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ABSTRACT

We analyze mandatory retirement in Sweden which eliminates entirely employment protection at age 67. Employment falls by about 10 percent and total average earnings by about 20 percent immediately at age 67. 8 percent of jobs separate immediately due to loss of protection, with effects stemming from jobs with stronger initial employment protection (long tenure, firms subject to "last in, first out" rules), and those in the public sector. We examine effects on continuing jobs. While wages appear rigid, we uncover novel, sizable intensive-margin hours reductions, resulting in an 8 percent drop in earnings conditional on staying on the job.

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"Mandatory retirement" laws are a common policy that eliminates employment protection for older workers after a certain age. About 40 percent of OECD countries have mandatory retirement laws that apply both in the private and public sectors, with an additional 25 percent of OECD countries having such laws for public sector workers only (OECD 2022, Figure 1B1). This phase-out of protection allows—but generally does not obligate—employers to dismiss older workers at low or no cost. These workers are otherwise shielded from dismissals because a defining feature of employment protection is its strengthening in tenure and age, due to seniority rules and phase-ins over job tenure.

In the policy debate, employment protection is valued by workers but disliked by employers as it can generate "deadwood" labor: unprofitable jobs that firms would like to terminate but cannot, because of employment protection. This "deadwood" labor concern is likely more pronounced among older workers due to wage and employment protection seniority rules, possibly combined with wage rigidity and a fall in productivity or ability to adapt to new tasks at older ages (in the spirit of Lazear (1979)). This is why countries with strong employment protection tend to adopt mandatory retirement laws (Appendix Figure A.1). For instance, OECD English-speaking countries (US, Canada, UK, Ireland, New Zealand, Australia) have weak employment protection (Appendix Figure A.2) and no longer have mandatory retirement laws, but many continental EU countries and Asian countries have both strong employment protection and mandatory retirement laws. Moreover, while those laws are highly heterogeneous (e.g., the cutoffs vary from age 60 in Japan and Korea to 70 in France and Norway, see Appendix Figure A.1, with complex variation in the underlying details), their unifying feature is the elimination or substantial weakening of protection at a certain age in the retirement vicinity.[1]

The empirical effects of such laws have been difficult to measure. In most countries, mandatory retirement ages are intentionally tied to statutory retirement ages of the pension system, which can also have by themselves a large impact on work behavior either through standard economic incentives (Gruber and Wise 1999) or through focal norm effects (Mastrobuoni 2009 and Behagel and Blau 2012 for the US, Seibold 2021 for Germany). As a result, all existing studies of mandatory retirement laws are either specific to a narrow profession–such as college professors—or in contexts where mandatory retirement is or

[1]There is surprisingly limited international data on the prevalence and evolution of mandatory retirement laws across countries. The OECD's only and preliminary attempt is in OECD (2022), a report on the Slovenian pension system, specifically in Annex 1.B due to Slovenia's introduction of mandatory retirement. Age discrimination laws have led to some repeals as in the United States or Canada, but the policies have remained in place in many countries. Moreover, OECD (2004) finds that while employment protection legislation strength is negatively correlated with employment rates for prime age workers, this correlation goes away for older workers, but does not draw on mandatory retirement specifically.

was tied to the pension system.[2]

Our paper breaks new ground on the impacts of mandatory retirement in the case of Sweden, which has important advantages. First, the age cutoff when employment protection ends in Sweden—67 in our benchmark period of interest—is completely independent of the pension system. The employment protection cutoff age is neither a statutory retirement age for the Swedish pension system nor an age for which there is a specific financial incentive to retire. The Swedish pension system allows great flexibility in retirement age and comes close to being actuarially fair. Hence, any discontinuous separation pattern at the employment protection cutoff age is exclusively due to the employment protection variation, providing compelling identification of pure employment protection effects using a bunching design. Second, reforms in the employment protection cutoff age provide additional identification and allow us to identify the full impact of mandatory retirement on older workers using a simple difference-in-differences design. Third, Sweden combines strong employment protection with a high employment rate among the elderly. As a result, mandatory retirement applies to a large fraction of the workforce and is highly policy-relevant. Finally, Sweden has a uniquely rich set of labor data with full population administrative earnings information at the monthly frequency linked to a large wage structure survey that provides detailed jobs and hours characteristics. This allows us to analyze causal impacts more precisely and not only along the extensive margin but also the intensive hours margin, a novel contribution. We obtain four main results.

First, focusing on overall effects *on a per-capita basis*, we find that the elimination of employment protection immediately lowers a cohort's employment-population ratio by 2.5 percentage points from 25 percent down to 22.5 percent, a 10 percent decline. This effect is driven by excess separations exactly at the age when employment protection ends, with no offsetting effect due to more hires afterwards. Therefore, employment protection prolongs jobs, but these workers either are unwilling to take another job or no other firm would employ them even without employment protection. Furthermore, the phase-out of protection reduces total earnings per capita by about 20 percent—equivalently, employment protection propped up earnings per capita among older workers by 20 percent. About half of this effect is due to novel intensive-margin effects that we document (hours reductions of stayers, but also composition as high earners separate more) and about half comes from the extensive margin (the aforementioned employment effects). We also

[2]For studies of professors, see Ashenfelter and Card (2002), Clark and Ghent (2008), Warman and Worswick (2010), who find large effects for US and Canadian professors. For studies where mandatory retirement is or was tied to pension incentives, see Burkhauser and Quinn (1983) for the US; Shannon and Grierson (2004) and Morris and Dostie (2023) for Canada; Kondo and Shigeoka (2017) for Japan; Rabaté (2019) for France; and Rabaté, Jobben, and Atav (2024) for the Netherlands.

show that the discontinuous drop in employment and earnings moves in lockstep with the cutoff age as a reform shifts it from 67 to 68 as well as from 68 to 69, lending credence to our causal interpretation.

Second, we find that 8 percent of jobs separate exactly at age 67 and we characterize these excess separations in heterogeneity analyses based on the characteristics of a deadwood worker, the type of organization that accumulates deadwood jobs, and variation in protection, i.e., treatment intensity. Legal factors determining employment protection strength (firm size and tenure) light up in our heterogeneity analysis. Besides stronger protection, tenure could also capture "good jobs" that older workers evidently hold on to. Workers terminated due to mandatory retirement go directly into retirement, rather than moving to another employer.

We also find symptoms of firms cherry picking (or, "lemon dropping") workers that are plausibly unproductive. Specifically, we find that workers with a recent sickness leave spell exhibit a two and a half times larger excess separation effect compared to healthy workers—with nearly 20 percent of those workers getting laid off exactly when they turn 67. Labor supply behavior cannot explain this pattern because sick workers could have voluntarily retired before or after turning 67. Relatedly, we do not find any firm that, as a matter of rigid personnel policy, terminates jobs at 67 across the board. There is, however, one organizational characteristic that does stand out: excess separations are twice as high in the *public sector* than in the private sector, even when controlling for firm size. Hence, private sector firms appear to largely get around employment protection for older workers.

Third, we study the effects of employment protection on the vast majority of jobs—92 percent—that survive the elimination of employment protection. To do so, we track job stayers: individuals that are employed in the same job before they turn 67 and after. Drawing on the Structure of Earnings Survey, in which we can decompose earnings into hours and hourly wages, we find no evidence for wage reductions at age 67. Hence, there is no evidence for firms and workers rebargaining wages to keep older workers on the job, perhaps reflecting wage rigidity.

Strikingly, while 92 percent of jobs stay active after 67 without employment protection, we find that these jobs do contain a substantial share of deadwood labor units (tasks or hours) at the *intensive* margin. This is because we uncover clear and strong hours and earnings responses among stayers (at constant hourly wage rates). This effect amounts to an 8 percent earnings reduction among stayers, hence *doubling* the earnings effects from the conventional extensive margin. These results on restructuring of jobs *among stayers* are novel to a literature on employment protection that has largely focused on extensive-margin separation and hiring responses, or on retirement.

Finally, while we focus on mandatory retirement (see Footnote 2 above), our work is also related to the empirical literature on employment protection, to which we contribute a quasi-experimental study of a large phase-out of a strong EPL, complementing existing work that has largely studied phase-ins or cross-country correlations.[3] We note that our estimates for the highly protected older workers might provide an upper bound of the employment effects of employment protection, but also draws on a highly specific sample of workers close to retirement, and only studies the separation margin.[4]

The paper is organized as follows. In Section I, we present a simple conceptual framework. In Section II, we review the institutional setting and data. Section III conducts the basic per-capita analysis. Section IV zooms in on separations and their characteristics and Section V reports effects on continuing jobs. Section VI concludes.

I A Simple Model of Mandatory Retirement Laws

We formalize the notion of deadwood jobs in a parsimonious model of jobs, separations and employment protection; we also formally introduce our identification strategy through excess separations in response to the elimination of employment protection. Rather than modeling the ex-ante contracting problem or modeling fuller lifecyle and tenure dynamics, we zoom into the periods adjacent to the mandatory retirement age through the lens of a model of endogenous separations. Hence, our model as well as research design cannot speak to ex-ante notions of efficiency or contracting.

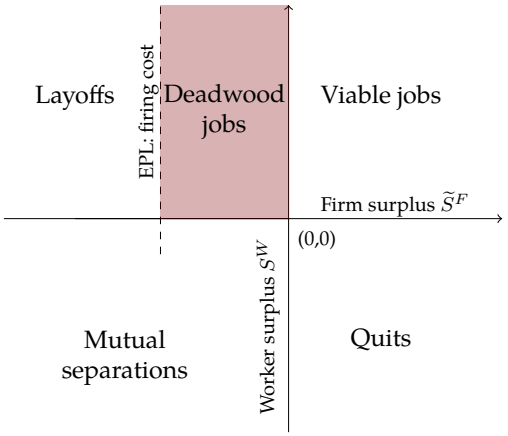
Jobs and separations. Our point of departure is an existing cross section of jobs, at the beginning of a period, before separation decisions are made, while not modeling the stochastic processes generating the heterogeneity or dynamic continuation values. Jobs give value J^W (amenities, labor disutility, etc. not counting wage w[5]) to the worker whose

[3]While there is a large empirical literature using cross-country variation (see, e.g., Lazear 1990, Bertola 1990, Bertola and Rogerson 1997, Addison and Teixeira 2003, Garibaldi and Violante 2005, Bassanini and Garnero 2013, Zeev and Ifergane 2022), there is relatively little compelling microeconomic evidence on the direct effects of employment protection. Existing work has primarily focused on short contracts or new hires aging into the first level of eligibility (e.g., Cahuc, Malherbet and Prat 2019, Heyman and Skedinger 2016, Daruich, Di Addario and Saggio 2023). On the firm-level side, studies have exploited employment (firm size) thresholds in cross-sectional regression discontinuity designs or reform-based difference-in-differences designs (Kugler and Pica 2008, Schivardi and Torrini 2008, Garicano, Lelarge and Van Reenen 2016, Hijzen, Mondauto and Scarpetta 2017, Bjuggren and Skedinger 2021). Market-level quasi-experiments generated by reforms (e.g., Autor, Kerr, and Kugler 2007) are rare but also have equilibrium effects that would mask the direct effect of employment protection on separations. See Cahuc and Palladino (2024) for an overview.

[4]The retirement literature has also focused on hazard rates similar to our separation rates and has found evidence of legacy effects in retirement ages (see e.g., Deshpande, Fadlon, and Gray 2024).

[5]The wage concept w denotes the expected present value of the wage package in this job from this point onward, such that job values J^W and J^F represent gross-of-w values for the worker and the firm. We consider fixed wages and unilateral dismissals or quits; flexibly bargained wages would collapse the two participation constraints into a single joint surplus condition, which we discuss below.

Figure 1: Deadwood Jobs and Employment Protection in the Model



Notes: The figure illustrates job separations by type (quits, layoffs, mutual separations) and viable jobs in the simple model, with fixed wages. Deadwood jobs supported by employment protection legislation (EPL) are denoted by the shaded red region. The axes denote unilateral surpluses; for the firm, it is gross-of-employment protection surplus such that the firing cost employment protection entails acts as a shift of the firm's participation constraint, curbing layoffs.

outside option is O^W, e.g., unemployment, retirement, or moving directly to another employer. Firms obtain value J^F (productivity,...) from the filled job, with outside option O^F (e.g., a vacancy, replacing the worker,...). Importantly, in the case of a separation, the firm pays a red-tape dismissal cost f (to an external party or a resource cost)—our simple representation of employment protection.

A job stays active if both parties' participation constraints are satisfied. Figure 1 expresses these cases. That is, jobs continue if the worker does not want to quit and the firm does not choose a dismissal:

$$\overbrace{J^W + w - O^W}^{\text{Worker surplus } S^W} \geq 0 \tag{1}$$

$$\underbrace{J^F - w - (O^F - f)}_{\text{Firm surplus } S^F \text{ net of emp. protection}} \geq 0 \Leftrightarrow \underbrace{J^F - w - O^F}_{\text{Firm surplus } \widetilde{S}^F \text{ gross of emp. protection}} \geq -f, \tag{2}$$

where S^W and S^F are worker and firm surpluses, and $\widetilde{S}^F = S^F(f = 0)$ is "gross-of-employment protection" firm surplus ignoring employment protection costs f. We take wages w as given (as we do not find evidence for wage adjustments).

Deadwood jobs supported by employment protection. Employment protection fosters a well-defined notion of deadwood jobs: jobs are viable with employment protection but not without it, with the only reason firms not dismissing those workers being the

employment protection firing cost. These jobs carry gross-of-employment protection firm surplus in the range $-f \leq \widetilde{S}^F < 0$. By contrast, workers obtain at least a weakly positive surplus from the job ($S^W \geq 0$). Hence, these workers hold on to it as long as they can, and a dismissal will leave them strictly worse off. Figure 1 depicts these cases as the shaded red region.

Research design: excess separations following an elimination of employment protection. Our research design, studying a quasi-experimental elimination of employment protection, can be formalized in the model as follows. We have two groups differing by employment protection costs $f^T = 0$ and $f^C = f > 0$. Both groups will draw from the same (gross-of-employment protection) firm surplus distribution $F^{\widetilde{S}^F}(.)$. The differential separation rate between the treatment and control group—which our research design measures in the form of excess separations—is:[6]

$$\text{ExcessSeparations} = \text{ShareSeparating}^T - \text{ShareSeparating}^C \tag{3}$$

$$= F^{\widetilde{S}^F}(0) - F^{\widetilde{S}^F}(-f) = F^{\widetilde{S}^F}\left(-f \leq \widetilde{S}^F < 0\right). \tag{4}$$

Hence, our excess separations measure will not identify the magnitude of the firing costs directly, but identify the share of jobs with gross-of-employment protection firm surplus $\widetilde{S}^F$ between $-f$ and 0.

Additional features. In Appendix A, we discuss additional features we have sidestepped: dynamic considerations (including retiming of separations until after the cutoff), compositional effects, retirement vs. reallocation to other jobs, wage adjustment, and the possibility for intensive-margin hours adjustment.

II Institutional Setting and Data

We describe employment protection in Sweden, its sharp elimination at an age cutoff, the flexible pension system, wage setting, the high labor force participation of older Swedes, and our datasets. Throughout, we focus on our main analysis period of 2019.

II.A Employment Protection Legislation in Sweden

Employment protection in Sweden is generous and multi-dimensional. In a comparison to OECD countries, Sweden's implementation of employment protection scores highly, very similar to France and much higher than the English-speaking countries (see Appendix Figure A.2 Panel (a)). These institutions are described in more detail in Heyman and Skedinger (2016), Bjuggren (2018) and in Cederlöf, Fredriksson, Nekoei and Seim (2025).

[6]For full treatment of a richer stochastic process, see, e.g., Jäger, Schoefer and Zweimüller (2023).

They originate from the Employment Protection Act of 1974, but Swedish employment protection has undergone reforms over the years. Below, we describe the rules for open-ended (permanent) contracts.

Tenure after 6 months. Swedish employment protection allows permanent (open-ended) jobs to be preceded by a trial period, during which the job protection institutions do not apply. The duration of this trial period is by law limited to six months. Therefore, most jobs in Sweden receive tenure after six months, at which point employment protection protections start and then ramp up further with additional tenure.

Layoff for legitimate cause for permanent jobs. After the trial period is over and the job has become permanent, any layoff needs to have a legitimate cause. First, a layoff may occur due to redundancy, e.g., lower demand for the firm's products or a restructuring of the organization. The key feature is that the layoff event is not directly related to the performance of the targeted workers. Most layoffs fall in this category. In case of a legitimate layoff event due to redundancy, the firm needs to follow the advance notice and last-in-first-out (LIFO) rules, described below. The second legitimate cause for a layoff (or to be more precise dismissal) is proven misbehavior or underperformance of the employee, but these claims need to be carefully documented and hence this route is costly for the employer.

Mandatory advance notice for layoffs. In Sweden, laid off employees are entitled to advance notice of at least 1 month. The required advance notice increases with tenure time at the firm up to 6 months for employees with more than 10 years of tenure. Collective bargaining agreements may extend these periods, particularly for older workers.

Last-in-first-out (LIFO) rules for layoffs. LIFO rules prescribe that layoffs have to start with workers with the lowest tenure. In case of a tie, the youngest worker needs to go first. LIFO rules apply within the establishment and occupational circuits. In practice, the occupational circuits are agreed upon in negotiations between the employer and union representatives. See Cederlöf (2024) for more details.

Moreover, LIFO applies in case the firm wants to recall displaced workers. If the firm starts hiring again within 9 months of the layoff event, priority must be given to recently laid off workers with the highest tenure.

Since 2001, firms with 10 or fewer employees can exempt two workers from LIFO, thus giving them substantially more flexibility in layoffs.

Severance payments. While the Swedish employment protection system does not include any right to severance pay, such payments exist in practice. Some collective bargaining agreements prescribe severance pay. A potential way to circumvent the employment

protection rules would be a bilateral agreement where the worker gets bought out by the firm via a severance package. In unreported analysis, we have not found evidence of such behavior surrounding the employment protection age cutoff. The Swedish data do not allow us to tell apart voluntary quits from layoffs. However, the frontier between quits and layoffs is fuzzy as employers may induce workers to quit either informally or through a formal severance payment, and workers do not receive unemployment insurance in Sweden starting age 65. Therefore, our analysis focuses on separations which includes both quits and layoffs.

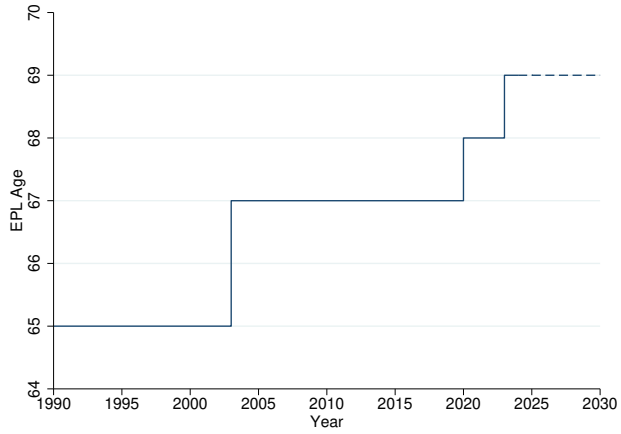
Wage setting. The vast majority of employees in Sweden are covered by collective bargaining agreements. Yet, many of those agreements leave considerable flexibility for setting wages bilaterally by guiding chiefly the procedural rules for negotiations or by specifying only broad wage increases, while delegating considerable discretion to bilateral negotiations between individual employees and their employer. For instance, Fredriksson and Topel (2010) show that 36 percent of all employees are covered by agreements in which wages are bilaterally bargained between employer and employee (so that, e.g., the collective agreement largely determines procedures) and 57 percent are covered by agreements in which increases in total labor costs are only set at the firm level and local negotiations then set the distribution of increases within the firm. Therefore, there is scope for bargaining at the individual level for many workers. On the other hand, either due to institutional or sociological constraints such as equity constraints, pay differentiation across workers within the same firm even with different fundamentals appears limited. In particular, sharp differentiation of wages between workers of different ages appears to be curbed, likely by equity constraints (see Saez, Schoefer and Seim 2019). This evidence leaves room for wage rigidity in mediating the effects of the specific policy discontinuity we study.

