Does reduced labor costs increase employment among minimum wage workers? Evidence from a Swedish payroll tax cut

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We use a youth payroll tax cut in Sweden to investigate if retail firms that were exposed to a high treatment intensity of the reform increased employment of minimum wage workers more than firms that received no or small labor cost savings. Our dataset includes information on both contracted wages and number of working hours for most employees in the Swedish retail trade industry. We find that a very large share of all retail employees had contracted wages near the negotiated minimum wage levels at the time of the reform, suggesting that the minimum wage levels are binding to a great extent. We also find that retail firms with large labor cost savings due to the youth payroll tax cut significantly increased the number - and working hours – of minimum wage employees that were employed by the hour. However, no such effects are observed for employees with more stable employment contracts or wages well above the negotiated minimum wages. Our study thus suggests that the relatively high minimum wage levels within the retail industry in Sweden prevents employment of workers who are perceived to have low productivity.

Keywords: Retail trade industry, minimum wages, payroll tax reform, natural experiments, collective bargaining

JEL classification: D24, L25, L26.

1. Introduction

The large and recent inflow of refugee immigrants to Europe accentuate the great mismatching difficulties on the European labor market, with a growing number of workers having difficulties to enter the labor markets (Brell et al., 2020; Bruno et al., 2014; Daunfeldt et al., 2019). A potential reason is that their perceived productivity does not match the minimum wage. Low-wage job tasks may thus be offered to workers that are perceived as higher skilled, become automated, or not being performed at all. This can cause involuntary unemployment among workers that are perceived as low-skilled (Kellermann, 2017; Neumark, 2017; Skedinger, 2015), and result in high persistent unemployment rates among these group of workers (Schmillen & Umkehrer, 2017).

However, the empirical evidence on the employment effects of minimum wages is inconclusive. Some studies find that higher minimum wages cause unemployment and create entry barriers for workers that are perceived as low-skilled (Campolieti, 2020; Jardim et al., 2017; Neumark & Wascher, 2006; Wolfson & Belman, 2019), while others find no strong relationship between high minimum wages and employment levels (Broecke et al., 2017; Card & Krueger, 1994; Doucouliagos & Stanley, 2009; Katz & Krueger, 1992; Schmitt, 2015). However, the bulk of evidence is based on studies that estimate minimum wage-employment elasticities using variation in the state-level and federal-level minimum wages in the United States (Neumark & Wascher, 2008). This is troublesome considering that evidence from these quasi-natural experiments may lack external validity for labor markets elsewhere.

Minimum wages tend, for example, to be much higher in Europe than in the United States[1], particularly in the Scandinavian welfare states (Schulten & Lübker, 2021). It is thus more likely that minimum wages are binding and set above the equilibrium wage in these countries, thereby causing involuntary unemployment among workers that are perceived to have low skills. Minimum wages are also set by industry-level negotiations between trade unions and employer associations in Scandinavia, rather than mandated by law. Policymakers are thus unable to implement minimum wage changes to increase employment among marginalized workers. An alternative that remains is to reduce firms' total labor costs by lowering their payroll taxes. In contrast to a decrease of the legislative minimum wage, a payroll tax cut increases firms' demand for labor but does not lower employees' wages. The opportunity cost of labor market entry is therefore unchanged, and there is consequently no off-setting supply-side reaction. This implies that a payroll tax cut should increase employment for minimum wage workers through an increase in labor demand if minimum wages are binding and set above the market equilibrium.

[1] Note that there are substantial variations in minimum wages between countries in Europe (Christl et al., 2018), although minimum wages, on average, are higher in Europe than in the United States.

There is, however, limited evidence on how payroll tax cuts affect minimum wage jobs. One rare exception is Kramarz & Philippon (2001) who investigated the employment effects in France due to changes in labor costs that were partly due to payroll tax changes. They found that increased labor costs decreased employment, while the effect of decreasing labor costs on minimum wage employment was not significantly different from zero. This suggests that the employment effect of labor cost changes might be asymmetric. One shortcoming is that the study only investigates the transition from non-employment to employment, which means that we still lack information on how reduced labor costs influence the number of working hours of incumbent workers.

We use a Swedish youth payroll tax cut in 2007 as a quasi-natural experiment to investigate how reduced labor costs for firms influence minimum wage jobs – both at the extensive (number of jobs) and intensive margin (number of working hours). The Swedish payroll reform implied that firms' labor costs were reduced by 11 percentage points for all employees that were between 19-25 years old. As such, firms received different treatment intensities of the reform based on the size of their total wage costs for young employees. Following Daunfeldt et al., (2021), we exploit this firm-level variation in treatment intensities by estimating a Difference-in-Difference-in-Differences (DDD) model. Our empirical set-up enables us to analyze if firms that received large labor cost reductions increased the number and working hours of minimum wage employees compared to firms that received small or no labor cost savings due to the youth payroll tax cut.

Our analysis is made possible due to access to wage statistics from the employers' organization Confederation of Swedish Enterprise (*Svenskt Näringsliv*), covering a large share of all employees in the Swedish retail trade industry. Numerous studies have investigated the effects of the Swedish youth payroll tax cut in 2007 on, for example, number of employees (Daunfeldt et al., 2021; Saez et al., 2019), number of young workers (Egebark & Kaunitz, 2018; Skedinger, 2014), number of employed immigrants (Gidehag, 2019), and number of working hours of insiders employed in the retail trade industry (Seerar Westerberg, 2021). We contribute to the literature by using the payroll tax cut to investigate how the reform affected minimum wage jobs – both on the extensive and intensive margin. Retail jobs are of particular interest to study considering that retailers tend provide jobs that do not require higher education or previous labor market experience (Skedinger, 2015).

We find that firms with large labor cost savings due to the youth payroll tax cut hired significantly more minimum wage employees after the reform than firms with smaller savings. The effect is limited to hourly employed individuals, but not employees with a monthly salary, implying that the reduction of firms' labor costs benefitted those with a weaker attachment to the labor market. We also find a significant positive effect of firms' labor cost savings on the total number of hours worked in the vicinity of the minimum wage. Our findings thus suggest that payroll

tax cuts can create job opportunities for employees who have difficulties in entering a labor market. Hence, payroll tax cuts seem to be a way to increase employment among low-wage workers in an institutional setting where minimum wages are high and set by centralized collective agreements.

The outline of this paper is as follows. The next section provides a theoretical background and an overview of previous research on the link between labor costs and employment at the minimum wage level. Our data and descriptive statistics are presented in section 3, while our empirical framework is described in section 4. In section 5, we present our findings. Finally, section 6 concludes the paper.

2. Theoretical background and previous findings

2.1 Theoretical background

To illustrate the employment effects of a payroll tax cut that reduces firms' labor costs, we use a combination of the queuing hypothesis and the substitution hypothesis (Kellermann, 2017). Let us first assume, following the queuing hypothesis, that all workers skill level (q) are perceived as low-skilled by the employer, $q = l$, at time $t = 0$, and can choose between investing in higher skills, $q = h$, through education, or seek employment in a job that pays the low-skilled wage W_t^l. Education costs are defined by training expenses, CH_t and the absence of the low-skilled wage W_l. Finishing an education means that the worker is perceived as high-skilled and is rewarded with a higher wage at W_t^h, i.e., $W_t^h > W_t^l$.

The opportunity cost of education is given by $H_0\mathrm{C}+H_0W_t^l$, where H_0 is the time spent on education and C is the direct cost of education. In addition, $H_0W_t^l$ is the forgone wage income from the low-skilled job position. Income, Y, given an investment in education in period t = 0, a market interest rate, r, and a discount factor β is given by:

$$Y(H_t) = \sum_{t=1}^{T} \beta^t \left(\frac{W_t^h}{(1+r)^t}\right) H_t - \left(\mathrm{C} + \mathrm{W}_0^{\mathrm{l}}\right)\mathrm{H}_0. \qquad (1)$$

The optimal decision is obtained by maximizing (1) with respect to time spent on education, giving us the point where the marginal utility of education equals the marginal cost:

$$\sum_{t=1}^{T} \beta^t \left(\frac{W_t^h}{(1+r)^t}\right) = \left(\mathrm{C} + \mathrm{W}_0^{\mathrm{l}}\right) \qquad (2)$$

When the minimum wage is binding for low-skilled workers only, $W_0^h > \mathrm{MW} > W_0^l$, i.e., set above the market wage, then $MW_t = W_t^l$. This implies that the opportunity

cost of education rises for workers that are perceived as low-skilled, which results in an excess supply of workers:

$$\sum_{t=1}^{T} \beta^t \left(\frac{W_t^h}{(1+r)^t}\right) < (\mathrm{C} + \mathrm{MW_t})\mathrm{H_0} \qquad (3)$$

The implication of the queuing hypothesis is that a high minimum wage will induce labor market entrants that are perceived to have low productivity, such as young low-educated individuals and refugees, to prefer a direct entry into employment because the opportunity cost of education is high. Labor market entrants are thus more likely to consist of a high share of such workers, as more of them are incentivized for queuing for a limited number of job positions.

