VATT Working Papers 105

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Valtion taloudellinen tutkimuskeskus
VATT Institute for Economic Research
Helsinki 2018

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Financial support from the Finnish Centre for Pensions is gratefully acknowledged. We thank Susan Kuivalainen, Meeri Kesälä, Mikko Laaksonen, Anu Polvinen, Heikki Pursiainen and Juha Rantala for their helpful comments, and Jukka Lampi and Hanna Pesola for constructing the data set.

ISBN 978-952-274-215-5 (PDF)

ISSN 1798-0291 (PDF)

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Arkadiankatu 7, 00100 Helsinki, Finland

Helsinki, March 2018

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Abstract

We study whether the experience rating of employers' disability insurance premiums affects the inflow to disability benefits in Finland. To identify the causal effect of experience rating, we exploit "kinks" in the rule that specifies the degree of experience rating as a function of firm size. Using comprehensive matched employer-employee panel data, we estimate the effects of experience rating on the inflow to sickness and disability benefits. Our results suggest that experience rating has reduced the disability inflow among men under age 50. For other groups we find no significant effects, yet we cannot rule out relatively small effects.

Key words: Experience rating, disability insurance, early retirement

JEL classes: J14, J26, H32

1 Introduction

In many countries, disability benefit costs are increasing rapidly and reforming disability programs is high on the policy agenda. While several studies have analyzed the effects of disability benefits or eligibility criteria, the role of employers and their incentives has attracted little attention, even though the employers may play an important role as well. The employer can invest in workplace health and safety, and allocate the workload evenly between its employees in an attempt to reduce the onset of health problems at the workplace. When a worker anyway develops a medical condition that reduces his or her working capacity, the employer has the discretion of whether to provide physical aid or retraining, and whether to modify job assignments in order to keep the worker at work. However, the employer's incentives to implement disability reducing measures can be weak even when the costs of such measures to the employer are considerably less than the costs of a new disability benefit recipient to the society. Experience rating of disability insurance premiums may help to mitigate this incentive problem.

With experience rating, the employer's premium is adjusted to reflect the costs of its workers' past disability benefit claims in comparison to other employers. Employers with high disability costs are penalized through a surcharge on top of the base premium, while employers with low disability costs are rewarded by giving a discount on the base premium. If successful, experience rating helps employers to internalize the societal costs of disability benefit claims and encourages them to implement cost-effective disability reducing measures, leading to lower disability benefit enrollment.

Although experience rating is used in other forms of social insurance, such as in workers' compensation and unemployment insurance schemes, it is still rare in the context of disability insurance (DI). To the best of our knowledge, DI premiums are currently experience rated only in the Netherlands and Finland. In some other countries, experience rating has attracted interest as a potentially effective means to curb growth in the disability caseload. Autor (2011) and Burkhauser and Daly (2011), for example, have proposed that the U.S. Social Security DI program should be financed by an experience-rated payroll tax. Their proposals are motivated by declines in disability benefit enrollment in the Netherlands after the experience-rated DI premiums were introduced in the late 1990s. However, due to the number of simultaneous reforms that confound the effects of individual policy measures, it is not entirely clear to what extent experience rating has contributed to this development, even though the findings of Koning (2009), van Sonsbeek and Gradus (2013) and de Groot and Koning (2016) do imply that experience rating has reduced the disability inflow in the Netherlands. We contribute to this literature by studying the effects of experience rating in the Finnish labor market using panel data that cover the universe of firms and all their employees.

In Finland, the employers are subject to various degrees of experience rating depending on their size. The smallest firms are not subject to experience rating at all, whereas the largest firms are fully experience rated (in the sense they only pay experience-rated DI premiums). Among the medium-sized firms the degree of experience rating increases linearly from 0 to 1 with firm size. As such, the rule that specifies the degree of experience rating as a function of firm size has discontinuities or "kinks" at the threshold values of small and large firms. Under the assumption that the effect of firm size on disability risk is smooth, we can distinguish the causal effect of experience rating from the firm size effect using a regression kink design (e.g. Nielsen et al. 2010, and Card et al. 2015).

In the first step of the analysis, we construct firm-year disability inflow measures that account for differences in the characteristics of the employees across firms and over time. As outcomes we consider the inflow to sick leave, which typically precedes receipt of a disability benefit, and the inflows to different types of disability benefits (fixed vs. indefinite duration, and partial vs. full benefit), which all affect the employer's DI premium rate differently. Since our data contain medical diagnoses for those who were awarded a disability benefit, we also consider the disability inflows by main diagnosis category. In the second step, we examine to what extent differences in the adjusted disability risks between firms can be explained by differences in the degree of experience rating.

Our graphical analysis shows that the disability risks vary little with firm size. In particular, the relationship between disability risk and firm size is roughly the same for the medium-sized firms among which the degree of experience rating increases with firm size, and for the small firms and large firms among which the degree of experience rating is constant. This observation suggests that experience rating has no effect or only a small effect on disability outcomes. In the regression analysis, we find no evidence that experience rating would affect any of our disability outcomes when using pooled data on all workers and their employers. However, when analyzing subgroups we find that experience rating reduces the inflow to full disability pensions (the benefit for a fully disabled worker that is awarded for indefinite duration) among men under age 50. Our estimates imply that, within this group, the maximum degree of experience rating reduces the likelihood of being awarded a full disability pension by one-half compared to the counterfactual case of no experience rating. For the same worker group, we also find a negative effect on the likelihood of being awarded a rehabilitation benefit (the disability benefit awarded for a fixed period due to the expected recovery) due to mental and behavioral disorders. Although this result is somewhat less robust, it suggests that experience rating may induce employers to pay more attention on workload and other stress factors. We find no significant effects for women, nor for men aged 50 and over. The larger effect for younger workers can be due to particularly large economic incentives, given that the disability pension claims of young workers have a much larger impact on the employer's DI premium rate than the claims made by older workers.

Overall, our results do not give support that experience rating would have a notable impact on the disability inflow. This is somewhat surprising, given that the expected cost of a new benefit claimant to the employer can be quite high. One interpretation is that the employer's chances to influence the disability outcomes of its employees are so slim that economic incentives do not work. On the other hand, the Finnish experience rating system is rather complex. It is possible that a simpler system with more transparent cost effects could be more effective.

The remainder of the paper proceeds as follows. Section 2 provides a brief review of the relevant literature. Section 3 discusses the sickness and disability benefit schemes and the determination of the DI premiums in Finland. Section 4 describes our data and reports some descriptive statistics. Section 5 discusses the statistical method and reports the empirical results. Section 6 contains concluding remarks.

2 A review of experience rating literature

In the Netherlands, experience-rated DI premiums were introduced in 1998. This change applied to all firms, and it was part of a series of disability program reforms implemented over the past two decades. Following these reforms, both the disability inflow and the share of the Dutch population on disability benefits have declined considerably (see e.g. García-Gómez et al. 2011, and Koning and Lindeboom 2015). Koning (2009) exploits variation in the DI premiums triggered by past changes in the disability benefit claims made by the firm's own employees. He finds that disability inflow decreased in the firms that experienced a premium change compared to the firms with unchanged premiums. Koning interprets this as evidence that employers were not completely aware of experience rating and therefore the premium change served as a "wake-up call", which induced preventative measures that reduced the disability events in subsequent years. Using quarterly data, van Sonsbeek and Gradus (2013) regress the aggregate disability inflow rate against a set of policy-relevant variables, including the gradually increasing degree of experience rating. Their estimates imply that experience rating has reduced the disability inflow by 13%. This conclusion however hinges on the assumption that their business cycle proxy (the unemployment rate or a business cycle indicator based on unemployment, and producer and consumer confidence) is a sufficient control for the time trend in the disability inflow. This is a strong assumption as it is not obvious that the disability inflow and business cycle have identical trends. Both of these studies use data only from the post-reform years and lack a comparison group that would not have been subject to experience rating.

de Groot and Koning (2016) exploit more recent changes in the Dutch system for identification. Their difference-in-differences analysis suggests that the removal of experience rating from small firms in 2003 increased the disability inflow by 7% over the years 2003–2004. This estimate is clearly smaller than the estimated effect of van Sonsbeek and Gradus (2013). However, due to confounding reforms de Groot and Koning only use the years 2003 and 2004 as the post-treatment period in their main analysis. It is unclear how strong behavioral impacts we can expect to see in such a short time period as disability prevention actions potentially have long-lasting impacts. Interestingly, the experience-rated DI premiums for the small firms were re-introduced in 2008. de Groot and Koning find no change in the disability inflow among small firms following this reform, a result that seems to be in sharp contrast to the estimated effect of the removal of experience rating five years earlier. However, the institutional setting changed significantly between these reforms: the sickness benefit period, which precedes DI benefit receipt, was extended from one to two years in 2005 (the Dutch employers are responsible for sickness benefit costs of their employees), and separate disability benefit schemes for those who are permanently and fully disabled, and for those who are only partially and/or temporarily disabled were introduced in 2006, and since then the experience-rated DI premiums have only covered the latter group. The difference in the effects of the 2003 and 2008 reforms highlights the importance of the institutional context.

In Finland, firms have been partially responsible for the disability benefit costs of their employees since the 1960s. Until 2005, the system was based on lump-sum contributions. Firms employing more than 50 workers (300 workers before 1996) were required to pay a given share of the present value of a new disability benefit claim as a lump-sum payment to the insurance provider at the time when the benefit was awarded to their former employee. Medium-sized firms paid only a small share of this present value, but large ones paid the full amount. Korkeamäki and Kyyrä (2012) exploit the 1996 change in the relationship between the cost share and firm size for identification. They find that the disability cost liability reduced transitions to sickness benefits and further transitions from sickness benefits to disability benefits. The former effect implies that a higher share of disability benefit costs encouraged the employers to invest in preventive measures, whereas the latter suggests that the greater cost share also motivated the employers to make accommodations for their workers with health problems.

In 2006, the lump-sum liabilities were abolished and replaced with an experience-rated payroll tax. Although the new experience-rating system was designed to closely mimic the incentive structure of the lump-sum payment system in terms of average costs and the allocation of costs across individual employers, it is not obvious that the desired effects of the lump-sum liabilities documented in Korkeamäki and Kyyrä (2012) did transfer into the new experience-rating system. From the viewpoint of the employer the lump-sum liabilities are more transparent as the costs of a new disability benefit claim realizes immediately and are directly attributable to the disability of a given worker. In this study, we are interested in the causal effect of experience rating compared to the counterfactual case of flat-rate premiums, which is the status quo in most countries. The 2006 reform is not helpful for addressing this question because it only converted the lump-sum liabilities into experience-rated premiums.[1]

A related branch of literature has examined the effects of experience rating in U.S. and Canadian workers' compensation (WC) programs, which cover the medical cost of work-related injuries and cash payments to injured workers. The WC premium is determined as a weighted average of a base rate, which is a mixture of industry and occupation rates, and the firm's incurred loss rate. The weight of the firm's incurred loss rate rises with firm size, as in the Finnish DI system. Bruce and Atkins (1993) find that the fatality rate went down significantly in the forestry and construction industries after experience rating was introduced in those sectors in the province of Ontario in 1984. Ruser (1985; 1991) exploits variation in benefit levels across U.S. states and finds that higher benefits increase benefit claims, but this effect is much smaller in larger firms that are subject to a higher degree of experience rating. This implies that greater experience rating leads to higher investments in workplace safety in response to benefit increases.

By comparing the injury duration of employees of self-insured firms (fully experience-rated) and privately insured firms (imperfectly experience-rated) in Minnesota, Krueger (1990) finds that workers return to work after an injury more quickly if their employer bears the full cost of WC claims instead of being only partially experience-rated. In addition to positive impacts on workplace safety, some unwanted behavior has also been documented. Thomason and Pozzebon (2002) find that experience rating induces "claims management", where firms attempt to reduce their WC costs by disputing workers' benefit claims rather than by investing in proactive health and safety measures.