II.B Elimination of Employment Protection for Older Workers

We present the sharp variation in employment protection created by mandatory retirement.

The employment protection age cutoff. As depicted in Figure 2, the employment protections we have discussed are entirely eliminated at age 67 (in 2003-2019), at age 68 (in 2020-2022), and age 69 (since 2023). Before 2003, employment protection was eliminated at age 65. This implies that when a worker crosses the age threshold on her birthday, the worker can be laid off without cause at any time just with a month advance notice. She also does not get priority in case the firm starts rehiring again. Because these workers are no longer covered by the employment protection, LIFO rules also do not apply. This

Figure 2: Evolution of Employment Protection Cutoff Age in Sweden



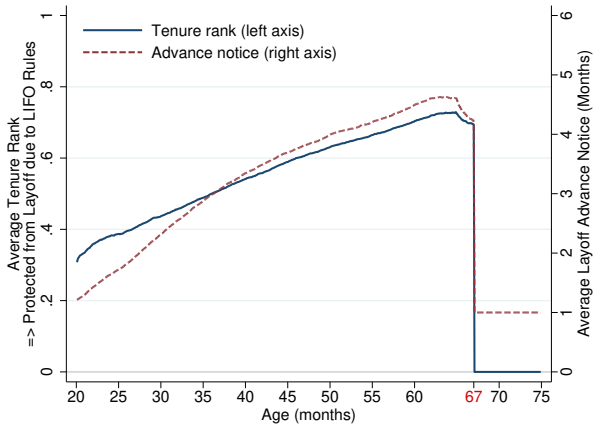
Notes: The figure depicts the evolution of the employment protection cutoff age in Sweden since 1990. Employment protection is entirely eliminated once a worker reaches the cutoff age (based on birthday of the worker). The cutoff age was 65 up to 2002, 67 in 2003-2019, 68 in 2020-2022, and 69 since 2023.

means that an employer is free to choose whether and when to lay her off in case of a collective dismissal.

Window for layoff without legitimate cause. Up to the end of 2019, formally, the law stated that employers could lay off workers above the cutoff age of 67 without the need to provide a legitimate cause only during the month when the worker reached the cutoff age. After that month, the employer would have to document a legitimate cause for layoff (the worker lost all her other employment protections). Therefore, the law seemingly provided an incentive for employers to lay off workers exactly at the threshold age rather than later. However, in practice, it was easy for employers to by-pass this legitimate cause constraint by shifting the worker to temporary contracts at the cutoff age of 67. These temporary contracts can be as short as the employer wants (e.g., one month) and allow the employer to let go of the worker when they end with no justification required. They can be renewed without limit as long as both employer and employee agree.[7] As we shall see, there is a large shift to temporary contracts at the age threshold, especially in the public sector (Appendix Figure A.4 Panel (b)). For example, Swedish universities generally automatically shift professors to one-year temporary contracts at the age threshold (renewable if both parties agree). This legitimate cause requirement after the cutoff age was formally repealed in the law starting in 2020 to make the law

[7]For a worker below the age cutoff, employers who hire a given worker through temporary contracts have to offer a permanent contract when the time worked under temporary contracts exceeds two years within the last five years to prevent abuse. But this two-year limit does not apply for workers above the age cutoff.

Figure 3: First Stage Effects of Employment Protection Elimination



Notes: This figure depicts the first stage effect of employment protection elimination for older workers along two dimensions: Tenure rank within firms for LIFO layoff rule (blue solid line using the left y-axis), legal mandatory advance notice period in months (dashed red line using the right y-axis). In Sweden, employment protections are eliminated when the worker turns 67 (in 2003-2019, see Figure 2 for the complete history).

conform with practice. As we shall see, the spike in layoffs at the age threshold persists after 2019 implying that the spike in 2019 is not driven by this requirement. Therefore, in this paper, for simplicity of exposition, we consider that employment protection is always fully repealed at the age threshold.

Empirical variation: average advance notice and LIFO rank by age. Firing costs are eliminated once the worker reaches the relevant age where employment protection no longer applies. How large is the drop in firing costs at that threshold? While those costs are multidimensional and generally not possible to quantify, we now present empirical evidence along two dimensions that we can estimate in the data. These pieces of evidence draw on 2019 data, described below in Section II.E.

First, Figure 3 depicts average tenure rank among wage earners (left y-axis, blue solid line) within the occupational circuit inside the firm against age. Workers who approach the employment protection cutoff age of 67 have on average a high tenure rank around .70, which implies that they cannot be laid off until 70 percent of the workforce, specifically their lower-tenure coworkers, are laid off (in firms with 10 or more employees). At the age threshold, LIFO rank falls to zero as employment protections are eliminated.[8] Second, the figure shows the average statutory mandatory advance notice period in months (excluding the additional collective bargaining agreement extensions) (right y-axis, red dashed line).

[8]While in principle the drop can reflect an empirical decrease in tenure among older workers, the essentially full drop reflects the mechanical effect of the discontinuity in the EPL rules.

When crossing the age-67 threshold, advance notice drops to 1 month. Before crossing the threshold, workers would be entitled to almost 5 months on average of advance notice when laid off. Additionally, not depicted are other important dimensions of employment protection that are also eliminated at age 67, crucially, the requirement to have a just cause for dismissal (or the lifting of the limits on temporary contract renewals)

Importantly, there is no other relevant policy change at age 67 and in particular in the pension system, which we describe in more detail next.

II.C The Pension System in Sweden

The Swedish setting is a particularly suitable context for our analysis because its pension system does not interfere with the employment protection discontinuity. Palme and Svensson (1999) and OECD (2021) provide an overview of the system and Kolsrud et al. (2023) presents a recent analysis of its incentives and empirical impact on retirement and savings decisions.

The pension system in Sweden is both flexible, i.e., lets people choose their retirement age, and broadly actuarially fair, i.e., does not impose strong financial incentives to retire early or late. The Swedish pension system has several mandatory components: a notional defined contribution component (income pension), a funded defined contribution component (premium pension), and occupational pension schemes.[9] The first two schemes are national and uniform across workers. The funded defined contribution component is actuarially fair by definition as benefits correspond individual-by-individual to mandatory contributions plus the returns earned on these contributions, which can be invested flexibly in a range of financial assets. The notional defined contribution pension provides benefits equal to individual contributions plus a fictitious return based on national demographic evolution and growth (typically lower than financial returns). When the pension starts, the accumulated notional capital is converted into an annuity. Therefore, this component also comes fairly close to being actuarially fair. Both pensions could be drawn as early as age 61 up to 2019. The earliest age increased from 61 to 62 in 2020 and to 63 in 2023. It is possible to defer the income pension and the premium pension with no upper age limit, again with automatic actuarial adjustments. It is also possible to combine work and pension receipt.

The occupational pensions are transitioning from defined benefit to defined contribution pensions. For our population of interest, people around age 67 in 2019, the occupational pensions are still mostly defined benefits but they have adjustments in benefits

[9]There are four main occupational pension schemes: one for blue collar workers in the private sector, one for private sector white collar workers, one for central government workers, one for local government workers.

based on claiming age that makes them close to actuarially fair as well. Such pensions can also be claimed early (typically even earlier than the income and premium pensions described above and in all cases by age 65) or deferred with an actuarial adjustment and no discontinuity at age 67 when employment protection stops (Palme and Svensson, 1999 provide a detailed presentation).

In sum, workers have full flexibility to choose their retirement age and when to draw their pension with no discontinuity in pension rules and incentives at the cutoff age threshold when employment protection ends.

Note also that unemployment benefits are no longer available after age 65 (older workers are expected to draw their pension if they cannot find work) but this policy discontinuity happens at age 65 and not the age threshold of 67.

Historically, age 65 was considered the normal retirement age and was also the age at which employment protection protection ended. However, since 2003, the government has tried to push more people to work beyond age 65 by extending employment protection up to age 67 (and recently, to 68 and 69, see Figure 2) and also by providing additional tax incentives to keep working past age 65 through an employer payroll tax cut and an earned income tax credit for employees both of which start to apply at age 65–and with no discontinuity at age 67.[10] Overall, as we shall see, the norm of retiring at age 65 still persists somewhat in spite of the financial incentive to keep working past 65.

II.D Labor Force Participation

OECD statistics show that Sweden ranks among the highest for labor force participation among the population aged 65 or more, almost as high as the United States and higher than any other EU country as depicted in Appendix Figure A.2 Panel (b). As we shall see, about a quarter of the population is still wage-employed just before age 67 in 2019. Therefore, there is still substantial attachment to the workforce in Sweden at that age, which increases the relevance of our analysis.

II.E Data and Analysis Sample

Our analysis is based on the full population of all Swedish residents with 2019 as our focal year. We use pseudo-anonymized individual-, firm- and establishment-identifiers to merge several administrative datasets for this population.

Merged administrative micro datasets. The Integrated Database for Labour Market Research (LISA by Swedish acronym) contains individual-level demographics, such as gender, immigrant status, education, as well as 4-digit occupation codes. We use matched

[10]Occupational pensions are also funded by employer contributions based on wage earnings. These contributions however generally stop at 65 and hence there is no discontinuity at age 67.

employer-employee data (separately from RAMS and AGI) to measure monthly earnings. Our main focus is on 2019, because this is the year when Sweden shifted from reporting individual-level earnings by employers from the annual level to the monthly level. Before 2019, we observe annual wage payments for each employer-employee pair together with the start and end months of the job spell. Starting in 2019, we observe wage payments each month. These data include 3-digit information about the industry of the firm as well as private vs. public sector. The matched employer-employee records stretch back to 1985 and we use these data to calculate tenure within the firm, censored from above at 34 years for 2019. We use data from the Swedish Social Insurance Agency to calculate the number of sick leave days of each individual in our sample. In Sweden, the first two weeks of a sick-leave spell is covered by the employer. Therefore these data are truncated below two weeks.

Structure of Earnings Survey. The Structure of Earnings Survey is a detailed dataset on full-time equivalent (FTE) monthly wages, working hours and compensation, reported at the employer-employee level for all public-sector workers and sampling about half of private sector workers. We measure hours of work relative to full-time (where 100 percent means full-time and 50 percent half-time. etc.).[11] Employers respond to the survey annually (typically September-November). The wage measure includes fixed-wage components, piece-rate compensation, performance pay, and fringe benefits. The survey covers workers above the age threshold for employment protection only for the public sector, which is why we limit the use of the survey to this group only. We use this survey only in the longitudinal analysis in Section V.A.

Labor Force Survey. The Labor Force Survey (LFS) is a rotating panel that covers roughly 0.4 percent of the population aged 15-74. These data also include information on workers' contract type (permanent or temporary).

Summary statistics. Appendix Table A.2 shows summary statistics for the population as a whole in Panel A and for workers in Panel B for 2019.

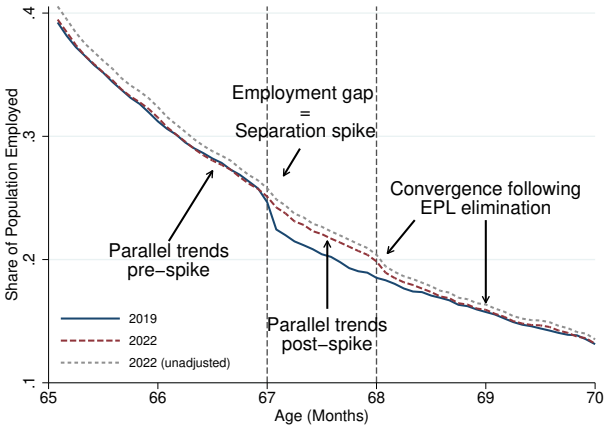
III Overall Effects of Employment Protection

The simplest way to illustrate the overall impact of the loss of employment protection is to look at employment rates and average earnings per capita—i.e., including non-workers as contributing zero earnings—by age. We start with employment rates and then turn to

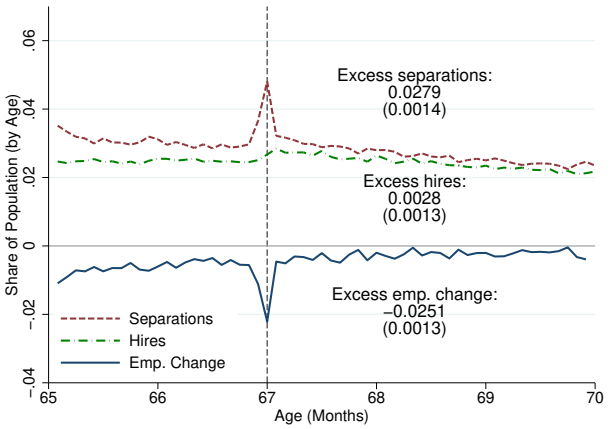
[11] Precisely, the survey asks about actual hours worked and hours worked for a full-time position for that type of employee. For blue-collar workers, it ask for the hourly wage which it then adjusts using the full-time hours definition to get the monthly full-time equivalent. For white-collar workers, it asks for the monthly wage payment. This is then adjusted by hours worked as a fraction of full-time for part-time employees so that the final measure is a full-time wage for all groups.

Figure 4: Employment to Population Ratio and Worker Flows by Age

(a) Employment/Population in 2019 and 2022



(b) 2019 month-to-month employment changes



Notes: Panel (a) depicts monthly wage employment to population ratios by age (in months) in 2019 (solid blue line) and 2022 (dashed red line) using the administrative monthly wage earnings records. The employment numerator includes only wage earners and excludes the self-employed. The 2022 series is adjusted by a constant multiplicative factor to match the 2019 series at age 66+8 months (unadjusted raw series for 2022 are depicted in the dotted grey line). Employment protection is eliminated at age 67 in 2019 but at age 68 in 2022. Panel (b) expresses the series in *straight differences* (i.e., percentage point changes) from month to month (solid blue line). There is a 2.52 point (about 10 percent) excess drop in the employment to population ratio at 67, when employment protection is eliminated. This excess drop is the sum of the series in Panel (b) for the 3 months: 67-1/12, 67, 67+1/12 over and above average series for the 6 months below 67-1/12, and the 6 months above 67+1/12 (see Figure 7 below). Panel (b) also decomposes the change in employment as hires (green dash-dotted line) minus separations (red dashed line), always in percentage points relative to population. Hires are defined as positive earnings in the month while not having any earnings in the preceding month. Separations are defined symmetrically: having no earnings in the corresponding month while having earnings in the preceding month. Excess separations and hires are also estimated in the same way as excess employment changes. The drop in employment to population ratio at 67 is almost fully explained by the spike in separations at that age.

earnings per capita. We first focus on 2019, and then bring in 2022 exploiting a reform in the EPL cutoff age in a simple difference-in-differences design (in Section III.C).

III.A Total Effects on Employment

Figure 4 Panel (a) depicts monthly wage employment to population ratios by age (in months) in 2019 (solid blue line) and 2022 (dashed red line) using the administrative monthly wage earnings records.[12] Employment is defined as having some wage earnings in a given month, with any employer; the employment numerator includes only wage earners and excludes the self-employed. The denominator includes the full resident population at each age. The series are depicted from age 65 to age 70. Age 66 is the month

[12]A person alive the full calendar year therefore shows up as 12 observations corresponding to the 12 months of the year.

when the worker turns 66, 66+1/12 is the month after, etc.

Employment protection is eliminated at age 67 in 2019 but at age 68 in 2022 (the change kicked in 2020 as shown in Figure 2). In Panel (a), the 2022 series is adjusted by a constant multiplicative factor to match the 2019 series at age 66+8 months. The figure also depicts in light dotted line the raw unadjusted series for 2022. The unadjusted series are almost identical to the adjusted series as the Swedish economy had fully recovered from the COVID shock by 2022.

Discontinuity at employment protection cutoffs. Figure 4 Panel (a) shows that there is a downward trend in employment as workers progressively retire as they age, with a sizable 25 percent employment population ratio even right before age 67 in 2019. However, the 2019 series shows a clear and discrete drop in employment exactly at age 67 when employment protection ends. The solid blue series Panel (b) depicts the between-monthly-age change in the employment to population ratio (in percentage points) obtained as a simple difference of the employment to population series for 2019 presented in Panel (a). We can define the *excess drop* around age 67 as the sum of the solid blue series in Panel (b) for the three months: 67-1/12, 67, 67+1/12 over and above average series for the 6 months below 67-1/12, and the 6 months above 67+1/12 (see Figure 7 below for a full explanation of this bunching method). Effectively, this simple estimation identifies the excess drop *caused by* the end of employment protection under the assumption that, absent the employment protection ending, the trend would stay smooth—a plausible identification assumption because there is no other policy discontinuity at age 67—and in particular no specific pension incentive at that age. The estimated excess drop is 2.52 percentage point. As only about 25 percent of individuals have positive wage earnings at age 67 as seen in Panel (a), this excess drop in employment is around 10 percent in relative terms. Similarly, the 2022 series show a drop at age 68 instead, which in 2020 is the relevant mandatory retirement age (see Figure 2), further validating our causal interpretation and motivating a difference-in-differences analysis in Section III.C below.

Decomposition of employment effects into worker flows: hiring and separations. Employment protection ending can generate more separations as firms may lay off the unprotected workers they deem less productive and overpaid. But employment protection ending can also encourage hiring, as newly hired workers can subsequently be laid off at no cost or moved onto temporary contracts. Both the hiring and separation margin may impact employment. Therefore, to decompose the employment effects we have analyzed above, we now consider the following law of motion across monthly ages (up to an

approximation from population shifts):

$$\frac{\Delta \text{Emp}}{\text{Pop}} = \frac{\text{Hires}}{\text{Pop}} - \frac{\text{Sep}}{\text{Pop}}, \tag{5}$$

where Pop is the full population at a given monthly age.

Panel (b) provides this decomposition by additionally plotting hires per capita (in green dash-dotted line) and separations per capita (in red dashed line). Hires are defined as having positive earnings in the corresponding month while not having any earnings in the preceding month. Separations are defined symmetrically: having no earnings in the corresponding month while having earnings in the preceding month. Figure 4 Panel (b) clearly shows that the equation above holds as the blue employment change series are indeed the difference between the hires series (dash-dotted green) and the separation series (red dashed). There is a clear spike in separations with an excess separation effect of 2.79 points (relative to population) estimated as the excess drop in employment above. However, there is no strikingly visible change in hires at age 67 (dotted-dash green series). Hence, separations account essentially for the full drop in the employment to population ratio at age 67. Therefore, we will focus specifically on the separation margin in Section IV, characterizing the nature of jobs, workers and firms that are more prone to separating at the cutoff age.