Next, we use the substitution hypothesis and consider a profit function where firms have access to high- and low-skilled workers as inputs, L_t^l, L_t^h; P is the price for output; and output is defined as $F\left(L_t^l, L_t^h\right)$. The profit function is given by:

$$\Pi_\mathrm{t} = P_t F\left(L_t^l, L_t^h\right) - \sum_{q=l,h} W_t^q \, L_t^q \qquad (4)$$

The profit max can then be written:

$$P_t\left[F'\left(L_t^l\right) + F'\left(L_t^h\right)\right] = W_t^l + W_t^h \qquad (5)$$

If we again consider a situation where minimum wages are binding for low-skilled workers, but not for high-skilled workers, $W_t^h > MW_t$, $> W_t^l$, we have an unbalance given by:

$$P_t\left[F'\left(L_t^l\right) + F'\left(L_t^h\right)\right] < MW_t + W_t^h, \qquad (6)$$

implying that the firm will substitute and hire more high-skilled workers instead of low-skilled workers whose productivity does not match the higher marginal cost defined by MW_t . The minimum wage thus implies a shift in labor demand from the low-skilled to employees that are perceived to have high-skills, meaning that L_t^l will decrease and L_t^h will increase.

The probability of being employed is higher for high-skilled workers even in the absence of a minimum wage, $p^h > p^l$. However, the introduction of a minimum wage that is higher than the market equilibrium wage means that demand shift even more towards high-skilled workers, i.e., the probability of employment for higher-skilled is now even higher, $p_h^{MW} > p_h$, while it is lower for those that are perceived as low-skilled $p_l^{MW} < p_l$. If we insert these probabilities in equation (3), this leads to the following implication:

$$p_h^{MW} \sum_{t=1}^{T} \beta^t \left(\frac{W_t^h}{(1+r)^t}\right) H_t > p_l^{MW}(\mathrm{C} + MW_t\ )\mathrm{H}_0. \qquad (7)$$

The substitution hypothesis thus states that workers that are perceived as low-skilled will face a lower probability of employment when the minimum wage is higher than the market clearing wage, and that they will try to accumulate more skills to earn W_t^h in the future. The implication is that low-skilled workers will leave the labor force to a greater extent and that labor market entrants are more likely to consist of workers that are perceived to have higher skills.

In Sweden, minimum wages are not set by politicians but rather in negotiations between trade unions and employer organizations. This means that politicians do not have the opportunity to lower minimum wages to create more job opportunities for job seekers that are perceived to have a lower productivity. An opportunity that remains for them is to implement payroll tax cuts targeted towards individuals with perceived low productivity, such as young employees and immigrants. This will not lower the minimum wages on the labor market, which means that the alternative cost of education remains constant for low-skilled workers. However, a payroll tax cut directed at the low-skilled will reduce firms' labor costs of this group, which means that the demand for low-skilled workers will increase.

To summarize, equation (3) predicts that less low-skilled entrants will enter the labor market if the legislated minimum wage is reduced, while equation (7) predicts that the probability of being employed for low-skilled workers, p_l^{MW}, increases. As such, the effects on minimum wage employment of a reduction of legislated minimum wages is ambiguous. However, the wage floor in equation (3) remains if firms' labor costs are reduced by a payroll tax cut. Thus, there is no off-setting force on the opportunity cost of education for low-skilled workers, suggesting that the demand for low-skilled workers will increase when firms' payroll taxes are lowered.

2.2 Previous findings

A significant number of studies has previously analyzed how minimum wage increases affect employment[2]. Most of these studies are conducted in the United States, typically investigating exogenous changes of federal and state minimum wages, using a wide range of methodological approaches and datasets. Most of the early contributions indicated that higher minimum wages reduce employment for low-wage workers (Brown, 1999; Neumark & Wascher, 2006). However, this conventional position has been challenged by several studies (Card & Krueger, 1994;

[2] Note that very few studies investigate minimum wage reductions. While there are some recent exemptions (Bossler et al., 2020; Georgiadis et al., 2020), the lack of papers that studies reductions are problematic since the effect of minimum wages can be asymmetrical, i.e., that the employment effect can be of different magnitude for increases and reductions, respectively.

Katz & Krueger, 1992), finding no or even positive employment effects of minimum wage increases.

There have been several recent attempts to summarize the minimum wage literature but the results from these literature reviews and meta-analyses are inconclusive. On the one hand, some studies conclude that there is strong support that minimum wage increases cause negative effects on employment, and that vulnerable groups are more negatively affected (Campolieti, 2020; Neumark & Shirley, 2021; Wolfson & Belman, 2019). On the other hand, there are reviews indicating no or a weak relationship between minimum wages and employment outcomes (Card & Krueger, 2015; Schmitt, 2015). There are also indications of a publication bias that favors negative and significant effects on employment of minimum wage increases (Broecke et al., 2017; Doucouliagos & Stanley, 2009).

However, most studies on the employment effects of minimum wage changes are based on data from the United States. This means that these studies might not be generalizable outside their institutional context. For example, the federal minimum wage per hour worked in the United States is $ 7.25, which equates about 62 Swedish krona (SEK) at today's exchange rate[3]. This can be compared with the lowest negotiated entry wage in the retail trade industry in Sweden, which is SEK 133.68[4] ($ 15.58), i.e., more than twice as high as the federal minimum wage in the United States[5]. Such large differences in entry wages are important to consider since effects of small changes of low minimum wages are likely to be modest compared to large changes of high minimum wages (Jardim et al., 2017; Schmitt, 2015).

Minimum wages are furthermore set in industry-level collective agreements between trade unions and employer associations in Sweden, and these agreements are also extended to non-member firms and employees without a collective agreement to a great extent. Policymakers in Sweden are therefore unable to implement legislated minimum wage changes. These institutional differences mean that a change in labor costs might have different employment effects for minimum wage workers in Sweden compared to a change of the legislated minimum wage in the United States.

Previous evidence from Sweden have consistently indicated that workers with a weak attachment to the labor market are disadvantaged by high minimum wages (Calmfors et al., 2016). However, these studies are limited to investigating the effect on extensive margin employment, which means that they ignore that many low-wage jobs are part-time positions (Skedinger, 2015) and that the effect on intensive margin employment might be a more significant adjustment mechanism (Jardim et

[3] Using the 2021 average exchange rate, equivalent to 8.58 SEK/USD.
[4] For employees aged at least 18 years old, with no prior experience.
[5] Considering that the payroll tax level in the USA is 12.4 percent in total compared to 31.42 percent in Sweden, the total minimum wage cost difference is even higher.

al., 2017). These studies are furthermore not using quasi-natural experiments but are rather based on effect of minimum wage changes on employees with different positions in the wage distribution, making causal inference more questionable.[6] The results indicate that increasing minimum wages are associated with an increase in job separations and a decrease in labor market entry among low-wage and low-skilled workers. There are also studies that find a lower probability of labor market entry for low-wage workers when minimum wages increase, but no indications of job separations. However, these results are mostly concentrated to workers within the public sector (Eliasson & Nordström Skans, 2014; Forslund et al., 2014).

Skedinger (2014) has previously realized that the 2007 payroll tax reform can be utilized as a quasi-natural experiment to investigate the effect of firms' labor cost reductions on low-wage jobs. He uses the same dataset as us but his analysis is limited to analyzing the effect of the youth payroll tax cut on the employment of eligible workers compared to marginally older workers. However, this approach means that the aggregated firm-level tax cut windfall is ignored and that the total employment effect as a consequence will be underestimated (Daunfeldt et al., 2021; Saez et al., 2019). These limitations might explain why only modest effects on employment for young workers were found, including for those bound by minimum wages. Recent studies (Daunfeldt et al., 2021; Saez et al., 2019, 2021) that have accounted for the firm-level tax windfall of the 2007 payroll tax reform indicate increase employment and wage incomes for both younger and older workers. However, these studies have no access to data on hourly wages and number of working hours and were therefore unable to investigate the employment effect across hourly wage rates, and effects on intensive margin employment. How minimum wage employment responded to the labor cost reductions following the payroll tax cut in 2007 is thus yet unexplored.

3. Data and descriptive statistics

3.1 Data

Our study is based on wage statistics from a database compiled by the employers' organization Confederation of Swedish Enterprise (*Svenskt Näringsliv*), covering all firms that were members of the Swedish Trade Federation (*Svensk Handel*) from year 2000 to 2015. The data are collected in September each year, and include information about individuals' age, contracted wages, performance-related wages, number of working hours, inconvenience allowance, and whether they have a monthly salary or are employed by the hour. The data also contain a firm-identification number, making it possible for us to construct an employer-employee dataset.

[6] This type of analysis has been performed with data from the hotel and restaurant industry (Skedinger, 2006), the retail trade industry (Skedinger, 2015) and among refugee immigrants (Lundborg & Skedinger, 2014).

Initially, our dataset includes 2,671,071 individual-year observations, with the number of individuals ranging from approximately 123,000 to 226,000 per year. We restrict our sample to the years 2003-2008 and employees who are 18-65 years old, which leaves us with 907,958 observations in total. We are thus investigating the short-run effects of a reduction in firms' wage costs on the number of hires and working hours near the minimum wage. We refrain from investigating long-run responses because these estimates are likely to accommodate contemporaneous shocks and reforms that may interfere with the results (Mian & Sufi, 2012). Another reason for restricting the post-reform period to 2008 is that the payroll tax cut was lowered once more in 2009, and the age threshold was also extended at that time. Finally, we exclude individual-year duplicates since some of these are due to individuals who are registered multiple times at the same employer. After excluding these duplicates, our sample consists of 894,320 individual-year observations, with the number of individuals being equal to 331,039 and the number of firms being equal to 5,802.