To sum up, several studies have found that experience rating in WC reduces on-the-job injuries and the duration of injury spells, and that most of these effects are likely to be due to actual improvements in workplace safety, not just due to benefit claims suppression

[1] A large pension reform in 2007 provides some useful quasi-experimental variation for the employers of a particular worker group. This reform unified the major pension Acts in the private sector, which coincidentally extended experience rating to cover a small group of manual workers in construction, forestry, agriculture and dock work who were not subject to the lump-sum liabilities before the reform. As a result of the pension reform, large employers became liable for the costs of disability benefit claims made by this group for the first time through experience-rated DI premiums, yet only gradually over time due to a transition period. Preliminary results of the analysis exploiting this variation for identification are reported in Kyyrä and Tuomala (2013). However, these results are inconclusive and preliminary due to a short follow-up period. In an ongoing project, we are collecting additional data to analyze the effect of experience rating using the variation caused by the 2007 reform.

by employers. These findings are only suggestive when considering the potential role of experience rating in DI, given that the employers have less control over disability outcomes than workplace injuries. The evidence on the incentive effects of experience rating in DI is much more limited.

3 Institutional framework

3.1 Sickness and disability benefits

When a worker falls ill and receives a doctor's statement certifying that he or she is not capable of work, he or she is entitled to a compensation for wage loss. For the first weeks (typically one to three months depending on the collective agreement), the worker is fully compensated and receives payment from the employer, after which he or she can claim a *sickness benefit* from the Social Insurance Institution.[2] The sickness benefit can be received for a maximum of about one year (300 working days, Saturdays included).

Depending on the medical condition, the applicant's rehabilitation needs are assessed in a more extensive medical examination during the sickness benefit period. In case of prolonged disability, the individual may qualify for one of four possible disability benefits: (*i*) a *partial rehabilitation benefit*, (*ii*) a *full rehabilitation benefit*, (*iii*) a *partial disability pension*, or (*iv*) a *full disability pension*. When it is probable that the applicant will return to work, he or she is awarded a rehabilitation benefit for a specific period provided that a rehabilitation plan has been drafted. If the return to work is unlikely, the applicant may qualify for a disability pension, which is awarded for an indefinite period of time. For both benefits, a full benefit is conditional on a loss in the working capacity of at least 60% and a partial benefit for a loss of at least 40% but below 60%. The disability evaluations are always made by trained professionals.

When determining eligibility, the individual's age, education, occupation, place of residence and capability to support himself or herself by gainful employment are all taken into account along with the medical assessment. A disability pension may also be discontinued if the working capacity of the recipient improves but that rarely happens among older recipients. There is no automatic retesting of the disability status, except for new periods of the rehabilitation benefit. Disability benefits can be collected until age 63, when the entitlement to old-age pension begins.

[2] For part of the fully compensated period that exceeds 9 working days, the Social Security Institution pays the sickness benefit to the employer, so the employer's direct cost for this period is the difference between the wage rate and sickness benefit.

3.2 Disability insurance premiums

Since 2006 a major part of disability benefit costs have been financed by partially experience-rated premiums (or payroll taxes). A firm's DI premium rate in year t is obtained as a weighted sum of base premium rate Q_t and experience-rated premium rate $M_t Q_t$ as

$$C_t = (1 - S_t) Q_t + S_t M_t Q_t,$$

where $S_t \in [0, 1]$ is the degree of experience rating. The base premium rate depends on the age structure of the workforce and varies over time, being around 1.5% of the payroll in our observation period. The experience-rated premium rate is obtained by multiplying the base rate with the experience multiplier $M_t = m(r_{t-2,t-3})$, which is an increasing function of the risk ratio $r_{t-2,t-3}$. The risk ratio is a measure of the costs of the disability pension claims made by the firm's former employees in years $t-2$ and $t-3$,[3] and it is constructed in a such a way that $r_{t-2,t-3} = 1$ if the firm's past disability costs were equal to the average costs in firms with the same age structure.[4] On the basis of the risk ratio, the firm is allocated to one of 11 possible contribution categories, each of which corresponds to a particular value of M_t between 0.1 and 5.5 (see the first three columns in Table 1). The experience-rated premium rate $M_t Q_t$ can thus differ substantially from the base rate Q_t. Namely, a firm can earn a 90% discount on the base premium or be obligated to pay a 450% surcharge on top of the base premium.

The degree of experience rating $S_t = s(W_{t-2})$ is a function of the firm's payroll two years earlier, W_{t-2}. Throughout the paper, we measure the payroll in 2004 euros. Firms with payroll 1.5 mEUR or less ("small firms") are not subject to experience rating and pay the base rate because for them $S_t = 0$. For firms whose payroll is at least 24 mEUR ("large firms") $S_t = 1$, so they pay only the experience-rated premium rate.[5] Other firms ("medium-sized firms") pay a premium rate equal to a weighted sum of the base and experienced-rated rates, and are thus only partially covered by experience rating. Within this group, S_t increases linearly with W_{t-2} from 0 to 1 with the slope $\frac{1}{22.5}$. This key relationship is plotted in Figure 1.

The last four columns of Table 1 show the DI premium in each possible contribution category for four selected firm sizes. The smallest firm (1 mEUR payroll) cannot affect its premium rate which is completely determined by the base premium rate, assumed to

[3]The cost of a new pension claim equals the expected amount of disability pension benefits until age 63, so that the pension claims by younger workers have much larger impact on the risk ratio.

[4]The risk ratio is adjusted for the age structure in order to eliminate incentives to discriminate against older applicants in hiring.

[5]The payroll threshold values for small and large firms were set in 2006, when the reform came into effect. These threshold values are updated annually using a payroll index. With an average salary level, the thresholds correspond approximately to firm sizes of 50 and 800 employees.

Table 1: Contribution categories and DI premiums

Risk ratio $r_{t-2,t-3}$	Contribution category	Experience multiplier M_t	DI premium by firm size, EUR			
			Payroll W_{t-2} (Degree of experience rating S_t)			
			1 mEUR (0.0)	5 mEUR (0.22)	15 mEUR (0.67)	25 mEUR (1.0)
≥ 5	11	5.50	16,000	160,000	960,000	2,200,000
$[4, 5)$	10	4.50	16,000	142,222	800,000	1,800,000
$[3, 4)$	9	3.50	16,000	124,444	640,000	1,400,000
$[2.5, 3)$	8	2.75	16,000	111,111	520,000	1,100,000
$[2, 2.5)$	7	2.25	16,000	102,222	440,000	900,000
$[1.5, 2)$	6	1.75	16,000	93,333	360,000	700,000
$[1.2, 1.5)$	5	1.35	16,000	86,222	296,000	540,000
$[0.8, 1.2)$	4	1.00	16,000	80,000	240,000	400,000
$[0.5, 0.8)$	3	0.65	16,000	73,778	184,000	260,000
$[0.2, 0.5)$	2	0.35	16,000	68,444	136,000	140,000
< 0.2	1	0.10	16,000	64,000	96,000	40,000

be 1.6% of the payroll in this example (the average base premium rate in 2009). The difference between the largest and smallest possible premium is 96,000 EUR or 1.9% of the payroll for the firm with total payroll equal to 5 mEUR. This difference is as much as 5.8% and 8.6% of the payroll for the two larger firms with payrolls equal to 15 and 25 mEUR, respectively.

As another example, consider a firm whose disability costs are close to the adjusted average, so that its risk ratio lies on the interval $[0.8, 1.2)$. For this firm, regardless of its size, $M_t = 1$ and thus $C_t = Q_t$. Suppose that the firm adopts a successful health and safety program that reduces its risk ratio to the interval $[0.5, 0.8)$. As a result, M_t drops to 0.65 with a delay of two to three years and therefore the DI premium rate will decline by $0.35 S_t Q_t$. The size of this reduction is fully determined by firm size, being 35% for a large firm ($S_t = 1$), 0% for a small firm ($S_t = 0$), and something between 0% and 35% for a medium-sized firm. For this reason, we treat S_t as a measure of the firm's incentives to invest in disability-reducing measures due to experience rating, and focus on estimating the effect of S_t on the inflow to sickness and disability benefits.[6]

The likely effects of experience rating on disability outcomes are not as obvious as one might expect at first glance. First, notice that the risk ratio depends only on disability pension claims, not on rehabilitation benefit claims. This may induce large and

[6]The Finnish Centre for Pensions performed a survey among Finnish employers in 2016 regarding firms' awareness on and attitudes towards the experience rating system. The responses suggest that the larger the firm (i.e. the higher the rate of experience rating), the more the employer considered the system to provide incentives to take care of employees' capacity to work (Liukko et al., 2017).

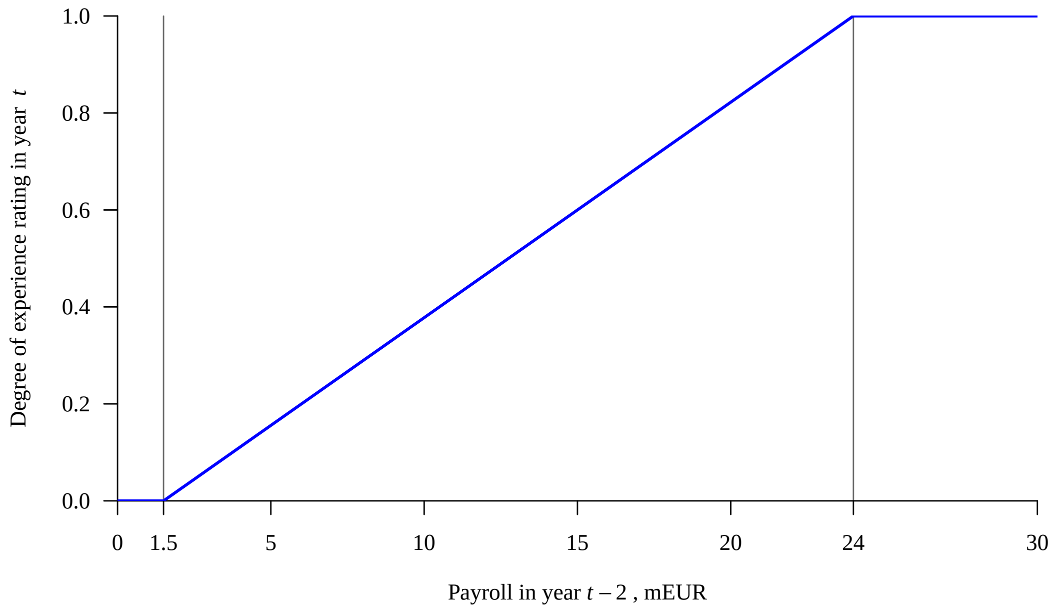

Figure 1: Degree of experience rating S_t as a function of payroll W_{t-2}

medium-sized employers to encourage newly disabled workers to apply for a rehabilitation benefit rather than for a disability pension. Another important point is that only the first disability pension claim of each worker is taken into account when determining the risk ratio. If a worker is first entitled to a partial disability pension but then qualifies for a full disability pension in the next year or later, only the cost of the partial pension has an effect on the firm's risk ratio in the year when that pension was awarded. Large and medium-sized employers may thus encourage their workers with health problems to apply for a partial disability pension by providing part-time work for at least a short period of time. These two features of the risk ratio calculations suggest that the effect of experience rating on partial disability pension claims and on rehabilitation benefit claims is ambiguous. To the extent that greater experience rating induces preventive measures, it should reduce transitions to sickness benefits and to all types of disability benefits. However, for a given overall inflow to disability benefits, a higher degree of experience rating may increase the shares of partial disability pension and rehabilitation benefits, and therefore the overall effect of experience rating on these benefits is a priori ambiguous.

4 Data and descriptive statistics

Our data was compiled by merging administrative registers of the Finnish Centre for Pensions (ETK) and Statistics Finland. ETK is a semi-governmental body that co-ordinates the entire pension system and collects data from all pension insurance providers for statistics and research purposes. Its databases include comprehensive records on job spells and earnings for all people with some insured work history, as well as detailed information on disability benefit spells and the spells of sickness benefits paid directly to the worker by the Social Insurance Institution.[7] The records also include the "retirement events", that is, the dates when a diagnosis was made for the medical condition that eventually led to a rehabilitation benefit or disability pension. This is important as the disability pension costs are assigned to the employers on the basis of the year of the retirement event. Namely, the cost of a new disability pension claim increases the risk ratios of the firms where the claimant worked one and two years prior to the year of the retirement event.

