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DEADWOOD LABOR?
THE EFFECTS OF ELIMINATING EMPLOYMENT PROTECTION FOR OLDER WORKERS

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

We study the role of employment protection legislation (EPL) in boosting employment among older workers. We do so by conducting a comprehensive analysis of the sharp and complete elimination of EPL that occurs at age 67 in Sweden, as well as reform-driven shifts in this age cutoff. First, focusing on direct separation effects, we find that 8% of jobs separate in response to the elimination of EPL. Effects stem from jobs with stronger initial EPL (long-tenure, firms subject to "last in, first out" rules), and those in the public sector. Separations appear involuntary to workers, with firms targeting plausibly unproductive workers (sick leave users). Second, we focus on effects on continuing jobs. While wages appear rigid to EPL elimination, we uncover novel, sizable intensive-margin hours reductions among continuing jobs, and an 8% drop in earnings conditional on staying on the job. Third, we estimate total equilibrium effects at the cohort level, where separations fully pass through into employment to population rate effects, with no offsetting effect from hiring. On a per-capita basis, total earnings of older workers causally drop by 21.5% due to EPL elimination. We validate these local effects by leveraging a reform-driven shift in the age cutoff from 67 to 68. EPL is therefore a potential tool to prop up labor income among older workers, by prolonging the duration of their final job.

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1 Introduction

Employment protection legislation (EPL) consists of regulations that mainly constrain layoffs through regulations on severance pay, just-cause restrictions for dismissals, advance notice, lengthy negotiations with worker representatives, and redress in labor courts. A defining feature of EPL is that it favors high-tenured, older insiders as its strength increases in tenure and age, due to seniority rules and phase-ins over the job tenure. Hence, against the backdrop of an aging workforce, policymakers around the world have recognized the role EPL may play in propping up employment of older workers. For example, OECD (2004) finds that while EPL is negatively correlated with employment rates for prime age workers, this correlation goes away for older workers.[1]

However, the basic economics of EPL implies that *any* positive employment effects *necessarily* come in the form of "deadwood" labor: unprofitable jobs that firms would like to terminate but cannot, because of EPL and because entrenched older workers insist on staying put to reap rents.[2] Yet, because sharp phase-outs of EPL are rare and confounded by, e.g., variation in pension incentives, little is known about how EPL shapes the jobs of older protected workers in the data and, specifically, the extent and kind of "deadwood labor" it may foster.[3]

This paper directly identifies the jobs EPL protects among older workers and provides a comprehensive analysis of their share and characteristics. Our strategy exploits the quasi-experimental elimination of strong EPL for older, highly-protected insiders in Sweden. Sweden ranks highly—alongside France—in the strictness of EPL across countries.[4] During the main period under study, Swedish workers enjoy multi-month (up to 12) mandatory advance

[1]OECD (2006, Chapter 3, p. 82) notes that these correlations or absence thereof are somewhat sensitive to specifications and control variables included.

[2]These patterns can emerge endogenously, as in the Lazear (1979) model of implicit contracts and backloaded compensation, where workers with higher seniority enjoy rents ex post, with wages above productivity—so that firms would like to lay them off—and wages below workers' outside options—so that workers would like to continue.

[3]While there is large literature on EPL 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 EPL. 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 2022). On the firm-level side, studies have exploited employment (firm size) thresholds in cross-sectional regression discontinuity designs or reform-based difference-in-difference 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 EPL on separations. There is also a small literature on mandatory retirement that we discuss below. See Cahuc and Palladino (2024) for an overview.

[4]According to the OECD index, Sweden ranks relatively high in EPL strictness (very similar to France) and much higher than the United States and other English speaking OECD countries (see Appendix Figure A.1 Panel(a)).

notice and various additional firm-level protections such as from "last in, first out" layoff mandates and other restrictions on dismissals such as just cause requirements until age 67. But once they turn 67, Swedish workers *lose all protections*.

This elimination of EPL at age 67 allows employers to costlessly terminate any worker who reaches age 67. Hence, protected jobs identify themselves in the form of excess separations concentrated at the EPL cutoff age—allowing us to implement a research design drawing on simple bunching estimators (Saez, 2010, Chetty et al. 2011) in the raw data of separations against age.

Importantly, unlike in other settings, the modern Swedish system does not match the EPL cutoff age with any other policy discontinuity that may confound the effects of EPL termination. In particular and importantly, pension benefits are actuarially fair in the cohorts we study, retirement timing is flexible for workers, there is no mandatory retirement age, and the individuals can start drawing pensions by 65 or even earlier in many cases, i.e., years earlier than the EPL cut-off. Hence, any discontinuous separation pattern at age 67 is exclusively due to the EPL variation. We also rule out retirement norms as a confounder.

Our first main finding is that overall, EPL has moderate effects on separations of workers at age 67: 92 out of 100 initially protected jobs continue even without *any* EPL. We do document a clear but moderate excess spike in separations at age 67. Read through our bunching estimator, this spike *identifies 8% of jobs as protected by EPL*. Consistent with EPL as the driver, the excess separations are concentrated among high-tenure workers (who until 67 had longer advance notice and tenure protections) and firms subject to stricter last-in-first-out rules (exploiting a regulatory cutoff in firm size). We also show that the spike in separations migrates when a reform shifts the EPL cutoff age from 67 to 68, and that no spike was present at 67 in a pre-period when the cutoff was at age 65. Hence, retirement norms (as in Seibold, 2021) do not appear to confound our estimate.

The migration of the spike tracking the EPL cutoff wage, from 67 to 68, further illustrates the logic of deadwood labor as a conflict between employees and employers in action: the deadwood workers in the new regime could have voluntarily separated at 67, yet they insist on staying put in their jobs a year longer, consistent with a strictly positive rent. Conversely, firms could have offered workers contracts through 68 already before the reform but chose to lay them off at 67 in the old regime, indicating a strictly negative surplus for firms.

Second, we characterize the excess separations at 67 in heterogeneity analyses, by devising a novel (univariate and multivariate) regression approach applied to the bunching estimator. The heterogeneity in excess separations traces out three related concepts: the characteristics of a deadwood worker, the type of organization that accumulates deadwood jobs, and the pre-elimination, baseline degree of protection, i.e., treatment intensity. As mentioned above, legal factors determining EPL strength (firm size and tenure) light up in our heterogeneity analysis.

Besides stronger EPL, tenure could also capture "good jobs" that older workers evidently hold on to. But 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 two and a half times larger an excess separation effect—with nearly 20% 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 67.

Consistent with firms targeting specific deadwood jobs, 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: the *public sector* lays off twice as many workers as the private sector, even when controlling for firm size. Hence, private sector firms appear to largely get around EPL for older workers. Perhaps they lay off deadwood workers or induce them to quit beforehand, perhaps they keep older workers productive, or because private sector firms experience more frequently the kind of events that effectively relax EPL (e.g., business reasons that provide just causes for dismissals or that weaken worker representatives' opposition to layoffs). Alternatively, public sector jobs may be the kind of jobs that older workers hold on to as long as they legally can because they provide higher rents. We find that the vast majority of the excess separators go directly into retirement, rather than employment with another employer. This pattern indicates a stronger form of deadwood, such that the worker's reservation wage exceeds the market wage (e.g., her marginal product at *all* other firms).

Third, we study the effects of EPL on the vast majority of jobs—92%—that survive the elimination of EPL. 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. Such wage rigidity may help explain the divergence of productivity and wages among the deadwood jobs that separate at 67.

Strikingly, while 92% of jobs stay active after 67 without EPL, we find that these jobs do contain a non-negligible share of deadwood labor units at the *intensive* margin—indicating that part of the hours or part of the tasks some older workers worked before 67 were not profitable. This is because we uncover clear and strong hours and earnings responses among stayers (at constant hourly wage rates). Quantitatively, intensive-margin hours reductions among stayers are about 8%, hence *doubling* the total amount of deadwood labor when added to the separation, extensive-margin effects.[5] Drawing on the Labor Force Survey, we find that

[5]There are three interpretations. First, conceptualizing EPL as a firing cost, perhaps such downgrading of hours is needed to prevent a layoff now that the firing cost from EPL is eliminated; e.g., workers were previously paid for unproductive hours. Second, EPL itself may have prohibited contract restructuring, in a broader notion of EPL besides firing costs. Third, it appears that workers move into "partial retirement" and part-time jobs.

employers also issue new contracts, but issue fixed-term (temporary) rather than open-ended (permanent) ones. These results on the structure of jobs *among stayers* are novel to a literature on EPL that has largely focused on extensive-margin separation and hiring responses, or on retirement as a binary choice.

Fourth, motivated by these rich margins of adjustment and thanks to the age-based variation, we conduct a comprehensive (equilibrium) analysis of the effects of EPL on older workers, moving from studying job-level outcomes to an analysis *on a per-capita basis*. We find that the elimination of EPL lowers a cohort's employment-population ratio by 2.5 percentage points (10%). That is, separation effects pass through almost fully into employment, as we find essentially no offsetting response in the form of hiring. Therefore, EPL prolongs deadwoods' final job, but these workers either are unwilling to take another job or no firm would employ them even without EPL, with reservation wages exceeding productivity among all employers, or due to wage rigidity.

As our most comprehensive equilibrium outcome, we consider earnings per capita, incorporating all extensive margin (separations and hiring) and intensive margin adjustments (hours, job quality, composition). That is, we essentially measure deadwood in earnings per capita units. Overall, the elimination of EPL reduces total earnings per capita by nearly 22%—equivalently, EPL propped up earnings per capita among older workers by 22%. Slightly more than half of this effect is due to the novel intensive-margin effects we document (hours reductions of stayers, but also composition as high earners separate more). The remainder reflects separations, but specifically the fact that they go into retirement rather than reallocate to other employers.

We use those per-capita graphs to additionally validate the implicit identification assumption underlying our local analysis: that all responses are concentrated sharply around the cutoff age, in the form of one-time adjustments and without effects on behavior before or after. Indeed, we find parallel trends in the employment rate and earnings per capita comparing the 2019 and 2022 regimes, when cutoffs were 67 and 68, respectively. The only divergence occurs sharply at age 67, and then lines quickly reconverge following age 68. Hence, the EPL reform delays the shedding of deadwood from age 67 to age 68, elevating employment rates in this interim age interval.

Sweden has passed further legislation that raised this cutoff to 69 starting in 2023. The policy motivation is the belief that the EPL age props up employment among older workers. Our results support this idea, with EPL providing a moderate boost to the length of the working life by extending the duration of, and hours in, the last jobs, albeit presumably by reducing firm profits and with potential equilibrium effects on the hiring of younger workers.

At the highest level, our findings indicate that EPL 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, EPL 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). Créchet (2023) presents a model of how firing costs may facilitate long-term contracts. Lazear (1979) devises a model in which deadwood ex post emerges due to backloaded compensation, which is ex ante efficient due to incentive problems. At a more micro level, the excess layoffs may be inefficient if older workers may be 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. Our evidence for wage rigidity leaves room for the possibility that older workers might fail to strike a Coasian bargain in the form of lower wages (Jäger, Schoefer and Zweimüller, 2023).

Our paper also includes an additional analysis that may be of particular personal interest to the reader. We study professors—in an exercise in the spirit of the study of Ashenfelter and Card (2002). Ashenfelter and Card (2002) study the elimination of mandatory retirement in US universities for professors with tenure—one of the strongest forms of employment protection. They show that when mandatory retirement of professors at age 70 was legal, universities pushed out nearly all of them at that age; when age discrimination laws led this arrangement to be phased out starting 1994, cohorts aging across 70 in the new regime held on to their jobs. Our paper can be read as implementing this unique case study in the full labor market for the case of EPL. When we turn to Swedish professors, we find strong responses too. However, in Sweden, most of the effect works through the intensive margin, with professors obtaining part-time, temporary contracts, with dramatic (about 70%) reductions in hours worked and hence earnings.

Most related to our study, there is a small literature on the banning of mandatory retirement policies in the United States and Canada. Consistent with our findings, Burkhauser and Quinn (1983), Shannon and Grierson (2004) find modest effects overall but Ashenfelter and Card (2002), Clark and Ghent (2008), Warman and Worswick (2010) find large effects for the specific case of professors. In important contemporaneous work, Morris and Dostie (2023) revisit the Canadian experience using comprehensive administrative data and find significant effects with substantial heterogeneity across industrial sectors and firms characteristics consistent with our findings; they also draw on reform-based (province-level) variation. Outside North America, some recent studies have also studied mandatory retirement policies but identification is challenging due to the interaction with pension systems,[6] an issue that does not arise in the Swedish case we study, allowing us to characterize the deadwood phenomenon more precisely and not only along the extensive margin but also the intensive margin.

[6]See Kondo and Shigeoka (2017) for Japan, Rabaté (2019) for France, and Rabaté, Jobben, and Atav (2023) for the Netherlands.

The paper is organized as follows. In Section 2, we present a simple conceptual framework. In Section 3, we review the institutional setting and data, and our source of variation of EPL. Section 4 describes the direct effects on separations and their characteristics. Section 5 reports effects on continuing jobs. Section 6 conducts the per-capita analysis. Section 7 concludes.

2 A Simple Conceptual Framework: Deadwood and EPL

We start by formalizing the notion of deadwood jobs and EPL in a parsimonious model of jobs, separations and EPL; we also formally introduce our identification strategy through excess separations in response to the elimination of EPL.

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[7]) to the worker whose 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 EPL.

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:

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

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

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

Deadwood jobs supported by EPL. EPL fosters a well-defined notion of deadwood jobs: jobs are viable with EPL but not without it, with the only reason firms not dismissing those workers being the EPL firing cost. These jobs carry gross-of-EPL firm surplus in the range

[7]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.

$-f \leq \widetilde{S}^F < 0$. 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 EPL. Our research design, studying a quasi-experimental elimination of EPL, can be formalized in the model as follows. We have two groups differing by EPL costs $f^T = 0$ and $f^C = f > 0$. Both groups will draw from the same (gross-of-EPL) 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:[8]

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

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

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

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 EPL.

Formally, we can represent this dynamic context by considering four ages $a = 0, 1, 2, 3$, and we 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 EPL is eliminated, and hence $f_2 = 0$. Comparing separations at ages 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 $f_3 = 0$, providing a window either into persistent (compositional) effects or another control age.

In principle, EPL may have dynamic effects before and after the anticipated elimination of EPL 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 those dynamics, as we do not find declines in separations right before the elimination of EPL—perhaps because of imperfectly

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

persistent surplus shocks or due to EPL rules, including advance notice. In an empirical extension, we also exploit a reform that shifts the age cutoff for the EPL elimination.