It should also be noted that we restrict our empirical analysis to individuals who are manual workers - as opposed to non-manual workers - and who follow the collective agreement for the retail sector (the so-called *Detaljhandelsavtalet*)[7]. Approximately 50.5 percent – 447,555 observations – of the sample are constituted by such workers. Lastly, the firm-level analysis is restricted to firms that are existent in each year over the 2003-2008 period, which reduces the number of firms to 1,182. The reason for only including surviving firms is that we utilize the years 2003-2005 as a placebo period in the estimations (see section 4.3). To ensure that our results are not affected by outliers, we exclude firms that have an employment growth that deviates by more than +/- three standard deviations from the average change, leaving us with a total of 1,124 retail firms.

Minimum wages are not determined by law in Sweden, but rather in negotiations between trade unions and employer organizations. This means that there are multiple minimum wage levels, varying both across and within industries. According to *Detaljhandelsavtalet*, there were six different minimum wages during our study period that depended on the age and tenure of the employees. More specifically, the hourly minimum wage levels in 2006, expressed in USD and in the price level of 2021, were[8]:

(a) 18-year-olds with less than one year tenure (12.04 USD).
(b) Minimum 19 years of age and have less than one year tenure (12.31 USD).

[7] We have also performed estimations with the full sample, covering individuals within all collective agreements within retail. Utilizing the full sample, results remain very similar and are available upon request.
[8] Note that we use the average 2021 USD/SEK exchange rate to convert the minimum wages to USD. The negotiated minimum wages in the retail trade industry have as of 2022 increased to (in USD) a) 14.68, b) 14.89, c) 15.28, d) 15.50, e) 16.35, e) 16.37.

(c) Minimum 19 years of age and have at least one year tenure (12.80 USD).
(d) Minimum 19 years of age and have at least two years tenure (13.09 USD).
(e) Minimum 19 years of age and have at least three years tenure (14.18 USD).
(f) Minimum 19 years of age, at least three years of tenure and five years at the same firm (14.27 USD).

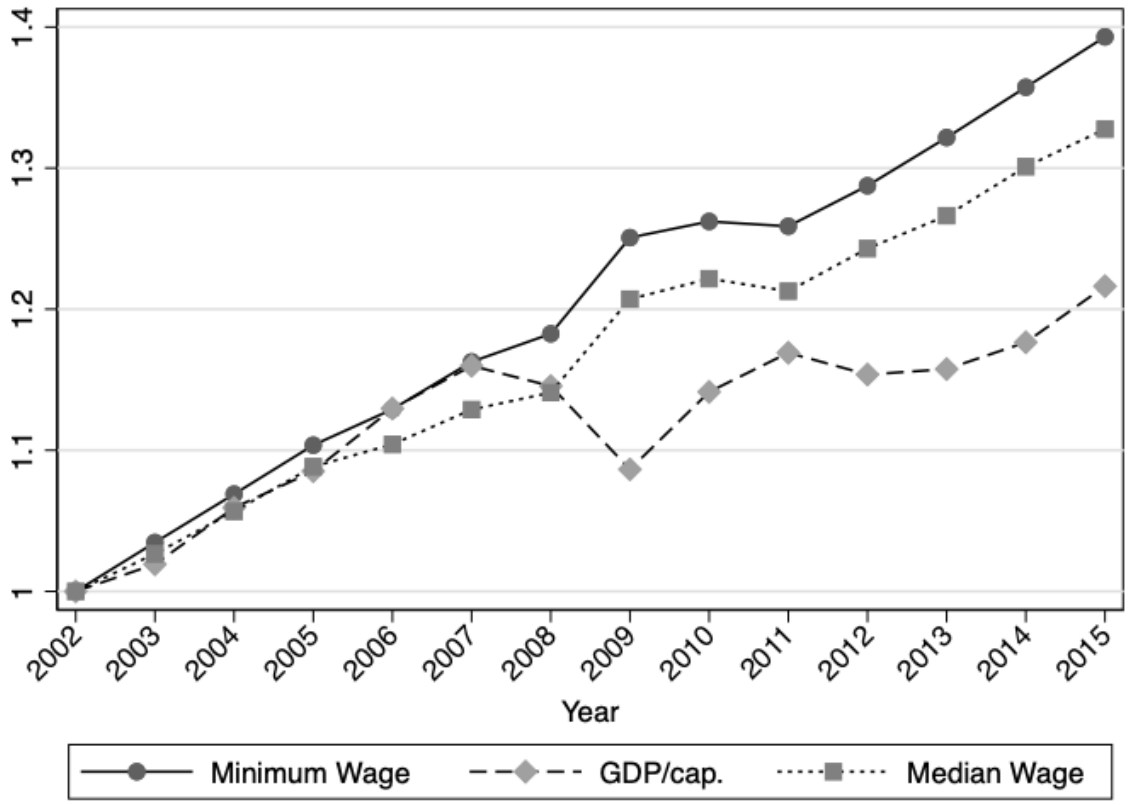
Henceforth, we choose to relate employees' wages to minimum wage (b) as this is the most representative for a typical labor market entrant[9]. Figure 1 illustrates how minimum wage level (b) has evolved for employees covered by the retail trade agreements over the period 2002-2015. The corresponding developments for GDP per capita and the median wage level within the retail industry are also displayed in the figure.

Figure 1 shows that the minimum wage level has increased by 39.3 percent during the study period, while the median wage has increased by 32.8 percent, implying that the negotiated minimum wage has increased considerably more than the wage of a representative employee within the retail trade industry. The general productivity growth, represented by growth in GDP per capita, has also increased at a slower pace than the minimum wage in the retail trade industry.

Note that the illustrated growth of minimum wages will only cause involuntary unemployment if the minimum wage exceeds the equilibrium wage. If this is the case, the negotiated minimum wage level constitutes a binding condition for becoming employed. We cannot observe the equilibrium wage, but if wages tend to cluster around the negotiated minimum wages, wages are likely set above market equilibrium (Skedinger, 2015).

[9] Minimum wage level (a) is only applicable for employees that are 18 years, and these individuals constitute a very low share of all new hires in the retail trade industry (e.g., 6.6 % in 2006).

Figure 1. Percentage growth in the minimum wage level over 2002-2015.

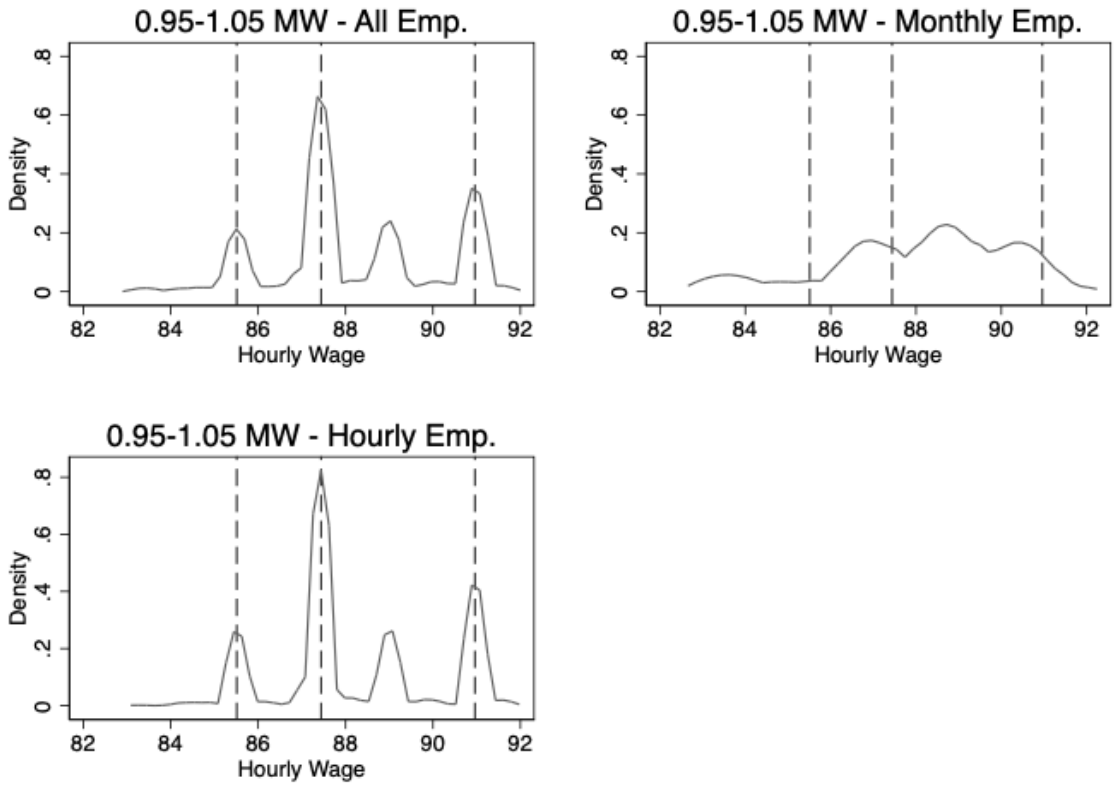


Note. Minimum wage and median wage levels are measured in the price level of 2021. Real GDP per capita (constant prices). The reference year is 2002 (=1) for all variables.