The ETK data was supplemented by merging background information on worker characteristics from the Finnish Longitudinal Employer-Employee Database of Statistics Finland, which covers all people who live in Finland. Additional information on firm characteristics was obtained from the Business Register of Statistics Finland, which includes all firms subject to value added taxation or that have at least one paid employee. Together these databases allow us to follow the entire Finnish population and the universe of all firms over time until 2015. We restrict our analysis to private-sector firms and their workers in the years 2007–2015 when the experience rating system has been in effect.[8]

The outcome of interest is the probability that the worker develops a medical condition that reduces his or her working capacity, temporarily or permanently, by the extent that he or she qualifies for a sickness or disability benefit. When analyzing the incidence of sick leave, we model the probability that a new benefit period begins within the calendar year. In the case of disability benefits, we model the probability of the onset of a disability that leads to receipt of a rehabilitation benefit or disability pension, typically with the lag of one or two years. That is, we do not consider the year when the disability benefit is granted, but the year when the underlying medical condition was diagnosed. We focus on disability events until 2013, as this leaves enough time to observe receipt of any disability-related benefits by 2015 (the disability event is only recorded once a disability benefit is granted). Note that our outcome variables are not mutually exclusive. As an example, consider a worker who first collects a sickness benefit for one year, then a rehabilitation benefit for the next two years and finally transfers into a disability pension. Provided that all these benefits were awarded for the same medical condition diagnosed at the beginning of sick leave, the worker became a recipient of the sickness benefit, rehabilitation benefit

[7] Since for the first weeks of sickness (typically one to three months depending on the collective agreement) the applicant is paid by the employer, we only observe relatively long sick leave spells.

[8] We exclude 2006 because in that year the degree of experience rating was determined by the number of workers, not by the payroll.

and disability pension in the same year in our analysis.

To be at risk of becoming disabled in year t we require that the worker (i) is 20–62 years old, (ii) worked in the same private firm from year $t-2$ to year t, and (iii) received a certain minimum amount of wages from that firm in years $t-1$ and $t-2$, and that these wages accounted for over 50% of the worker's all wages in both years. These conditions imply that a major part of disability pension costs will be assigned to this primary employer in the case the worker becomes disabled and receives a medical diagnosis in year t that eventually leads to receipt of a disability pension.[9] Finally, we drop workers whose primary employer is very small by requiring that the firm's payroll was no less than 100,000 EUR in year $t-2$ and that at least 10 employees of the firm belong to the risk set in year t .

There are about one million workers who satisfied these conditions at least once between the years 2007 and 2013. They worked in 14,723 different firms, amounting to over 4.1 million worker-year observations and 68,002 firm-year observations, as seen in Table 2. 83% of these firms are classified as small according to their past payroll, and hence are not subject to experience rating. Only 187 belong to the group of large firms that is fully covered by experience rating. In terms of workers, differences in the number of observations between the size categories are much smaller, and most workers are employed by medium-sized firms. This is further illustrated in Figure 2, which displays log payroll density functions for workers who were at risk in 2011, and for their employers (densities for other cross sections are very similar).[10] Around the cutoffs of 1.5 and 24 mEUR for small and large employers, there are roughly an equal number of workers in the risk set but much less firms at the upper cutoff. The average degree of experience rating across firms is only 0.05. But as the experience-rated firms employ over 80% of all workers, the average degree of experience across workers is much higher, being 0.48.

On average, workers of large firms have a longer job tenure and a higher education compared to those employed in small and medium-sized firms. Larger firms have a higher share of foreign owners, and quite often operate in the manufacturing sector. Some of these differences between firms of different size, such as those in education and industry, are likely to be correlated with the disability risk.

Figure 3 shows the incidence of sick leave and different disability benefits by age. Not surprisingly, both sickness benefits and all kinds of disability benefits are much more

[9]To be specific, if a worker is awarded a disability pension in year $s \geq t$ based on the disability diagnosed in year t, the cost of this pension is assigned to the firms in which the individual worked in years $t-1$ and $t-2$, when determining the risk ratios for year s. If there were more than one employer, the pension cost is divided between the employers in proportion to the wages they paid to the worker in years $t-1$ and $t-2$.

[10]Because the firm size distribution is heavily skewed towards small firms and because relative differences in firm size are probably more relevant than absolute differences when explaining differences in the disability risk, we shall use log payrolls throughout our analysis.

Table 2: Sample means by firm size

	All firms (1)	**Small** (2)	**Med-sized** (3)	**Large** (4)
A. Means across workers				
Age	42.7	42.4	42.8	42.8
Tenure	11.8	10.0	11.9	12.8
Female,%	40.9	40.7	39.4	42.9
Married,%	52.9	51.2	52.9	53.9
Education,%				
Basic	14.1	16.3	14.0	12.8
Upper secondary	46.4	50.2	46.9	43.3
Lower tertiary	29.1	26.3	29.1	30.8
Upper tertiary	10.4	7.2	10.0	13.0
Degree of experience rating	0.48	0.00	0.32	1.00
Number of worker-year observations	4,159,792	899,959	1,833,114	1,426,719
Number of workers	1,028,468	289,590	494,844	348,964
B. Means across firms				
Payroll, mEUR	2.6	0.7	4.7	63.4
Firm's age, years	24.6	23.7	26.7	31.0
Number of plants	3.4	1.8	5.7	46.2
Incorporated company,%	83.9	82.4	87.9	89.2
Industry,%				
Manufacturing	27.9	25.8	33.3	38.5
Construction	6.4	6.8	5.3	8.3
Wholesale and retail trade	20.4	21.6	17.3	15.9
Transportation and storage	6.5	6.9	5.6	2.9
Information and communication	5.5	4.6	8.2	7.9
Finance and insurance	2.9	2.3	4.2	7.0
Health and social work	6.5	7.1	4.8	2.8
Other	23.9	24.9	21.3	16.6
Foreign ownership,%	10.4	5.5	23.5	31.5
Exporter,%	42.4	35.4	60.2	84.8
Importer,%	28.9	22.8	44.6	62.8
Degree of experience rating	0.05	0.00	0.14	1.00
Number of firm-year observations	68,002	49,782	17,200	1,020
Number of firms	14,723	12,191	3,596	187

Notes: Small firms had a payroll of 1.5 mEUR or less in year $t-2$ and large firms no less than 24 mEUR, while the two-year lagged payroll for medium-sized firms is between these thresholds. The firm and its workers can change size category between years.

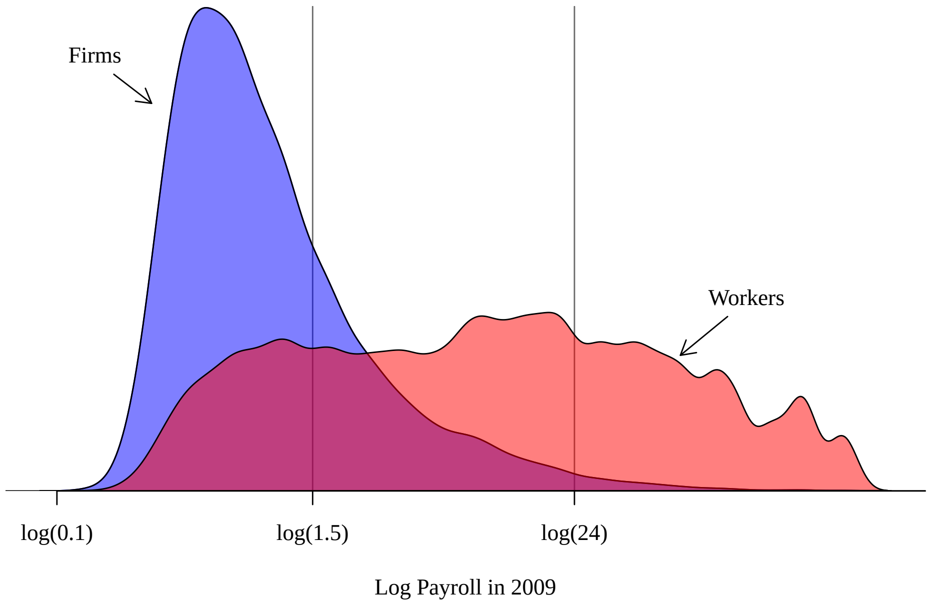

Figure 2: Kernel density functions of log payroll in 2009 for workers at risk in 2011, and for their employers

common among old than young workers. The age differences are particularly pronounced in the case of full disability pensions. Workers below age 53 have been granted a full rehabilitation benefit more often than a full disability pension. The entry rate to partial rehabilitation benefits is very low at all ages, and therefore we shall merge partial and full rehabilitation benefits into one measure of rehabilitation benefits.

Table 3 reports some descriptive numbers for our disability measures by firm size. Despite the large number of workers in our data, the aggregate numbers of transitions to disability benefits are not overwhelmingly large in Panel A. Most workers in the data are relatively young and thereby have a very small risk of disability. Another reason is that a notable fraction of all disability benefit recipients have been out of work for a few years before being diagnosed as disabled, and these cases do not belong to our risk set.

As seen in Panel B, the average duration of partial and full disability pension spells is much longer than that of rehabilitation benefits (spell duration is measured until the end of 2015). This is not surprising because the rehabilitation benefits are awarded for a fixed period of time due to the expected recovery and because the recipients of such benefits are much younger on average. The periods of rehabilitation benefits are not longer compared to those of disability pension for the medium-sized and large firms than for the small firms, which we might expect to find, had the experience-rated firms encouraged their disabled employees to stay on rehabilitation benefits as long as possible in an attempt to minimize their DI premiums. An alternative check of the same hypothesis is to look at the

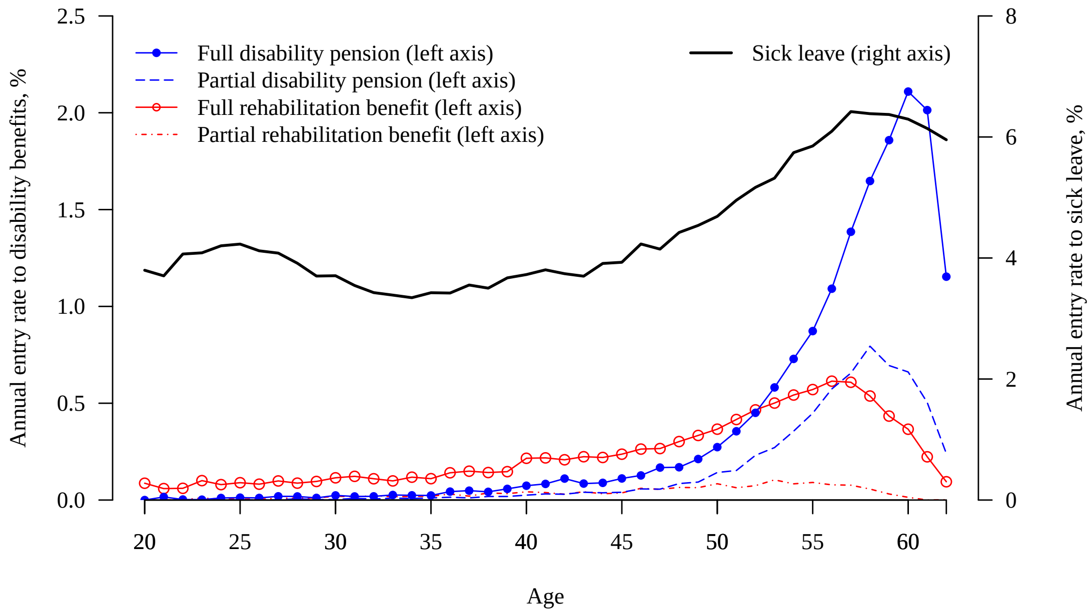

Figure 3: Hazard rates to sickness and disability benefits

share of a given type of benefits in all benefit days received for the same medical condition (i.e. different benefit periods that have the same retirement event). From Panel C we see that in all firm size categories around 55% of all benefit days associated with the same diagnosis are full disability pension benefit days. The relative importance of rehabilitation benefits is smaller while that of partial disability pension is larger in the medium-sized and large firms than in the small firms. One might have expected the opposite for the relative importance of rehabilitation benefits, given that the large employers have an incentive to favor rehabilitation benefits. On the other hand, the higher frequency of partial disability pensions in experience-rated firms is in accordance with the likely effect of experience rating.

