From Pensions to Personnel:
The Incentive Effects of Retirement Benefits on Retention

December 2025[1]

Kristy Kim Caleb Wroblewski

Abstract: Private retirement plans are a crucial component of worker's compensation in the U.S. and have long been thought to influence labor supply. This study uses a cohort-based regression discontinuity design to examine how a change in the retirement plan at the largest U.S. employer, the federal government, impacted the retention of employees over their full career. Workers with less valuable employer pensions but more portable retirement benefits were more likely to separate from the government between 15 and 30 years after beginning federal service. These effects are driven by highly productive workers, identified through supplemental compensation or early promotions, and workers with better outside options. These findings demonstrate that non-wage compensation impacts labor supply decisions across a worker's lifecycle and the distribution of human capital over time, particularly in labor markets where employers compete through diverse compensation structures.

[1]Email: kristykim@berkeley.edu and caleb.wroblewski@gmail.com.
We want to thank our advisors Alan Auerbach, Emi Nakamura, Emmanuel Saez, Jón Steinsson, Dmitry Taubinsky, and Danny Yagan for invaluable feedback across the many iterations of this paper. We would also like to thank Sarah Baker, David Card, Taha Choukhmane, Hilary Hoynes, Adam Leive, Cormac O'Dea, Charlie Rafkin, Benjamin Schoefer, and seminar attendees at UC Berkeley, BU Questrom, CBO, Treasury OTA, the Federal Reserve Bank of Philadelphia, and the NBER Summer Institute for helpful comments and suggestions. We are grateful for the Center for Retirement Research at Boston College and the Social Security Administration for providing funding for this research.

1 Introduction

Over the past half century, the structure of employment compensation in the United States has changed dramatically. According to the Bureau of Labor Statistics, employer-provided benefits account for roughly 30 percent of total compensation. This paper studies the labor supply effects of a broad shift in one of the largest components of non-wage compensation: retirement benefits.

Prior to the 1980s, most covered workers participated in defined benefit (DB) pensions, which provided guaranteed lifetime annuities based on salary and years of service. These plans tied retirement wealth to tenure and rewarded long careers at a single firm. Following the expansion of tax-preferred savings accounts in the mid-1980s, employers increasingly adopted defined contribution (DC) plans, which accumulate contributions and investment returns in portable, worker-owned accounts. Due to pension underfunding and the desire to reduce uncertainty in costs, many firms shrunk or completely froze their DB offerings in favor of DC programs.[2] From 1975 to 2020, active DB membership fell from 27 million to 12 million, while DC membership rose from 11 million to 85 million (Bureau of Labor Statistics).

Today, over half of U.S. workers participate in an employer-sponsored retirement plan. Economists have long argued that the design of these plans shapes both employee retention and labor market dynamism by influencing when and where workers choose to supply labor (Lumsdaine et al. (1990); Kotlikoff and Wise (1987)). DB pensions, which link the value of your annuity to tenure and highest salary, may create "golden handcuffs," where the value of continued work rises steeply with tenure, encouraging long careers at a single employer. However, once workers reach retirement eligibility, the opportunity cost of not claiming your pension acts as a substantial tax on work, which can potentially lead workers to immediately retire. In contrast, DC plans offer portable accounts that continue to grow when workers leave for other jobs, weakening tenure-based incentives and allowing greater mobility throughout the career. As employers have shifted from DB to DC systems, the rewards to staying have declined, and may have affected both career duration and the timing of separations.

Empirically isolating responses to these changes in retirement incentives has proven difficult, despite extensive economic and policy attention. Prior studies have examined labor supply effects of DB-to-DC shifts using earnings-based national programs (e.g., French et al. (2022); Lauletta and Bérgolo (2022)). However, these programs exclude a key margin of adjustment relevant to employer-provided benefits: in competitive labor markets, workers can switch jobs. In order to stop contributing to these national programs, workers would need to go into informal work (Bergolo and Cruces (2014), Lauletta and Bérgolo (2022), Feinmann et al. (2022)), migrate, or leave the labor force. As a result, studying responses to employer-specific plans is essential for understanding how these broad shifts in compensation structure affect labor supply.

[2] A plan freeze halts new accruals for existing participants or closes enrollment to new hires. By the early 2020s, more than 40 percent of DB participants were in some form of frozen plan.

Causal estimates are also difficult to obtain without quasi-experimental variation. Observed differences in labor supply between DB and DC participants (Munnell et al. (2006)) often reflect worker sorting rather than incentive effects (Goda et al. (2017)). Disentangling these forces requires quasi-random variation in job attributes, as in studies exploiting exogenous changes to employment conditions (Lavetti and Schmutte (2018); Lee and Taylor (2019)). In addition, changes in workplace amenities may be offset by compensating wage adjustments, confounding inference about the effect of any single benefit.

Finally, data from private employer pensions tend to be limited. Payroll data used by researchers often only span a few years, rather than their entire career. Furthermore, retirement reforms may target people within narrow age bands, rather than the full workforce, limiting our understanding of how changes in benefits affect labor supply across a worker's entire career.

This paper addresses these three challenges in identifying the *incentive effects* of the DB-to-DC retirement shift by studying a representative retirement reform using 50 years of data at the largest U.S. employer, the federal government. We examine how the shift from DB to a mixed DB-DC plan affected retention and workforce composition, leveraging a quasi-experimental setting in which a 1984 policy retroactively changed retirement coverage for newly hired federal workers.

Like many pension reforms, the government reduced the DB annuity and increased portable retirement benefits. Because the policy change was retroactive, workers were unaware of the form of the new retirement policy when they joined the government. We show that this change occurred without significant changes in the characteristics of new workers around the discontinuity that determined which plan workers were sorted into. Notably, workers were also not compensated for changes in retirement benefits with wages: salaries also remained the same around the policy change. This institutional feature allows us to employ a regression discontinuity design with local randomization: we compare the last cohorts under the old DB system, or the "old" system, to the first cohort under the new DB-DC system, or the "new" system, isolating the effect of the plan change on labor supply outcomes. The policy timing also lets us track effects over the life cycle, with up to 35 years of observations per worker.

We find that the shift from backloaded pensions to portable benefits significantly reduced workforce attachment. The policy change shortened the average federal career by nine months and decreased the likelihood of staying until retirement by 3 percentage points. Consistent with the loss of backloaded accruals, we find negligible effects in the early career but large separation responses in the mid- to late-career stages. We find that workers under the new system are 2 to 3 percentage points more likely to separate during their mid-to-late career (between 15–30 years of tenure). Consequently, workers in the 50th to 80th percentiles of the tenure distribution shortened their federal careers by 1 to 3 years—a decline of 3–16%. These results hold across a battery of robustness checks, including seasonal adjustments, varying bandwidth choices, and donut RDs to control for any strategic manipulation.

Thus, while the change in the program saved money for the federal government, it came at the cost of reduced retention. Policymakers at the time argued that loosening the "golden handcuffs" of the old system could improve workforce quality by allowing less-motivated employees to leave voluntarily. In practice, we find that the policy disproportionately prompted exits among more productive workers with better outside options. Exploiting the compression of federal pay scales relative to private-sector wages, we find that higher-paid and more educated workers—those underpaid relative to private-sector peers—account for most of the aggregate response. Using incentive pay and rapid promotion within occupation–education cells as proxies for productivity, we estimate that higher productivity workers were 3 to 5 percentage points more likely to separate mid- to late-career under the new system, while less productive workers showed no meaningful change. This differential attrition implies that, mid- to late-career, the average post-policy worker was valued about $251 less per year, which is equivalent to one to three months of experience-based pay. As a result, we show that changes in amenities and non-wage compensation can meaningfully alter the composition and productivity of a firm's workforce. In the federal government's case, reduced retirement benefits made it harder to retain highly educated and productive employees, amplifying existing challenges in competing with private-sector employers.

