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ABSTRACT

We study the role of employment protection legislation (EPL) in boosting employment among older workers. Our analysis juxtaposes the quantitative employment gains with the qualitative "deadwood labor" problem that such gains entail. 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 (sick) workers. Second, we focus on effects of continuing jobs. While wages appear rigid to EPL, 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.

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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 deadwood jobs EPL creates 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 notice and various additional firm-level protections such as from "last in, first out" layoff mandates

[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 2021, 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 retirements that we discuss below.

[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)).

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 permits employers to costlessly terminate all deadwood jobs. Hence, deadwood jobs identify themselves in the form of excess separations concentrated at the EPL cutoff age—permitting us 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; e.g., pension benefits are actuarily fair in the cohorts we study, and retirement timing is flexible for workers, and there is no mandatory retirement age. 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: 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 deadwood supported 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 "last in, first out" rules (exploiting a regulatory cutoff in firm size). We also show that the spike migrates when a reform shifts the EPL cutoff age from 67 to 68, and that no spike was present at 67 in a preperiod when the cutoff was at age 65. Hence, retirement norms (as in Seibold, 2021) do not 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 spell exhibit two and a half time 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. Higher income is also associated with higher excess separation risk.

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 or induce quitting deadwood workers 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 give 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 separated 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—*tasks or hours*—at the *intensive* margin. This is because we uncover clear and strong hours and earnings responses among stayers (at constant hourly wage rates). Quantitatively, intensive-margin hours reductions among stayers are about 8%, *doubling* the total amount of deadwood labor.[5] Drawing on the Labor Force Survey, we find that 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

[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.

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 2.5ppt (10%). That is, separation effects pass through almost fully into employment, as we find essentially no offsetting response in the form of hiring. Again, 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.

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 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 reconverges following age 68. Hence, the EPL reform delays the shedding of deadwood from age 67 to age 68, propping up employment 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 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 Coasean 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. This effect is much stronger than the average response in the public sector.

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. 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. 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 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.

The paper is organized as follows. In Section 2, we present a simple model of long-term jobs and separations under EPL, and derive our research design and its model-based interpretation. In Section 3, we review the institutional setting and data, and our source of variation of EPL. In Section 4, we describe the direct effects on separations and their

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

characteristics. Section 5 reports effects on continuing jobs. Section 6 conducts the per-capita analysis. Section 7 studies the case study of professors. Section 8 concludes.

2 A Simple Model of Deadwood

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. Our point of departure is an exisitng 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 and separations. 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 firing 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, which we can cast in the form of positive surplus for each party—defined as the value of the job net of the wage, minus the outside option. For the worker, the condition is

$$S^W = J^W + w - O^W \geq 0, \tag{1}$$

and for the firm, it is

$$S^F = J^F - w - (O^F - f) \geq 0. \tag{2}$$

Equivalently, we express firm surplus as $\widetilde{S}^F$ "gross of EPL" and equal to the firm surplus without EPL ($f = 0$):

$$\widetilde{S}^F = S^F(f = 0) = J^F - w - O^F \geq -f. \tag{3}$$

If either (or both) of the two participation constraints is violated, the job separates—a quit if condition (1) is violated, and a layoff if condition (2) is violated. Figure 1 expresses these cases.

[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.

In our baseline, we take wages w as given (we do not find evidence for wage adjustments); below, we also permit flexibly rebargained wages.

Deadwood jobs supported by EPL. In this setting, EPL fosters a well-defined notion of deadwood jobs. Figure 1 depicts these cases as the shaded red region. Specifically, deadwood is made up of the jobs with gross firm surplus in the following range: $-f \leq \widetilde{S}^F < 0$. These jobs are viable with EPL but not without it. Put differently: firms obtain negative (gross) surplus from them, and the only reason they keep the workers employed is the firing costs EPL brings.

Workers, by contrast, obtain at least a weakly positive surplus from the job ($S^W \geq 0$), and hence hold on to it as long as they can, and the layoff will leave them strictly worse off.

Excess separations following an elimination of EPL. We now study a quasi-experimental elimination of EPL by considering two EPL levels $f^T = 0$ and $f^C = f > 0$, with the control group staying at the baseline firing cost and an elimination in the treatment group, out of the same initial (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]

$$\text{ExcessSeparations} = \text{ShareSeparating}^T - \text{ShareSeparating}^C \tag{4}$$

$$= F^{\widetilde{S}^F}(0) - F^{\widetilde{S}^F}(-f) = F^{\widetilde{S}^F}\left(-f \leq \widetilde{S}^F < 0\right). \tag{5}$$

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 another job. 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]

[8] As mentioned above, the simple model takes a given cross-section of jobs as given, but does not model the stochastic process that would lead some jobs to separate even at a stable f. In a different context, see Jäger, Schoefer and Zweimüller (2023) for a more complete and multi-period model explicitly including the stochastic process of surplus that would place previously viable jobs into separation territory.

[9] It is possible that wage rigidity across all firms (e.g., due to regulatory wage floors) 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).

Flexible wages and bilaterally efficient separations. We briefly also define a notion of deadwood absent wage rigidities. This model applies under the assumption of 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 is needed as otherwise the parties could always eliminate f if the worker were willing to agree to label the separation as a quit, against some 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. However, this framework also clarifies the stronger notion of deadwood indicated by a laid off worker never taking up another job after her initial layoff (if one is willing to believe that wages are set flexibly in new jobs); here, the participation constraints describe the conditions for hiring absent EPL.

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:

$$\widetilde{S} = \underbrace{(J^W - O^W) + (J^F O^F)}_{\text{Gross-of-EPL joint job surplus}} \geq - \underbrace{f}_{\text{EPL}}. \tag{6}$$

In this setting, EPL fosters a notion of bilaterally efficient deadwood: jobs for which $-f_t \leq \widetilde{S}_t < 0$, 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. Moreover, if new jobs are not subject to wage rigidity, an empirical finding in which deadwood workers do not transition to another job, in indicative of negative joint surplus (where the worker's reservation wage exceeds that of potential new employers after EPL is abolished).

3 Institutional Setting and Data

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

3.1 Employment Protection Legislation in Sweden

Employment protection in Sweden is very generous and multi-dimensional with Sweden ranking high in the OECD index, very similar to France and much higher than english speak-

ing 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. Most jobs in Sweden receive tenure after 6-months at which point, EPL protections start and then ramp up further with additional tenure.[10]

Layoff for legitimate cause for permanent jobs. After the 6-month tenure point is reached, any layoff needs to have a legitimate cause. Those causes can be divided in two. First, a layoff may occur due to redundancy, e.g., lower demand for the firm's products or a restructuring of the organization. The key feature is that the layoff event is not directly related to the performance of the targeted workers. Most layoffs fall in this category. In case of a legitimate layoff event due to redundancy, the firm needs to follow the advance notice and Last-In-First-Out (LIFO) rules, described below. The second legitimate cause for a layoff is personal reasons, which occur if the employee has misbehaved in the job.

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.[11]

"Last in, first out" (LIFO) rules for layoffs in firms with more than 10 employees. All firms with more than 10 workers have to follow LIFO rules for layoffs, namely 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 representatives. 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. [12] Moreover, LIFO also applies in case the firm wants to recall displaced workers.

[10]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.

[11]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.

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

If the firm starts hiring again within 9 months of the layoff event, priority must be given to recently laid off workers with the highest tenure.

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

Severance payments. While 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.[13]

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 Appendix Figure A.2, the employment protections we have discussed are entirely eliminated at age 67 (in 2002-2019), at age 68 (in 2020-2022), and age 69 (since 2023). Before 2002, employment protection was eliminated at age 65. This implies that when a worker crosses the age threshold, 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. In terms of LIFO rules, these workers have the least tenure and should be the first ones to be laid off before other tenured workers.[14]

Empirical variation: average advance notice and LIFO rank by age. Figure 2 depicts the empirical age gradient of average employment protection along two dimensions that are easy to calculate and present quantitatively: tenure rank within firms for the LIFO layoff rule (left y-axis, blue solid line), and legal mandatory advance notice period in months (right y-axis, red dashed line). We calculate these two variables for workers employed at each (monthly) age. (To do so, we draw on 2019 data, described below in Section 3.5.) Workers that approach the EPL cutoff age of 67 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 10 or more employees). At the age threshold, LIFO rank falls to zero as employment protections are eliminated. Similarly, advance notice grows from 1 month to 6 months with tenure. When crossing the age threshold, advance notice drops back to 1 month, i.e., the lowest possible. Before crossing the threshold, workers would be entitled to almost 5 months on average of

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

[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.

advance notice when laid off. Not depicted are other important dimensions of EPL that are also eliminated sharply at age 67, crucially, the requirement to have a just cause for dismissal.

No other policy discontinuity at the EPL cutoff. Importantly, there is no other relevant policy change at age 67. Age 65 used to be a retirement norm in Sweden. Since 2007 however, the government has introduced payroll tax cuts and an earned income tax credit for workers over 65 in 2007 precisely as a way to encourage workers to keep working beyond age 65. As we shall see however, and in spite of these financial incentives, age 65 remains a retirement norm (although substantially weaker than pre-2007). Most importantly, in Sweden, there is also no matching of pension incentives at the EPL cutoff age, which we discuss in more detail in the next section.

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 and Kolsrud et al. (2023) 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.[15] 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 provide benefits equal to individual contributions plus a fictitious return based on 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 can be drawn as early as age 61 up to 2019. The earliest age increases 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

[15]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.

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) but 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.

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

Indeed, 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.

3.4 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). This evidence leaves room for wage rigidity in mediating the effects the specific policy discontinuity we study.

3.5 Data from Statistics Sweden

Our analysis is based on the full population of all Swedish residents (as of December 31 each year) aged 60 or more. To study employment and earnings, we use monthly earnings and employment spells from matched employer-employee records. Our main focus is on 2019, but we draw on earlier years to, e.g., construct tenure or lagged variables. For years before 2019, the data are not as detailed at the monthly level creating measurement error (see below). Therefore we start our main analysis in 2019. Specifically, for each spell, pre-2019 data record annual wage earnings payments and months worked (used to administer the social security and income tax systems) rather than exact monthly earnings, month-by-month as is done starting in 2019.

We also merge in financials for firms and workers' educational attachment and test scores, to permit us to proxy for the quality of workers. We have also merged in the Structure of Earnings Survey, which covers about 50% of the Swedish labor market and covers hours and compensation structure to be able to estimate wages controlling for time worked. Finally, we merge on the Labor Force Survey, which contains information on contract type (permanent or temporary).

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. 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 ppt 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, interestingly, in the public sector.

Definitions: separations and age. We use the administrative monthly wage earnings records in Sweden, which are organized by calendar month. We classify workers by their age in a given month, and we relate age and separations.

A job separation is defined as a worker being employed with employer j in month t but not working with that employer during any of the next 12 months. We aggregate these data to the

worker-level as follows. An individual is working if she has positive earnings. She separates in case any of her spells ends in the month.[16] 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.

