study, namely gross hourly wage, gross wage per month as well as working hours per week and unemployment. The time dummy $* time_t$ is 1 for all time periods in or after 2015 and 0 otherwise. The treatment dummy $treated_j$ is determined by country and 1 for all individuals in Germany and 0 for those located in Austria. Vector $X_{i,j,t}$ contains various control variables, in particular gender, age, education, marital status, health, and the size of the company one is employed. If unemployment is the dependent variable, the control variable of company size is excluded since unemployed individuals by definition cannot work in a business. The interaction effect of the regression formula pictures the crucial DiD-estimator, which estimates the causal effect of the German minimum wage introduction towards the four dependent variables of interest.

For the sake of additional robustness, a further regression model with individual fixed effects and year fixed effects is estimated. In this case, the regression formula above gets extended by the term ηi capturing all time-invariant individual effects and ψt for year fixed effects. Note, that in the fixed effects estimation strategy the treatment dummy is no longer necessary as its effect is taken up by the individual fixed effect. The crucial estimator in such a Difference-in-Differences estimation - the interaction effect - remains valid.

Note, that unemployment is an individual-level dummy indicating whether a person is unemployed or not. This has two notable implications regarding the estimation: First, the study does not estimate the minimum wages on the economy's unemployment rate, but rather the effect on the individual's risk of becoming unemployed. Moreover, the Difference-in-Difference estimation of a dummy variable goes along with heterogeneity issues which possibly invalidate the corresponding standard errors and hence their significance. However, size and – particularly important in this study – the sign remain consistent. Nevertheless, the study's expressive power of the minimum wage's effect on unemployment may be attenuated. Therefore, the estimation results on unemployment should not be interpreted exclusively. Raher, they serve as additional robustness for the effect on labor demand represented by working hours. For the second main goal of this study, the exploration of heterogenous effects among different income groups, the estimation of unemployment is not possible anyways, since wage earners are by definition not unemployed and are hence absent in a subset of a certain wage class.

One should also note, that in both countries minimum wages have also been adjusted after 2015. In Germany the statutory minimum wage increased by about 2% per year (Bundesministerium für Arbeit und Soziales, 2022). Since January 1st, 2022, the German minimum wage is at EUR 9,82. In Austria the average minimum wage increase of all collective bargaining agreements was between 1.7% in 2017 and 3.0% in 2019 (Statistik Austria, 2022). Hence, the increases roughly kept up with inflation and cannot be interpreted as a further minimum wage increase and the Difference-in-Differences estimation approach with a time dummy being 1 for all observation in or after 2015 remains valid. However, this could change for analyses going beyond 2022. Recently, the new coalition in Germany has announced to increase the hourly minimum wage to EUR 12.00 per hour in October 2022 (Tagesschau, 2022). This would imply a remarkable relative increase of 22% compared to the minimum wage valid since January 2022.

5. Results

This study evaluates the introduction of a federal minimum wage in Germany by conducting a Difference-in-Differences setup, which compares German individuals exposed to the law with Austrian individuals not exposed to the law. Table 3 pictures the crucial Difference-in-Differences estimator (the coefficient of the country/minimum wage interaction term) of the four estimations for the dependent variables explained in section 3. The first line refers to the pooled OLS estimation, in the second line the study makes use of the panel data structure and estimates Fixed Effects. Note, that all standard errors are clustered on the country level.

Table 3 Difference-in-Differences estimators

Dependent variables				
	wages		Labor demand	
	log(wage/hour)	log(wage/month)	log(hours/week)	unemployment
	(1)	(2)	(3)	(4)
Pooled OLS	0.040***	0.049***	0.013***	−0.013***
	(0.001)	(0.0001)	(0.001)	(0.0002)
FE	−0.054	−0.034	0.003	−0.011**
	(0.002)	(0.009)	(0.009)	(0.001)
Observations	180,193	196,058	193,664	287,970

Note: Difference-in-Difference estimators of the corresponding dependent variables using the full sample. All standard errors are clustered on the country level. The logarithm is taken of all dependent variables except for unemployment. All four regressions include the same vector of independent control variables, except for the fourth one, where company size is excluded,*p<0.1;**p<0.05; ***p<0.01

In line with economic theory and basic common sense both hourly and monthly wages increased due to the minimum wage introduction by 4 to 4,9 per cent. In contradiction to neoclassic theory, labor demand did not decrease due to the minimum wage neither by laying off staff (extensive margin) nor by demanding fewer working hours (intensive margin). Rather, the results of Table 3 suggest the opposite. In the pooled OLS model, working hours increase significantly by 1.3%. The fixed effects estimators cannot confirm such an increase, however, they neither confirm the decrease expected by neoclassic theory. The negative effect on unemployment provides additional robustness to the thesis of a non-decreasing labor demand. As mentioned above this estimator may be insignificant but certainly is not positive. The fixed effects estimator provides additional robustness regarding the effect on labor demand. However, it can neither confirm the positive labor demand nor wage effects, the pooled OLS estimation suggests.