Finally, we document that separation rates under the new and old systems converge late in the career, as workers in the old system become increasingly likely to exit after roughly 25 years of service. This "catch-up" effect is driven by two forces: (1) more workers under the old system reach retirement eligibility within the federal government, and (2) conditional on eligibility, those workers respond more sharply to retirement incentives. This pattern is consistent with the larger defined benefit plan imposing a higher implicit tax on continued work. We find that old-system workers are 33 percent more likely to separate after reaching retirement eligibility, suggesting greater intertemporal substitution of labor toward periods with lower annuity values.

Our setting provides a unique opportunity to study how implicit taxes embedded affect labor supply. While prior research has documented sharp retirements at pension eligibility thresholds, distinguishing monetary incentives from social norms (Seibold, 2021a) or changes in other policies that coincide with retirement ages (Saez et al., 2024) has been challenging. In our case, retirement norms, ages, and policies remain constant, while only the implicit tax varies, allowing us to isolate its causal effect on work decisions. Our estimates show that the implicit tax from defined benefit pensions cause meaningful reductions in firm-level labor supply, and suggest the shift from DB to DC plans may have increased labor supply for older workers, even as it reduced attachment to any individual employer.

Overall, reducing DB generosity and increasing portability raises separation rates in mid- and late-career, with the largest effects among more productive workers and those with better outside options. These insights suggest that although moving from DB to a mixed system saved the government money, it came at the cost of losing experienced personnel. Furthermore, we show that DB pensions encourage higher separations when eligible to receive the benefit.

The contributions of this paper are threefold. First, it provides one of the largest quasi-experimental estimates of how changes in employer pension plans affect labor supply within a firm. Falk and Karamcheva (2018) examine the same policy using a probit model to study how changes in the option value of defined benefit pensions influence separations. In contrast, this paper employs a regression discontinuity design to estimate the causal effects of the reform on retention and workforce composition across the career. Ippolito (2002) also study the same reform but focus on Department of Defense employees hired a decade apart. We instead analyze all non–Department of Defense civilian workers who began federal service within a narrow window around the policy change, ensuring comparable cohorts. With 35 years of longitudinal data, we trace the full career effects of the shift in retirement benefits on federal employees.

Goda et al. (2017) study a quasi-experimental setting in which university employees were assigned by default to a DB or DC plan based on their age at a policy cutoff. They find that exogenous assignment to DC plans reduces short-term job mobility relative to DB plans around age 45, with positive selection effects amplifying this difference. Our setting allows us to isolate incentive effects directly, as there is no evidence of differential selection into federal employment around the reform. Moreover, we extend their findings by examining retention responses at all points in the career, capturing labor supply effects over the entire lifecycle.

Second, other papers have studied shifts from DB to DC plans using national programs (French et al. (2022); Lauletta and Bérgolo (2022)), and many others have studied the impact of DB reforms, mainly changes to national plans (Costa (1995), Asch et al. (2005), Friedberg and Webb (2005), Brown (2013), Biasi (2024), Fetter and Lockwood (2018), Staubli and Zweimüller (2013), Mastrobuoni (2009), Liebman et al. (2009), Lalive et al. (2023), Seibold (2021b)). We contribute to this broader literature by examining a key margin of adjustment: exit to outside employment. Our setting provides evidence from an employer-specific plan, where workers operate in a competitive labor market with heterogeneous compensation structures across firms. Finally, we show that such changes in non-wage amenities can reshape the firm's human capital by altering both the composition and productivity of its workforce, as heterogeneous workers respond differently to shifts in pension incentives.

Lastly, our paper adds to the literature on worker preferences for non-wage job attributes. In particular, we contribute to the large literature on the valuation of job amenities (some which include Rosen (1986), Mas and Pallais (2017), Wiswall and Zafar (2018), Hall and Mueller (2018), Chen et al. (2018), Le Barbanchon et al. (2021), (Cole and Taska (2023)), Maestas et al. (2023)) from quasi-random variation in job attributes (Lavetti and Schmutte (2018), Lee and Taylor (2019)). We show how firm-specific job satisfaction may determine voluntary quits (Akerlof et al. (1988), Clark (2001), Card et al. (2012), Sockin (2021)) and heterogeneous turnover (Ouimet and Tate (2023)). Nekoei (2024) provide a theoretical framework in which adverse selection leads firms to underprovide amenities when they attract less productive workers due to a negative correlation between productivity and preferences for job amenities. Emanuel and Harrington (2024) and Palmer (2025)

provide empirical evidence consistent with this mechanism. In contrast, we document advantageous selection: productive workers were disproportionately likely to exit in response to the reduction in defined benefit pension generosity. This pattern has broader implications for workforce design and public-sector compensation. When productive workers are more responsive to changes in non-wage benefits, reductions in amenities can erode the quality and experience of the workforce over time, even if they reduce fiscal costs in the short run.

The remainder of the paper is organized as follows. Section 2 describes compensation in the public sector and outlines how the reform changed retirement benefits. Section 3 presents a simple theoretical framework for understanding the effects of changes in employer-provided benefits. Sections 4–6 present the data, empirical strategy, and main results.

2 Institutional Details

2.1 History

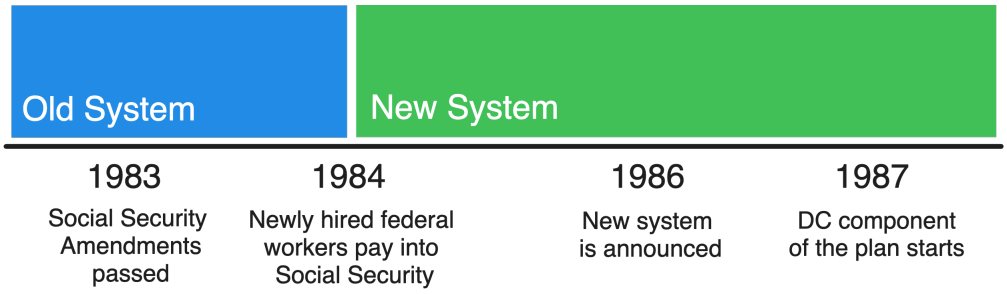
Prior to 1984, all United States federal workers were covered by the Civil Service Retirement System (referred to as the "old system"). This system was established in 1920 and created a public pension fund which paid out retirement benefits to employees in a pay-as-you-go DB program: active employees paid some percentage of their wages towards the fund each month, and in turn, the government paid out a fixed benefit (or annuity) commensurate to one's wage and tenure every month after retirement. Any individual covered by the old system was exempt from Social Security payroll taxes and benefits.[3]

During 1983, the U.S. enacted a series of amendments to Social Security due to concerns over the solvency of the Social Security Trust Fund. These amendments reduced future expenditures and expanded the revenue base. One such provision expanded Social Security coverage to include all federal workers hired on or after January 1, 1984. This expansion necessitated a restructuring of the federal retirement system in order to cut back on the government's cost as an employer and to prevent employees from undue burden of paying into two pension systems. Between 1984 and 1986, the Senate Committee on Governmental Affairs oversaw the development of the new retirement program that was modeled after non-federal retirement practices (Finch (1995)). In 1986, the Federal Employees Retirement System (henceforth referred to as the "new system") was signed into law, replacing the old system with a mixed DB and DC system for employees that were newly hired on or after 1984. A visual timeline is represented in Figure 1.

Crucially, the law applied retroactively for workers who began their federal career between 1984

[3]Social Security is a social insurance program in the U.S. that is largely funded by payroll taxes and pays out retirement, disability, and survivor benefits.