Taken together these numbers do not point to clear differences between the firm size categories that we could interpret as being indicative of the behavioral effects of experience rating. Of course, these findings should be treated with caution because firms of different sizes are not directly comparable due to a large degree of heterogeneity among them. In the next section, we discuss statistical methods to control for heterogeneity and to conduct causal inference.

Table 3: Sickness and disability outcomes

	All firms (1)	**Small** (2)	**Med-sized** (3)	**Large** (4)
A. Number of events				
Sick leave	183,884	37,610	80,661	65,613
Rehabilitation benefits	11,777	2,871	5,047	3,859
Partial disability pension	6,331	1,214	2,748	2,369
Full disability pension	15,558	3,615	6,726	5,217
B. Average duration in days				
Sick leave	59	66	59	55
Rehabilitation benefits	525	558	513	516
Partial disability pension	1,129	1,151	1,142	1,104
Full disability pension	1,049	997	1,060	1,069
C. Share of days associated with the same retirement event,%				
Rehabilitation benefits	20.9	24.3	20.2	19.6
Partial disability pension	24.1	21.2	24.4	25.7
Full disability pension	55.0	54.6	55.4	54.8

5 Econometric analysis

5.1 Two-step estimation

We consider the following linear probability model for the onset of disability:

$$Y_{ijt} = \varphi_t + \tau S_{jt} + \mathbf{X}_{ijt}\boldsymbol{\beta} + \mathbf{Z}_{jt}\boldsymbol{\theta} + v_{jt} + \eta_{ijt}, \tag{1}$$

where Y_{ijt} equals 1 if worker i in firm j becomes disabled in year t, and 0 otherwise;[11] φ_t is the calendar time effect; $S_{jt}\left(W_{j(t-2)}\right)$ is the degree of experience rating which is a deterministic function of the firm's payroll in year $t-2$, $W_{j(t-2)}$; $\mathbf{X}_{ijt}$ is a vector of worker characteristics; $\mathbf{Z}_{jt}$ is a vector of firm characteristics, and v_{jt} and η_{ijt} are error terms. The parameter of interest is τ, the effect of experience rating on the worker-specific disability risk.

Since workers in the same firm are affected by the same health and safety policy, and also share other working conditions, the disability outcomes within firms are likely to be correlated. This correlation is captured by v_{jt}. Moreover, the firm-specific working

[11]Since we analyze different disability outcomes, the disability event may refer to the beginning of a sickness benefit period in year t or to the retirement event in year t associated with receipt of a given type of disability benefits in year $s \geq t$.

environment on the one hand, and unobserved determinants of individual health on the other hand are likely to be persistent over time, suggesting that both v_{jt} and η_{ijt} are potentially serially correlated.

We estimate the model using a simple two-step procedure. In the first step, we construct covariate-adjusted firm-year effects by estimating

$$Y_{ijt} = \mu_{jt} + \mathbf{X}_{ijt}\boldsymbol{\beta} + \eta_{ijt}, \tag{2}$$

where $\mu_{jt} = \varphi_t + \tau S_{jt} + \mathbf{Z}_{jt}\boldsymbol{\theta} + v_{jt}$. The estimated $\hat{\mu}_{jt}$ are the firm-year disability inflow rates adjusted for differences in worker characteristics across firms and over time. In the second step, we consider the firm-level model

$$\hat{\mu}_{jt} = \varphi_t + \tau S_{jt} + \mathbf{Z}_{jt}\boldsymbol{\theta} + \varepsilon_{jt}, \tag{3}$$

where the error term is given by $\varepsilon_{jt} = v_{jt} + (\hat{\mu}_{jt} - \mu_{jt})$. The problem for inference is that the adjusted disability risk may vary with firm size also for reasons not related to the degree of experience rating. There may be economies of scale in preventive health and safety measures; it may be easier for larger firms to accommodate and rehabilitate employees with impairments due to a larger pool of jobs; and firms with risky working environments may need to pay higher wages to compensate for the risk level, inflating their payrolls compared to safer firms with the same number of workers. For these kinds of reasons, v_{jt} may be correlated with $W_{j(t-2)}$ and, consequently, with S_{jt}. If so, the estimate of τ from (3) will be biased. This can be viewed as a standard omitted variable problem, suggesting that we should also control for the direct effect of $W_{j(t-2)}$. But, because S_{jt} is the deterministic function of $W_{j(t-2)}$, it is not obvious how to separate the effects of these two variables without imposing strong functional assumptions.

As seen in Figure 1, the relationship between S_{jt} and $W_{j(t-2)}$ is not smooth but has kinks at the size thresholds of small and large firms. By contrast, the distribution of the unobservables is plausibly smooth at these points in the sense that

$$\lim_{w\downarrow w^*} \frac{\partial E\left(\varepsilon_{jt} | \, W_{j(t-2)} = w, T = t\right)}{\partial w} = \lim_{w\uparrow w^*} \frac{\partial E\left(\varepsilon_{jt} | \, W_{j(t-2)} = w, T = t\right)}{\partial w}$$

where w^* is 1.5 mEUR or 24 mEUR. Under this assumption, we can augment the second-stage equation with a control function $g\left(W_{j(t-2)}\right) \equiv E\left(\varepsilon_{jt} | \, W_{j(t-2)}, T = t\right)$ to obtain

$$\hat{\mu}_{jt} = \varphi_t + \tau S_{jt} + \mathbf{Z}_{jt}\boldsymbol{\theta} + g\left(W_{j(t-2)}\right) + \xi_{jt}, \tag{4}$$

where S_{jt} and $W_{j(t-2)}$ are mean-independent of the new error term ξ_{jt} by construction.

It follows that the kinks in the experience rating rule identifies the causal effect of S_{jt}, without any assumptions about $g(\cdot)$ except the smoothness. This identification strategy was coined "regression kink design" (RKD) by Nielsen, Sørensen and Taber (2010).[12]

In practice, the control function $g(\cdot)$ is unknown. One possibility is to adopt some flexible function for $g(\cdot)$, such as a polynomial function, and estimate τ from (4) by weighted least squares (WLS) using the number of workers at risk as weights. Another possibility is to estimate the kink in $E\left(\hat{\mu}_{jt} \middle| W_{j(t-2)}\right)$ at w^* nonparametrically using a local linear regression and observations in the neighborhood of w^* (1.5 mEUR or 24 mEUR). An estimate of τ is then obtained by dividing the estimated kink in the adjusted risk with the known kink in the experience rating rule at w^*. The former approach ("global RKD") is more efficient as it uses all available data, but the latter ("local RKD") is more robust by utilizing only data around the payroll cutoff at which the parameter of interest is identified. In practice, the local RKD estimates are very imprecise and not informative due to the limited number of firms around the payroll cutoffs, especially around the upper cutoff.[13] We therefore apply the global approach in our analysis.

The smoothness assumption for $g(\cdot)$ rules out discrete changes in other policy parameters at the size thresholds of small and large firms. If there were other discrete changes at the same size thresholds, $g(\cdot)$ may not fully capture their confounding effects and thereby the estimate of τ will be biased. This is a matter of concern in our case because large employers are partially liable also for the costs of extended unemployment benefits received by their former employees, and the firm size thresholds for these liabilities coincide with those for DI premiums.

In Finland, the entitlement period of unemployment insurance (UI) benefits is about two years, but those who are 59 or older (60 or older for those born in 1955 or later) on the day when the regular benefits expire are entitled to extended benefits until age 63. That is, workers aged 57 or above (58 or above for later cohorts) at the time of dismissal can collect UI benefits until old-age retirement. This scheme is known as the "unemployment tunnel" (UT).

Large employers in particular target dismissals at those employees who can qualify for the extended benefits after two years of unemployment (Kyyrä and Wilke, 2007). When an extended benefit is granted to the worker, the former employer may have to pay a given share of the extended benefit costs as a lump-sum payment to the Unemployment

[12]Earlier applications using similar strategies include Guryan (2001), Rothstein and Rouse (2007) and Dahlberg et al. (2008). Card et al. (2015) develop a formal statistical theory for RKD and provide conditions under which causal effects in even more general nonseparable models are identified. They also discuss nonparametric inference using local linear and local quadratic regression models. Böckerman, Kanninen and Suoniemi (2015) apply the RKD approach to study the effects of sickness benefits on the duration of sick leave using Finnish data.

[13]These results are available upon request.

Insurance Fund.[14] This cost share increases linearly from 0% to 80% as a function of the employer's payroll in the year preceding the dismissal. The payroll thresholds for these minimum and maximum cost shares are the same as those used in DI, and thereby any two firms that differ in the degree of experience rating in DI also differ in the degree they are responsible for the extended UI benefit costs. By implication, the estimate of τ could also capture the effect of employer's liabilities for the extended UI benefits.

Nevertheless, we can still identify the effect of experience rating in DI because the disability pension benefits of workers of all ages affect the DI premium, whereas the extended UI benefits received only by the oldest workers affect the employer's UI liabilities. To separate the two effects we augment our model by allowing the effect of experience rating to differ between workers who would be eligible for the UT scheme if laid off, and those who would not be; that is, we replace the first-stage equation (2) with

$$Y_{ijt} = \mu_{jt} + \delta \left(UT_{ijt} \cdot S_{jt}\right) + \alpha UT_{ijt} + \mathbf{X}_{ijt}\boldsymbol{\beta} + \eta_{ijt}, \tag{5}$$

where UT_{ijt} is a dummy variable for UT eligibility; it equals 1 if the worker is aged 57+ and born before 1955 or if the worker is aged 58+ and born in 1955 or later, and 0 otherwise. The second-stage equation (4) remains unchanged. For UT-eligible workers the effect of S_{jt} is $\tau + \delta$, where δ is the confounding effect of employers' liabilities for extended UI benefits, and it is identified from differences in the disability risk between workers under and above the UT age threshold within medium-sized and large firms. The effect of UT eligibility, α, is separately identified from the age effects ($\mathbf{X}_{ijt}$ contains age dummies) because the age threshold of the UT scheme differs between those born before 1955 and later birth cohorts.

Finally, note that even if v_{jt} were uncorrelated across different firms, the error terms in the equations (3) and (4) are generally not. This is because of the covariance of $\hat{\mu}_{jt}$ that arises from the estimation of the individual-specific coefficients in the first stage.[15] To obtain the standard errors for the second-stage results we adopt block bootstrapping; that is, we draw 400 samples with replacement from the population of the firms and then re-estimate the models using the two-step estimation procedure for each sample.

[14] The cost of extended benefits is calculated assuming the worker will collect them until age 63 irrespective of the actual behavior. In the case of a worker who qualifies for an old-age pension before the regular benefits expire, the former employer is liable for a share of the costs of regular benefits actually paid to the worker.

[15] The covariance problem could be avoided by allowing the individual-level coefficients to vary freely across firms and estimating a distinct first-stage model for each firm. The implementation of this approach would, however, require dropping a large number of the small firms from the analysis.

5.2 Validity of identifying assumptions

The smoothness assumption for identification implies two testable predictions. First, the payroll density should be sufficiently smooth at the payroll cutoffs. This implies that firms cannot perfectly control which side of the kink they end up on, which plausibly holds in our case. Even though firms can decide the number of workers they hire and they are free to raise wages, it would be difficult for them to precisely determine the sum of all wages. This is because the firms cannot easily cut wages, and because wages can increase during the year due to the collective agreement negotiated at the industry or economy level, and because the size and composition of the workforce can change unexpectedly due to quits, parental leaves etc. And even if the firms were able to manipulate freely their payroll, it is unlikely they would do so in order to choose a particular degree of experience rating because the DI premiums are only a small fraction of the overall labor costs and small payroll changes imply small changes in the degree of experience rating.

To test the smoothness of the density around the kinks we apply the test proposed by McCrary (2008) separately to two samples of observations.[16] The "bottom kink sample" includes firms with past payroll between 0.18 and 12.75 mEUR (the bandwidth $h \approx 2.14$ for log payroll), while the "top kink sample" includes those firms with past payroll between 12.75 and 45.18 mEUR (the bandwidth $h \approx 0.63$). These bandwidths were chosen in such a way that the degree of experience rating varies on the interval $[0, 0.5)$ in the bottom kink sample and on the interval $[0.5, 1]$ in the top kink sample. The results of the test are graphically illustrated in Figure 4, where we plot the density estimates and the smoothed regression lines along with the 95% confidence intervals for both samples. The density looks very smooth at both cutoffs, and we cannot reject the null hypothesis that the discontinuity at the cutoff is zero.