We will pair this separation outcome with the age of the individual, again in months in order to pair this one-to-one to the calendar months in our monthly administrative earnings data. For example, a worker that 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, we restrict 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 3 depicts the monthly separation probabilities for employed workers in 2019, for monthly 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 to our cohort in 2019, see Section 3.3).[17] There are also mild spikes at round ages. Overall, as shown in Seibold (2021) for Germany, these patterns—including the large spikes 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. At age 67, the data reveal a clear excess spike in separations at exactly that age—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.

[16] 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, with the results essentially unaffected (results not reported).

[17] 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.

Excess separations: formal estimation. Figure 4 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. 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). Excess separations are simply the sum of the three differences (gray area). 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).

Excess separations: 8.4% of jobs at 67 are "deadwood." The bunching estimator reveals that in the full sample (corresponding to Figure 3), the estimate of excess separations is 8.4%. That is, means that 8.4% of jobs end because of the discontinuity in EPL around age 67—i.e., separate in response to its elimination. 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 5 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 plotted this variation in EPL in Figure 2. In addition, all other EPL dimensions are also abolished, importantly, the just-cause requirements and no other rules apply to layoffs after 67 anymore.

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, and firms would have preferred to lay off those workers even before (hence would have obtained negative firm surplus had it not been for the firing cost of EPL), 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, parties obtained positive surplus before and do so also after the elimination of EPL.

Post-separation outcomes: reallocation to other employers vs. retirement. The framework in Section 2 distinguished two types of deadwood in terms of outside options and rents: jobs in which workers' reservation wage exceeds their productivity everywhere (hence, indicating negative joint surplus)—such that they never work again, i.e., they retire—, and those that move to their outside option with another employer. Panel (a) of Figure 5 decomposes the

baseline separations and the excess spike therein at 67 (light dashed-dotted line) separations into retirement (in solid 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. Hence, the excess job losers are not able to find, or willing to accept, another job. This pattern supports the stronger notion of deadwood.

Idiosyncratic deadwood 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 5 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 layoff all their workers at age 67 as a matter of policy. This implies workers 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 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 softer retirement norms may lead workers and employers to coordinate retirement at age 67 due to the emergence of retirement norms in a way that does not reflect neoclassical labor supply choices (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 6 replicates Figure 3 for three years: 2019, 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 Appendix Figure A.2) However, due to data and COVID confounders, we however throughout prefer our main estimates for 2019, which also reflects an equilibrium level after the cutoff age had been in place since 2003.[18]

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 laid off their deadwood workers 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 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 65 to 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.

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 except for EPL would have prevented firms to employ those workers through 68 already in 2019; 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. Appendix Figure A.2 depicts the evolution of the EPL cut-off age in Sweden since 1990.

[18] 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 cut-off age was 65 up to 2002, 67 in 2003-2019, 68 in 2020-2022, and 69 since 2023.

Figure 7 Panel (a) replicates Figure 3 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 large spike just before age 65 is due to both the elimination of employment protection but also retirement norms, which cannot be disentangled.

Figure 7 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.[19] These estimates are produced following the same methodology depicted in Figure 4, with a simple adjustment for the break in data quality starting in 2019.[20] The series are solid when EPL ends at the corresponding age and dashed otherwise.

For the age 68 series in Figure 7 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 6. 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 EPL continuing past 65 in 2003, pension changes, and tax incentives to work longer set in place in the 2000s.[21]

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 8 Panel (a) replicates Figure 3 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, and are much more modest for workers with tenure below 2 years.

[19] 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).

[20] 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.

[21] 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.

About 90% of workers at age 67 have jobs with tenure above 2 years. This explains why excess separations in the full sample are fairly close in level to excess separations in the high tenure sample. To show the role of tenure more continuously, Appendix Figure A.3 Panel (a) depicts excess separations by tenure decile. The graph shows that the excess separations estimate grows fairly smoothly with tenure.

Panel (b) in Figure 8 breaks down the worker sample by employer size: up to 10 employees (solid blue line) vs. more than 10 employees (dashed red 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.3 Panel (b) depicts this effect with more bins for firm size.

We caveat that while these patterns are consistent with the treatment intensity differences (while all jobs fall to zero 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.

4.3 Regression-Based Heterogeneity Analysis

We now study *which jobs* are supported solely by EPL—and hence separate in response to its elimination. We do so in a systematic heterogeneity analysis by devising univariate and multivariate regression approach—in a methodological contribution to the bunching literature.

Read through the framework in Section 2, this heterogeneity in excess separations traces out three related concepts: the characteristics of a deadwood job (or worker), the type of organization that accumulates deadwood jobs, and the pre-elimination, baseline degree of protection. Above, we have already traced out the treatment intensity along legal factors determining EPL strength (firm size and tenure).

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 in the example of the

variable) as follows:

$$\text{Univariate specification: } s_{ima} = \alpha_a + \beta_a \cdot D_{ima} + \varepsilon_{ima}. \tag{7}$$

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 4.

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 (7) but regresses s_{ima} on monthly age dummies α_a and monthly age dummies interacted with all dummy variables of interest $D^1_{ima}, D^2_{ima}, ...$:

$$\text{Multivariate specification: } s_{ima} = \alpha_a + \beta^1_a \cdot D^1_{ima} + \beta^2_a \cdot D^2_{ima} + .. + \varepsilon_{ima}. \tag{8}$$

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 Figure 9, which depicts excess separation estimates by groups defined by dummy variables listed in rows. The univariate blue empty circles report the additional excess separation (in percentage points) when the dummy variable is equal to one (relative to the dummy variable equal to 0) as in specification (7). The multivariate red full circles in Figure 9 report the additional excess separation when the dummy variable is equal to one (relative to the dummy variable equal to 0), and controlling for all other dummy variables listed in the figure as in specification (8). We sort the variables by the coefficient size in the univariate analysis.

The univariate regression analysis recaps that dimensions driving EPL stringency—tenure and firm size—are important drivers. 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.

Our remaining analysis follows an inductive and exploratory approach, considering some variables we a priori envisioned as plausibly being linked with deadwood status as defined in Section 2, but also including a broader set of standard labor market variables such as gender or the earnings level. 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 fact that excess separations are larger for high earners than for low earners implies that the impact of separations on overall earnings is somewhat more than the 8.4% impact on jobs that we find.

We have also explored how the spike varies with a number of additional variables such as receiving a bonus (which could signal high value to the employee), 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) and hence are omitted in our analysis.

Next, we dissect specific factors that stand out to us as indicators of deadwood labor.

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. 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 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.

Indeed, the regression analysis estimates larger effects for this variable. Workers with 3+ weeks of sickness in 2018 experience an excess separation at age 67 of 11.5 percentage points relative to other workers. Controlling for all the other variables reduces slightly the effect on excess separation from 11.5 points down to 10 points. This pattern strongly suggests that firms target less productive workers for layoffs.

To illustrate this effect in the raw data, Panel (a) of Figure 10 depicts the separation hazards for employed workers by age in 2019 broken down by the sickness history of the worker as described above. 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. Another variable that stands out is public vs. private sector, with an about 5ppt additional effect for the public sector. Panel (b) of Figure 10 again provides the raw separation-age gradients along with the excess separation estimates by subgroup. 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.[22] 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

[22]While the public sector represents about one third of the total workforce in Sweden, about 40% of workers aged 60-67 are public sector workers (in 2018), explaining why the overall sample has a spike about mid-way between the spike for public sector workers and the spike for private sector workers.

layoffs, or because it offers good jobs for older workers, to which workers hold on longer, until they are laid off at 67.

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–about 92% of them–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: 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 adjustment. 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.

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 covers all workers in the public sector including those past 67. We have above established that in this subset of the economy, 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 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). Wages do not fall after crossing the 67 age threshold. Hence, there is no evidence for firms and workers rebargaining wages to keep older workers on the job. This finding has two implications for our understanding of the effects of EPL on protected insiders. First, while we cannot definitively extrapolate to the wage negotiations that may have occurred in the jobs that separated, such wage rigidity may, if exhibited by the separating jobs too, help explain exactly the divergence of productivity from wages that leads firms to want to lay them off in the first place. Second, conversely, when considering the stayers, the absence of wage reductions 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. This evidence that is consistent with a notion of wage rigidity leads us to favor the model with fixed rather than flexible wages among the two we sketch in Section 2.

Hours. Our analysis of labor quantities so far permits only a binary adjustment of hours between positive and zero. 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, again drawing on 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.4 Panel (a), we find that much of those movement 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. We close the analysis of the public sector with the outcome of 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.

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 resort to 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 EPL end 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.

Panel (b) takes the depicted series in Panel (a) and then expresses them in percent differences from month-to-month. The figure shows that, consistent with Figure 11, there is a large drop in earnings at age 67. To compute this drop, and to be consistent with the separation effects, we again compute *excess* earnings growth, and permit the adjacent age months to be part of the treated area as in the bunching analysis, as when computing excess separations in Section 4.1.

For the public sector, we know that this drop in earnings is driven by hours reductions against constant wages. Turning to the private sector, the figure reports a much smaller 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.

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.4 reports those results. Again, we draw on a notion of stayers below and above 67, such that these results can be interpreted as contract conversions.[23] 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.

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), permitting the parties to plan ahead for longer horizons. Temporary/fixed-term contracts might permit the parties to provide a basic, sprivate 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.

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. 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,

[23] 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.

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; Panel (b) expresses this series in simple differences (in percentage points) (solid blue line).

The figure reveals a clear 2.5 percentage point (about 10%) 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.) To quantify this effect, we again employ bunching methods to estimate local effects, based on the changes figure and the pronounced spike it reveals.

This result implies that the deadwood 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 5 (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 (up to an approximation from population shifts):

$$\frac{d\text{Emp}}{\text{Pop}} = \frac{d\text{Hires}}{\text{Pop}} - \frac{d\text{Sep}}{\text{Pop}}, \tag{9}$$

where Pop is the full population at a given monthly age. Panel (b) plots the change in the employment ratio 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. This analysis of worker flows reveals at best a very modest increase in hiring and labor market fluidity following the elimination of EPL. Hence, 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). We again use the bunching methods to estimate the excess effects, here applied to the earnings growth gradient.

There is a 21.5% drop earnings per capita at 67 when employment protection is eliminated. This is a large effect—larger than the about 10% extensive margin effect on the employment margin we documented above. Below, we therefore provide an explicit account of the intensive margin.

Decomposition of earnings per capita: extensive and intensive margins. Additionally, Panel (b) also decomposes the total earnings per capita changes into an extensive margin (employment changes in green dotted-dashed line) and an intensive margin (earnings conditional on working in red dashed line). This analysis exploits the following accounting approximation (suppressing population and compositional subtleties), showing that the effect on total earnings per capita growth reflects intensive margin effects (on earnings conditional on working, $\overline{y}$ below), and extensive margin effects (on employment):

$$\frac{\text{Earn}}{\text{Pop}} = \overline{y} \cdot \frac{\text{Emp}}{\text{Pop}} + 0 \cdot \frac{\text{Pop} - \text{Emp}}{\text{Pop}} \quad \Rightarrow \quad \frac{d\frac{\text{Earn}}{\text{Pop}}}{\frac{\text{Earn}}{\text{Pop}}} \approx \frac{d\overline{y}}{\overline{y}} + \frac{d\frac{\text{Emp}}{\text{Pop}}}{\frac{\text{Emp}}{\text{Pop}}}, \tag{10}$$

Hence, this perspective on Figure 14 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).

