The effect of the minimum wage on youth employment in Germany

Abstract:

This paper investigates the effect of the minimum wage on youth employment in Germany. The effect consists of the impact on employment and labor choice, whereby the intensity of the effect is also discussed. The research question of this paper is as follows: *How did the minimum wage effect youth employment in the short run?* A difference in difference design is constructed to answer the research question. The concept of regional variation defines the control (treatment) group to states within Germany, where the *fraction* (proportion of teenagers owning less than the minimum wage) is the lowest (highest). The results implicate a positive effect on the unemployment rate, but an insignificant effect on working hours. Based on that, the conclusion is that the minimum wage negatively affected youth employment in the short run.

Thesis B.Sc. Economics and Business Economics

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Table of Contents

1. Introduction

January 1, 2015, will go down in German history as a turning point. Since 1990 the low paid sector grew significantly in Germany, and ever since statements were made about introducing a minimum wage. Finally, after the elections of 2013, the CDU, CSU, and SPD agreed on a federal minimum wage of 8.50 euros per hour. Consequently, four different papers did research, explained in the literature review. Not only they found conflicting results, but both their investigations were limited to the overall effect on employment. This paper concentrates on the impact of the minimum wage on youth employment (from now on indicated as teenagers, young people, youth). The European Union addresses several reasons why youth employment needs to be encouraged. Teenagers face specific challenges in the transition from school to work. They are being thrown into the deep, resulting in limited job opportunities and often being employed on temporary or part-time contracts. Furthermore, young people are more dependent on economic cycles. If the economic cycle is weak, the youth is more easily dismissed. Hence, the research question is as following:

How did the minimum wage effect youth employment in the short run?

The research question is approached by analyzing the employment effect through the demand for labor and the working choice of an individual. The employment effect through the demand for labor depends on the labor market structure. Analyzing the tradeoff an individual faces between leisure and work will explain the employment effect of the minimum wage through the working choice. Furthermore, the intensity of the employment effect is approached using the theory of wage elasticity, subsequently, the results for adults and teenagers are compared.

This research contributes to the research done by Caliendo et al (2018), Bruttel, Bauman, and Dütsch (2018), Garloff (2016), and Bossler & Gerner (2016) for precisely the minimum wage effect in Germany. In general, it contributes firstly to research done on the impact of a minimum wage in an everlasting discussion. Secondly, this paper helps to examine employment effects on teenagers. Especially for policymakers it is helpful to get exact knowledge on how youth employment responds to wage changes. In 2019, more than 3.3 million individuals, aged between 15 and 24, were unemployed in the European Union. It is thus useful to know whether a minimum wage would reinforce unemployment or could function as a remedy of the problem.

In the paper, individual data obtained from the German Socio-Economic Panel (SOEP) is used to run a Difference-in-Difference analysis, which analyzes the effect of a treatment on a treatment group versus a control group. The treatment is the introduction of the minimum wage in 2015. Subsequently, the control and treatment groups are defined based upon the concept of the *fraction* and *regional variation*. The control group consists of 8 states within Germany, where the fraction (proportion of teenagers earning below the minimum wage) is the lowest. These regions expect to respond less heavily to the treatment, and thus make an adequate control group. The opposite holds for states with a high fraction and accordingly respond more heavily to the treatment. These states are therefore the treatment group.

The sample is defined based on the EU definition of youth. The minimum wage only applies to those older than 18; thus the youth sample was reduced to teenagers between 18 and 24 years old. Adults are defined on an age spectrum between 24 and 67 years old since 67 is the age of retirement in Germany.

The structure is as follows. First, the theoretical framework section describes the theory behind the effect of a minimum wage. Subsequently, the data and method are discussed respectively in the sections data and methodology. After that, the empirical results section displays and analyzes the effects on employment. Finally, a conclusion is drawn based on the results which answers the research question.

2. Theoretical Framework

In the first section, labor demand describes the theory behind a minimum wage effect. In the second section, the theory behind labor choice analyzes another side of the employment effect. Finally, in the third section, the method of elasticity is explained to explore the intensity of the impact.

2.1 Employment – Labor Demand

The labor market structure determines the effect of a minimum wage on employment. Rocheteau and Tasci (2007) analyze two extreme situations in which the competitiveness of a labor market could be either a perfectly competitive market or a monopsonistic market. A perfectly competitive market consists of many firms that compete for employees, while in a monopsonistic market, firms have a dominant position over employees. The competitiveness of a market determines the power which an employer owns over wage decisions. Figure 1 illustrates the two labor market theories. First, we analyze a perfectly competitive market, in which the wage is equal to the point where labor demand and supply cross each other, denoted as W* (Figure 1, left panel). An equilibrium exists due to two reasons. The first reason is that the market wage will adapt to the marginal product of labor. Intuition is clarified when imagining two possible cases. If the wage is lower than the marginal product of labor, the cost of hiring an employee outweighs the benefit. When the wage exceeds the marginal product of labor, there is an opportunity for firms to attract other firm's workers by offering a higher wage. Higher wage offers will continue to happen until the wage equals the marginal product of labor. Secondly, the market wage must also equal the highest reservation wage (the lowest wage at which a worker would be willing to accept work) of workers in the labor force. Those with reservation wages below the equilibrium wage are employed, and those with reservation wages higher than the equilibrium wage, are voluntarily unemployed. Now consider the introduction of the minimum wage indicated as W^{-}. The new minimum wage is higher than the equilibrium wage, and so leads to a reduction in employment. As the minimum wage rises above the equilibrium wage, the labor demand declines. The gap between N_1 and N_2 stands for the employment loss. Involuntary employment arises because some of the employers are only willing to offer jobs for less than the minimum wage. The labor demand declines so not everyone can now find a job.

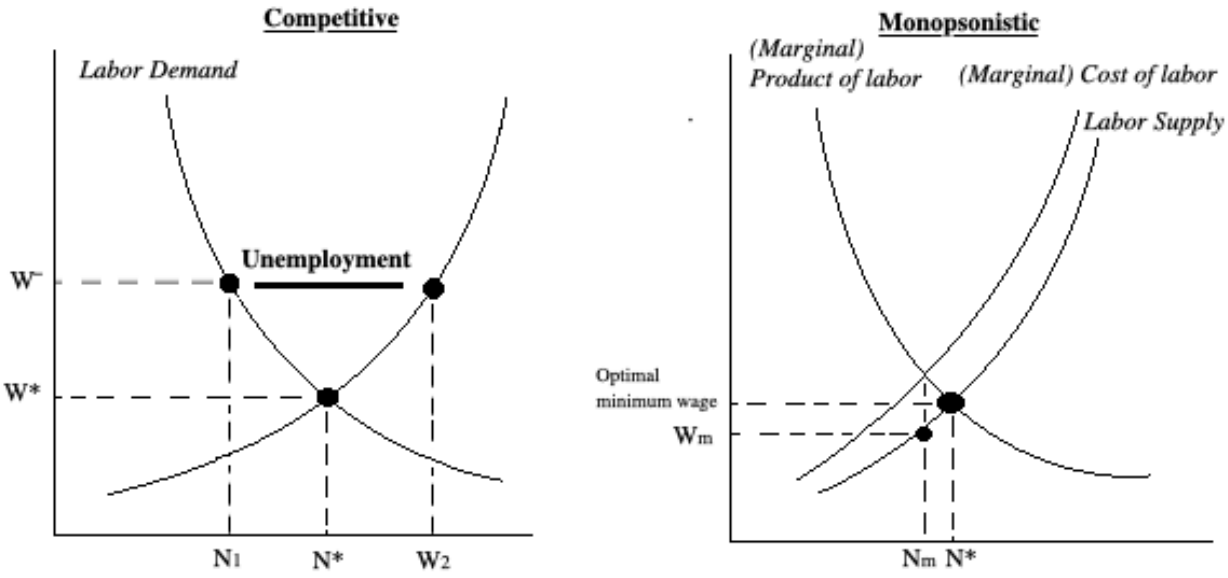

***Figure 1*:** Competitive and Monopsonic Labor Market - With and without Minimum Wage

The right panel of Figure 1 displays the monopsonistic situation. Without the minimum wage, it is profit-maximizing for the firm to set wage W_M at the point where the marginal product of labor is equal to the cost of labor. A comparison between the left and the right panel indicates a lower employment level ($N_M < N^*$) and a lower average wage ($W_M < W^*$) in equilibrium for a monopsonistic market instead of an equilibrium in a competitive market. Suppose now the introduction of a minimum wage. Through the eyes of the employer, the marginal costs of labor are now constant, resulting in flattening of the marginal cost of labor curve to the labor supply curve in (right panel). The new employment level will be N*, which is the same as the equilibrium level for the competitive market. Thus, the theory of the labor market structure indicates that as a market structure is leaning towards a monopsonist market, a minimum wage could be beneficial for employment.