Another prediction arising from the identifying assumption is that the distributions of the predetermined variables should evolve smoothly across firms near the payroll cutoffs. This can be tested by plotting the local averages of the firm covariates against log payroll (we show such graphs for selected covariates in Appendix Figures A1 and A2). Some of the covariates, such as foreign ownership, importer and exporter status, are clearly correlated with firm size, but their values evolve smoothly through the cutoff values as required. We find no evidence of notable discontinuities in the covariate values at the payroll cutoffs, and thus conclude that the identifying assumptions of the RKD model are satisfied.

[16]The test was performed using Drew Dimmery's rdd package for R.

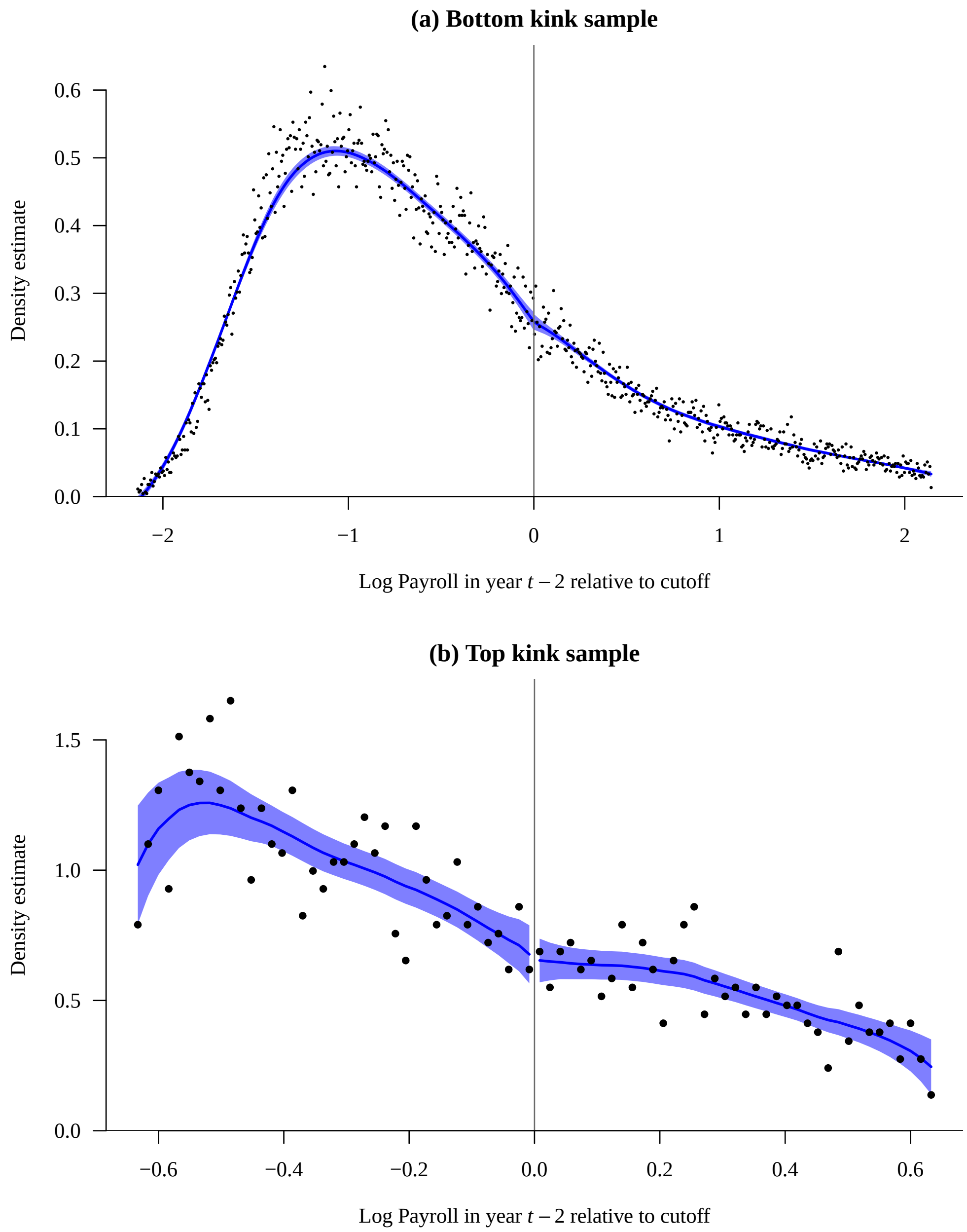

Figure 4: Densities for log payroll around the cutoffs of 1.5 and 24 mEUR from the firm-level data pooled over the years

5.3 The first-stage estimates

Due to the large number of firm-year fixed effects, we estimate $\boldsymbol{\beta}$, $\boldsymbol{\theta}$, α and δ using the within estimator, and then compute $\hat{\mu}_{jt}$ from the residuals of this regression. The estimated effects of the individual-level covariates for various outcomes are reported in Appendix Tables A1 and A2. Of these estimates, the coefficient on the interaction term $UT_{ijt} \cdot S_{jt}$ is of some interest, as it captures the possible confounding effect due to employer liabilities in the extended UI benefit costs. This effect appears to be statistically significant only for receipt of a partial disability pension. The point estimate of 0.129 (scaled by 100, with the standard error 0.049) implies that in a large firm with $S_{jt} = 1$, the likelihood of being awarded a partial disability pension is about one-fifth higher for an UT-eligible worker than for an otherwise similar worker who is not eligible for the UT scheme (the average annual probability is 0.67% for 56–57-year-old workers who are not eligible for UT scheme).

For an experience-rated firm, laying off a worker with reduced working capacity who is eligible for the UT scheme can be a costly choice compared to offering a part-time job combined with a partial disability pension. If laid off, the worker may decide not to apply for a partial disability pension but just collect full-time UI benefits until old-age pension, in which case the employer has to pay its share of the extended UI benefits. Or, if the laid-off worker chooses to claim a partial disability pension, he or she may also receive partial UI benefits on top of the partial pension, in which case the employer will incur costs from both types of benefits. Recall that the employer cannot avoid disability costs by laying off workers with health problems because the disability pension costs are assigned to the firms in which the individual worked one and two years prior to the medical diagnosis. In the case of a younger worker whose working capacity drops due to a medical condition, there is no risk of extra costs through the UI system if the employer decides to lay off the worker.

5.4 Adjusted disability risk by firm size

Turning to the main outcomes, we plot the local averages of $\hat{\mu}_{jt}$ against log payrolls in Figure 5. Within size categories, which are separated by vertical lines, the firms are divided into 40 equally-sized subsets. The dots in the graph correspond to the average disability risk of a reference worker (i.e. one with $\mathbf{X}_{ijt} = \mathbf{0}$ and $UI_{ijt} = 0$) within firm groups, and differences between them describe how this risk varies with firm size. The regression lines shown in the graphs are estimated using firm-level panel data, so that they are independent of the chosen bin sizes for the local averages. The slope of the regression line for small and large firms describes the effect of firm size only, because

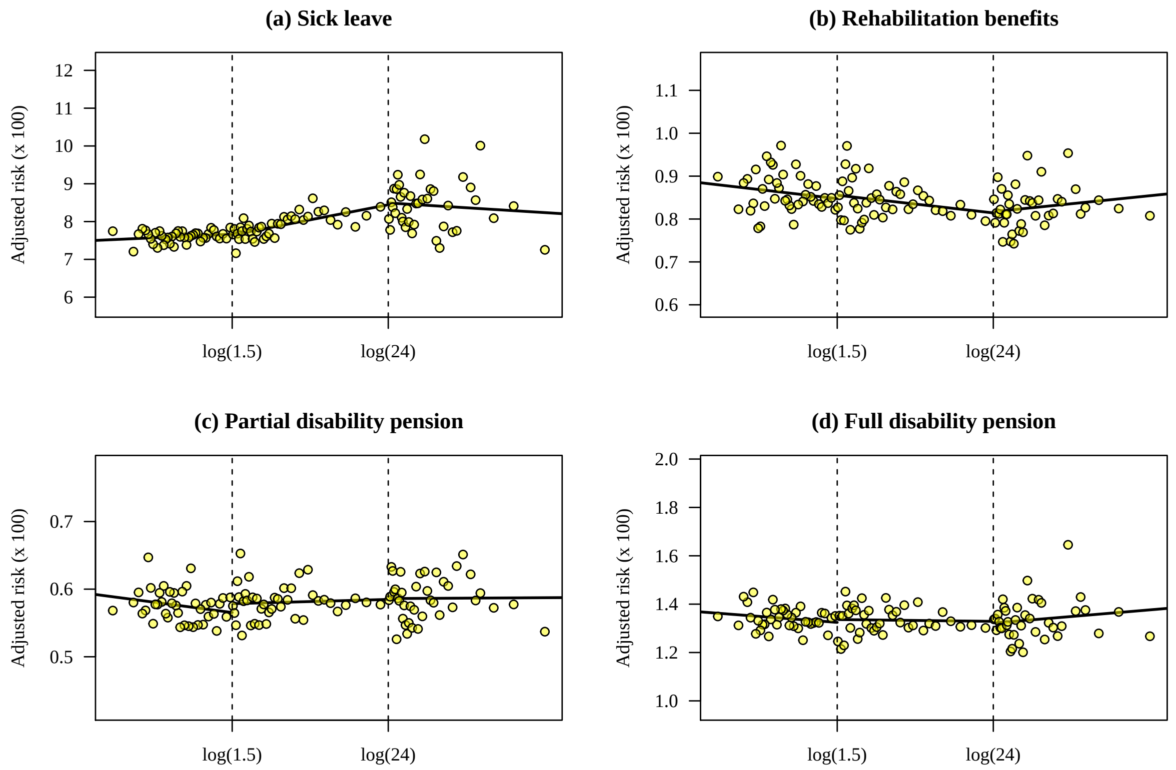

Figure 5: Local average of adjusted risk $\hat{\mu}_{jt}$ plotted against log payroll $W_{j(t-2)}$

the degree of experience rating is constant within these groups. Among medium-sized firms, the degree of experience rating increases with payroll, and therefore the slope for these firms captures the joint effect of firm size and experience rating. Thus, if the firm size effect is approximately constant across the size distribution, a smaller (larger) slope for the medium-sized firms than for the other two firm groups would indicate a negative (positive) effect of experience rating.

In Figure 5a, the differences in the slopes suggests that the likelihood of sick leave *increases* with the degree of experience rating. This could suggest that experience-rated employers encourage their employees with mild health problems to move into sick leave in an attempt to prevent the medical condition getting worse. However, we find no evidence of a statistically significant effect on sick leave in the subsequent regression analysis.