Figure 2 shows the wage distribution around the negotiated minimum hourly wage levels in 2006. Here, we include employees that have a negotiated wage that is 5 percent lower or higher than minimum wage level (b). This wage interval includes three out of six negotiated minimum wage levels, illustrated by the dashed lines. Figure 2 includes the joint wage distribution of all employees within this wage interval, as well as separate distributions for employees that work for a monthly and an hourly wage, respectively.

Figure 2 shows spikes exactly at the minimum wage thresholds for all employees that work within this wage interval (upper-left), showing a clear overrepresentation of employees that work at one of the minimum wage rates. The wage distribution for those employees that are working per hour (bottom-left) closely resembles the joint distribution, while the wage distribution for those employed on a monthly wage (upper-right) contains no spikes in the vicinity of the minimum wage thresholds. Employees that are employed on a monthly wage are more established on the labor market, while those that are paid by the hour tend to have a looser attachment. The negotiated minimum wage levels thus seem to exceed the equilibrium wage for workers with less experience, but not for employees with more seniority.

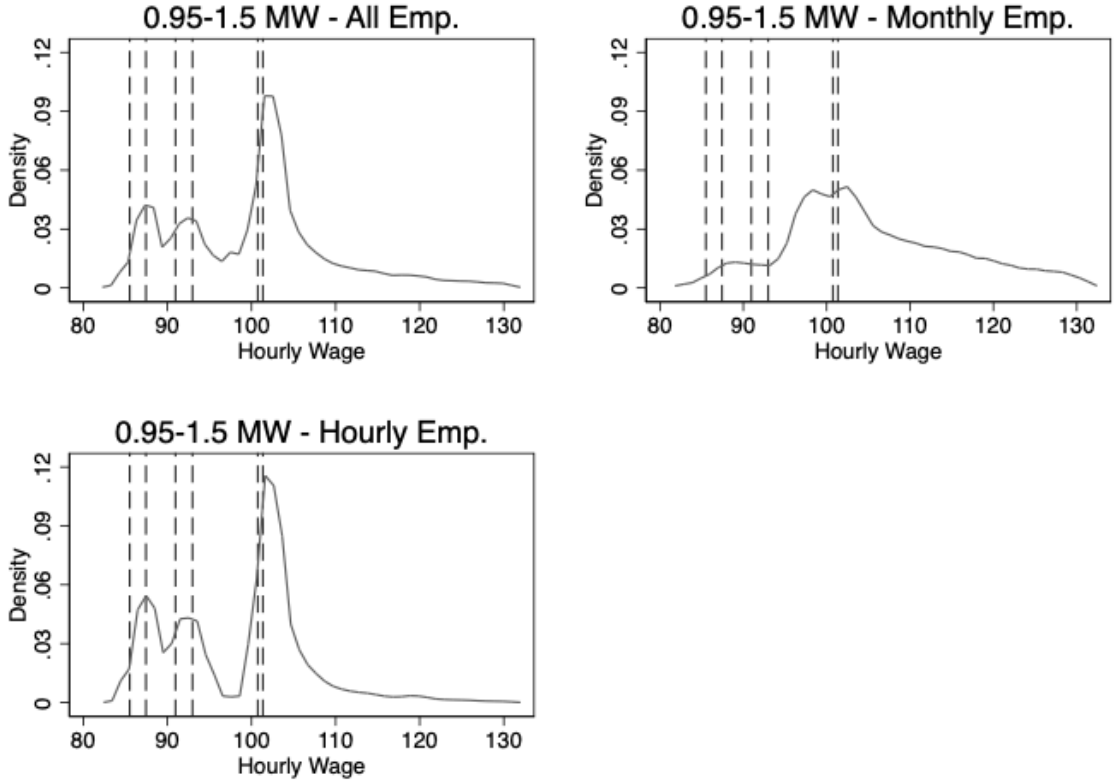
Figure 2. 2006 hourly wage distribution around the three lowest minimum wages.



Note. The distributions include hourly wages in the interval 95-105 % around the minimum wage applicable for individuals aged 19 or above and that have less than one year tenure, illustrated by the dashed vertical line in the middle. The left and right dashed lines represent minimum wages for 18-year-olds with less than one year tenure and individuals aged 19 or above with at least one year tenure, respectively. Hourly wage rate is measured in Swedish krona (SEK).

In Figure 3, we illustrate the wage distribution around all six minimum wages, including wages well above the highest minimum wage. Again, we observe spikes in the vicinity of most minimum wages. However, when we include all six minimum wages, it is noticeable that the largest spike occurs at minimum wage level (f). This occurrence is much more prevalent for employees that are working at an hourly wage rate compared to those employees that have a monthly salary.

Figure 3. 2006 hourly wage distribution around all minimum wages.



Note. The distributions include hourly wages in the interval 95-150 % around the minimum wage applicable for individuals aged 19 or above and that have less than one year tenure (i.e., minimum wage (b)). The dashed lines represent minimum wages (a)-(f). Hourly wage rate is measured in Swedish krona (SEK).

4. Empirical method

4.1. Treatment intensity

To investigate the effects of lower payroll taxes on minimum wage employment, we use the Swedish youth payroll tax cut in 2007 as a quasi-natural experiment. This reform reduced firms' payroll taxes with 11.1 percentage points for all employees who had turned 18 but were younger than 25 years at the beginning of the year (Proposition 2006/07: 84)[10]. It thus created firm-level variation in labor cost savings that were proportional to firms' total wage costs for employees aged 19-25 years.

Following (Daunfeldt et al., 2021), we use the youth payroll tax cut to construct a treatment intensity measure that is related to firms' labor cost savings in absolute (monetary) terms. The reason for using an absolute measure is that hiring decisions

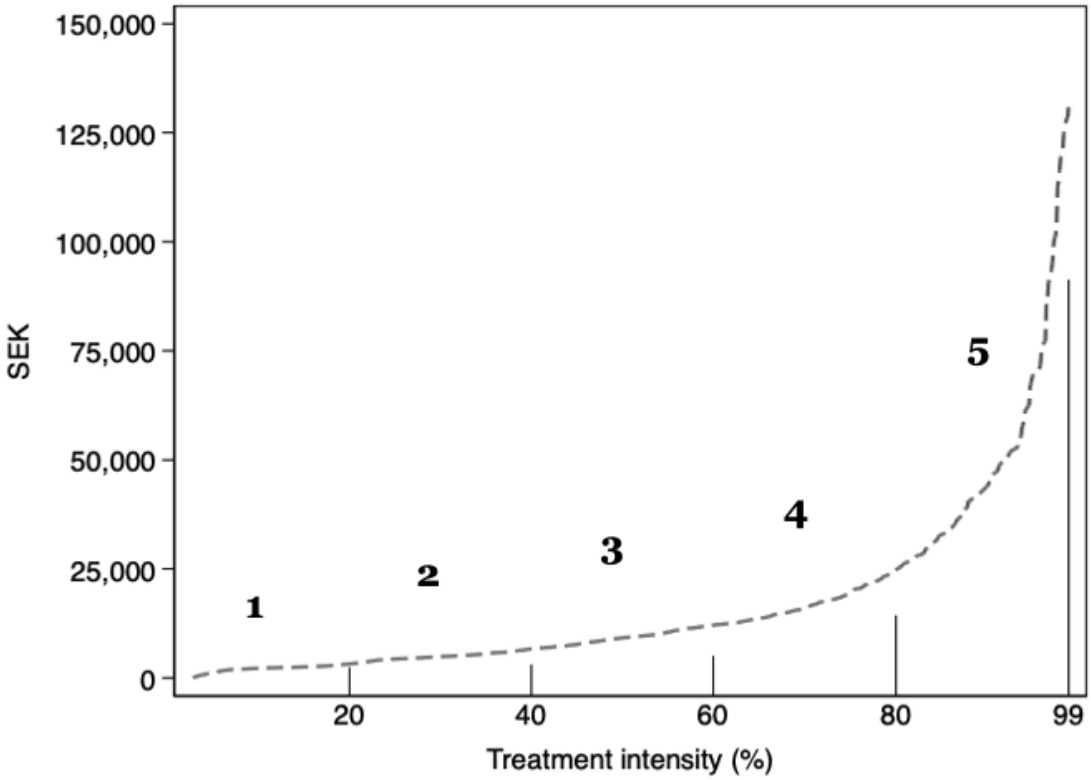
[10] A further reduction of six percentage points was implemented in 2009 (Proposition 2008/09: 7), when the payroll tax cut was also expanded to include all individuals under 27 years of age. The payroll tax was incrementally returned to a uniform rate for all workers, at 31.42 percent, in 2016.

are likely to be based on how much the firm saves in monetary terms, rather than in percentage terms.[11] More specifically, we define our treatment intensity measure as:

$$Treatment\ intensity_{i,t=2006} = (0.3242 - 0.2132) * W\_young_{i,t=2006} \qquad (1)$$

where indices *i* and *t* denote firm and year, respectively; and the figures 0.3242 and 0.2132 represent the youth payroll tax levels before and after the youth payroll tax cut in 2007, implying a reduction by approximately 11.1 percentage points. We multiply this reduction by the firms' total gross wages paid to the eligible age group of young employees during September 2006 ($W\_young_{i,t=2006}$), i.e., a year before the reform was implemented. Hence, given that the wage sum of all young employees in September 2006 is of similar size in September 2007, the treatment intensity measure is pre-determined and captures the size of firms' labor cost savings induced by the reform.