III.B Total Effects on Earnings

Figure 5 presents results on total earnings per capita. This outcome variable incorporates all extensive margin (separations and hiring) and intensive margin adjustments (hours, job quality, composition). Earnings include only wage earnings and exclude self-employment earnings. The figure follows the structure of Figure 4, with Panel (a) depicting the level of earnings per capita by age in 2019 (solid blue line) and 2022 (dashed red line), and Panel (b) focusing on earnings change from month-to-month from the 2019 series, but in this case in *percent* (solid blue line).[13]

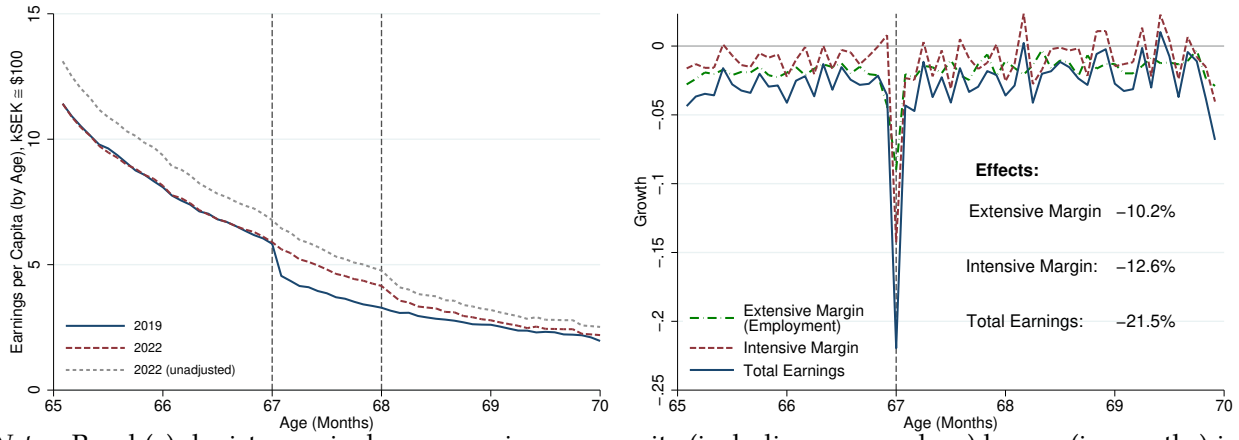
Discontinuity at ELP cutoffs. While earnings per capita decline smoothly with age, there is a large discrete drop in earnings per capita at age 67 in 2019 and at age 68 in 2022, which are the corresponding ages when employment protection ends for these two years. To quantify this drop more precisely, Panel (b) depicts the 2019 earnings per capita series in percent differences across monthly ages. It shows that there is a 21.5 percent excess

[13] Again, series for 2022 are adjusted multiplicatively to match 2019 series at age 66+8/12. The unadjusted series for 2022 are depicted in the dotted line. They are naturally higher due to nominal growth in wages over the three year period reflecting both inflation and real growth. The multiplicative adjustment allows us to control for such nominal growth.

Figure 5: Earnings per Capita by Age

(a) Earnings per Capita in 2019 and 2022

(b) 2019 Month-to-Month Earnings Changes



Notes: Panel (a) depicts nominal wage earnings per capita (including non-workers) by age (in months) in 2019 (solid blue line) and 2022 (dashed red line) using the administrative monthly wage earnings records (self-employment earnings are excluded from the analysis). The 2022 series is adjusted by a constant multiplicative factor to match the 2019 series at age 66+8 months (unadjusted raw series for 2022 are depicted in the dotted grey line). Employment protection is eliminated at age 67 in 2019 but at age 68 in 2022. Panel (b) expresses the series in *percent differences* from month-to-month (solid blue line). The effects in Panel (b) excess drop are the sum of the series in Panel (b) for the 3 months: 67-1/12, 67, 67+1/12 over and above average series for the 6 months below 67-1/12, and the 6 months above 67+1/12 (see Figure 7 below). Panel (b) also decomposes the total earnings per capita changes into an extensive margin (percent changes from the 2019 employment to population series in Panel (a) of Figure 4, in green dashed line) and an intensive margin (percent change in earnings conditional on working in red dashed line).

drop in earnings per capita at 67 when employment protection is eliminated (estimated again as the sum of the solid blue series in Panel (b) for the three months 67-1/12, 67, 67+1/12 over and above the average for the 6 months below 67-1/12 and the 6 months above 67+1/12.)

This is a large effect—twice larger than the about 10 percent extensive margin effect on the employment margin we documented above in Figure 4. Next, we therefore provide an explicit decomposition into intensive and extensive margins.

Decomposition of earnings per capita: extensive and intensive margins. Figure 5 Panel (b) also decomposes the total earnings per capita changes into an extensive margin (employment changes in green dotted-dashed line) and an intensive margin (earnings conditional on working in red dashed line) for 2019. This analysis exploits the simple fact that:

$$\text{Earnings per capita} = \frac{\text{Employment}}{\text{Population}} \cdot \text{Earnings per worker},$$

so that earnings per capita are simply the product of employment to population and earnings per worker. Therefore, the percent changes in these three series decompose

additively as follows:

$$\Delta\%\text{Earnings per capita} \approx \Delta\%\frac{\text{Employment}}{\text{Population}} + \Delta\%\text{Earnings per worker}.$$

The three series in percent changes are depicted in Panel (b) of Figure 5. Excess drops in intensive and extensive margins are also estimated in the same way as excess earnings drops. The figure reveals that slightly more than half of the total earnings per capita effect is due to novel intensive-margin effects. The rest is due to the conventional extensive margin.

Estimates: extensive, intensive, and total effects. Table 1 gathers all these full population estimates in column 1. The large intensive margin effect can either arise from reductions in hours or wages among stayers, or from a compositional shift towards low earners. In Section V below, we will track stayers and show that there is no wage effect but a large negative effect on hours (conditional on staying at work past the employment protection threshold), accounting for about two thirds of the intensive margin effect.

Private sector, public sector, and professors. Additionally, Table 1 repeats the extensive and intensive analysis while breaking it down by private and public sector in columns 2 and 3. The corresponding graphical analyses are in Appendix Figure A.5. The earnings excess drop is twice as large in the public sector than in the private sector. While the extensive and intensive margin effects are equally split in the public sector, two thirds of the private sector effect is due to intensive margin adjustments. Moreover, in column 4, the table foreshadows our case study of professors, which we pick up again in Section V. Within the public sector, the effects are much larger for professors, with a 68 percent reduction in total earnings, largely due to the large intensive margin at 48 percent, and a 25 percent extensive margin drop.[14]

III.C DiD Analysis Comparing 2019 and 2022

In Panel (a) of Figures 4 and 5, both the 2019 and 2022 series follow the same "parallel trends" before age 67. This finding has two facets.

First, economically, this suggests that employment protection does not distort the separation dynamics nor the dynamics of earnings before its elimination, whether this occurs at 67 or 68. Employers do not seem less eager to recruit older workers aged less than 67 in 2022 (relative to 2019) in anticipation of the EPL extension for the next year.

Second, econometrically, this result can also be viewed as the analog of the parallel

[14]Therefore, in Sweden, the loss of employment protection of professors has impacts primarily along the intensive margin rather than through the extensive margin, in contrast to the US findings by Ashenfelter and Card (2002).

Table 1: Effects of Employment Protection Ending on Employment and Earnings

Outcome	Excess % drop at age 67 in 2019				DiD 2022 vs. 2019 around age 67 (%)
Sample	All	Public sector	Private sector	Professors	All
	(1)	(2)	(3)	(4)	(5)
Earnings / capita	-21.5	-28.9	-13.5	-69.3	22.1
	(6.02)	(8.48)	(3.28)	(12.99)	(4.91)
Earnings / worker	-12.6	-15.7	-9.44	-49.4	14.2
	(4.59)	(6.14)	(2.93)	(11.93)	(1.88)
Employment / pop.	-10.2	-15.7	-4.47	-26.1	7.97
	(2.05)	(3.19)	(0.78)	(4.03)	(3.08)
Observations	387,858	176,999	210,859	3,873	36

Notes: This table shows aggregate excess changes in earnings per capita, wage earnings per worker, and employment rate at the age 67 threshold (when employment protection ends) in 2019 (first four columns) and the difference-in-differences comparing 2019 and 2022 around the 67 age threshold (last column). All changes are expressed in percent (not percentage terms). These results correspond to the graphical analysis of Figures 4 and 5 . For each outcome (listed by row), we compute the excess change around age 67 estimated by applying the bunching method as in Figure 7. The first row (earnings per capita) measures the full effect. The second row (earnings per worker) measures the intensive margin, the third row (employment to population) measures the extensive margin. Note that rows 2 and 3 do not add up exactly to row 1 due to slight compositional changes (leavers and stayers at age 67 may not have the same average earnings). Columns 1 and 5 are for all workers corresponding to the graphical analysis of Figures 4 and 5. Column 2 is for public sector workers, column 3 for private sector workers, and column 4 for Professors. The corresponding graphical analysis for these three subgroups is presented in Appendix Figure 4. Observations count the number of months times individuals, including only months with positive earnings as separations are always defined relative to the working population, for the ages 67-7/12 to 67+7/12. The number of monthly population observations (irrespective of earnings) pertaining to rows 1 and 3 is constant across columns and is 1,597,263. The last column provides a DiD analysis comparing 2022 vs. 2019 around age 67. We use the aggregate series depicted on Figures 4 Panels (a) and (b) for ages 66+2/12 to 66+10/12 (when employment protection is present in both 2019 and 2022) and 67+2/12 to 67+10/12 (when employment protection is present only in 2022). The DiD regression is therefore based on $2 \times 2 \times 9 = 36$ observations. Robust standard errors are reported in parentheses. We exclude the three observations at ages 66+11/12, 67, 67+1/12 as these are the 3 transition months when the drop occurs.

trends assumption underlying DiD designs: in our context, since the running variable is age rather than time, the DiD analysis appeals to an identifying assumption that in the absence of the policy change, the employment gradient in 2019 would follow the 2022 pattern between age 67 and 68 had the EPL cutoff age been at age 68 rather than 67. The pre-67 patterns support this assumption.

Comparing the 2019 and 2022 series in the age window 67 to 68 provides the equilibrium effect of eliminating employment protection on older workers under the classic DiD identification assumption that absent the differential employment protection policy in 2019 and 2022, the two series would have remained on parallel trends past age 67. Importantly, the gap that opens up between the two series exactly at age 67 stays more or less constant over the next 12 months between 67 and 68. Along the extensive margin in Figure 4 Panel (a), the elimination of employment protection moves the workers into persistent nonemployment. But the other workers' employment dynamics appear unaffected whether employment protection is active or not.

Quantitatively, we run a DiD regression of the log employment rate series depicted on Figure 4 Panel (a) for ages 66+2/12 to 66+10/12 and 67+2/12 to 67+10/12 (=2×2×9=36 observations).[15] As shown in Table 1 column 5, the regression delivers an employment rate drop of 8.0 percent (highly significant) and consistent (within the margin of statistical precision) with the excess drop of 10.2 percent at age 67 in 2019 reported on Table 1 column 1.[16]

Along the full extensive plus intensive margin in Figure 5 Panel (a), employment protection ending reduces earnings permanently but has no subsequent differential dynamics in earnings based on employment protection status either. Quantitatively, DiD regression of the log earnings per capita series depicted on Figure 4 Panel (b) for ages 66+2/12 to 66+10/12 and 67+2/12 to 67+10/12 delivers a coefficient of 0.222 (0.049). This 22.2 percent effect comparing 2019 and 2022 is almost identical to the excess drop of 21.5 percent at age 67 in 2019 reported in Table 1. Hence, the excess drop exactly when employment protection ends is the full response.

Then, at age 68, the 2022 series drops and converges quickly to the 2019 series—consistent with employment protection simply delaying the termination of jobs by a year. This effect is somewhat faster along the employment margin in Figure 4 Panel (a), where convergence happens within 6 months after 68, than along the full intensive plus extensive

[15]We exclude the three observations at 66+11/12, 67, 67+1/12 as these are the three transition months when the drop occurs. We stop at 67+10/12 because the 2022 drop starts in 67+11/12. We start at 66+2/12 to have the same number of observations before and after (estimates are not sensitive to the starting month).

[16]The DiD effect is slightly lower because there remains a small excess drop in employment at 67 in 2022. We document this legacy effect in detail in Section IV.B.

margin of earnings per capita in Figure 5 Panel (a), where convergence happens within 12 months. Intuitively, this convergence again reflects the persistent nature of deadwood jobs, but also that those workers managed to hold on to their jobs by a full year longer thanks to the protection granted to them in 2019 that they do not have in 2022.[17]

In conclusion, the almost perfect convergence of the two series shortly after age 68 and the parallel trends after 68 suggests that there are no long-term impacts of having lost employment protection one year earlier and that the initial and local impact captures the full effects of the employment protection elimination. Therefore, most of the remaining of the paper will focus on what happens exactly at the age where employment protection ends along extensive and intensive margins.

IV Direct Effects on Separations

We now estimate the effect of the elimination of employment protection on separations. Recall that our research design pools quits and layoffs because available data does not separate quits and layoffs, and that there is no UI for workers starting age 65. Conceptually, employers may induce workers to quit through informal or formal severance pay, so that the frontier between layoffs and quits is fuzzy.

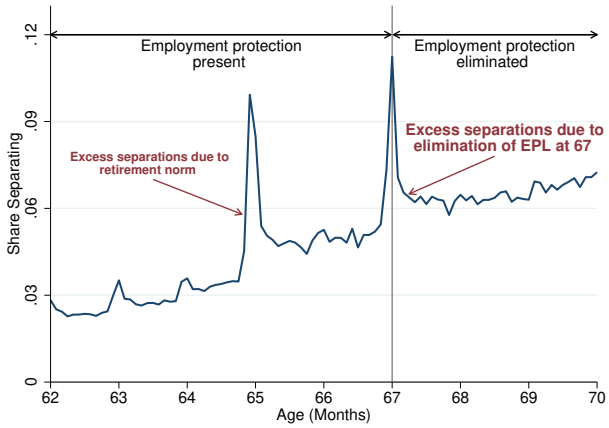
We document a clear bunching response in the form of a spike in job separations at the age cutoff—sharply bunched into the cutoff month when workers turn 67. This spike corresponds to an 8.4 percentage point increase in separations—indicating that about 8 out of 100 jobs occupied by older workers in Sweden are classified as deadwood labor in the formal definition in Section I.

The jobs bear the hallmarks of deadwood labor fostered by employment protection: the spike migrates with reform-driven shifts in the employment protection cutoff age, and is more pronounced among workers subject to stronger pre-67 employment protection levels. Most of those separations go into persistent nonemployment ("retirement"), indicating that the workers enjoyed a strong rent. The effect is stronger among recently sick workers, and in the public sector.

Definitions of separations and age. We use the administrative monthly wage earnings records in Sweden, which are organized by calendar month. An individual is working if she has positive earnings from an employer. Separation is an indicator for whether any of her spells ends in the month. In each month, the separation probability is defined as the fraction of individuals employed in the month who separate from a job during this month. A job separation is defined as a worker being employed with a specific employer

[17]Of course, these two time series represent different cohorts of workers and jobs. All this holds at least three calendar years (through 2022) into the new regime; it is possible that future cohorts may start to exhibit differential trends.

Figure 6: Separations by Age in 2019



Notes: The figure depicts the share of monthly separations of employed workers by age in 2019 using the administrative monthly wage earnings records in Sweden. In each month, the separation share is defined as the fraction of individuals employed in the month that do not have any positive earnings with their original employer in the 12 subsequent months. Employment protection is eliminated when workers turn 67. There is a clear excess spike in separations at exactly that age. There is no other policy relevant change at age 67. There is also a "legacy" spike at age 65 due to the remnants of a retirement norm.

in a given month but not working with that employer during any of the next 12 months.[18] We pair this separation outcome with the month-level age of the individual corresponding to our monthly earnings data. For example, a worker who turns 67 in March 2019 will be classified as exactly age 67 in March 2019, age 67-1/12 in February 2019, age 67+1/12 in April 2019, etc.

IV.A Estimating the Share of Deadwood Jobs: Excess Separations at Age 67

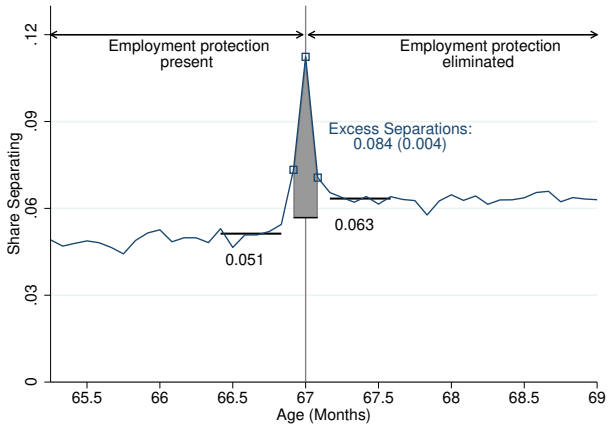
We start with the cornerstone of our analysis: estimating the excess separations that occur at at 67. As discussed when describing the data in Section II.E, our main analysis restricts our analysis to 2019 onward, when the administrative data started to have the highest precision at the monthly level, minimizing the risk of missing separations in our local bunching method.

The age gradient of separations. Figure 6 depicts the monthly separation probabilities for employed workers in 2019 for ages between 62 and 70. The data reveal a spike at age 65 due to the remnants of a retirement norm (and former financial incentives no longer applicable to our cohort in 2019, see Section II.C).[19] The implied "stickiness" of retirement

[18] We have done sensitivity analyses showing that our results are not much affected by the length of the window. Temporary separations of a couple months without earnings are not uncommon in Sweden, hence our decision to only consider separations that last at least one year. We have also done sensitivity analysis that only considers the main job (i.e., the one with the highest earnings in the year), with the results essentially unaffected (results not reported).

[19] As mentioned above, that norm was actually weakened as the government introduced payroll tax cuts

Figure 7: Bunching Estimation of Excess Separations



Notes: The figure depicts how we estimate excess separations at the age threshold where employment protections are eliminated using the bunching methodology developed by Saez (2010). Excess separations are the difference between separations for the 3 months: 67-1/12, 67, 67+1/12 (squared on the series) and counterfactual separations in these 3 months absent bunching. Counterfactual separation shares are estimated as average separations for the 6 months below 67-1/12, and the 6 months above 67+1/12 (black lines). Excess separations are simply the sum of the three differences (gray area). Excess separations are 8.4 percent, which means that 8.4 percent of jobs end because of the age 67 excess separation effect. Standard errors at each age are computed based on an OLS regression of separation indicators on age dummies in the micro data, and the standard error for excess separations is then computed using the delta method.

ages echoes results in Deshpande, Fadlon and Gray (2024) at age 65 in the United States.

Excess separations at 67: raw data. To recap, employment protection is eliminated when workers turn 67. There is no other policy relevant change at that age threshold. Exactly at age 67, the data reveal a clear excess spike in separations—implying that either workers quit or (more likely) firms lay off or otherwise nudge those workers into retirement exactly in the month when they lose their strong protection. This spike contrasts with the smooth age gradient suggested by the ages adjacent to the cutoff. Below, these adjacent ages will provide our counterfactual for the separations that would have occurred absent the discontinuity in employment protection.

Excess separations: formal estimation. Figure 7 illustrates how we estimate excess separations at the age threshold where employment protections are eliminated using the bunching methodology developed by Saez (2010).

Broadly, we subtract from the separations at age 67 the normal level constructed from adjacent ages. Precisely, we extend the interval around the cutoff month by one month in either direction to account for potential anticipation effects, delays, or measurement error. Figure 7 shows that separations are abnormally elevated in these 3 months and only these

and an earned income tax credit for workers over 65 in 2007.

3 months. Excess separations are the difference between separations for the 3 months: 67-1/12, 67, 67+1/12 (marked by squares in the figure) and counterfactual separations in these 3 months absent bunching. The counterfactual separation level is estimated as average separations for the 6 months below 67-1/12, and the 6 months above 67+1/12 (black lines in Figure 7). Excess separations are simply the sum of the three differences (gray area in Figure 7). (We sidestep an adjustment by the shrinking base month-to-month, making the resulting estimate a slight overestimate of the spike.) Standard errors are obtained using the delta method on the age-specific coefficient estimates (from a basic OLS regression of the separation indicators on age dummies in the micro data).

The key identification assumption is that, absent the end of employment protection, there should be no bunching at age 67. This counterfactual assumption seems reasonable because there is no visible bunching at age 66 nor at ages 68 or 69 in Figure 7.[20]

As noted, there is substantial bunching at age 65 due to a retirement norm. Figure 6 also shows very modest bunching at ages 62, 63, and 64.[21] Because there is no bunching at 66 nor 68, the two years surrounding 67, the most reasonable and simplest assumption is that the counterfactual would have no bunching at age 67.