Figure 1: Historical Timeline



Note: This figure reports the timeline and key events surrounding the policy change regarding the retirement system for federal workers.

and 1986. Publicly available action on the retirement plan was first proposed in October 1985 (S. 1527) by the Committee on Governmental Affairs, which outlined a preliminary plan that was ultimately rejected. Prior to this, little was known regarding the new retirement system.[4] Hence, this research will exploit the 1.5 year window after 1984 where workers were unable to anticipate the exact components of the new system that were eventually established.

Since the 1984 policy change for federal employees, numerous employers have adopted similar reforms. Following the Great Recession, state governments, including Pennsylvania, South Carolina, and Tennessee, began transitioning to hybrid DB and DC retirement systems to mitigate long-term pension liabilities. Public and private university systems have also moved away from traditional DB pensions, with institutions like the University of California adopting hybrid plans and many private universities freezing DB benefits. Moreover, public teacher pensions have scaled back DB benefits in favor of more portable savings. These parallel reforms across a variety of sectors highlight a broader institutional movement toward more flexible retirement systems.

2.2 Comparing the Old and New System

In this section, we explore the similarities and differences between the two retirement systems. The new retirement system included several changes to align more closely with private sector practices: reduced pension benefits, increased portability through Social Security and a DC savings plan, and added incentives for extended careers. However, the two systems had the same employee contribution rate and similar eligibility criteria for retirement.

[4]The Office of Management and Budget (OMB) and the Office of Personnel Management (OPM) had considered two separate plans in 1984 (Rich (1984)). One was a pure DC system for new workers and another was a DB system that was as generous as the old system with the addition of Social Security benefits. Neither plans included a hybrid component similar to the new system that was eventually enacted.

Similarities

Several aspects of the retirement system remained unchanged. First, the employee's contribution of pay for the annuities and social security under the old and new systems was nearly equivalent at 7%.[5] Second, in order to receive one's annuity without a penalty (which we refer to as "full retirement eligibility"), a worker must satisfy a tenure and age requirement. Under both systems, this would occur at the same three milestones:

1. 62 years old with 5 years of tenure,
2. 60 years old with 20 years of tenure, and
3. Your minimum retirement age (MRA) and 30 years of tenure.

Lastly, workers' retirement benefits vest after five years under both systems. If a worker does not reach full retirement eligibility after five years, then a worker may defer their benefit until they turn 62 years of age.

Differences

Table 1 reports the differences between the old and new system. We distill the changes into three categories: (1) pension reduction, (2) increased portability, and (3) additional options to incentivize extended careers.

Annuity reduction. The employees under the new system still receive an annuity, albeit at a much lower rate. Under the new system, these annuities are calculated as 1% of an employee's average highest three years of salary ("high-3") for each year worked, as opposed to 1.5-2% per year under the old system. This translated into a 33-50% drop in the monthly benefit received from the government. Under the new system, if a worker reached at least 20 years of service and retires at the age of 62 or older, then their annuity is calculated with an additional 0.1% for all working years. To illustrate the differences in annuities, an employee in the old system who works for 30 years and retires at age 62 receives a pension benefit equal to about 56.25% of their high-3 average salary. An identical worker in the new system receives a pension benefit equal to only 32% of their average high-3 salary. Notably, these benefits are non-portable, meaning that the value of the pension benefit cannot be transferred to another employer. Pension benefits accrue based on wages and tenure with

[5] Under the old system, workers paid 7% of their wages to the employer pension fund. Under the new system, workers paid 6.2% to Social Security and 0.8% to the employer pension fund. During the interim period between 1984 and 1987, the Social Security employee contributions were 5.7% and workers paid 1.3% to the pension fund. Later, the federal government will increase the contributions to the new system (Social Security plus the employer pension fund) to 9.3% and 10.6% for workers who were hired in 2013 and 2014 and beyond, respectively.

Table 1: Differences between the Old and New System

		Old System	New System
PENSION REDUCTION	**Annuity benefits**	DB plan (1.5-2%)	DB plan (1-1.1%)
	Annuity penalty	2% per year for each year under 55	5% per year for each year under 62
	MRA	55 years	55-57 years, depending on birth year
INCREASED PORTABILITY	**Social Security**	No	Yes
	DC benefits	No match	Match up to 5%, agency automatically puts away 1%
ADDITIONAL OPTIONS	**Deferments**	Tenure of 5 years	Tenure of 5 years (to claim at 62) or 10 years (to claim at MRA)
	Annuity Bonus	N/A	Additional 0.1% after 20 years of service and at least 62 years old

Note: This table lists the differences between the old and new retirement system. The first column categorizes the changes. The second column lists the type of change. And the third column describes the policies under the old system, and the fourth column describes the policies under the new system.

a specific employer. The full annuity formula can be found in Appendix A and B, and a graphical example is shown in Appendix C.

The new system also discouraged early retirement withdrawal: the penalties for an receiving early retirement benefits increased from 2% per year for each year under 55 years old to 5% per year for each year under 62 years old. In context, an employee under the old system who retires at age 50 with less than 30 years of service receives a 10% reduction in her annuity if the annuity is taken immediately, whereas the same employee under the new system receives a 60% reduction in her annuity. Additionally, the new system increased the minimum retirement age (MRA) from 55 to 55-57, depending on the birth year. Thus, workers under the new system who began their federal career earlier in their life, and would therefore be eligible for retirement at MRA, would have to wait 0-2 more years to receive their annuity without penalty compared to their old system counterparts. In our sample, the MRA increases by about 2 quarters on average.

Portability. In lock step with private sector retirement programs, the new system increased the portability of benefits with the addition of Social Security and a DC saving plan, known as the Thrift Savings Plan.[6] A retirement benefit is portable if the value of the benefits from a current

[6]Under the new system, the agency would automatically contribute 1% of a worker's salary to the DC plan and then match at a one-to-one rate for the first 3% of contributions and then match 50 cents to a dollar for further contributions up to 5%. Hence, the agency would contribute up to 5% of an employee's salary to the DC plan. Those under the old system could still contribute to this DC plan, but the agency would not match or contribute at any rate.

employer can be transferred to a new employer after leaving the current employer. Both Social Security and DC benefits are portable: Social Security calculates the benefits based on the past 35 years of work experience, regardless of the type of employer, and after an employee leaves federal work, DC contributions can (1) continue to grow in the DC account, (2) be transferred to a different employer retirement plan, or (3) withdrawn (but with significant penalties if under the minimum withdrawal age). All new system workers were enrolled for Social Security, while old system workers were not. Workers under the old and new system could opt in to the DC savings and investment plan;[7] however, workers under the old system were not eligible for employer matching.[8] Under the new system, the agency where an employee worked would automatically contribute 1% of his or her wage to the DC plan, regardless of whether or not the employee had enrolled in the plan. The agency would match any employee contributions dollar-for-dollar up to 3%, and then 50 cents to the dollar for additional contributions up to 5%. Thus, a new system worker could receive up to 5% contribution by the employer if the worker contributed 5% or more to their DC plan.

Career extension incentives. Under the new system, workers received two additional options later into their tenure. If a worker has at least 20 years of service when filing for retirement at 62 or later, then an additional 0.1% of the high-3 wages per year is added to their pension. Thus, rather than receiving 1% of the high-3, this worker would receive 1.1% of their high-3. Furthermore, if a worker has 10 years of tenure and is not eligible for full retirement, then the worker may separate and defer their benefits to their MRA, instead of to 62. Claiming deferred benefits before full retirement eligibility is subject to the early retirement penalties.

3 Conceptual Framework

Retirement plans shape employer retention by embedding dynamic incentives throughout a worker's career. Traditional DB plans are typically backloaded, encouraging long tenures. However, in doing so they also generate sharp disincentives to work beyond retirement eligibility by imposing an implicit tax on working. By contrast, DC plans and Social Security provide portable benefits that weaken the relationship between retirement wealth and employment at a particular employer. Sections 3.1 and 3.2 outline these contrasting incentive structures and their implications for labor supply. Section 3.3 incorporates these concepts in a simple three period model.