Figure 4. Labor cost savings (Swedish krona, SEK), by continuous treatment intensity (%). Year 2006.



Note. Labor cost savings in SEK on the vertical axis. Percentiles 1-99 of the treatment intensity measure on the horizontal axis. For illustrative purposes, savings that exceed the 99th percentile are excluded. Groups 1-5 correspond to percentiles in the range >0-20, >20-40, >40-60, >60-80 and

[11] Daunfeldt et al. (2021) have shown that the correlation between absolute and relative treatment intensities of the Swedish youth payroll tax cut is low, indicating that, for the most part, large labor cost savings in monetary terms are not equivalent to large labor cost savings in percentage terms.

>80-99, respectively. Includes firms that are existent over the 2003-2008 period. Outliers are excluded. Measured in the price level of 2021.

Next, we assign all firms into five treatment intensity groups based on their rank in the treatment intensity distribution. The first group (0-20) includes the 20 percentage of the firms with lowest labor cost savings, while the fifth treatment intensity includes those 20 percent of firms with the highest labor cost savings due to the youth payroll tax cut in 2007 (>80-100). The percentiles of the treatment intensity measure and the corresponding labor cost savings in Swedish krona are displayed in Figure 4. It is noticeable that most firms obtained small labor cost savings; while the yearly savings for firms within the highest treatment intensity group (>80-100), on average, equaled 65,700 SEK.

Table 1 provides a more detailed examination of the labor cost savings induced by the youth payroll tax cut. We notice that 80 percent of the firms obtained first-year savings of maximum 24,500 SEK, with the average savings in the treatment intensity groups ranging from approximately 2,200 SEK to 16,900 SEK. In the highest treatment intensity group (>80-100), the average saving amounts to 65,700 SEK, and the maximum saving equals as much as 955,700 SEK.

Table 1. Labor cost savings (Swedish krona, SEK), by treatment intensity group. Year 2006.

Group	Savings	Mean	Median	# Firms
>0–20 %	69–3,224	2,204	2,354	180
>20–40 %	3,228–6,674	4,951	4,908	180
>40–60 %	6,681–12,125	9,224	9,281	179
>60–80 %	12,176–24,526	16,885	16,201	180
>80–100 %	25,059–955,734	65,719	43,936	179

Note. Includes firms that are existent over the 2003-2008 period. Outliers are excluded. Measured in the price level of 2021.

4.2. Wage intervals

To investigate the effects of the youth payroll tax cut on minimum wage jobs, we define four wage intervals around negotiated minimum wage (b). Table 2 presents these wage intervals, and which minimum wages they overlapped with from 2006 to 2008. The 95-105 % wage interval covers the three lowest minimum wages every year, while wage intervals 105-115 % and 115-125 % cover minimum wages of workers with at least two years of tenure, i.e., at least one of the three highest minimum wages. The highest wage interval, i.e., 125-150 %, exceeds the negotiated minimum wage levels for all study years.[12]

[12] We ensure that the wage intervals do not overlap by defining them as 95-105, >105-115, >115-125 and >125-150 %. Since the distances between the minimum wages vary over time, the minimum wage coverage of the wage intervals also varies. Over our period of study 2006-2008, the 95-105 %

Table 2. Wage intervals, their range in Swedish krona (SEK), and how they relate to the six negotiated minimum wages 2006-2008.

Wage intervals	2006	2007	2008
0.95-1.05	83.07–91.81	87.44–96.64	91.99–101.67
1.05-1.15	91.81–100.56	96.64–105.8	101.67–111.35
1.15-1.25	100.56–109.30	105.8–115.05	111.35–121.04
1.25-1.5	109.30–131.16	115.05–138.06	121.04–145.25

Note. Measured in SEK. The wage range depart from the minimum wage of an individual at least 19 years of age and with no prior experience which corresponds to 87.44 SEK in 2006, 92.04 SEK in 2007, and 96.83 SEK in 2008.

4.3. Empirical method

We estimate a Difference-in-Difference-in-Differences model, henceforth DDD model. (Chetty et al., 2009; Daunfeldt et al., 2021; Gruber, 1994) to capture the effect of reduced labor costs on minimum wage jobs within the retail industry. In contrast to a Difference-in-Differences model (DiD), the DDD model adds a third difference by including an additional pre-treatment period over which the outcomes of treated and control firms are compared. This means that we compare the outcomes of treated and control firms across 2003-2005 and 2006-2008. The years 2003-2005 are considered a placebo period, where we assign the firms into placebo groups by calculating the hypothetical labor cost savings that firms would have received if the reform had been introduced in year 2004 instead of year 2007.

The identifying assumption of our DDD model is that underlying differences between treated firms and control firms that could have affected employment outcomes are identical in both 2003-2005 and 2006-2008. Thus, existing differences between treated and control firms in the 2003-2005 period should constitute the differences that would have been the case if the reform had not been implemented. We know, for example, that there is a positive correlation between firms' labor cost savings and the number of employees, i.e., firms with high treatment intensities tend to have many employees. Previous research has also showed that large firms tend to grow more in absolute terms than smaller firms (Delmar et al., 2003), suggesting that firms with a high treatment intensity tend to hire more employees because of their size rather than because of their reduced labor costs. The positive correlation between firm-level savings and number of employees constitutes one potentially confounding factor that our empirical model accounts for.

The estimated DDD-model can be expressed as:

interval consistently covers minimum wages (a)-(c), whereas the 125-150 % interval does not cover any minimum wage. In 2007, wage interval 105-115 % covers minimum wages (d)-(e), and 115-125 % covers minimum wage (f). In 2008, the 105-115 % interval covers minimum wages (d)-(f).

$$H_{ijt} = \alpha + \beta_1 Time_t + \beta_2 Group_j + \beta_3 Treat_i + \beta_4(Group_j * Time_t) + \beta_5(Treat_i * Time_t) + \beta_6(Group_j * Treat_i) + \delta_{DDD}(Group_j * Treat_i * Time_t) + \eta_i + \varepsilon_{ijt},$$

where the indices i, j and t denote firm, group belonging (treated or control) and year, respectively. The outcome variable H_{ijt} represents either the number of hires or number of work hours in the vicinity of the minimum wage. $Time_t$ is binary variable that is equal to zero for the pre-treatment years of both time periods and equal to one for the corresponding post-treatment years. Hence, $Time_t$ is equal to zero in the years 2003 and 2006, and equal to one in the years 2004-2005 and 2007-2008. The variable $Group_j$ is an indicator variable for firms' group belonging and is equal to zero for the control firms and equal to one for the treated firms in both time periods. $Treat_i$ separates all firms included in the period 2003-2005 from those included in the period 2006-2008 by being equal to zero for the former, and one for the latter.

The main variable of interest is the interaction term of these three binary variables - $Group_j * Treat_i * Time_t$ – which is equal to one for the treated firms in the actual post-treatment years, i.e., in 2007-2008. Its parameter, δ_{DDD}, isolates the effect of reduced labor costs on minimum wage jobs by deducting underlying differences between treated firms and control firms in the 2003-2005 period, i.e., in the pre-reform years.[13] Lastly, η_i accounts for time-invariant firm-specific factors, whereas ε_{ijt} is an idiosyncratic error term.

Our DDD-model is estimated separately for our treatment intensity groups >20-40, >40-60, >60-80 and >80-100. The control group consists of firms with either no or small reductions, i.e., with a treatment intensity in the range of 0-20. The effects on the number of minimum wage jobs are based on the four different wage intervals under study (see Table 2). We thus estimate the relationship between reduced labor costs and minimum wage jobs and, in addition, if the effect varies with the magnitude of the labor cost reductions.