As discussed comprehensively in Section 2, economic theory suggests that the exposure of a minimum wage law and hence its consequences are limited to the population earning below the minimum wage prior to its introduction. Based on this assumption many studies, such as Bossler and Gerner (2020) use an inner-country estimation strategy, where treatment status is assigned to below minimum wage earners. This strategy, however, is neglects the existence of possible spillover effects of the minimum wage for people earning wages higher than the minimum-wage prior to its introduction. In order to check for heterogeneous effects among different wages along the income distribution, this study assigns individuals into six different wage groups corresponding to their hourly wage. If an individual's wage changes over time such that it falls into a new wage category, the individual is assigned to the wage category of his or her lowest wage in the research period.

In Table 4, this study finds evidence for the spillover effects addressed above, since all wage classes experience a significant rise in hourly wages and not only those below the minimum wage threshold. In line with economic theory, wage classes at the very bottom-end of the income distribution experienced the highest increases of up to 18.6%. Furthermore, there is no robust evidence that labor demand decreases in the form of fewer demanded working hours. Instead, wage classes who experienced the highest increase in hourly wages also experienced significant rises in working hours by up to 11.7%.

Table 4 DiD estimator among different wage classes

Dependent variables			
	wages		**labor demand**
hourly wage	log(wage/hour)	log(wage/month)	log(hours/week)
EUR/h	(1)	(2)	(3)
<6	0.186***	0.295***	0.117***
	(0.001)	(0.002)	(0.0001)
6-8.50	0.117***	0.165***	0.049***
	(0.0005)	(0.0005)	(0.001)
8.50-12	0.075***	0.068***	−0.002***
	(0.0003)	(0.001)	(0.0005)
12-18	0.081***	0.097***	0.010***
	(0.0003)	(0.00002)	(0.0003)
18-25	0.074***	0.067***	−0.014***
	(0.002)	(0.003)	(0.001)
>25	0.070***	−0.027**	−0.086***
	(0.00000)	(0.011)	(0.013)

Note: Pooled OLS Difference-in-Difference estimators of the corresponding dependent variables using a subset for each wage class. Standard errors are clustered on the country level. The logarithm is taken of all dependent variables. All three regressions include the same vector of independent control variables. *p<0.1; **p<0.05; ***p<0.01

Therefore, monthly wage increases were the highest in low-wage classes, with gross wages rising by up to 29.5%. However, for some wage classes above the minimum wage working hours did decline. Yet, their magnitude is minor and not large enough to decrease monthly wages expect for in the upper end of the wage distribution.

5.1 Subset Hairdresser and Cosmeticians

Most employees in Austria are covered by a collective agreement, which includes minimum wages on the sector level. This study's research design with Austrian data in the control group hence rather evaluates the aftermath of the German introduction of a minimum wage by a federal law instead of providing external validity to the aftermath of minimum wages introductions in general. In order to tackle this shortcoming, in this subsection the analysis is additionally performed on a data subset only containing hairdresser and cosmeticians, because this Austrian industry is only partly covered by a minimum wage or has none at all. Note, that the data used in this study are not ideal for this purpose (see Section 7). Furthermore, this study investigates heterogeneous effects among different income segments. Since the hairdressing industry is among the worst paid, their results serve as robustness check to the results presented in Table 3 and Table 4.

The results pictured in Table 5 largely confirm the results in Table 3, since they neither find significant robust evidence suggesting a decline in labor demand. The OLS approach finds working hours to increase by 14.1%. This effect, however, cannot be confirmed by the fixed effects estimation. The risk of unemployment in this subset turned positive in the OLS approach but is negatively insignificant in the fixed effects estimation. Since standard errors in the estimation of unemployment risk are uncertain, the adverse effect may also be insignificant, or the negative fixed effect estimator may be significant. In all scenarios, there is no robust evidence of an adverse employment effect. Surprisingly, hourly wages remain unaffected and gross wages per month seemed to solely have increased due to the rise in working hours. Overall, the table finds no robust evidence supporting neoclassic theory which predicts decreasing labor demand, i.e. an increase in unemployment and a decrease in hours worked.