Giuliano, L (2013) researched the effect of a federal minimum wage increase in the United States around 1996. The results showed a significant positive employment effect on teenagers, of which there are two possible explanations.

The first explanation is consistent with the monopsony theory. Monopsonistic models show that even if there are many firms in the market, still one firm could yield market power over employees. Reasons for this are imperfect information available to job seekers, preference for workplace location, or other distinctive nonwage job attributes. Especially in the case of teenagers, it is easier for a firm to yield higher monopsony power. First of all, teenagers face more exceptional scheduling and transportation constraints than adults do. Secondly, teenagers own less employment experience, and so may have less alternative jobs.

The second explanation founds its foundation in higher labor demand through job-search costs and wage-setting constraints. First, Flinn (2006) argues that searching is costly for both employers and job seekers, and waging is determined through ex-post bargaining. Since it's cheaper for firms to fill vacancies when there are more applicants, the incentive of a firm to create new jobs depends on the number of individuals searching for a job. A minimum wage would increase the number of applicants because it raises the expected salary, thus also individuals searching for a job. Secondly, Lang and Kahn (1998) claim that a minimum wage raises the average applicant quality, and therefore labor demand. The model analyzes search costs regarding workers and firms. Subsequently, it argues that wages will achieve a separating equilibrium for high- and low skilled workers. Due to less searching costs, a minimum wage can induce high-quality workers to apply for low-wage jobs. Job openings will then respond to higher quality and quantity of applicants.

This chapter reviews literature on the effects the minimum wage has on youth employment in Germany. More specifically, it reviews methods based on regional variation which examine the impact on full-time employment.

First of all, Williams (1993) investigated the regional effects of the minimum wage on teenage employment in the United States. Williams found that in some states an increase in the minimum wage led to no change in teenage employment, whereas in other states it reduced teenage employment significantly. He concluded that the results call for attention to regional differences when investigating a minimum wage impact.

His call was heard and acted upon by Garloff (2016) and Bossler & Gerner (2016). Bossler & Gerner used a difference-in-difference (diff-in-diff) method, based on regional variance to investigate the overall employment effect in Germany through establishments. They found that while the average wage increased, the overall employment rate decreased, and even more interesting, typical contracted working hours reduced. A diff-in-diff method with more resemblance to the one used in this paper comes from Garloff (2016). His article also investigated the overall employment effect in Germany as a result of the minimum wage, based on regional variation. But more specifically, it used the proportion of the workers earning close the minimum wage to determine where the introduction of the minimum wage would 'bite' the strongest. More or less the same is done in this paper, which is further explained in the Methodology-section. Although the study found a relationship between the 'bite' and the minimum wage, there were no significant employment effects.

Moreover, Caliendo et al (2018) and Bruttel, Bauman, and Dütsch (2018) researched the minimum wage effect in Germany in a broader time-spectrum. Although Caliendo et al found broadly negative results, the latter of the two investigations found an absence of significant negative effects.

Since the Socio-Economic Panel does not include an explicit variable for employment, data on labor hours per week serve to measure the employment effect. Teenagers who devote their time entirely to work function as a further approximation of the labor-demand employment effect. In that case, the possibility that the effect is due to a conscious choice of teenagers to work less is limited. The information above created the following two hypotheses:

Hypothesis 1a: The minimum wage decreased the working hours of the full time working youth.

Hypothesis 1b: The minimum wage increased the unemployment rates of the youth.

2.2 Employment – Working Choice

This section analyzes the working choice of an individual. An individual faces a choice between hours of working and hours of leisure, where the opportunity cost of one hour of leisure is the wage of working one hour. An increase in wage creates two sorts of effects. First of all, it creates a so-called *income effect*. A rise in wage causes an individual to get the desired income with fewer hours working than was necessary before the wage increase. Thus, the income effect shifts an employee's preference towards hours of leisure over labor hours. The second effect is described as the *substitution effect.* A pay rise then increases the opportunity costs of an hour of leisure. In the trade-off between hours of leisure and labor hours, employees prefer to work more and take less time of leisure. The substitution (income) effect explains an increase (decrease) of working hours caused by a rise in wage could be explained by the

This chapter reviews literature of the effects a minimum wage has on the working choice of an individual teenager. For teenagers, there could be several reasons driving one of two effects. One aspect that exercises influence is school enrollment. On the one hand, jobs stimulate school enrollment by supplying an income which could pay the costs of school. On the other hand, a more excellent supply of job opportunities could facilitate more school dropouts and leads to more full-time working youth employees. The study of Gustman and Steinmeier (1981) shows that higher relative wage offers, reduce the probability of youth

enrollment in school. His research could be interpreted as a substitution effect since teenagers started to work more. Neumark & Wascher (1995) also find an increase in the probability for teenagers to become employed, or to work more hours. The evidence suggests that although they found an overall net disemployment (fulltime and part-time) effect, there are still subgroups that should be a concern to policymakers.

Since precisely the effect of the minimum wage on youth employment in Germany has is not investigated yet, there is only an effect on the overall German population. However, Brüttel, Bauman, and Dütsch (2018) found that the minimum wage in Germany led to a decrease in marginal part-time jobs. These jobs are comparable to the part-time jobs of teenagers, suggesting that the minimum wage effect in Germany is pointing towards an income effect.

This chapter investigates part-time employment effects, since teenagers who work part-time own more autonomy over the choice of their working hours. The following hypothesis is thus as follows:

Hypothesis 2: The minimum wage decreased the working hours of the part-time employed youth

3. Intensity

It is also interesting to evaluate the impact of the minimum wage on youth employment compared to adults. *Wage elasticity* (from now on elasticity) describes the intensity of a minimum wage effect. Wage elasticity of supply and demand further distinguish the term. Both elasticities are measured in the same way, and the outcome is either *inelastic* or *elastic.* When the fluctuation in labor demand changes relatively less than the adjustment in wage, the result is called inelastic. If the raise or reduce in salary is relatively smaller than the employment loss or gain, the outcome is called elastic. Figure 2 illustrates the concept, where D_1 denotes an elastic demand curve, and D_2 an inelastic demand curve. An adjustment in wage from W to W' causes a more significant loss in labor demand for D_1 than for D_2. Thus the intensity of the alteration in wage is higher for the elastic labor demand curve.