5. Findings

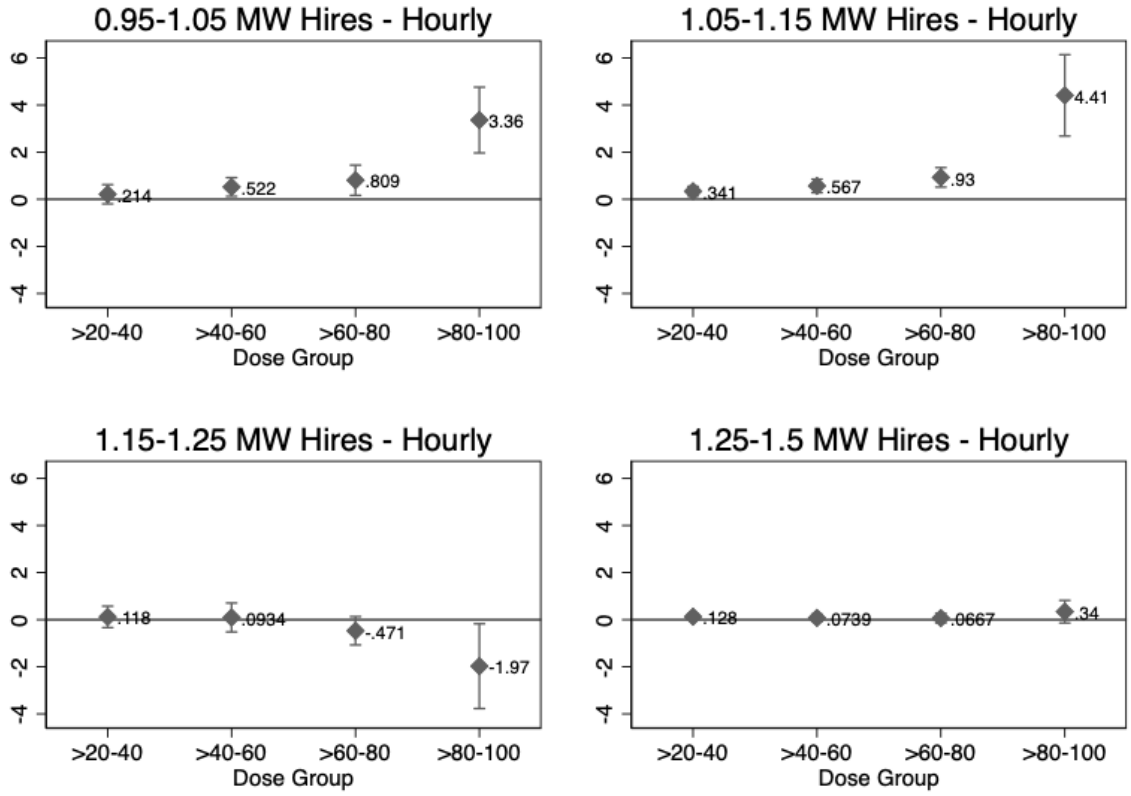
5.1. Effect on number of minimum wage hires

The estimated effects on the number of hourly employed hires are presented in Figure 5. The results show that retail firms with large labor cost reductions hired significantly more employees than firms with small labor cost reductions. The point estimates for firms with the smallest labor cost reductions (>20-40) are only statistically significant within one of the four wage intervals (1.05-1.15), while we

[13] The parameter δ_{DDD} is equivalent to the difference between two DiD models over the periods 2006-2008 and 2003-2005. Specifically, $\delta_{DDD} = \delta_{DiD,2006-2008} - \delta_{DiD,2003-2005}$.

can observe a positive and statistically significant effects on the number of hires within the two lowest wage intervals among firms with larger labor cost reductions. A firm with labor cost savings in the range >40-60 increased its number of hires in proximity of the minimum wage (0.95-1.05) by 0.52 individuals, while the corresponding estimate for firms in the two highest treatment intensity groups (i.e., >60-80 and >80-100) amounts to 0.81 and 3.36 hires, respectively.

Figure 5. DDD estimations. The effect on number of hourly employed hires over treatment intensity, by wage intervals relative the minimum wage rate.



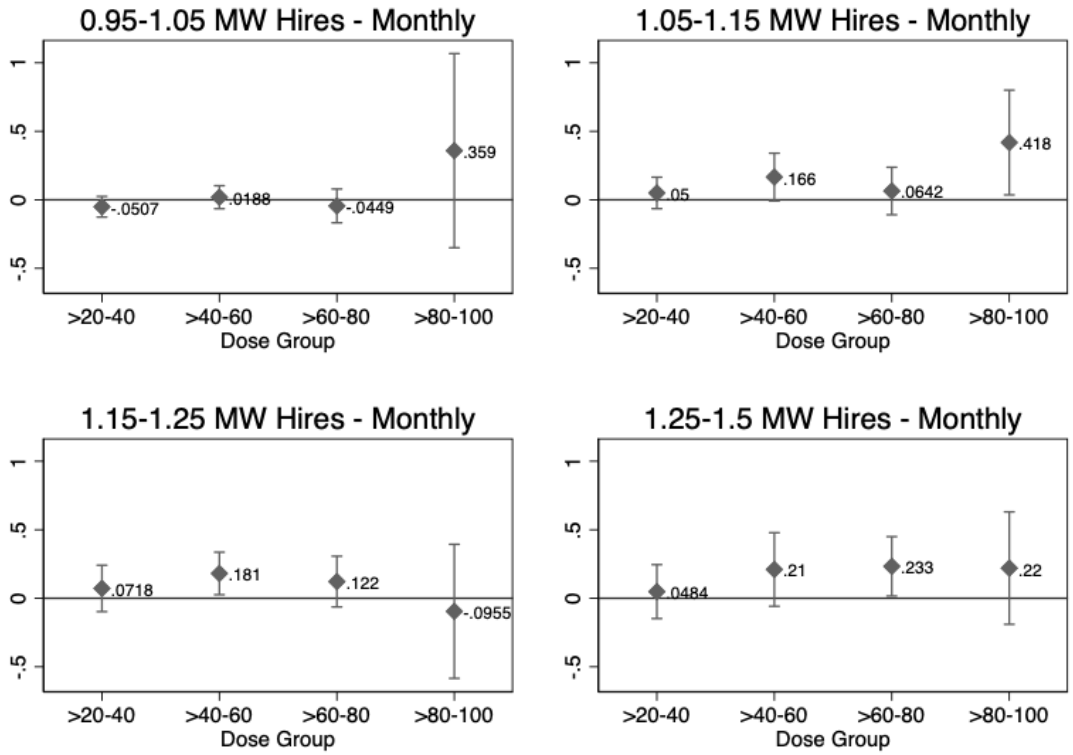
Note. Firms that exist over the 2003-2008 period are included. Firms with extreme annual employment changes are excluded (+/- 3 std.dev. from mean). Point estimates with corresponding 95 % confidence intervals. Within-firm estimation. Standard errors are clustered at the firm level.

An even stronger effect of firms' labor cost savings can be observed on employees in the 1.05-1.15 wage interval, showing an average increase of 4.41 employees for firms in the >80-100 treatment intensity range. Note that the 95% confidence interval for firms in the >80-100 group does not overlap the confidence intervals for the lower treatment intensity groups, suggesting that firms with the largest labor cost savings hire significantly more employees than firms with smaller labor cost savings. The increase in the number of minimum wage workers is thus significantly higher among firms with large labor cost savings than for firms with smaller labor cost savings.

In contrast, we find no positive and statistically significant effects on the number of hires at higher wages, as seen in the lower panels. The positive effect on hires of firms' labor cost reductions thus primarily holds for low-wage jobs. For wage levels that are 15-25 percent above the minimum wage (i.e., wage interval 1.15-1.25), we instead obtain one negative and statistically significant point estimate. This can be explained by a substitution effect, i.e., that firms with large labor cost reductions are incentivized to hire low-wage workers instead of workers with higher wages. However, the total number of hires within the two lower wage intervals outweigh the negative effect found in wage interval 1.15-1.25, implying that the total number of hires at these wage levels have increased due to the payroll tax cut.

To test whether reduced labor costs also benefit individuals who have a more permanent position on the labor market, we perform separate estimations for individuals who work for a monthly salary. These individuals tend to have permanent and more stable job positions through long-term contracts than employees that are contracted by the hour, who are commonly vacated by young and part-time employees (Skedinger, 2015). If reduced labor costs primarily increase the number of jobs for individuals that generally have more difficulties to enter the labor market, we expect to find no significant estimates for hires that are monthly employed.

Figure 6. DDD estimations. The effect on number of monthly employed hires over treatment intensity, by wage intervals relative the minimum wage rate.



Note. Firms that exist over the 2003-2008 period are included. Firms with extreme annual employment changes are excluded (+/- 3 std.dev. from mean). Point estimates with corresponding 95 % confidence intervals. Within-firm estimation. Standard errors are clustered at the firm level.

From Figure 6, it is apparent that the point estimates suggest very small changes in the number of monthly employed hires and that most estimates are statistically insignificant. Thus, our findings indicate that reduced labor costs cause an increase in the number of hourly wage hires in the vicinity of the minimum wage but has only a marginal effect on the number of monthly wage hires.