Understanding the intensive-margin effect. 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 exceeds 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 (Figure 9), so that separations reduce earnings by more than employment (in percent).[24]

Public vs. private sector earnings. Appendix Figure A.5 repeats this analysis but breaks it down by public and private sector. The earnings drop is twice as large in the public sector than in the private sector. While the extensive and intensive margin are equally split in the public sector, two thirds of the private sector effect is due to intensive margin adjustments.

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 (following a 2020 reform). 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.

In both panels, the drop at age 67 happens in 2019—which the analysis in the previous section entirely attributes to the excess separations then (and sharply concentrated hours/composition effects for earnings per capita).[25]

Importantly, there is no subsequent reversal of this effect over the next 12 months between 67 and 68: along the extensive margin (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

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

[25]Recall that 2022 exhibited a small legacy spike of separations at 67 too, as seen in Figure 5 and discussed in Section 4.2. Hence, the statement about 67 above refers to *differential* separation rates and reductions in earnings at that age cutoff.

(Panel (b)), it reduces earnings permanently but has no subsequent differential dynamics in earnings based on EPL status either. Hence, the 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 extraction 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.[26]

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 impact 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.

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 this prolongation of the working life of Swedish older workers, with future additional increases in the EPL cutoff age scheduled then. We discuss the policy implications of our final DiD analysis, incorporating our full set of other findings of the paper, below in the conclusion.

7 Case Study: Professors (Ashenfelter and Card, 2002)

We close our analysis by zooming into the case study of university professors. This investigation is in the spirit of the study by Ashenfelter and Card (2002).[27] Ashenfelter and Card

[26]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.

[27]Clark and Ghent (2008) and Warman and Worswick (2010) provide additional analysis of university professors and mandatory retirement in the US and Canada, respectively.

(2002) study the elimination of a legal exception that permitted US universities to force into retirement tenured professors, which was legal starting age 70 through 1994. Tenure for professors is among the strongest forms of employment protection. Indeed, universities seemed to push out their faculty at that age; once such EPL got extended, professors seemed to hold on to their jobs as excess separations got smoothed out, with professors retiring later.

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. 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.

The excess separations for professors at the 67 cutoff in Sweden is much more modest than what the US and Canadian studies found. To see this, Appendix Figure A.5 Panel (c) reports the effects of total professor earnings per capita, decomposing it into an intensive and extensive margin. There is a 71% reduction in total earnings, largely due to the intensive margin, with an 27% extensive margin component. Hence, all effects are *much* stronger for professors than the the full public sector (depicted in Appendix Figure A.5 Panel (b) and discussed above in Section 6.1).

8 Conclusion

How does employment protection affect employment of older workers? Basic economic reasoning clarifies that any employment gain comes with the "deadwood" labor problem: those jobs that EPL prolongs firms would prefer to terminate, 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. Appendix Figure A.2 plots the full evolution of the EPL cutoff age since 1990. The policy motivation is the belief that the EPL age props up employment among older workers.[28]

[28]The largest Swedish employer organization, the Confederation of Swedish Enterprise (Svenskt Näringsliv, 2017), was critical of the reforms warning of unintended consequences. They noted, at the time, that "seven out

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 a 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 also 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 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. 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.

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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."

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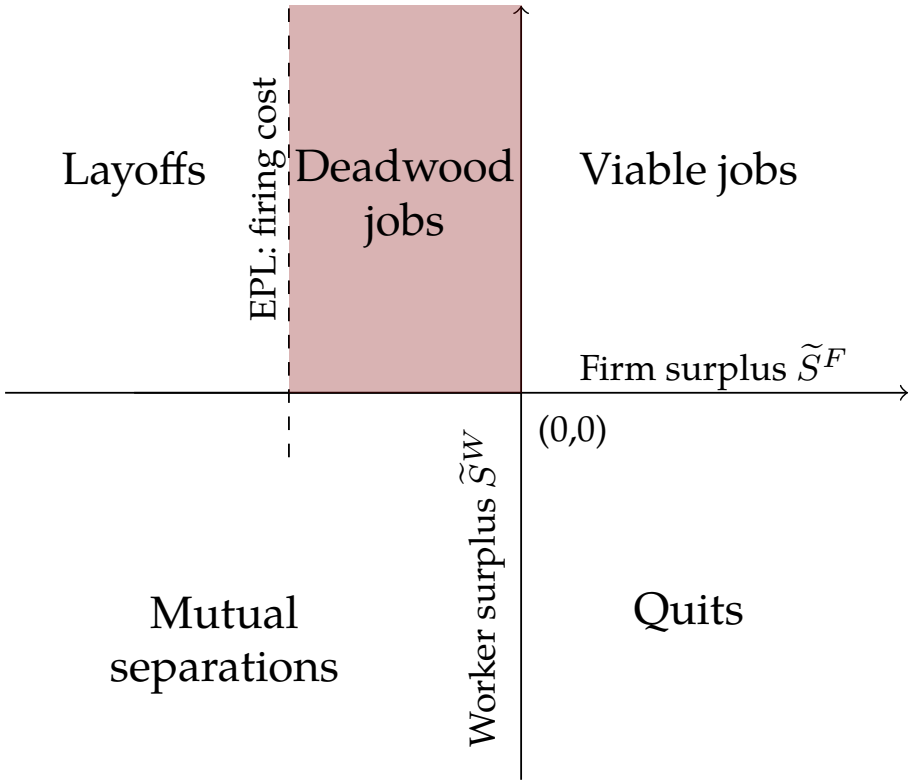
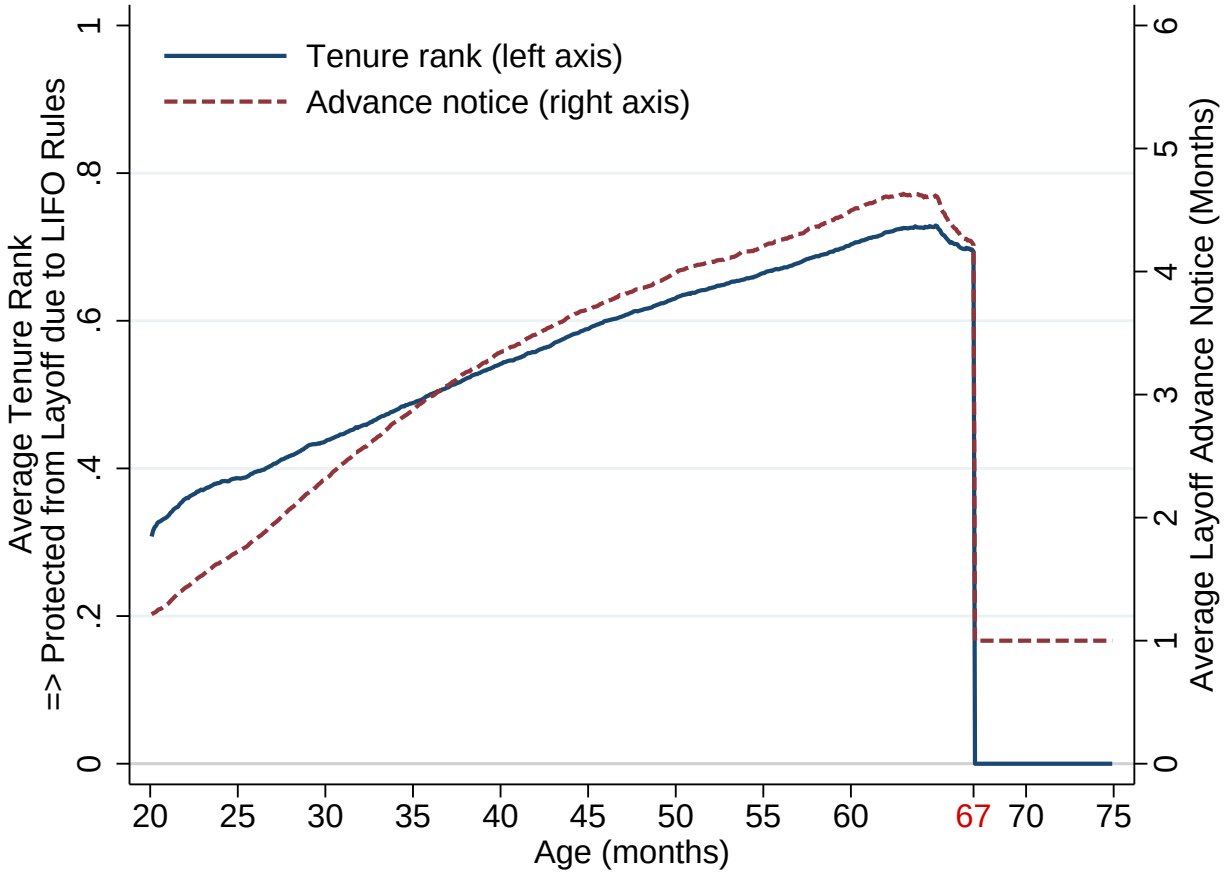
Figure 1: Deadwood Jobs and Employment Protection in the Model



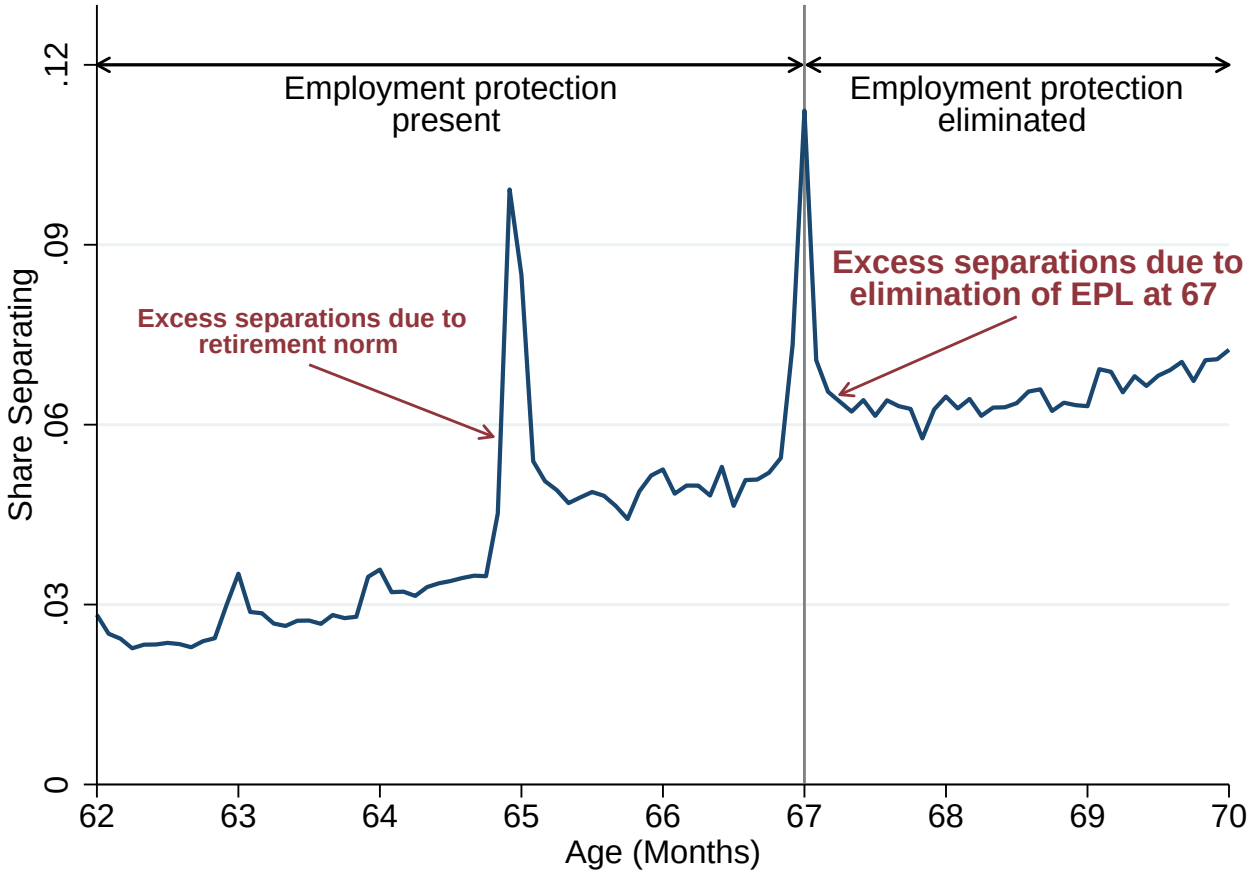
Notes: The figure illustrates job separations by type (quits, layoffs, mutual separations) and viable jobs in the simple model, with fixed wages. Deadwood jobs supported by EPL are denoted by the shaded red region. The axes denote gross-of-EPL surplus concepts $\widetilde{S}$, such that the firing cost 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: First Stage Effects of Employment Protection Elimination