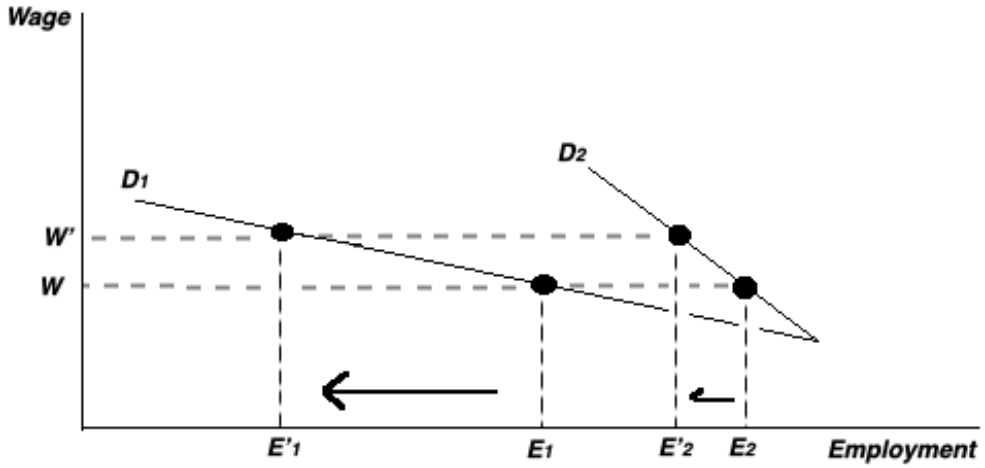

Figure 2: Wage elasticity - Labor Demand

Pemberton (1989) outlined the Hicks-Marshall laws of determinants for the elasticity of labor demand. Four factors influence the wage elasticity of demand. Firstly, the demand for the final product. Since labor costs are a substantial part of the total production costs, and since product prices reflect production costs, a rise in wage will thus raise the price of the final product. Imagine the demand for the final product is elastic, then a firm needs to economize more to keep the profit the same. Labor demand gets more sensitive, and thus more elastic. The paper of Smith (2012) illustrates the second factor. Smith investigated the impact of low skilled immigration on the youth labor market. He found that low skilled immigration had a negative effect on the employment to population rate of high school-aged youth than for adults. The more suitable work is for substitution, the more elastic the demand for it is. Thirdly, the supply of other factors. Imagine that due to a wage increase firms are willing to replace their labor by other production factors, such as capital. If the sudden rise in demand for capital outweighs the supply, the price of capital rises. The increase in price on this turn discourages firms to substitute the labor. Thus the more significant the supply of other production factors, the more elastic the demand for labor. Finally, the share of the labor costs in total costs plays a role. A higher percentage in employment costs means more significant losses when the wage rises. Thus, the bigger the share of total expenses, the more elastic the demand

The elasticity of labor supply measures the extent to which supply of labor reacts to a change in wage. Figure 3 illustrates the elasticity of labor supply. The left panel denotes an elastic supply of labor. Low skilled jobs cause a more elastic effect because the supply of labor is ‘greater’ than for more skilled required jobs. For highly skilled jobs, labor supply is thus more inelastic, illustrated in the right panel of figure 3.

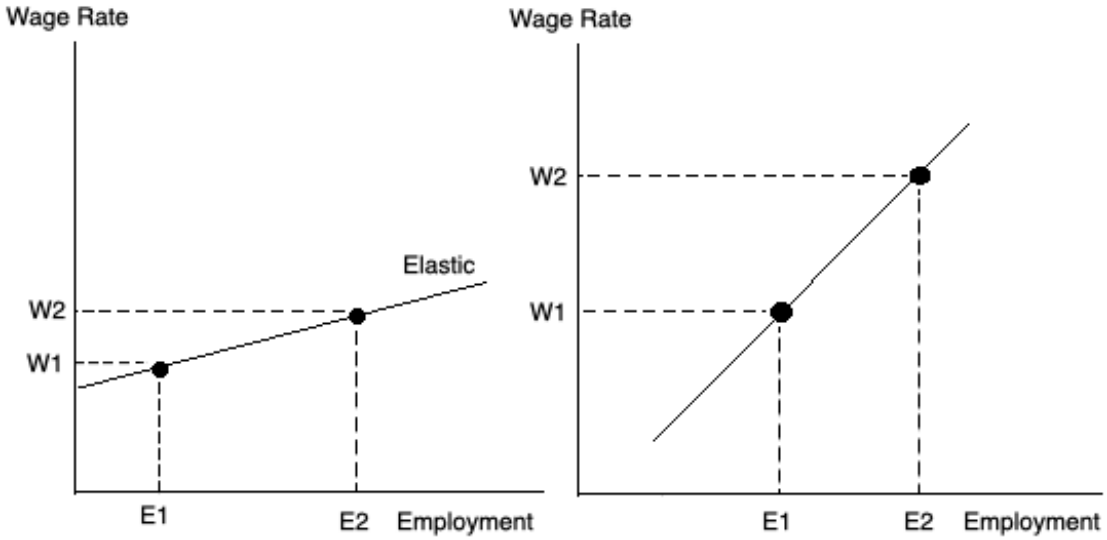

***Figure 3*:** Wage Elasticiy - Labor Supply

Nial O'Higgins (1997) also investigates the elasticity of youth employment. O'Higgins (1997) found several reasons for youth employment to be more elastic than adult employment. On the supply side, he found that young people are more likely to quit their jobs voluntarily than older workers. The opportunity costs for them to just "shop around in jobs" are lower than for adults. A consequence is that when job opportunities become scarce, unemployment will increase more amongst those groups with a higher likelihood of quitting their jobs, the youth. On the demand side, the opportunity costs of firing young people are lower than for older workers because teenagers are less skilled. Moreover, the youth is less protected by employment legislation, and employers are less constrained by the law. As a third reason, in times of crisis, firms are more eager to cease labor costs than other expenses. It is obvious to say that young people will be more heavily affected by a freeze in recruitment in these times.

The theory on wage elasticity and the research done by O'Higgins, created the following hypothesis:

Hypothesis 3: The minimum wage has a bigger employment effect on youth than on adults.

3. Data

The data is obtained from the *Socio-Economic Panel* (SOEP) Germany. This database consists of panel data from 1984 until 2018, with interviews of more than 30,000 individuals. Information build upon questions on topics such as date of birth, education, employment, and wage were used for this research. First of all the refusals to answer were excluded from the data. Secondly, youth employment and adult employment are separated. Individuals aged between 18 and 24 when the legislation of the minimum wage passed in January 2015, define teenagers. The extent of the adult age dimension is between 25 and 67. Furthermore, the dataset did not include a variable for an hourly wage. The wage per hour was solved by first dividing the individual monthly income by four to get the individual income per week. Subsequently, dividing it by the actual working hours per week results in the hourly wage. Some individuals reported a minimum income of fewer than 8.5 euros after the introduction. Since this is likely to be a reporting error those observations were excluded. Finally, for the use of the Difference in Difference design, the results over the period 2010 until 2018 are measured. After all of these changes, the youth-sample contains 30,114 observations, and the adults' sample contains 232,422. Both of them are divided into subsamples in Table 1.

Table 1: Observations in the sample for Youth-Adults per subsample.

	Youth (18-24)	**Adults (25 – 67)**
Total	30,114	232,422
Employment		
Employed	18,553	129,220
Non-Employed	11,561	103,202
Employed		
Part-Time	3,982	42,420
Full-Time	4,283	85,747
Vocational training	3,249	960
Sheltered workshop	47	93
Education		
In education	8,405	26
Not following education	21,709	129.194
Sex		
Male	15,315	65,009
Female	14,799	64,211

The observations in total and per subsample. All subsamples were self-reported by the SOEP interview respondents, which means e.g. individuals themselves make the distinction between part-time and full-time.

Employment consists of *part-time, full-time, vocational training,* and *sheltered workshop workers*. The indication of *full-time* and *part-time* jobs serve for measuring how many time an individual spends on his work. As illustrated in table 2, the average labor hours per week for a full-time employee is close to 40 hours per week. The average working hours of part-time employees were between 14 and 22 hours a week. Furthermore, the term *vocational training* is designed specifically for jobs that require specific on-the-job-knowledge. It includes of 70% training or working on the job, and 30% training in school. Vocational training forms a greater share amongst the youth compared to adults, as illustrated by the observations in Table 1. Fourthly, *Sheltered Workshop* involves disabled persons in sheltered employment. Furthermore, individuals following education have divided. Education in Germany consists of 3 subcategories. Primary level: primary schools, age 6 to 13 (irrelevant for the sample). Secondary level: The same as the definition of high schools in the United States, plus school-based vocational training programs, age 13 until 19. Tertiary Level: mostly universities, age 19+.

Table 2 shows the means on wage and labor hours, before and after the minimum wage. For each subsample, the average salary rose sharply after the introduction. Although full-time employees earned on average more than before the minimum wage, they started to work less after the minimum wage. This finding could be an indicator of a negative employment effect. On the other side, part-time employees began to work more while the mean of their wages rose, which is an indicator of a substitution effect. Note that although the mean of the wage for teenagers in education increased, there is not a substantial effect on their labor hours per week. Finally, Table 2 does not include sheltered workshop since there were no observations past the minimum wage for the subsample.