Analogous to Table 4, Table 6 provides evidence of the minimum wage aftermath among various classes along the wage distribution for the subset of hairdresser and cosmeticians. Since the highest wage class (>25 EUR) is not represented in the subset (also shown in Table 8), it is omitted compared to Table 4. Table 4 found working hours to slightly decrease for some wage classes above the minimum wage. Table 6 finds no such decrease in working hours in any wage class for the hairdresser and cosmetician subset.

Table 5 Difference-in-Differences estimators on the subset of Hairdresser and Cosmeticians

Dependent variables				
	Wages		**labor demand**	
	log(wage/hour)	log(wage/month)	log(hours/week)	unemployment
	(1)	(2)	(3)	(4)
OLS	0.041	0.234***	0.141***	0.081***
	(0.043)	(0.043)	(0.014)	(0.003)
FE	−0.254	−0.112	−0.053	−0.019
	(0.058)	(0.056)	(0.024)	(0.018)
Observations	977	951	873	1,459

Note: Difference-in-Difference estimators of the corresponding dependent variables using the sample of hairdresser and cosmeticians. All standard errors are clustered on the country level. The logarithm is taken of all dependent variables except for unemployment. All four regressions include the same vector of independent control variables, except for the first one, where company size is excluded *p<0.1; **p<0.05; ***p<0.01

Table 6 Heterogeneous effects among wage classes in the Hairdresser and Cosmeticians Subset

Dependent variables			
	Wages		labor demand
hourly wage	log(wage/hour)	log(wage/month)	log(hours/week)
EUR/h	-2	-3	-1
<6	0.218***	0.328***	0.109***
	(0.003)	(0.006)	(0.003)
6-8.60	0.132***	0.299***	0.167***
	(0.003)	(0.012)	(0.009)
8.50-12	−0.074***	0.375***	0.450***
	(0.010)	(0.076)	(0.086)
12-18	−0.044	0.888	0.931
	(0.090)	(1.645)	(1.735)
18-25	−0.463	−0.204	0.259
	(0.382)	(1.087)	(1.469)

Note: Difference-in-Difference estimators of the corresponding dependent variables using a subset for each wage class inside the hairdresser and cosmeticians subset. Standard errors are clustered on the country level. The logarithm is taken of all dependent variables. All three regressions include the same vector of independent control variables. *p<0.1; **p<0.05; ***p<0.01

Instead, working hours increased by up to 45%. Just like in Table 4 and in line with economic theory, the results in Table 6 find wages at the bottom-end of the income distribution to be affected the strongest. In the lowest wage class hourly wages rose by 21.8% in the hairdressing and cosmeticians' industry. Interestingly it found hourly wages for those already above the minimum wage to decrease. In such a case, employers decrease wages for medium and high wage to offset the cost increase they face for increasing wages for low-wage earners. those earning less. However, this theory is unlikely to be applied here. In such a case, employers would also decrease labor demand of higher income earners and Table 6 shows no such reduction.