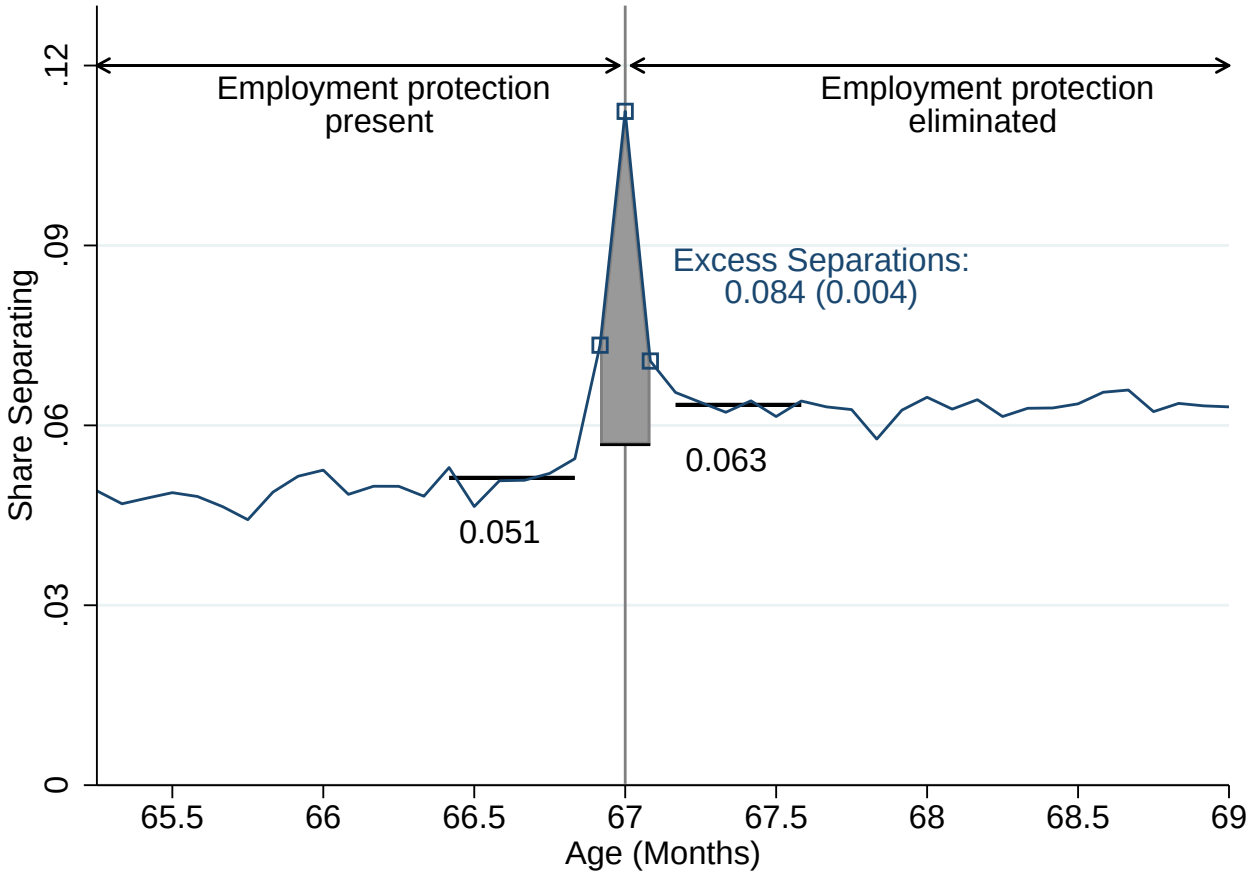
Notes: This figure depicts the first stage effect of employment protection elimination for older workers along two dimensions: Tenure rank within firms for LIFO layoff rule (left y-axis), legal mandatory advance notice period in months (right y-axis). In Sweden, employment protections are eliminated when the worker turns 67 (in 2003-2019, see Appendix Figure A.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 3: Separations by Age in 2019



Notes: The figure depicts the share of 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.

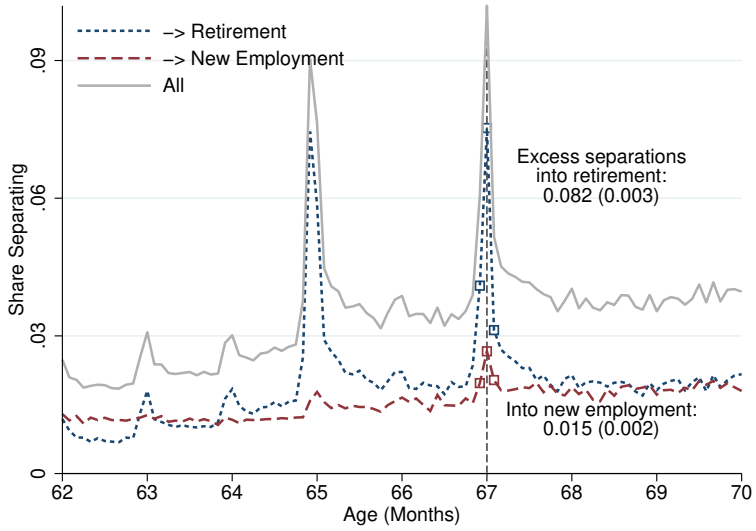
Figure 4: Bunching Estimation of Excess Separations



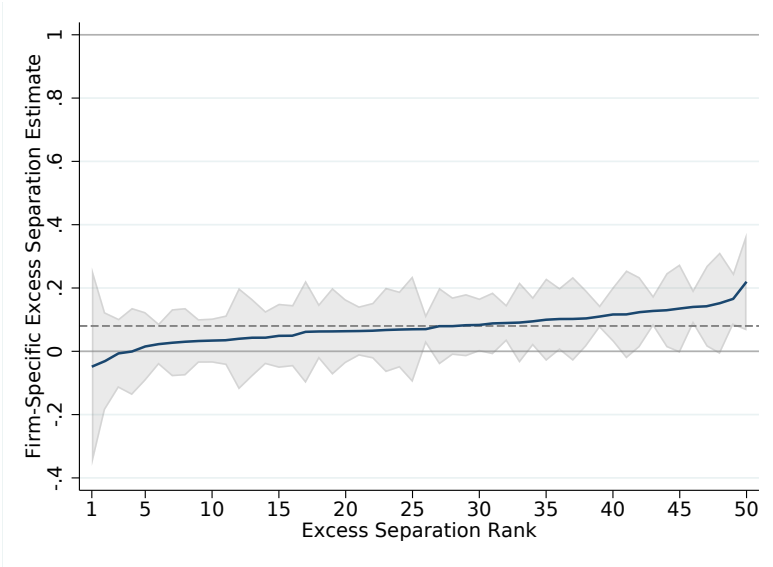
Notes: The figure depicts how we estimate excess separations at the age threshold where employment protections are eliminated using the bunching methodology developed by Saez (2010). Excess separations are the difference between separations for the 3 months: 67-1/12, 67, 67+1/12 (squared on the series) 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). In the full sample (corresponding to Figure 3, excess separations is 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 5: Features of Excess Separations

(a) Excess Separators Go Into Retirement



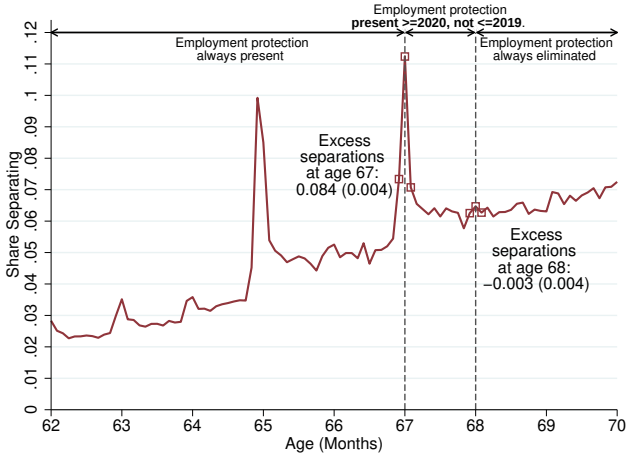
(b) Excess Separations not Concentrated in Specific Firms



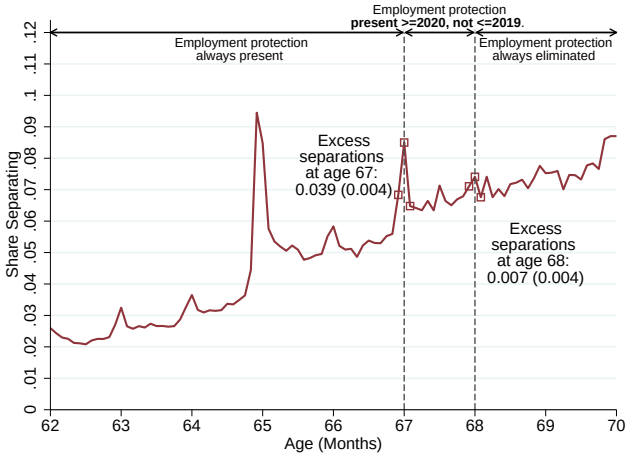
Notes: Panel (a) depicts the separation shares by age in 2019 (light dashed-dotted line) and decomposes the series into moves into retirement (solid blue line) vs. into new employment (dashed red line). Separations into retirement are defined as separations where the worker will not take a new job that lasts at least six months within the next 24 months. The spike at 67 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 6: Reform: Change in EPL Age Threshold from 67 to 68 in 2020