[7] Under the Thrift Savings Plan Enhancement Act of 2009, newly hired employees were automatically enrolled into the DC plan with a contribution of 3%. In 2020, the Federal Retirement Thrift Investment Board increased this automatic enrollment to 5% for new hires.

[8] Old system workers had two open seasons in 1987 and 1998 in which they were eligible to switch to the new system. Reportedly, less than 5% switched in 1987 and less than 1% switched in 1998.

3.1 Features of the DB Plan: Backloading

Traditional DB pensions typically exhibit a "backloaded" benefit structure (Kotlikoff and Wise (1988)). In such plans, the marginal benefit of each additional year of service increases with tenure. This occurs because of two reasons: (1) DB formulas often calculate benefits based on a worker's highest earning years, such as the average of the highest three years of pay, and (2) DB formulas typically apply a benefit factor that rises with total years of service. As a result, tenure raises both the benefit base and the multiplier applied to it, amplifying pension accruals late in one's career. This structure creates powerful incentives to remain with a specific workplace until key retirement milestones, discouraging mid-career exits.

To illustrate this backloading effect in our setting, Figure 2, Panel (A) plots the present discounted value (PDV) of the DB benefit from one additional year of federal service as a share of salary. Formally, let $PDV^{\text{DB}}(a,s,w_f)$ be the present discounted value of the stream of DB benefits if the worker separates from the federal government at age a, tenure length s, and with wage w_f. The marginal benefit from staying an additional year is

$$\Delta PDV_s^{\text{DB}}(a,s,w_f) = PDV_s^{\text{DB}}(a+1,s+1,w_f) - PDV_s^{\text{DB}}(a,s,w_f).$$

Figure 2, Panel (A) plots ΔPDV_s^{DB} for a worker whose real wages do not change over time and who begins federal work at 27 years, so retirement eligibility occurs at 30 years of service. Panel (A) shows that the PDV marginal benefit increases steeply with tenure, demonstrating the backloaded nature of DB plans. Early in one's federal career, the gain from one more year is less than 5 percent of salary, but this climbs to 69 percent under the old system and 36 percent under the new system[9] by retirement eligibility. At these thresholds, workers face strong incentives to remain until qualifying for large pension jumps. Note, this is only accounting for increases in the benefit factor; we do not account for the growth in the benefit base as real wages are held fixed.

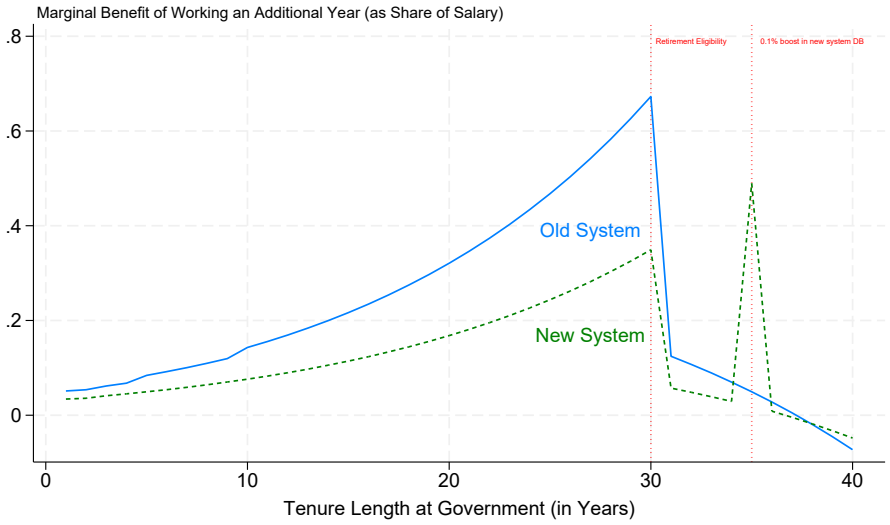
Under the new system, the annuity reduction will lower the backloading effect, resulting in a flatter growth in benefits. This is illustrated by the lower shift in marginal benefits in the new system curve in Panel (A). A reduction in the backloading in turn generally lowers the retention incentives by tempering the marginal benefit to work.

However, while backloaded DB plans strongly incentivize workers to remain with an employer until retirement eligibility, it simultaneously creates strong incentives to leave once those benefits are available. Once a worker qualifies for benefits, continuing to work delays pension collection, effectively taxing additional labor. As shown in Panel (A), the marginal value of continued work drops sharply after eligibility and can even become negative when the incremental pension increase

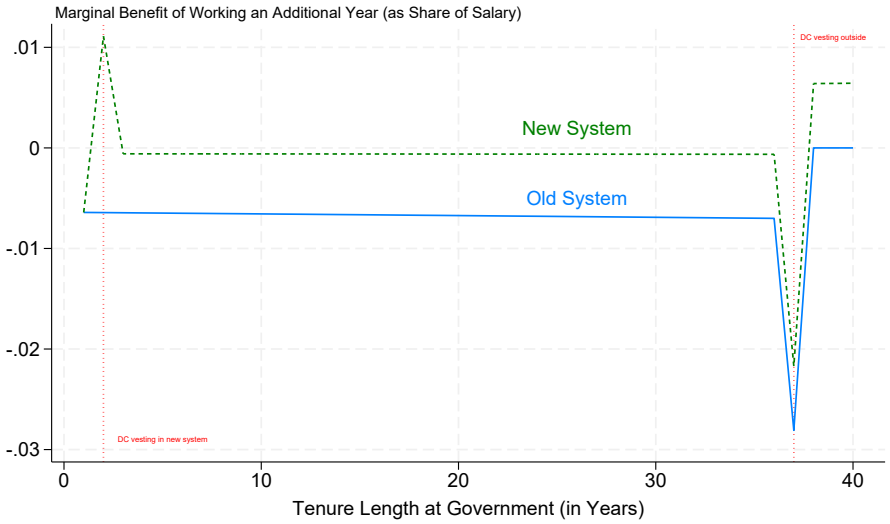
[9]The new system provides an additional benefit when turning 62 with at least 20 years of service (35 years of service in our example): the benefit factor increases from 1.0% to 1.1% for all years of service, creating an additional jump after retirement eligibility.

Figure 2: Benefit of Working an Additional Year in the Federal Government

(a) Defined Benefit



(b) Defined Contribution



Note: This figure reports the marginal benefit to working at the federal government for an additional year ΔPDV_s for a sample worker that begins employment at 27 years old and has a career span of 40 years. We calculate the marginal benefit by estimating the present discounted value of the future stream of benefits, assuming that real wages stay constant and workers have a fixed labor supply of 40 years. Additionally, we assume that other employers have similar DC benefits, so that if a worker leaves the federal government, they can obtain similar portable benefits elsewhere. Panel (A) plots the PDV of the DB plan and Panel (B) plots the PDV of the DC plan.

no longer compensates for the forgone annuity. Thus, backloading creates a cliff: the structure that encourages long service also triggers retirement spikes once eligibility is reached. This implicit tax on work at older ages may help explain the sharp increase in retirements upon DB or Social Security eligibility.

3.2 Features of the DC Plan and Social Security: Portability

In contrast to DB pensions, incentives for DC plans and Social Security across tenure are more neutral. Their key feature is portability: employees can carry accrued balances or creditable years of service from one job to another. In a DC plan, retirement wealth equals the worker's account balance, such as in a 401(k), which can be transferred or rolled over across employers. Likewise, Social Security credits accumulate with any covered employment, so leaving a particular employer does not forfeit future benefit growth. Because workers can continue to earn and grow benefits after switching jobs, portable systems do not generate the increasing, tenure-based incentives characteristic of DB plans.