In Figure 5b, the slope of the regression line is smaller for medium-sized firms than for large firms, which is consistent with a negative effect of experience rating on the inflow to rehabilitation benefits. The difference in slopes is very small, however, nor is there a similar difference between the slopes for small and medium-sized firms. In Figure 5c, the difference between the slopes for small and medium-sized firms points to a small positive effect on the inflow to partial disability pension, but the slopes for medium-sized and large firms are equal and not supportive of that interpretation. In the case of the inflow to full

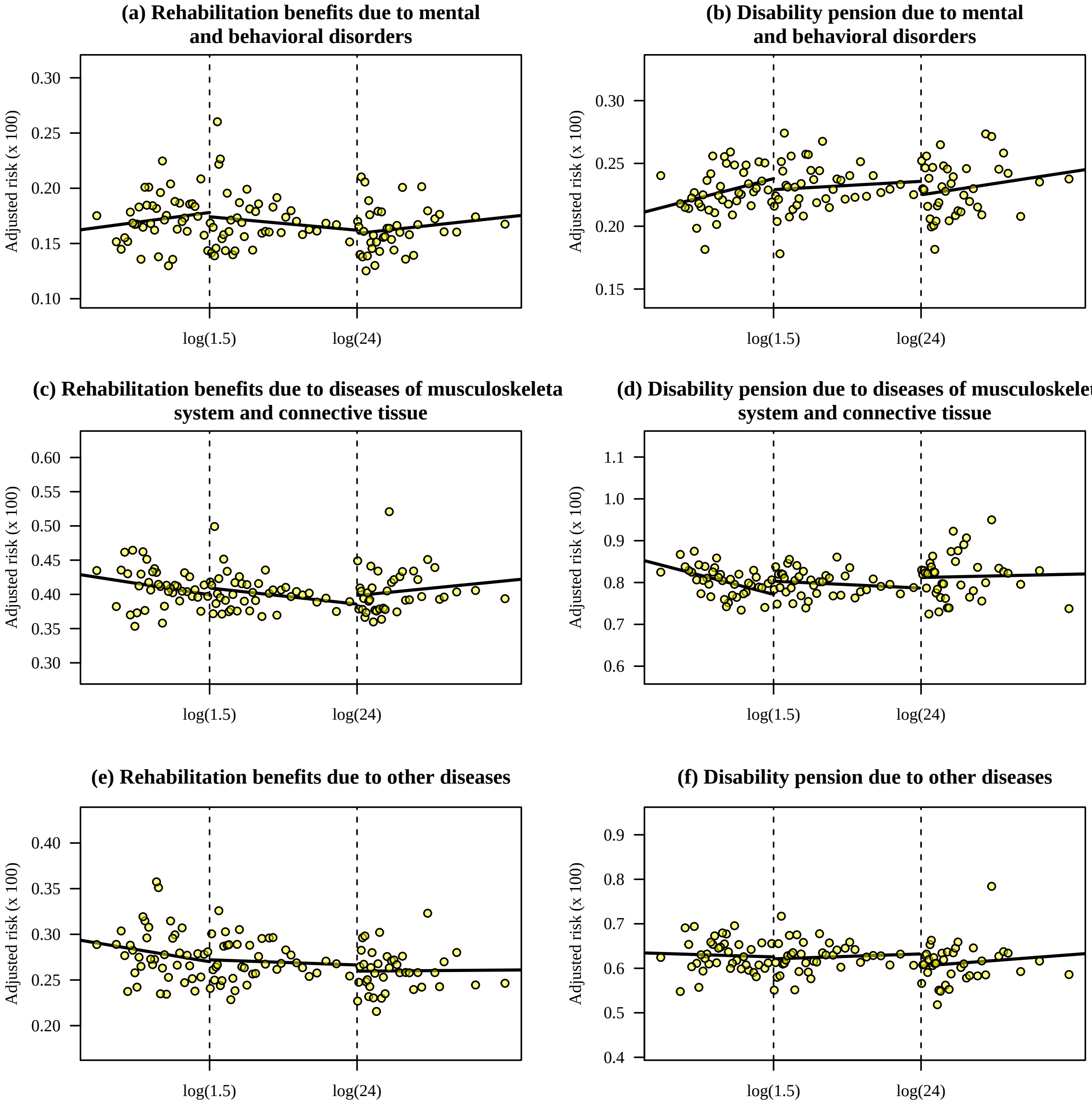

Figure 6: Local average of adjusted diagnosis-specific disability risk $\hat{\mu}_{jt}$ plotted against log payroll $W_{j(t-2)}$

disability pension, the regression lines are equally flat in each size group (Figure 5d).

As the employers can only influence the onset of certain health problems, we also analyze the receipt of disability and rehabilitation benefits that are granted for a given medical condition. In these cases, we make no distinction between partial and full disability pensions, and only consider the two most common diagnosis categories — mental and behavioral disorders, and diseases of musculoskeletal system and connective tissue — while pooling all other medical diagnoses into a single category. The local averages of adjusted risks in this case are shown in Figure 6. Compared to Figure 5, the local averages are more noisy but the slope differences between firm size groups remain small in most cases. In Figure 6a, there is some indication that the likelihood of being awarded a rehabilitation benefit due to mental and behavioral disorders may decline with the degree of experience rating. No clear patterns are found for other cases.

To sum up, the adjusted disability risks vary very little with firm size, indicating a very small or no effect at all for the degree of experience rating. It should be noted that we have only controlled for differences in the composition of the workforce across firms and over time. If uncontrolled differences in observed or unobserved characteristics of firms are correlated with firm size, the visual evidence in Figures 5 and 6 may describe poorly the causal effect of experience rating. In the regression analysis below, we aim to control for confounding firm-level factors.

5.5 The effects of experience rating

Table 4 reports the estimates of τ obtained by estimating equation (4) when $g(\cdot)$ is specified as a linear or quadratic function of log payroll. All numbers are multiplied by 100, so that the point estimates give the change in the outcome probability measured in percentages when the degree of experience rating jumps from 0 to 1, i.e. when the flat-rate premiums are completely removed and replaced with experienced-rated premiums.

The estimated effects for the entire worker population in columns 2 and 3 are in general relatively small, and all of them are statistically insignificant at the conventional risk levels. It is reassuring that the results from the linear and quadratic specifications are almost identical, reflecting the fact that the adjusted disability risks vary very little with firm size (see Figure 5). The flatness of the disability risks with respect to firm size also implies that the coefficients on log payroll and its square are almost always statistically insignificant. This also explains, in part, why the estimated effects are rather imprecise. For example, the 95% confidence interval for the effect of experience rating on receipt of a disability pension from the linear specification is $(-0.051, 0.087)$, which contains the effects ranging from a reduction of 14% to an increase of 23% in the average disability risk. As such, we cannot rule out moderate effects of experience rating on the outcomes considered, even though one should keep in mind that the coefficients reported describe the effect of the maximum increase in the degree of experience rating.

Consistently with the visual evidence in Figure 6, the largest relative effects are found for the likelihood of being awarded a disability benefit due to mental and behavioral disorders: the point estimate for rehabilitation benefits, -0.016, corresponds to a reduction of 21% in the average risk, and that for the disability pension, -0.012, corresponds to a reduction of 17% in the average risk, yet neither of these estimates is significantly different from zero.

If the effect of experience rating varies across workers, the average effect for the en-

Table 4: The effect of the time-varying degree of experience rating τ ($\times 100$) using a linear or quadratic specification for the payroll effect

	All workers			Women						Men					
				Ages 20 to 49			Ages 50 to 62			Ages 20 to 49			Ages 50 to 62		
	Mean (1)	Linear (2)	Quadr. (3)	Mean (4)	Linear (5)	Quadr. (6)	Mean (7)	Linear (8)	Quadr. (9)	Mean (10)	Linear (11)	Quadr. (12)	Mean (13)	Linear (14)	Quadr. (15)
A. Baseline results															
Sick leave	4.421	0.343	0.356	4.904	0.201	0.007	6.625	-0.701	-0.371	3.249	0.631	0.274	5.448	1.033	0.644
		(0.480)	(0.493)		(0.929)	(0.819)		(1.370)	(1.093)		(0.602)	(0.482)		(0.886)	(0.743)
Rehabilitation benefits	0.283	-0.019	-0.019	0.207	0.001	-0.001	0.543	-0.042	-0.012	0.164	-0.032	-0.027	0.466	-0.057	-0.063
		(0.022)	(0.022)		(0.033)	(0.034)		(0.112)	(0.113)		(0.024)	(0.025)		(0.078)	(0.082)
Partial disability pension	0.152	0.016	0.016	0.032	0.021	0.019	0.592	0.182	0.133	0.020	-0.002	-0.003	0.357	0.082	-0.003
		(0.020)	(0.019)		(0.014)	(0.014)		(0.111)	(0.111)		(0.007)	(0.007)		(0.082)	(0.081)
Full disability pension	0.374	0.018	0.017	0.060	-0.024	-0.023	0.976	0.078	0.152	0.066	-0.036**	-0.036**	1.111	0.015	0.007
		(0.035)	(0.037)		(0.020)	(0.020)		(0.175)	(0.172)		(0.015)	(0.015)		(0.174)	(0.159)
B. Rehabilitation benefits by diagnosis															
Mental and behavioral disorders	0.077	-0.016	-0.016	0.085	-0.009	-0.008	0.119	0.032	0.045	0.053	-0.023*	-0.021*	0.078	-0.033	-0.037
		(0.010)	(0.010)		(0.018)	(0.018)		(0.040)	(0.042)		(0.012)	(0.012)		(0.030)	(0.029)
Diseases of musculoskeletal system and connective tissue	0.107	-0.006	-0.006	0.057	-0.003	-0.006	0.254	-0.064	-0.019	0.049	-0.002	-0.001	0.211	-0.025	-0.013
		(0.014)	(0.014)		(0.017)	(0.017)		(0.070)	(0.075)		(0.012)	(0.013)		(0.048)	(0.051)
Other diseases	0.099	0.003	0.003	0.064	0.012	0.013	0.170	-0.010	-0.038	0.062	-0.007	-0.004	0.177	0.001	-0.013
		(0.012)	(0.012)		(0.017)	(0.017)		(0.054)	(0.056)		(0.013)	(0.013)		(0.043)	(0.047)
C. Disability pension by diagnosis															
Mental and behavioral disorders	0.071	-0.012	-0.012	0.024	0.000	0.002	0.210	-0.000	0.009	0.023	-0.011	-0.012	0.149	-0.028	-0.051
		(0.009)	(0.009)		(0.011)	(0.011)		(0.051)	(0.054)		(0.008)	(0.008)		(0.048)	(0.043)
Diseases of musculoskeletal system and connective tissue	0.206	0.030	0.030	0.017	0.000	-0.001	0.716	0.094	0.139	0.015	-0.005	-0.007	0.582	0.072	0.048
		(0.028)	(0.029)		(0.009)	(0.009)		(0.152)	(0.156)		(0.007)	(0.007)		(0.116)	(0.112)
Other diseases	0.193	0.000	0.000	0.044	-0.002	-0.001	0.434	0.048	0.013	0.042	-0.017	-0.016	0.586	-0.003	-0.017
		(0.017)	(0.018)		(0.015)	(0.015)		(0.085)	(0.089)		(0.011)	(0.012)		(0.088)	(0.089)
# of worker-year obs.		4,159,792			983,639			427,208			1,548,845			586,156	
# of firm-year obs.		68,002			19,288			9,592			30,389			13,337	

Notes: Mean is the average outcome probability multiplied by 100. In addition to the linear or quadratic effect of log payroll, all models include indicators for industry, multiple establishments, export/import status and legal form, as well as the share of foreign ownership and log firm age. The bootstrapped standard errors in parenthesis. Significance levels: *** 1%, ** 5% and * 10%.

tire population may mask larger and potentially significant effects for some subgroups. Therefore, we also report the estimates for subgroups defined by gender and age. This analysis covers firms and their employees when at least 10 members of the subgroup are at risk of becoming sick or disabled in a given year. It turns out that the signs of the point estimates quite often differ between the age groups considered. Nevertheless, the estimated effects for almost all subgroups are insignificant. The only exception is the effect of experience rating on the receipt of a full disability pension among male employees between the ages of 20 and 49 (columns 11 and 12 in Panel A). For this group the likelihood of being granted a full disability pension is estimated to be halved if the employer paying only flat-rate DI premiums became subject to the maximum degree of experience rating.[17] The effects on disability pensions associated with different medical conditions are all negative and of similar magnitude in relative terms (columns 11 and 12 in Panel C). While these estimates are too imprecise for any strong conclusions, they suggest that experience rating potentially lowers the onset of all kinds of health issues that may lead to disability pension claims by men under 50.

It is worth noting that the effects on the receipt of a full disability pension are relatively large also for women under age 50 (columns 5 and 6 in Panel A), as they indicate a drop of one-third in the disability risk due to the maximum increase in the degree of experience rating. In addition to being smaller in absolute value, these estimates are also associated with larger standard errors than the corresponding estimates for men of the same age, and therefore they do not differ from zero at the conventional risk levels.

Furthermore, there is some weak evidence that experience rating may also reduce rehabilitation benefits awarded for younger men due to mental and behavioral disorders (columns 11 and 12 in Panel B). Though only marginally significant, the estimates point to a one-half drop in the likelihood due to the maximum increase in the degree of experience rating. For men between the ages of 50 and 62, the estimated effects are of similar magnitude but even less precisely estimated. No evidence of significant effects are found for women in either age group.