Second, separations after, rather than before, the EPL 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 in raw data do not suggest clear evidence for such levels shift in separations following the elimination of EPL.

Third, EPL rules typically strengthen in tenure, and hence EPL *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 EPL 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 EPL hence raise a stronger notion of deadwood: the worker's reservation wage exceeds his productivity everywhere.[9]

In the data, we will find that most workers our strategy identifies as separating due to the elimination of EPL experience permanent nonemployment, i.e., retirement. These results therefore do not speak to the role of EPL 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 we will check, and will not find evidence, for wage adjustment as workers age out of EPL. Still, bargaining responses are difficult to measure empirically. An

[9]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.

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. 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.[10]

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, akin to the business cycle model with wage stickiness and endogenous effort by Bils, Chang and Kim (2022). 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 EPL 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 additional 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 EPL.

3 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.

3.1 Employment Protection Legislation in Sweden

We start by describing employment protection in Sweden. The regulations are very generous and multi-dimensional with Sweden ranking high in the OECD index, very similar to

[10]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-EPL *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, EPL 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 EPL but would have negative surplus absent EPL—and hence separate when EPL is eliminated.

France and much higher than English speaking OECD countries (see Appendix Figure A.1 Panel (a)). These institutions are described in more detail in Heyman and Skedinger (2016), Bjuggren (2018) and in Cederlöf, Fredriksson, Nekoei and Seim (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 EPL 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 at most six months. Therefore, most jobs in Sweden receive tenure after six months, at which point EPL protections start and then ramp up further with additional tenure.[11]

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.[12] 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 this needs to be carefully documented and hence is costly for the employer.

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.[13]

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 tenure tie, the youngest worker needs to go first. LIFO rules apply within establishment and occupational circuits. In practice, the occupational circuits are agreed upon in negotiations between the employer and union

[11]Junior academic positions in Universities work around this tenure after 6-month system by being classified outside of regular jobs. Academic positions become regular jobs only after academic tenure has been granted. Such a workaround is however exceptional in the overall Swedish labor market.

[12]In case the layoff event involves five or more workers, the firm is obliged to report this to the Public Employment Service (PES). The goal of this institution is for the PES to prepare for an inflow of unemployed job seekers.

[13]Cederlöf, Fredriksson, Nekoei and Seim (2023) exploit the feature that white-collar workers in the private sector get a 6-month extension when they turn 55 years old for identification in an investigation of the causes of longer advance notice on various outcomes.

representatives.[14] The typical configuration is that a circuit represents all workers covered by one collective bargaining agreement within the establishment. See Cederlöf (2021) 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.[15]

Severance payments. While the Swedish EPL 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 EPL age cutoff.[16] The Swedish data does not allow 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 after age. 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. 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 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 (Saez, Schoefer and Seim, 2019, who focus on younger workers). This evidence leaves room for wage rigidity in mediating the effects the specific policy discontinuity we study.

[14] Landais et al. (2021) show that the within-firm tenure-rank is highly predictive of who gets laid off in a collective dismissal in the Swedish setting, but do not study the elimination of EPL at the age cutoff.

[15] On October 1 2022, Sweden implemented a large reform to the employment protection rules. Among other things, all employers are allowed to exempt 3 workers from the LIFO rules when intending to lay off workers.

[16] Severance payments cannot be directly observed in the data but can be inferred from excess earnings at the end of a spell creating measurement error (Cederlöf, Fredriksson, Nekoei and Seim, 2023).

3.2 Elimination of EPL for Older Workers

We now present the sharp variation in employment protection brought about by the age rule.

The EPL 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 his/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 EPL, LIFO rules also do not apply. This means that an employer is free to choose whether and when to lay her off in case of a collective dismissal.

Empirical variation: average advance notice and LIFO rank by age. Firing costs are eliminated once the worker reaches the relevant age where EPL 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 3.5.

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 EPL cutoff age of 67 have on average a high tenure rank around .70, which implies that they cannot be laid off until 70% 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.

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). 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 EPL that are also eliminated at age 67, crucially, the requirement to have a just cause for dismissal.

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.

3.3 The Pension System in Sweden

The Swedish setting is a particularly suitable context for our test because of the structure of the pension system, which does not interfere with the EPL 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 chose 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.[17] 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 pensions toward 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 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 EPL 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 cut-off age threshold when EPL ends.

Note also that unemployment benefits are no longer available after age 65 (unemployed elderly 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 EPL protection ended. However, since 2003, the government has tried to push more people to work beyond age 65 by extending EPL up to age 67 and also by providing additional tax incentives to keep working past age 65 through an employer payroll tax cut

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

and an earned income tax credit for employees both of which start to apply at age 65–and with no discontinuity at age 67.[18] 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.

3.4 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.1 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.

3.5 Data and Analysis Sample

Our analysis is based on the full population of all Swedish residents (as of December 31 each year) in 1998-2022, with 2019 as our focal year. We use pseudonymized 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 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 structures, reported at the employer-employee level for the all public-sector workers and sampling about

[18]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.

half of private sector workers. We measure hours of work relative to full-time where 100% means full-time and 50% half-time. etc. Employers respond to the survey once every year (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 EPL only for the public sector, which is why we limit the use of the survey to this group only.

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

Summary statistics. Table 1 shows summary statistics for the population as a whole in Panel A and for workers 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 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% working vs. 78% for the younger group. Around age 67, the fraction working is 25%. 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% of older workers aged 62-70 work full-time and only 27% do so around age 67 in contrast to the younger workers for whom the average is around 78%. 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 demographic characteristics, with the exception that older workers are less likely to be immigrants.

4 Identifying Deadwood Jobs: The Direct Effects of the Elimination of EPL 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. 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 2.

The jobs bear the hallmarks of deadwood labor fostered by EPL: the spike migrates with reform-driven shifts in the EPL cutoff age, and is more pronounced among workers subject to stronger pre-67 EPL 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. She separates in case 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 in a given month but not working with that employer during any of the next 12 months.[19] We pair this separation outcome with the age of the individual at a monthly level 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.

4.1 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 3.5, 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 between 62 and 70. Figure 4 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 lagged incentives no longer applicable

[19]We have done sensitivity analysis 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).

to our cohort in 2019, see Section 3.3).[20] Overall, as shown in Seibold (2021) for Germany, these patterns—including the large spike at 65—cannot be rationalized by neoclassical labor supply choices but reflect retirement norms.

Excess separations at 67: raw data. To recap, employment protection is eliminated when workers turn 67. There is no other policy relevant change at age 67. 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 EPL-based 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 EPL.

Excess separations: formal estimation. Figure 5 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 5 shows that separations are abnormally elevated in these 3 months and only these 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 5). Excess separations are simply the sum of the three differences (gray area in Figure 5). Standard errors are obtained using the standard 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 EPL, 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 5. We provide a formal test below in Table 2. We did note above that there is substantial bunching at age 65 due to a retirement norm. Figure 4 also shows very modest bunching at ages 62, 63, and 64.[21] Because there is

[20] As mentioned above, that norm was actually weakened as the government introduced payroll tax cuts and an earned income tax credit for workers over 65 in 2007.

[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.

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% of jobs at 67 are "deadwood." The bunching estimator reveals that in the full sample (corresponding to Figure 4), the estimate of excess separations is 8.4%. This result means that 8.4% of jobs separate because of the discontinuous elimination of EPL at age 67. The remaining 91.6% of previously heavily protected jobs continue without any EPL whatsoever.

Quantitatively, our estimate can also be read as in response to the specific first stage effects (on average a loss of 4 months of advance notice from about 5 to 1 months), and a loss of last-in-first-out privileges (falling from the about 70th to to first percentile rank in the pecking order of firing at the firm level). We plot this variation in EPL in Figure 3. In addition, all other EPL dimensions are also abolished. Importantly, the just-cause requirements and any other rules no longer apply to layoffs after 67.

Hence, read through the model in Section 2, 8.4% of Swedish jobs occupied by workers at age 67 are deadwood in the specific sense that EPL supports them: firms would have preferred to terminate those jobs even before had it not been for the EPL costs (due to negative firm gross-of-EPL 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% of jobs that continue, the parties obtained positive (gross) surplus before and do so also after the elimination of EPL.

Table 2 reports the excess separation estimates, separately by calendar year (columns) and by age (panels). Results for 2019 are reported in column 1, and for age 67 in Panel A. (Estimates for 2020-2022, when the age threshold increases to 68, are reported in the next three columns and will be discussed below.) Panels B and C report excess separations at ages 68 and 69. In 2019, these are placebo tests as there is no change in EPL status at these ages. Table 2 shows that there are no significant excess separations at these ages; in fact, the estimates are slightly negative and insignificant. These placebo checks confirms the visual analysis from Figure 4 that showed no excess spikes at these ages. This check justifies our identification assumption, that absent the elimination of EPL, there should be no excess separations at age 67 in 2019.

Post-separation outcomes: reallocation to other employers vs. retirement. Panel (a) of Figure 6 decomposes the baseline separations (solid grey line) and the excess spike 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 2.

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 EPL, rather than specific large organizations implementing an across-the-board human resource policy that simply ends all contracts 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 6 reports those results. The excess spikes increase smoothly from around 0% for firms with the lowest excess separations to about 15-20% for firms with the highest excess separations. The excess spike economy-wide is depicted in the horizontal dashed grey line. The important conclusion is that 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") particularly unprofitable jobs.

4.2 Bolstering the Causal Link Between EPL and Excess Separations

Our interpretation attributes a causal chain from EPL to separations. This argument rests on the institutional facts described in Section 3, 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 EPL as our model in Section 2 posits. By contrast, if EPL caused the spike, one would expect the spike to shift in response to shifts in the EPL cutoff age.

Reform: change in age threshold from 67 to 68. To further substantiate the causal effect of EPL in the spike, we exploit a reform that shifted the cutoff from 67 to 68. Figure 7 replicates Figure 4 for 2019 and three additional years: 2020, 2021 and 2022, along with the year-specific bunching estimates, separately for 67 and 68 in each year. EPL is eliminated at age 67 up to 2019 and at age 68 in 2020-2022 (see Figure 2).[22]

[22]We caveat that for year 2022, only separations for the period January-April 2022 are included (as separations require not working for the same employer again for one year and our data currently ends in April 2023); as a result, the 2022 gradient may not be directly comparable to 2019-21. Moreover, the year of 2021 is subject to the COVID dislocation in the labor market. The year of 2020 is subject to the caveat that the deadwood in that cohort was eliminated in 2019 already, as discussed below.

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 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 has also the advantage of being the last year not affected by COVID disruptions.

Table 2 reports the corresponding excess separations estimates for years 2019 to 2022 at ages 67 and 68 and including age 69 as a placebo. Note that none of the 69 placebo estimates are significant which justifies our identification assumption, that absent the elimination of EPL, there should be no excess separations at ages 67 (in 2019) or 68 (in 2020-2022).

Further substantive interpretation of the migration of the spike. 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, EPL 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 EPL 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 2 and its definition of deadwood labor.

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 EPL cut-off age in Sweden since 1990. The cut-off age was 65 up to 2002, 67 in 2003-2019, 68 in 2020-2022, and 69 since 2023.

Figure 8 Panel (a) replicates Figure 4 for 2002, when the EPL 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 EPL 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.

Figure 8 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% confidence intervals computed as described above.[23] These estimates are produced following the same methodology depicted in Figure 5, with a simple adjustment for the break in data quality starting in 2019.[24] The series are solid after EPL ends and dashed otherwise.

For the age 68 series in Figure 8 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 7. Excess separations at age 67 appear in 2005 after the cut-off age increases from 65 to 67 in 2003. The 2-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 EPL continuing past 65 in 2003, pension changes, and tax incentives to work after 65 set in place in the 2000s.[25]

Treatment intensity variation and role of EPL rules: tenure and firm size. To further bolster the causal interpretation, we exploit treatment effect heterogeneity in the form of varying baseline strength of EPL. 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 firm; we obtain similar results when proxying for it).

Figure 9 Panel (a) replicates Figure 4 but splits up the sample into workers by 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 workers with high tenure (solid blue line), and are much more modest for workers with tenure below

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

[24] 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 are almost identical in 2018 and 2019 without correction.

[25] 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 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.

2 years (dashed red line).

About 72% 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.2 Panel (a) depicts excess separations by tenure decile. The graph shows that the excess separations estimate grows fairly smoothly with tenure.

Panel (b) in Figure 9 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 for layoffs are substantially relaxed in firms with at most 10 employees (see Section 3.1). Again, Appendix Figure A.2 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 EPL at 67, they had heterogeneous levels before), heterogeneity in excess separations can also arise from a larger share of marginal matches with gross-of-EPL surplus between zero and the firing cost (see model Section 2). For instance, perhaps larger firms have accumulated more low-surplus matches and smaller firms get rid of them (or make them more productive) before they turn 67. Or, higher tenure implies a higher probability of having obtained a negative shock that rendered a job unproductive deadwood.

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 10, we therefore break down the sample into workers with fewer than 3 weeks of sick days (dashed red line) claimed vs. workers with more than 3 weeks of sick days (solid blue line); we calculate these sick-leave days in 2018 (the previous calendar year). We choose 3 weeks because any sick leave of two weeks or less is not recorded in the administrative data. This definition reflects the fact that spells of such severity show up in our administrative data (and spells that are shorter do not, generating the other category). 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%, vs. 8% for healthy workers.

Public sector. Panel (b) of Figure 10 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%, compared to just 5% 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 EPL-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.

4.3 Regression-Based Heterogeneity Analysis

In this section, we present a systematic heterogeneity analysis of excess separations by devising univariate and multivariate regression approach—in a methodological contribution to the bunching literature.

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:

$$\text{Univariate specification: } s_{ima} = \alpha_a + \beta_a \cdot D_{ima} + \varepsilon_{ima}. \tag{5}$$

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 5. This differential bunching analysis essentially formalizes the estimation of the contrast in excess separations across 2 groups that we discussed in Figures 9 and 10 at the end of Section 4.2 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 (5) but regresses s_{ima} on monthly age dummies α_a and monthly age dummies interacted with all dummy variables of interest $D^1_{ima}, D^2_{ima}, ...$:

$$\text{Multivariate specification: } s_{ima} = \alpha_a + \beta^1_a \cdot D^1_{ima} + \beta^2_a \cdot D^2_{ima} + .. + \varepsilon_{ima}. \tag{6}$$

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 Table 3. This table lists in each row a specific characteristic (e.g., sick $>$ 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 (5). 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 (6).