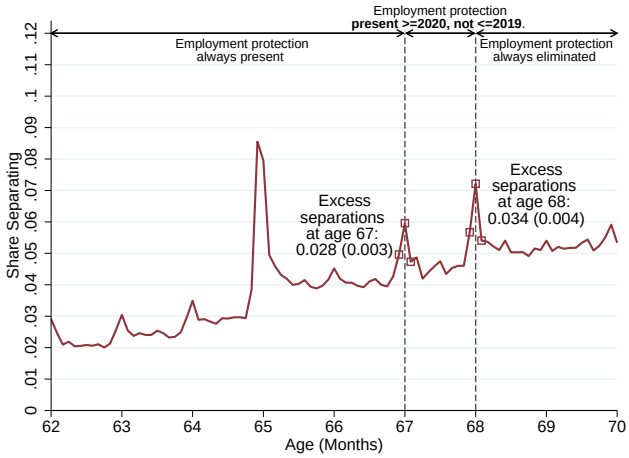
(a) 2019: Cutoff at 67



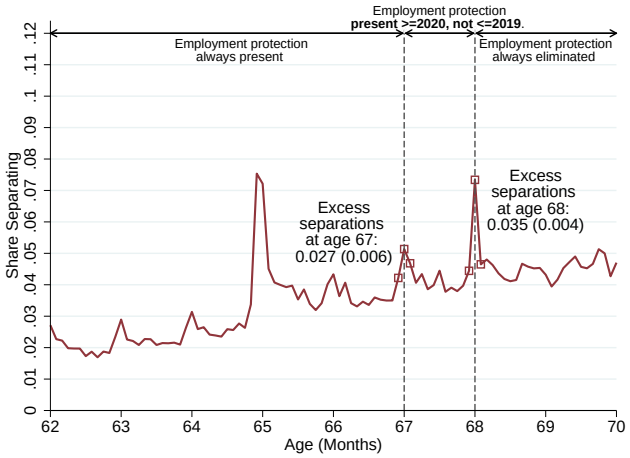
(b) 2020: Cutoff at 68, But Age-68 Cohort's "Deadwood" Was Already Extracted the Year Prior



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



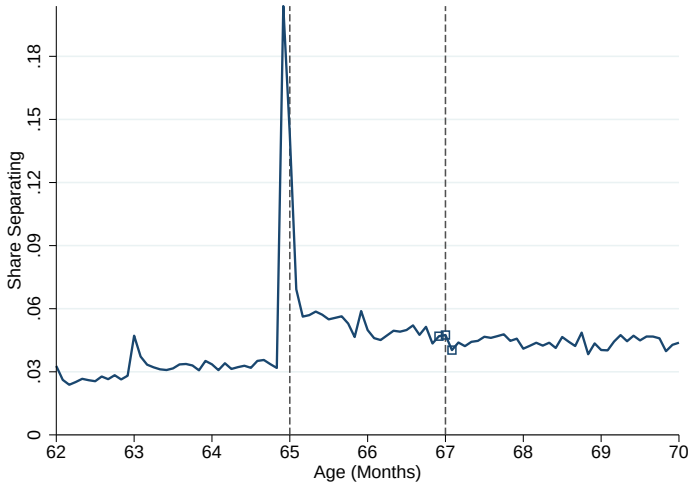
(d) 2022: Migration Continues



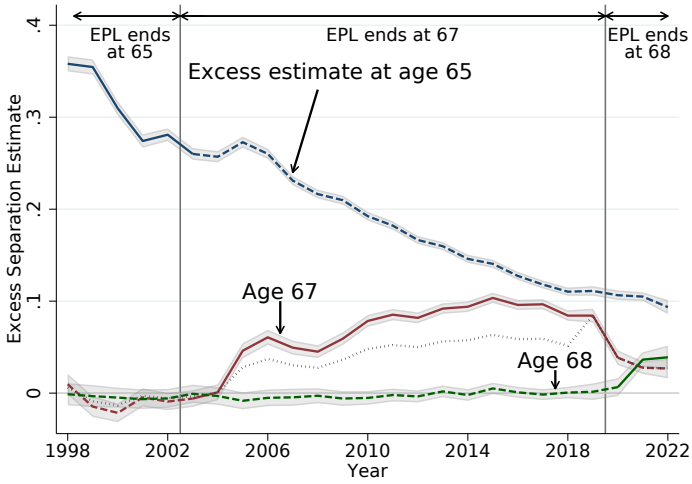
Notes: The figure depicts the separation shares by age in 2019, 2020, 2021 and 2022. Employment protection is eliminated at age 67 up to 2019 and at age 68 in 2020-2022. Each panel depicts the bunching estimator of excess separations at age 67 and at age 68 using the method depicted on Figure 4. The 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 separated 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 7: Excess Separations in Earlier Years

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



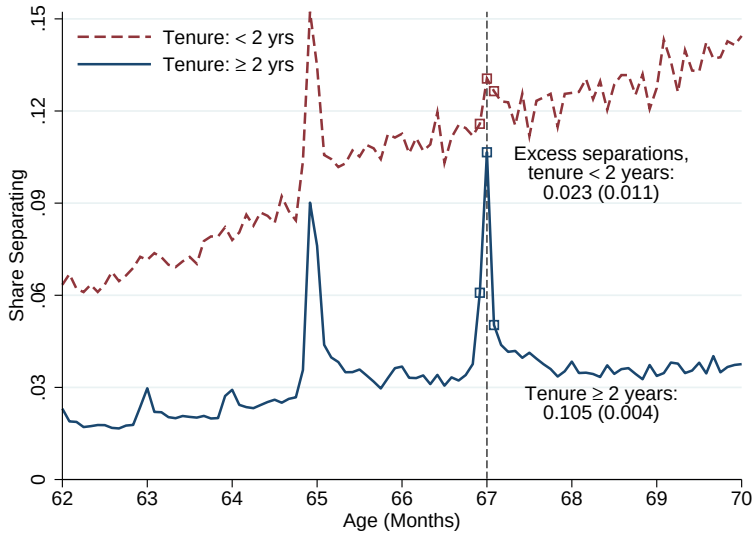
(b) Excess Separations by Year at Ages 65, 67, and 68



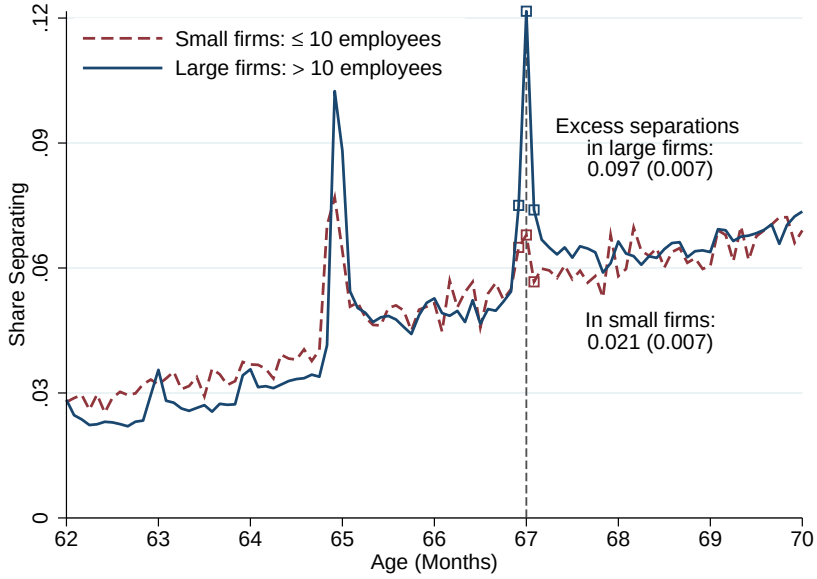
Notes: Panel (a) depicts the separation shares by age in months in 2002, when EPL ended at age 65. There is no spike at all at age 67, consistent with our interpretation that the spike at age 67 observed in recent years is driven by EPL ending at 67. The spike at age 65 is due to both the elimination of EPL but also retirement norms and incentives prevailing in those cohorts, which cannot be disentangled. Panel (b) depicts the excess separation estimates (estimated as in Figure 4) 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 4). 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 8: Role of EPL Rules: Heterogeneity by Tenure and Firm Size

(a) Tenure Above vs. Below 2 Years

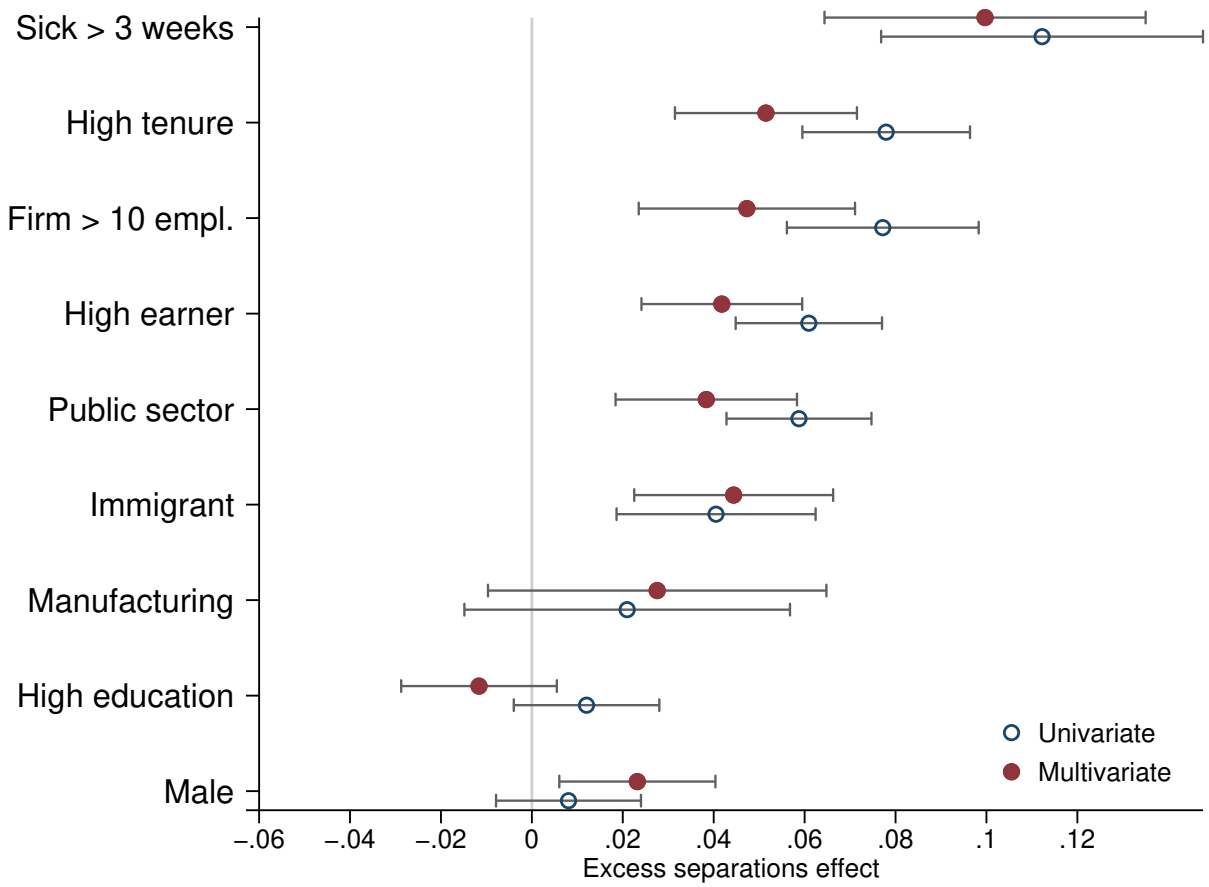


(b) Large vs. small firms



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.