Excess separations: 8.4 percent of jobs at 67 are "deadwood." The bunching estimator reveals that in the full sample (corresponding to Figure 6), the estimate of excess separations is 8.4 percent. This result means that 8.4 percent of jobs separate because of the discontinuous elimination of employment protection at age 67. The remaining 91.6 percent of previously heavily protected jobs continue without employment protection.

Hence, read through the model in Section I, 8.4 percent of Swedish jobs occupied by workers at age 67 are deadwood in the specific sense that employment protection supports them: firms would have preferred to terminate those jobs even before had it not been for the employment protection costs (due to negative firm gross-of-employment protection surplus), whereas workers earned a positive rent and strictly preferred to stay put (and thus held out in those positions until the last possible moment). For the remaining 91.6 percent of jobs that continue, the parties obtained positive (gross) surplus before and do so also after protection is eliminated.

Post-separation outcomes: reallocation to other employers vs. retirement. Panel (a) of Figure 8 decomposes the baseline separations (solid grey line) and the excess spike

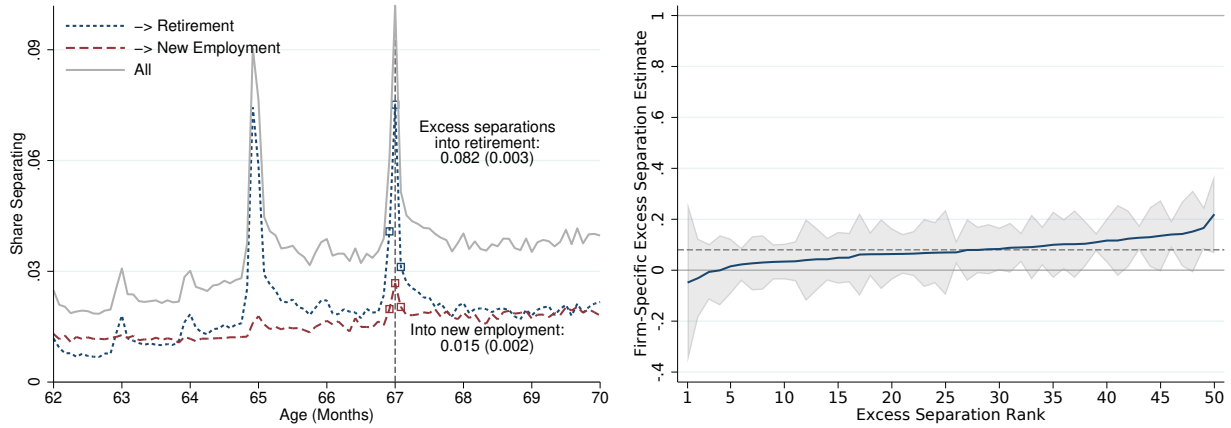
[20] Appendix Table A.3 provides a formal test. It shows that there are no significant excess separations at "placebo" age 68 in 2019 and "placebo" age 69 in 2019-2022; in fact, the estimates are slightly negative and insignificant.

[21] Our interpretation is that such modest bunching arises due to the fact occupational pensions can start being drawn at round ages and this early claiming age is always 65 or less as we discussed above. It varies across sectors, occupations, and bargaining agreements.

Figure 8: Features of Excess Separations

(a) Excess Separators Go Into Retirement

(b) Excess Separations not Concentrated in Specific Firms



Notes: Panel (a) depicts the separation shares by age in 2019 (grey solid line) and decomposes the series into moves into retirement (dotted blue line) vs. into new employment (dashed red line). The sum of the latter two series add up to the solid line. Separations into retirement are defined as separations where the worker will not take a new job that lasts at least six months within the next 24 months. . Panel (b) uses the 50 largest firms (by number of employees aged 66-70) and ranks them based on the size of the excess separations for the corresponding firms, and then plots the excess separation spike estimate for each of these 50 firms. The economy-wide excess spike is depicted in the horizontal dashed grey line.

therein into retirement (dotted blue line) and into new employment (in dashed red line). Separations into retirement are defined as separations where the worker will not take a new job that lasts at least six months within the next 24 months. The spike at 67 is nearly entirely into retirement. That is, the excess job losers are not able to find, or willing to accept, another job. This result suggests that workers' reservation wage exceeds their productivity everywhere, possibly indicating the stronger type of deadwood jobs raised in Section I.

In a suggestive direct test, we have found that the excess separations appear to stem from jobs with if anything modestly longer rather than shorter predicted subsequent duration.[22] Hence, this finding does not lend support to the view that the spike of separation at 67 has limited effects on lifetime employment by terminating jobs that were about to end.

Targeted idiosyncratic separations vs. HR policies. We also conduct a simple check that substantiates the interpretation that firms lay off specific workers as they lose employment protection, rather than specific large organizations implementing an across-the-board

[22]We report those results in Appendix Figure A.6. Specifically, we construct separation probabilities predicted by observables (fed into a linear probability model trained on data from ages 59-61 in 2019, using public/private sector, gender, immigrant status, ten tenure categories, and all their interactions, as well as a cubic polynomial in previous earnings, and fixed effects for education-industry indicators). We then plot the average predicted separation rate among separators and find a sharp but modest decline rather than increase at 67.

human resource policy that simply ends all jobs at age 67. To do so, we select the 50 largest firms according to employment in ages 66-70 (so that we can estimate firm-specific excess separations precisely). We then estimate firm-specific excess separations at age 67 and rank firms by these excess separation estimates, and plot the excess separation spike estimate for each of these 50 firms.

Panel (b) of Figure 8 reports those results. The excess spikes increase smoothly from around 0 percent for firms with the lowest excess separations to about 15-20 percent for firms with the highest excess separations. The excess spike economy-wide is depicted in the horizontal dashed grey line. Hence, separations are not concentrated in specific firms that lay off all their workers at age 67 as a matter of policy. This implies that layoffs at age 67 are likely made on a case-by-case basis, with firms cherry picking (or "lemon dropping") particular unprofitable jobs.

IV.B Bolstering the Causal Interpretation

Our interpretation attributes a causal chain from employment protection to separations. This argument rests on the institutional facts described in Section II, that no other policy discontinuities exist. However, it is possible that an emergence of softer retirement norms may lead workers and employers to coordinate retirement at age 67 (as in the analysis of Germany in Seibold, 2021). Indeed, Lazear (1979) too describes the potential for implicit contracts to end at a certain coordinated point. All those mechanisms could show up as a spike at 67, with no direct role for employment protection as our model in Section I posits. By contrast, if employment protection caused the spike, one would expect the spike to shift in response to shifts in the employment protection cutoff age.

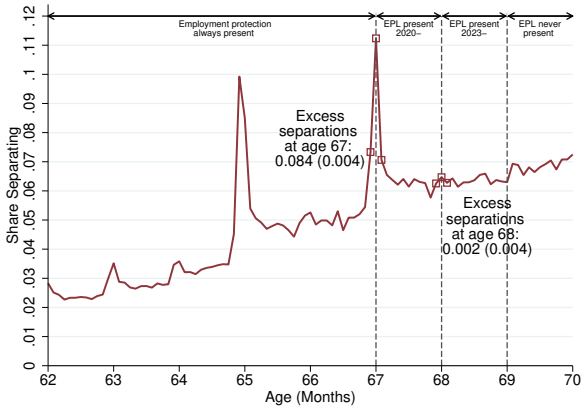
Reform: change in age threshold from 67 to 68, and to 69. To further substantiate the causal effect of employment protection in the spike, we exploit the reforms that shifted the cutoff from 67 to 68 in 2020 and to 69 in 2023 (see Figure 2).[23] Figure 9 replicates Figure 6 for 2019 and five additional years: 2020-2024, along with the year-specific bunching estimates, separately for 67, 68, and 69.

The panels show the strong and steady migration of the spike from 67 to 68. Immediately in 2020, the spike at 67 is greatly reduced. The legacy spike at 67 in 2020 may reflect preplanned separations or retirements. Importantly, there is no spike at age 68 in 2020 exactly because firms already separated their deadwood jobs at age 67 in 2019. This evidence points to a relatively persistent deadwood status in a given job at least year to year. If deadwood jobs were a transitory status generated by i.i.d. shocks, a spike at 68

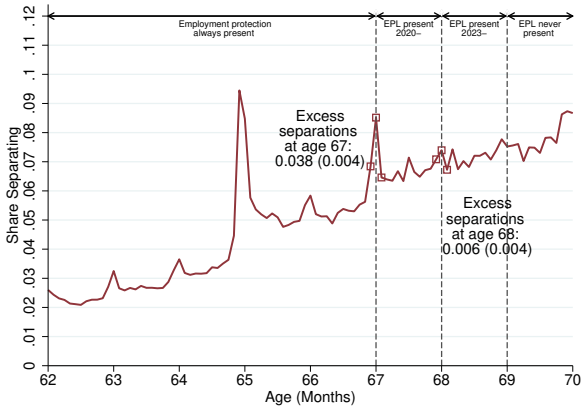
[23] A caveat is that the year of 2021 is subject to the COVID dislocation in the labor market. The year of 2020 is subject to another caveat, namely that the deadwood in that cohort was eliminated in 2019 already, as discussed below.

Figure 9: Reform: Change in Employment Protection Cutoff Ages

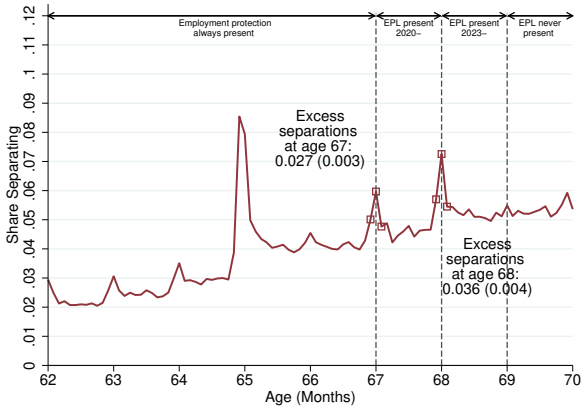
(a) 2019: Cutoff at 67, with clear 67 spike



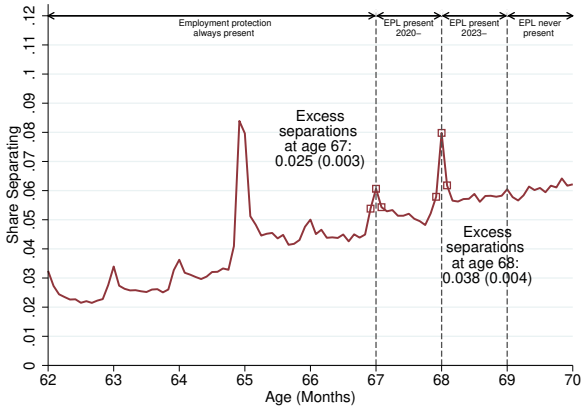
(b) 2020: Cutoff at 68, no 68 spike yet



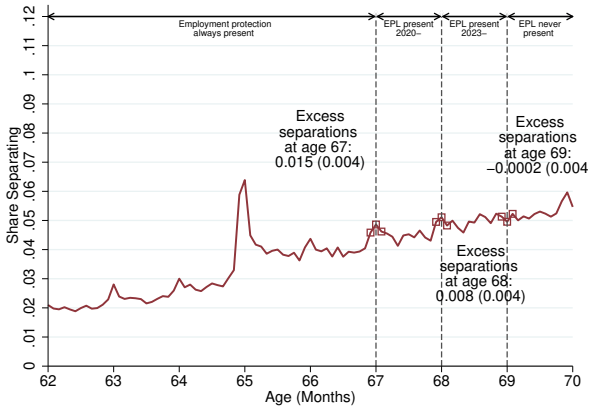
(c) 2021: Cutoff at 68, Spike at 68 emerges



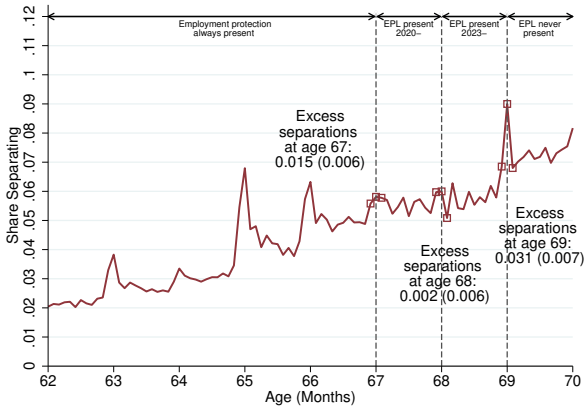
(d) 2022: Cutoff at 68, Spike at 68 grows



(e) 2023: Cutoff at 69, no 69 spike yet



(f) 2024: Cutoff at 69, Spike at 69 emerges



Notes: The figure depicts separation rates by age (as in Figure 6) for 2019 to 2024. Employment protection is eliminated at age 67 up to 2019, age 68 in 2020-22, and age 69 in 2023+. Bunching estimators of excess separations at ages 67, 68, and 69 (in 2023-4) are reported. The spike in separations at age 67 is sharply reduced in 2020. A new spike at age 68 starts appearing in 2021. There is no spike at age 68 in 2020 because that cohort's "deadwood" jobs could be laid off at 67 in 2019. The same logic applies to the 2023 increase of the cutoff to 69 with no spike yet in 2023 and an emerging spike in 2024. Because our data end in October 2024, 2024 separations are based on the first 4 calendar months and we define a separation in 2024 as not working with the employer over the next 6 months (instead of 12 months). Appendix Figure A.7 presents results with that 6-month-definition for all years and shows almost identical results. 2023 separations are based on the first 9 calendar months (as we need 12 months afterwards to measure separations).

would emerge immediately in 2020. A new spike at age 68 starts appearing in 2021 and 2022. By 2022, more than half of the spike has migrated to age 68, with the legacy spike at 67 steadily shrinking. Hence, the migration from 67 to 68 supports the interpretation that the spike we observe at age 67 in 2019 is indeed causally driven by the elimination of employment protection. The figure also shows that reaching an excess separation equilibrium is not instantaneous and takes some time. Therefore, our baseline analysis will use 2019, which reflects a long-run equilibrium level after the cutoff age had been in place since 2003. 2019 is also the last year not affected by COVID disruptions.[24]

The same logic applies to the shift to age 69 in 2023: in 2023, we do not see a spike at age 69 because employers were able to dismiss the relevant workers already in 2022. Instead, a spike emerges at age 69 in 2024. Interestingly, we do not find a legacy spike at all at wage 68 in either 2023 or 2024—in contrast the legacy spike at age 67 that persisted for longer (even more so for the 65 one). This suggests that either the relatively brief presence of the age-68 did not shift norms or expectations, or anticipation of the EPL cutoff age path played a role.

Evidence from earlier years. The data before 2019 are not as precise as they report spells start and end within the year with some measurement error instead of reporting exact earnings month by month. This leads to an underestimation of excess separations before 2019 explaining why we focus most of our analysis on the 2019 and after period. In spite of this limitation, valuable and confirmatory evidence can be obtained by analyzing these earlier years. Figure 2 depicts the evolution of the employment protection cutoff age in Sweden since 1990. The cutoff age was 65 up to 2002, 67 in 2003-2019, 68 in 2020-2022, and 69 since 2023.

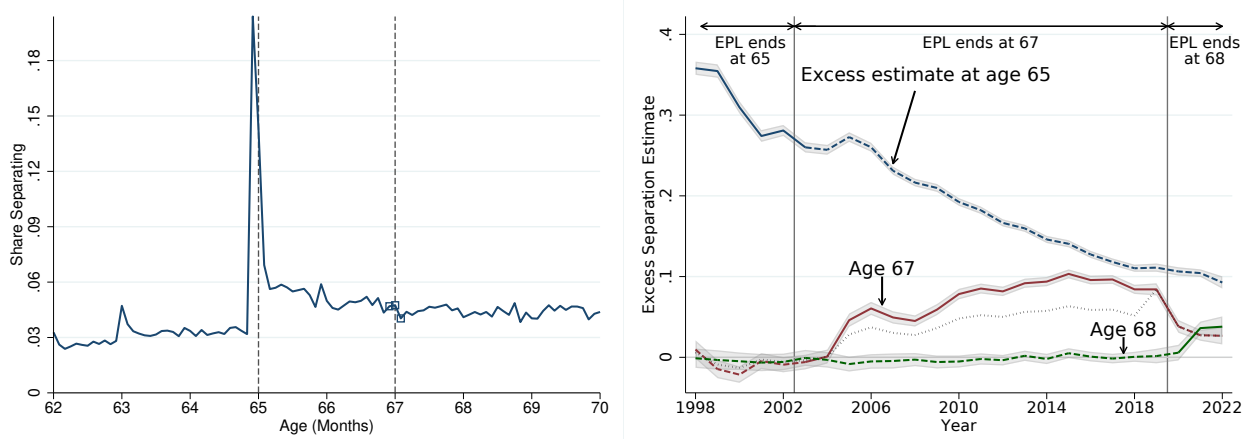
Figure 10 Panel (a) replicates Figure 6 for 2002, when the employment protection cutoff age was 65. There is no spike at all at age 67. This placebo check bolsters the causal interpretation of the spike at 67 and the employment protection cutoff age. The very large spike just before age 65 is due to both the elimination of employment protection but also retirement norms, which cannot be disentangled.

[24]Besides bolstering the causal interpretation, the evidence in the form of the migration of the spike further illustrates the logic of deadwood labor in action: in the model, it results from a disagreement between the employer and the employee in a deadwood job. In 2022, those workers, aging across 67 and 68, could have voluntarily separated at 67. Yet (the legacy spike aside), they insist on staying put in their jobs through 68, consistent with those workers earning a positive rent. Similarly, nothing would have prevented firms from employing those workers through 68 already in 2019, with the only difference being that in 2019, employment protection was eliminated at age 67; instead, they laid them off at 67 in the old regime, consistent with them having negative surplus (once the firing cost employment protection constitutes is eliminated at 67 in 2019). These observed patterns square directly with the properties of firm and worker surplus, wage rigidity, and one-sided layoffs and quits featured in the simple model in Section I and its definition of deadwood labor.