Table 2: Average Wage / Labor hours per subsample for Youth-Adults

	Youth (18-24)				Adults (25 - 67)			
	Before Minimum Wage		After Minimum Wage		Before Minimum Wage		After Minimum Wage	
Subsample	**Wage**	**Labor Hours**	**Wage**	**Labor Hours**	**Wage**	**Labor Hours**	**Wage**	**Labor Hours**
Employment Status								
Full-Time Employment	10.58	42.17	14.65	41.70	19.26	44.29	20.48	43.89
Part-Time Employment	8.28	14.17	13.71	15.34	14.15	21.61	15.78	22.03
Vocational Training	4.34	40.47	13.66	34.14	5.01	40.25	6.17	39.71
School Degree								
In Education	5.99	32.39	8.92	33.12	6.41	26.92	15.62	32.04
Not in Education	6.82	34.51	10.19	34.53	17.38	26.92	21.05	36.71
Sex								
Male	6.85	36.16	10.72	36.13	19.90	43.04	23.33	42.08
Female	6.78	32.67	10.07	32.30	14.85	30.27	18.71	31.17

Wage is measured in Euro's, whereas Labor Hour indicates how many hours an individual spent on work per week. The Youth spectrum contains of ages between 18 and 24, whereas the Adult spectrum contains of ages between 25 and 67 (the retirement age). The hourly wage is constructed by first dividing the monthly wage by 4, and afterward by the Labor Hours per week.

This paper also uses the data on the employment rate per state is. The data is obtained from *the Bundesagentur für Arbeit* (Federal Employment Agency). The panel data on employment rates per state for a period of 2010 – 2018 accounted for individuals who were between 15 and 24 years old. Since the Bundesagentur für Arbeit only published the total number of unemployed individuals per state, the unemployment rate was divided by the total number of unemployed teenagers/non-teenagers to get the total number of employed teenagers/non-teenagers and total labor force of teenagers/non-teenagers.

4. Methodology

The method used for answering the hypotheses in this paper is a *Difference-in-Difference* design. Usually, this method takes the difference in the control and treatment group, caused by the difference in treatment. Only in the case of a federal minimum wage, there are no differences in implementation. The concept of *regional variation* solves this problem. The first evidence of regional variance descends from Card (1992). Card investigated the effect of a federal minimum wage increase in the United States on teenagers by analyzing regional variance based on the concept of the *fraction.* The fraction is the number of employees earning less than the minimum wage before the introduction divided by the total number of employees before the introduction. The effect of the minimum wage rise in states with a high fraction has been compared to the effect of the minimum wage rise in states with a low fraction. Whereas Card (1992) researched regional variation across more autonomous states in the US, Stewart (2002) took it one step further analyzing less autonomous states within the United Kingdom. Similarly to Card, Stewart argued that in high-fraction areas the minimum wage would create a larger effect compared to low-fraction areas. More specifically, they expected a relative decline in employment in high-fraction areas compared to low-fraction areas.

The regional variance method was further used by Caliendo et al (2017) in their research on employment effects due to the introduction of a minimum wage specifically in Germany. The study emphasized that the states with the highest fraction form the treatment group because their adaptions to wage differences will be stronger. This paper applies the same technique. Table 3 classifies states to either treatment or control group based on the median of the *Fraction* in 2014.

Table 3: States split based on fraction: Control < Median 0.250 < Treatment.

Control Group	**Treatment Group**
Baden-Wuerttemberg (0.237)	Brandenburg (0.325)
Berlin (0.180)	Saarland (0.357)
Mecklenburg-West Pomerania (0.231)	Saxony (0.315)
North Rhine-Westphalia (0.246)	Rhineland-Palatinate (0.306)
Schleswig-Holstein (0.242)	Lower-Saxony (0.277)
Hamburg (0.243)	Thuringia (0.253)
Bremen (0.244)	Bavaria (0.306)
Hessen (0.240)	Saxony (0.275)

The formulas of the difference-in-difference designs are presented below.

$$LaborHours_{ijt} = A + pState_j + \beta MinimumWage_{jt} + \gamma Year_t + \theta Indiv_{ijt} + \mathcal{E}_{ijt}$$

The dependent variable is the actual labor hours per week for individual i, in state j, in year t. Hypothesis 1a requires labor hours of full-time employed teenagers, whereas for hypothesis 1b the dependent variable is filled in by part-time labor hours. A is the constant, p indicates the effect of the dummy variable state, and γ indicates the impact of the dummy variable year. Furthermore, θ illustrates the effect of several control variables. These control variables include individual characteristics: education, gender, and age. $\mathcal{E}_{ijt}$ stands for the standard error, which uses robust standard errors. Finally, the coefficient that we are interested in is β. It indicates the minimum wage effect and is the interaction term of being in the treatment group after 2015.

For hypotheses 2b and 3, the Unemployment Rates per state in the year between 2010 and 2018 replaces the Labor Hours as dependent variable. Furthermore, θ indicates the control variable of the proportion of teenagers in the labor force for each state in each year. The formula is as following:

$$UnemploymentRate_{jt} = A + pState_j + \beta MinimumWage_{jt} + \gamma Year_t + \theta Proportion_{jt} + \mathcal{E}_{ijt}$$

One of the main assumptions of a Difference-in-Difference design is the *Parallel Trend Assumption*. In the absence of a minimum wage, the outcomes (labor hours or unemployment rates) between the states in the control and treatment group need to be constant over time. To test the parallel trend assumption, the treatment (introduction of the minimum wage) shifts hypothetically one year back. To do so, a variable named *lead* is created to simulate this. This variable is 1, and starts at the year before the initial treatment, 2014, until 2018. For the assumption to hold, the coefficient of the *lead* should be insignificant. The following models are constructed to check the assumption:

$$\begin{aligned} UnemploymentRate_{jt} \\ &= A + pState_j + \beta MinimumWage_{jt} + \gamma Year_t + \lambda MinimumWage_{T-1,j} \\ &+ \theta Proportion_{jt} + \mathcal{E}_{ijt} \end{aligned}$$

$$LaborHours_{ijt} = A + pState_j + \beta MinimumWage_{jt} + \gamma Year_t + \lambda MinimumWage_{T-1,j} + \theta Indiv_{ijt} + \mathcal{E}_{ijt}$$

Thus if λ is significant, the coefficient of the lead is significant, and the parallel trend assumption does not hold.

Besides the difference-and-difference approach described above, Neumark and Wascher (2017) address several other methods in their paper for a credible research design to invest the effect of minimum wages. One of them is the *Synthetic Control Method* in which a weighted combination of groups is constructed to use as a possible control group. The group which shows the most resemblance with the treatment group functions as the control group. Albadie (2019) used a combination of OECD countries to create a control group that showed the most similarity with West-Germany. Based on the research of Albadie, a control group drawn on the comparison of unemployment rates through 2010 and 2018 of all OECD countries was made. Figure 8, appendix, shows the results. Unfortunately, the synthetic control group does not follow the same trend as Germany before the intervention of the minimum wage, which makes it an inadequate control group. Therefore it is decided not to use the synthetic control method. Another method described in Neumark and Wascher (2017) is the *Instrumental Variable Method*. Baskaya and Rubinstein (2015) used this in their research on minimum wage effects in the US. The interaction of a state minimum wage with the federal minimum wage served as an instrumental variable. Only in the case of Germany, the sixteen states do not own such autonomy to yield their state wages.

5. Empirical Results

5.1 Employment

Table 4 presents the results of the minimum wage on the total youth employment. A total of 11,561 observations over the period 2010 until 2018 result in a negative, insignificant minimum wage effect of -0.810. Education, age, and gender are control variables, of which gender and education are interpreted further on. With each extra year of age, an individual will start to work 186 minutes more on average. Furthermore, the Parallel Trends assumption is satisfied when the lead coefficient is insignificant. In figure 4, appendix, displays the trends of both the labor hours for the control and treatment group. For the Parallel Trends assumption to hold, the trends of the treatment and control group before the treatment date (2015, introduction of the minimum wage) have to follow the same pattern. In other words, the pre-trends have to be parallel to each other. In this case, the assumption holds. Further on the results part Diff-in-Diff is indicated as (1) and Parallel Trends as (2).