We sort the variables in row by the coefficient size in the univariate analysis. 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. 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.

The univariate effects leave open whether omitted variables may confound this estimate. However, turning to the multivariate analysis, we find that the effect sizes fall at best moderately, implying that the univariate analysis we have focused on is unlikely to be confounded by omitted variables. 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).

5 Beyond Separations: Effects on Stayers

We now study potential effects on those jobs that continue after the elimination of EPL. After all, the vast majority of jobs do not separate at age 67. Most obviously, wage adjustments may attenuate layoffs at 67, explaining the moderate excess separations we estimate above or indicating a reshuffling of surplus. Other job aspects may also be adjusted when workers lose EPL, such as hours, contract types or reassignments across activities. As common across OECD countries, EPL often restricts reorganization of job duties for protected workers.

We do not find evidence for wage adjustments. However, among the continuing jobs, we find a non-negligible share of deadwood labor units—*tasks or hours*, with hours dropping by about 8%. Combined with the extensive-margin separations effect, this intensive margin hours effect we uncover *doubles* the total amount of deadwood labor. We also find that firms shift to fixed-term rather than open-ended contracts.

Overall, these results on the structure of jobs *among stayers* are novel to the literature on EPL that has largely focused on extensive-margin separation and hiring responses, or on retirement as a binary choice.[26]

5.1 Wages, Hours, and Earnings of Stayers: Structure of Earnings Survey (Public Sector Only)

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 3.5). This dataset unfortunately stops including private sector workers after age 67. However, it samples 100% 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% of the labor force as shown in Table 1), 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 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 it is measured in both datasets) .

In the Structure of Earnings Survey, we extract workers who show up with the same employer in two consecutive years of the SES data (meaning that they have positive earnings in both years). We then pool two survey years, 2018 and 2019, as we aim to consider a panel of stayers (who hence show up twice in our sample). 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 at some point before turning 67 and at some point after turning 67. We therefore restrict the sample to workers aged between 66 to 68. Hence, our longitudinal analysis of stayers eliminates compositional effects.

Wages. Figure 11 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.

[26]Such intensive-margin responses among stayers could occur for various reasons although we are not aware of dedicated theoretical treatments in the EPL literature in theory or in empirical work. For instance, firms may bargain higher effort or lower hours (under diminishing marginal products) when firing costs fall and hourly wages are rigid (e.g., in another context, Bils, Chang and Kim, 2022, present a business cycle model with endogenous effort and fixed wages). Alternatively, it is possible that the firm can, once the worker ages across the EPL threshold, select only the subset of tasks that give positive firm surplus, whereas with EPL and before age 67, such restructuring was not possible (yet the full job across all tasks did yield on net positive surplus).

Hence, there is no evidence for firms and workers rebargaining wages to keep older workers on the job. This finding has two implications for our understanding of the effects of EPL on protected insiders. First, regarding the excess separators, while we cannot definitively extrapolate to the wage negotiations that may have occurred in those jobs, such wage rigidity may, if exhibited by them 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 EPL and without a wage adjustment.

Hours. We have only considered the extensive margin so far: 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, EPL 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 EPL generates.

To address this possibility, we study effects on hours adjustment within the job. In Panel (a) of Figure 11, 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. In the data, we find a considerable reduction of hours, with the sharpest adjustment exactly at age 67. Additionally, in Appendix Figure A.3 Panel (a), we find 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 11. 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 5.2, 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 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.[27] Figure 11 Panel (b) 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. 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 the cross the age 67 threshold. We show below in Section 6.1 that the extensive margin response for professors is considerably smaller.

5.2 Administrative Data: Earnings of All Stayers (Private and Public)

We now study the effects on earnings among stayers in the administrative data. 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 5.1 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 sample of 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 (and hence the sample period of subsequent outcomes may then include some months in 2020).

Figure 12 presents the impact of the end of EPL at age 67 on monthly earnings among all workers (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 as stayers by construction all have positive earnings). The public sector's earnings gradient in the administrative data mirrors the one documented in the Structure of Earnings Survey from Figure 11, 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%) of workers around age 67 are public sector workers (Table 1).

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 as conceptually similar that our earlier separation rates but capture the intensive margin on stayers rather than the

[27] See, e.g., the following webpage for a description of the rules at Stockholm University: https://www.su.se/staff/organisation-governance/governing-documents-rules-and-regulations/personnel/rules-for-retirement-and-employment-after-retirement-1.534564.

extensive separation margin. They display a (negative) spike at age 67 reflecting the fact that there is an excess drop in earnings precisely when EPL ends. Therefore, we can estimate excess earnings drop paralleling our bunching methodology from Section 4 as follows. On Figure 12, 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 EPL under the assumption that, absent the EPL ending, there would be no excess drop in intensive earnings at age 67.

The figure shows that, consistent with Figure 11, there is a large excess drop of 12.3% 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 11). Turning to the private sector, the figure reports a much smaller excess drop in earnings of about 3.4% 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 10 Panel (b)) and the intensive margin (this Figure 12).

Taken together, average earnings drop among all workers is 7.7%, most likely being accounted for by hours reductions against relatively rigid wages. This intensive margin response is quantitatively similar to the extensive response of 8.4% excess separations that we obtained in Section 4. Therefore, the intensive margin, which, to the best of our knowledge, has not been studied before in the EPL context, is about as important as the extensive margin for which there is large body of work as we explained in introduction.

5.3 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. Appendix Figure A.3 reports those results. Again, 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.[28] This result is another indication that workers and employers rebargain aspects of the job structure when workers lose EPL 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 as we explained in Section 3.5.

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 EPL),

[28] 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.

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 the temporary contract 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).

6 Macro Deadwood: Per-Capita Analysis of Employment, Hiring, Total Earnings

We conclude our comprehensive study of the effects on EPL on protected insiders and its role in generating "deadwood labor" by zooming out to a *per-capita* analysis. This strategy can be thought of as approximating aggregate, equilibrium effects of EPL on older workers. We do so in in two steps. First, we provide a cross-sectional analysis in which we study the effects of the 2019 cutoff at 67 on the employment to population ratio (by age), teasing out the margins of hiring into new jobs vs. separations. In this cross-sectional analysis of the 2019 setting, we can also study per-capita total earnings as an outcome and then decompose this full response into the extensive margin employment response and the intensive margin earnings conditional on working response.

Second, we provide a difference-in-differences-style (DiD) analysis that compares those per-capita outcomes between the 2019 regime to the new regime in 2022 with the cutoff at 68. First, this DiD analysis can be read as a macroeconomic policy evaluation of this reform, with respect to its effect on boosting older workers' labor market engagement. Indeed, Sweden has passed further legislation that raised this cutoff to 69 starting in 2023 (see Figure 2). Second, this additional comparison permits us to check for the implicit identification assumptions underlying our local analysis thus far: that all responses are concentrated sharply around the cutoff age, through one-time adjustments, with no effects on behavior before or after.

6.1 Cross-Sectional Analysis of 2019

We start by studying per-capita aggregate equilibrium outcomes in 2019 along the discontinuity at age 67.

Employment to population. Figure 13 analyzes the employment to population ratio around the age 67 cutoff. Employment is defined as having some labor earnings in a given month, with any employer; the employment numerator includes only wage earners and excludes the self-employed. Panel (a) depicts this ratio by age in levels. While the employment to population

rate declines smoothly with age, there are clear discontinuous drops in employment rate exactly at ages 65 (the remnants of a retirement norm) and 67 (when EPL ends). Panel (b) expresses this series in simple differences (i.e., in percentage points) in the solid blue line series. Using again our bunching method applied to the series from Panel (b), we estimate a 2.5 percentage point (about 10%) excess drop in the employment to population ratio at 67, exactly when EPL is eliminated. (Again, the drop in employment at age 65 is due to the remnants of a retirement norm.) This result implies that the jobs that are terminated at age 67 due to the expiration of EPL are occupied by workers that permanently leave the labor force. This per-capita result is consistent with our micro perspective discussed in Section 4.1 and depicted in Figure 6 (which showed that at the micro level, most separations go into permanent nonemployment).

Decomposition of employment effects into worker flows: hiring and separations. The employment-to-population ratio result also reveals explicitly that there is no counteracting boost in hiring among workers older than 67, neither from those that originally had a job nor from those that were already unemployed or out of the labor force. In principle, a boost in hiring could have left employment per capita stay constant (or led it to recover quickly) despite a large amount of excess separations.

To track this explicitly, we consider following law of motion across monthly ages (up to an approximation from population shifts):

$$\frac{d\text{Emp}}{\text{Pop}} = \frac{d\text{Hires}}{\text{Pop}} - \frac{d\text{Sep}}{\text{Pop}}, \tag{7}$$

where Pop is the full population at a given monthly age. Panel (b) plots the between-monthly-age change in the employment to population ratio (in percentage points) and additionally decomposes it as in the equation above, plotting hires per capita (in green dash-dotted line) and separations per capita (in red dashed line). Hires are defined as positive earnings with an employer in the corresponding month while not having any earnings with this employer in the preceding month. Separations are defined symmetrically: not working in this month but having worked in the past month. Consistent with our earlier analysis on separations, there is a clear spike in separations (dashed red series) which translates, using again our bunching method, into an estimated 2.8 points excess separation relative to population.[29] However, there is no spike in hires at age 67 (dotted-dash green series). We estimate only a .28 point excess hire effect and marginally significant, one order of magnitude smaller than the excess separation effect. Therefore, this analysis of worker flows reveals at best a very modest increase in hiring and labor market fluidity following the elimination of EPL. Hence,

[29] As only about 25% of individuals have positive wage earnings, this excess separation is around 10% of the working population, commensurate with our findings from Section 4.

older nonemployed workers overall do not become more attractive to employers now that their labor comes with no regulatory strings attached, nor do those workers seem to seek new employment. This suggests that their reservation wages exceed their productivity among all employers. Hence, the separation line (which is in per-capita terms and hence reflects a lower effect than as a share of employment before) accounts essentially for the full decline in drop in employment to population at 67. The modest increase in hiring attenuates only about 10% of the separation effect.

Earnings per capita. Figure 14 provides our most comprehensive analysis: effects on earnings per capita. This outcome variable incorporates all extensive margin (separations and hiring) and intensive margin adjustments (hours, job quality, composition). That is, we essentially measure deadwood in earnings units. The figure follows the structure of Figure 13, with Panel (a) depicting earnings per capita by age in 2019, and Panel (b) taking differences of these lines, but in this case in *percent* (solid blue line). While earnings per capita decline smoothly with age, there are large discrete drops in earnings per capita at ages 65 and 67. Using the series in percent difference from Panel (b), we again use the bunching method to estimate the excess effects around age 67, here applied to the earnings growth gradient. There is a 21.5% excess drop in earnings per capita at 67 when employment protection is eliminated. This is a large effect—twice larger than the about 10% extensive margin effect on the employment margin we documented above. Next, we therefore provide an explicit account of the intensive margin.

Decomposition of earnings per capita: extensive and intensive margins. Additionally, Panel (b) of Figure 14 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). 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 3 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 14. The figure reveals that slightly more than half of the total earnings per capita effect is due to the novel intensive-margin effects we document. The rest is due to the conventional extensive margin (here, separations into retirement). Table 4 gathers all these full population estimates in column 1.

The large intensive margin effect can either arise from reductions in hours or wages, or from a compositional shift towards low earners. But we have previously, in Section 5, ruled out large wage effects. Indeed, compositional effects seem significant as the intensive margin effects we obtain here exceed the hours/earnings effects among stayers obtained in Figure 12 Panel (b). The compositional effect was indeed foreshadowed in our heterogeneity analysis, where excess separations were larger for high earners (Table 3), so that separations reduce earnings by more than employment (in percent).[30]

Private sector, public sector, and professors. Table 4 repeats the extensive and intensive analysis but breaks it down by private and public sector in columns 2 and 3 and also provides estimates specifically for professors in column 4. The corresponding graphical analysis for these 3 groups is presented in three panels in Appendix Figure A.4. 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. Within the public sector, the effects are much larger for professors with a 68% reduction in total earnings, largely due to the intensive margin (48% drop), with a 25% extensive margin drop. 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 for professors by Ashenfelter and Card (2002) discussed above.

6.2 DiD Analysis Comparing 2019 and 2022

We close our paper by comparing the per-capita graphs under two regimes: in 2019 when the EPL cutoff was 67, and 2022, three years into the new regime with the 68 cutoff. Our analysis has a difference-in-difference (DiD) spirit. Our results support the implicit identification assumption of our local designs thus far, and serve as a policy evaluation.

DiD analysis. Figure 15 analyzes the employment to population ratio (Panel (a)) and earnings per capita (Panel (b)) by age in 2019 and 2022. Employment protection is eliminated at age 67 in 2019 but at age 68 in 2022 (the change kicked in 2020). In both panels, the 2022 series is adjusted by a constant multiplicative factor to match the 2019 series at age 66+8 months.

In both panels, both the 2022 and 2019 series follow the same parallel trends before age 67. This fact supports the idea that EPL does not appear to distort the separation dynamics nor the dynamics of earnings before its elimination, whether this occurs at 67 or 68.

[30]It is also the case that intensive earnings cuts are more pronounced among higher earners than for lower earners (results not reported).

Comparing the 2019 and 2022 series in the age window 67 to 68 provides the equilibrium effect of EPL ending on older workers under the classic DiD identification assumption, that absent the differential EPL policy in 2019 and 2022, the two series would have remained on parallel trends past age 67. In both panels, the 2019 series display an excess drop relative to the 2022 series at age 67 exactly consistent with our earlier analysis that causally attributes the excess drop in employment and earnings at age 67 in 2019 to EPL ending.

Importantly and novel to this DiD analysis, there is no subsequent reversal of this effect over the next 12 months between 67 and 68. Along the extensive margin in Panel (a), the elimination of EPL moves the workers into persistent nonemployment. But the other workers' employment dynamics appear unaffected by whether EPL is active or not. Along the full extensive plus intensive margin in Panel (b), it reduces earnings permanently but has no subsequent differential dynamics in earnings based on EPL status either. Hence, the excess drop at exactly age 67 is the full response, removing a well-defined and persistent set of deadwood jobs.