To illustrate this difference, Figure 2, Panel (B) plots the marginal PDV gain from an additional year of federal work. For simplification, we assumed that a worker has a fixed total career length of 40 years and that outside employers offer the same wages and DC benefits as the federal employer. Formally, let $PDV^{DC}(a,s,w|S)$ denote the present discounted value of DC wealth if separating at age a with government tenure s, wage w, and total working years S. The marginal benefit of an additional year of federal government work is

$$\Delta PDV_s^{\mathrm{DC}}(a,s,w|S) = PDV_s^{\mathrm{DC}}(a+1,s+1,w|S) - PDV_s^{\mathrm{DC}}(a,s,w|S).$$

Panel (B) of Figure 2 shows that this marginal benefit is roughly flat over time, reflecting the absence of backloading. The only difference between staying and leaving arises because, under the old system, outside employers contributed to DC plans while the federal government did not. Consequently, working an extra year in federal service meant forgoing a year of outside DC contributions, making the marginal PDV slightly negative. Under the new system where we assume all employers contribute similarly, the marginal PDV is approximately zero, indicating no incremental advantage to remaining in federal employment.

Two sharp spikes appear around vesting thresholds. The upward spike occurs when the worker reaches the federal vesting requirement after 3 years of service, converting employer contributions into vested balances; the downward spike near 38 years of service reflects the need to re-vest at a new employer's DC plan after switching jobs. Beyond these brief discontinuities, the marginal PDV remains flat, underscoring the lack of dynamic incentives under portability. Portable benefits weaken employer-specific attachment by eliminating tenure-contingent gains.

Although portability does not affect dynamic incentives, it can amplify differences in outside options if the value of the retirement benefit is tied to wages. If we relax our assumptions on homogeneous employers and allow other employers to offer higher pay or better DC matches for example, the marginal PDV of staying in federal service becomes negative; workers will gain from switching employers today versus tomorrow. If outside options are weaker or uncertain, the marginal PDV becomes slightly positive, providing a small incentive to stay. In this way, DB plans create internal, tenure-based incentives, whereas portable systems shift incentives to depend on external market opportunities.

3.3 A Simple Three-Period Model

To show how retirement benefits affect workers' labor supply and guide our empirical analysis, we incorporate DB and DC benefits into a simple three-period model where workers decide between competing firms.

Set-up. Consider a worker who worked for the federal government for wage w_f in the first period. In period two, they face a decision to (1) continue working for the federal government for wage w_f or (2) seek outside options for wage w_p. In period three, all workers retire and claim their benefits. Workers receive a benefit from the federal government, which consists of benefits from working in period one, τ_1, and additional DB benefits from working in period two, $\Delta\tau$. An employer will contribute $\lambda \in [0,1]$ of a worker's wages to DC benefits.

In this set-up, we have two parameters of interest: $\Delta\tau$ and λ. The reduction in the value of the DB pension will decrease $\Delta\tau$. When the DB benefits are smaller, the benefit of working an additional year does not grow as steeply. The effect of portable benefits is reflected in λ, which is the share of the worker's salary that is contributed by the employer to their 401(k).

Budget Constraint. We model a federal worker's lifetime budget that is composed of wages and retirement benefits. In parallel with our institutional setting, we take the worker's perspective in period two. We have the following budget constraint:

$$c_2+c_3 = \begin{cases} w_f + a_1 + (\tau_1+\Delta\tau)w_f + \lambda w_f(1+r)^2 + \lambda w_f(1+r) & \text{if working for the federal government} \\ w_p + a_1 + \tau_1 w_f + \lambda w_f(1+r)^2 + \lambda w_p(1+r) & \text{if working at an outside option} \end{cases}$$

The Worker's Problem. Consider a worker who has preferences in the following form:

$$\sum_{t=1}^{T} \beta^{t-1} \left[u(c_t) - \alpha \mathbb{1}\{\text{if working}\}\right]$$

where β is the discount factor, c_t denotes consumption in period t, $u()$ is a CRRA utility function,

and α is some disutility of working. Then given our budget constraint and objective function, we can write the decision rule[10] of working at the federal government over working in the private sector as

$$U^f > U^p \Rightarrow w_f - w_p + \beta\Delta\tau + \beta(\lambda w_f - \lambda w_p) > 0.$$

Rearranging, we get

$$\underbrace{\beta\Delta\tau w_f}_{\text{forgone benefits in period 2}} > \underbrace{(w_p - w_f)}_{\text{outside option wage premium}} \times(1+\lambda)$$

An employee remains in federal service when the discounted value of forgone federal benefits $\beta\Delta\tau$ exceeds the outside wage premium $w_p - w_f$, adjusted by $(1+\lambda)$. In other words, a worker stays if the future value of accumulated federal benefits outweighs the pay advantage of switching jobs.

A reduction in $\Delta\tau$ lowers this incentive, making early separation more likely. Crucially, however, the worker only leaves if their wage in the private sector is higher than their wage with the government (e.g. $w_p - w_f$ is positive). The employer's contribution to the DC plan further amplifies this effect through λ, making differences in outside options more salient and weakening the attachment to federal employment.

Workers with less favorable outside options, where $w_p - w_f < 0$, are more likely to remain in federal employment. For these workers, the reduction in the benefit is less likely to induce moves to other employers, because their wage from the federal government alone dominates their outside option. Because the federal government features compressed pay scales relative to the private sector, this implies that workers with lower education and lower pay will respond less to the change in benefits, because they are already being paid higher wages than similar private-sector workers. As a result, we expect these employees to be inframarginal, with minimal changes in their labor supply decisions in response to the retirement benefit change.

4 Data

We study the response of employment to changes in benefits using payroll data made public by the Office of Personnel Management (OPM) under the Freedom of Information Act (FOIA). The primary dataset was compiled by Buzzfeed News and contains quarterly records of all federal government workers from 1973 to 2016. Using our own FOIA request to OPM, we extended the data until 2022. The data provides comprehensive information on salary, education level, tenure, age groups, agency, worker type, separations, and accessions at the employee level. Although the data originates from a single employer, the federal government employs a diverse set of workers across different education

[10]The full solution can be found in Appendix D.

groups, industries, salary ranges, and ages.

Due to a data breach in 2014, employee linkages are not provided beyond 2014, and thus employees are matched on names, education levels, and subagencies as done in Spenkuch et al. (2023). We also use a transformer large language model trained on record linkages of company aliases (Arora and Dell (2024)) to validate these matches.

We make a series a sample restrictions to ensure we accurately observe workers across their career. First, we exclude workers who have ever worked in sensitive positions, like the Department of Defense, as their names and other personally-identifiable information are redacted from the data set and cannot be linked beyond 2014.

Second, we keep workers for whom we can confidently infer their job start quarter. Due to measurement error in the data, we rely on multiple methods to improve our ability to deduce the true entry date. We use both the earliest observed appearance of the worker in the data and also look at changes in the tenure variable, which is recorded in coarse bins. We also use changes in the binned variable for workers' ages to infer the exact age of each worker. However, because OPM had released age bins with a noise-infusion algorithm, the inferred birth quarters are noisier, and we avoid using this variable extensively in our analysis.[11]

Third, we dropped individuals who work in occupations or agencies that have distinct retirement plans. These include individuals who were (1) employed as police, air traffic control, firefighters, or nuclear transporters and/or (2) seasonal or part-time workers. Thus, we only keep full-time, non-seasonal workers.[12]

Our full sample consists of 1,581,402 unique full-time workers across a sample period of 50 years. The main sample, which consists of individuals who began work between six quarters before and after the policy change, contains 99,251 unique individuals.[13]

4.1 Summary Statistics

Table 2 reports the summary statistics of our main sample, using demographic characteristics at hire. Roughly half of the sample are under the old system while the other half are under the new system.