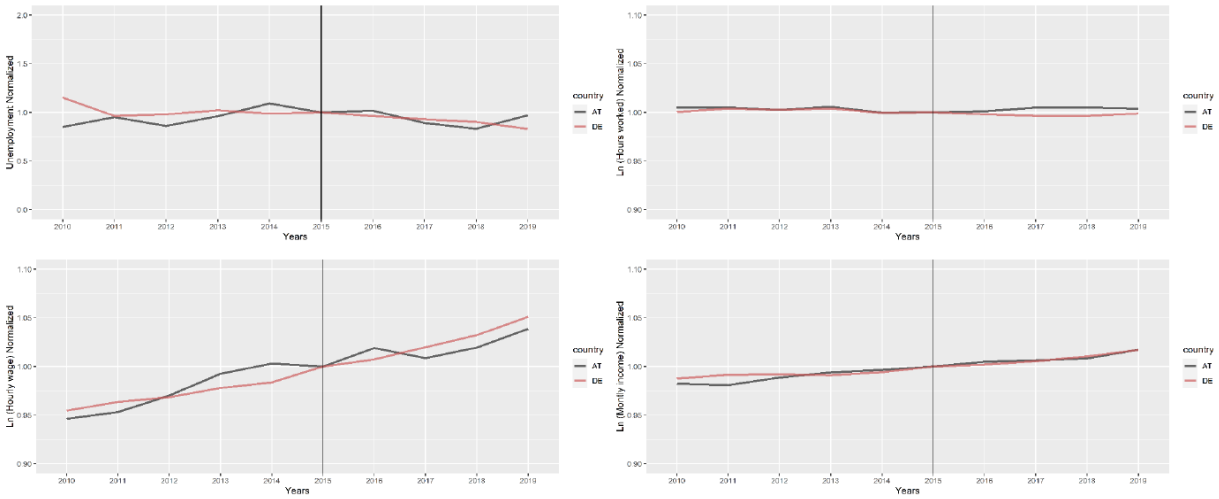
6. Robustness Checks

As discussed in section 5, Table 5 and Table 6 serve as first robustness check towards the main specification in Table 3 and Table 4. The regression results of the subset containing only hairdresser and cosmeticians, which are only insufficiently covered by a minimum wage in Austria, provide additional external validity to the main results. Furthermore, this chapter provides additional checks to support the results shown in the previous section.

Difference-in-Differences estimations assume parallel trends among treatment and control group, such that they would have had developed constantly over time in the absence of a treatment (Lechner, 2011). Since such parallel trends cannot be statistically proven by a test, Figure 3 shows the development of the four dependent variables over time. The dark-grey line represents Austrian EU-SILC data from Statistik Austria (2021), whereas the red line represents German data from Socio-Economic Panel (SOEP) (2021). The vertical line represents the effective date of the German minimum wage law on January 1st, 2015. All values in the four figures below are normalized by the treatment's group value when the law became effective, that is the German value in 2015. In all four sub-figures, the assumption of parallel trends seems to hold, since both groups proceed parallel over time before the minimum wage was enforced.

Figure 5: Normalized Parallel Trends among both countries in all four dependent variables,

Note: Each value is normalized by the value of Germany in 2015



Besides, Figure 1Figure 5 provides descriptive information of this study's four dependent variables over time. Hourly wages increase in both countries over time, whereas the increase before treatment is slightly sharper in Austria. In the post treatment period this gap shrinks, which again is statistically significantly shown in Table 3. Gross monthly wages behave very similar in both groups over time. The same holds for working hours. In the pre-treatment period, working hours behave almost completely homogeneously in both countries, while the difference gets slightly larger from 2016 onward. Hence, Figure 5 additionally serves as visualization of the difference in the estimated in Table 3. Unemployment is observed to be the most volatile index among the four. Also note, that the unemployment dummy is not logged. In 2013, the European recession is likely to be responsible for the hike in unemployment in Austria, while German unemployment seems unaffected. From 2015 onward German unemployment levels continually decrease. Austrian unemployment levels do so after 2016 but experience an increase in 2019. The difference in unemployment between both groups is relatively small across time, the minimum wage law seems to have no visual impact and hence supports the results from Table 3, which finds no adverse employment effects but rather a decrease in unemployment since minimum wage became effective.

A further threat to the validity of Difference-in-Differences results are possible anticipation effects, which could lead to an underestimation of the coefficients. In the view of a minimum wage intervention, this anticipation effect is unlikely. In such a setting, employers anticipate the minimum wage law by paying above minimum wage salaries earlier than legally necessary. Such a behavior is economically unreasonable, yet not impossible.

7. Limitations

In the sense of a transparent and responsible handling of weaknesses and strengths of studies, this section illuminates the limitations of this work.

First, Table 1 and Table 6 cannot estimate a possible heterogeneous effect along the wage distribution on unemployment since this study uses micro-level unemployment data. Hence unemployment is a dummy variable, either 1 for those officially reported unemployed or 0 for those employed. Those unemployed do not receive a wage by definition and therefore cannot be assigned into wage classes. Furthermore, the subset of hairdresser and cosmeticians suffers from a small number of observations, which are particularly important for the Fixed Effects estimation.

Second, as mentioned in 4, this study's main sample investigates the aftermath of the German minimum wage introduction in 2015, its external validity towards other countries introducing similar laws may be flawed, since individuals in the Austrian control group are mostly covered by a minimum wage regulation via collective bargaining agreement. Therefore, this study aims to find additional robustness for its results by investigating a industry which is only partially covered by a collective bargaining agreement in Austria but subject to the minimum wage law in Germany, namely hairdresser and cosmeticians. The robustness check regarding unemployment may be biased due to misreporting and data issues. As observable in Table 2, all dependent variables in this subset seem reasonable, except for the unemployment rate, which is extraordinarily higher for the Austrian control group. This has two reasons: First, the German unemployment rate among hairdressers and cosmeticians is systematically underrepresented in this sample, since German data from the Socio-Economic Panel (SOEP) (2021) does not contain information about the individual's former job in the case of unemployment. Hence, only individuals who declare to work in the occupation of hairdressers and cosmeticians are represented in this sample. Since these individuals cannot work as hairdressers and cosmeticians and be simultaneously registered as unemployed, there should exist no unemployment in the subset. Nevertheless, some individuals did declare unemployed while also working in the hairdressing industry.