Then, at age 68, the 2022 series drops and converges quickly to the 2019 series—consistent with EPL simply delaying the termination of deadwood jobs by a year. This effect is somewhat faster along the employment margin in Panel (a), where convergence happens within 6 months after 68, than along the full intensive plus extensive margin of earnings per capita in Panel (b), 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.[31]

In conclusion, the almost perfect convergence of the two series shortly after age 68 and the parallel trends after 68 suggest that there are no long-term impacts of having lost employment protection one year earlier and that the initial and local impact–which was the focus on most of our paper–captures the full effects of the employment protection elimination.

Validation of identification assumptions underlying previous local designs. There are two interpretations of our DiD analysis. First, the graphs provide an additional validation of the implicit identification assumption underlying our *local* discontinuity-based analysis thus far: that all responses are concentrated sharply around the cutoff age, with one-time adjustments, with no effects on behavior before or after. Parallel trends before and after as well as the sharp responses concentrated at 67 and 68 bolster this perspective.

[31]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.

Policy evaluation and implications. Second, our DiD analysis amounts to a policy evaluation of the extension of the EPL cutoff—in light of the stated goal of those extensions being exactly such prolongation of the working life of Swedish older workers, with future additional increases in the EPL cutoff age scheduled (see Figure 2). We discuss the policy implications of our full set of findings below in the conclusion.

7 Conclusion

How does employment protection affect employment of older workers? Basic economic reasoning clarifies that any employment gain comes with the "deadwood" labor problem: firms would prefer to terminate those jobs that EPL prolongs, and those jobs are held by entrenched workers earning rents. We have studied the Swedish context, which provides an exceptionally powerful and clean empirical setting for this question. In Sweden, EPL is strong but is sharply and completely eliminated at administratively defined age cutoffs, with no interference from other policy discontinuities such as pensions. We have read the employment gains the policy provides through the lens of a simple model, and characterized these deadwood labor units along a rich set of margins, including hours and contract structure, beyond the standard separation channel.

Policy considerations. Sweden has passed further legislation that raised the EPL cutoff age further, from 68 to 69 starting in 2023 (see Figure 2). The policy motivation is the belief that the EPL age props up employment among older workers.[32] It will be important to assess in coming years whether the increase of EPL protection up to age 69 in 2023 further shifts the employment and earnings of older workers in Sweden.

Our local as well as difference-in-difference designs provide consistent results that support the prediction underlying the policy motivation. Indeed, in the data, EPL 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. However, our paper also highlights that those additional labor units fostered by EPL come with the "deadwood labor" problem, as firms evidently would prefer to lay off those workers beforehand already, and hence they reduce profits and potentially curb hiring to begin with. At a higher level however, EPL thereby shifts some of social insurance and retirement funding to employers. EPL may also offset some frictions (e.g., wage rigidity) that may lead to inefficient separations of older workers with high surplus, or it may counter moral hazard in social insurance (e.g., curbing the subsidizing

[32]The largest Swedish employer organization, the Confederation of Swedish Enterprise (Svenskt Nä ringsliv, 2017), was critical of the reforms warning of unintended consequences. They noted, at the time, that "seven out of ten firms with employees in the affected age ranges would become less prone to hire older workers... The reason is that an increased EPL age increases the risks associated with hiring older workers."

of early retirement).

Caveats and open questions. We close with questions our paper leaves open with its comprehensive analysis of the ex-post effects on separations that the elimination of EPL among older workers implies. First, our design cannot credibly speak to some important equilibrium aspects of EPL 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.[33] 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 EPL 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 EPL for older workers.

[33] In principle, the sharp effects of EPL termination on both the extensive and intensive margins as a function of exact birthdate (likely exogenous to other firm dynamics) that we have documented in this paper create an instrument that could be used to estimate the causal effects of a layoff (total or partial) of an older worker on hiring, younger workers, or other firm outcomes. Such a design would complement existing studies on spillovers on younger worker's careers and firm-level outcomes that typically focus on older workers' retirement choices, i.e., labor-supply decisions (e.g., Bianchi et al., 2023, Carta et al., 2021), rather than dismissals.

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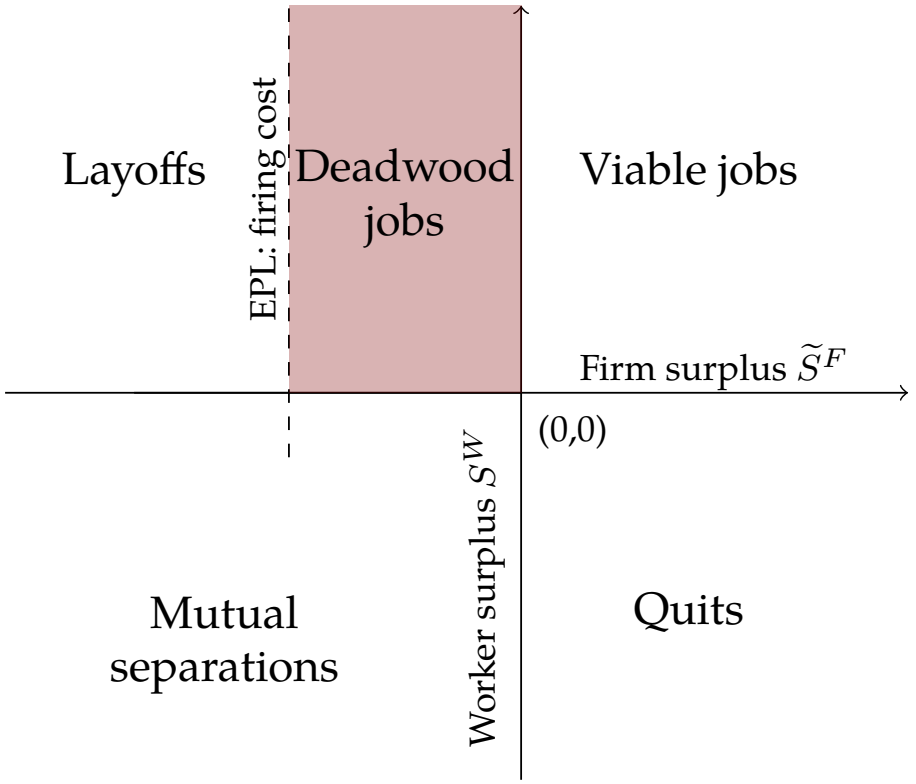
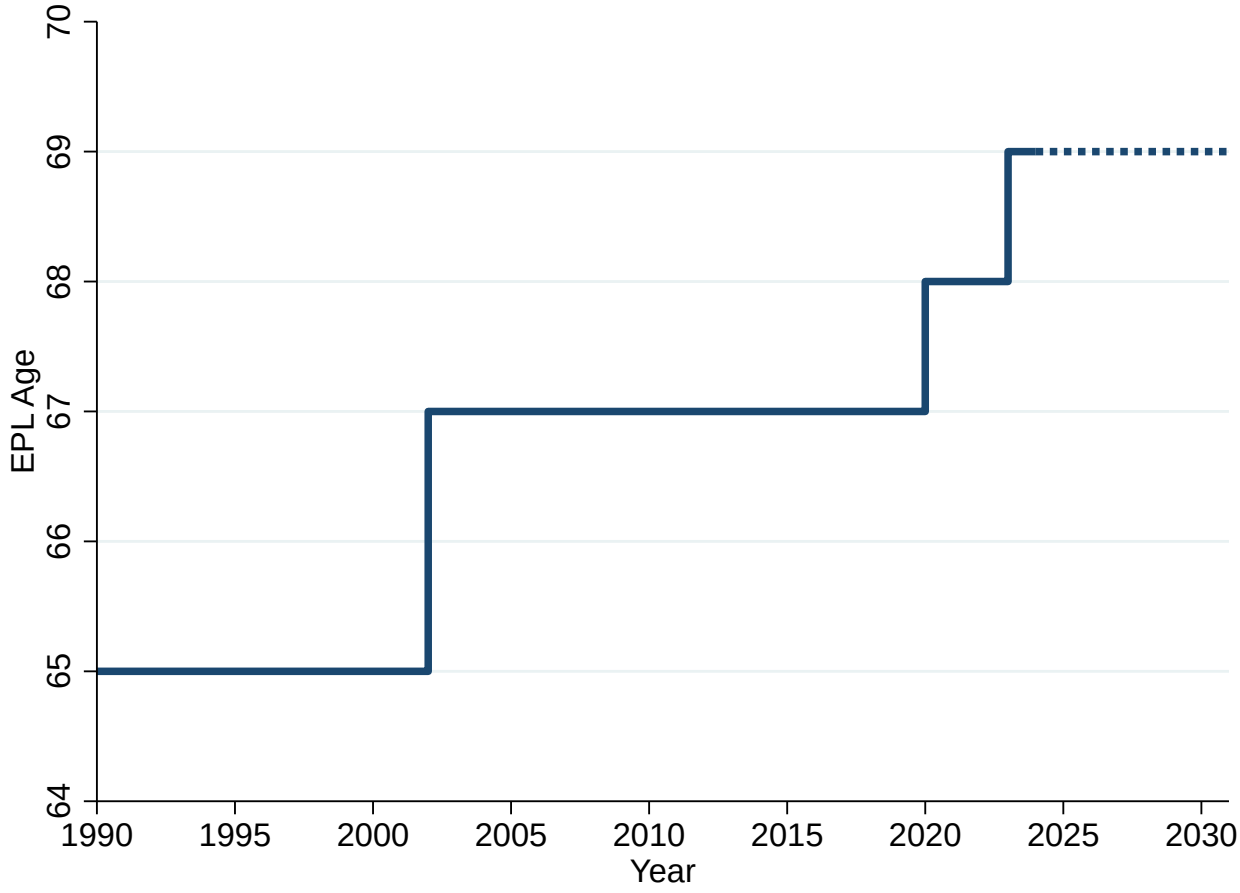
Figure 1: Deadwood Jobs and Employment Protection in the Model



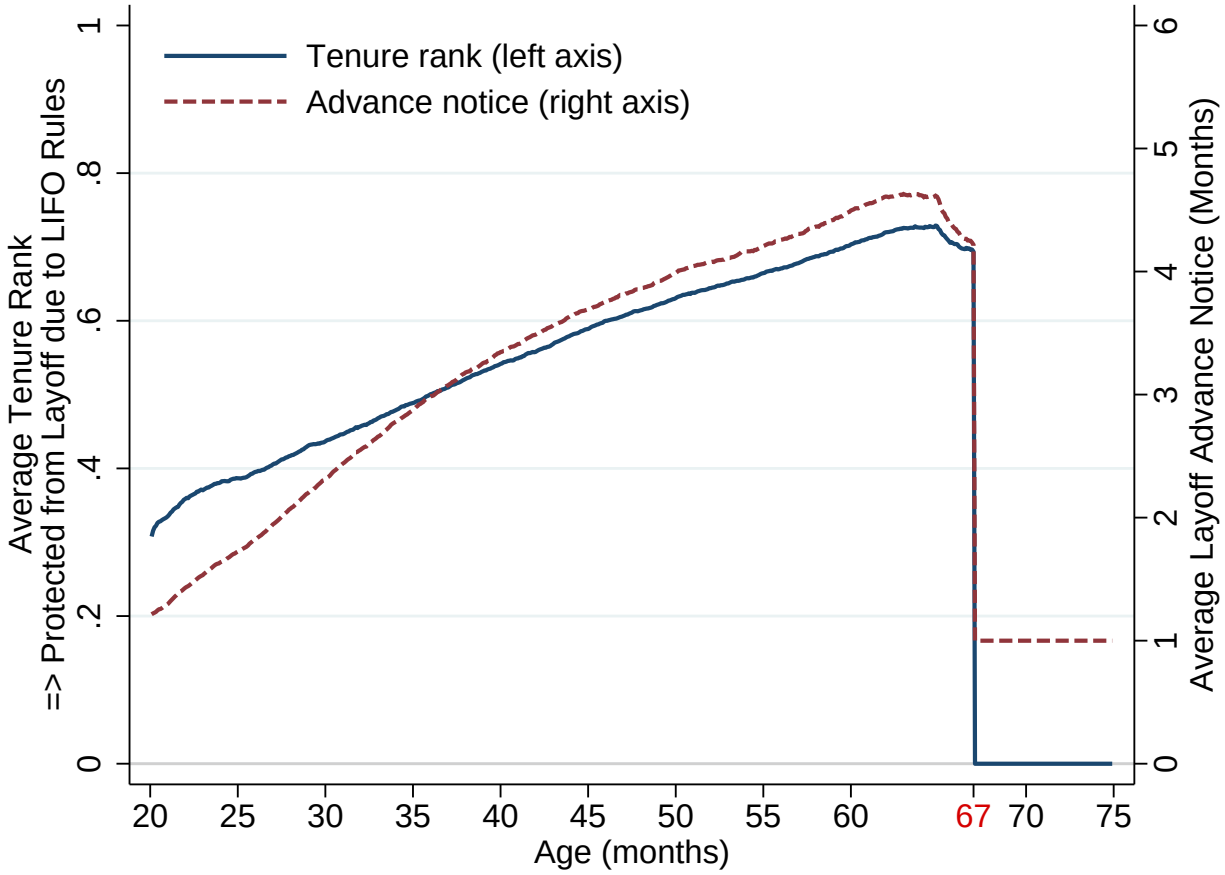
Notes: The figure illustrates job separations by type (quits, layoffs, mutual separations) and viable jobs in the simple model, with fixed wages. Deadwood jobs supported by EPL are denoted by the shaded red region. The axes denote unilateral surpluses; for the firm, it is gross-of-EPL surplus such that the firing cost EPL entails acts as a shift of the firm's participation constraint, curbing layoffs. Hence, when EPL is eliminated, the layoff region expands, leading deadwood jobs to separate. These layoffs will come in the form of layoffs (as firms then incur negative surplus) that are involuntary to workers (who would still enjoy positive surplus).