[11] To combat the noisiness, we used two methods to infer birth quarters: (1) we calculated the midpoint of each age bin that appeared in the dataset and averaged them within person, and (2) we use bin changes to calculate the birth quarters and average that within person. For the main analysis, we use the first method; however, the results are consistent across both methods.

[12] Part time and seasonal or intermittent work may count towards the retirement eligibility. However, part time work results in a prorated annuity calculation and intermittent work may be calculated in more complex ways that are not shown in the data. If a worker has continuous full-time employment and transitions into non-full time employment, we can examine this in the dataset and will often keep workers that choose to do so.

[13] As discussed in Section 2, this creates a balanced set of cohorts who would not have been aware of the new policy at the time they began work.

Table 2: Sample Demographics

	Old System Col %	**New System** Col %	**Total** Col %
Start Age			
Less than 20	11.6	11.3	11.5
21-30	48.8	48.7	48.8
31-40	24.8	25.6	25.2
41-50	10.7	10.5	10.6
50+	4.1	3.9	4.0
Total	100.0	100.0	100.0
Education			
Less than Bachelor's	58.4	59.0	58.7
Bachelor's Degree	23.2	22.7	23.0
Higher Educ. Degree or More	18.4	18.3	18.3
Total	100.0	100.0	100.0
Supervisory Status			
Not Manager	78.9	79.1	79.0
Ever Manager	21.1	20.9	21.0
Total	100.0	100.0	100.0
Occ. Category			
White	89.5	89.0	89.3
Blue-Collar	6.0	5.6	5.8
Other	4.5	5.3	4.9
Total	100.0	100.0	100.0
Separations			
Still Working	4.2	6.6	5.4
Separated	95.8	93.4	94.6
N	49,750	49,501	99,251

Note: This table reports the demographic characteristics of the sample data which contains full-time federal workers from the third quarter of 1982 to the second quarter of 1985. The values are the percentages of the variable represented in a particular category, which is in bold.

Workers across the old and new system have similar demographic characteristics. More than half start employment with the federal government before the age of 30, with an average start age of about 31 years. The median nominal starting annual salary in this sample is $13,903 with an average of $17,467. Around 41% of individuals have a Bachelor's degree or higher and approximately 21% eventually transition into a manager or supervisory role. The majority of federal workers are white-collar (89%) and approximately 6% are blue-collar workers. Under the new system, there are 2.4 percentage points fewer individuals that have separated from federal work, which is consistent with the average yearly separation rates (i.e. 2%).

5 Empirical Strategy

5.1 Regression Discontinuity Design

To investigate the impact of the change in retirement benefits on the labor supply of federal government workers, we examine the differences in retirement benefits, hiring characteristics, and labor supply to the firm between the employees who began federal work just before the policy change and employees who began right after the policy change. Because the new system applied retroactively, we exploit the window around the policy change in which new hires were unaware of the terms of the new retirement system (a year and a half or 6 quarters). This timing, as described in Section 2, provides an ideal setting to employ a regression discontinuity design with local randomization. We employ a local randomization technique for inference because (1) the start dates for federal work around the policy change resemble a treatment mechanism in a randomized control trial, and (2) our running variable is discrete and traditional RD techniques impose continuity assumptions (Cattaneo et al. (2016)). Our specification is as follows:

$$Y_{it} = \beta_0 + \beta_1 NS_{it} + \delta_1(start_i - 1984Q1) + \delta_2 NS_{it}(start_i - 1984Q1) + \varepsilon_{it} \quad (1)$$

where $start_i$ is the start quarter for person i and Y_{it} is the outcome for person i at quarter t. The coefficient β_1 is the local average treatment effect of switching from the old DB system to the new mixed DB and DC system (i.e. when there is a reduction in retirement benefits tied to the employer and increase of portability). Essentially, the effect is measured by approximating a line before and after the policy change and taking the difference of the average at the time of the change. Our main analysis includes this parametric assumption to absorb trends in hiring, retention, or worker characteristics.

6 Results

6.1 Selection and Hiring Characteristics

We first show that the policy did not generate any meaningful change in the composition of workers hired around the discontinuity. To document this, we estimate a series of RD regressions on pre-hire characteristics in a neighborhood of the cutoff.

Table 3, Column (1) shows the results for our main sample and baseline specification. We examine the following observable characteristics in our data: time needed until full retirement, log of the starting salary, start age, educational variables, and occupational categories. Across these character-

Table 3: Changes in Hiring Characteristics

	Baseline Mean	(1) Main Sample	(2) Main Sample w/Quarter FE	(3) Main Sample Seasonally-Adj
Quarters Needed for Full Retirement	110.61	0.09	1.08	-0.10
		(1.79)	(1.69)	(0.39)
ln(Starting Salary)	10.74	-0.01	0.04	-0.01
		(0.02)	(0.04)	(0.02)
Starting Age (in Quarters)	121.22	2.09	0.26	0.08
		(2.76)	(1.60)	(0.57)
No. Hires in Subagency	35.15	-2.06	-2.98	19.62
		(15.97)	(5.72)	(23.50)
Education				
High School or More	0.98	-0.00	-0.00	-0.02
		(0.00)	(0.00)	(0.02)
Bachelor's Degree or More	0.41	-0.04*	0.03	-0.01
		(0.02)	(0.09)	(0.01)
Higher Educ. Degree or More	0.18	0.01	0.01	-0.02
		(0.03)	(0.06)	(0.02)
Years of Educ.	14.74	-0.13	0.21	-0.26
		(0.09)	(0.45)	(0.23)
Occupation Category				
White-Collar	0.90	-0.01	-0.00	0.01**
		(0.02)	(0.00)	(0.00)
Blue-Collar	0.06	0.00	0.01	-0.00
		(0.00)	(0.02)	(0.00)
Other	0.04	0.01	-0.01	-0.01
		(0.02)	(0.07)	(0.01)

Note: This figure reports the RD coefficients that relate to the change in hiring characteristics under the new retirement system. The running variable is the quarter in which an employee begins federal government work, and the regression contains the six quarters before and after the policy change. Column (1) reports the coefficients using the main sample. Column (2) reports the RD coefficients with quarter fixed effects. Column (3) reports the coefficients where we seasonally adjust the series using X-13ARIMA-SEATS (U.S. Census Bureau). Standard errors are reported in parenthesis. $*p < 0.1, **p < 0.05, ***p < 0.01$.

istics, we find no meaningful, statistically significant difference between those under the old system and new system. Moreover, there is limited evidence that subagencies hired at differential rates before and after the policy change. The percent of workers with a bachelor's degree is marginally significant at the 10 percent level after the retirement policy change. However, when controlling for quarter fixed effects, this difference becomes insignificant, as shown in Column (2). In fact, we find very similar null results after seasonally adjusting our estimates. In Column (3), we seasonally adjust our estimates using the U.S. Census' X-13ARIMA program. There are no significant changes in observables for new hires before and after the policy change, with the exception of white-collar workers. This difference is small in magnitude. These results are consistent with the timeline of the policy announcement and its retroactive application to workers who had already begun employment at the federal government.

Crucially, despite the large change in retirement benefits, we show that the government did not

change starting wage levels. Thus, our empirical strategy isolates the effect of retirement benefit changes, and is not affected by any compensating change in wages.

6.2 Changes in benefits

The policy created large changes in the value of workers' retirement benefits. Figure 3 reports the average PDV (in 2022 dollars) of retirement benefits for workers, incorporating real separation behavior. Under the new system, annual annuities are about $11,000 lower (55% reduction), implying a $150,000 decline in their PDV, as shown in Panel (A). Offsetting this, portable wealth rises: Panel (B) shows roughly a $167,000 increase in the PDV of Social Security and the agency's mandatory 1% DC contribution. To estimate Social Security contributions, we assume that the wages earned contribute towards the first dollar of social security.[14] For the DC contributions, we only account for the mandatory 1% yearly contribution by the employer and do not include employee savings information. We include a generous 9% yearly return for DC contributions. We also assume a 3% discount rate across all PDV calculations. Note that in the main analysis, we only include mandatory contributions by the employer because we do not have information on the employees' voluntary contributions. Netting the two in Panel (C) yields a $15,000 increase in the PDV of all benefits combined, which is not statistically significant. Thus, our results suggest that, on average, workers were about as well off (or slightly better off) in PDV terms, though the composition of the benefits changed dramatically.

