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ABSTRACT

Happy Birthday, You're Fired! The Effects of Age-Dependent Minimum Wage on Youth Employment Flows in the Netherlands*

This paper investigates the effects of the age-dependent minimum wage on youth employment flows in the Netherlands. The Dutch minimum wage for workers aged 15-23 is defined as a step-wise increasing function of a worker's calendar age. At the age of 23, workers become eligible for the "adult" minimum wage which does not increase further. This creates an incentive for firms to discriminate against employees on the basis of their age, substituting more expensive older workers with younger ones. In order to grasp the size of these effects, I analyze monthly flows in and out of employment using administrative records for the entire youth population of the Netherlands. I account for the time remaining until workers' next birthdays, exploiting the fact that firms are facing a sharp discontinuity in labor costs in the month when a worker turns one year older. The results show a significant increase in job separation around the time of this discontinuity: the probability of job separation increases by 1.1% in the three calendar months which are closest to a worker's next birthday. This effect exhibits substantial heterogeneity with respect to a worker's age, showing that young and inexperienced workers are more likely to be affected by the discontinuities. The size of the effect also varies by the sector of employment, being particularly large for supermarket employees. Job accession peaks just after workers' birthdays, representing both entry of the workers with higher reservation wages and re-employment of the workers whose jobs are dissolved around the time of the discontinuity.

JEL Classification: J23, J31, J38, M51

Keywords: minimum wage, age-dependency, labor market flows

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1 Introduction

Many countries use age-dependent minimum wage systems in order to facilitate the entry of young workers into the labor force. The age-dependency turns the minimum wage rate into a stepwise increasing function of workers' calendar age, rendering young workers comparatively cheaper than older workers. Being subject to the reduced minimum wage, the youth job seekers become more desirable for firms, and therefore more likely to find a job which fits their level of skills and experience. Indeed, several empirical studies provide evidence of the positive effects of an age-dependent minimum wage on youth employment (Yuen, 2003, Neumark and Wascher, 2004, Shannon, 2011, and Dickens, Riley, and Wilkinson, 2014). However, what they fail to address is that apart from the effect on employment stocks, this policy design fundamentally changes the youth labor market flows, introducing new dynamics into the decision making of both employers and employees.

Firstly, the age-dependency motivates employers to discriminate against their own employees on the basis of their age. Since the costs of minimum wage labor increase with a worker's age, employers are facing the incentive to periodically replace their older, costlier employees with younger ones. Accordingly, it can be expected that more workers get fired when they are close to reaching the eligibility threshold for the higher minimum wage rate. Secondly, the age-dependency is likely to affect the timing of people's labor market entry. The step-wise increases of the minimum wage rate bring forth the reservation wage arguments of Card and Krueger (1994), suggesting that more people should enter the labor market shortly after becoming eligible for the higher minimum wage rate (provided that the new rate is above their reservation level). Both job separations and job accessions are therefore likely to reflect the variation of labor costs which is inherent in the age-dependent policy design.

In this paper, I investigate how pronounced these effects are among Dutch workers, who are subject to 9 age-dependent increases of the youth minimum wage rate. The Dutch minimum wage rate is increasing in annual steps, with the lowest rate being assigned to workers aged 15. The adult rate is attained on workers' 23rd birthday. A convenient feature of the age-dependent system is that the increases of the minimum wage rate are discrete and fixed by a worker's calendar age. The resulting changes in labor market flows are therefore easy to analyze by focusing on the behavior of workers and firms around workers' birthdays. This paper analyzes these sharp discontinuities in labor costs, and it is the first study to present the effects of age-dependent minimum wages on labor market flows.

The analysis rests on an administrative dataset covering the entire population of the Netherlands followed over the years 2006 to 2012. The data contain detailed information on individual labor market histories, including starting dates and (if available) end dates of every employment spell observed in this period. When linked with information on individual birthdays, it can be quantified how far the workers were from their next birthdays at the time of their job accessions and job separations. In this way, I can assess whether the prox-

imity to birthdays (and hence to the minimum wage discontinuities) is having an influence on employment flows in the Dutch labor market.

The employment duration analysis shows that for workers aged 16-23, the probability of job separation increases by 1.1% in the three months preceding their birthdays. This increase translates into 2275 youth employment spells terminated on an annual basis. The size of this effect varies with age, exhibiting a sawtooth pattern which peaks at workers' 16th and 19th birthdays and falls in the following years. The second peak occurs in the year following high school graduation, coinciding with the entry of many inexperienced workers into the labor force. The gradual attenuation of the effect is suggestive of better screening of older/more experienced workers and possibly also of changes in the job mix applicable to the older workforce (lower substitutability of personnel in "adult" jobs). The effects are also exhibiting sectoral dependence, being particularly large in the supermarket sector. The effects are shown to be stronger in the employment sectors which offer jobs that do not require extensive training. The job accessions are shown to increase in the month immediately following the workers' birthdays. This spike seems to be driven partially by the the labor market entry of individuals with higher reservation wages, and partially by re-employment of those workers who have lost their jobs due to the minimum wage discontinuities.

This paper contributes to the voluminous literature on the labor supply and demand effects of minimum wages[1] by exploiting a policy variation which has been largely overlooked. Until now, the majority of minimum wage studies analyzed US state-level changes of minimum wage rates using either a difference-in-differences or panel designs. However, despite the amount of work done in this area, there is still little consensus on an estimation strategy which would ensure consistent estimation of the minimum wage effects.[2] Furthermore, since the minimum wage changes in the US tend to be rather small in magnitude, it is an open question whether the results derived using such sources of variation could prove informative for more pronounced changes of minimum wage rates (such as those considered by the current US administration).

Such identification problems contrast starkly with the identifying policy variation exploited here. The age-dependent minimum wages in the Netherlands induce substantial (up to 17%) year-on-year variation of individual labor costs for a sizable share of the youth workforce. These changes are dependent only on a worker's age, and therefore they are not confounded by business cycles, political factors, spatial heterogeneity, spurious trends, or other issues commonly discussed in the minimum wage literature. Furthermore, since the Dutch system

[1] For a thorough overview, see Neumark and Wascher (2008) and the papers cited therein. Recent studies focusing on youth employment include Giuliano (2013), Brochu and Green (2013) and Dube, Lester, and Reich (forth.).

[2] Recently, Dube, Lester, and Reich (forth.) advocate the use of the dif-in-dif design with bordering county pairs in order to attenuate the confounding effects of state-specific unobserved trends. In another recent study, Meer and West (forth.) argue that the dif-in-dif design might be suboptimal if the minimum wage changes are affecting employment growth, rather than levels. They propose to study the effects using a dynamic panel specifications of Arellano and Bond (1991).

exhibits multiple increases of the minimum wage rate, it can be verified that the estimated effects are not driven by other age-dependent policy changes which are specific to certain ages, such as 15 or 16 years. It remains to be added that the effects presented here correspond to age-dependent minimum wage systems, and describe how do the labor flows behave within the boundaries of such systems. The results cannot be directly applied to make a prediction about, *e.g.*, the changes in labor flows induced by a universal increase of the minimum wage.

The studies analyzing age-dependent minimum wage systems generally focus on the employment effects of the simplest form of age-dependency, that is, the single subminimum wage rate for youth workers. Neumark and Wascher (2004) use a cross-national analysis to show that the presence of a youth subminimum wage rate reduces the negative employment effects of a minimum wage among young workers. Yuen (2003) and Shannon (2011) study the effects of the abolition of the youth subminimum wage rate in several Canadian states, finding mixed evidence of the disemployment effects among their youth workforce. Very close to the focus of this paper is the study of Dickens, Riley, and Wilkinson (2014) who analyze the British variant of the age-dependent minimum wage system, focusing on the discontinuity which occurs on workers' 22nd birthdays. Using a regression discontinuity (RD) design they find that this increase of the minimum wage rate has a positive employment effect for low-skilled individuals. However, the analysis of job separations and job accessions presented in this paper casts doubt on the validity of their findings. The job separations are shown to increase well ahead of the birthday discontinuity, which is a clear violation of no-anticipation, one of the key assumptions underlying the RD design. The positive employment effect of the minimum wage increase found by Dickens, Riley, and Wilkinson (2014) is therefore likely to be an artifact of the applied estimation strategy.[3]

This paper is organized as follows. The next section introduces the minimum wage system in the Netherlands. Section 3 documents the data set used for the empirical analysis, and Section 4 discusses the results. Section 5 concludes.