Third, Austrian EU-SILC data from Statistik Austria (2021) does only contain information about the individual's occupation on the ISCO-08 two-digit level. On this level, hairdressers and cosmeticians are not clearly distinguished from other occupations. Therefore, individuals in the Austrian sample are considered as hairdresser or cosmetician by this study, if they match both the correct ISCO-08 two-digit code and the correct NACE Rev.2 two-digit code of either their current occupation or their last occupation in the case of unemployment. There remains the possibility of falsely assigning individuals in the hairdressing subset, however its probability is low. As long as this misreporting is not correlated with the minimum wage introduction nor any other event in the research period, the Difference-in-Difference estimator remains consistent.

Overall, the limitations urge caution in the interpretation of the minimum wage's effect on unemployment. However, this effect is well-researched by existing economic literature (see section 2). This study's main goal, the investigation of heterogenous wage and labor demand effects among different income classes, is rarely affected by the addressed limitations.

8. Conclusion

This study investigates the aftermath of the German minimum wage introduction in 2015 by conducting a Difference-in-Differences estimation, which exploits regional differences in the validity of the minimum wage. German data from Socio-Economic Panel (SOEP) (2021) make up the treatment group, whereas Austrian EU-SILC data from Statistik Austria (2021) are assigned to the control group. This estimation specification allows for spillover effects of the minimum wage for wages already above the introduced minimum wage. Neoclassic economic theory predicts a decrease in labor demand due to higher labor costs, which should show up either in unemployment if firms are laying off staff (extensive margin) or by reducing working hours (intensive margin). Eventually, these decreases in labor demand could result in total income losses particularly concentrated at the bottom-end of the wage distribution, which could worsen income inequality – the opposite of the minimum wage's initial goal. Therefore, this study analyzes the heterogeneity in the aftermath of the minimum wage along the wage distribution.

The assumption that a minimum wage only affects those who earn below the minimum wage threshold prior to its introduction, which is made by many research contributions, such as Bossler and Gerner (2020) can be falsified by this study. I find all groups along the wage distribution to experience significant hourly wage increases, not only those on the bottom end. Furthermore, neoclassic theory predicts a decline in working hours particularly for those, whose wages were affected the most. I find no such decline at the bottom end of the wage distribution, instead low wage individuals experience an increase in working hours,

while higher wage groups experience some decline. Finally, all wage groups except for the highest (> 25 EUR per hour) experience monthly wage increases. The extension of this analysis to a subset of hairdresser and cosmeticians, which are only insufficiently covered by a minimum wage in Austria finds additional robustness to these results.

Since Germany, as well as Austria, had a collective bargaining agreement scheme before the federal minimum wage became effective in 2015, this work allows the conclusion to be drawn that Austria has no reason to expect adverse effects in case of an analogous minimum wage introduction. Moreover, collective bargaining agreements and statutory minimum wages should not be seen as substitutes, but rather as complementary. In a state where both systems exist, labor unions can still bargain for higher wages in industries with high profits, while the federal minimum wage provides an effective lower bound that also covers those employees, who are not - or only insufficiently - covered by a collective bargaining agreement.

While this study finds no adverse results for a minimum wage introduction of 8.50 EUR, a substantially higher minimum wage could lead to adverse results such as suggested by the literature. Analogously a minimum wage, which is substantially lower may also not contribute to the positive effects suggested by this study.

References

Autor, D. H., A. Manning, and C. L. Smith (2016). The contribution of the minimum wage to US wage inequality over three decades: A reassessment. American Economic Journal: Applied Economics 8 (1), 58–99.

Bossler, M. and H.-D. Gerner (2020). Employment effects of the new ger- man minimum wage: Evidence from establishment-level microdata. ILR Review 73 (5), 1070–1094.

Bossler, M. and T. Schank (2020). Wage inequality in germany after the minimum wage introduction. IZA Discussion Papers (13003).

Brown, C., C. Gilroy, and A. Kohen (1982). The effect of the minimum wage on employment and unemployment: A survey. Technical report, National Bureau of Economic Research.