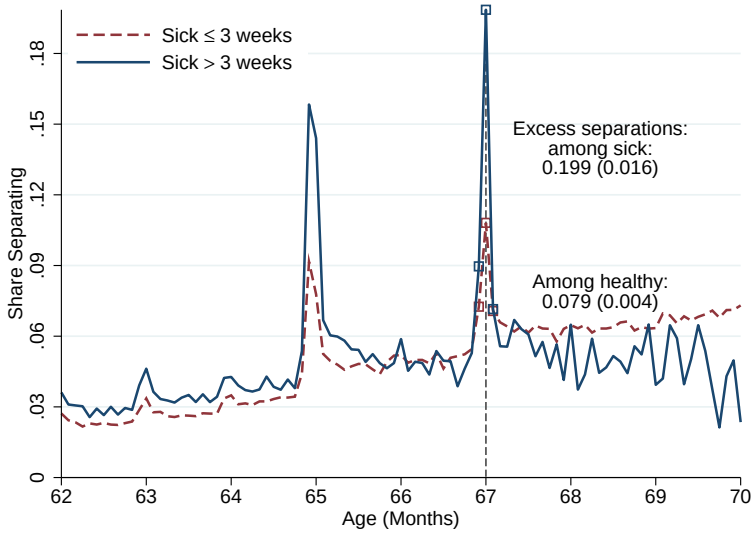
Figure 9: Excess Separation Heterogeneity: Univariate and Multivariate Regressions



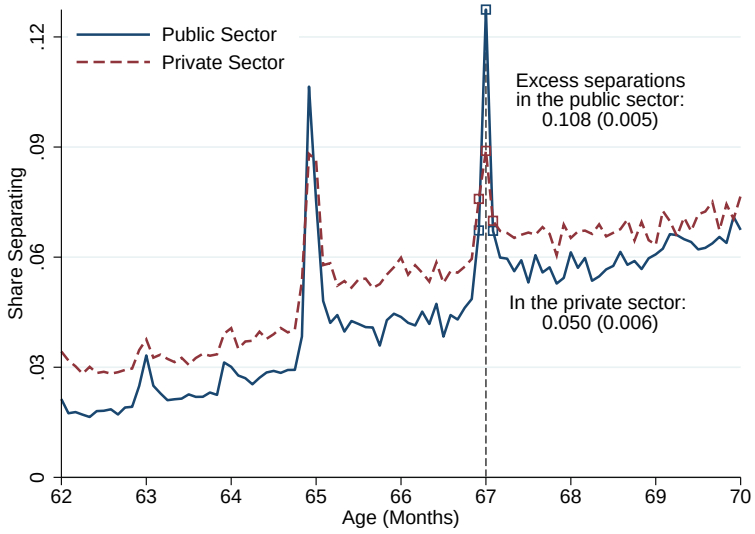
Notes: The figure is a coefficient plot depicting heterogeneity in the excess separation estimates for 2019 by groups defined by dummy variables listed in rows. The effects are regression coefficients in percentage points. The univariate effects (blue empty circles) report the additional excess separation share (in percentage points) when a given dummy variable is equal to one (relative to the dummy variable equal to 0). For example, workers with 3+ weeks of sickness in 2018 experience an additional excess separation probability at age 67 of 11.5 percentage points relative to other workers. The multivariate effects (red full circles) do so while controlling for all other dummy variables listed in rows. In the case of sickness status, controlling for all the other variables reduces slightly the effect from 11.5 to 10 points. Broadly, the multivariate effects stay close to the univariate ones.

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

(a) Sickness



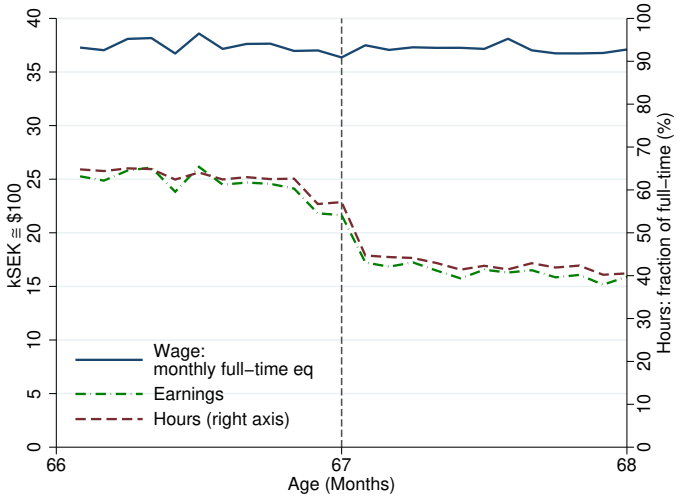
(b) Public vs. Private Sector



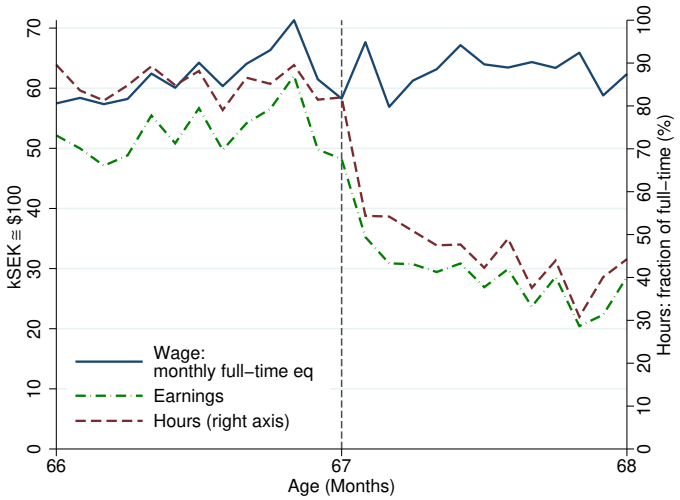
Notes: Panel (a) depicts the separation shares by age in 2019 breaking down the sample by sickness status of the worker: workers with sick days claimed below 3 weeks in 2018, the previous year, (dashed red line) vs. workers above that level (solid blue line). The excess separation at age 67, when employment 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), with 5% vs. 11%. This suggests that firms in the private sector are better able to find ways around employment protection laws before 67.

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

(a) Public Sector Workers

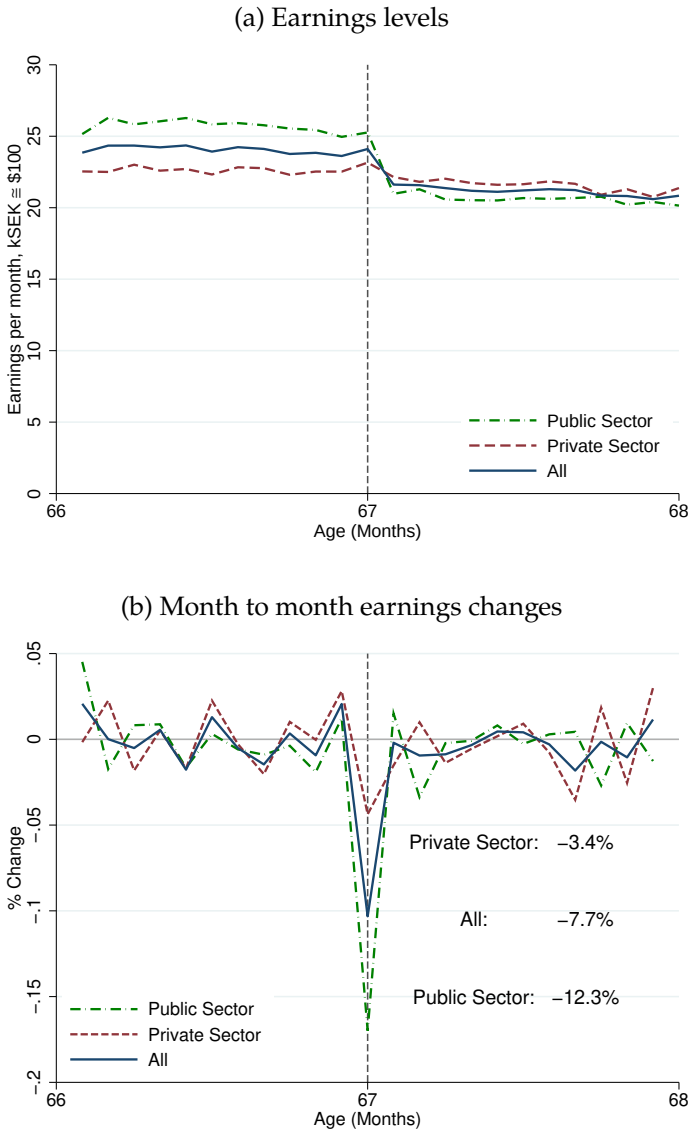


(b) University Professors



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, and hence restrict the sample to workers aged between 66 to 68, thereby studying stayers aging across the 67 threshold and eliminating compositional effects. Panel (b) repeats the same analysis but limited to university 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 not laid off. This effect is particularly large for university professors, who lose about half of their hours and earnings even when staying employed.