Figure 2: Evolution of EPL Cut-off Age in Sweden



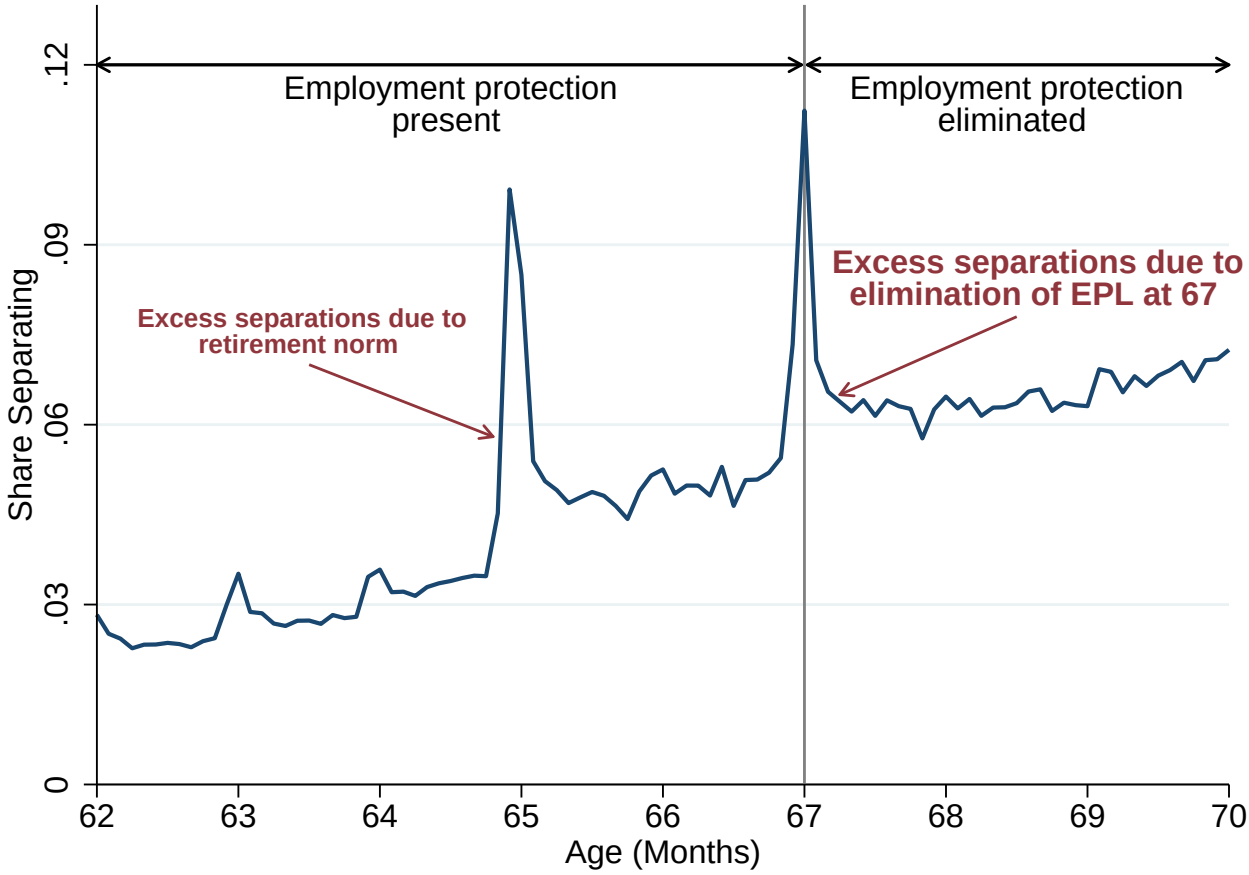
Notes: The figure depicts the evolution of employment protection legislation (EPL) cut-off age in Sweden since 1990. EPL is entirely eliminated once a worker reaches the cut-off age (based on birthday of the worker). The cut-off age was 65 up to 2002, 67 in 2003-2019, 68 in 2020-2022, and 69 since 2023.

Figure 3: First Stage Effects of Employment Protection Elimination



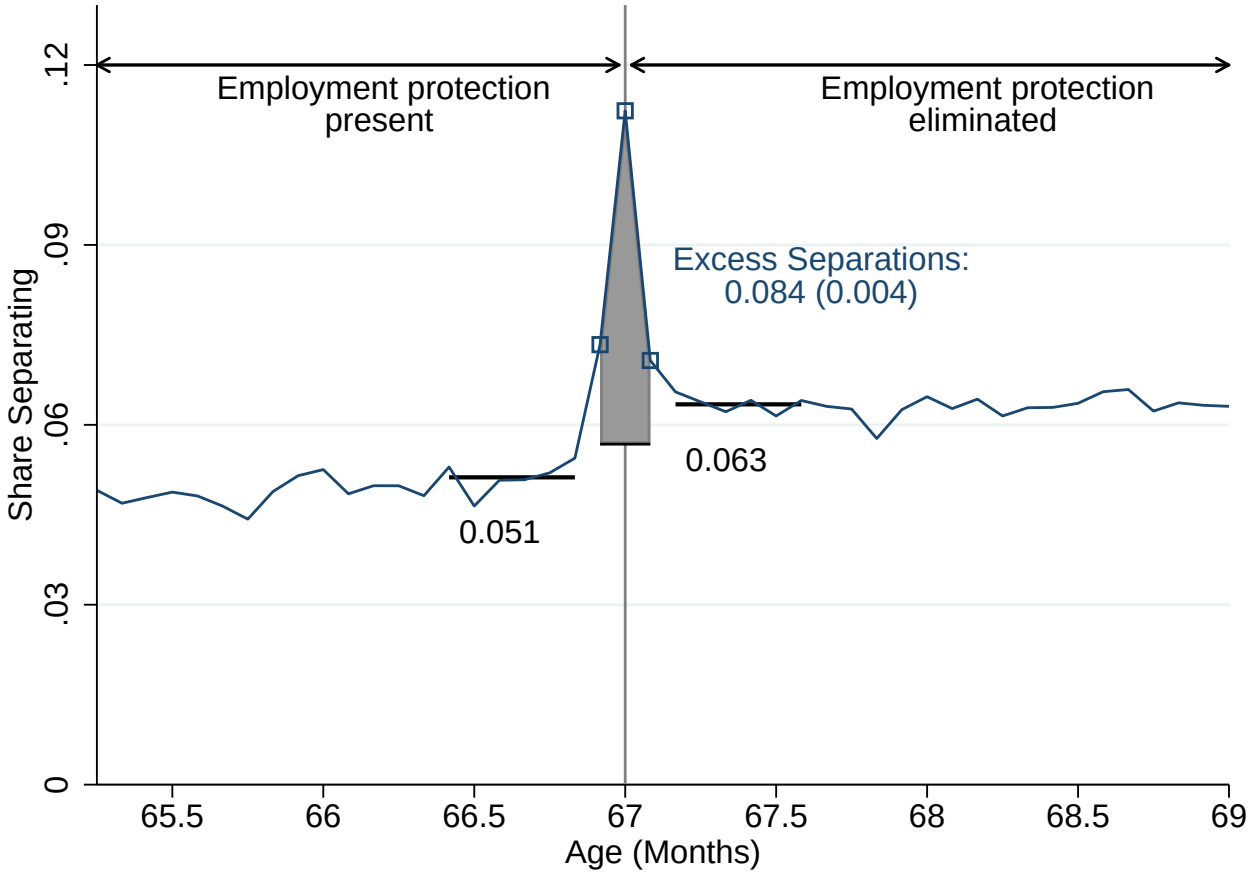
Notes: This figure depicts the first stage effect of employment protection elimination for older workers along two dimensions: Tenure rank within firms for LIFO layoff rule (left y-axis), legal mandatory advance notice period in months (right y-axis). In Sweden, employment protections are eliminated when the worker turns 67 (in 2003-2019, see Figure 2 for the complete history). When there is employment protection, employers with more than 10 employees have to follow last-in-first-out (LIFO) rules for layoffs so that higher-tenure workers are more protected. The figure depicts in solid blue line (left y-axis) the average tenure rank for LIFO rules within the firm for workers still employed at each (monthly) age. At the age threshold, tenure rank falls to zero as employment protections are eliminated. Before crossing this age threshold, workers have on average a high tenure rank around .70, which implies that they cannot be laid off before 70% of their lower-tenure coworkers are laid off (in firms with more than 10 employees). The figure also depicts in dashed red line (right y-axis) the legal mandatory advance notice period (in months) for layoffs (assuming the employee can be laid off per LIFO rules). Advance notice grows from 1 month to 6 months with tenure. When crossing the age threshold, advance notice drops back to 1 month, the lowest possible. Before crossing the threshold, workers would be entitled to almost 5 months on average of advance notice.

Figure 4: 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 spike at age 65 due to the remnants of a retirement norm.

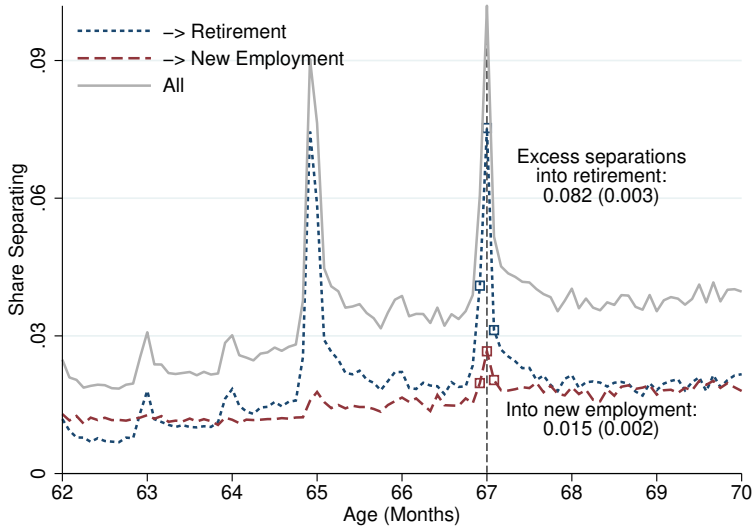
Figure 5: Bunching Estimation of Excess Separations



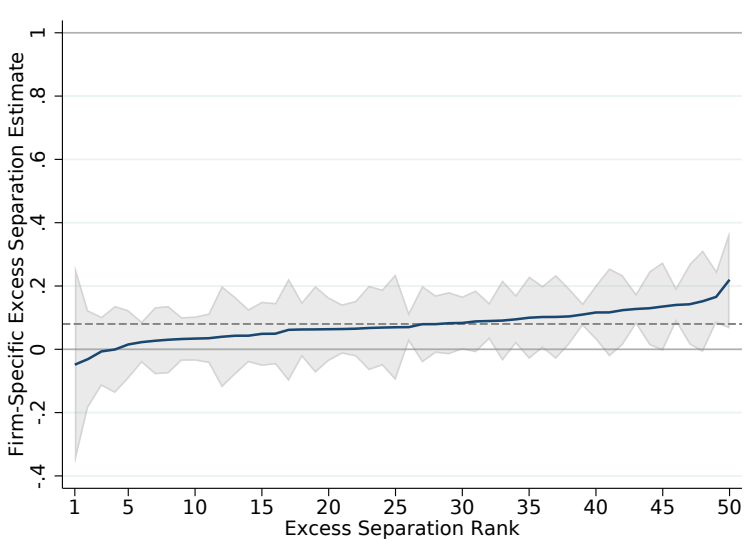
Notes: The figure depicts how we estimate excess separations at the age threshold where employment protections are eliminated using the bunching methodology developed by Saez (2010). Excess separations are the difference between separations for the 3 months: 67-1/12, 67, 67+1/12 (squared on the series) 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%, which means that 8.4% 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. Polynomial counterfactual (Chetty et al. 2011) delivers very similar results but the simple linear method lends itself to the regression-based heterogeneity analysis in Section 4.3.

Figure 6: Features of Excess Separations

(a) Excess Separators Go Into Retirement



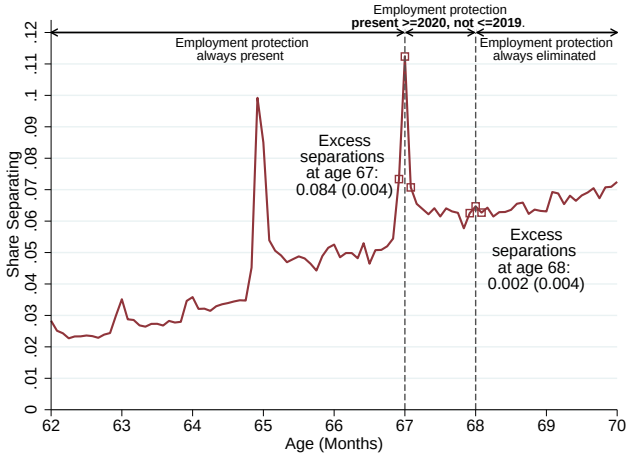
(b) Excess Separations not Concentrated in Specific Firms



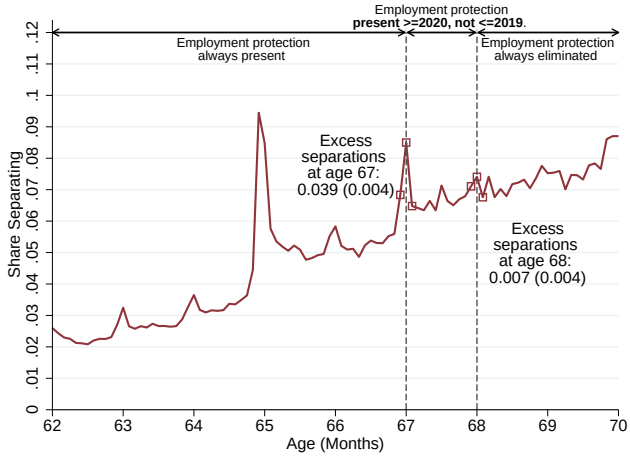
Notes: Panel (a) depicts the separation shares by age in 2019 (grey solid line) and decomposes the series into moves into retirement (dotted blue line) vs. into new employment (dashed red line). The sum of the latter two series add up to the solid line. Separations into retirement are defined as separations where the worker will not take a new job that lasts at least six months within the next 24 months. The excess spike at 67 largely goes into retirement, implying that involuntary displaced workers are not able or willing to take another job, consistent with the notion that they were getting a rent from their job that they cannot replicate on the job market. 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 excess spikes increase smoothly from around 0% at the bottom to about 15-20% at the top. The economy-wide excess spike is depicted in the horizontal dashed grey line. The implication is that separations are not concentrated in specific firms that lay off all their workers at age 67 as a matter of human resource policy. Instead, the excess layoffs at age 67 are likely made on a case-by-case basis.