2 Institutional Setting

2.1 Minimum Wage in the Netherlands

The minimum wage has been a central part of the Dutch labor legislation for more than 40 years. The minimum wage regulation (applicable for workers older than 23) was formally introduced in 1968 and the installment of youth minimum wage (applicable for workers aged 15-22) followed in 1974. The youth minimum wage has been defined as a stepwise increasing function of a worker's calendar age, with age-specific wage rates expressed as fixed percentages of the adult

[3]Recent working paper by Fidrmuc and Tena (2013) re-examines the UK data using an alternative RD design. The authors find mixed evidence of negative employment effects around the birthday discontinuities. The presence of anticipation effects (acknowledged by the authors) however poses the same problems for the interpretation of their results as in Dickens, Riley, and Wilkinson (2014).

minimum wage. This legislation remained largely unchanged - the youth rates were only slightly reduced in 1981 and 1983 in response to high levels of youth unemployment, and the same setup has been maintained up to the present time. The real values of minimum wages are stable - unlike in the United States, the Dutch system is indexed to inflation and the rates are updated twice a year.

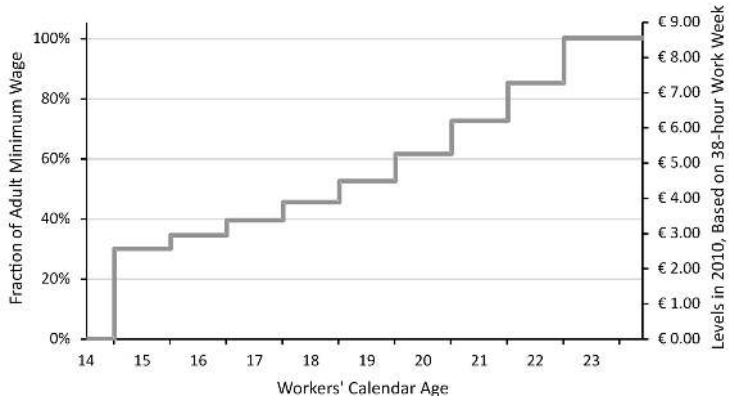


Figure 1: Minimum hourly wage rates in the Netherlands, expressed as percentages of the adult minimum wage, and in actual levels applicable in 2010.

Figure 1 illustrates the age-dependence of Dutch minimum wages. Workers become eligible for the minimum wage at the age of 15, and the applicable rate gradually rises up to the age of 23 when workers reach the eligibility for the adult minimum wage. The discontinuities of minimum wage rates are sharp - the applicable rates are subject to change on the day of a youth worker's birthday. We can see that the nominal increments get more pronounced each year, but when expressed in relative terms, the year-on-year changes prove to be fairly stable (raising the minimum wage rate by 15-17% of the level applicable for the preceding year). Given that the age dependence spans 8 consecutive years, the difference between the initial youth rate and the adult rate becomes very pronounced. In 2010, the hourly minimum wage rate for 15-year olds was €2.57, whereas the adult rate was more than three times larger, €8.55.[4]

The Dutch minimum wage legislation applies to almost all types of labor, with the sole exception being internships (which amount to approximately 7% of the youth employment spells) and self-employment (0.5% of the youth employment spells). Compliance is very high (see descriptive statistics presented in

[4]As indicated in Figure 1, the 2010 levels of hourly wage rates are specific to the firms which operate under the 38-hour definition of the full-time working week. The reason for this distinction is that the Dutch minimum wage is defined in terms of weekly full-time equivalent (fte) rates, rather than the more common hourly rates. Since different firms operate under different definitions of the full-time working week (36- and 40-hour definitions are also common), the value of the applicable hourly minimum wage rate will be specific to each of the definitions. To illustrate, the weekly fte adult rate in 2010 was set to be €325.08, which translates into three hourly rates of €9.03, €8.55, and €8.13 for the firms using the 36-, 38-, and 40-hour definitions of the working week, respectively.

the next section), and given the amount of time which has passed since the last change of the legislation, the current minimum wage system should be deeply embedded in the functioning of Dutch labor markets. Both workers' and firms' expectations are likely to reflect the legislation in place, and the measured effects should not be confounded by learning or other policy introduction effects on either side of the labor markets.

Along with the minimum wage policy, it is essential to consider that there are many other age-dependent changes in the lives of youth workers which are likely to influence their labor market decisions. Most importantly, the Dutch labor market legislation imposes heavy restrictions on the types of jobs that can be performed by very young workers. Almost all of these restrictions are alleviated on 15th and 16th birthdays, which should be borne in mind when interpreting the data corresponding to these age groups.[5] Other age-dependent changes can, for example, be related to the completion of different levels of schooling. However these changes, albeit being dependent on age, are not directly related to the month of birth and so they do not distort the following analysis. The only potentially confounding effect of the proximity to birthday on labor market performance could manifest itself through the combination of worker's relative seniority within his or her school grade (determined by school entry cutoff dates), and seasonality of youth employment (which peaks in the summer).[6] In order to prevent omitted variable bias, the estimated models include both seasonal controls and indicators of relative seniority among the covariates.

3 Data

3.1 Overview of the Dataset

The dataset is constructed from several administrative sources collected by Statistics Netherlands (CBS). It covers the entire population of the Netherlands (approximately 14 mil. individuals), from January 2006 to December 2012.[7] The data is aggregated into yearly blocks and contains exhaustive information about workers' labor market histories, specified at the level of individual employment spells. This information includes gross annual labor earnings, gross hourly wages, sector of employment, work intensities (specified as a fraction of full-time equivalent hours), and most importantly, the dates of initiation and (if observed) termination of each employment spell. The data also contains various demographic characteristics such as gender and an immigration background (accounting for the 1st and 2nd generation immigrants).

[5] A detailed description of all age-dependent labor restrictions imposed by the Dutch labor legislation is presented in Appendix A.1.

[6] An illustration of such mechanism is as follows: the oldest children within the school grade (born in September-October) might be, *ceteris paribus*, more likely to work. If they plan to work only during the summer, their employment spells are bound to end in August. This would create a disproportionate number of spells ending 1-2 months prior to the workers' birthdays, which would be falsely attributed to the minimum wage variation.

[7] The data is available also for 1999-2005, but there were changes in the CBS coding definitions between the waves 2005 and 2006.

The key data entries for the analysis are related to the date of birth. The exact date is not observable - in order to ensure personal privacy, the individual information is restricted to the year and month of birth. Nevertheless, this is enough to approximate a worker's monthly age at any given point of time. Together with the information about individual labor market histories, this allows me to quantify how many months were remaining to workers' next birthdays at the time of initiation and termination of their employment spells.

3.2 Descriptive Statistics

Summary statistics for the population of interest (15-23-year olds) are shown in Table 1.

Table 1: Summary statistics, ages 15-23, years 2006-2012

Individual-level data, annual frequency

Variable	Mean	Std. Dev.
Age (on July 1)	19.511	2.304
Female	0.507	
1^{st} gen. immigrant	0.194	
2^{nd} gen. immigrant	0.141	
% observed to work within a calendar year	0.707	
Number of individual observations	13,166,185	

We can see that the dataset is well-balanced by age and gender, which follows from having the information over the entire Dutch population. A substantial fraction of the youth population is shown to have immigrant background, with the 1st and 2nd generation immigrants representing approximately 34% of the observations. The labor participation of the youth population is also high - on average, 70.7% of the individuals are observed to engage in a formal employment within the span of a calendar year. The actual employment rate is however lower, since many of the observed employment spells have rather short durations. The employment rate is also highly dependent on workers' ages, which is illustrated in Figure 2.