Table 4: Effect of Minimum Wage on all youth employees (18-24)

Variables	**Diff-in-Diff (1)**	**Parallel Trends (2)**
Minimum Wage	-0.810	-0.839
Constant	-31.311***	-31.299***
Lead		-0.431
Education	-1.391***	-1.391***
Age	3.108***	3.107***
Gender	-2.559***	-2.558***
Observations	11,561	

The outcome variable is the labor hours per week for teenage employees, which is used as a proxy for Employment. Education indicates whether an individual is still in education or not. Gender indicates whether an individual is a man or a woman. Age indicates the age of an individual from 2010 until 2018. ***p<0.01, **p<0.05, *p<0.1. The minimum wage is the treatment variable, and the lead coefficient is interpreted regarding the significance.

To answer hypotheses 1a and 2 it is necessary to make a distinction between the employment status of the youth, presented in table 2. Minimum wage effects for full time, part-time and vocational training workers are insignificant positive. The insignificance means that the data cannot form decisive evidence for a conclusion. Furthermore, for all of the three types

of employment status, the leads are insignificant, which means that the parallel trend assumption holds.

Table 5: Effect of Minimum Wage on Full-Time, Part-Time and Vocational Training (18-24)

	Full-Time		**Part-Time**		**Vocational Training**	
Variables	(1)	(2)	(1)	(2)	(1)	(2)
Minimum Wage	0.0007	0.002	0.459	0.350	0.329	0.200
Constant	27.868***	27.867***	-33.494***	-33.495***	4.658	4.699
Lead		-0.031		1.404		1.470
Education	-1.553	-1.553	-0.274***	-0.274**	-2.066***	-2.063***
Age	0.634***	0.634***	2.033***	2.029***	-1.655***	-1.652***
Gender	-0.574**	-0.574**	1.720***	1.734***	0.251	0.260
Observations	4283		3982		3,249	

The outcome variable is the labor hours per week for teenage employees, which is used as a proxy for Employment. Education indicates whether an individual is still in education or not. Gender indicates whether an individual is a man or a woman. Age indicates the age of an individual from 2010 until 2018. Difference between Full-Time, Part-Time, and Vocational Training is self-reported. ***p<0.01, **p<0.05, *p<0.1. The minimum wage is the treatment variable, and the lead coefficient is interpreted regarding the significance.

To better understand what is the source of the effect of a minimum wage introduction, it is interesting to analyze different subsamples. The impact on gender on women and men separately is presented in Table 6. On average, women tend to work 70 minutes less after the introduction of the minimum wage, at a significance level of 10%. The coefficient for man does not make sense, since it is insignificant. Furthermore, the lead coefficient of both is insignificant, which means that the control and treatment group follow same parallel trend.

Table 6: Effect of Minimum Wage on Labor Hours of Man and Woman (18-24)

	Man		**Woman**	
Variables	(1)	(2)	(1)	(2)
Minimum Wage	-0.632	-0.559	-1.165**	-1.272
Constant	-29.304***	-29.320***	-41.595***	-41.545***
Lead		-0.551		1.502
Education	-1.565***	-1.565***	-1.144***	-1.142***
Age	2.920***	2.920***	3.324***	3.321***
Observations	6119		5442	

The outcome variable is the labor hours per week for teenage employees, which is used as a proxy for Employment. Education indicates whether an individual is still in education or not. Age indicates the age of an individual from 2010 until 2018. ***p<0.01, **p<0.05, *p<0.1. The minimum wage is the treatment variable, and the lead coefficient is interpreted regarding the significance.

Furthermore, it is interesting to evaluate the minimum wage effect amongst those who are in education, for whom work is most likely to be a side job, and those who are not in school and thus devote their hours per week fully to their work. Table 7 shows that teenagers in education are more heavily affected by the minimum wage compared to those not in school. However, the coefficient of those not in education is insignificant. Still, teenagers in education started to work 180 minutes less after the minimum wage at a significance level of 10%. This is an indicator of a substitution effect. Moreover, both of the leads are insignificant which means the parallel trends assumption holds.

Table 7: Effect of Minimum Wage on Labor Hours of those in Education & not in Education

	In Education		**Not in education**	
Variables	(1)	(2)	(1)	(2)
Minimum Wage	-3.014*	-3.143*	-0.915	-0.939
Constant	-45.900***	-46.066***	-31.706***	-31.695***
Lead		1.931		-0.379
Age	2.638***	2.645***	3.141***	3.141***
Gender	0.513	0.547	-2.664***	-2.663***
Observations	421		11140	

The outcome variable is the labor hours per week for teenage employees, which is used as a proxy for Employment. Gender indicates whether an individual is a man or a woman. Age indicates the age of an individual from 2010 until 2018. ***p<0.01, **p<0.05, *p<0.1. The minimum wage is the treatment variable, and the lead coefficient is interpreted regarding the significance.

In Table 8, the minimum wage showed a positive significant effect employment effect for those with a secondary school leaving degree. Contrary to this finding is the significant negative employment effect on dropouts. Note also that Table 8 omits the coefficients of *Minimum Wage*, *Proportion*, and *Constant* in the lead-formula because of the more subsamples. The parallel trends assumptions hold for every kind of degree except for 'other'.

Table 8: Effect of Minimum Wage on Labor Hours per week – School Degree

Variables	Secondary School	Intermediate School	Technical School	Upper secondary	Other	Dropout
Minimum Wage	2.980***	-0.294	-1.951	-0.849	-0.436	-8.893**
Constant	34.007***	-31.463***	-11.048*	-20.990***	-14.515**	-0.364
Age	3.585**	3.382***	2.330***	2.250***	2.298***	1.484***
Gender	-2.756***	-1.836***	-2.861**	-0.378	-1.381	-1.370
Lead	-3.508	-0.998	3.310	1.377	-6.047**	-6.224
Observations	1,595	3226	598	2091	693	301

The outcome variable is the labor hours per week for teenage employees with different diplomas, which is used as a proxy for Employment. Gender indicates whether an individual is a man or a woman. Age indicates the age of an individual from 2010 until 2018. All different diplomas are self-reported ***p<0.01, **p<0.05, *p<0.1. The minimum wage is the treatment variable, and the lead coefficient is interpreted regarding the significance.

The results in Table 9 describe the effects of the minimum wage on the unemployment rate over the period 2010 until 2018. The data consists of 16 different unemployment rates per state, of Figure 5, appendix, displays the parallel trends. First, the proportion of the labor force served as a control variable, but the lead was significant, and so the parallel trend assumption did not hold. Subsequently, the proportion of the unemployment per state resulted in a positive significant effect, for which the parallel trend assumption holds. The coefficient implies that a minimum wage resulted in an increase of 0.020 on the unemployment rate.

Table 9: Effect of Minimum Wage on Unemployment Rate

	Labor Force		Unemployed	
Variables	(1)	(2)	(1)	(2)
Minimum Wage	0.022***	0.014***	0.020***	0.015***
Proportion	-1.9160***	-0.191***	-0.362**	-0.329**
Constant	0.099***	0.098***	0.114***	0.110***
Lead		0.010**		-0.007
Observations	144		144	

The outcome is the unemployment rate per state, which is used as a proxy for Employment. Proportion is the proportion of teenagers either in the labor force or in the total unemployed.. ***p<0.01, **p<0.05, *p<0.1. The minimum wage is the treatment variable, and the lead coefficient is interpreted regarding the significance.