Figure 7: Reform: Change in EPL Age Threshold from 67 to 68 in 2020

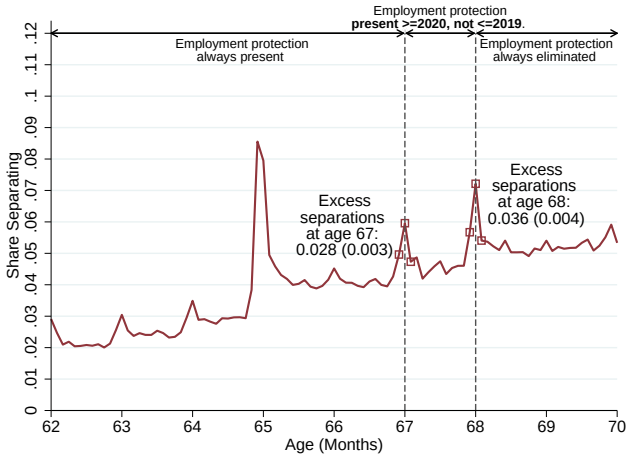
(a) 2019: Cutoff at 67



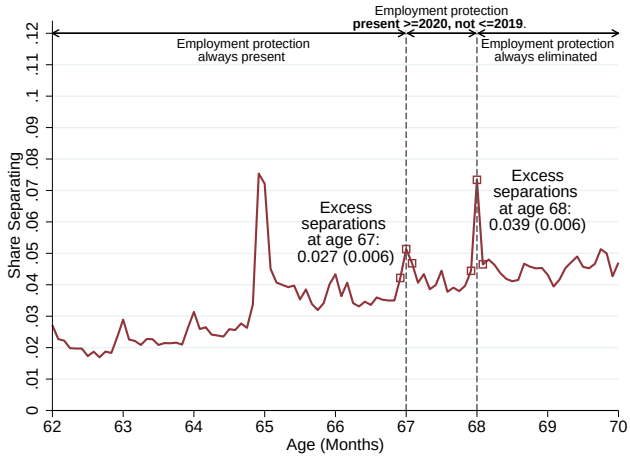
(b) 2020: Cutoff at 68, But Age-68 Cohort's "Deadwood" Was Already Extracted the Year Prior



(c) 2021: Migration of Spike to 68, Small Legacy Spike



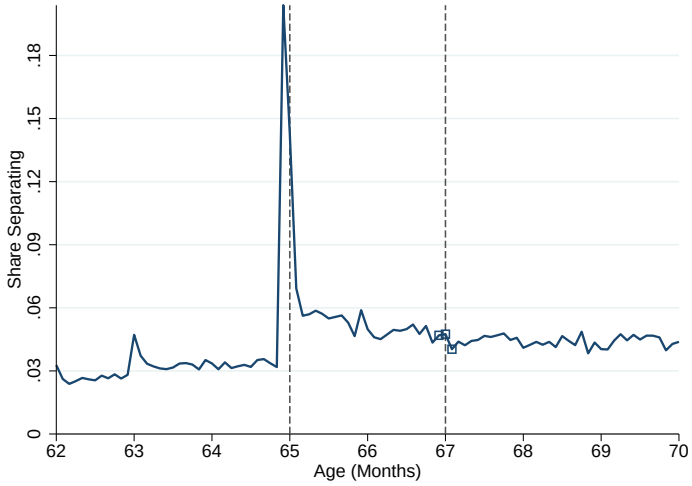
(d) 2022: Migration Continues



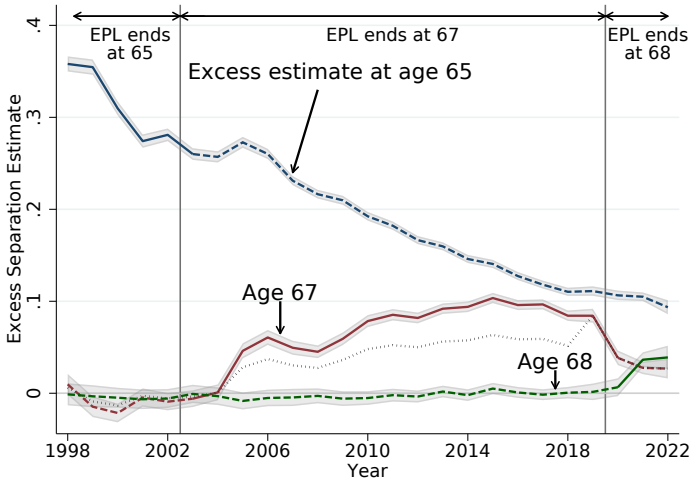
Notes: The figure depicts the separation shares by age in 2019, 2020, 2021 and 2022 following the model of Figure 4. Employment protection is eliminated at age 67 up to 2019 and at age 68 in 2020-2022. Each panel reports the bunching estimator of excess separations at age 67 and at age 68 using the method depicted on Figure 5. The spike in separations at age 67 is sharply reduced in 2020 and after. A new spike at age 68 starts 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. For year 2022, only separations for the period January-April 2022 are included (as separations require not working for the same employer again for 1 year and our data currently ends in April 2023).

Figure 8: Excess Separations in Earlier Years

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



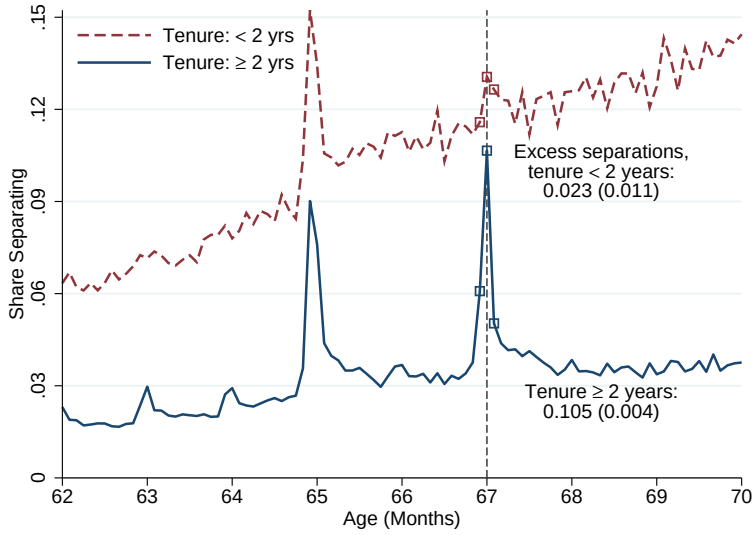
(b) Excess Separations by Year at Ages 65, 67, and 68



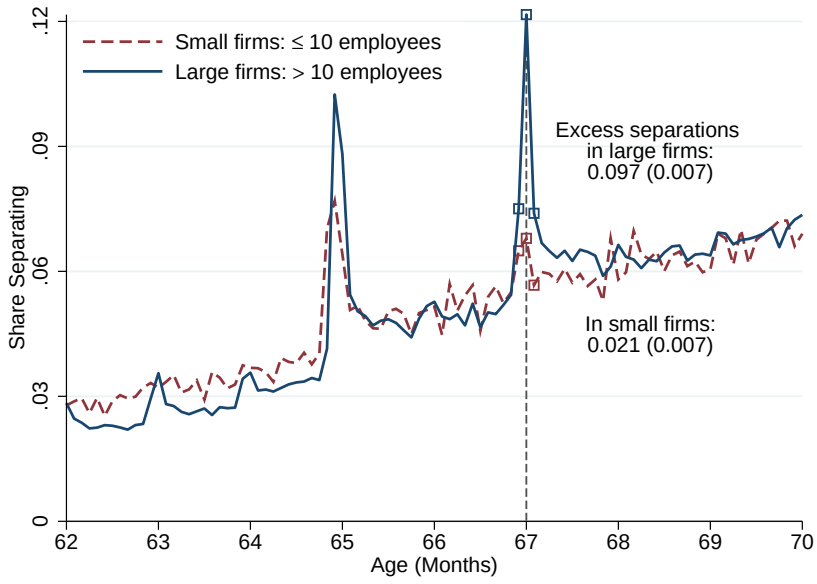
Notes: Panel (a) depicts the separation shares by age in months in 2002, when EPL ended at age 65. There is no spike at all at age 67, consistent with our interpretation that the spike at age 67 observed in recent years is driven by EPL ending at 67. The spike at age 65 is due to both the elimination of EPL 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% confidence intervals (estimated as in Figure 5). The series are solid when EPL 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 2018-9 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 cut-off age increases from 65 to 67 in 2003 (the 2-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 EPL continuing past 65 in 2003, pension changes, and tax incentives to work longer set in place in the 2000s.

Figure 9: Role of EPL Rules: Heterogeneity by Tenure and Firm Size

(a) Tenure Above vs. Below 2 Years



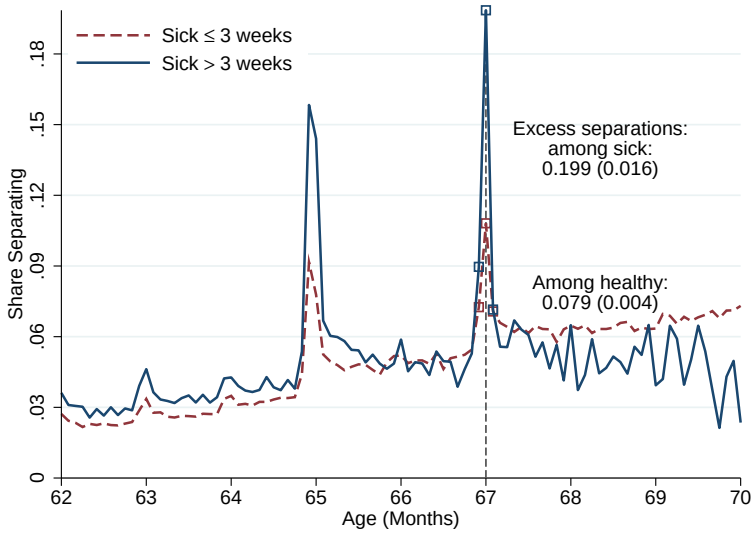
(b) Large vs. small firms



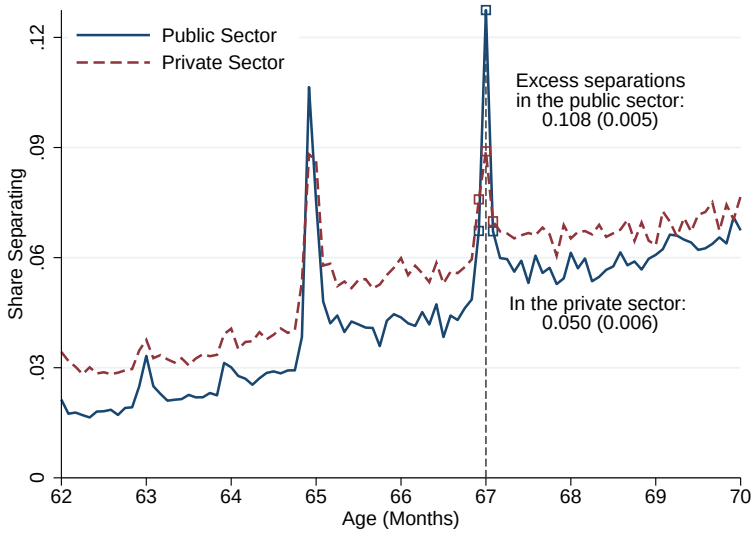
Notes: Panel (a) depicts the separation shares by age in 2019 breaking down the sample by tenure: below 2 years (dashed red line) vs. 2 year or more (solid blue line). Tenure is defined as number of months with positive earnings with a given employer. In case of a gap in the employment spell of more than 12 months, tenure is reset to zero. The excess separation at age 67, when employment protection ends, is concentrated among workers with high tenure and is much more modest for workers with tenure below 2 years. 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. The excess separation at age 67, when employment protection ends, is concentrated among workers in large firms and is much more modest for workers in small firms. Excess separations are estimated as described in Figure 5. Appendix Figure A.2 shows the heterogeneity in excess separations across more granular tenure and firm size bins.

Figure 10: Heterogeneity by Sickness History and by Public/Private Sector

(a) Sickness



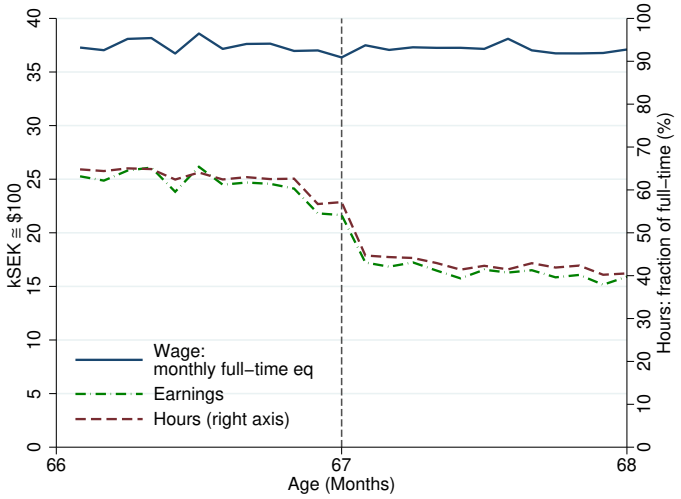
(b) Public vs. Private Sector



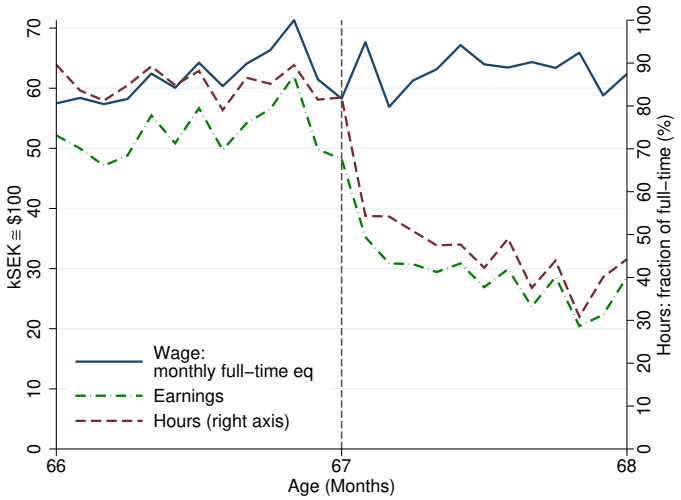
Notes: Panel (a) depicts the separation shares by age in 2019 breaking down the sample by sickness status of the worker: workers with sick days claimed below 3 weeks in 2018, the previous year, (dashed red line) vs. workers above that level (solid blue line). The excess separation at age 67, when employment protection ends, is much higher for sick workers than for healthy workers, 20% vs. 8%. This strongly suggests that firms target less productive workers for layoffs. Panel (b) splits the sample into private sector (solid blue line) vs. public sector (dashed red line). The excess separation at age 67, when employment protection ends, is substantially higher in the public sector than in the private sector (11% vs. 5%). This suggests that firms in the private sector are better able to find ways around employment protection laws before 67. Excess separations are estimated as described in Figure 5.