The employment rate starts rising sharply once teenagers reach the age of 15, which coincides with the loosening of the most stringent work restrictions. The rapid growth continues throughout the teenage years, although it gradually becomes less pronounced. The positive age-dependence is also apparent among workers in their early twenties, reflecting the labor market entry of college-educated job seekers.[8]

[8]Similar employment patterns are observed in other countries as well. Blundell, Bozio, and Laroque (2013) report the age-specific employment rates for France, the United Kingdom and the United States, showing that both the UK and the US exhibit relatively similar employment trends as the Netherlands. The French youth employment rates are shown to be consistently lower. In comparison to the UK and the US, the Dutch employment rates are considerably higher for workers aged 15-17, and lower for workers older than 21. The former finding can

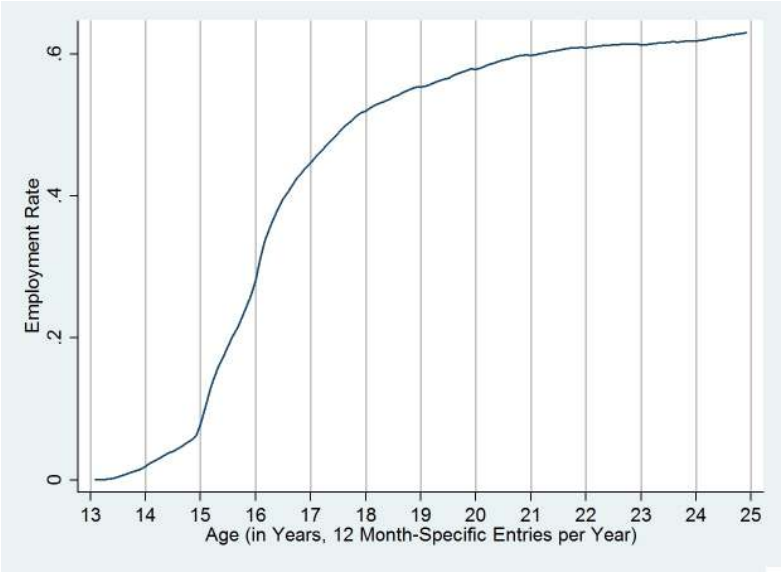


Figure 2: Youth employment rate as a function of age, Dutch population aged 13-25, years 2006-12

Focusing on the employment-related information, Table 2 presents the summary statistics corresponding to the universe of youth employment spells.

Table 2: Summary statistics for employment spells, workers aged 15-23, years 2006-2012

Employment spell-level data, annual frequency

Variable	Mean	Std. Dev.
Annual gross income (in 1000€)	4.253	7.094
Gross hourly wage (in €)	7.904	38.791
Work intensity (share of fte)	0.442	0.330
Employment spell length (months)	7.268	11.093
Number of employment spells observed	15,479,453	

The mean annual income coming from a single employment spell is €4253, which is approximately 25% of the annual income corresponding to a full-time adult minimum wage job. The gross wages average €7.9 per hour, and they exhibit substantial variance which is driven by the long upper tail of the wage distribution. Figure 3 shows the distribution of youth workers' gross hourly wages standardized by the minimum wage rates applicable for the respective age groups (the tail observations are censored).

be potentially attributed to the low minimum wage rates for 15-17 year-old workers in the Netherlands, while the latter finding is likely to be related to the relatively generous allowances

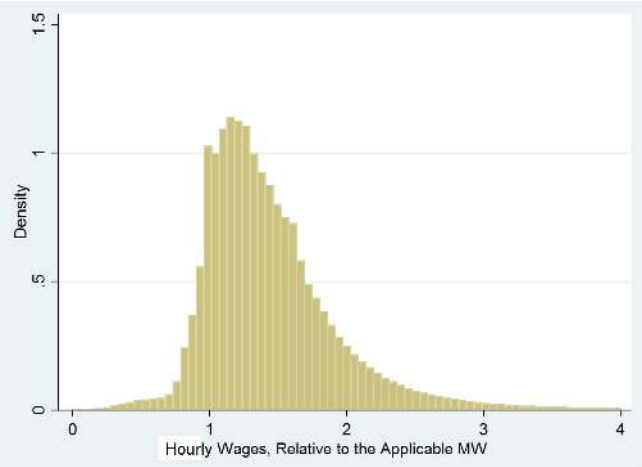


Figure 3: Empirical distribution of gross hourly wages, normalized by the applicable minimum wage rates, 15-22 year old workers, years 2006-12

We see that the density starts rising sharply above 1 which is the point of identity between the observed wages and the corresponding minimum wage rates. Although the majority of the workforce is earning wages well above the minimum levels, there are workers who are observed to earn wages below the legal minimum.[9] However, the general trend is consistent with the assumption that the minimum wage is indeed constituting a binding minimal amount of earnings which can be generated from formal employment.

The average duration of a finished youth employment spell is 7.3 months and the average work intensity is 0.44 fte, which corresponds to approximately 17 hours of work per week. Similarly to the other labor-related indicators, both the spell duration and the work intensity are strongly dependent on the age of workers. The duration of the employment spells increases with age, and the intensity of work also rises from the minimal part-time work allocations of the 15-year olds to the full-time allocations which are prevalent among the adult workers.

3.3 Employment Dynamics

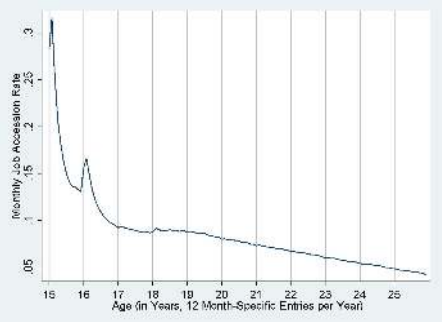
Figure 2 shows that the employment stocks are increasing with age, although minor disturbances of the general trend seem to occur around workers' birthdays (indicated by the grey vertical lines). To investigate this dependence further, I

for Dutch students engaged in tertiary education.

[9] In the observed period, 2% of the employment spells are recorded to yield wages below the applicable minimum rate. This discrepancy is well-documented in the literature (Flinn, 2011), and its occurrence can be attributed to many causes, including firms' failure to comply with the legislation, reporting errors, issues with employment spells with irregular working hours, *etc.*

focus on employment flows and calculate age-specific job accession rates and job separation rates. These rates represent the number of employment spells initiated and terminated among workers of specific age relative to the total number of employment spells observed within the same age group (the exact definitions of the job accession and the job separation used in this paper are included in Appendix A.2). The age profiles of the population-wide job separation and job accession rates are shown in Figure 4.

(a) Job Accession



(b) Job Separation

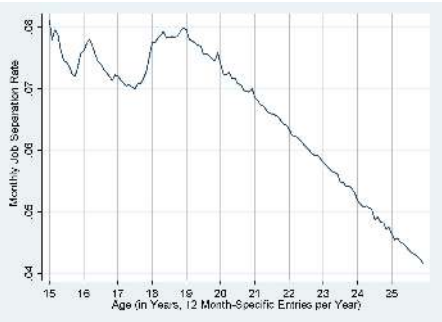


Figure 4: Job accession and job separation rates, 15-25 year old workers, years 2006-12

The general trend of the job accession rate is dominated by two spikes following workers' 15th and 16th birthdays. These spikes are however caused by institutional changes unrelated to the minimum wage. As discussed in Section 2, the 15th and 16th birthdays mark the gradual alleviation of labor restrictions imposed on the types of work popular among teenagers. Rather than the minimum wage effects, the two spikes therefore represent the expansion of work opportunities for workers of the respective ages. In the following years, the job accession rate is mostly falling. A slight reversion occurs past workers' 18th birthdays, but the downward trend is quickly resumed. The job separation rate exhibits similar non-monotonicities as the job accession rate, although their magnitudes differ. The two spikes following workers' 15th and 16th birthdays are much less pronounced, and the reversion occurring at the age of 18 is larger and more persistent.[10] In line with the general employment trend, the job accession rate is shown to be consistently above the job separation rate, although the difference between the two rates is getting less pronounced with age.