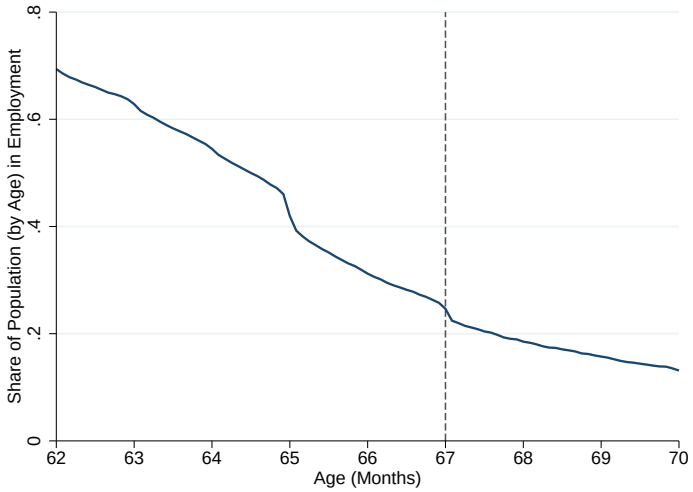
Figure 12: Panel Analysis of Earnings of Stayers in the Administrative Data



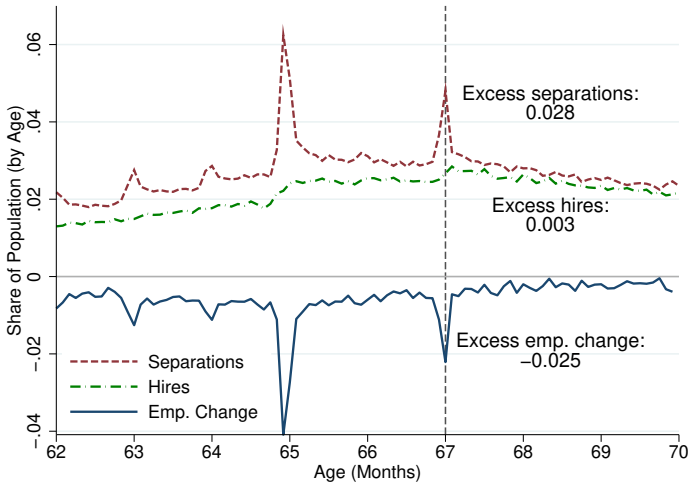
Notes: This figure uses the monthly earnings administrative data and focuses on the sample of stayers defined as workers continuously employed with same employer between age 66 and 9 months and 67 and 4 months in year 2019-2020 and who turn 67 in 2019. Panel (a) depicts the monthly average earnings among 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 these 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 4: 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 drop of 12.3% in earnings of public sector workers at age 67. However, the drop for the private sector workers is much smaller at 3.4%. The overall average 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



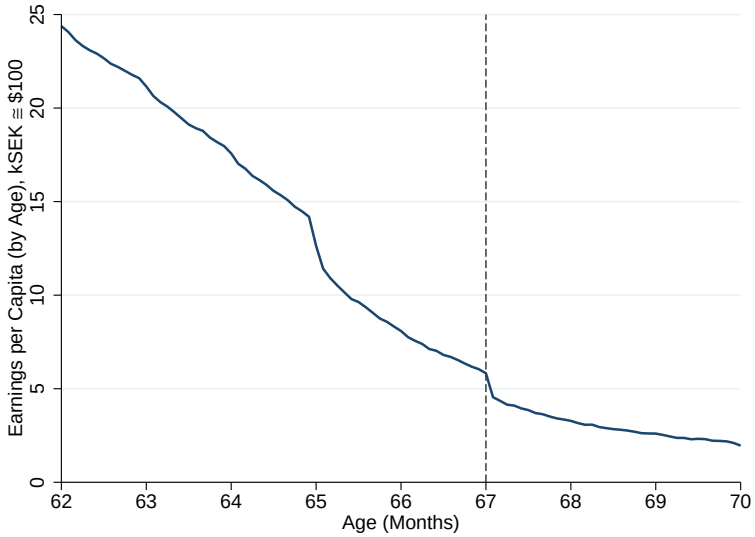
(b) Employment changes = Hires − Separations



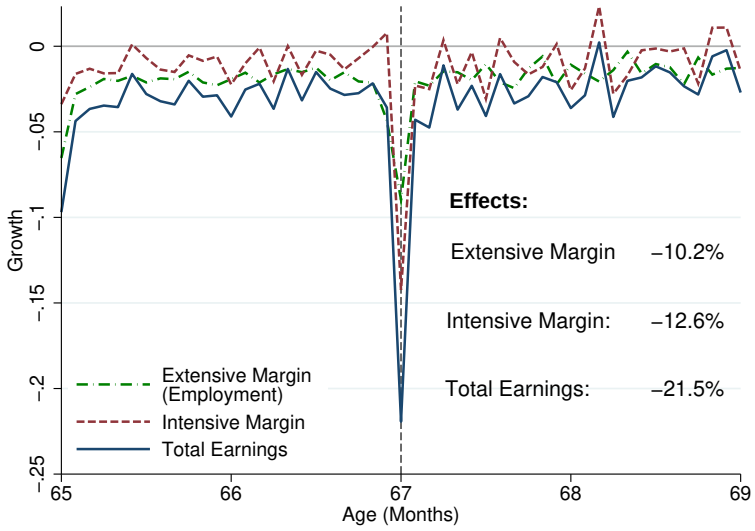
Notes: Panel (a) depicts monthly employment to population ratios by age (in months) in 2019 using the administrative monthly wage earnings records. The employment numerator includes only wage earners and excludes the self-employed. Panel (b) takes this series and expresses it in *straight differences* from month-to-month (solid blue line). Using the bunching method as in Figure 4, we estimate a clear 2.5 point (about 10%) 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 4, 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



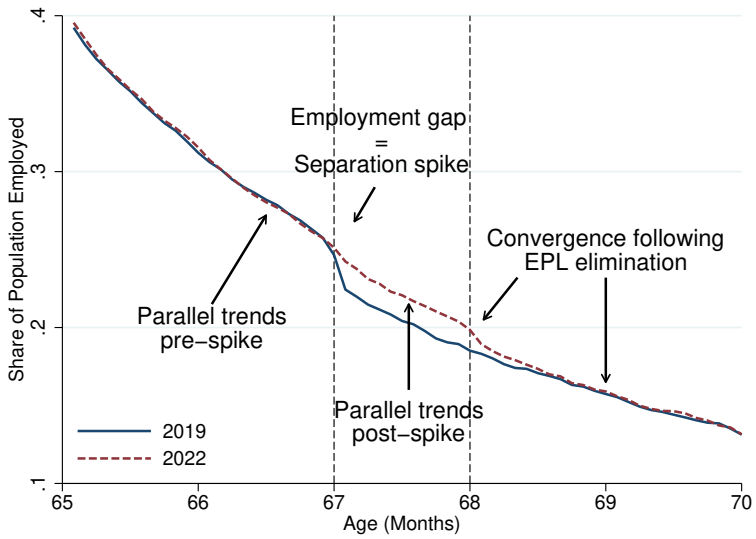
(b) Earnings per capita changes, extensive vs. intensive effects



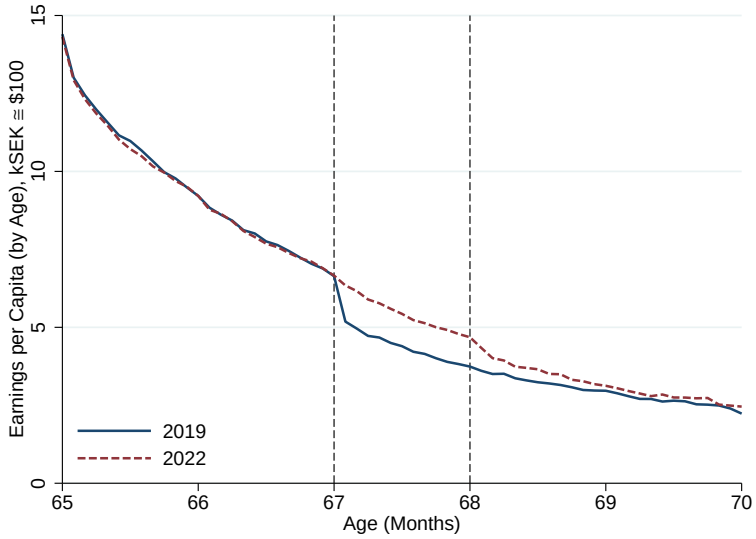
Notes: Panel (a) depicts monthly average employment earnings per capita (including zeros) by age (in months) in 2019 using the administrative monthly wage earnings records. Panel (b) takes this series and expresses it in *percent differences* from month-to-month (solid blue line). There is a 21.5% drop earnings per capita at 67 when employment protection is eliminated, estimated by applying the bunching method as in Figure 4 to this series. Panel (b) also decomposes the total earnings per capita changes into an extensive margin (employment changes in green dotted-dashed line) and an intensive margin (earnings conditional on working in red dashed line). Again using the bunching method, it shows that the drop in earnings per capita 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

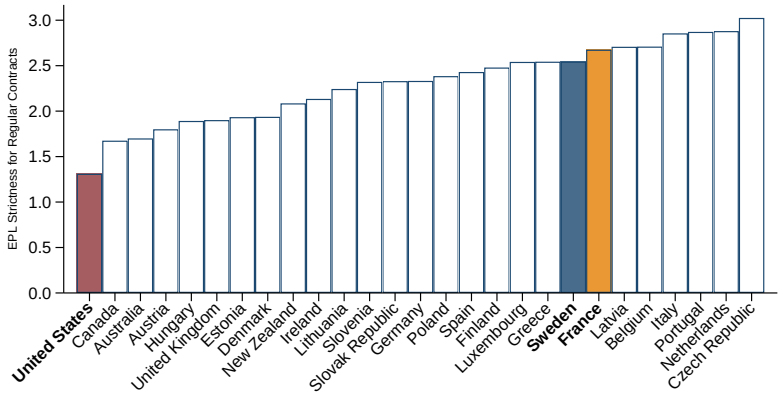


Notes: The figure depicts monthly employment to population ratios (Panel (a)) and earnings per capita (Panel (b)) by age (in months) in 2019 (solid blue line) and 2022 (dashed red line) using the administrative monthly wage earnings records. The 2022 series is adjusted by a constant multiplicative factor 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 almost perfect convergence of the 2 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.