Bundesministerium für Arbeit und Soziales (2022). Das mindestlohnge- setz. Last accessed on 23.02.2022, https://www.bmas.de/DE/Arbeit/Arbeitsrecht/Mindestlohn/mindestlohngesetz.html.

Burauel, P., M. Caliendo, M. M. Grabka, C. Obst, M. Preuss, and
C. Schröder (2020). The impact of the minimum wage on working hours.
Jahrbücher für Nationalökonomie und Statistik 240 (2-3), 233–267.

Caliendo, M., L. Wittbrodt, and C. Schro¨der (2019). The causal effects of the minimum wage introduction in germany–an overview. German Economic Review 20 (3), 257–292.

Card, D. and A. B. Krueger (1994). Minimum wages and employment: A case study of the fast-food industry in new jersey and pennsylvania. The American Economic Review 84 (4), 772–793.

Card, D. and A. B. Krueger (1995). Time-series minimum-wage studies: a meta-analysis. The American Economic Review 85 (2), 238–243.

Connolly, S. and M. Gregory (2002). The national minimum wage and hours of work: implications for low paid women. Oxford Bulletin of Economics and Statistics 64, 607–631.

Doucouliagos, H. and T. D. Stanley (2009). Publication selection bias in minimum-wage research? a meta-regression analysis. British Journal of Industrial Relations 47 (2), 406–428.

Draca, M., S. Machin, and J. Van Reenen (2011). Minimum wages and firm profitability. American Economic Journal: Applied Economics 3 (1), 129–51.

Dube, A. (2019). Minimum wages and the distribution of family incomes. American Economic Journal: Applied Economics 11 (4), 268–304.

Dustmann, C., A. Lindner, U. Schönberg, M. Umkehrer, and P. Vom Berge (2021). Reallocation effects of the minimum wage. The Quarterly Journal of Economics.

Eurofound (2022). Statutory minimum wages, 2022.Minimum wages in the EU in 2022. Last accessed 4. February 2022. https://www.eurofound. europa.eu/data/statutory-minimum-wages-2022.
Harasztosi, P. and A. Lindner (2019). Who pays for the minimum wage? American Economic Review 109 (8), 2693–2727.
Katz, L. F. and A. B. Krueger (1992). The effect of the minimum wage on the fast-food industry. ILR Review 46 (1), 6–21.
Lechner, M. (2011). The estimation of causal effects by difference-in- difference methods, Volume 4. Now Hanover, MA.
Lee, D. S. (1999). Wage inequality in the united states during the 1980s: Rising dispersion or falling minimum wage? The Quarterly Journal of Economics 114 (3), 977–1023.
Manning, A. (2021). The elusive employment effect of the minimum wages. Journal of Economic Perspectives, American Economic Association 35 (1), 3-26.
Ragacs, C. (2003). Mindestlöhne und Beschäftigung: die empirische Evidenz. Ein Literaturüberblick, Wirtschaft und Gesellschaft 2003, 29 (2), 215-246
Socio-Economic Panel (SOEP) (2021). Data for years 2010-2019, SOEP-Core v36, EU edition.
Statista (2020). Ranking der Berufe mit dem niedrigsten Bruttojahresgehalt* (Median) nach der Ausbildung in Deutschland im Jahr 2018. https://de.statista.com/statistik/daten/studie/939588/umfrage/ berufe-mit-den-niedrigsten-gehaeltern-nach-der-ausbildung/.
Statistik Austria (2021). EU-SILC 2010-2019.
Statistik Austria (2022). Tariflohnindex für hauptreihen ab 1986 (Basis: 2016 = 100). https://www.statistik.at/web_de/statistiken/menschen_und_gesellschaft/soziales/tariflohnindex/041010.html.
Stewart, M. B. and J. K. Swaffield (2008). The other margin: Do minimum wages cause working hours adjustments for low-wage workers? Economica 75 (297), 148–167.
Stigler, G. J. (1946). The economics of minimum wage legislation. The American Economic Review 36 (3), 358–365.
Tagesschau (2022). Mindestlohn soll auf zw¨olf euro erho¨ht werden. Last accessed on 23.02.2022, https://www.tagesschau.de/inland/ mindestlohn-erhoehung-105.html.
Wachter, M. L. (2012). Neoclassical labor economics: its implications for labor and employment law. In Research handbook on the economics of labor and employment law. Edward Elgar Publishing.
Wirtschaftskammer Österreich (2014). Kollektivvertragliche Mindestmonatslöhne im Friseurgewerbe ab 01.04.2014. https://www.wko.at/Content.Node/Service/Arbeitsrecht-und-Sozialrecht/Kollektivvertraege/
-KV-Struktur-/Sparte-Gewerbe-und-Handwerk/Friseure/ Lohn--und-Gehaltstafeln/Friseure_Mindestlohntabelle_2014.pdf.
Wirtschaftskammer Österreich (2015). Kollektivvertragliche Mindestmonatslöhne im Friseurgewerbe ab 01.04.2015. https://www.wko.at/Content.Node/Service/ Arbeitsrecht-und-Sozialrecht/Kollektivvertraege/ -KV-Struktur-/Sparte-Gewerbe-und-Handwerk/Friseure/Lohn--und-Gehaltstafeln/Friseure_Netto-Loehne-ab-1-4-2015_2. pdf.
Wirtschaftskammer Österreich (2020). Kollektivverträge für Fußpfleger, Kosmetiker und Masseure. https://www.wko.at/branchen/gewerbe-handwerk/fusspfleger-kosmetiker-masseure/ kollektivvertraege.html.
Wolfson, P. and D. Belman (2019). 15 years of research on us employment and the minimum wage. Labour 33 (4), 488–506.
World Inequality Database (2021). Top 10% and Bottom 50% income shares. https://wid.world/data/.
Zavodny, M. (2000). The effect of the minimum wage on employment and hours. Labour Economics 7 (6), 729–750.