Apart from the general trend, Figure 4 also reveals the dependence of job separation rate on the proximity to workers' next birthdays: Past the age of 16,

[10]The increase of the job separation rate past the 15th and 16th birthdays is also likely to be caused by the loosening of labor restrictions. The coinciding spikes of job accession rate represent the labor market entry of many young workers who are facing high risk of job separation due to their lack of work experience. Similarly, the increase of separations among 18- and 19-year olds is likely to be caused by high school graduates entering the labor market for the first time.

the rate is exhibiting short spikes one month prior to workers' birthdays. This means that disproportionately more spells are being terminated among workers who are just about to turn one year older. Similarly, the job accessions past the age of 16 increase in the month following workers' birthdays. These increases are however hard to see due to the magnitude of the initial spikes. The dependence becomes clearer in Figure 5 where the job accession and separation rates are de-trended and pooled by age starting 6 months past the 17th birthday and ending 5 months past the 23rd birthday.[11]

Figure 5: Monthly fluctuations of the de-trended job accession and separation rates, 17-23 year old workers, years 2006-12

The de-trended job accession rate is shown to fall in the months preceding workers' birthdays, but once workers turn one year older, it immediately increases by 12 basis points and remains at the same level in the following months. This behavior is suggestive of the standard reservation wage arguments advocated by Card and Krueger (1994): Workers whose reservation wages are higher than the current minimum wage rate but lower than its next yearly increment should be observed to enter the labor market past their next birthday. Since it is unlikely that each of them finds a job straight away, the job accession rate can be expected to stay elevated for several months. The job separation rate exhibits a wave-like pattern which peaks in the 3 months closest to workers' next birthdays. A second, smaller peak is observed 3 months past the discontinuity. The spike of job separations preceding workers' birthdays is reinforcing the evidence of employers responding to the minimum wage discontinuities.[12] Furthermore, it can also offer an alternative explanation for the post-birthday surge

[11] This selection is imposed in order to avoid the initial job accession and separation spikes. The figures corresponding to the full sample are presented in Appendix A.3.

[12] An alternative explanation of the spikes is based on income targeting. The argument is that some workers may decide to end their employment prior to their next birthday, because with the higher minimum wage rate they do not need to work as much to earn their targeted level of income. Accordingly, they will attempt to switch to a less-intensive job which is sufficient to reach their desired income level. In Section 4.4, I look for empirical evidence

of job accessions: Since a disproportionate amount of workers have their employment spells terminated prior to their birthday, the increase of job accessions in the following months could be an evidence of them finding new jobs. This would render the post-birthday increase of job accession rate to be a mechanical consequence of the preceding spike of the job separation rate.

The following econometric analysis is focused mainly on quantifying the effects of minimum wage discontinuities on job separations. This is motivated by limitations of the data. An analysis of the job accessions would require models of unemployment duration, however since young job seekers are rarely recognized as unemployed by the authorities, it would be very difficult to set up such models with the current administrative dataset. That being said, the analysis of job separations can still prove useful for disentangling the job accession effects. Its results can provide an indirect evidence of the relative importance of the reservation wage channel and the mechanical channel discussed above.

4 Econometric Analysis

4.1 Models of Job Separation

The figures in the previous section are highly suggestive of positive effects of the minimum wage discontinuities on job separation. However, the actual size of the effects cannot be directly derived from these descriptive plots, since they can be distorted by various confounders, such as workers' experience and general age effects. In order to control for these issues, I estimate a conditional log-log duration model with time-varying covariates. The model is specified as follows,

$$\begin{aligned}\log[-\log(1-\lambda_{it})] &= \alpha + \beta_1 \log(dur_{it}) + \sum_{j=1}^{3} \beta_{2j} age_{it}^{j} \cdot \mathbf{1}\left(age_{it} \leq 210\right) \\ &+ \sum_{j=1}^{3} \beta_{3j} age_{it}^{j} \cdot \mathbf{1}\left(age_{it} > 210\right) + \sum_{m=1}^{11} \gamma_m \cdot \mathbf{1}\left(mtbd_{it} = m\right) \quad (1) \\ &+ other\, controls,\end{aligned}$$

where $(1-\lambda_{it})$ represents the survival probability (*i.e.*, the likelihood of keeping the same job) corresponding to the worker i, who is observed to be employed at the time t (a unit of time corresponds to one calendar month). The covariates include a constant, the logarithm of employment duration (accounting for job-specific tenure) and two third-order age polynomials, one for workers in the high school age range, and one for adult workers.[13] The main variables of interest are eleven indicator functions / dummies which differentiate the workers by the proximity to their next birthday. The proximity is captured by the variable $mtbd_{it}$, which quantifies the number of months remaining until the worker i's next birthday at the time t. Other controls include a set of calendar

supporting this argument, concluding that such strategic behavior is unlikely to be the cause of the observed fluctuations.

[13]The cutoff for the high school age range is 210 months, which corresponds to 17 years and 6 months. Very similar estimates have been obtained with the cutoff placed at 222 months.

month dummies which account for seasonality, year dummies, and dummies for workers' months of birth. In this setup, the *mtbd* dummies are identified through the interaction of calendar months and birth months. An inclusion of such interaction terms in the regression equation would render the *mtbd* dummies perfectly collinear.

The model is estimated using the employment histories of Dutch youth workers who are in the age range corresponding to the minimum wage discontinuities. The following censoring is applied: I discard the employment spells which end prior to the age of 15 years and 6 months, and the employment spells which start past the age of 23 years and 5 months. The remaining employment spells are used for the estimation. The spells which span over either of the two cutoff ages are kept in the dataset, but the parts of spells which precede the lower cutoff age (or follow the upper cutoff age) are censored. Furthermore, the period of observation is restricted to years 2006-11. The employment spells observed in the last available year (2012) are not analyzed as it cannot be determined whether the recorded job separations are permanent, or whether they correspond to jobs that were resumed in the following year. The only other sample selection pursued is to drop those workers who are either engaged in internships or self-employed, as they are exempted from the minimum wage regulation. The results are presented in Table 3. The parameter estimates are reported in exponentiated form, so that the coefficients larger than one imply, *ceteris paribus*, a higher relative risk of failure (job separation) compared to the baseline case. The coefficients smaller than one have the opposite interpretation. Accordingly, we see that the duration of employment is found to reduce the risk of failure, reflecting the higher job-specific experience and better screening of tenured workers. The *mtbd* coefficients reveal a pattern which is reinforcing the evidence of employers acting on the minimum wage discontinuities. For ease of exposition, this is documented graphically in Figure 6.

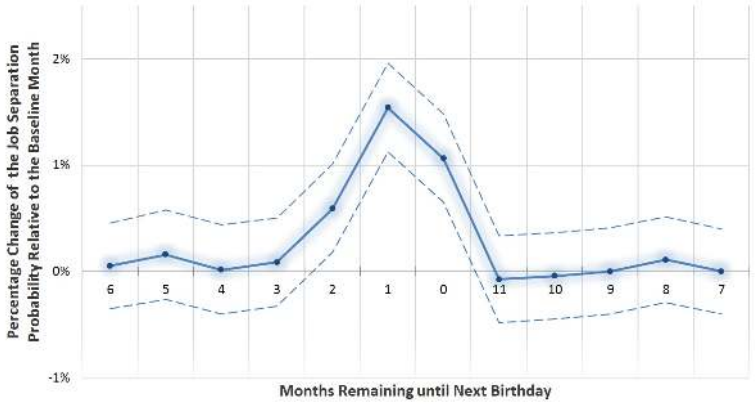


Figure 6: Predicted changes of job separation probability at different proximities to the birthdays, workers aged 15-23, years 2006-11