Figure 10: Excess Separations in Earlier Years

(a) 2002 Placebo: No Spike at 67 when Employment Protection Cutoff Age was 65

(b) Excess Separations by Year at Ages 65, 67, and 68



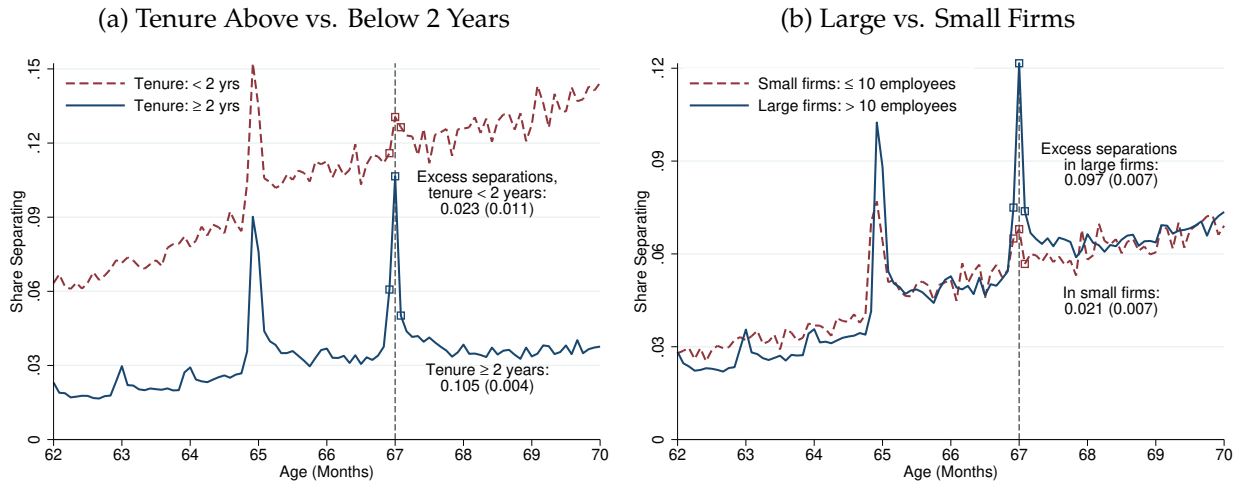
Notes: Panel (a) depicts the separation shares by age in months in 2002, when employment protection ended at age 65. There is no spike at all at age 67, consistent with our interpretation that the spike at age 67 observed in recent years is driven by employment protection ending at 67. The spike at age 65 is due to both the elimination of employment protection but also retirement norms and incentives prevailing in those cohorts, which cannot be disentangled. Panel (b) depicts the excess separation estimates by year from 1998 to 2022 at ages 65 (blue series), 67 (red series), and 68 (green series), along with 95 percent confidence intervals (estimated as in Figure 7). The series are solid when employment protection ends at the corresponding age and dashed otherwise. The data before 2019 are not as precise as they report spells' start and end within the year with some measurement error (instead of monthly earnings). This leads to an underestimation of excess separations before 2019 (explaining why we focus most of our analysis on the 2019 and after period). The figure undoes this discontinuity by re-adjusting the series of separations at age 67 multiplicatively so that excess separations in 2018 are equal to to excess separations in 2019 (the raw uncorrected series with a 2018-19 discontinuity are depicted in the dotted line). We do not correct the age 65 and 68 series because excess separations are almost identical in 2018 and 2019 without correction. The figure shows that excess separations at age 67 appear in 2005 after the cutoff age increases from 65 to 67 in 2003 (the two-year delay is expected as workers turning 67 in 2003 and 2004 could be laid off at no cost at age 65 in 2001 or 2002). The spike at age 65 trends down over the period due employment protection continuing past 65 in 2003, pension changes, and tax incentives to work longer set in place in the 2000s.

Panel (b) looks at the full history. It depicts the excess separation estimates by year from 1998 to 2022 at ages 65 (blue series), 67 (red series), and 68 (green series), along with 95 percent confidence intervals computed as described above.[25] These estimates are produced following the same methodology depicted in Figure 7, with a simple adjustment for the break in data quality starting in 2019.[26] The series are solid after employment

[25]We have also produced placebo series showing that there is no or minimal excess separations at the placebo ages 66 or 69 where no employment protection (nor any other policy) discontinuity takes place (results not reported).

[26]As mentioned above, there is a data discontinuity from 2018 to 2019, leading to an underestimation of excess separations before 2019. We have corrected this discontinuity by re-adjusting the series of separations at age 67 multiplicatively so that excess separations in 2018 are equal to to excess separations in 2019 (the raw series are depicted in the dotted line). We do not correct the age 65 and 68 series because excess separations

Figure 11: Role of Employment Protection Rules: Heterogeneity by Tenure and Firm Size



Notes: Panel (a) depicts the separation shares by age in 2019 breaking down the sample by tenure: below two years (dashed red line) vs. two year or more (solid blue line). Tenure is defined as number of months with positive earnings with a given employer. In case of a gap in the employment spell of more than 12 months, tenure is reset to zero. Panel (b) breaks down the sample by size of firm: up to 10 employees (red dashed line) vs. more than 10 employees (solid blue line). Firms with more than 10 employees have to respect stricter LIFO rules when laying off workers, making employment protection more stringent. Excess separations are estimated as described in Figure 7. Appendix Figure A.3 shows heterogeneity in excess separations across granular tenure and firm size bins.

protection ends and dashed otherwise.

For the age 68 series in Panel (b), excess separations are zero before 2020. The figure confirms the migration of excess separations from age 67 to age 68 after 2019 as shown in our earlier Figure 9. Excess separations at age 67 appear in 2005 after the cutoff age increases from 65 to 67 in 2003. The two-year delay is expected as workers turning 67 in 2003 and 2004 could be laid off at no cost at age 65 in 2001 or 2002. Finally, the spike at age 65 trends down over the period due to employment protection continuing past 65 in 2003, pension changes, and tax incentives to work after 65 set in place in the 2000s.[27]

Treatment intensity variation and role of employment protection rules: tenure and firm size. To further bolster the causal interpretation, we exploit treatment effect heterogeneity in the form of varying baseline strength of employment protection. A crucial determinant is tenure: the worker's LIFO rank and her advance notice minimum both increase in tenure (formally, the LIFO rank would be the tenure rank within the occupational circuit in the

are almost identical in 2018 and 2019 without correction.

[27]The fact that it is almost constant from 2018 to 2019—instead of being declining—suggests that there is also some underestimation of the spike at 65 before 2019 due to lower granularity of the data but it is likely small. As we do not use the spike at 65 for quantitative analysis, we felt it was simpler to leave this series uncorrected.

firm; we obtain similar results when proxying for it).

Figure 11 Panel (a) replicates Figure 6 but splits up the sample into workers below/above 2 years of tenure. Tenure is defined as number of months with positive earnings with a given employer. In case of a gap in the employment spell of more than 12 months, tenure is reset to zero. The figure reveals that the excess separations at age 67 are concentrated among high tenure workers (solid blue line), and are much more modest for workers with tenure below 2 years (dashed red line).

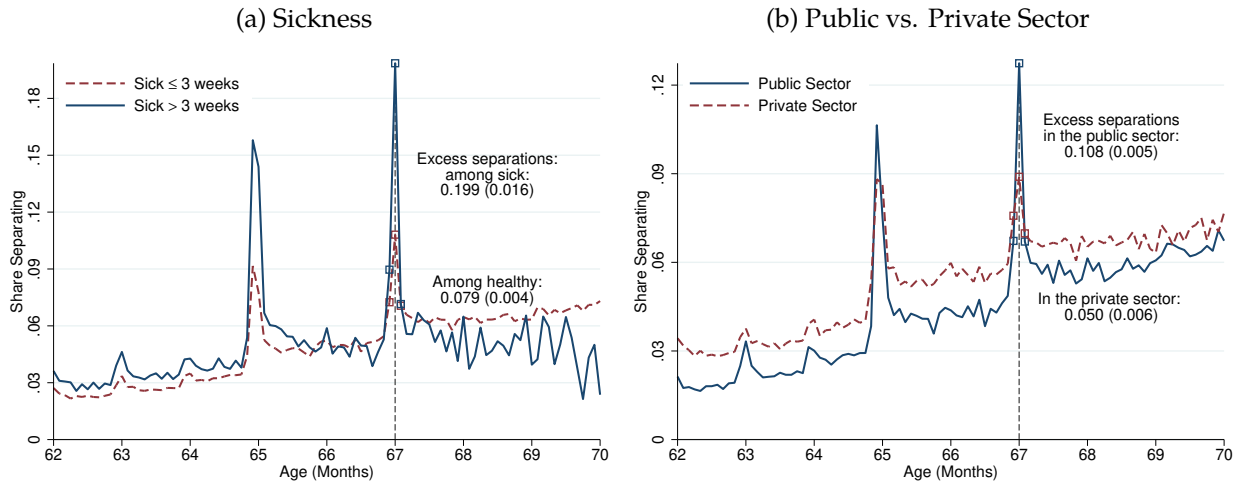
About 72 percent of workers at age 67 have jobs with tenure above 2 years. This explains why excess separations in the full sample are fairly close in level to excess separations in the high tenure sample. To show the role of tenure more continuously, Appendix Figure A.3 Panel (a) depicts excess separations by more granular tenure quantiles. The graph shows that excess separations grow with tenure—up until EPL strength no longer grows in tenure, consistent with the mechanism.

Panel (b) in Figure 11 breaks down the worker sample by employer size: up to 10 employees (dashed red line) vs. more than 10 employees (solid blue line). The figure shows that excess separations are concentrated in the larger firms, with a much smaller spike in small firms. This is consistent with the fact that LIFO rules are substantially relaxed in firms with at most 10 employees (see Section II.A). Again, Appendix Figure A.3 Panel (b) depicts this effect with more bins for firm size.

We caveat that while these patterns are consistent with the treatment intensity differences (while all jobs fall to zero employment protection at 67, they had heterogeneous levels before), heterogeneity in excess separations can also arise from a larger share of marginal matches with gross-of-employment-protection surplus between zero and the firing cost (see model Section I). For instance, perhaps larger firms have accumulated more low-surplus matches and smaller firms get rid of them (or boost their productivity) before they turn 67. Or, higher tenure implies a higher probability of having obtained a negative shock that rendered a job deadwood. Finally, we note that this analysis can be viewed as our design's only and imperfect handle speaking on the effects of lower tenured workers, a limitation we bring up again in the conclusion when discussing the important question we leave open of how the EPL variation affects younger workers or the hiring margin.

Recent sickness. As a proxy for a shock that may have rendered a previously more productive match less productive, we consider substantial sick leaves, which are recorded in the administrative data. In Figure 12, we therefore break down the sample into workers with fewer than three weeks of sick days (dashed red line) claimed vs. workers with more than three weeks of sick days (solid blue line); we calculate these sick-leave days in 2018

Figure 12: Heterogeneity by Sickness History and by Public/Private Sector



Notes: Panel (a) depicts the separation shares by age in 2019 breaking down the sample by sickness status of the worker: workers with sick days claimed below three weeks in 2018, the previous year, (dashed red line) vs. workers above that level (solid blue line). Panel (b) splits the sample into private sector (solid blue line) vs. public sector (dashed red line). Excess separations are estimated as described in Figure 7.

(the previous calendar year). We choose 3 weeks because any sick leave of two weeks or less is not recorded in the administrative data. But this definition is also appealing because these are absences that are not too large to lead the worker to sever employment, but instead her coming back and staying attached to the firm, presumably at a lower productivity level but fixed wages. There is a clear differential in the excess separation at age 67: the spike is much higher for sick workers, at 20 percent, vs. 8 percent for healthy workers. We note that besides being consistent with "lemon dropping" (or cherry picking) from the perspective of employers, such patterns may also point to EPL effectively acting as insurance for workers against sickness or productivity shocks more broadly. We pick up this discussion again in the conclusion.

Public sector. Panel (b) of Figure 12 provides the raw separation-age gradients along with the excess separation estimates in the public (dashed red line) vs. the private sector (solid blue line). The excess separation at age 67, when employment protection ends, is much higher in the public sector, 11 percent, compared to just 5 percent in the private sector. This suggests that firms in the private sector are better able to find ways around employment protection laws. Or, the public sector accumulates more deadwood jobs, either because other informal employment protection-like factors prevent layoffs, or because it offers good jobs for older workers, to which workers hold on longer, until they are laid off at 67.

IV.C Regression-Based Heterogeneity Analysis

In Appendix B, we present a systematic heterogeneity analysis of excess separations by devising univariate and multivariate regression approach—in a methodological contribution to the bunching literature. As we saw in the graphical analysis, the recently sick, the high-tenure, large-firm or public sector workers have much higher excess separations. The table shows that being a high earner or an immigrant is also associated with significantly more excess separations at age 67 but working in the manufacturing sector, having a high education or being male are not.[28] Hence, overall, our analysis reveals that excess separations are larger for public sector jobs and recently sick workers, immigrants, and highly paid workers, but similar for men and women and across education groups. We have also explored how excess separations vary with a number of additional variables such as receiving a bonus (which could signal high value to the employee) and manual vs. intellectual work (as productivity in manual work may decline faster with age). These variables did not come out as significant either in the univariate or multivariate analysis (results not reported). Finally, to dissect the earnings heterogeneity effect, we have also experimented with heterogeneity analyses by AKM fixed effects (results not reported). We found no heterogeneity by worker fixed effect but somewhat larger effects for workers in high wage firms (i.e., high firm fixed effects).

V Beyond Separations: Effects on Stayers

We now study effects on jobs that continue despite and beyond the elimination of employment protection. Wage reductions could have attenuated layoffs at 67, and indicate a surplus shift to firms. Moreover, firms could push for adjustments in other job aspects, such as hours, contract types or reassignments across activities, because employment protection restricted reorganization of job duties before 67.

We do not find evidence for wage adjustments. However, we find that hours reductions of about 8 percent—indicating deadwood *tasks or hours* that *doubles* the total amount of deadwood labor on top the conventional separation extensive margin. We also find that firms shift to fixed-term rather than open-ended contracts. These effects on the structure of jobs *among stayers* are novel to the literature on employment protection that has largely focused on extensive-margin separation and hiring responses, or on retirement as a binary choice (see in particular our discussion of the mandatory retirement and EPL literatures in Footnotes 2 and 3 in the introduction).

[28] We note that it would be interesting to check for between-occupation heterogeneity in worker productivity or associated stereotypes among older workers specifically (e.g., as in the study of age discrimination in hiring in Burn, Button, Corella, and Neumark, 2022).

V.A Wages, Hours, and Earnings of Stayers: Structure of Earnings Survey

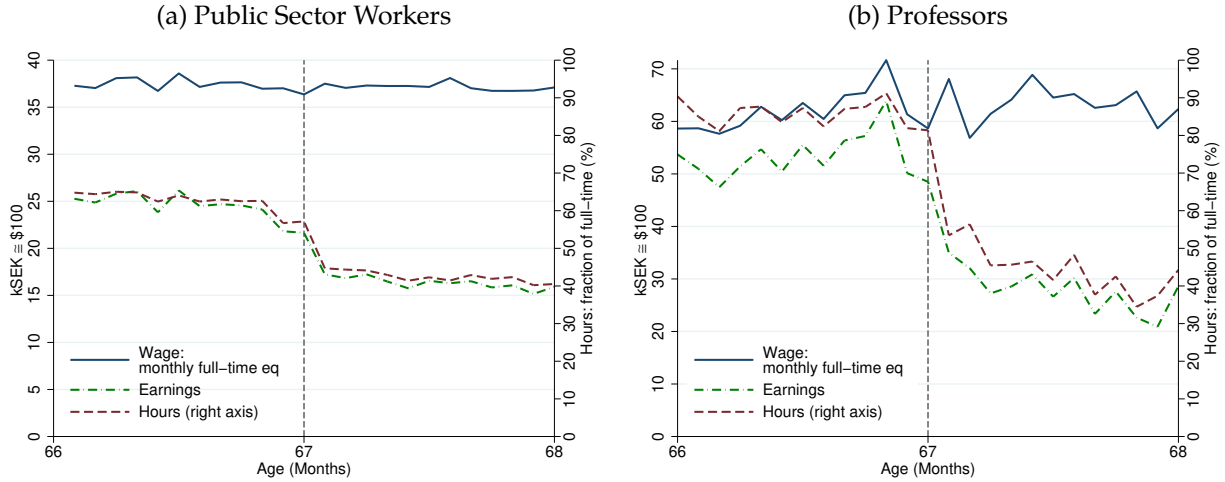
We start our analysis of continuing jobs (stayers) by drawing on the Structure of Earnings Survey, which is carried out annually in September–November (see Section II.E). This dataset unfortunately stops including private sector workers after age 67. However, it samples 100 percent of workers in the public sector every year including those past 67. We have above established that in this large sector of the labor market (more than 40 percent of the labor force as shown in Appendix Table A.2), the effect on separations is the largest, such that we may be able to find effects on wages and hours in this sector too. However, as we find no evidence for sizable wage effects, we will then extend our analysis to the private sector and full economy by studying stayers' earnings in the administrative data, using earnings in the public sector as a bridge (as earnings are measured in both datasets) .

In the Structure of Earnings Survey, we extract workers who show up with the same public employer (positive hours and earnings) in two consecutive years of the SES data (meaning that they have positive earnings in both 2018 and 2019). We therefore restrict the sample to workers aged between 66 to 68.

Wages. Figure 13 Panel (a) depicts the full-time equivalent monthly wage (solid blue line) in this sample of stayers in the public sector. Wages do not fall after crossing the 67 age threshold. Hence, there is no evidence for firms and workers rebargaining wages to keep older workers on the job. This finding has two implications. First, such wage rigidity may, if exhibited by the excess separators, too, help explain exactly the divergence of productivity from wages that leads firms to want to terminate them in the first place. Second, conversely, when considering the continuing jobs for which we do document stable wages, the absence of wage reductions among them also substantiates the interpretation that these surviving jobs were not deadwood jobs *before* 67 either, but gave positive surplus to the firm even absent employment protection and without wage adjustment.

Hours. We have only considered the extensive margin so far when considering employment: working vs. not. However, such discrete extensive margin adjustment may be the outcome of a latent continuous intensive margin optimum (as in Rogerson and Wallenius, 2009). Moreover, it is possible that workers before age 67 perform some tasks with productivity below the wage rate, or collected a full-time wage while effectively working part-time. Such a scenario would imply "deadwood labor units" at the intensive margin. Lastly, employment protection may restrict the firm's ability to restructure the worker's job, due to legal requirements or due to the bargaining position effects of the firing cost employment protection generates.

Figure 13: Panel Analysis of Stayers in the Public Sector in the Structure of Earnings Survey: Hours vs. Wages



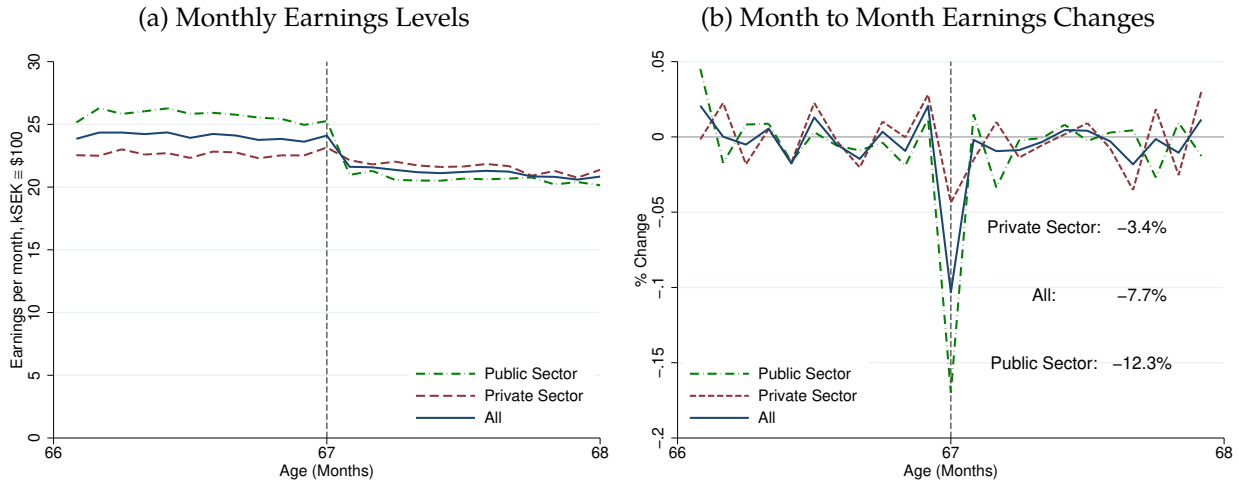
Notes: Panel (a) depicts the full-time equivalent monthly wage (solid blue line), actual monthly earnings (dotted-dashed green line), and hours of work as a fraction of full-time (red dashed line on the right y-axis). We plot outcomes for workers who are recorded with positive wages and hours in the Structure of Earnings Survey and with the same public sector employer (as the private sector is not covered beyond age 67) at some point before turning 67 and at some point after turning 67. We draw on the 2018 and 2019 waves of the survey, and hence restrict the sample to workers aged between 66 to 68, thereby studying stayers aging across the 67 threshold between the two waves and eliminating compositional effects. Panel (b) repeats the same analysis but limited to professors.