9. Appendix

Table 7 Complete Summary Statistics Full Sample

	DE.pre			DE.post			AT.pre			AT.post		
Variable	N	Wt.Mean	Wt.SD	N	Wt.Mean	Wt.SD	N	Wt.Mean	Wt.SD	N	Wt.Mean	Wt.SD
unemployment	116.323	0.082	0.275	115.055	0.074	0.262	31.252	0.086	0.281	30.210	0.086	0.28
hourlywage	70.293	16.071	16.763	71.061	18.277	17.776	25.420	17.621	15.107	24.965	19.47	17.487
workinghours/week	82.712	37.922	15.93	82.642	37.265	15.37	26.739	36.331	11	25.860	36.283	11.096
grossincome/month	74.816	2.592.481	2.305.464	74.766	2.896.816	6.952.601	30.110	2.408.925	2.367.474	28.923	2.696.997	2.669.839
age	116.335	42.523	13.23	123.190	42.866	13.477	44.903	40.696	13.967	41.469	41.333	14.043
gender	116.335			123.181			44.903			41.469		
...male	52.365	50.2%		59.007	50.6%		21.570	50%		19.778	50.1%	
...female	63.970	49.8%		64.174	49.4%		23.333	50%		21.691	49.9%	
educationlevel	114.771			121.106			44.598			41.466		
...compulsory	17.105	14.3%		27.176	14.8%		8.153	19.8%		6.181	17.6%	
...vocation	10.321	8.5%		10.951	9.8%		15.168	34%		14.595	34.7%	
...professional	-	0%		-	0%		5.207	11.3%		5.533	12.6%	
...secondary	55.473	50.7%		48.907	46.2%		8.495	18.9%		7.297	17.6%	
...tertiary	26.658	21.6%		29.557	24.5%		5.861	12.3%		6.839	15.5%	
...postsecondary	5.214	4.8%		4.515	4.7%		1.714	3.7%		1.021	2%	
companysize	78.020			78.677			27.218			26.914		
...<5	7.896	9.3%		6.393	7.2%		4.085	15.2%		3.688	14%	
...5-10	7.403	8.9%		7.501	8.3%		3.517	12.9%		3.189	12.2%	
...10-19	6.573	8.3%		6.727	8%		3.415	12.5%		3.391	12.7%	
...>20	56.148	73.5%		58.056	76.6%		16.201	59.4%		16.646	61.1%	
maritalstatus	115.847			122.592			44.901			41.468		
...married	31.694	35.3%		36.895	36.7%		15.835	38%		15.710	40%	
...single	67.992	50.3%		68.910	48.6%		23.213	50.1%		20.444	48.7%	
...seperated	3.097	2.6%		4.321	2.7%		657	1.5%		603	1.4%	
...widowed	1.932	1.9%		1.964	1.8%		992	2%		740	1.6%	
...divorced	11.132	9.9%		10.502	10.2%		4.204	8.5%		3.971	8.3%	
health	116.241			123.059			44.892			41.463		
...verygood	14.954	12.3%		20.551	12.5%		17.010	37.6%		15.700	37.6%	
...good	51.212	42.2%		51.397	42.1%		17.613	38.7%		16.741	39.8%	
...satisfactory	33.592	30.3%		33.552	29.8%		7.712	17.6%		6.936	17%	
...notwell	13.308	12.2%		14.198	12.7%		2.012	4.8%		1.673	4.4%	
...bad	3.175	3%		3.361	2.9%		545	1.3%		413	1.2%	
wageclass	94.216			91.076			29.325			28.461		
...<6	20.117	21.6%		19.430	22.2%		5.993	22.9%		4.759	19.5%	
...6-8.50	16.119	16.8%		15.293	16.6%		2.275	8.7%		1.914	7.6%	
...8.50-12	20.288	21.7%		19.262	21.1%		4.567	16.5%		3.625	14.4%	
...12-18	21.742	24%		20.549	23.8%		7.658	25.3%		7.418	25.4%	
...18-25	10.050	10.6%		9.719	10.4%		5.100	15.7%		5.785	18.2%	
...>25	5.900	5.4%		6.823	6%		3.732	11.1%		4.960	14.9%	