Table 3: Estimation results of the employment duration analysis, workers aged 15-23, years 2006-11

log(duration)	0.576***	*Age (at least 17.5 yrs)*	1.760***	*Birth month = 2*	0.989***
	(0.0003)		(0.0223)		(0.0021)
mtbd = 6	1.000	*Age^2 (at least 17.5 yrs)*	0.998***	*Birth month = 3*	0.984***
	(0.0021)		(0.0001)		(0.0021)
mtbd = 5	1.001	*Age^3 (at least 17.5 yrs)*	1.000***	*Birth month = 4*	0.989***
	(0.0021)		(0.0000)		(0.0021)
mtbd = 4	1.000	*Calendar month = 1*	0.666***	*Birth month = 5*	0.988***
	(0.0021)		(0.0014)		(0.0021)
mtbd = 3	1.001	*Calendar month = 2*	0.583***	*Birth month = 6*	0.992***
	(0.0021)		(0.0013)		(0.0021)
mtbd = 2	1.006***	*Calendar month = 3*	0.601***	*Birth month = 7*	0.9980
	(0.0021)		(0.0013)		(0.0021)
mtbd = 1	1.015***	*Calendar month = 4*	0.608***	*Birth month = 8*	0.992***
	(0.0021)		(0.0013)		(0.0021)
mtbd = 0	1.011***	*Calendar month = 5*	0.659***	*Birth month = 9*	0.992***
	(0.0021)		(0.0014)		(0.0021)
mtbd = 11	0.999	*Calendar month = 6*	0.762***	*Birth month = 10*	0.992***
	(0.0021)		(0.0015)		(0.0021)
mtbd = 10	0.999	*Calendar month = 7*	0.893***	*Birth month = 11*	0.995**
	(0.0021)		(0.0017)		(0.0021)
mtbd = 9	1.000	*Calendar month = 8*	1.200***	*Year = 2006*	1.005***
	(0.0021)		(0.0022)		(0.0015)
mtbd = 8	1.001	*Calendar month = 9*	1.043***	*Year = 2007*	1.106***
	(0.0021)		(0.0020)		(0.0016)
Age (below 17.5 yrs)	1.942***	*Calendar month = 10*	0.793***	*Year = 2008*	1.114***
	(0.0319)		(0.0016)		(0.0016)
Age^2 (below 17.5 yrs)	0.997***	*Calendar month = 11*	0.712***	*Year = 2009*	1.057***
	(0.0001)		(0.0015)		(0.0016)
Age^3 (below 17.5 yrs)	1.000***	*Birth month = 1*	1.001	*Year = 2010*	1.014***
	(0.0000)		(0.0021)		(0.0016)
	Observations			79.3 mil.	
	Likelihood			-1.91E+07	

The coefficients are presented in the exponentiated form, standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The coefficients are expressed as percentage changes of the baseline job separation rate, which corresponds to the workers who are 7 months short of their next birthday. The dotted lines indicate the 95% confidence interval. The graph shows that after controlling for the job-specific experience, age, and other potential confounders, the wave-like pattern and the second peak of the job separation rate (captured in Figure 5 and Figure A.1) disappears. The job separation probabilities are shown to be indistinguishable from the baseline in all months except for the three which are the closest to workers' next birthdays. Within this period, the aggregate job separation probability increases by 0.5-1.5%, and remains significantly higher than the baseline.

The stable profile of the job separation probabilities with a single peak preceding workers' birthdays is well-aligned with the hypothesis that employers discriminate against their employees on the basis of their age. The cost-minimizing employers have little incentive to act upon the age-dependency of minimum wage when workers are far from their birthday, but they will take it into account when the change of individual labor costs becomes imminent. The increase of the job separation probability within these 3 months is therefore considered to be the effect of minimum wage discontinuities.[14] The elimination of the second peak of the job separation rate (observed 3 months after workers' birthdays) is fully attributed to the inclusion of spell duration among the covariates. This finding has an important implications for empirical analyses - the increase of the job separation rate following workers' birthdays is caused by the workers who get employed very soon after their birthdays (recall the post-birthday surge of job accessions) and who face higher risk of job separation due to their lack of job-specific experience. The failure to account for spell duration in the analysis of job separation would therefore bias the effect of minimum wage discontinuities downwards due to the non-random starting dates of youth employment spells.

It remains to be added that the effect is expressed in terms of changes of the *aggregate* job separation probability, although it is borne only by a subset of the youth workforce. The workers who can retain their former wages should not face higher job separation rates close to their birthdays. Only the workers who are earning wages below the next increment of the minimum wage rate are directly at risk, as their labor costs are bound to change when they reach their next birthdays. This group represents approximately 20% of the youth workforce, which means that the effect of minimum wage discontinuities for workers at risk should be about 5 times larger than the aggregate effect.[15]

[14] The spread of this effect over 3 months is partially caused by imperfect observability of individual birthdays. If the data contained the exact dates of birth instead of months of birth, then the job separation probability would be peaking more sharply 1 month prior to workers' birthdays.

[15] The exact size of this group-specific effect is, however, difficult to quantify due to the problems with selection of the workers at risk. The intuition is as follows: The workers who earn minimum wage immediately after their birthdays are likely to be different from those who remain in the minimum wage jobs as they approach their next birthdays (at this point, some of the more-able workers have switched jobs and earn higher wages). Isolating the workers who earn wages below the next minimum wage rate would therefore lead to a sample of employment spells in which workers' abilities and effort levels are correlated with

4.2 Age-Specific Effects

Since the Dutch system employs multiple increases of the youth minimum wage rate, the employment duration can be analyzed separately for workers observed in the twelve months around each of the birthday discontinuities. The duration model used for these birthday-specific analyses is a simplified version of the baseline model, specified as

$$\begin{aligned}\log[-\log(1-\lambda_{it})] \quad &= \alpha + \beta_1 \log(dur_{it}) + \beta_2 age_{it} + \beta_3 age_{it}^2 \\ &\quad + \gamma \cdot \mathbf{1}\left(mtbd_{it} < 3\right) + \; other\, controls.\end{aligned} \tag{2}$$

Here, the third-order age polynomial with splines is replaced by a second-order polynomial (the age-specific job separation rates are reasonably well-behaved within the isolated 12-month intervals), and the set of *mtbd* dummies is replaced by a single dummy variable representing the three months closest to workers' next birthdays. The model is estimated for each birthday discontinuity included in the full sample, and also for workers aged 24-26 who are no longer subject to the changes of the minimum wage rate. Figure 7 documents the effects for each of the age groups together with 95% confidence bands.

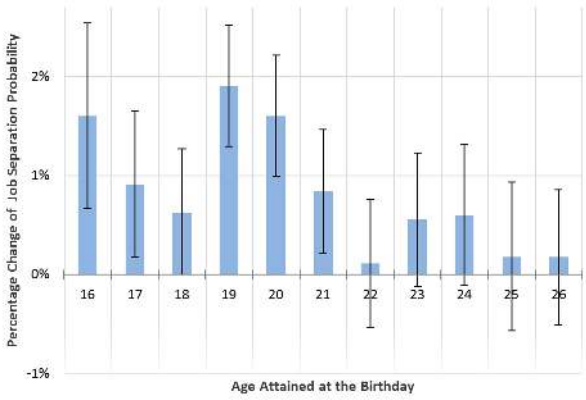


Figure 7: Predicted changes of job separation probability in the 3 months closest to workers' next birthdays, workers aged 15-23, years 2006-11

The age profile of the birthday effects resembles a sawtooth pattern. The effect is high for 16 year olds, which is to be expected as this is the youngest (and the least-skilled) group of workers in the analyzed population. The size of the effect falls in the two following years and rebounds when workers reach the age of 19. For a majority of Dutch students, the 19th birthday occurs in

the proximity to their birthdays. This would reflect in the values of *mtbd* dummies, making the minimum wage effects hard to disentangle. For this reason, I restrict my analysis to the full population of youth workers, evading the problems with dynamic sample selection. I also provide indirect evidence that the measured effects indeed correspond only to those workers for whom the discontinuities are binding.

the year following high school graduation, and therefore it represents the first minimum wage discontinuity for workers who decided to join the labor force after finishing high school (and who are likely to lack prior work experience). The effect then starts to decline again and becomes insignificant at the age of 22. The effects attributed to 23rd and 24th birthdays seem to increase again (the 23rd birthday follows college graduation) but neither of them proves significant. No dependence has been found in the following years, which should also be the case since the workers are no longer subject to the minimum wage discontinuities.

We see that the discontinuities have the strongest effect on the job separation of the youngest and least experienced workers. The effects are less pronounced for the older age groups, which is suggestive of better screening for older workers' abilities. An alternative explanation is that the jobs performed by older minimum wage workers require more job-specific skills and therefore the workers are less substitutable by younger and cheaper labor market entrants.

4.3 How Many Workers Are Losing Jobs Due to the Discontinuities?

The effects of the minimum wage discontinuities on the probability of job separation are statistically significant, but whether they are practically important depends on the actual job separation frequencies. For the sake of better exposition, I quantify how many workers are expected to lose their job due to the minimum wage discontinuities on an annual basis. Following the estimation results, I assume that the minimum wage discontinuities affect job separation only in the three months which are closest to workers' birthdays. I quantify job separation frequencies within these three months and compare them to the job separation frequencies in the remaining months of the year (abstracting from the age and tenure effects). Table 4 reports the findings.