The model specifications considered so far assume an instant effect for the degree of experience rating. In practice, disability reducing programs are likely to last for some years and their effects may be realized with a lag. Firms also have forecasts for their growth rates and can therefore anticipate their degrees of experience rating over the next few years. If so, annual variation in the degree of experience rating around the average level may not be very important for the employer's health and safety policy. As a robustness check, we re-estimate the models without using the annual variation for identification. In

[17]The point estimate remains stable, but becomes statistically insignificant, when the third or fourth order polynomial is used for log payroll (all polynomial terms are very imprecisely estimated).

Table 5: The effect of the average degree of experience rating τ ($\times 100$) using a linear or quadratic specification for the payroll effect

	All workers			Women						Men					
				Ages 20 to 49			Ages 50 to 62			Ages 20 to 49			Ages 50 to 62		
	Mean (1)	Linear (2)	Quadr. (3)	Mean (4)	Linear (5)	Quadr. (6)	Mean (7)	Linear (8)	Quadr. (9)	Mean (10)	Linear (11)	Quadr. (12)	Mean (13)	Linear (14)	Quadr. (15)
A. Baseline results															
Sick leave	4.421	0.273	0.506	4.904	0.085	0.029	6.625	-0.392	-0.192	3.249	0.531	0.412	5.448	1.010	0.739
		(0.435)	(0.506)		(0.799)	(0.802)		(1.163)	(1.058)		(0.563)	(0.490)		(0.869)	(0.750)
Rehabilitation benefits	0.283	-0.016	-0.018	0.207	-0.013	-0.014	0.543	-0.060	-0.020	0.164	-0.044	-0.043	0.466	-0.053	-0.051
		(0.025)	(0.025)		(0.042)	(0.041)		(0.121)	(0.125)		(0.029)	(0.030)		(0.092)	(0.111)
Partial disability pension	0.152	0.013	0.021	0.032	0.017	0.016	0.592	0.203*	0.201	0.02	-0.001	-0.001	0.357	0.063	-0.015
		(0.021)	(0.020)		(0.015)	(0.015)		(0.120)	(0.127)		(0.008)	(0.009)		(0.084)	(0.086)
Full disability pension	0.374	0.035	0.030	0.06	-0.031	-0.031	0.976	0.083	0.133	0.066	-0.037**	-0.037**	1.111	0.061	0.096
		(0.034)	(0.038)		(0.021)	(0.022)		(0.175)	(0.186)		(0.018)	(0.018)		(0.182)	(0.186)
B. Rehabilitation benefits by diagnosis															
Mental and behavioral disorders	0.077	-0.026**	-0.027**	0.085	-0.010	-0.009	0.119	-0.017	-0.001	0.053	-0.036**	-0.036**	0.078	-0.025	-0.032
		(0.012)	(0.012)		(0.025)	(0.026)		(0.046)	(0.051)		(0.016)	(0.016)		(0.034)	(0.037)
Diseases of musculoskeletal system and connective tissue	0.107	0.002	0.002	0.057	-0.010	-0.012	0.254	0.022	0.068	0.049	0.000	0.000	0.211	-0.041	-0.037
		(0.016)	(0.016)		(0.019)	(0.019)		(0.084)	(0.092)		(0.014)	(0.014)		(0.059)	(0.069)
Other diseases	0.099	0.008	0.007	0.064	0.007	0.007	0.170	-0.065	-0.088	0.062	-0.008	-0.007	0.177	0.013	0.018
		(0.014)	(0.013)		(0.019)	(0.019)		(0.059)	(0.063)		(0.017)	(0.017)		(0.051)	(0.065)
C. Disability pension by diagnosis															
Mental and behavioral disorders	0.071	-0.016	-0.017	0.024	-0.008	-0.008	0.21	-0.026	-0.011	0.023	-0.008	-0.008	0.149	-0.040	-0.065
		(0.011)	(0.011)		(0.011)	(0.011)		(0.060)	(0.067)		(0.010)	(0.010)		(0.051)	(0.055)
Diseases of musculoskeletal system and connective tissue	0.206	0.040	0.044	0.017	0.002	0.001	0.716	0.201	0.254	0.015	-0.005	-0.006	0.582	0.130	0.126
		(0.028)	(0.030)		(0.009)	(0.009)		(0.155)	(0.168)		(0.007)	(0.007)		(0.124)	(0.134)
Other diseases	0.193	0.008	0.007	0.044	-0.008	-0.007	0.434	-0.019	-0.049	0.042	-0.022	-0.022	0.586	-0.002	0.014
		(0.019)	(0.020)		(0.017)	(0.017)		(0.093)	(0.097)		(0.013)	(0.013)		(0.095)	(0.110)
# of worker-year obs.		4,159,792			983,639			427,208			1,548,845			586,156	
# of firm obs.		14,723			4,356			2,021			6,775			2,855	

Notes: Mean is the average outcome probability multiplied by 100. In addition to the linear or quadratic effect of log aveage payroll, all models include year effects, indicators for industry, multiple establishments, export/import status and legal form, as well as the share of foreign ownership and log firm age. The bootstrapped standard errors in parenthesis. Significance levels: *** 1%, ** 5% and * 10%.

the first-stage equation, we replace S_{jt} with its average over the years, and replace the firm-year fixed effects with the year effects and firm effects. In the second stage, we then regress the estimated firm fixed effects on the average degree of experience rating while controlling for the direct effect of the average payroll.

The results of this exercise are shown in Table 5. The estimated effects are in accordance with those in Table 4, though some of the effects are slightly larger in absolute value. The effect of experience rating on the receipt of a full disability pension for men under age 50 is -0.037 in both the linear and quadratic model (columns 11 an 12 in Panel A), and thereby the estimated effects are essentially identical to the ones reported in Table 4. For the same subgroup, we find an effect of -0.036 on the receipt of rehabilitation benefits due to mental and behavioral disorders (columns 11 and 12 in Panel B), which is larger in absolute value than the corresponding effects in Table 4, and this time the effect is also significant at the 5% level. The large impact on younger men explains why we find statistically significant average effects also for the whole population (columns 2 and 3 in Panel B). These estimates imply that the maximum degree of experience rating decreases the likelihood of being granted a rehabilitation benefit due to mental or behavioral disorders by one-third, compared to the case where the employer is not subject to experience rating but only pays flat-rate DI premiums.

6 Concluding remarks

In Finland, a new disability pension claimant can cause substantial costs to the former employer through an increase in the DI premium. Given the size of the potential costs, experience rating should promote preventive health and safety practices and encourage employers to accommodate their employees who develop a medical condition that reduces working capacity. In the light of our empirical results, experience rating does not seem to be a particularly effective policy to reduce sick leaves or disability benefit claims.

Our graphical analysis did not reveal any notable differences in sickness or disability inflow rates between small, medium-sized and large firms, which are subject to different degrees of experience rating and thus have differential incentives. In our regression models the degree of experience rating did not have a desired effect on the disability inflow among the population of all workers. This finding proved to be robust in terms of the model specification and the outcome variable considered. In particular, we found no effects on the incidence of sick leave or receipt of three different types of disability benefits, nor did we find effects on the receipt of disability benefits associated with different types of medical conditions.

However, when analyzing different gender/age groups separately, we found that experience rating may induce large employers to put effort in preventing the disability events of their (male) employees under age 50. Within this group, experience rating reduces the receipt of disability pensions in general, as well as the receipt of rehabilitation benefits that are awarded due to mental and behavioral disorders. The latter effect may imply that experience-rated employers pay more attention on workload and other stress factors that could lead to temporary disability due to burnout. It is worth noting that men under age 50 account only for 8% of all full disability pension claims and 24% of rehabilitation benefit claims in our data. As such, the effect of experience rating on this single group has only a small impact on the overall disability caseload. On the other hand, we cannot rule out moderate effects for other groups due to limited statistical power. But these moderate effects cannot produce large aggregate effects. To see this, suppose that the degree of experience rating is increased to 1 for all employers and the behavioral responses are assumed to be equal to the lower bounds of the 95% confidence intervals of the estimated effects for the whole population. Even in this extreme case, the inflow rates to rehabilitiation benefits and full disabilitity pension would decline only by 7% and 11% from the present levels, respectively.

In summary, experience rating in disability insurance has no notable impact on the overall disability inflow in the Finnish labor market. From the description of the institutional framework it is evident that the design of the Finnish experience rating scheme is rather complex. A long delay, of possibly several years, between a medical diagnosis of disability and a possible, but not inevitable, increase in the experience-rated premium may hinder employers from recognizing the causes for premium changes. If so, a simpler and more transparent procedure to determine the DI premiums could work better. However, even without the desired behavioral effects, the experience rating system provides a means of allocating the overall costs of the disability benefits more equitably among individual employers.

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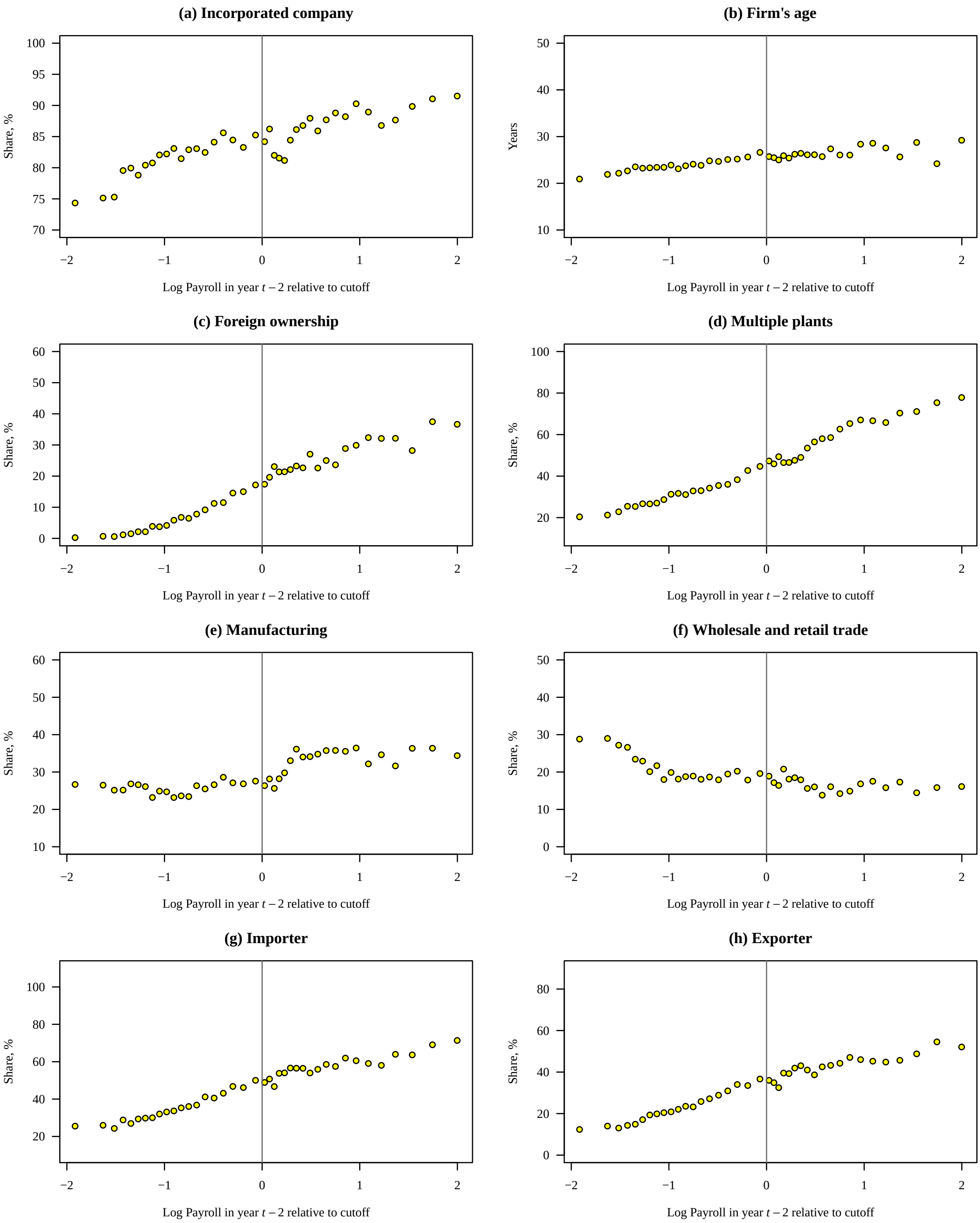

Figure A1: Local averages of selected firm covariates around the bottom kink. On each side of the cutoff, firms are divided into 20 equally-sized bins, and the dots in the graphs are local averages plotted against the bin midpoints.