5.2 Analysis Employment

The results lead to different kinds of implications. First of all, most of the results are insignificant which indicates that the data does not show a connection between the labor hours of individuals worked per week and the introduction of the minimum wage. However, we will still interpret the results in this section. full-Time, part-Time, and vocational Training employees started to work insignificantly more than before the introduction of the minimum wage. To answer hypothesis 1a, the effect on Full-Time labor hours is analyzed. The insignificance shows that there is no relation between full-Time labor hours and the minimum wage, based on the data. Hypothesis 1a is thus rejected. Hypothesis 1b is tested through analyzing the effect of the minimum wage on the unemployment rates of the youth. The results show a significant positive relationship between the unemployment rate and the minimum wage. Furthermore, the lead is insignificant which implies that the parallel trend assumption holds. The minimum wage leads to an increase in the unemployment rate across youth, which means that hypothesis 1b holds. An explanation based on the theory is that the labor market of the youth in Germany is constructed as a perfectly competitive labor market. In a perfectly competitive market, an increase in wage creates disequilibrium and leads to a negative employment effect. The results regarding the labor demand in employment effects are in one line with the research of Bossler & Gerner (2016). This paper, similarly to Bossler & Gerner, examines negative employment. However, the study of Bossler & Gerner found a negative employment effect not only through the employment rate but also through contractual labor hours. The data obtained from the SOEP does not show a significant relationship between working hours and the minimum wage. The results are also in line with Bruttel, Bauman, and Dütsch (2018), whereas they found broadly absence of significant effects.

For hypothesis 2 vocational training could be interpreted likewise part-time work since teenagers spend time in work beside their study. Both of them show an insignificantly positive effect, which means that based on the data there is no connection between the working choice of part-time labor hours and the minimum wage. Hypothesis 2 is thus rejected. However, teenagers in education started to work significantly less after the minimum wage. The surveys classifies it not exactly as part-time jobs, but it is likely for teenagers to work part-time since they are still in education. The significant negative result on the labor hours of those in education point towards an income effect. An increase in wage leads to a more feasible desired income with fewer hours working. The results regarding the working choice in employment effects are contrary to what Brüttel, Bauman, and Dütsch (2018) found. Their research showed a negative employment effect on marginal part-time jobs, which are comparable to those of

part-time working youth. The significant negative employment effect of those in education in this research is not in line with Gustman and Steinmeier (1981) and Neumark & Wascher (1996). Both papers argued that a minimum wage results in more hours working, and less focus on education for Teenagers.

Furthermore, there is no significant interpretation of comparison between men and women, although women started to work on average significantly 70 minutes less per week. Moreover, the subsample *School Degree* implies that teenagers with any kind of degree started to work more after the introduction of the minimum wage compared to school-dropouts

5.3 Intensity

This section investigates the employment effect of the minimum wage on the chosen labor hours per week for both adults as teenagers. To evaluate the size of the impact on youth a comparison to adults is needed. Table 10 describes the effects of the minimum wage on the total of adults and youth who participated in the SOEP survey. The results of the teenagers are obtained from the previous section. For adults, the minimum wage led to a negative employment effect with significance at 5%. Adults started to work on average 30 minutes less as an effect of the minimum wage, whereas teenagers worked on average insignificantly 48.6 minutes less. Note also that *education* is not a control variable to the prediction of the minimum wage effect on adults.

Table 10: Effect of Minimum Wage Adults compared to Youth (Labor Hours)

	Adults (25 - 67)		**Youth (18-24)**	
Variables	**(1)**	**(2)**	**(1)**	**(2)**
Minimum Wage	-0.484**	-0.614***	-0.810	-0.839
Constant	57.088***	57.088***	-31.311***	-31.299***
Lead		0.237		-0.431
Age	-0.059***	-0.059***	-1.391***	-1.391***
Gender	-12.075***	-12.075***	3.108***	3.107***
Observations	129,220		11,561	

The outcome is the labor hours per week, which is used as a proxy for Employment. Age indicates the age of an individual throughout 2010 and 2018. Gender is either woman or man. ***p<0.01, **p<0.05, *p<0.1. Minimum wage is the treatment variable, and the lead coefficient is interpreted regarding its significance

Table 11 displays the results of exclusively the subsample *gender*. Only adult men and teenage women have a significant coefficient. Unfortunately, there is no opportunity for interpretation of a comparison between the same gender. However, on average an adult man worked 37 minutes less per week after the introduction of the minimum wage. For teenage women, the effect was almost twice as strong since they started to work on average 70 minutes less.

Table 11: Effect of Minimum Wage on Gender. Adults compared to Youth.

	Adults (25 - 67)		**Youth (18-24)**	
Variables	Man	Woman	Man	Woman
Minimum Wage	-0.616**	-0.344	-0.632	-1.165**
Constant	45.978***	32.034***	-29.304***	-41.595***
Lead	-0.050	0.448	-0.551	1.502
Age	-0.0670***	-0.052***	2.920***	3.324***
Observations	65,009	64,211	6119	5442

The outcome is the labor hours per week, which is used as a proxy for Employment. Age indicates the age of an individual throughout 2010 and 2018. ***p<0.01, **p<0.05, *p<0.1. Minimum wage is the treatment variable, and the lead coefficient is interpreted regarding its significance

Table 12 shows the results of a comparison between the average unemployment rates of teenagers and adults, as a result of the minimum wage. With the labor force as a proportion, the lead is significant. Swapping the proportion of the labor force for unemployment also results in a significant coefficient of the lead. The significance means the parallel trend assumption does not hold, and thus no useful interpretation can be made.

Table 12: Effect of Minimum Wage on Unemployment Rate - Youth compared to Adults.

	Adults (25 – 67)		**Youth (15-24)**	
Variables	Labor Force	Unemployed	Labor Force	Unemployed
Minimum Wage	0.015**	0.049***	0.0218***	0.020***
Proportion	-0.672***	0.458**	-1.916***	-0.362**
Constant	0.672***	-0.333	0.099***	0.114***
Lead	0.018***	0.033***	0.010**	-0.007
Observations	144		144	

The outcome is the unemployment rate per state, which is used as a proxy for Employment. Proportion is the proportion of teenagers either in the labor force or in the total unemployed.. ***p<0.01, **p<0.05, *p<0.1. The minimum wage is the treatment variable, and the lead coefficient is interpreted regarding the significance.

5.4 Analysis Intensity

The results in the intensity section have several implications in terms of the size of the employment effect on youth. First of all, adults experienced a negative significant employment effect regarding their labor hours. The result is 1.67 times as small as the insignificant effect of the minimum wage on teenagers. Secondly, a comparison within the subsample *gender* between a significant effect of the minimum wage on adult men and teenage women leads to a more intense effect on the teenager. The effect on teenage women is 1.89 times more intense when compared to the effect on an adult man. Thirdly, a comparison of the effect of minimum wage on unemployment rates between adults and teenagers was analyzed. However, the parallel trend assumption does not hold for the minimum wage effect on the unemployment rate for adults. Both leads of both kinds of proportions are significant, and figure 6 shows non-parallel pre-trends. Unfortunately, the effect of the minimum wage on the unemployment rates for adults and teenagers make no useful comparison. All results taken into account, hypothesis 3 is rejected. The data shows no significantly more intense effects for youth compared to adults.

However, the literature addresses several reasons for the difference in elasticity between adults and youth. On the supply side, teenagers have a higher likelihood of quitting jobs when job opportunities become scarce. From the perspective of demand, teenagers get fired more quickly due to a lack of experience and flawed legal protection. Only these theories found no foundation in the results of this research.

6. Conclusion

This paper provided an answer to the research question: "*What effect does the introduction of the German minimum wage has on youth employment".* First of all, the employment effect was approach by analyzing the demand for labor, and the working choice of an individual. Full-time labor hours per week and unemployment rates distinguish the impact on the change in labor demand. Part-time working hours help investigate the minimum wage effect on the working choice. Secondly, adults and teenagers are compared to measure the intensity of the effect. The minimum wage effect on the total labor hours per week and the unemployment rates were compared between the two age groups.