Table 4: Quantification of the discontinuity effects on annual job separation frequencies, workers aged 15-22, years 2006-11

Age	#Separations per year	Predicted separations in the 3 months closest to workers' BD	Predicted quarterly separations in other months	#Separations caused by MW increase
16	64878.2	16154.9	16413.4	258.5
17	95647.2	23857.5	24074.8	217.3
18	119515.3	29832.3	30018.4	186.2
19	133924.2	33322.4	33957.1	634.8
20	132544.7	33004.0	33532.7	528.7
21	126727.1	31615.3	31881.2	265.9
22	118280.0	29561.9	29594.4	32.5
23	109338.6	27296.7	27448.5	151.8
total	**900855.3**	**224644.9**	**226920.6**	**2275.7**

In the second column we see how many employment spells were terminated per year for each of the age groups of interest. The frequencies initially rise with age, reflecting higher employment rates among older cohorts, but the trend reverts past the 19th birthday, which is in line with the falling job separation rate. The third column contains the predicted number of job separations in the three months closest to workers' birthdays, and the fourth column contains the predicted quarterly frequencies corresponding to the remaining months. The fifth column then quantifies how many of the terminated spells can be attributed to the increased job separation in the three months prior to workers' birthdays. The number of jobs lost per year due to the minimum wage discontinuities is calculated to be 2275.7. The workers who are contributing the most to this figure are aged 19, which stems from a combination of the relatively large pool of 19 year old workers, and the strong effect of the minimum wage discontinuity on the workers within this age group.

The number of job separations attributed to the minimum wage discontinuities represents about 0.25% of the annual youth job separations, which represents a relatively small effect in aggregate terms. However, as discussed above, this effect is borne only by workers for whom the discontinuities are binding (that is, whose wages cannot be sustained past their birthday). 3 months prior to workers' birthday, this group contains approximately 215,000 employment spells. The size of the effect can be therefore likened to a termination of approximately 1% of the employment spells at risk.

4.4 Who Loses Jobs Due to the Discontinuities?

It can be expected that the minimum wage discontinuities will affect some workers more than others. In order to explore who is more likely to lose the job due to the discontinuities, I estimate a variant of the initial cloglog model where the set of covariates is augmented by dummies for a worker's gender, immigration status and the employment sectors which are in the focus of the minimum wage literature (see Giuliano, 2013, or Dube, Lester, and Reich, forth.). In order to obtain the group-specific effects of minimum wage discontinuities, these dummies are also interacted with the $mtbd < 3$ dummy.

The sectoral estimates are presented graphically in Figure 8, and they reveal a sizable heterogeneity of the minimum wage effects. The effect is found to be very large in the supermarket sector, which is a sector that accommodates $\sim$15% of the youth employment spells. The effects are smaller for other retail, and for restaurants and bars. The effects for these two sectors are shown to be higher than the effects for all the remaining sectors combined, but the difference is not statistically significant. The finding of large effects in the supermarket sector conforms with the intuition that the effects are likely to be stronger in sectors with job opportunities which do not require extensive training, thereby making the individual workers easily replaceable.[16] The last column in Figure 8 is

[16] More detailed analysis of sectoral minimum wage effects confirms this line of reasoning - further sectors with large minimum wage effects are agriculture, bakeries, and butchers. In contrast, the sectors which do not show sizable effects include science & education, logistics,

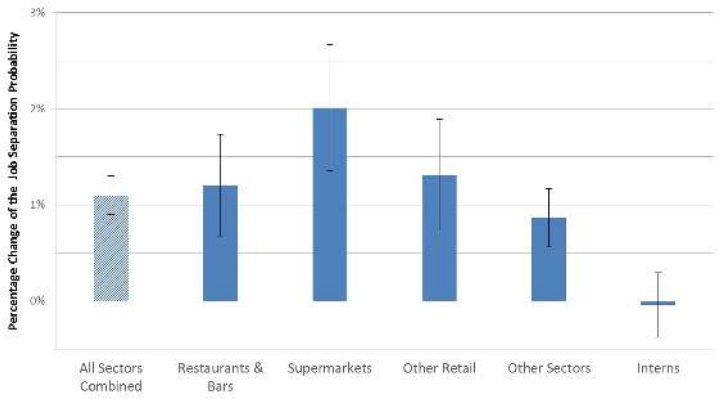


Figure 8: Percentage change of the job separation rate within the 3 months closest to workers' next birthdays, workers aged 15-23, differentiated by sector of employment, years 2006-11

coming from a separate model which evaluates the birthday effects for interns and apprentices. As discussed above, this is the group of workers which is not legally subject to the minimum wage regulation, so that it can be considered a placebo group. The employers should have no particular reason to dismiss these workers close to their birthdays, and this is also what we see from the figure. For interns and apprentices, the probability of job separation close to their next birthday is the same as the probability of job separation in other times of the year. Interestingly, the regression results also show no significant difference between the minimum wage effects for men and women. There is also no change of the effect size among immigrants, although both immigrants and women are shown to be subject to a higher baseline probability of job separation.[17]

Apart from the analysis of job separation probabilities, it is also interesting to look at the outcomes of workers who have actually experienced the job separation and investigate whether their outcomes exhibit some dependence on the proximity to a birthday at the time of separation. In order to do so, I split the population of separated workers into two groups: the 'treatment' group of workers who have experienced job separations within the 3 months closest to their birthdays, and the 'control' group of those who have experienced separations at other points in time. Firstly, I compare how long it takes the workers in the two groups to start a new job.[18]

Figure 9 plots the monthly frequencies of jobless durations for both groups, showing that the workers whose jobs are terminated close to their birthdays are likely to experience slightly longer jobless spells. The share of job-to-job transitions (*i.e.*, starting a new job within the same month or one month fol-

postal services and healthcare. Detailed results are available upon request.

[17]The table listing all estimated coefficients is included in Appendix A.3.

[18]The jobless durations can be thought of as rough proxies for unemployment durations in the population which is unlikely to be tracked by the unemployment agencies.

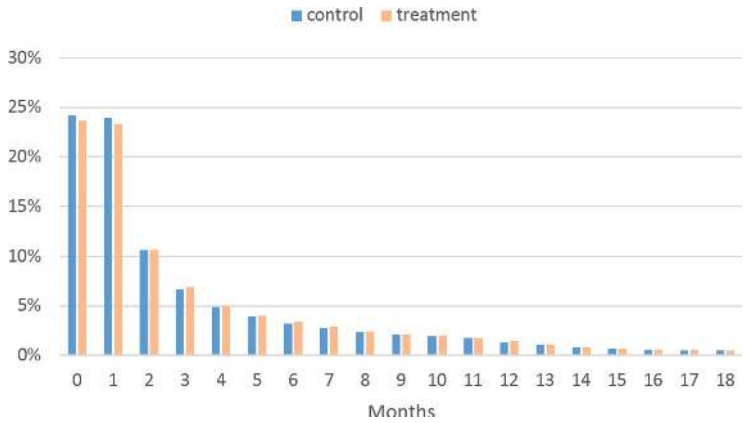


Figure 9: Duration of jobless spells, 16-23 year old workers whose job spell ended in years 2006-10

lowing the job separation) is 1.09 percentage points lower than in the control group, and the re-employment frequencies are slightly higher in the period of 3-8 months following the initial event. This finding suggests that the effects of minimum wage discontinuities are unlikely to be driven by workers who are switching jobs past their birthdays. I also assess whether these workers differ in terms of hours of work when re-employed. Compared to their initial jobs, both groups are shown to increase their hours of work by a substantial margin (approximately 22%), and the increase in the treatment group is 0.3 percentage points higher than in the control group.[19]

4.5 Job Accessions and Employment Stocks

The analysis of jobless duration suggests that the post-birthday increase of job accession rate documented in Figure 4 cannot be fully attributed to the re-employment of those workers who lost their job due to the minimum wage discontinuities. These workers will certainly contribute to the surge of job accessions, but their re-employment flows are not strong enough to fully explain the observed spikes of the job accession rate. Other channels are likely to contribute to the observed patterns, such as the increased inflow of new labor market entrants (whose reservation wages fall above the pre-birthday minimum wage rate but below the post-birthday minimum wage rate).