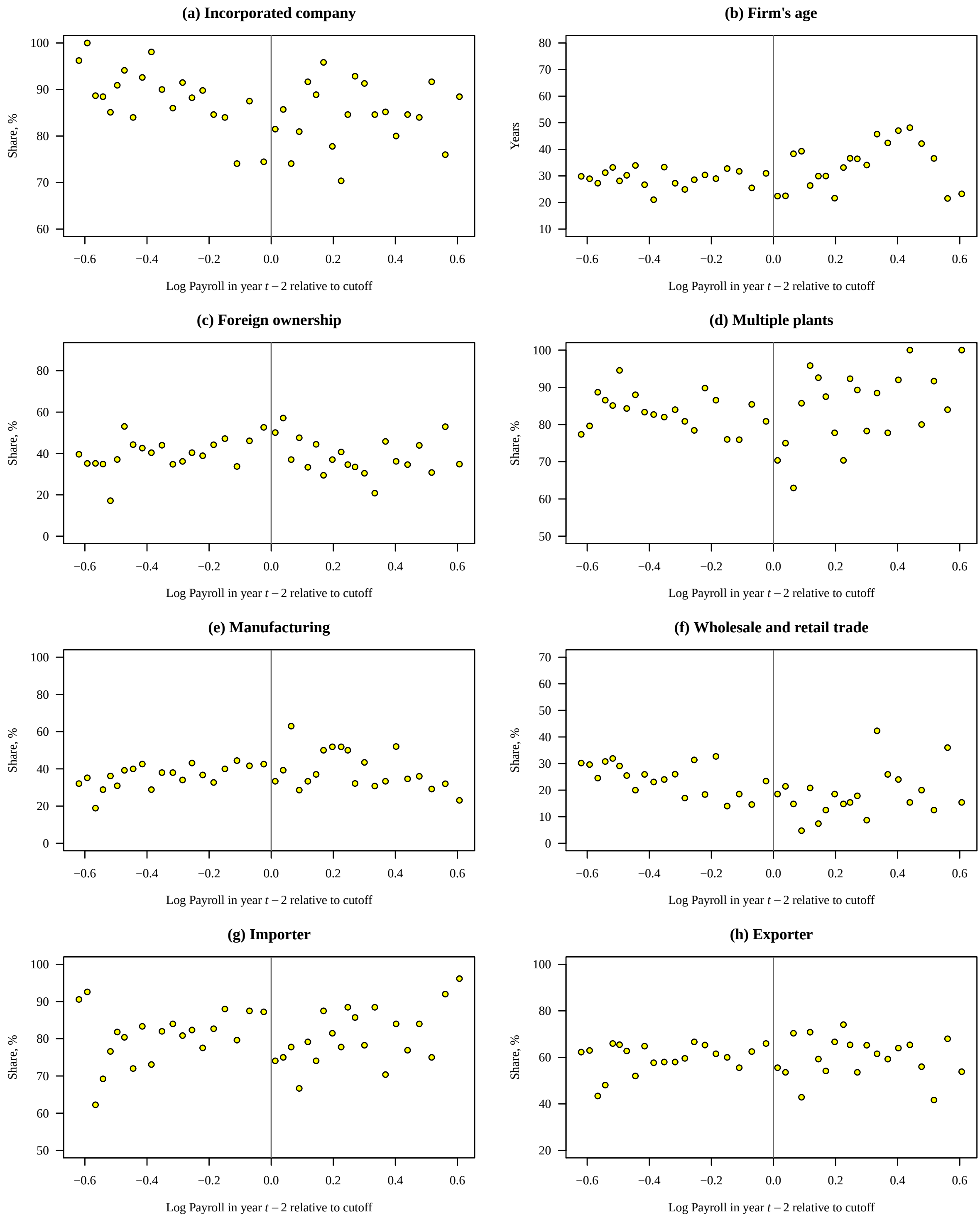

Figure A2: Local averages of selected firm covariates around the top kink. On each side of the cutoff, firms are divided into 20 equally-sized bins, and the dots in the graphs are local averages plotted against the bin midpoints.

Table A1: Within estimates of coefficients (×100) on worker-specific covariates for main outcomes

	Sick leave	**Rehabilitation benefit**	**Partial disability pension**	**Full disability pension**
	(1)	(2)	(3)	(4)
Female	1.176***	0.058***	0.066***	-0.013
	(0.066)	(0.007)	(0.006)	(0.009)
Married	-0.137***	-0.034***	0.018***	-0.007
	(0.033)	(0.006)	(0.004)	(0.007)
Upper secondary education	-1.300***	-0.127***	-0.048***	-0.247***
	(0.077)	(0.012)	(0.008)	(0.016)
Lower tertiary education	-3.720***	-0.290***	-0.130***	-0.403***
	(0.168)	(0.012)	(0.009)	(0.019)
Upper tertiary education	-4.427***	-0.327***	-0.135***	-0.398***
	(0.217)	(0.013)	(0.010)	(0.020)
Tenure - 11, years	-0.105***	-0.004***	0.002***	-0.001
	(0.005)	(0.001)	(0.001)	(0.001)
Age 20–30	-3.996***	-0.649***	-0.550***	-1.077***
	(0.165)	(0.028)	(0.028)	(0.042)
Age 31–40	-2.894***	-0.502***	-0.519***	-0.982***
	(0.106)	(0.027)	(0.027)	(0.041)
Age 41–45	-2.325***	-0.405***	-0.505***	-0.928***
	(0.096)	(0.026)	(0.027)	(0.040)
Age 46–50	-1.611***	-0.298***	-0.463***	-0.838***
	(0.087)	(0.026)	(0.027)	(0.040)
Age 51	-1.031***	-0.192***	-0.404***	-0.688***
	(0.098)	(0.031)	(0.029)	(0.041)
Age 52	-0.833***	-0.140***	-0.327***	-0.604***
	(0.101)	(0.033)	(0.029)	(0.043)
Age 53	-0.713***	-0.091***	-0.292***	-0.480***
	(0.098)	(0.033)	(0.029)	(0.042)
Age 54	-0.314***	-0.068**	-0.210***	-0.337***
	(0.095)	(0.034)	(0.030)	(0.043)
Age 55	-0.194**	-0.027	-0.121***	-0.206***
	(0.094)	(0.033)	(0.030)	(0.042)
Age 57	0.279*	0.074	0.163***	-0.072
	(0.149)	(0.054)	(0.056)	(0.065)
Age 58	0.261	0.018	0.330***	0.051
	(0.197)	(0.064)	(0.073)	(0.092)
Age 59	0.300	-0.107	0.229***	0.258***
	(0.198)	(0.066)	(0.070)	(0.094)
Age 60	0.221	-0.190***	0.197***	0.503***
	(0.204)	(0.066)	(0.069)	(0.097)
Age 61–62	-0.048	-0.407***	-0.090	0.003
	(0.195)	(0.062)	(0.066)	(0.092)
UT	-0.142	-0.116**	-0.184***	0.567***
	(0.183)	(0.059)	(0.064)	(0.079)
$UT \times S$	0.254	0.013	0.129***	-0.157
	(0.198)	(0.031)	(0.049)	(0.105)
R-squared	0.042	0.021	0.019	0.028

Notes: The reference worker is a 56-year-old unmarried man with a lower than upper secondary education and 11 years of job tenure. Number of observations is 4,159,792. The robust two-way clustered standard errors in parenthesis. Significance levels: *** 1%, ** 5% and * 10%.

Table A2: Within estimates of coefficients (×100) on worker-specific covariates for disability benefits by diagnosis

	Rehabilitation benefit			Partial or full disability pension		
	Mental and behavioral disorder	Diseases of muscu-loskeletal system and connective tissue	Other diseases	Mental and behavioral disorder	Diseases of muscu-loskeletal system and connective tissue	Other diseases
	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.026***	0.028***	0.004	0.006*	0.064***	-0.036***
	(0.004)	(0.005)	(0.004)	(0.004)	(0.007)	(0.006)
Married	-0.021***	-0.003	-0.010***	-0.020***	0.030***	-0.010**
	(0.003)	(0.004)	(0.003)	(0.003)	(0.005)	(0.005)
Upper secondary education	-0.017***	-0.068***	-0.041***	-0.022***	-0.148***	-0.094***
	(0.006)	(0.007)	(0.006)	(0.006)	(0.012)	(0.009)
Lower tertiary education	-0.045***	-0.149***	-0.096***	-0.042***	-0.283***	-0.145***
	(0.006)	(0.008)	(0.006)	(0.006)	(0.015)	(0.010)
Upper tertiary education	-0.064***	-0.154***	-0.108***	-0.055***	-0.259***	-0.154***
	(0.007)	(0.008)	(0.007)	(0.007)	(0.015)	(0.011)
Tenure - 11, years	-0.001***	-0.002***	-0.001**	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Age 20–30	-0.107***	-0.343***	-0.199***	-0.192***	-0.694***	-0.507***
	(0.012)	(0.020)	(0.016)	(0.014)	(0.035)	(0.024)
Age 31–40	-0.075***	-0.278***	-0.149***	-0.173***	-0.642***	-0.460***
	(0.012)	(0.019)	(0.015)	(0.014)	(0.033)	(0.023)
Age 41–45	-0.056***	-0.239***	-0.110***	-0.157***	-0.633***	-0.421***
	(0.012)	(0.019)	(0.015)	(0.014)	(0.033)	(0.023)
Age 46–50	-0.038***	-0.184***	-0.076***	-0.130***	-0.591***	-0.369***
	(0.012)	(0.018)	(0.015)	(0.014)	(0.033)	(0.024)
Age 51	-0.022	-0.123***	-0.047**	-0.098***	-0.512***	-0.287***
	(0.015)	(0.023)	(0.020)	(0.016)	(0.034)	(0.026)
Age 52	0.005	-0.112***	-0.032*	-0.066***	-0.452***	-0.262***
	(0.016)	(0.023)	(0.019)	(0.017)	(0.034)	(0.026)
Age 53	-0.005	-0.072***	-0.014	-0.055***	-0.391***	-0.196***
	(0.015)	(0.022)	(0.021)	(0.017)	(0.033)	(0.029)
Age 54	0.003	-0.053**	-0.018	-0.040**	-0.301***	-0.117***
	(0.016)	(0.025)	(0.020)	(0.018)	(0.036)	(0.028)
Age 55	-0.004	-0.042*	0.018	-0.035*	-0.190***	-0.061**
	(0.016)	(0.021)	(0.021)	(0.018)	(0.033)	(0.031)
Age 57	0.018	0.029	0.027	0.004	0.103*	0.034
	(0.025)	(0.038)	(0.033)	(0.028)	(0.056)	(0.048)
Age 58	-0.004	0.037	-0.015	-0.014	0.287***	0.141**
	(0.029)	(0.047)	(0.040)	(0.038)	(0.077)	(0.063)
Age 59	-0.033	-0.070	-0.004	0.003	0.339***	0.299***
	(0.029)	(0.046)	(0.040)	(0.040)	(0.077)	(0.065)
Age 60	-0.057**	-0.086*	-0.046	0.010	0.549***	0.379***
	(0.029)	(0.047)	(0.041)	(0.037)	(0.082)	(0.065)
Age 61-62	-0.082***	-0.191***	-0.134***	-0.081**	0.171**	0.182***
	(0.028)	(0.046)	(0.037)	(0.037)	(0.076)	(0.063)
UT	-0.034	-0.062	-0.021	0.056*	0.084	0.121**
	(0.025)	(0.041)	(0.035)	(0.033)	(0.071)	(0.055)
$UT \times S$	-0.006	-0.003	0.021	-0.002	-0.024	-0.065
	(0.009)	(0.020)	(0.016)	(0.019)	(0.088)	(0.044)
R-squared	0.019	0.019	0.019	0.018	0.025	0.022

Notes: The reference worker is a 56-year-old unmarried man with a lower than upper secondary education and 11 years of job tenure. Number of observations is 4,159,792 . The robust two-way clustered standard errors in parenthesis. Significance levels: *** 1%, ** 5% and * 10%.