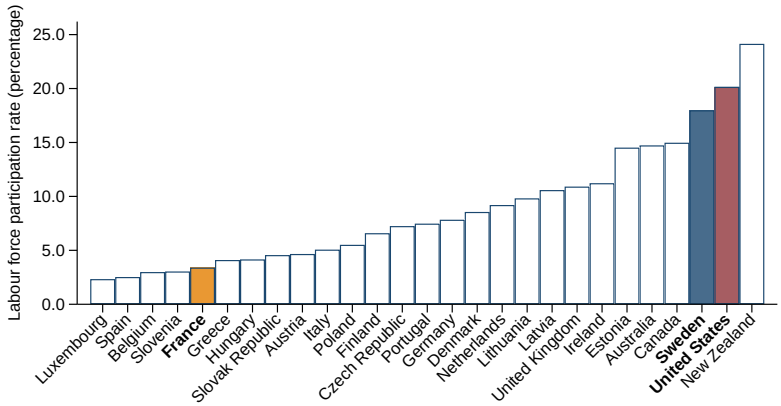
Appendix

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

(a) Stringency in Employment Protection Legislation

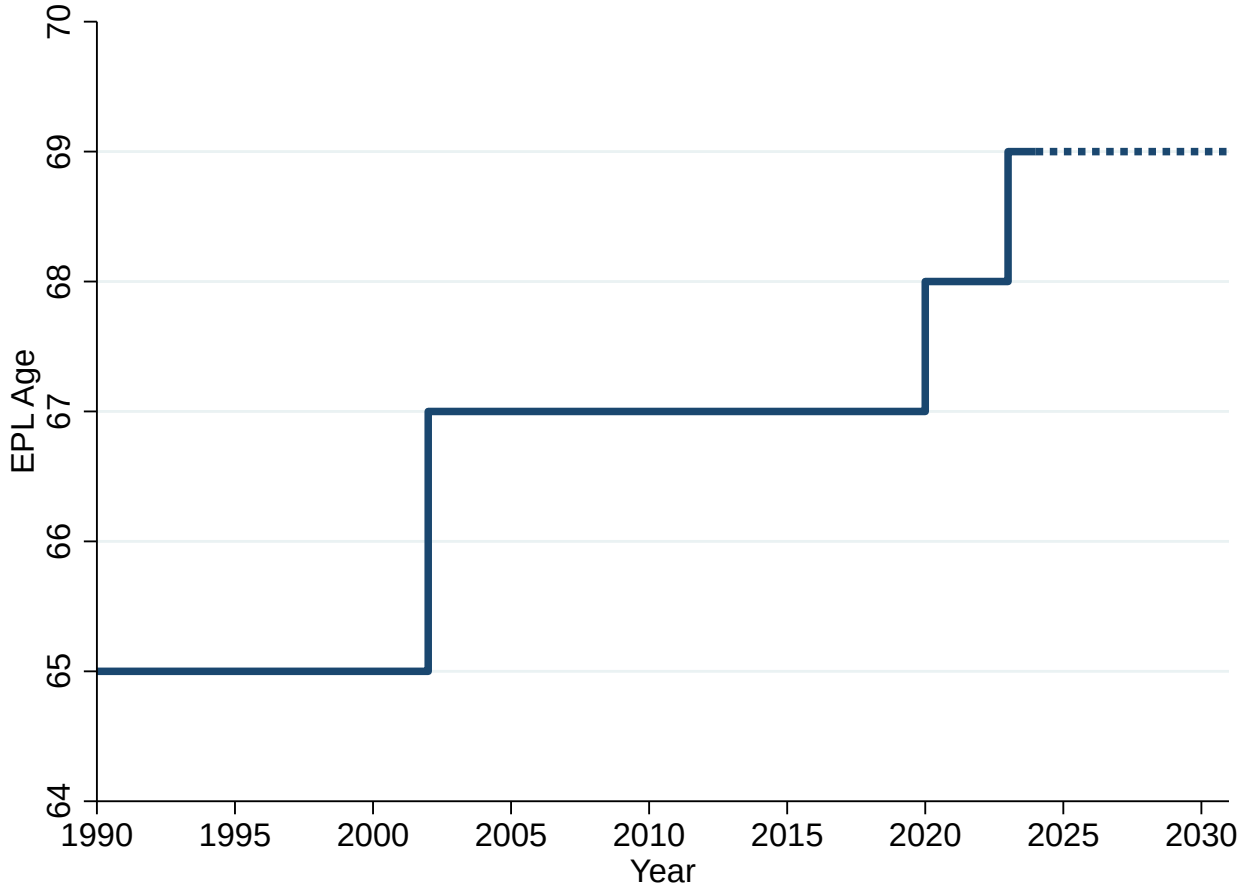


(b) Labor Force Participation at Age 65+



Notes: This figure uses OECD statistics to compare Sweden vs. EU countries and Anglo-American countries in terms of stringency of employment protection legislation (Panel (a)) and labor force participation of the population aged 65 and over (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.

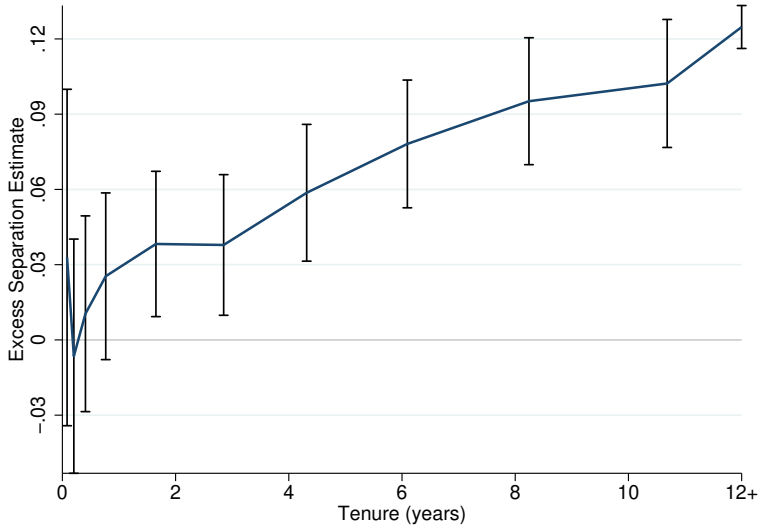
Figure A.2: Evolution of EPL Cut-off Age in Sweden



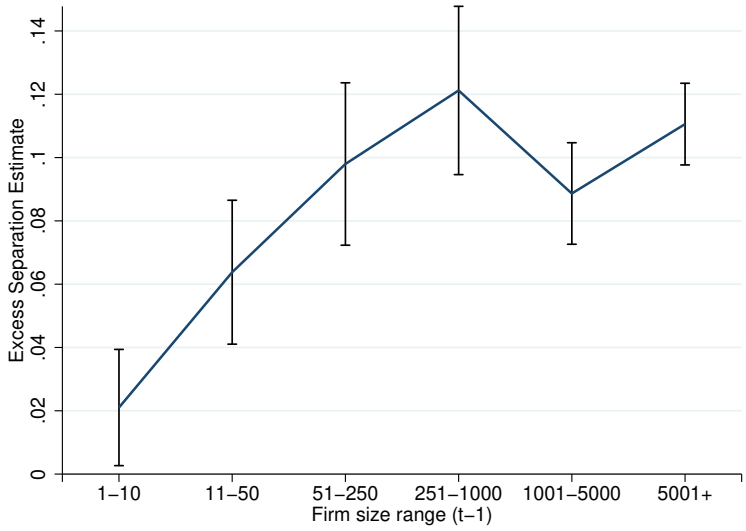
Notes: The figure depicts the evolution of employment protection legislation (EPL) cut-off age in Sweden since 1990. EPL is entirely eliminated once a worker reaches the cut-off age (based on birthday of the worker). The cut-off age was 65 up to 2002, 67 in 2003-2019, 68 in 2020-2022, and 69 since 2023.

Figure A.3: Heterogeneity by Tenure and Firm Size

(a) Excess Separations by Tenure



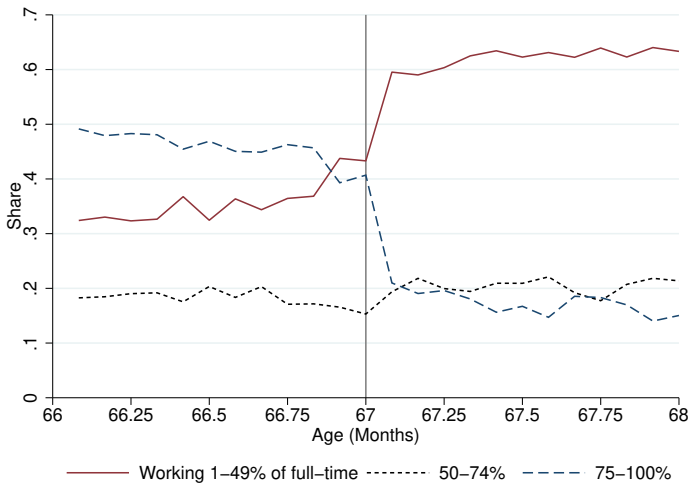
(b) Excess Separations by Firm Size



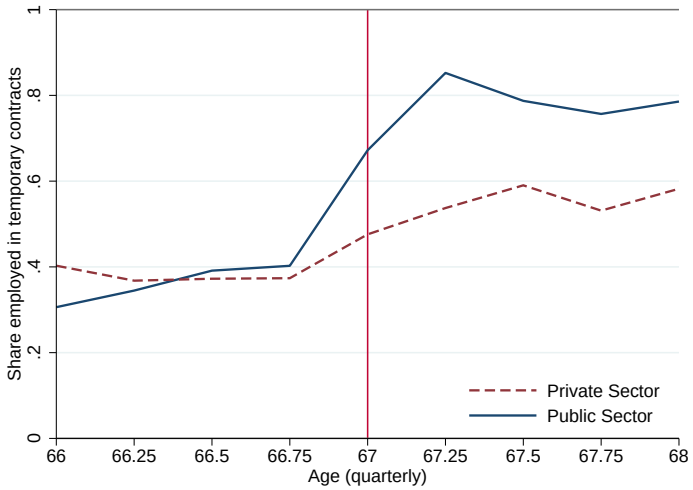
Notes: Panel (a) depicts the excess spike, estimated using the bunching procedure, by tenure decile among those with tenure below 12 years, and then a single top group with tenure in excess of 12 years. The x-axis captures the average tenure in each decile, except for the top group with tenure above 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.4: Impact of EPL Elimination on Contracts

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



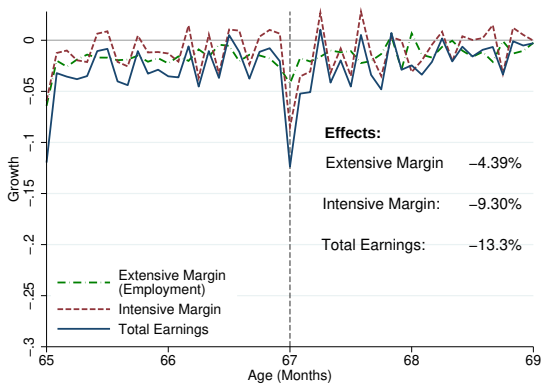
(b) Temporary vs. Permanent Contracts



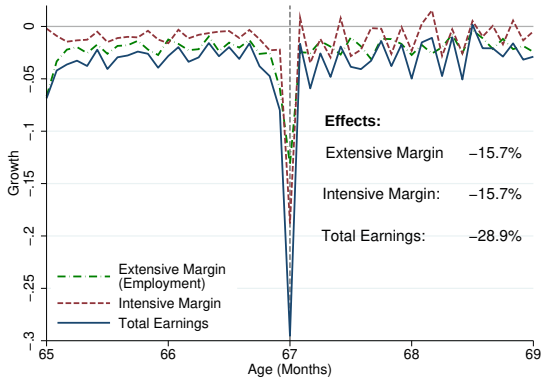
Notes: Panel (a) considers the panel of stayers (with the same employer on both sides of 67) among public sector workers (in the 2018-2019 Structure of Earnings Survey waves as in Figure 11), but then breaks it down into hours categories, displaying the fraction of workers working less than half of full-time, 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 contract) among private sector workers and among public sector workers. 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.

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

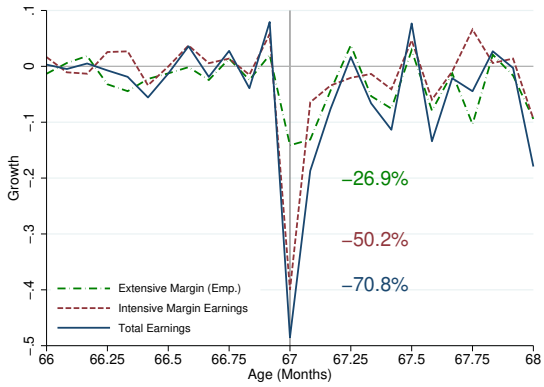
(a) Private Sector Workers



(b) Public Sector Workers



(c) University Professors



Notes: The figure repeats the analysis of percent earnings drop 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 university 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 university 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.