To address this possibility, we study effects on hours adjustment within the job. In Panel (a) of Figure 13, we include this outcome variable (red dashed line) in the form of fraction of full-time worked using the same sample of stayers drawn from the Structure of Earnings Survey. We find a considerable reduction of hours, with the sharpest adjustment exactly at age 67. Additionally, in Appendix Figure A.4 Panel (a), we show that much of this change involves workers switching from full-time jobs to part-time jobs (rather than a downward shift across the board, or even a shift within part-time jobs only).

Earnings. Last, we consider actual monthly earnings, depicted in the dotted-dashed green line in Panel (a) of Figure 13. These earnings are the average of the individual-level hours times the wage. Consistent with no discontinuous change in wage rates, the earnings series are essentially parallel to the hours series. The earnings outcome for the public sector will serve as our bridge into the administrative data below in Section V.B, where we will start by replicating the earnings drop for public sector workers, and then study the private and the full Swedish economy.

Professors. Ashenfelter and Card (2002) found a very large impact of removing mandatory retirement policies for professors in the United States on the retirement age of professors. As professors are part of the public sector in Sweden, we can zoom on this group

Figure 14: Panel Analysis of Earnings of Stayers in the Administrative Data



Notes: This figure uses the monthly earnings administrative data and focuses on the sample of stayers defined as workers continuously employed with the same employer between age 66 and 9 months and 67 and 4 months in years 2019-2020 and who turn 67 in 2019. Panel (a) depicts the monthly average earnings among all such workers with positive earnings (solid blue line), and the subsample of public sector workers (dotted-dash green line) and private sector workers (dashed red line). Panel (b) takes the depicted series and expresses them in percent differences from month to month. The excess drop in earnings at age 67 is estimated using our bunching methodology presented in Figure 7: namely, the earnings drop is the difference between drops for ages: 67-1/12, 67, 67+1/12 and the average drop for the 6 months below 67-1/12, and the 6 months above 67+1/12.

using our Structure of Earnings Survey data. We find strong responses in Sweden, too. However, in Sweden, most of the effect works through the intensive margin, with professors obtaining part-time, temporary contracts, with dramatic reductions in hours worked and hence earnings. Importantly, universities are free to keep professors at full-time salary past the age threshold if they so choose, although this requires writing a new contract. Figure 13 Panel (b) illustrates this pattern in the Structure of Earnings Survey. It reports the results on hours drops for professor-*stayers*, repeating our analysis for the entire public sector in the Structure of Earnings Survey (Panel (a)) for this occupation group and complementing our check on earnings in the administrative data reported in Section III.B. The drops in hours among professors that stay employed is much larger than in the overall public sector. While the full-time wage remains constant, professors who stay lose about half of their hours and hence their earnings when they cross the age 67 threshold.

V.B Administrative Data: Earnings of All Stayers (Private and Public)

We now study the effects on earnings among stayers in the administrative data and in the wider economy. Since the Structure of Earnings Survey does not include private sector observations beyond the age of 67, we draw on monthly earnings data in the administrative data. To do so, we first build a bridge for the public sector, which we see in both datasets,

on the basis of monthly earnings. The end of Section V.A above showed that in the public sector, earnings and hours fall in lockstep, due to the absence of wage adjustment at 67. Again, we do so among the job stayers, here defined as workers continuously employed with same employer between age 66 and 9 months and 67 and 4 months and who turn 67 in 2019 (hence the sample period of subsequent outcomes may then include some months in 2020).

Figure 14 presents the impact of the end of employment protection at age 67 on monthly earnings among all stayers (solid blue line), as well as separately for public (dotted-dash green line) and private sector workers (dashed red line). Panel (a) depicts the monthly average earnings among all such workers (who by construction all have positive earnings). The public sector's earnings gradient in the administrative data mirrors that in the Structure of Earnings Survey from Figure 13, validating this bridge. Again, we see a large drop in earnings sharply around 67 for this group. The drop for private sector workers is much more muted and the drop for all sectors is approximately the average of the two sectors as almost half (44 percent) of workers around age 67 are public sector workers (Appendix Table A.2).

Panel (b) takes the depicted series in Panel (a) and then expresses them in percent differences from month to month. These series expressed in differences are conceptually similar to our earlier separation rates but capture the intensive margin on stayers rather than the extensive separation margin. They display a (negative) spike at age 67, indicating the excess drop in earnings precisely when employment protection ends. Therefore, we can estimate excess earnings drop paralleling our bunching methodology from Section IV as follows. On Figure 14, Panel(b), the excess earnings drop is the difference between the average drops for ages: 67-1/12, 67, 67+1/12 and the average drops for the 6 months below 67-1/12, and the 6 months above 67+1/12. Effectively, this identifies the excess drop due to the end of employment protection under the assumption that, absent the employment protection ending, stayers' earnings would have been smooth at age 67.

The figure shows that, consistent with Figure 13, there is a large excess drop of 12.3 percent in earnings of public sector workers at age 67. For the public sector, we know that this drop in earnings is driven by hours reductions against constant wages (Figure 13). Turning to the private sector, the figure reports a much smaller excess drop in earnings of about 3.4 percent among job stayers. This implies that the *combined* response of hours and wages among private workers is much smaller than among public sector workers; it also suggests that wage adjustments are unlikely to explain the attenuated separation responses in the private sector. Hence, the response in the private sector is smaller both along the extensive margin (Figure 12 Panel (b)) and the hours adjustment portion

of the intensive margin (this Figure 14) (the remainder of the intensive margin reflects compositional effects).

Taken together, average earnings drop among all workers is 7.7 percent, most likely being accounted for by hours reductions against relatively rigid wages. This intensive margin response at the stayers' hours margin is quantitatively similar to the extensive response of 8.4 percent excess separations that we obtained in Section IV. (The remaining effects on average earnings per worker is due to compositional effects.) Therefore, the intensive margin, which, to the best of our knowledge, has not been studied before in the employment protection context, is about as important as the extensive margin, for which there is a large body of work (see introduction in Footnotes 2 and 3 on mandatory retirement and EPL, respectively).

V.C Contract Adjustments

Drawing on the Labor Force Survey, we find that employers also issue new contracts, but fixed-term (temporary) rather than open-ended (permanent) ones. (See Section II for the institutional details.) Appendix Figure A.4 reports those results. Again, now using the panel structure of the Labor Force Survey, we draw on a notion of stayers below and above 67, such that these results can be interpreted as contract conversions.[29] This result is another indication that workers and employers rebargain aspects of the job when employment protection disappears at age 67, and adjust not only hours but also the legal structure of the job. We caveat that the Labor Force Survey draws on considerably fewer observations (see Section II.E).

There are two interpretations. First, a temporary contract may actually commit the firm to honoring a longer commitment (than a post-67 "open-ended" contract without any employment protection), permitting the parties to plan ahead for longer horizons. Temporary/fixed-term contracts might permit the parties to provide a basic, private notion of employment protection.

Second, the switch to temporary contracts may reflect the fact that a considerable share of full-time, permanent-contract workers may not have been consistently productive right before 67, and the switch to a temporary contract may be another facet of shedding deadwood labor at the intensive margin (between contract renewals).

[29]Because the Labor Force Survey does not identify the employer, we have to define stayers as those employed both before and after turning 67 and without being able to know for sure that they work with same employer.

VI Conclusion

Our local as well as difference-in-differences designs provide consistent results that show substantial effects of eliminating employment protections for older workers. Employment rates causally drop by 10 percent (or 2.5 points) when employment protection ends and earnings per capita drop even more by about 20 percent due to large intensive response effects as well driven by reduction in hours of work for stayers as wages per hour appear to be rigid. Therefore, in the data, employment protection appears to provide a moderate boost to the length of the working life by extending the duration of, and hours in, the last last jobs an older worker may hold.

At the highest level, our findings indicate that employment protection in Sweden can be seen as shifting social insurance and retirement funding to employers, forcing them to keep on the payrolls some older workers at wages at a premium. Perhaps richer features or frictions may justify this policy goal. For instance, employment protection may prevent employers from offloading workers from long-term implicit contracts early in a way that may be subsidized by social insurance (as in the model of Hutchens, 1999). This effect of course would vary depending on the funding of the retirement and social insurance systems and hence across settings. Créchet (2023) presents a model of how firing costs may facilitate long-term contracts. At a more micro level, the excess layoffs may be inefficient if older workers are particularly attached to their original employer and may still enjoy large surplus, while firms' surplus may be just barely negative and yet lead to layoffs (Jäger, Schoefer and Zweimüller, 2023).

We close with questions our paper leaves open with its comprehensive analysis of the ex-post effects on separations that the elimination of employment protection among older workers implies. First, our design cannot credibly speak to some important equilibrium aspects of employment protection for older workers. For instance, we cannot estimate the indirect effects on hiring, anticipation effects, or spillovers on other, especially younger, workers—although the sharp and high-frequency variation we document could likely be leveraged in future work in the form of firm-level event study designs. Second, our study focuses on the "end of life" of a job, but does not provide a full analysis of the entire labor market biography of workers subject to employment protection for longer. Third, we also do not provide a quantitative assessment of the profit costs the deadwood labor entails for firms, and more generally do not provide a quantitative welfare assessment of the costs and benefits of employment protection for older workers.

References

Addison, John, and Paulino Teixeira. 2003. "The Economics of Employment Protection." *Journal of Labor Research* 24 (1): 85-128.

Ashenfelter, Orley, and David Card. 2002. "Did the Elimination of Mandatory Retirement Affect Faculty Retirement?" *American Economic Review* 92(4): 957-980.

Autor, David, William Kerr, and Adriana Kugler. 2007. "Does Employment Protection Reduce Productivity? Evidence from US States." *Economic Journal* 117 (521): F189-F217.

Bassanini, Andrea, and Andrea Garnero. 2013. "Dismissal Protection and Worker Flows in OECD Countries: Evidence from Cross-country/Cross-industry Data." *Labour Economics* 21: 25-41.

Behagel, Luc, and David M. Blau. 2012. "Framing Social Security Reform: Behavioral Responses to Changes in the Full Retirement Age." *American Economic Journal: Economic Policy* 4 (4): 41-67.

Bertola, Giuseppe. 1990. "Job Security, Employment and Wages." *European Economic Review* 34 (4): 851-879.

Bertola, Giuseppe, and Richard Rogerson. 1997. "Institutions and Labor Reallocation." *European Economic Review* 41 (6): 1147-1171.

Bjuggren, Carl Magnus. 2018. "Employment Protection and Labor Productivity." *Journal of Public Economics* 157: 138-157.

Bjuggren, Carl Magnus, and Per Skedinger. 2021."Does Job Security Hamper Employment Prospects?" IFN Working Paper No. 1255.

Burkhauser, Richard, and Joseph F Quinn. 1983. "Is Mandatory Retirement Overrated? Evidence from the 1970s." *Journal of Human Resources* 18 (3): 337–358.

Burn, Ian, Patrick Button, Luis Munguia Corella, and David Neumark. 2022. "Does Ageist Language in Job Ads Predict Age Discrimination in Hiring?" *Journal of Labor Economics* 40 (3): 613-667.

Cahuc, Pierre, Franck Malherbet, and Julien Prat. 2019. "The Detrimental Effect of Job Protection on Employment: Evidence from France." IZA Discussion Paper No. 12384.

Cahuc, Pierre, and Marco Palladino. 2024. "Employment Protection Legislation and Job Reallocation Across Sectors, Firms, and Workers." In *Handbook on Labour Markets in Transition* 212-223. Edward Elgar Publishing.

Cederlöf, Jonas. 2024. "Reconsidering the Cost of Job Loss: Evidence from Redundancies and Mass Layoffs." IFAU-Institute for Evaluation of Labour Market and Education Policy.

Cederlöf, Jonas, Peter Fredriksson, Arash Nekoei and David Seim. 2025. "Mandatory notice of layoff, job search, and efficiency." *Quarterly Journal of Economics* 140 (1): 585-633.

Clark, Robert L, and Linda S Ghent. 2008. "Mandatory Retirement and Faculty Retirement Decisions." *Industrial Relations* 47 (1): 153–163.

Créchet, Johnathan. 2023. "Risk Sharing in a Dual Labor Market." University of Ottawa Working Paper. `https://doi.org/10.20381/ruor-29923`

Deshpande, Manasi, Itzik Fadlon, and Colin Gray. 2024."How Sticky Is Retirement Behavior in the United States?" *Review of Economics and Statistics* 106 (2): 370-383.

Daruich, Diego, Sabrina Di Addario, and Raffaele Saggio. 2023. "The Effects of Partial Employment Protection Reforms: Evidence from Italy." *Review of Economic Studies* 90 (6): 2880-2942.

Fredriksson, Peter, and Robert H. Topel. 2010. "Wage Determination and Employment in Sweden since the Early 1990s: Wage Formation in a New Setting." In *Reforming the Welfare State: Recovery and Beyond in Sweden.* 83-126.

Garibaldi, Pietro, and Giovanni L. Violante. 2005."The Employment Effects of Severance Payments with Wage Rigidities." *Economic Journal* 115(506): 799-832.

Garicano, Luis, Claire Lelarge, and John Van Reenen. 2016. "Firm Size Distortions and the Productivity Distribution: Evidence from France." *American Economic Review* 106 (11): 3439-3479.

Gruber, Jonathan and David Wise. 1999. "Social Security and Retirement around the World." *Research in Labor Economics* 18: 1-40.

Heyman, Fredrik, and Per Skedinger. 2016. "Employment Protection Reform, Enforcement in Collective Agreements and Worker Flows." *Industrial Relations: A Journal of Economy and Society* 55 (4): 662-704.

Hijzen, Alexander, Leopoldo Mondauto, and Stefano Scarpetta. 2017. "The Impact of Employment Protection on Temporary Employment: Evidence from a Regression Discontinuity Design." *Labour Economics* 46: 64-76.

Hutchens, Robert. 1999. "Social Security Benefits and Employer Behavior: Evaluating Social Security Early Retirement Benefits as a Form of Unemployment Insurance." *International Economic Review* 40 (3): 659-678.

Jäger, Simon, Benjamin Schoefer, and Josef Zweimüller. 2023. "Marginal Jobs and Job Surplus: A Test of the Efficiency of Separations." *Review of Economic Studies* 90 (3): 1265-1303.

Kolsrud, Jonas, Camille Landais, Daniel Reck, and Johannes Spinnewijn. 2024. "Retirement Consumption and Pension Design." *American Economic Review* 114 (1): 89-133.

Kondo, Ayako, and Hitoshi Shigeoka. 2017. "The Effectiveness of Demand-side Government Intervention to Promote Elderly Employment: Evidence from Japan." *Industrial Relations Review* 70 (4): 1008–1036.

Kugler, Adriana, and Giovanni Pica. 2008. "Effects of Employment Protection on Worker and Job Flows: Evidence from the 1990 Italian Reform." *Labour Economics* 15 (1): 78-95.

Lazear, Edward. 1979. "Why is there Mandatory Retirement?" *Journal of Political Economy* 87 (6): 1261-1284.

Lazear, Edward. 1990. "Job Security Provisions and Employment." *Quarterly Journal of Economics* 105 (3): 699-726.

Mastrobuoni, Giovanni. 2009. "Labor Supply Effects of the Recent Social Security Benefit Cuts: Empirical Estimates Using Cohort Discontinuities." *Journal of Public Economics* 93 (1112), 1224-33.

Morris, Todd, and Benoit Dostie. 2023. "Graying and Staying on the Job: The Welfare Implications of Employment Protection for Older Workers." IZA Discussion Paper No. 16430.

OECD. 2004. *Employment Outlook, OECD, Paris.*, "Employment Protection Regulation and Labour Market Performance." Chapter 2.

OECD. 2021. *Pensions at a Glance 2019: Country Profile-Sweden*.

OECD. 2022. *OECD Reviews of Pension Systems: Slovenia,* OECD Reviews of Pension Systems, OECD Publishing, Paris, https://doi.org/10.1787/f629a09a-en.

Palme, Marten and Ingemar Svensson. 1999. "Social Security, Occupational Pensions, and Retirement in Sweden." In *Social Security and Retirement around the World* 355-402. University of Chicago Press.

Rabaté, Simon. 2019. "Can I stay or Should I go? Mandatory Retirement and the Labor-Force Participation of Older Workers." *Journal of Public Economics* 180, 104078.

Rabaté, Simon, Egber Jobgen, and Tilbe Atav. 2024. "Increasing the Retirement Age: Policy Effects and Underlying Mechanisms." *American Economic Journal: Economic Policy* 16 (1): 259-291.

Rogerson, Richard, and Johanna Wallenius. 2009. "Micro and Macro Elasticities in a Life Cycle Model with Taxes." *Journal of Economic Theory* 144 (6): 2277-2292.

Saez, Emmanuel. 2010. "Do Taxpayers Bunch at Kink Points?" *American Economic Journal: Economic Policy* 2 (3): 180-212.

Saez, Emmanuel, Benjamin Schoefer, and David Seim. 2019. "Payroll Taxes, Firm Behavior, and Rent Sharing: Evidence from a Young Workers' Tax Cut in Sweden." *American Economic Review* 109 (5): 1717-63.

Schivardi, Fabiano, and Roberto Torrini. 2008. "Identifying the Effects of Firing Restrictions Through Size-Contingent Differences in Regulation." *Labour Economics* 15 (3): 482-511.

Seibold, Arthur. 2021. "Reference Points for Retirement Behavior: Evidence from German Pension Discontinuities." *American Economic Review* 111 (4): 1126-1165.

Shannon, Michael, and Diana Grierson. 2004. "Mandatory Retirement and Older Worker Employment." *Canadian Journal of Economics* 37 (3): 528-551.

Warman, Casey, and Christopher Worswick. 2010. "Mandatory Retirement Rules and the Retirement Decisions of University Professors in Canada." *Labour Economics* 17 (6): 1022–1029.

Zeev, Nadav Ben, and Tomer Ifergane. 2022. "Firing Restrictions and Economic Resilience: Protect and Survive?" *Review of Economic Dynamics* 43: 93-124.

Supplemental Appendix

Deadwood Labor? The Effects of Eliminating Employment Protection for Older Workers

by Emmanuel Saez, Benjamin Schoefer, and David Seim

A Additional Model Discussion

Dynamic considerations. Our model above is written in a quasi-static way, with treatment and control groups. In practice, we have treatment and control *ages*, and we focus on excess separations occurring at the narrow focal ages where workers lose employment protection.

Formally, we can represent this dynamic context by considering four ages $a = 0, 1, 2, 3$, and measure separations between age pairs. Age 0 is our background age. Since firing costs $f_0 = f_1$ do not change between ages 0 and 1, separations between those two periods emerge only because of shifts in the job's non-regulatory fundamentals $(S^W, \widetilde{S}^F)$. We think of these types of baseline separations as "normal churn," and they correspond to our control period. Age 2 is our treatment age, when employment protection is eliminated, and hence $f_2 = 0$. Comparing separations at age 1 (control age) with those at age 2 (treatment age) identifies the treatment effect of the elimination of f on separations in the form of *excess separations*. Identifying those excess separations at age 2 is the main focus of our paper. Finally, at age 3, the firing cost in our context persistently stays eliminated, and hence $f_3 = 0$, so that the third period provides either a window into persistent (compositional) effects or another control group.

In principle, employment protection may have dynamic effects before and after the anticipated elimination of employment protection cost f. First, employers may retime separations to earlier ages, strategically delaying separations until after f drops to zero (i.e., separations from age 0 to 1 should be lower than those from another age -1 to 0). Our results do not suggest such dynamics, as we do not find declines in separations right before the elimination of employment protection—perhaps because of imperfectly persistent surplus shocks or due to employment protection rules, including advance notice. When we exploit a reform that shifts the age cutoff for employment protection in an empirical extension, we also do not see any response to separations prior to the age cutoff.