Figure 11: Panel Analysis of Stayers in the Public Sector in the Structure of Earnings Survey: Hours vs. Wages

(a) Public Sector Workers



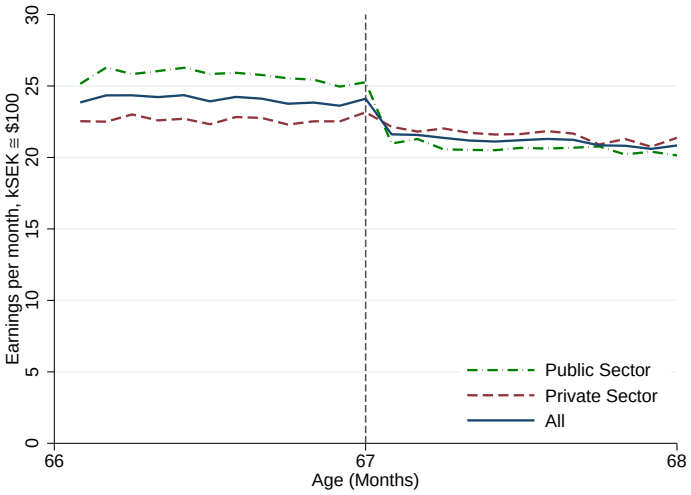
(b) Professors



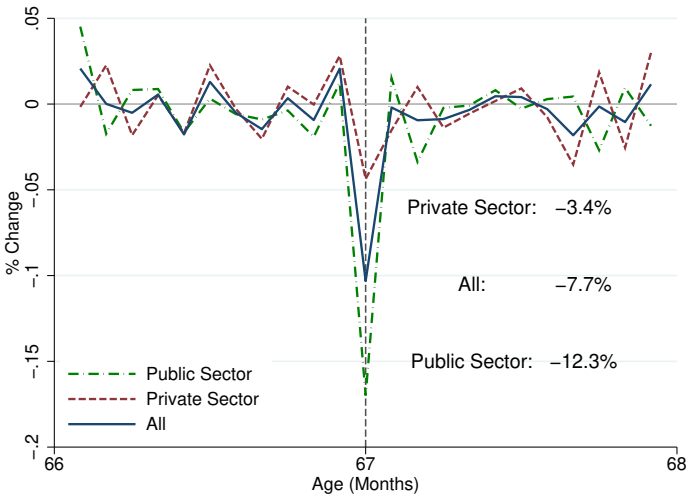
Notes: Panel (a) depicts the full-time equivalent monthly wage (solid blue line), actual monthly earnings (dotted-dashed green line), and hours of work as a fraction of full-time (red dashed line on the right y-axis). We plot outcomes for workers who are recorded with positive wages and hours in the 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. Both panels show that full-time monthly wages do not fall after crossing the 67 age threshold, implying that employers are not able to reduce wages upon loss of employment protection. However, there is a clear drop in hours of work, which translates into a similarly sized drop in monthly earnings (as full-time wages do not fall). This implies that the loss of employment protection at age 67 also leads employers (in the public sector) to reduce employment along the intensive hours of work margin for workers who are not laid off. This effect is particularly large for professors, who lose about half of their hours and earnings even when staying employed.

Figure 12: Panel Analysis of Earnings of Stayers in the Administrative Data

(a) Monthly Earnings Levels



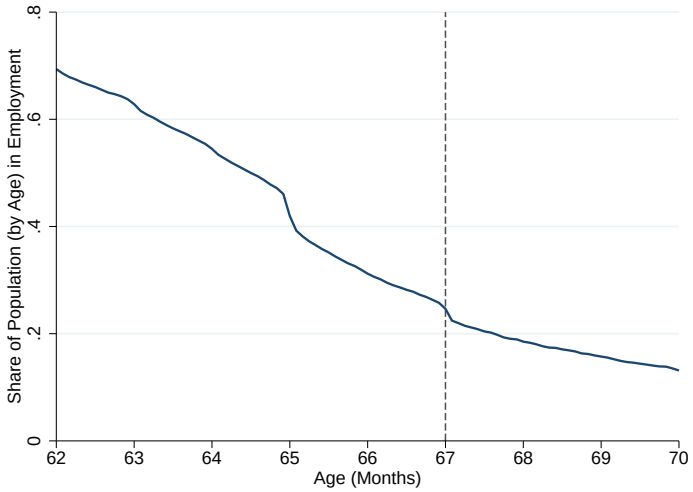
(b) Month to month earnings changes



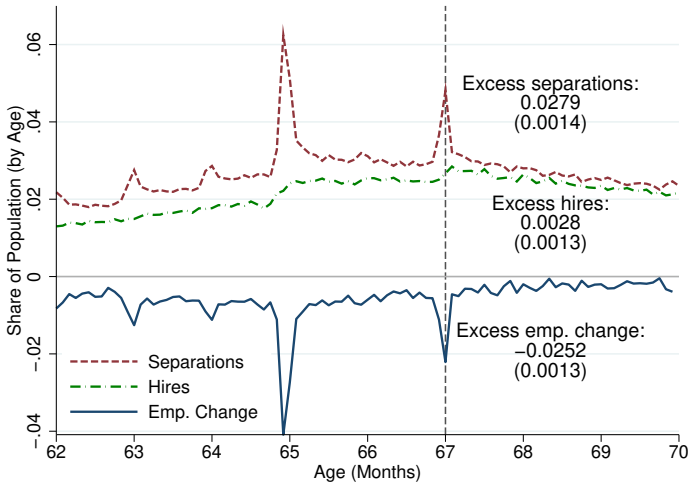
Notes: This figure uses the monthly earnings administrative data and focuses on the sample of stayers defined as workers continuously employed with the same employer between age 66 and 9 months and 67 and 4 months in years 2019-2020 and who turn 67 in 2019. Panel (a) depicts the monthly average earnings 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 5: 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. The figure shows that, consistent with Figure 11, there is a large excess drop of 12.3% in earnings of public sector workers at age 67. However, the excess drop for the private sector workers is much smaller at 3.4%. The overall excess drop in earnings among all workers is 7.7%. This implies that the combined hours or work plus wage response of private workers is very small, making wage rates unlikely as a margin of adjustment in the private sector. Hence, the response in the private sector is smaller both along the extensive margin (Figure 10 Panel (b)) and the intensive margin (this figure).

Figure 13: Employment to Population Ratio and Worker Flows by Age in 2019

(a) Employment to Population Ratio



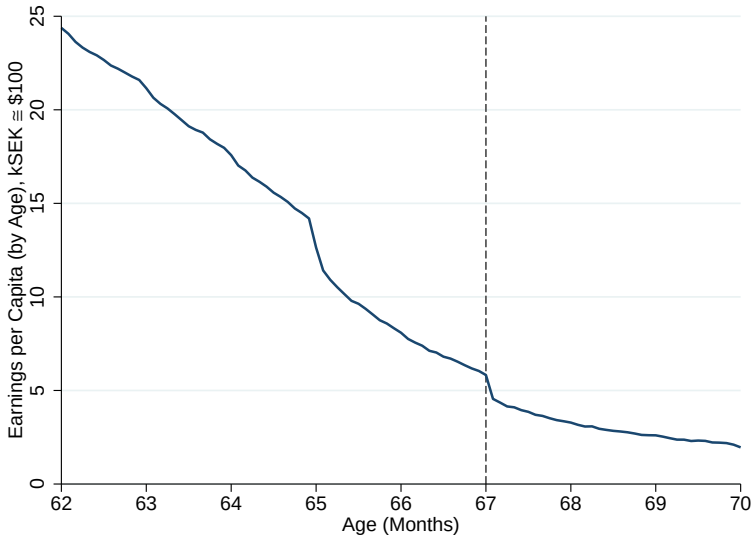
(b) Employment changes = Hires − Separations



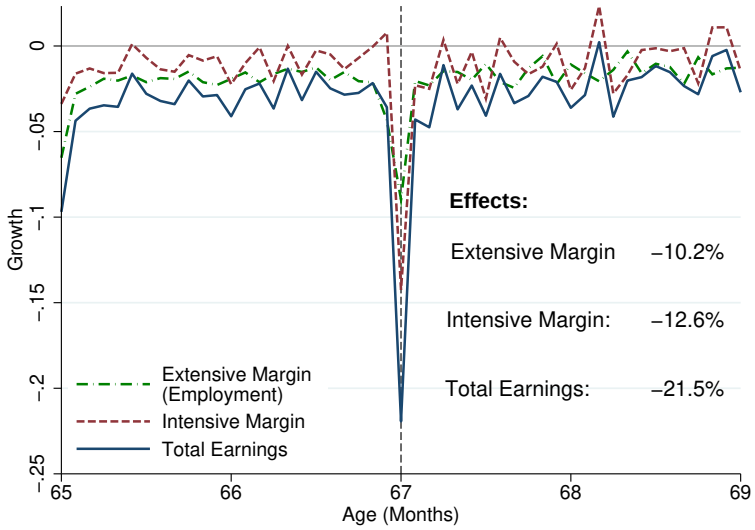
Notes: Panel (a) depicts monthly wage employment to population ratios by age (in months) in 2019 using the administrative monthly wage earnings records. The employment numerator includes only wage earners and excludes the self-employed. Panel (b) takes this series and expresses it in *straight differences* (i.e. percentage point changes) from month to month (solid blue line). Using the bunching method as in Figure 5, we estimate a clear 2.5 point (about 10%) excess drop in the employment to population ratio at 67, when employment protection is eliminated (the drop in employment at age 65 is due to the remnants of a retirement norm). Panel (b) also decomposes the change in employment as hires (green dash-dotted line) minus separations (red dashed line), always relative to population. Based on visual inspection of the series and considering the excess spikes estimated using the bunching method as in Figure 5, the drop in employment to population ratio at 67 is almost fully explained by the spike in separations at that age. There is a very modest increase in hiring (relative to population) as well at 67, which attenuates only about 10% of the separation effect.

Figure 14: Earnings per Capita by Age in 2019

(a) Earnings per Capita



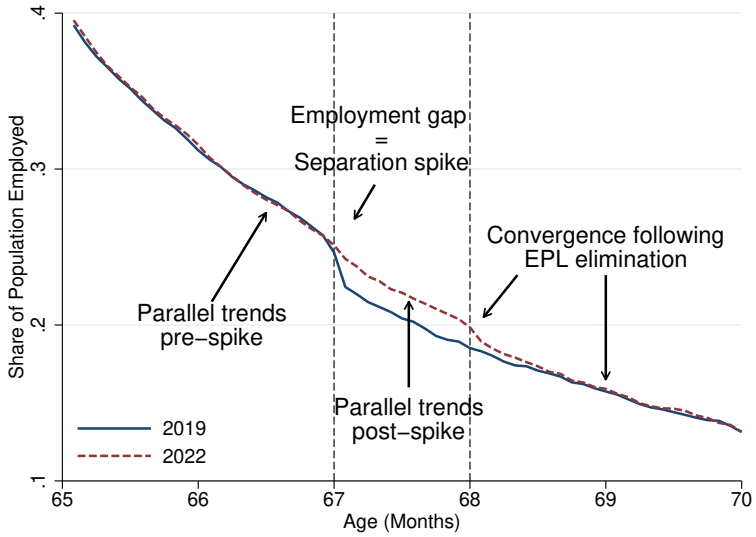
(b) Earnings per capita changes, extensive vs. intensive effects



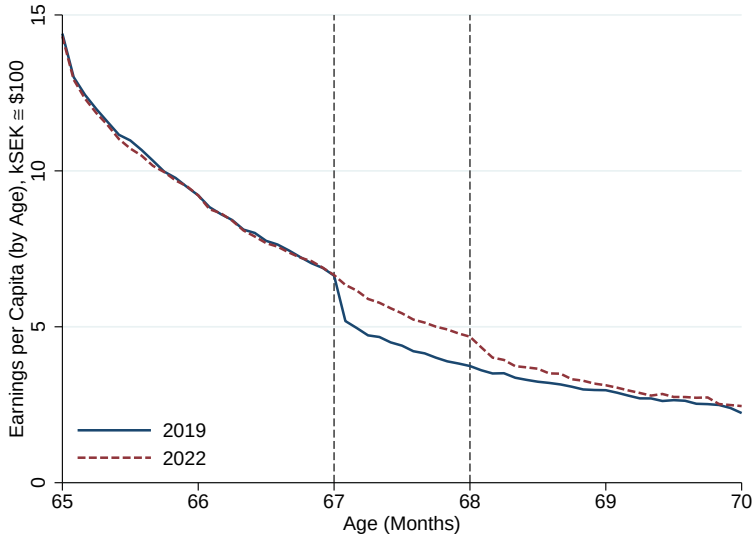
Notes: Panel (a) depicts monthly average employment wage earnings per capita (including zeros) by age (in months) in 2019 using the administrative monthly wage earnings records. Panel (b) takes this series and expresses it in *percent differences* from month-to-month (solid blue line). There is a 21.5% excess drop in earnings per capita at 67 when employment protection is eliminated, estimated by applying the bunching method as in Figure 5 to this series. Panel (b) also decomposes the total earnings per capita changes into an extensive margin (employment percent changes in green dotted-dashed line) and an intensive margin (percent change in earnings conditional on working in red dashed line). Again using the bunching method, it shows that the 21.5% excess drop in earnings per capita at age 67 is due half to the extensive margin employment drop and half to the intensive margin of earnings conditional on working.

Figure 15: Difference-in-Difference Comparison of Two EPL Regimes: 2019 and 2022

(a) Employment-Population Ratio



(b) Earnings per Capita



Notes: The figure depicts monthly employment to population ratios (Panel (a)) and earnings per capita (Panel (b)) by age (in months) in 2019 (solid blue line) and 2022 (dashed red line) using the administrative monthly wage earnings records. The 2022 series is adjusted by a constant multiplicative factor to match the 2019 series at age 66+8 months. Employment protection is eliminated at age 67 in 2019 but at age 68 in 2022. The figure shows that the two series follow exact parallel trends before age 67. The drop at age 67 happens only in 2019. Between age 67 and 68, the two series again follow a parallel trend suggesting that the effect of eliminating employment protection stays the same during this age interval: the drop at exactly age 67 is the full response with no subsequent reversal over the next 12 months. At age 68, the 2022 series drops and converges quickly to the 2019 series, consistent with the elimination of employment protection at age 68 in 2022. The fast convergence of the two series shortly after age 68 suggests that there are no long-term impacts of having lost employment protection one year earlier and that the initial impact captures the full effects of the employment protection elimination.