Capturing general employment effects induced by the minimum wage changes is also rather cumbersome. In Section 3 we saw that the employment rates grow as youths age, but these growth rates are unlikely to be related to the changes of

[19]These results go against the income targeting argument presented in Footnote 12. The workers whose job ended close to their birthdays get re-employed in more intensive jobs which bolsters the claim that the job separation effects of the discontinuities are driven by the behavior of cost-minimizing firms rather than the strategic considerations of workers themselves.

minimum wages (similar sustained growth paths are observed in other countries as well, irrespective of their use of age-dependent minimum wages, see Blundell, Bozio, and Laroque, 2013). The approach pursued by Dickens, Riley, and Wilkinson (2014) is to study the employment effects of age-dependent minimum wage changes using regression discontinuity (RD) design. In their study, the authors evaluate the employment effects of age-dependent minimum wage in the UK, focusing on the minimum wage rate discontinuity which occurs on workers' 22nd birthdays. Using a sharp RD design with polynomial age trends, the authors find that the minimum wage increase has a positive effect on aggregate employment rate, but this finding is restricted only to low-skilled individuals.

A similar exercise could be performed in the Dutch context as well, but the findings presented above suggest that there is a fundamental problem with this approach. The RD design uses the *no-anticipation assumption* to justify that the comparison of employment trends before and after the discontinuity can capture the true effect of the minimum wage rate change. This assumption is however likely to be violated, since employers are shown to anticipate the increased labor costs and terminate the minimum wage contracts before workers' next birthdays. The positive employment effect found by Dickens, Riley, and Wilkinson (2014) may be therefore an artifact of increased job separation rate prior to the discontinuity, and the consecutive spike of job accessions, partially driven by the re-employment of those workers who have lost their jobs due to the minimum wage change. For this reason, the commentary of employment effects is restricted to descriptive analysis. Figure 10 shows the evolution of the Dutch employment rate around the 22nd birthday.

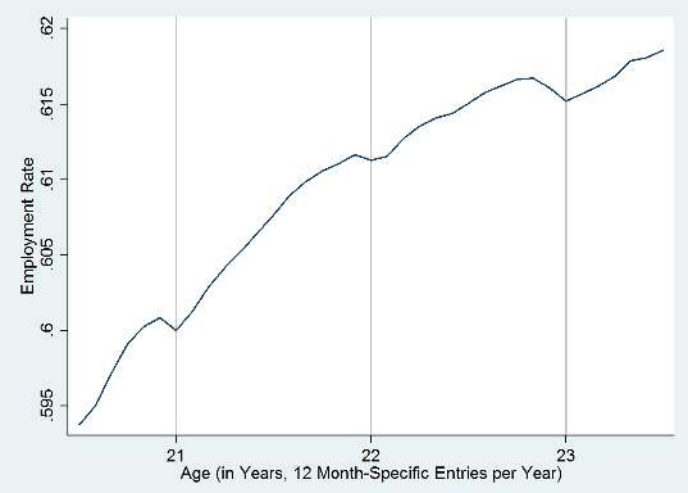


Figure 10: Youth employment rate as a function of age, Dutch population aged 21-23, years 2006-12

In line with the results presented so far, we see that the growth of employment slows down prior to the birthday, and rebounds after the birthday.

The figure does not indicate positive employment effects occurring at the very point of discontinuity. Rather than that, the general growth rate appears to be staggered by the minimum wage changes.

4.6 Further Discussion

The econometric analysis presented above documents the adverse effects of changes in age-dependent minimum wages on job separation of youth workers. The results are robust to several alternative model specifications. The effects are not sensitive to the inclusion of dummies for standard durations of employment contracts (6 months & 12 months), and they are also confirmed by the fully-nonparametric specification of the employment duration model, and by Probit and Logit models. The effects are both statistically and economically significant, and as such they should be of considerable interest to the ongoing debate regarding the merits of age-dependent minimum wage systems. Bearing that in mind, it is important to interpret the results in an appropriate context.

The measured effects imply that a 1% age-dependent increase of the minimum wage rate translates into approximately a 0.08% increase in the probability of job separation in the three months closest to the corresponding discontinuity.[20] However, this does not mean that if we raise minimum wages for the entire youth population, we would expect job separation effects of similar magnitude. A crucial feature of the age-dependent system is that the employers can always substitute their current workers by younger and cheaper ones. Such substitution is not feasible in the case of a universal minimum wage increase, since the labor costs change for the entire workforce. Therefore, the effects of a universal change of the minimum wage on job separation can be expected to be lower.

On the other hand, even in the universal case the adverse effects are unlikely to disappear completely - as shown above, the employers do respond to changes in the labor costs, and the aggregate increase of (youth) minimum wages may therefore facilitate implementation of new technologies which are less labor-intensive. An example of this could be the introduction of self-service checkout terminals in supermarkets, or automation of the wholesale warehouses. Since the minimum wage jobs are less intensive in human capital, introduction of such technology constitutes a viable, albeit costly alternative to the youth labor force.

5 Conclusions

This paper provides an evidence of the effects of age-dependent minimum wage on labor market flows among Dutch youth workers aged 15–23. The age-dependency is an important feature of the Dutch variant of minimum wage legislation, increasing the youth minimum wage rate by more than 300% in the

[20] This follows from the fact that the aggregate effect amounts to approx. 1.15% change of the baseline job separation probability, and corresponds to 15-17% year-on-year changes of age-dependent minimum wages.

span of 8 years. The empirical analysis exploits the fact that firms are facing a sharp discontinuity in labor costs in the month when worker turns one year older. Accordingly, the workers earning minimum wages can be expected to face higher risks of losing their jobs close to their birthdays.

Using administrative records for the entire population of the Netherlands, I analyze monthly flows in and out of the labor force, accounting for the time remaining until workers' next birthday. The results show a significant increase in the probability of job separation prior to the discontinuity: the job separation probability increases by 1.1% in the 3 months closest to workers' birthdays, compared to the rest of the year. There is a substantial heterogeneity in the minimum wage effects, with their size being heavily dependent on the sector of employment and a worker's age. The supermarket sector in particular is highly responsive to the discontinuities, with the job separation probability increasing by 2%, compared to the 0.9% increase applicable for the other sectors. The effect is shown to be the highest at ages that mark the influx of inexperienced workers into the labor force. Otherwise, the effect is decreasing with age, which is suggestive of human capital accumulation and better screening of older workers' abilities.

I also investigate the characteristics of workers whose jobs ended close to the time of the discontinuity, showing that they experience slightly longer jobless spells than the workers whose job ended at other points in time. These workers are not observed to sort themselves into less-intensive jobs after the job separation, which supports the hypothesis that the measured effects are induced by the personnel decisions of cost-minimizing firms, rather than the voluntary separations of workers who are targeting a specific level of labor income. The analysis presented here remains agnostic about the overall employment effects of the age-dependent minimum wages. This is due to current data limitations and potential confounding effects, such as the interplay between work and schooling decisions. The administrative dataset does not contain information on whether the youths are actively looking for employment, which makes the analysis of employment decisions difficult. More information is therefore needed in order to explore this domain of interest.

The results derived from the econometric analysis confirm that the employers respond to the minimum wage discontinuities, and they are likely to dismiss more than two thousand minimum wage workers each year due to their rising labor costs. However, it remains an open question whether the changes of similar magnitude could be expected in the case of minimum wage reform increasing the minimum wage rates across the board. The lack of a cheaper 'substitute' workforce would likely moderate the adverse effects on job separation, but it might motivate firms to switch to the less labor-intensive modes of operation. The analysis of such a change would be further complicated by the supply side effects of the minimum wage changes, which would require explicit structural modeling of individual decision making with respect to work and schooling decisions. These efforts are left for the follow-up analyses.

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A Appendix

A.1 Other Age-Dependent Labor Market Policies in the Netherlands

Apart from the minimum wage, the Dutch labor legislation makes use of other policies which are dependent on the calendar age of youth workers. These policies are regulatory measures which impose restrictions on the hours of work and the types of jobs that can be pursued by teenagers.