Second, separations after, rather than before, the employment protection cutoff age may also be affected. On the one hand, in a given job, surplus will stay persistently lower, increasing the chances that surplus shocks end in a dismissal. On the other hand, exactly in the presence of an initial spike in separations, positive composition effects among surviving jobs may curb separations. Our analyses of raw data do not suggest clear evidence for such a level shift in separations following the elimination of employment protection.[30]

[30]Modeling the law as $f_3 > 0$, i.e., a window to dismissal individuals (see Section II.B for the discussion of the regulatory context), would generate additional dynamic incentives to dismiss the worker in period 2

Third, employment protection rules typically strengthen in tenure, and hence employment protection *differentials* between the original job and the potential next job will generate strong surplus to the worker, who enjoys maximal protection in the current job. This dynamic will curb quits (in the form of job-to-job transitions) up to 67 (see Gielen and Tatsiramos, 2012, for cross-country evidence on this mechanism), but this differential will disappear as a consideration after 67, as employment protection is eliminated in *both* the current job and subsequent new jobs. Below, we also preview that most of the excess separations will go into permanent nonemployment (retirement), which we discuss next.

Separations into retirement vs. to other employers. There are two cases to distinguish regarding the worker's trajectory following the layoff. The worker may move to another employer, or leave the labor force and retire. Ignoring search frictions, a worker would move to the next job that gives her the highest worker surplus $S^{W\prime} = \text{argmax}_{j \in J | \widetilde{S}_j^F \geq 0} S_j^W$, where the set of jobs J is defined as those that also fulfill the participation constraint of the next employer. If that job gives the worker positive surplus, she will accept it and be employed. If the best job offer does not make the cut, the worker will go into retirement.

To the degree that wages in the next job can be set flexibly, separations into retirement following the elimination of employment protection hence raise a stronger notion of deadwood: the worker's reservation wage exceeds his productivity everywhere.[31]

In the data, we will find that most workers that our strategy identifies as separating due to the elimination of employment protection experience permanent nonemployment, i.e., retirement. These results therefore do not speak to the role of employment protection for a broader set of workers at younger ages, who will be more likely to go back into reemployment following a dismissal.

Wage effects, and flexible wages. We briefly also discuss a notion of deadwood absent wage rigidities—although our empirical analysis finds no evidence of wage adjustment as workers age out of employment protection. An alternative model would assume flexible wages in the original job. However, this mechanism is difficult to conceptualize in a realistic way exactly because firing costs f are only due upon a one-sided (firm-initiated) separation in practice. Some notion of wage rigidity or bargaining friction is needed as otherwise the parties could always eliminate f if the worker were willing to agree to label the separation as a quit, in exchange for a side payment (see Carry and Schoefer, 2024, for a direct empirical assessment of such mechanisms in another context). To understand the initial layoffs, we therefore favor the previous setup, with fixed wages and a clear notion of a layoff, to read the evidence.[32]

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in the presence of shocks between period 2 and 3.

[31] It is possible that wage rigidity is active also in newly formed jobs (e.g., due to regulatory wage floors), which may lead the worker to retire in an involuntary sense (i.e., she would accept the wage if a firm were willing to employ her); wage rigidity may also mean that her productivity does exceed her reservation wage.

[32] Under efficient bargaining of wages, the firm and worker find a wage within the bargaining set of the parties' reservation wages (respectively defined as the wage that would make each party's participation constraint hold with equality) to avoid an inefficient separation. Viable jobs have then gross-of-employment protection *joint* surplus (the sum of worker and firm surplus, with the bilaterally efficient wage cancelling out) above the firing costs: $\widetilde{S} = (J^W - O^W) + (J^F - O^F) \geq -f$. In this setting, employment protection fosters a notion of bilaterally efficient deadwood: jobs for which $-f \leq \widetilde{S} < 0$, i.e., that are viable (carry weakly positive net surplus) only because of the presence of employment protection but would have negative

Extensive margin and intensive margin adjustments. Our model features an extensive margin only, with no room for adjusting or rebargaining hours or other aspects of the job. When wages are rigid, firms may be able to bargain for higher effort or lower hours (under diminishing marginal products) when firing costs fall. Or, only some tasks of the worker may carry positive gross surplus to the firm, and the firm may effectively dismiss the worker and rehire the worker for only this subset of her tasks. Indeed, such patterns occur in Sweden in universities (as we discuss below), where a professor crossing the employment protection cutoff age may cease to be paid for research activities but paid for teaching courses on a case-by-case basis when recalled after retirement. One can view those intensive-margin adjustments as revealing deadwood labor units, and we document substantial evidence for their relevance in Sweden, in the form of hours and earnings reductions (at fixed wages) among continuing workers as they lose employment protection.

B Regression-Based Heterogeneity Analysis

Regression analysis. In the 2019 monthly micro-data, we define a separation indicator $s_{ima} = 0, 1$ for individual i observed in month m separating at age a (in months) for the sample of individuals who were working in the previous month. Each individual is observed up to 12 times in 2019 data depending on how many months she works during 2019. For the univariate analysis, we regress s_{ima} on monthly age dummies and monthly age dummies interacted with the dummy variable D_{ima} (being a public sector worker when we analyze public vs. private sector workers for example) as follows:

$$\text{Univariate specification: } s_{ima} = \alpha_a + \beta_a \cdot D_{ima} + \varepsilon_{ima}. \tag{A.1}$$

We then conduct the bunching analysis on the basis of the interaction-age coefficients—with the same age windows. We compute standard errors in the same way of for our benchmark excess separation estimates as described in Figure 7. This differential bunching analysis essentially formalizes the estimation of the contrast in excess separations across two groups that we discussed in Figures 11 and 12 at the end of Section IV.B above.

An important issue is that the various dimensions of heterogeneity might be correlated. For example, public sector workers may have longer tenure on average than private sector workers and the greater excess separations in the public sector might simply be a consequence of longer tenure and not public sector per se. To address this issue, we extend our univariate method to a multivariate approach that measures excess separations when a specific dummy is switched on while controlling for the other variable dummies as follows. That is, the multivariate regression follows the model in Equation (A.1) but regresses s_{ima} on monthly age dummies α_a and monthly age dummies interacted with all dummy variables of interest $D^1_{ima}, D^2_{ima}, ...$:

$$\text{Multivariate specification: } s_{ima} = \alpha_a + \beta^1_a \cdot D^1_{ima} + \beta^2_a \cdot D^2_{ima} + .. + \varepsilon_{ima}. \tag{A.2}$$

surplus absent employment protection—and hence separate when employment protection is eliminated.

Again, we conduct the bunching analysis and report excess separation effect estimates on the interactions of a given heterogeneity variable with the age coefficients.

Results. We summarize our heterogeneity analysis in Appendix Table A.1. This table lists in each row a specific characteristic (e.g., sick $\geq$ 3 weeks). The first column "Share group" displays the fraction of our estimation sample with the characteristic. The second column reports the excess separation estimate for the group with the characteristic. The third column reports the excess separation for the complement (i.e., individuals without the characteristic). The difference between columns 2 and 3 is reported in column 4. This is the univariate difference from the specification in Equation (A.1). The last column reports the additional excess separation when the dummy variable is equal to one (relative to the dummy variable equal to 0) when controlling for all the other dummy variables listed in the table as in the multivariate specification in Equation (A.2).

Appendix References

Carry, Pauline and Benjamin Schoefer. 2024. "Conflict in Dismissals: Evidence from "Separations by Mutual Agreement" in France." Working paper.

Gielen, Anne and Konstantinos Tatsiramos. 2012. "Quit Behavior and the Role of Job Protection." *Labour Economics* 19 (4): 624-632.

OECD. 2022. *OECD Reviews of Pension Systems: Slovenia,* OECD Reviews of Pension Systems, OECD Publishing, Paris, https://doi.org/10.1787/f629a09a-en.

Table A.1: Excess Separation Estimates: Heterogeneity

	Share in group	Excess Separations Group	Excess Separations Complement	$\Delta_{\text{univariate}}$	$\Delta_{\text{multivariate}}$
	(1)	(2)	(3)	(4)	(5)
Sick > 3 weeks	0.094	0.199	0.079	0.120	0.103
		(0.016)	(0.004)	(0.017)	(0.016)
High tenure	0.724	0.099	0.019	0.079	0.053
		(0.004)	(0.009)	(0.009)	(0.010)
Firm > 10 empl.	0.809	0.097	0.021	0.076	0.044
		(0.004)	(0.009)	(0.010)	(0.012)
High earner	0.364	0.114	0.054	0.061	0.041
		(0.005)	(0.006)	(0.008)	(0.009)
Public sector	0.471	0.108	0.050	0.058	0.037
		(0.005)	(0.006)	(0.008)	(0.010)
Immigrant	0.151	0.112	0.072	0.039	0.043
		(0.010)	(0.004)	(0.011)	(0.011)
Manufacturing	0.048	0.102	0.077	0.024	0.031
		(0.016)	(0.004)	(0.018)	(0.019)
High education	0.445	0.085	0.073	0.012	-0.011
		(0.006)	(0.005)	(0.008)	(0.009)
Male	0.494	0.081	0.076	0.005	0.020
		(0.006)	(0.005)	(0.008)	(0.009)
Observations				387,858	359,632

Notes: This table shows excess separation estimates by various subgroups, displayed in rows in column 1. All heterogeneity analysis are based on binary variables, and column 2 reports the share of the estimation sample for whom the binary variable equals one. For example, in our estimation sample around age 67, 9.42 percent of the workers experienced a sick leave of more than three weeks in 2018 (and hence 90.58 percent did not). In columns 3 and 4, we report the excess separation estimates separately for the target group (those with the value one on the dummy variable; e.g., the sick) and its complement (e.g., the non-sick). These bunching estimates are obtained just as in the baseline analysis described in Figure 7. In column 5, we report the coefficient difference between the target group and the complement group with its associated standard error. This is the univariate difference from specification (A.1). For example, sickly workers experience an additional excess separation probability at age 67 of 12.0 percentage points relative to other workers (19.9 percent vs. 7.9 percent). Column 6 estimates report the same differences in excess separations but controlling for all other dummy variables listed in all rows as in specification (A.2). In the case of sickness status, controlling for all the other variables reduces slightly the differential excess separation of sickly workers from 12 points down to 10 points. The sample in the last column differs slightly from the main analysis sample, because we remove observations where some characteristics cannot be uniquely determined.

C Additional Results

Summary statistics. Appendix Table A.2 shows summary statistics for the population as a whole in Panel A and for workers in Panel B for 2019.

All statistics are computed for the year 2019 and in Panel B a worker is defined as having positive earnings during the year. The first column shows averages among workers aged 25-61, which represent the working-age population outside of our analysis. The second column shows corresponding means for ages 62-70, our baseline sample used in most of our graphical analysis. The third column zooms in on individuals around the 67 age threshold (a fifteen month age window from 67 minus 7 months to 67 plus 7 months), the age window of the sample we use to estimate excess separations in our bunching methodology introduced below. Overall, the 62 to 70-year-olds are less likely to be working: 37 percent vs. 78 percent for the younger group. Around age 67, the fraction working is 25 percent. Correspondingly, unconditional wage earnings are substantially lower for the older groups. However, when conditioning on working in Panel B, the difference in earnings between older and younger cohorts decreases. The remaining difference is mainly driven by an intensive-margin hours difference. Around 56 percent of older workers aged 62-70 work full-time and only 27 percent do so around age 67, in contrast to the younger workers for whom the average is around 78 percent. Full-time-equivalent monthly wages among older workers are slightly higher so that the differences in earnings are due to labor supply both along the extensive and intensive margins. The elderly naturally have longer tenure and are slightly more likely to work in the public sector. The two groups score quite similarly in terms of other demographic characteristics, with the exception that older workers are less likely to be immigrants.

Table A.2: Summary Statistics in Year 2019

	Working Age Ages 25-61 (1)	Graph sample Ages 62-70 (2)	Estimation sample 15 months around 67 (3)
Panel A: **All individuals**			
Share working	0.78	0.37	0.24
Years of education	12.61	11.81	11.78
Annual wage earnings	328.37	131.98	65.83
Age	42.51	65.96	67.04
Individuals	4,877,308	990,200	233,797
Panel B: **Working individuals**			
Annual wage earnings	384.80	273.26	177.52
Monthly wage (FTE)	35.24	36.44	37.03
Share full-time	0.78	0.56	0.27
Years of education	12.86	12.31	12.43
Tenure (years)	7.43	12.46	11.68
Public sector	0.41	0.47	0.44
Manufacturing	0.11	0.09	0.06
Share women	0.49	0.49	0.49
Share immigrants	0.25	0.16	0.15

Notes: This table shows summary statistics for all individuals in Panel A and for working individuals in Panel B. All statistics are computed for the year 2019 and in Panel B a worker is defined as having positive earnings during the year. The first column shows averages among individuals aged 25-61, which represent the working-age population outside the scope of our analysis. The second column shows corresponding means for ages 62-70, our baseline sample used in our graphical analysis. The third column zooms in on individuals around the 67 age threshold (a fifteen month age window from 67 minus 7 months to 67 plus 7 months), which corresponds to the sample we use to estimate excess separations in our bunching methodology (described in Figure 7 and applied throughout). Note that the administrative data include 12 monthly earnings observations for each individual. The number of individuals is reported in the table for each sample. The first row—Share working—is defined as follows. For each individual, we compute the share of months during the calendar year that the individual has positive earnings and we take the average of this share across all individuals in the corresponding age sample. Wage earnings in the table are reported at the annual level (not monthly) while wages (FTE) represent the monthly full-time equivalent wage, measured using the Structure of Earnings Survey (SES) in one month (typically October or November). Share full-time is also measured in the SES. The number of observations that we observe monthly wages from the 2019 SES in the samples from left to right are 2,190,293; 188,491 and 21,312, respectively. Monetary values are expressed in nominal 1000 SEK (with $1 = 10 SEK approximately). Tenure is the number of years the individual has worked with the main employer (i.e., the one with the highest earnings) of 2019.

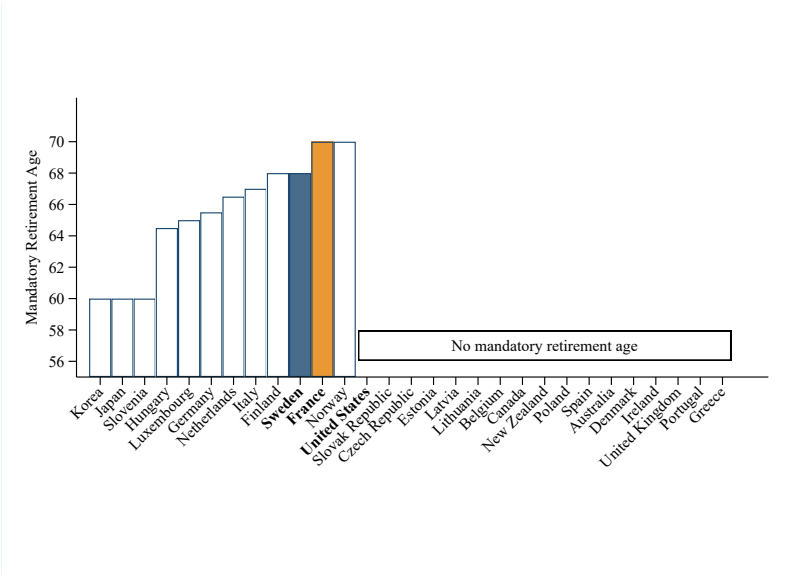
Table A.3: Excess Separation Estimates

	2019	2020	2021	2022
	(1)	(2)	(3)	(4)
Panel A: **Threshold age 67**				
Excess separation	**0.084**	0.038	0.027	0.025
	(0.004)	(0.004)	(0.003)	(0.003)
Observations	387,858	371,293	378,709	413,184
Panel B: **Threshold age 68**				
Excess separation	0.002	**0.006**	**0.036**	**0.038**
	(0.004)	**(0.004)**	**(0.004)**	**(0.004)**
Observations	294,432	271,050	290,971	317,815
Panel C: **Placebo threshold age 69**				
Excess separation	-0.002	0.009	0.001	0.001
	(0.004)	(0.005)	(0.004)	(0.004)
Observations	254,826	218,633	227,246	258,037

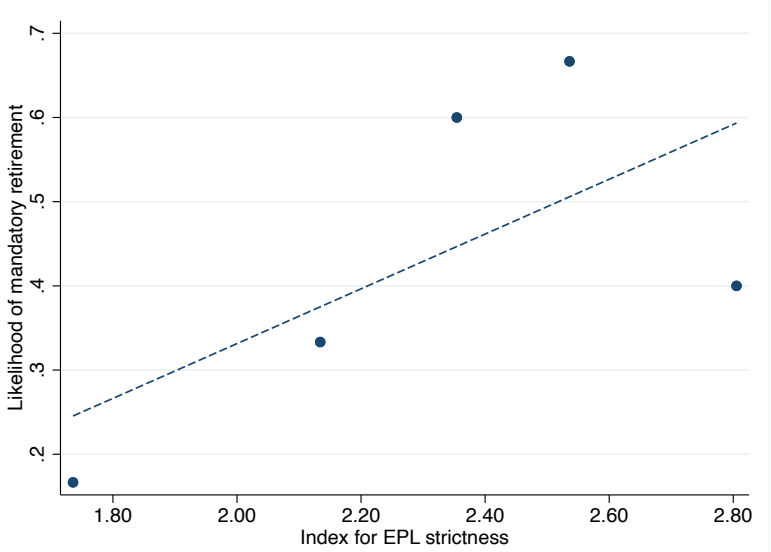
Notes: This table shows excess separation estimates across age thresholds and over years. The columns focus on different years while the panels zoom in on different age thresholds (67 in Panel A, 68 in Panel B). We include a placebo age threshold of 69 in Panel C. All estimates are obtained using the same bunching method described in Figure 7. The graphical analysis underlying these estimates is presented in Figure 9. Standard errors are computed using the delta method. The estimates are bolded when corresponding to the true legal thresholds when employment protection ends. Employment protection is eliminated at age 67 up to 2019 and at age 68 in 2020-2022. Excess separations at age 67 are sharply reduced in 2020 and after. Excess separations at age 68 start appearing in 2021 and 2022. There is no spike at age 68 in 2020 because that cohort's "deadwood" jobs could be laid off by employers at 67 in 2019. By 2021, more than half of the spike has migrated to age 68. This demonstrates that the spike we observe at age 67 in 2019 is indeed driven by the elimination of employment protection. None of the placebo estimates for age 69 are significant, validating our identification assumption that, absent employment protection ending, there would be no bunching at ages 67 or 68. Observations count the number of months times individuals, including only months with positive earnings as separations are always defined relative to the working population, for the ages 67-7/12 to 67+7/12. See also Figure 10 for the time series of excess separations by age cutoff.