5.2. Effect on number of working hours of minimum wage workers

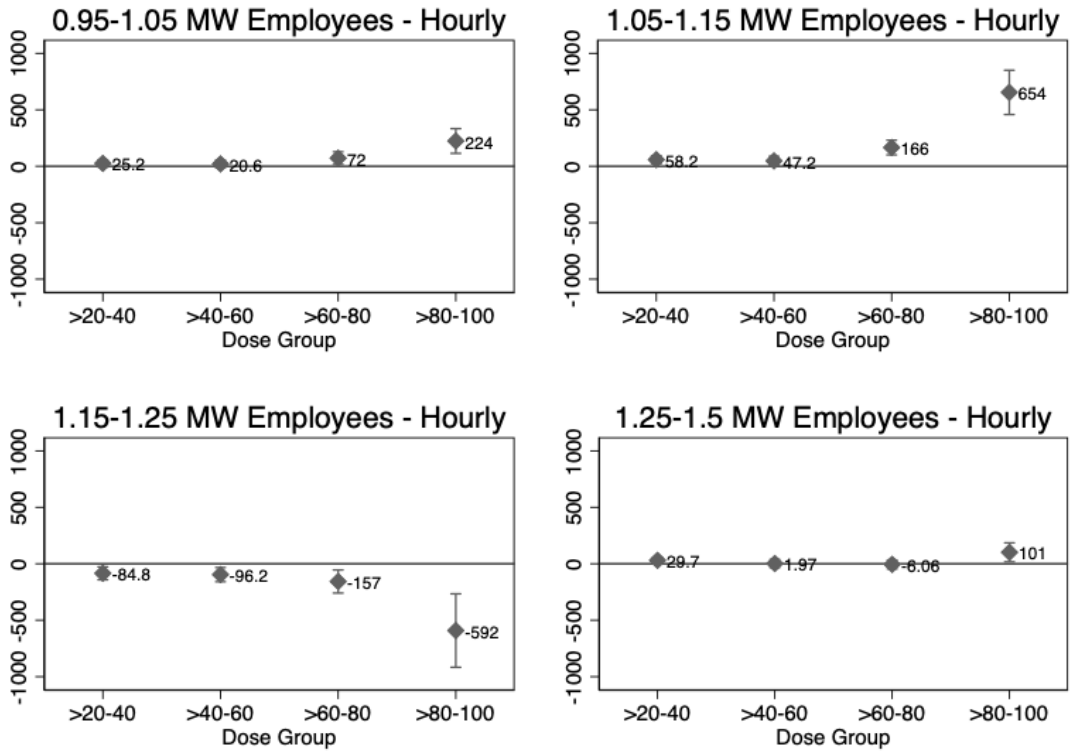
Studying the number of hires does not necessarily capture the total employment effect around the minimum wage since firms can also adjust the number of working hours among their existing personnel. We therefore proceed by investigating the effect of the labor cost savings on the total number of working hours in the vicinity of the minimum wage. This measure captures changes made to both the total number of employees and to the number of working hours among those already employed, i.e., it combines the extensive and intensive margin employment effect in one measure.

The estimated effects on the total number of working hours among employees that were hourly employed are presented in Figure 7. The results show that firms with large labor cost savings significantly increased the number of working hours for employees with wages in proximity to the minimum wage. For the lower treatment intensity groups, the estimates for wage interval 0.95-1.05 are insignificant whereas the estimates for wage interval 1.05-1.15 suggest only small increases in the number of hours worked. Within the wage interval 1.15-1.25, we obtain negative and statistically significant point estimates, suggesting negative effects on the number of work hours. This could potentially be explained by a substitution effect, which was discussed in section 5.1. Within the wage interval farthest away from the minimum wage (1.25-1.5), we find some indications of a positive effect on the number of work hours.

Within the two lowest wage intervals, firms with savings in the >60-80 and >80-100 treatment intensity groups, on average, hired 0.81-0.93 and 3.36-4.41 more employees paid by the hour, respectively (see Figure 5). The top panels of Figure 7 show that the corresponding increases in the number of hours worked per month are 72 and 224 hours in the 0.95-1.05 wage interval, and 166 and 654 hours, in the 1.05-1.15 wage interval. If we combine these estimates, the increase in number of work hours per new employee amounts to 89 and 178 hours per month for firms with savings in the >60-80 treatment intensity range (72/0.809 and 166/0.93), and to 67 and 148 hours per new employee and month (224/3.36 and 654/4.41) in the >80-100 treatment intensity range. This means that the increase in the number of hours in the 1.05-1.15 wage interval is close to, or exceeds, the number of hours that

corresponds to a full-time job. However, hourly employed retail employees rarely work full time. For example, hourly employed retail employees worked, on average, 89 hours in September 2006. This suggests that the effect of firms' labor cost savings on number of working hours near the minimum wage is partly explained by an employment effect on the intensive margin, i.e., that incumbent employees in the proximity of the minimum wage worked more hours.

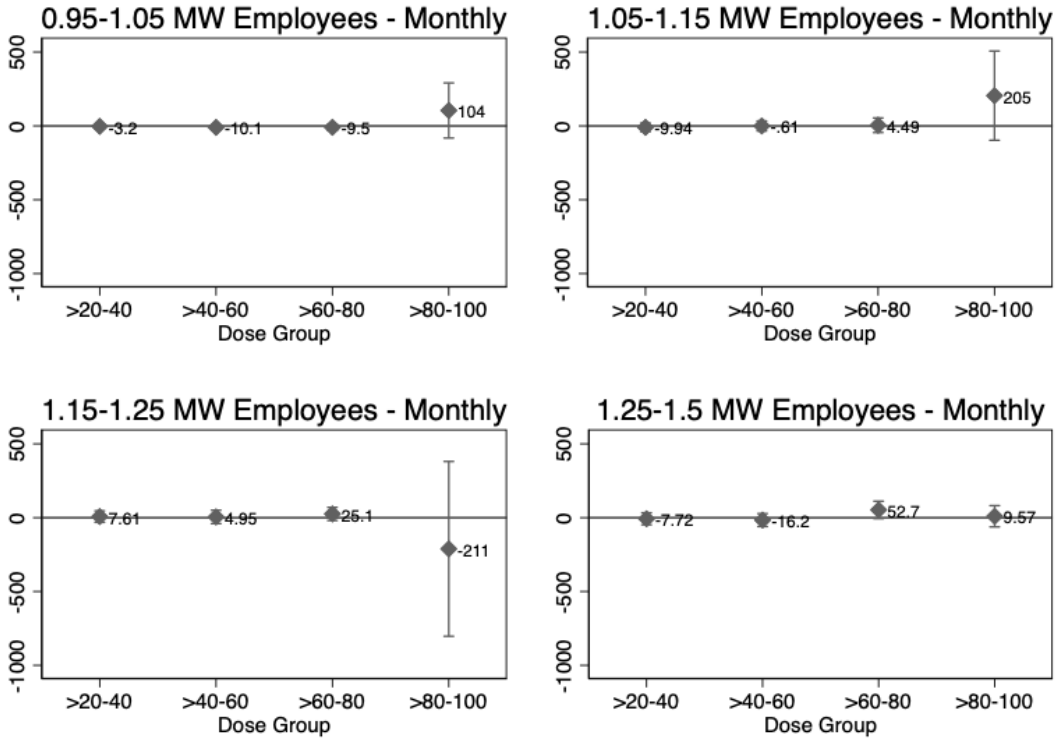
Figure 7. DDD estimations. The effect on number of hours worked for hourly employed employees over treatment intensity, by wage intervals relative the minimum wage rate.



Note. Firms that exist over the 2003-2008 period are included. Firms with extreme annual employment changes are excluded (+/- 3 std.dev. from mean). Point estimates with corresponding 95 % confidence intervals. Within-firm estimation. Standard errors are clustered at the firm level.

The estimated effects of firms' labor cost savings on number of hours worked for employees that are monthly employed are presented in Figure 8. We do not obtain any statistically significant point estimate. Thus, the findings in Figure 7-8 indicate that labor cost savings increased the number of work hours among low-wage workers paid by the hour, while workers with a more permanent labor market position were not affected.

Figure 8. DDD estimations. The effect on number of hours worked for monthly salaried employees over treatment intensity, by wage intervals relative the minimum wage rate.



Note. Firms that exist over the 2003-2008 period are included. Firms with extreme annual employment changes are excluded (+/- 3 std.dev. from mean). Point estimates with corresponding 95 % confidence intervals. Within-firm estimation. Standard errors are clustered at the firm level.

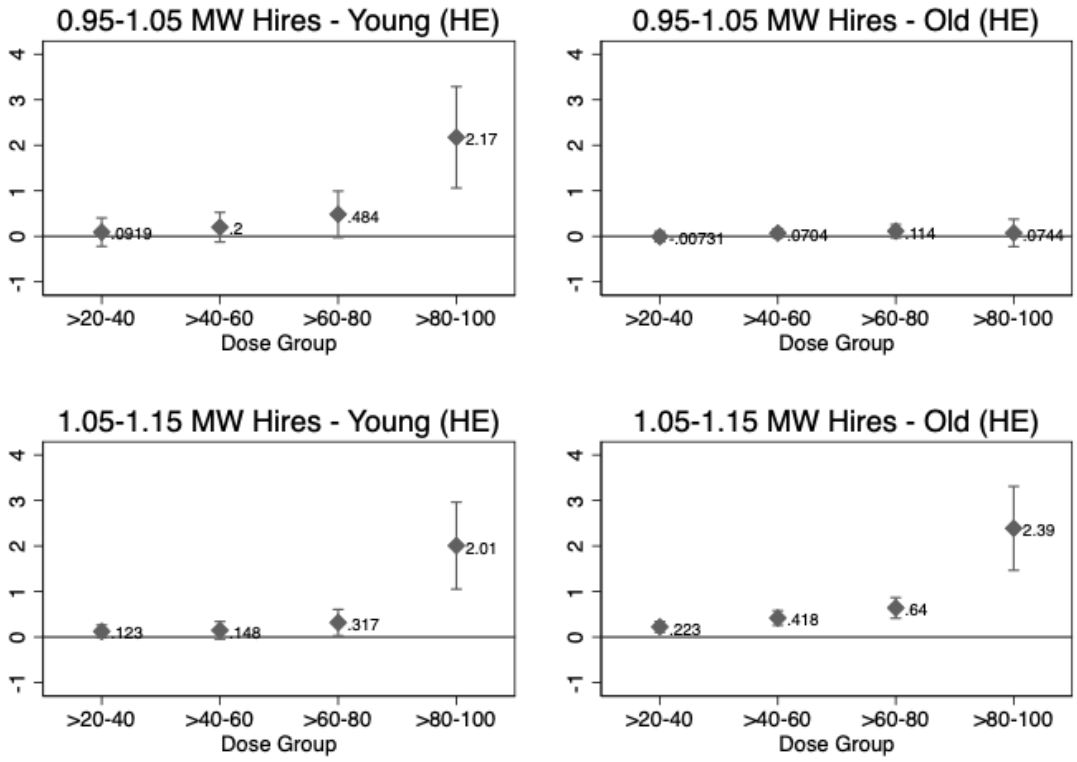
5.3. Robustness check

Earlier contributions have found that the Swedish youth payroll tax cut in 2007 increased employment of young individuals that were targeted by the reform (Daunfeldt et al., 2021; Saez et al., 2019). A potential concern is that the employment effects on minimum wage jobs that we observe are entirely explained by a positive effect within the reform's target group, i.e., 19-25-year-olds. This would imply that our findings are a direct consequence of the reform and may not be applicable to general reductions of firms' labor costs. We therefore perform a robustness check where we estimate the effect on minimum wage hires separately for the reform's age group (age 19-25) and non-targeted individuals (aged at least 26), respectively. These estimates are presented in Figure 9.