In Appendix E, we also show the difference in predicted potential DB, portable, and net benefits between the old system and the new system workers. To calculate counterfactual benefits for workers who separate, we interpolate wages and assume no prior employment.

6.3 Overall Labor Supply

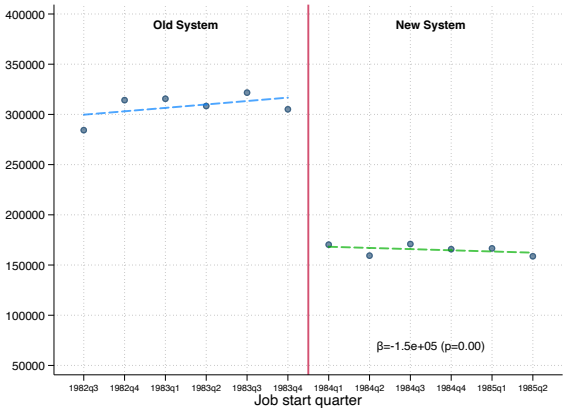
Despite a statistically insignificant change in total benefit levels, the shift from the DB system to the mixed DB-DC system reduced average service with the federal government. Figure 4, Panel (A) shows that the average tenure at separation dropped by three quarters (or 9 months) on average following the introduction of the new system. In addition, Panel (B) demonstrates that workers under the new system were 3 percentage points less likely to reach full retirement eligibility. Workers reduced their labor supply in response to the changes in benefits.

However, we find that these effects differ substantially across stages of a worker's career. Figure 5 plots 35 separate RD coefficients for cumulative separation rates across tenure lengths. For each point, we estimate an RD regression where the outcome is the probability that a worker has separated from the federal government by that year of service. In other words, the figure reports the additional

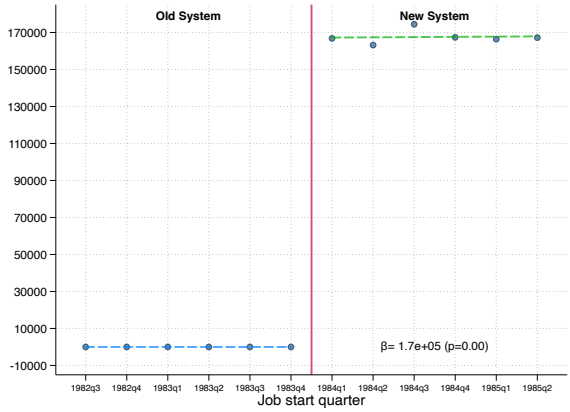
[14] Results are similar if conditioning on the average or last dollar of Social Security.