Figure A.1: Mandatory Retirement and Link with Employment Protection Strictness

(a) Mandatory Retirement Ages in 2021



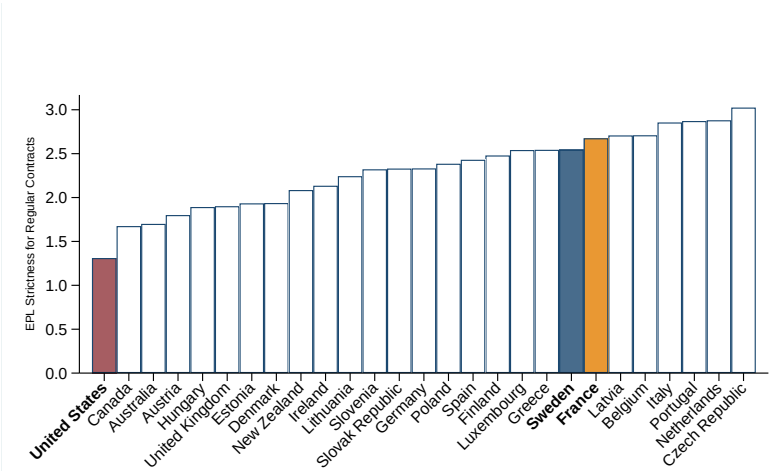
(b) Mandatory Retirement and Employment Protection Strictness



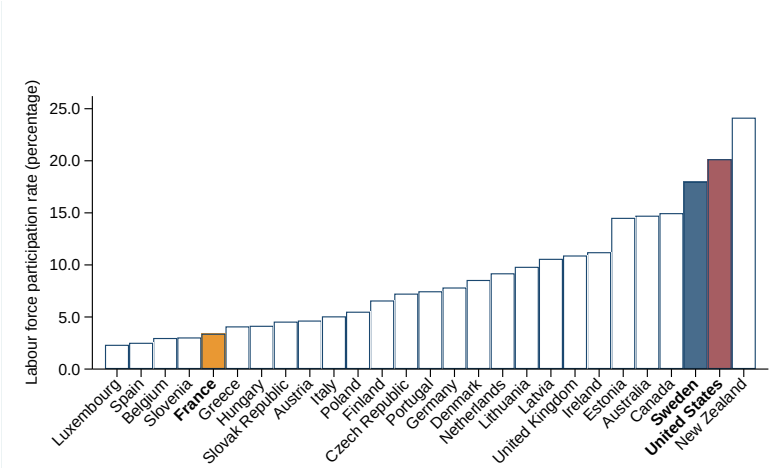
Notes: Panel (a) depicts mandatory retirement ages in OECD countries as of 2021 (source is OECD 2022). Countries are ordered by mandatory retirement age when such a mandatory age exists and applies to all workers in both the private and public sectors. Countries with no across the board mandatory age are listed on the right side (a number of these countries do have mandatory age in the public sector but not the private sector). Panel (b) shows that there is a positive correlation between the likelihood of having a mandatory retirement age across the board and the strictness of employment protection legislation (employment protection). OECD countries from Panel (a) are ranked in five bins of employment protection strictness using the data depicted on Appendix Figure A.2 Panel (a). For each bin, the compute the fraction of countries with a mandatory retirement age across the board using the data depicted in Panel (a). The regression line is depicted and is upward sloping.

Figure A.2: How Sweden Compares on Employment Protection and LFP at Age 65+

(a) Stringency in Employment Protection Legislation



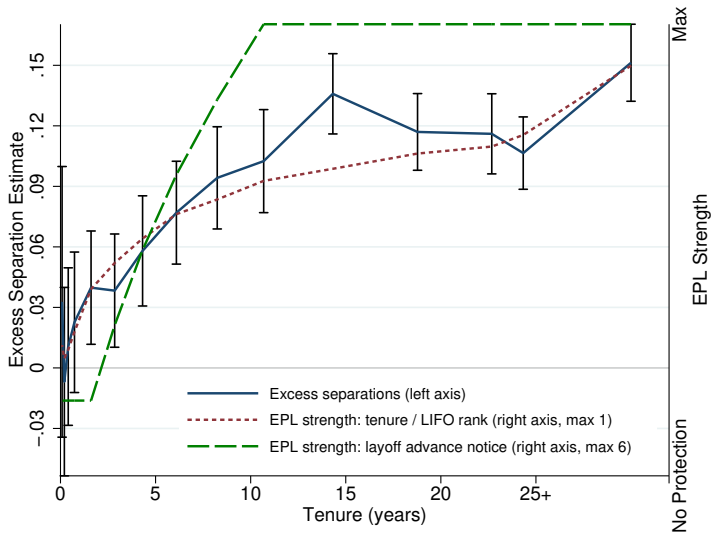
(b) Labor Force Participation at Age 65+



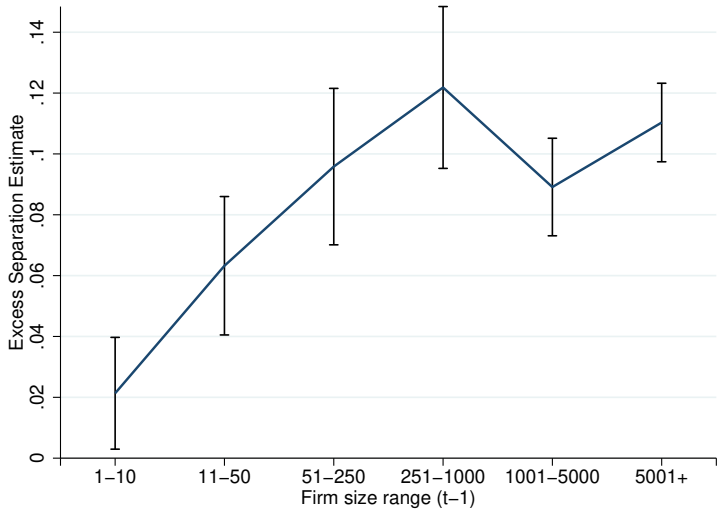
Notes: This figure uses OECD statistics to compare Sweden vs. EU countries and Anglo-American countries in terms of stringency of employment protection legislation (employment protection) in Panel (a) and labor force participation of the population aged 65 and over in Panel (b) in 2019. Sweden has a stringent employment protection comparable to France and much stricter than the United States. Sweden has high labor force participation at older ages, much higher than France and comparable to the United States.

Figure A.3: Heterogeneity by Tenure and Firm Size

(a) Excess Separations by Tenure



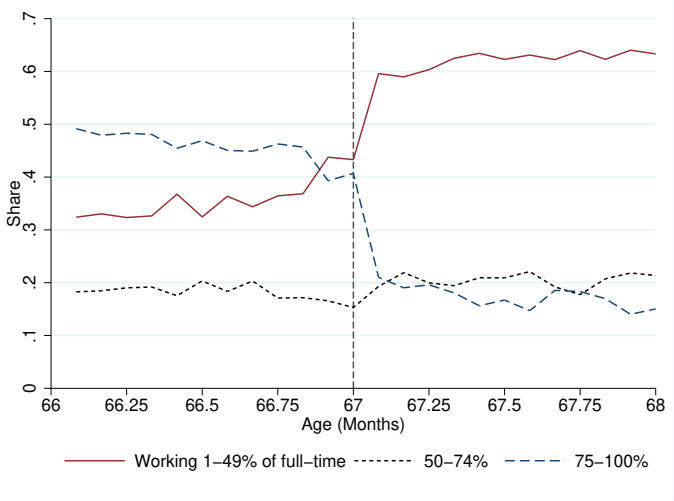
(b) Excess Separations by Firm Size



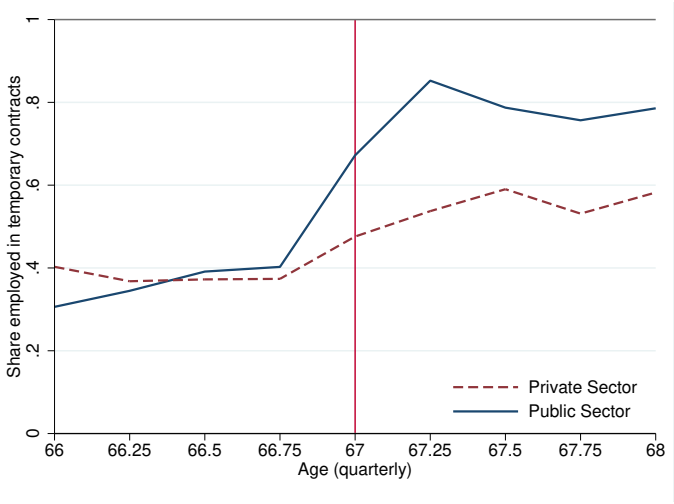
Notes: Panel (a) depicts the excess spike, estimated using the bunching procedure, by tenure decile among those with tenure of at most 12 years, and then five equally sized groups for the higher tenure groups. The x-axis captures the average tenure in each of these quantiles, except for the top group (which is above censored for data reasons, and hence we cannot calculate that group's mean). The graph shows that the excess separations estimate grows fairly smoothly with tenure. It becomes flat at higher tenure values, plausibly because EPL strength is maxed out. Indeed, we additionally plot two proxies for EPL strength as in Figure 3, for tenure rank (for LIFO rules) and advance notice (in months), where the max values are 1 (top of the tenure distribution relevant for LIFO) and 6 months, respectively. Panel (b) depicts the excess spike, estimated using the bunching procedure, by firm size measured as number of employees in the year before. The graph shows that the excess separations estimate grows with firm size, in particular at the lower end of the firm size distribution (recall that firms with 10 or fewer employees are partially exempt from LIFO rules for layoffs).

Figure A.4: Impact of Employment Protection Elimination on Contracts

(a) Full-time vs. Part-time Jobs in Public Sector



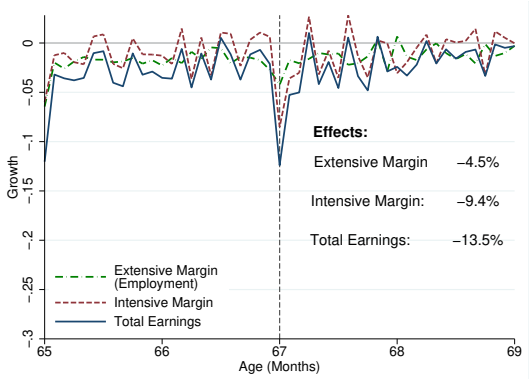
(b) Temporary vs. Permanent Contracts



Notes: Panel (a) considers the panel of stayers (with the same employer on both sides of 67) among public sector workers (in the 2018-2019 Structure of Earnings Survey waves as in Figure 13), but then breaks it down into hours categories, displaying the fraction of workers working less than half of full-time, between half-time and less than 75 percent of full-time, and 75 percent of full-time or more. The figure shows a large decline in fraction working at least 75 percent of full-time and a corresponding increase in the fraction working less than half of full-time. This shows that the main margin of intensive response in the public sector is to shift workers from (close to) full-time positions toward part-time positions. Panel (b) uses the Labor Force Survey pooling years 2010-2019 to plot the fraction of workers in temporary contracts (as opposed to permanent contracts) among private sector workers and among public sector workers by age (in quarters). The figure shows a large increase from 40 percent to 80 percent in temporary contracts surrounding the employment protection cutoff age 67 among public sector workers and a much more muted increase for private sector workers. In the Labor Force Survey, the definition of stayers (see main text) is among employed workers on both sides of 67, as we cannot identify employers in this dataset. Panel (b) is based on 1,693 observations.

Figure A.5: Earnings per Capita: Private vs. Public Workers, and Professors

(a) Private Sector Workers

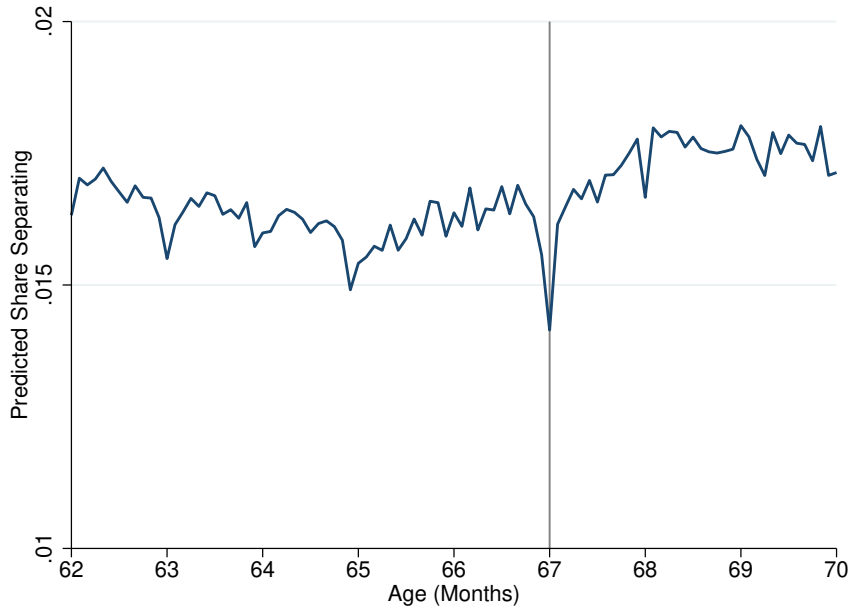


(b) Public Sector Workers

(c) Professors

Notes: The figure repeats the analysis of percent changes in monthly earnings per capita (including zeros) presented in Figure 4 Panel (b) but broken down by private sector workers (Panel (a)), public sector workers (Panel (b)), and professors (Panel (c)). For each group, the figure also decomposes the total earnings per capita changes into an extensive margin (employment changes in green dotted-dashed line) and an intensive margin (earnings conditional on working in red dashed line). The earnings drop are twice as large in the public sector than in the private sector, and are considerably larger for professors. In the overall public sector, the extensive margin employment drop and the intensive margin of earnings conditional on working contribute about half to the total earnings drop. In the private sector, the intensive margin accounts for more, about two thirds, similarly for professors. In 2019 and with public/private defined by ownership, and professors by occupational codes, the shares are 51 percent public, 49 percent private, and 0.72 percent professors.

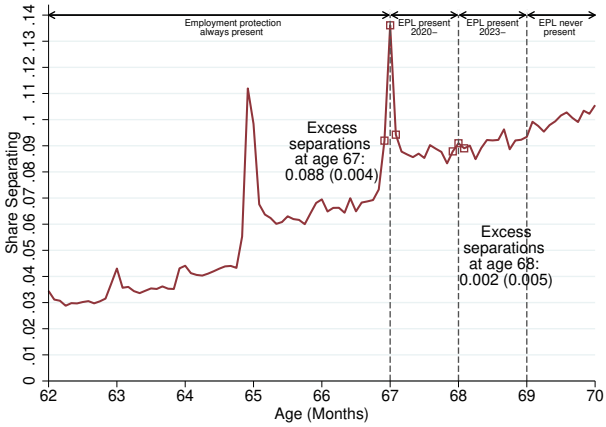
Figure A.6: Suggestive Test on Compositional Effects Among Separators Based on Predicted Separation Shares, if Anything Pointing to Lower Rather than Higher Separation Rates Among Age-67 Separators



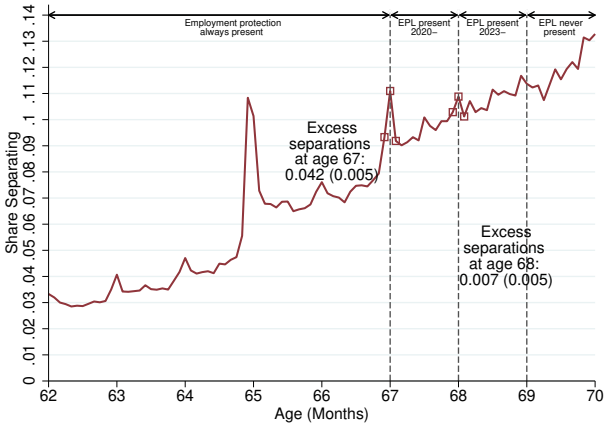
Notes: The figure reports the empirical analyses described in Footnote 22 in the main text: a suggestive direct test on compositional effects. Specifically, we constructed separation probabilities predicted by observables (fed into a linear probability model trained on data from ages 59-61 in 2019, using public/private sector, gender, immigrant status, ten tenure categories, and all their interactions, as well as a cubic polynomial in previous earnings, and fixed effects for education-industry indicators). We then plot the average predicted separation rate among separators and find a sharp but modest decline rather than increase at 67. Hence, the test suggests that the excess separations appear to stem from jobs with if anything modestly longer rather than shorter predicted subsequent duration. This finding does not lend support to the view that the spike of separation at 67 has limited effects on lifetime employment by terminating jobs that were about to end.

Figure A.7: Reform Robustness: Change in Employment Protection Age Cutoff

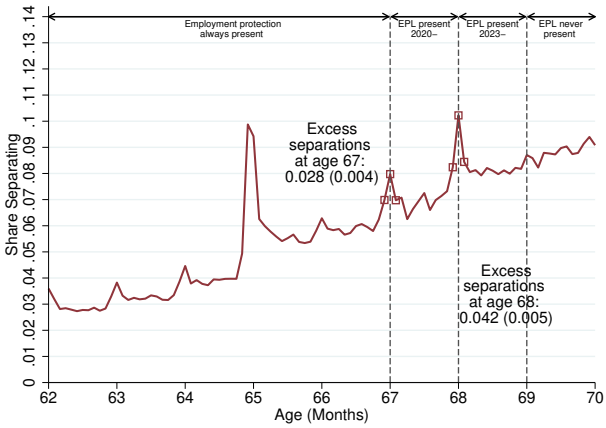
(a) 2019: Cutoff at 67, with clear 67 spike



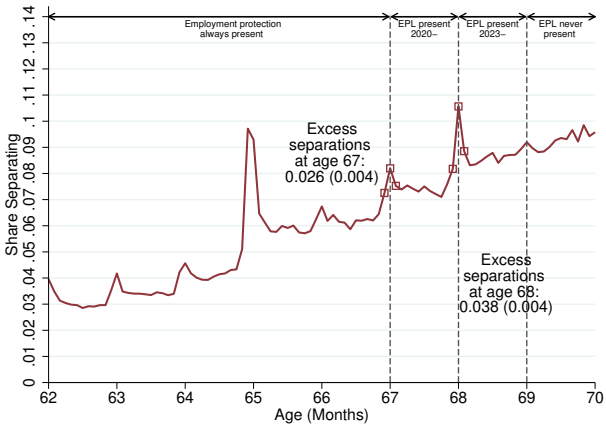
(b) 2020: Cutoff at 68, no 68 spike yet



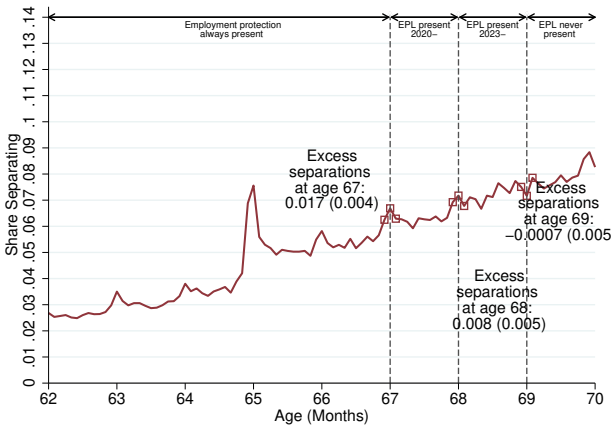
(c) 2021: Cutoff at 68, Spike at 68 emerges



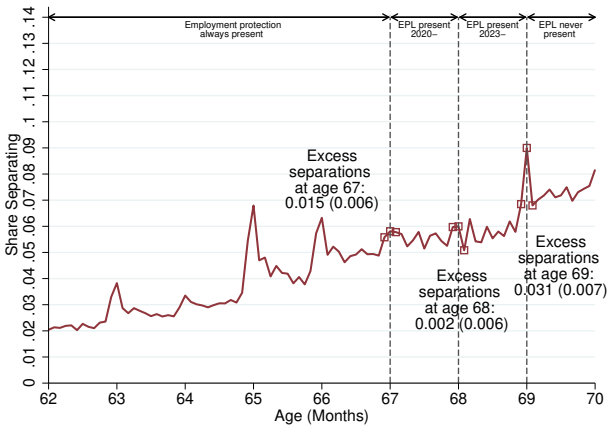
(d) 2022: Cutoff at 68, Spike at 68 grows



(e) Cutoff at 69, no 69 spike yet



(f) 2024: Cutoff at 69, Spike at 69 emerges



Notes: This figure repeats Figure 9 but defines a separation as being employed by a specific employer in a given month, but not working with that employer during any of the next 6 months–instead of 12 months in our baseline. The 2024 panel is identical to Figure 9(f) and based on the first 4 months of the year (instead of full year) because our data ends in October 2024 (and we need 6 months of post-separation data to measure separations). 2023 is full year in this figure while it was based on the first 9 months in Figure 9(e). Shifting the definition from 12 months to 6 months has only a minimal impact on excess separations at cut-off ages with nearly identical estimates. This validates the approach of Figure 9 of showing 2024 with a different definition due to data availability.