We find positive and statistically significant point estimates for the reform's targeted age group 19-25-year-olds within the wage interval closest to the minimum wage (0.95-1.05), while the point estimates for older employees are insignificant. This is expected since young employees are overrepresented in low-wage positions, while older individuals seldom get a wage in the 0.95-1.05 wage interval. However, when

investigating the employment effects in the wage interval 1.05-1.15, we find positive effects on hires of both young and older individuals. In the highest treatment intensity (>80-100), the average firm hired 2.01 more individuals aged 19-25 years, and 2.39 more individuals that were above the age of 25 years. Firms that received large labor cost reductions thus hired both young and old individuals in the vicinity of the minimum wage, suggesting that the positive effect of firms' labor cost savings on minimum wage employment is not limited to employees that were targeted by the reform.

Figure 9. DDD estimations. The effect on number of hourly employed hires over treatment intensity, by age group and wage intervals 95-105 % (upper) and 105-115% (lower) relative the minimum wage rate.



Note. Young employees are defined as 19-25-year-olds. Old employees are at least 26 years old. Firms that exist over the 2003-2008 period are included. Firms with extreme annual employment changes are excluded (+/- 3 std.dev. from mean). Point estimates with corresponding 95 % confidence intervals. Within-firm estimation. Standard errors are clustered at the firm level.

Thus far, our control group has consisted of firms that received either no, or minor, labor cost savings following the introduction of the youth payroll tax cut (treatment intensity 0-20). To assess whether our findings are sensitive to this choice, we use two alternative control groups. First, we only include firms that received small savings in our control group (>0-20), thereby excluding firms without any savings. Firms without any young employees, and thus not exposed to any savings, might be systematically different from firms in the treatment groups when it comes to recruitment, suggesting that they might not be a valid comparison group. Second,

for comparison, we do the opposite and only include firms without any savings in the control group. All results remain qualitatively similar when we use these two alternative control groups, suggesting that our results are not sensitive to how the control group is defined. [14]

6. Discussion

Numerous studies have argued that binding minimum wages cause involuntary unemployment among individuals that are perceived to have low productivity (Burkhauser et al., 2015; Campolieti, 2020; Neumark & Wascher, 2008; Wolfson & Belman, 2019). This view has, however, been challenged by several scholars who suggest that higher minimum wages do not necessarily cause negative employment effects (Allegretto et al., 2011; Broecke et al., 2017; Card & Krueger, 1994; Cengiz et al., 2019; Doucouliagos & Stanley, 2009; Katz & Krueger, 1992).

The most influential papers in the minimum wage literature are based on quasi-natural experiments in the United States, estimating employment effects of small increases of relatively low minimum wages. There is thus a possibility that the effects of minimum wage changes are different in other institutional settings. In Scandinavia, minimum wages are considerably higher than in the United States, suggesting that they are more likely to exceed the equilibrium wage. Minimum wages are in these countries furthermore set in negotiations between trade unions and employers' organizations, implying that politicians are not able to lower minimum wages by legislation. One opportunity that remains for the policymakers under these circumstances is to instead lower firms' payroll taxes. Contrary to a reduction of legislated minimum wages, a payroll tax cut will reduce firms' labor costs but not employees' wages. The opportunity cost of labor market entry is therefore constant and there is theoretically no offsetting supply side reaction.

However, we have very limited knowledge on how minimum wage jobs are affected by payroll tax cuts. Our aim has therefore been to investigate the effects of a youth payroll tax cut in Sweden on minimum wage employment – both at the extensive and intensive margin. Following Saez et al. (2019) and Daunfeldt et. al. (2021), we utilized the fact that the youth payroll tax cut created firm-level variation in labor cost savings based on firms' total wage costs for their young employees. We have used the labor cost savings created by the payroll tax cut to sort firms into five different treatment intensity groups. Using novel wage statistics from the Swedish retail trade industry, including data on contracted hourly wages and number of hours worked, we then investigated the effects of the reform on minimum wage employment by estimating a difference-in-difference-in-differences model.

We found clear indications that minimum wages in the Swedish retail industry were binding when the youth payroll tax cut was implemented. As much as 89 percent of

[14] These results are available upon request from the authors.

all hourly employees had a contracted hourly wage in a five percent interval around one of the negotiated minimum wages in the pre-reform year. Furthermore, firms that received major labor cost savings due to the youth payroll tax cut were found to significantly increase their number of employees and working hours in proximity of the minimum wage. However, no major effects could be observed for individuals who earned considerably more than the minimum wage. The positive effects of the labor cost savings on minimum wage employment were also, to a great extent, limited to employees that worked by the hour, i.e., who had less stable job positions. Our results thus suggest that retail firms primarily increased employment of low-wage workers when their labor costs were reduced due to the payroll tax reform.

We believe that our results are of importance considering the high unemployment rates among first-generation immigrants and low-educated youths across Europe (Bruno et al., 2014; Daunfeldt et al., 2019). It has been noted that the retail trade industry holds many job positions that do not require higher education or extensive training (Skedinger, 2015) and retail firms are therefore expected to provide jobs for workers that are typically perceived as low-skilled. However, our results suggest that high binding minimum wages deter retailers from employing workers that have difficulties to enter the labor market. This is in accordance with (Jardim et al., 2017), who found negative impact on low-wage labor market entry and a decrease in intensive margin employment when investigating a relatively large increase of minimum wages in Seattle.[15] This suggests that the long withstanding debate on the employment effects of minimum wage changes can benefit from considering the initial level of the minimum wage as well as the magnitude of the minimum wage change.

Our study also adds to the literature on the employment effects of the youth payroll tax cut in Sweden. The efficiency of this reform was first questioned because studies found a negligible effect of the youth payroll tax cut on employment, implying an extensive loss in government revenues per created job (Egebark & Kaunitz, 2018; Skedinger, 2014). However, these studies tend to underestimate the employment effects of the reform because they did not consider that firms received different treatment intensities of the reform, and that the firms were able to use their labor cost savings to hire both younger and older employees. Recent studies have consequently found larger effects on employment on the extensive margin, and thereby lower government revenue losses per created job (Daunfeldt et al., 2021; Saez et al., 2019). Recent findings have also documented a positive employment effect on the intensive margin, and small spillover effects on incumbent workers' wages (Seerar Westerberg, 2021). Our findings thus provide more evidence on the positive effects of the youth payroll tax cut, showing that the reform to a large extent

[15] The post-reform minimum wage level in Seattle also corresponds quite closely to the lowest minimum wage levels in the Swedish retail trade industry. The investigated post-reform minimum wage in Seattle was USD 13, while the lowest negotiated minimum wage in Sweden was USD 14.73 in 2021.

benefitted low-wage workers that had more difficulties to get stable positions on the labor market.

Our study does not come without limitations. First, we do not have any information on the human capital characteristics of the employees. As discussed in Section 2, there might be a trade-off between minimum wages and employment among those that are perceived as low-skilled, which might induce substitution towards high-skilled workers (Jardim et al., 2017; Kellermann, 2017; Skedinger, 2015). However, the substitution between workers that differ in their actual or perceived skills cannot be explicitly tested without information on characteristics such as educational attainment, unemployment history or test scores. A fruitful area for further research is therefore to study the dynamics between payroll tax changes and transitions in and out of employment among groups that are typically perceived as low-skilled and high-skilled.

Our results should furthermore not be generalized beyond its context. The payroll tax reform in 2007, for example, targeted young employees. This means that the results might not be applicable for a general payroll tax cut, which might shift the tax incidence towards workers since all firms are affected in a similar manner. Trade unions might under such circumstances be more able to use the centralized collective agreements to raise wages among insiders, thereby crowding-out the positive employment effect that we observe (Daunfeldt et al., 2021; Holmlund, 1983; Seerar Westerberg, 2021). Employment might furthermore respond differently to payroll tax cuts in other countries and industries. An interesting avenue for further research would therefore be to explore the effects on minimum wage jobs of general payroll tax cuts, and effects of payroll tax reforms in less centralized wage bargaining contexts. Finally, employment and wages may respond asymmetrically for payroll tax increases and decreases, respectively. This constitutes another fruitful area for further studies.

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