Table 8: Complete Summary Statistics Subset: Hairdresser and Cosmeticians

	DE.pre			DE.post			AT.pre			AT.post		
Variable	N	Wt.Mean	Wt.SD	N	Wt.Mean	Wt.SD	N	Wt.Mean	Wt.SD	N	Wt.Mean	Wt.SD
unemployment	598	0.028	0.165	531	0.02	0.141	167	0.237	0.426	173	0.134	0.341
hourly wage	443	10.795	11.688	413	11.592	9.628	131	7.815	7.158	150	8.601	5.607
working hours/week	527	34.061	15.474	478	30.9	14.542	138	33.753	9.89	155	31.838	10.178
grossincome/ month	489	1348.483	1198.973	446	1265.504	843.587	138	976.808	670.309	157	1038.08	667.831
age	598	40.199	13.451	561	41.353	14.068	182	28.422	12.002	186	30.035	11.864
gender	598			561			182			186		
... male	52	16.2%		103	13.2%		12	7.8%		11	6.6%	
... female	546	83.8%		458	86.8%		170	92.2%		175	93.4%	
education level	597			560			182			186		
... compulsory	70	11.2%		137	17.3%		41	24.1%		33	20.6%	
... vocation	46	6.7%		32	9.3%		125	66.2%		128	66.1%	
... professional	0	0%		0	0%		7	3.7%		7	4.3%	
... secondary	364	52.1%		319	56.3%		3	2.1%		13	5.9%	
... tertiary	33	10.3%		33	8.5%		1	0.5%		5	3.1%	
... post secondary	84	19.7%		39	8.6%		5	3.4%		0	0%	
company size	432			375			147			166		
... <5	208	50.9%		159	37.4%		76	50.9%		74	39.7%	
... 5-10	117	24.3%		119	36.8%		41	32%		62	38.9%	
... 10-19	33	8.7%		37	11.4%		19	10.6%		22	16.7%	
... >20	74	16.1%		60	14.4%		11	6.4%		8	4.8%	
marital status	597			555			182			186		
... married	150	34.6%		161	25.6%		103	64.1%		104	60.5%	
... single	361	54%		317	59.2%		57	27.5%		71	36.1%	
... seperated	24	5%		33	7.4%		0	0%		1	0.3%	
... widowed	4	0.6%		3	0.7%		1	0.4%		0	0%	
... divorced	58	5.8%		41	7%		21	8.1%		10	3%	
health	597			560			182			186		
... very good	73	16.4%		93	12.3%		89	48.6%		91	52.4%	
... good	274	43.4%		248	47%		67	37.8%		71	34.9%	
... satisfactory	179	31.5%		158	28.1%		21	10.7%		21	11.1%	
... not well	70	8.3%		55	10.6%		3	1.5%		3	1.6%	
... bad	1	0.4%		6	2%		2	1.4%		0	0%	
wage class	544			477			153			167		
... <6	290	47.5%		252	46.2%		72	52.8%		75	52.9%	
... 6-8.50	163	30.2%		138	32.1%		29	21.8%		11	8.2%	
... 8.50-12	40	10.2%		48	11.2%		39	18.5%		62	31%	
... 12-18	28	5.4%		23	5%		5	2.6%		17	6.9%	
... 18-25	15	5.2%		7	3.7%		4	2.1%		0	0%	
... >25	8	1.5%		9	1.9%		4	2.2%		2	1%	