A Difference-in-Difference approach resulted in an insignificant increase of full-time labor hours per week as an effect of the wage adjustment. Based on the lack of significance, hypothesis (1a) was rejected; the minimum wage did not decrease the working hours of full-time youth. Furthermore, a significant positive effect of the minimum wage on the average unemployment rates per state was found. This finding leads towards an acceptance of hypothesis (1b); the minimum wage increased the unemployment rates for youth. Furthermore, hypothesis (2) is was rejected since the minimum wage resulted in two times an insignificant positive effect on labor hours of vocational training and part-time teenagers. Thirdly, a comparison between insignificant results of adults and teenagers leads to a rejection of hypothesis (3) the data showed no bigger significant employment effects on teenagers than on adults.

Based on the results stated above, an answer to the research question is formulated. The employment effect regarding the demand of labor indicates that the minimum wage resulted in a negative employment effect on youth employment. It increased the youth unemployment rate, without significantly increasing or decreasing employment measured in full-time labor hours per week. A negative employment effect implies that the German labor market for youth leans towards a perfectly competitive structure. Regarding subsamples, the data showed a negative employment effect for teenagers in education. Moreover, those with an intermediate school-leaving degree experienced a significant positive employment effect, contrary to school drop-outs who experienced a significant negative employment effect. The impact on the working choice was leaning towards an income effect. Although the minimum wage had an insignificant impact on part-time labor hours, teenagers in education experienced a significant decrease in labor hours. The results are in one line with the research done by Bruttel, Bauman, and Dütsch (2018), in terms of finding no significant results. However, the results of a positive

unemployment effect point towards the research constructed by Caliendo et al (2018). Furthermore, the intensity of the minimum wage effect is expected not to be higher for youth compared to adults. The data gives no evidence that teenagers respond more elastic to wage adjustment, in terms of employment and unemployment. These results regarding the elasticity are the opposite of the research done by O'Higgins (1997).

Although the parallel trends assumption is the fundamental assumption of this this research, this paper still knows some limitations. First of all, a bigger sample would probably produce more significant outcomes, since differences in control and treatment will less likely be masked by randomness in the sample. Secondly, not all groups were evenly representative within the sample. This is clarified when looking at the observations for those in education versus not in education, or the different kind of degrees. It limits the external validity of the results. The existence of illegal work further limits the external validity. To capture the full employment effect, undeclared employment has to be taken into account. Nevertheless, the personal tracking of the survey strengthens the external validity. Teenagers who leave the household do not leave the program, as they still get to fill in the surveys.

Furthermore, labor hours per week do not give the same approximation for the employment effect. Nowadays, full-time employees do have some autonomy over their working hours. Further research could instead better approach an employment effect by using, for example, the full-time equivalent as the dependent variable. When still choosing labor hours per week as the dependent variable, an addition could be to process somehow a variable indicating how much time the youth spends on school each week. It could to a better explanation of why the labor hours declined or raised. Unfortunately, the SOEP did not contain such a variable.

Moreover, the method used in this paper is not undisputed. Neumark and Wascher (2017) addressed several methods for a good approximation of a minimum wage effect. Unfortunately, a comparison of unemployment rates between all OECD countries gave no resemblance between the treatment and control group for a synthetic control method. Then, the option of an instrumental variable in terms of a federal minimum wage did not seem applicable to Germany. So the Difference-in-Difference method used by Stewart (2002) remained. Although most of the results supported the Parallel Trends Assumption, the technique is not ideal. First, the distinction between the control and treatment groups is based upon a very small sample. With observations between zero and fifty for the proportion workers earning below the minimum wage the treatment and control group are not reliable. Secondly,

based on the proportion of teenagers earning below the minimum wage, a distinction between control and treatment group was made. Still, both treatment and control groups underwent the treatment. Consequently, the effects lean more towards an approximation, instead of indicating real results. This greatly limits the external validity of the research.

Future research could firstly investigate further into mechanisms driving the minimum wage effect on teenagers. Economic theories such as the labor market structure and income or substitution effects give some explanation, but do not lead to final results. Secondly, further research could emphasize more why substitution effects drive teenage employment or why the teenage labor market is structured as a perfectly competitive market. Thirdly, in the case of negative employment effects, it would be helpful for policies to investigate how to protect the youth from negative employment results. Finally, teenagers and immigrants tend to compete for employment. Including immigrant flows in research could lead to a more detailed employment effect on teenagers.

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Appendix A – Parallel Trends Assumption