Table 1: Summary Statistics in Year 2019

	Working Age Ages 25-61	Graph sample Ages 62-70	Estimation sample 15 months around 67
Panel A: **All individuals**			
Share working	0.78	0.37	0.25
Years of education	12.61	11.81	11.78
Annual wage earnings	328.37	131.98	65.87
Age	42.51	65.96	67.04
Individuals	4,877,308	990,200	233,737
Panel B: **Working individuals**			
Annual wage earnings	384.80	273.26	177.57
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)	7.44	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 5 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 2: Excess Separation Estimates

	2019	2020	2021	2022
Panel A: **Threshold age 67**				
Excess separation	**0.0843**	0.0385	0.0276	0.0268
	(0.0038)	(0.0041)	(0.0035)	(0.0055)
Observations	388,211	370,642	375,312	131,201
Panel B: **Threshold age 68**				
Excess separation	0.00150	**0.00650**	**0.0365**	**0.0390**
	(0.0042)	**(0.0045)**	**(0.0038)**	**(0.0060)**
Observations	294,684	270,505	288,141	101,002
Panel C: **Placebo threshold age 69**				
Excess separation	-0.00190	0.00930	0.000700	-0.00600
	(0.0043)	(0.0047)	(0.0041)	(0.0064)
Observations	255,052	218,157	224,786	80,633

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 5. The graphical analysis underlying these estimates is presented in Figure 7. Standard errors are computed using the delta method. The estimates are bolded when corresponding to the true legal thresholds when EPL 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 EPL 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. For year 2022, only separations for the period January-April 2022 are included (as separations require not working for the same employer again for 1 year and our data currently ends in April 2023), explaining the drop in 2022 observations.

Table 3: Excess Separation Estimates: Heterogeneity

	Share in group	Excess Separations Group	Excess Separations Complement	$\Delta_{\text{univariate}}$	$\Delta_{\text{multivariate}}$
Sick > 3 weeks	0.0942	0.199	0.0787	0.120	0.102
		(0.0159)	(0.0040)	(0.0170)	(0.0177)
High tenure	0.724	0.105	0.023	0.082	0.0529
		(0.0042)	(0.004)	(0.0058)	(0.0100)
Firm > 10 empl.	0.809	0.0975	0.0210	0.0764	0.0450
		(0.0042)	(0.0094)	(0.0104)	(0.0119)
High earner	0.364	0.115	0.0534	0.0614	0.0425
		(0.0054)	(0.0056)	(0.0081)	(0.0088)
Public sector	0.471	0.108	0.0502	0.0577	0.0366
		(0.0054)	(0.0058)	(0.0080)	(0.0100)
Immigrant	0.152	0.112	0.0725	0.0397	0.0436
		(0.0098)	(0.0044)	(0.0110)	(0.0109)
Manufacturing	0.0579	0.101	0.0775	0.0236	0.0304
		(0.0165)	(0.0041)	(0.0179)	(0.0186)
High education	0.445	0.0856	0.0729	0.0126	-0.0109
		(0.0062)	(0.0052)	(0.0080)	(0.0086)
Male	0.494	0.0813	0.0763	0.00500	0.0191
		(0.0059)	(0.0054)	(0.0080)	(0.0086)
Observations				388,211	359,955

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% of the workers experienced a sick leave of more than 3 weeks in 2018 (and hence 90.58% 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 5. 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 (5). For example, sickly workers experience an additional excess separation probability at age 67 of 12.0 percentage points relative to other workers (19.9% vs. 7.9%). The column 6 estimates report the same differences in excess separations but controlling for all other dummy variables listed in all rows as in specification (6). 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.

Table 4: Aggregate Effects on Employment and Earnings

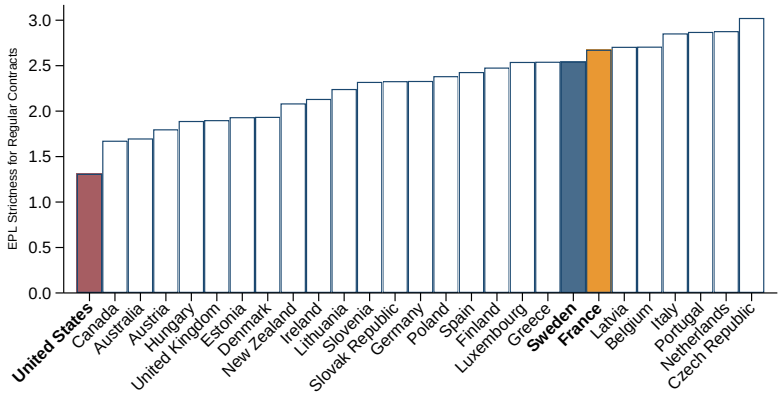
	All	Public sector	Private sector	Professors
Earnings / capita	-0.215	-0.289	-0.133	-0.684
	(0.0601)	(0.0848)	(0.0329)	(0.1327)
Earnings / worker	-0.126	-0.157	-0.0933	-0.479
	(0.0459)	(0.0615)	(0.0293)	(0.1215)
Emp. / pop. (percent)	-0.102	-0.157	-0.0439	-0.254
	(0.0204)	(0.0319)	(0.0078)	(0.0461)
Observations	388,211	177,167	211,044	3,284

Notes: This table shows aggregate excess changes in employment and earnings at the 67 threshold in 2019 corresponding to the analysis of Figure 14. For each outcome (listed by row), we compute the excess change around age 67 estimated by applying the bunching method as in Figure 5. 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). Column 1 is for all workers corresponding to the graphical analysis of Figure 14. Column 2 is for public sector workers, column 3 for private sector workers, and column 4 for Professors. The corresponding graphical analysis for these 3 subgroups is presented in Appendix Figure A.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.

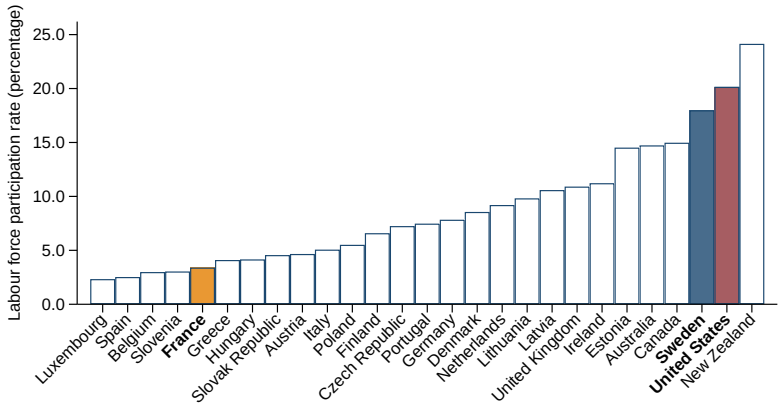
Appendix

Figure A.1: How Sweden Compares on EPL and LFP at Age 65+

(a) Stringency in Employment Protection Legislation



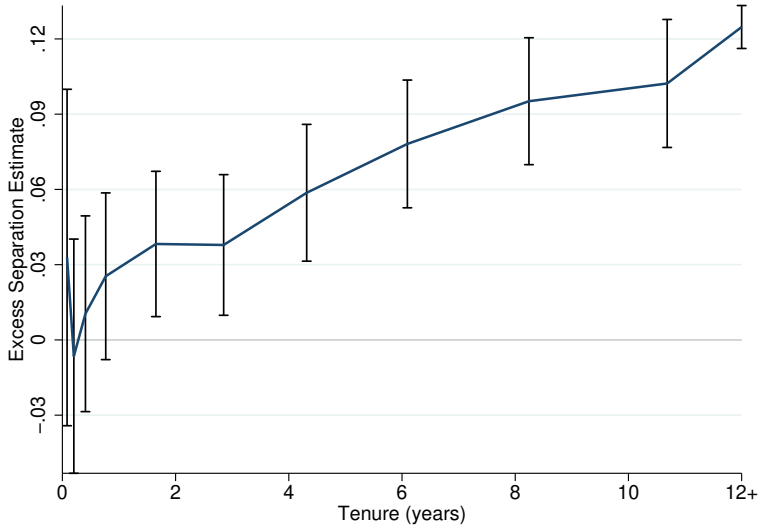
(b) Labor Force Participation at Age 65+



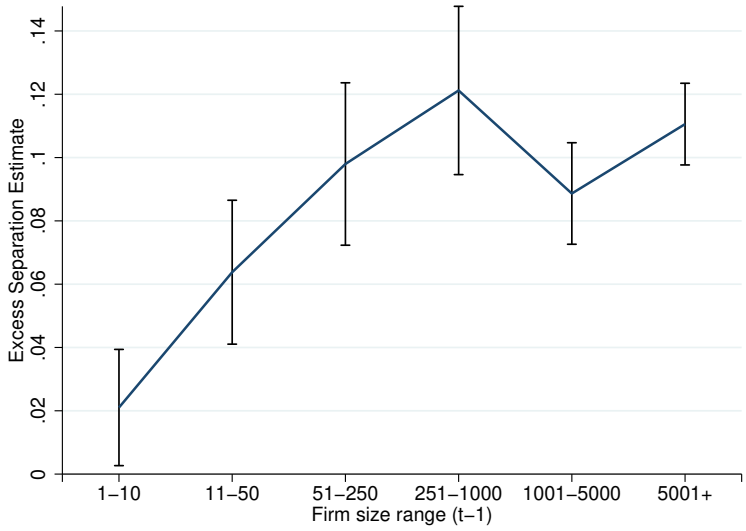
Notes: This figure uses OECD statistics to compare Sweden vs. EU countries and Anglo-American countries in terms of stringency of employment protection legislation (EPL) in Panel (a) and labor force participation of the population aged 65 and over in Panel (b) in 2019. Sweden has a stringent EPL comparable 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.2: Heterogeneity by Tenure and Firm Size

(a) Excess Separations by Tenure



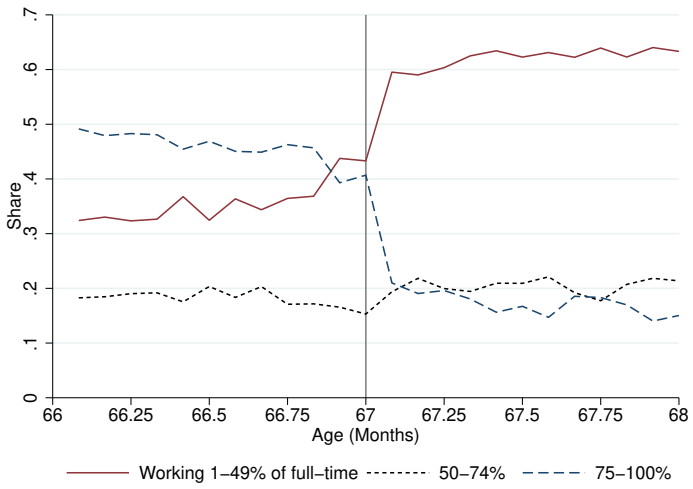
(b) Excess Separations by Firm Size



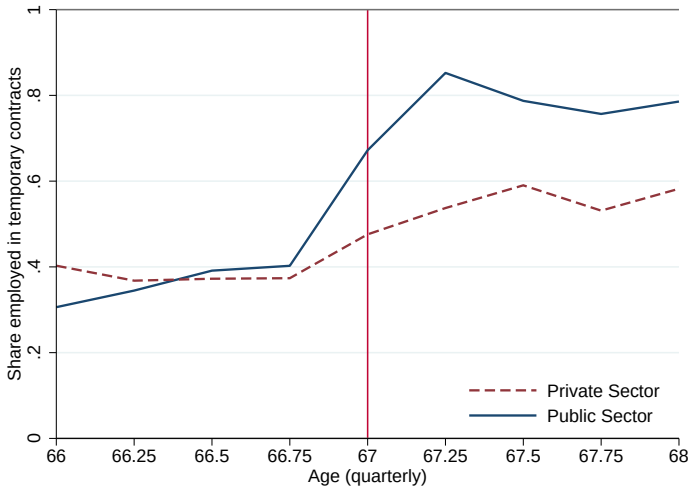
Notes: Panel (a) depicts the excess spike, estimated using the bunching procedure, by tenure decile among those with tenure below 12 years, and then a single top group with tenure in excess of 12 years. The x-axis captures the average tenure in each decile, except for the top group with tenure above 12 years (where average tenure is 21 years). The graph shows that the excess separations estimate grows fairly smoothly with tenure. 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.3: Impact of EPL Elimination on Contracts

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



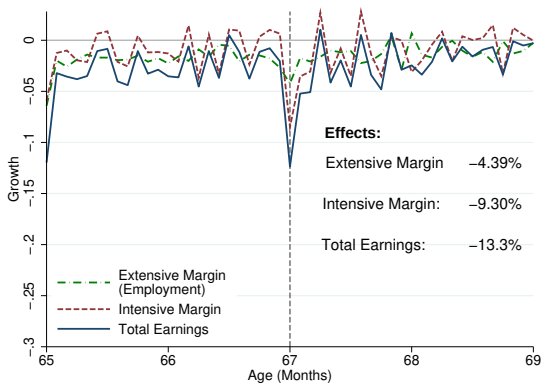
(b) Temporary vs. Permanent Contracts



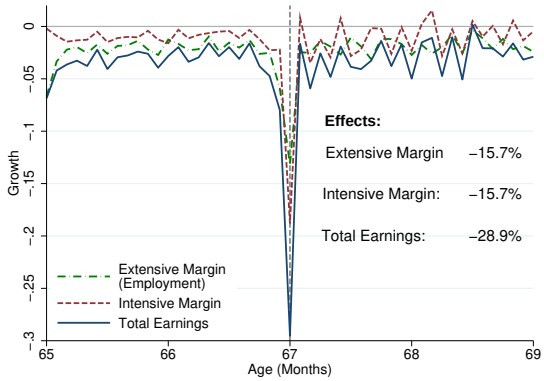
Notes: Panel (a) considers the panel of stayers (with the same employer on both sides of 67) among public sector workers (in the 2018-2019 Structure of Earnings Survey waves as in Figure 11), but then breaks it down into hours categories, displaying the fraction of workers working less than half of full-time, between half-time and less than 75% of full-time, and 75% of full-time or more. The figure shows a large decline in fraction working at least 75% 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 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% to 80% in temporary contracts surrounding the EPL cut-off 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.4: 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 14 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.