The institutional restrictions are most stringent for workers aged 13 & 14, who are allowed to be employed only by family businesses, and whose work engagement should not exceed 12 hours per week during the school year and 35 hours per week during the school holidays. These restrictions are partially loosened when workers turn 15. For this group, the total work & schooling engagement should not surpass 40 hours per week. The 15-year olds are however still heavily limited in the types of work they are allowed to do. The occupational restrictions include factory work, handling hazardous substances, heavy manual labor, but also working behind the counter and working in bars and restaurants (since alcohol is served). The major change comes with the 16th birthday, which marks the end of compulsory schooling in the Netherlands. Past this point, workers are allowed to engage in most types of work (the restrictions are maintained only for work involving hazardous substances and work in extremely noisy environments), and their maximal work engagement is increased up to 45 hours per week. The remaining restrictions are dropped at the age of 18.

Just like the minimum wage discontinuities, these restrictions are strictly adhered to and therefore they should be borne in mind when analyzing the employment flows around workers' 15th & 16th birthdays. Some workers may indeed decide to change their current labor market status around their 16th birthdays for reasons unrelated to the coinciding minimum wage change (especially if there are better work opportunities in the age-restricted occupations). On the other hand, the effects of minimum wage discontinuities occurring at the other birthdays should not be confounded by institutional changes. The alleviation of work restrictions at the 18th birthday applies only to a very specialized subset of the workforce, and the remaining six birthdays are not subject to any age-dependent variation in the labor market policies.

A.2 Definitions

Job Accession - The job accession is recorded in the calendar month when a worker starts working for a new employer. The job accession is not recorded when a worker resumes the work for the same employer after a period of absence (for example if he/she has worked for the same employer earlier in the same calendar year or the year before). This coding prevents misclassification of jobs with variable work days, job spells interrupted by school holidays, or promotions within the same firm.

Job Separation - The job separation is recorded in the calendar month when a worker is observed to stop working for a given employer, and he/she is not observed to resume the work for the same employer in the same calendar year or the following year.

Employment Duration - The employment duration in the month of observation is recorded as the number of months passed from a worker's job accession, accounting for any interruptions of his/her employment spell.

A.3 Figures and Tables

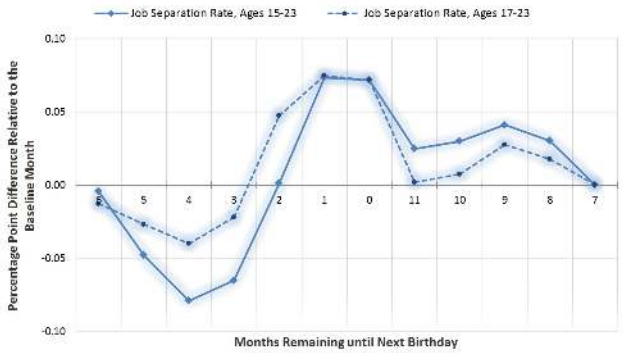

Figure A.1: Monthly fluctuations of the de-trended job separation rate, 15-23 year old workers, years 2006-11

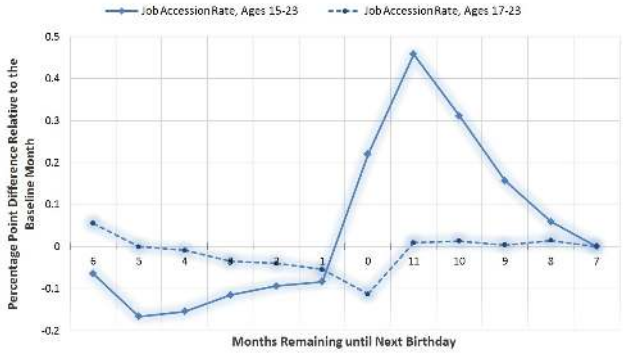

Figure A.2: Monthly fluctuations of the de-trended job accession rate, 15-23 year old workers, years 2007-12

Table A.1: Estimation results of the interacted version of the model, and the basic model for interns, workers aged 15-23, years 2006-11

Variables	Interacted model, full dataset	Basic model, population of interns
$mtbd = \{0, 1, 2\}$	1.086***	0.999
	(0.0010)	(0.0034)
$mtbd = \{0, 1, 2\} \cdot$ *female*	0.998	
	(0.0038)	
$mtbd = \{0, 1, 2\} \cdot$ *1st gen. immigrant*	0.998	
	(0.0071)	
$mtbd = \{0, 1, 2\} \cdot$ *2nd gen. immigrant*	0.993	
	(0.0052)	
$mtbd = \{0, 1, 2\} \cdot$ *rest. and bars*	1.003	
	(0.0027)	
$mtbd = \{0, 1, 2\} \cdot$ *other retail*	1.004	
	(0.0030)	
$mtbd = \{0, 1, 2\} \cdot$ *supermarkets*	1.011**	
	(0.0033)	
Female	1.016***	
	(0.0016)	
1st gen immigrant	1.177***	
	(0.0036)	
2nd gen immigrant	1.164***	
	(0.0026)	
Rest. and bars	0.735***	
	(0.0015)	
Other retail	0.528***	
	(0.0013)	
Supermarkets	0.566***	
	(0.0021)	
log(duration)	0.569***	1.532***
	(0.0004)	(0.0036)
Age (below 17.5 yrs)	1.801***	2.313***
	(0.0326)	(0.1380)
Age^2 *(below 17.5 yrs)*	1.682***	1.263***
	(0.0238)	(0.0502)
Age^3 *(below 17.5 yrs)*	0.997***	0.993***
	(0.0001)	(0.0004)
Age (at least 17.5 yrs)	0.998***	0.999***
	(0.0000)	(0.0002)
Age^2 *(at least 17.5 yrs)*	1.000***	1.000***
	(0.0000)	(0.0000)
Age^3 *(at least 17.5 yrs)*	1.000***	1.000***
	(0.0000)	(0.0000)
Calendar month = 1	0.745***	3.371***
	(0.0018)	(0.0214)
Calendar month = 2	0.635***	1.361***
	(0.0016)	(0.0102)
Calendar month = 3	0.639***	0.841***
	(0.0016)	(0.0071)
Calendar month = 4	0.647***	1.352***
	(0.0016)	(0.0098)

cont'd

Calendar month = 5	0.693***	1.002.
	(0.0016)	(0.0078)
Calendar month = 6	0.802***	4.799***
	(0.0018)	(0.0291)
Calendar month = 7	0.932***	4.880***
	(0.0020)	(0.0322)
Calendar month = 8	1.246***	1.457***
	(0.0025)	(0.0129)
Calendar month = 9	1.094***	0.564***
	(0.0023)	(0.0056)
Calendar month = 10	0.828***	0.518***
	(0.0019)	(0.0050)
Calendar month = 11	0.753***	0.758***
	(0.0023)	(0.0062)
Birth month = 1	1.006***	1.001
	(0.0023)	(0.0071)
Birth month = 2	1.000	0.991
	(0.0024)	(0.0072)
Birth month = 3	0.994**	1.001
	(0.0023)	(0.0070)
Birth month = 4	0.992***	1.002
	(0.0023)	(0.0070)
Birth month = 5	0.989***	0.994
	(0.0023)	(0.0069)
Birth month = 6	0.994**	1.005
	(0.0023)	(0.0071)
Birth month = 7	0.998	1.010
	(0.0023)	(0.0070)
Birth month = 8	0.997	1.011
	(0.0023)	(0.0071)
Birth month = 9	0.996*	0.999
	(0.0023)	(0.0070)
Birth month = 10	0.995**	0.995
	(0.0023)	(0.0071)
Birth month = 11	0.997	0.997
	(0.0023)	(0.0073)
Year = 2006	1.003***	1.109***
	(0.0015)	(0.0055)
Year = 2007	1.078***	1.143***
	(0.0016)	(0.0055)
Year = 2008	1.100***	1.129***
	(0.0016)	(0.0053)
Year = 2009	1.057***	1.082***
	(0.0016)	(0.0050)
Year = 2010	1.022***	1.021***
	(0.0016)	(0.0047)
Constant	0.000249***	0.0001***
	(0.0001)	(0.0000)
Observations	79,301,064	3,569,607
Log-likelihood	-1.56E+07	-1.28E+06

The coefficients are presented in the exponentiated form, standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$