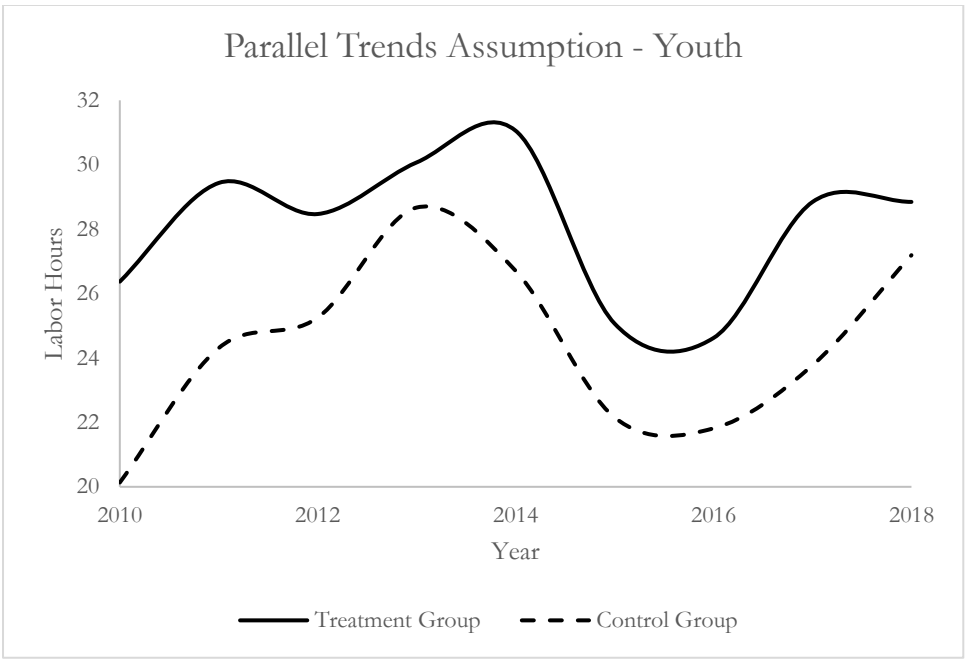

Figure 4: Parallel Trends of Labor Hours for Youth

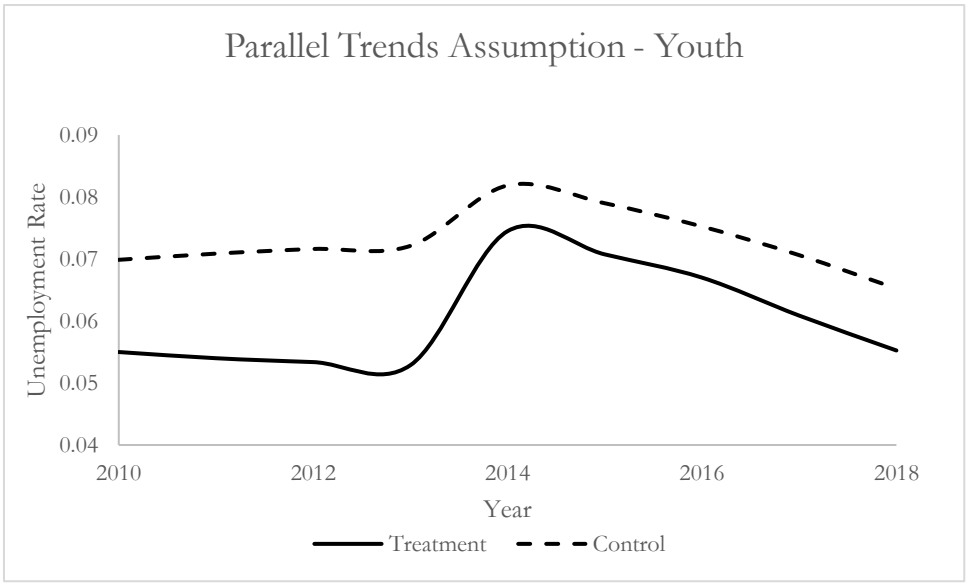

Figure 5: Parallel Trends of Unemployment Rate for Youth

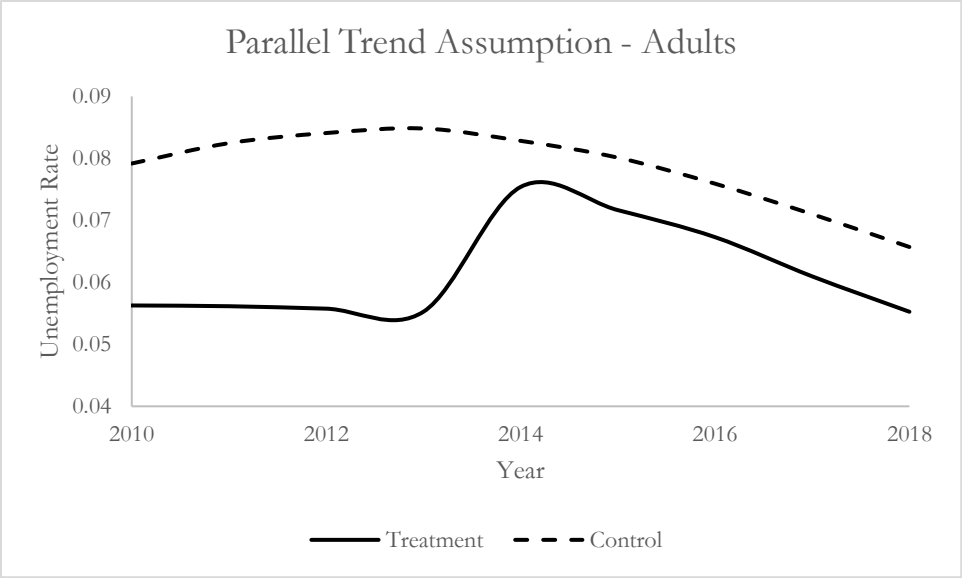

Figure 6: Parallel Trends of Unemployment Rate for Adults

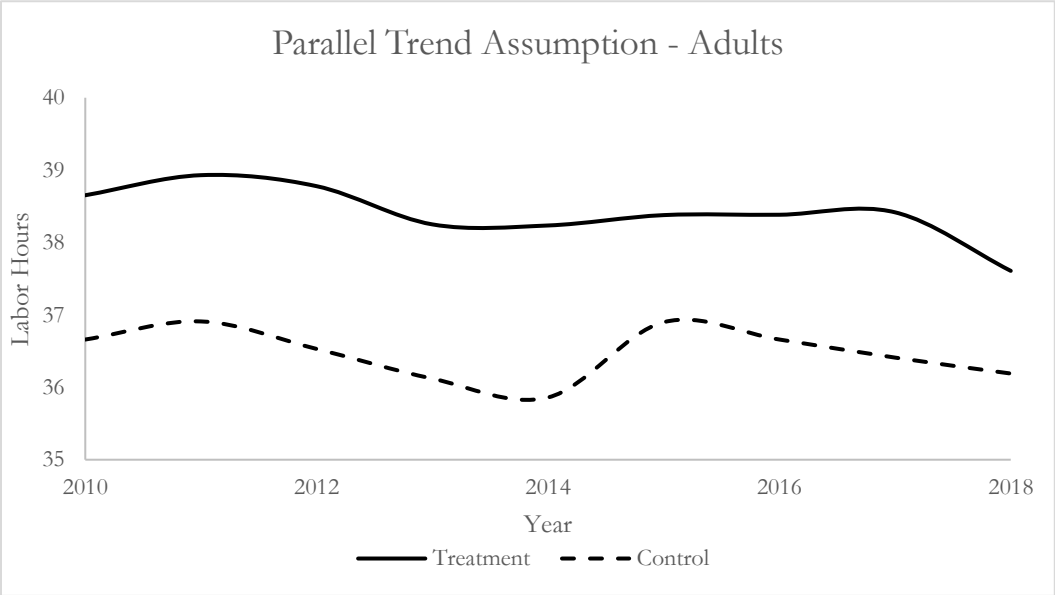

Figure 7: Parallel Trends of Labor Hours for Adults

Appendix B – Synthetic Control

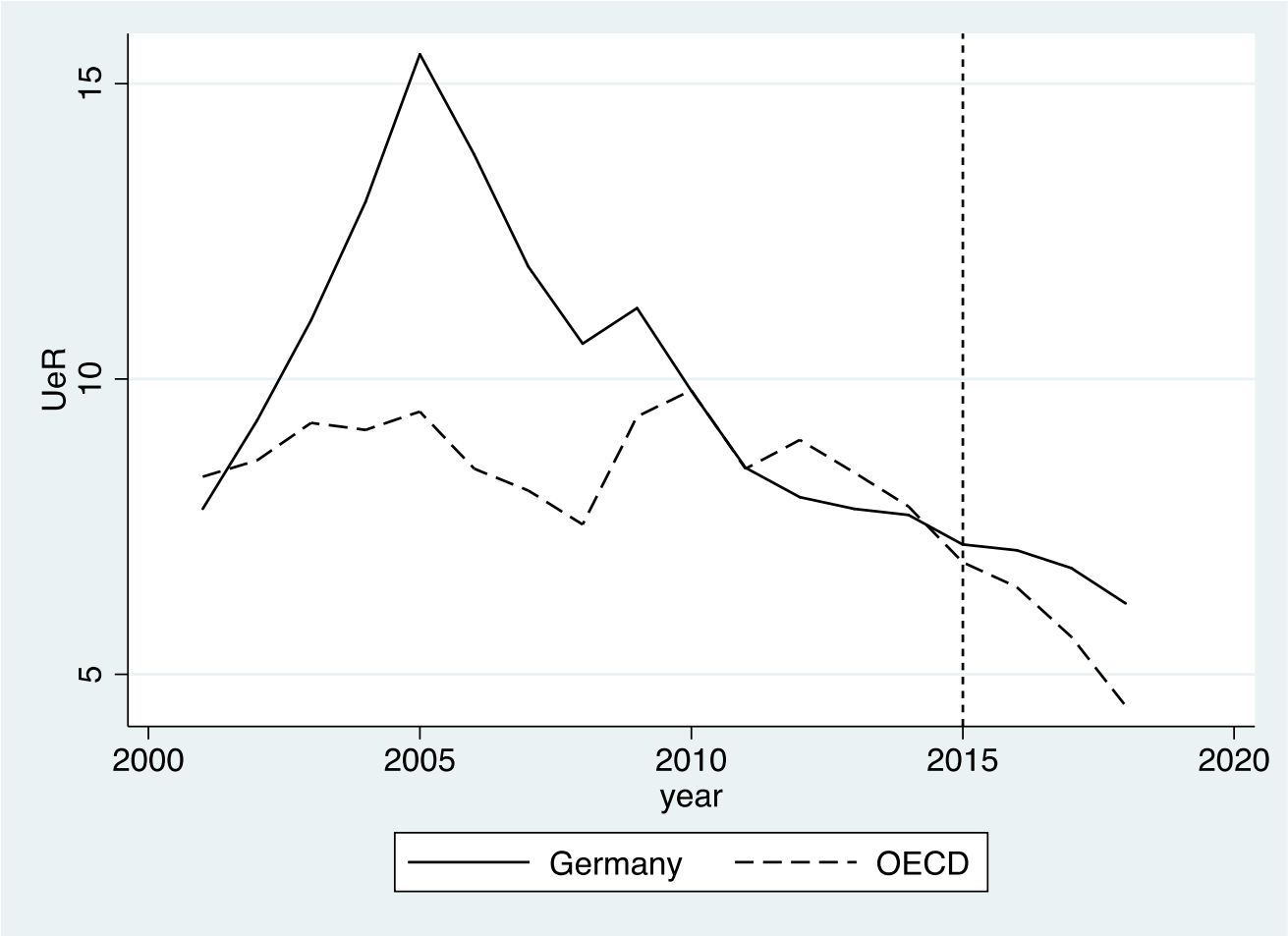

Figure 8: Synthetic Control Method, based on Unemployment Rates per OECD country.