Figure 3: Change in PDV Retirement Benefits

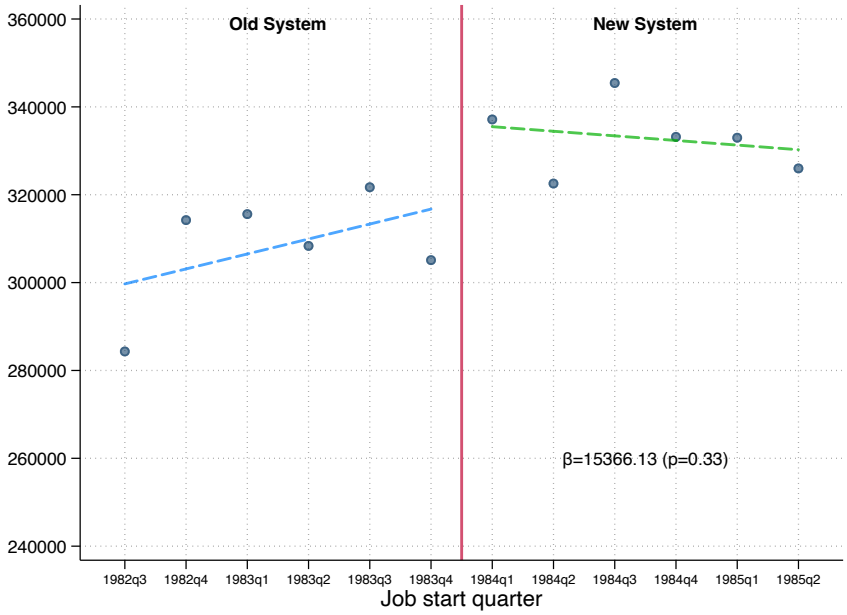
(a) PDV Annuity



(b) PDV Portable Benefits



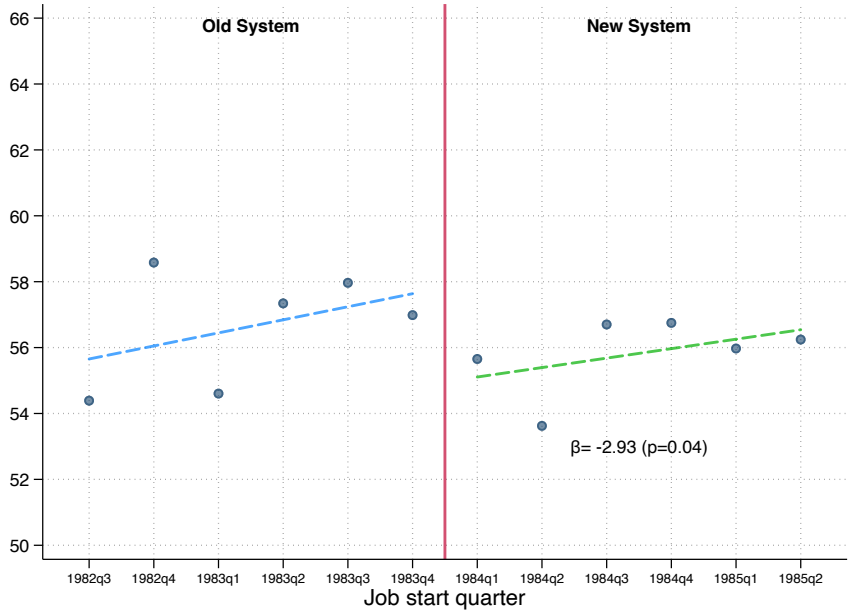
(c) PDV Total Benefits



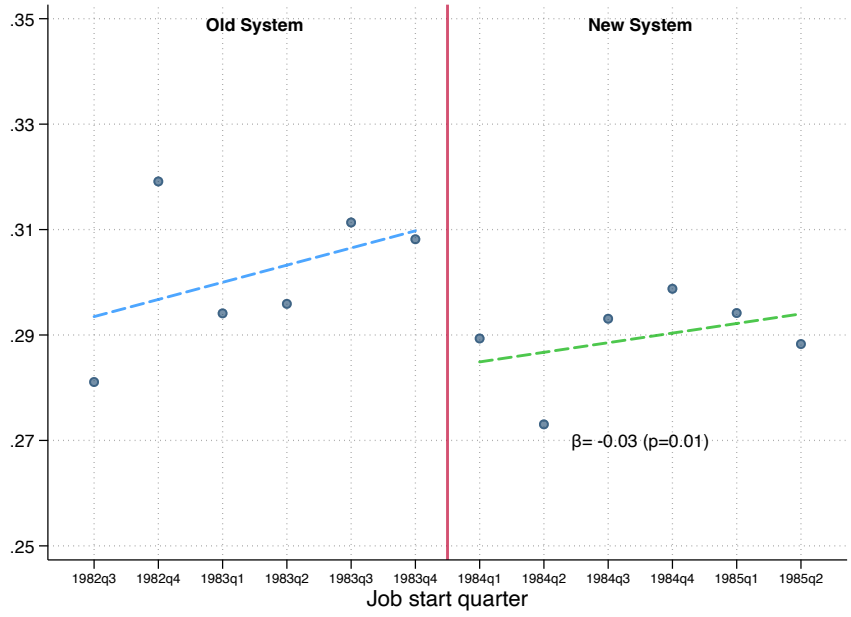
Note: This figure reports the RD coefficients on the changes in PDV of portable benefits, which is composed of Social Security and employer's DC contributions, after the new system is introduced. We assume the employer will contribute 1% of the worker's wages in the DC savings plan and that this account will have a generous yearly growth rate of 9%. We also assume that the wages will contribute to the first dollar of social security. The running variable is the quarter in which an employee begins federal government work. Thus, each point in the plots represents the sample of people who have started federal work at a given quarter. Panel (A) plots the average PDV annuity for those who have separated from the federal government in our data. Panel (B) plots the average PDV of the portable benefits (employer's mandatory contribution to TSP and social security). Panel (C) plots the average total benefits, summing Panel (A) and (B). The RD coefficients are reported as the β and p-values are given in parenthesis.

Figure 4: Tenure and Reaching Retirement Eligibility at Separation

(a) Average Tenure (in Quarters)

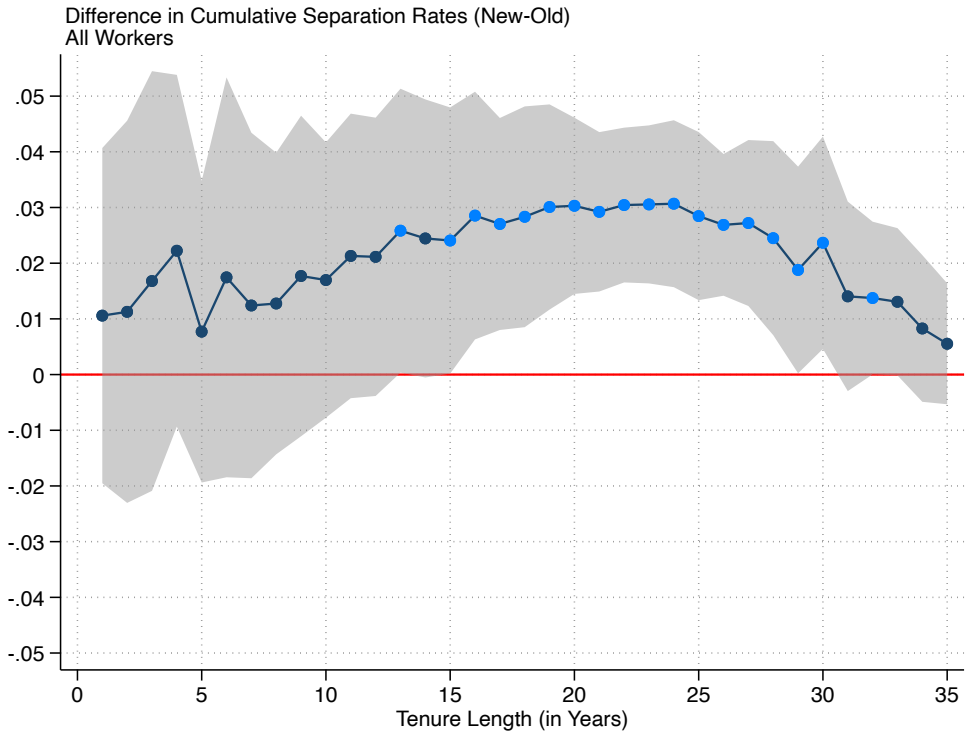


(b) Probability of Reaching Retirement Eligibility



Note: This figure reports the RD outcomes for tenure and the probability of reaching retirement eligibility at separation. Each point represents the sample of people that began federal government work in the quarter shown in the x-axis and have separated in our sample period. Panel (A) plots the average tenure in quarters at separation. Panel (B) plots the percent of workers who reach retirement eligibility at separation. The RD coefficients are reported as the β and p-values are given in parenthesis.

Figure 5: Difference in Cumulative Separations by Tenure Length in the Old vs. New System



Note: This figure plots the RD coefficients on the cumulative separation rates for 35 years of tenure. Each point represents the difference in the cumulative separation rates between old system workers and new system workers. The 95% confidence interval is shaded in gray. Light blue points represent coefficients which are statistically significant from zero at the 95% level.

probability that a new-system worker has separated at a given tenure length relative to an old-system worker.

While workers reduced their labor supply on average, the effects are driven by mid- and late-career workers who become more likely to separate from the government after they have already worked for ten or more years. We find no significant effect for early and mid-career workers, who do not respond to the change in benefits. Although these workers separate at much higher rates on average, the retirement systems did not have an effect on the labor supply of these workers.

This pattern aligns with the time path of changes in retirement benefits induced by the reform. Early in a worker's career, the marginal value of pension benefits is low relative to earnings. Moreover, the reform actually raised the present discounted value of benefits for newer workers by replacing back-loaded pension accrual with tenure-neutral contributions to workers' savings plans. Despite this increase in benefits early on, we find that workers' labor supply is largely unresponsive to the reform.

In contrast, in the later years of a worker's career when pension accrual is much larger and the reform generated its largest reductions in retirement benefits, we find that workers exit federal service at higher rates. Workers with 15 or more years of tenure are roughly 2 to 3 percentage points more likely to be separated in any given year. This pattern indicates that the reduction in pension benefits had a pronounced effect on labor supply, but primarily during the period when benefit losses were greatest and among workers with substantial tenure in the federal system.

Finally, we find in the latest years that the effect on cumulative separations converges back to zero, as workers under the old system leave at higher rates than workers under the new system. In part, this is due to a large number of workers under the old system retiring at their full retirement eligibility quarter around 30 years of service, "catching up" to the total separation rates of the new system workers. However, as discussed in Section 6.8, we also find that workers under the old system were more likely to respond to reaching full retirement eligibility by leaving federal service.[15] Overall, we find sharp heterogeneity across the lifecycle and in response to different types of benefit changes. Early-career workers received a higher PDV of benefits under the tenure-neutral DC plan yet displayed essentially no behavioral response. In contrast, late-career workers responded strongly to the much larger decline in pension wealth.

6.4 Robustness

We conduct a number of robustness tests to assess the stability of our baseline results.

Bin sizes. We test the robustness of our RD estimates by varying the bandwidth around the cutoff. While the window in the primary analysis is determined by the institutional setting, we present estimates with both larger (10 quarters) and smaller (4 quarters) bandwidths in Appendix K. Across these different specifications, we observe results similar to our main analysis, suggesting that our estimates are robust to variations in the window size.

Seasonal effects. Hiring may follow seasonal patterns, stemming from job-specific hiring cycles or shifts in the applicant pool. For example, the influx of new graduates typically entering the workforce in the third quarter post-graduation may skew the educational composition of hires during this period; new hires in that quarter tend to be more educated relative to those in other quarters. Since our RD is centered around the start of 1984, this asymmetry may skew our results. To account for this seasonality, we conduct a robustness check by residualizing our labor supply outcomes on quarter fixed effects before running an RD in Appendix M. Both the baseline specification and the fixed effects-adjusted estimates lead to very similar results.

Placebo test. We conduct a more standard placebo test that re-centers our RD design around the second quarter of 1985, such that we can compare two cohorts of the same size as our baseline

[15] In Appendix F, show that the policy reform did not have strong differential effects based on workers' ages.

estimates, but who are both under the same retirement system. The figure is shown in Appendix L. We estimate null effects in our placebo specification.

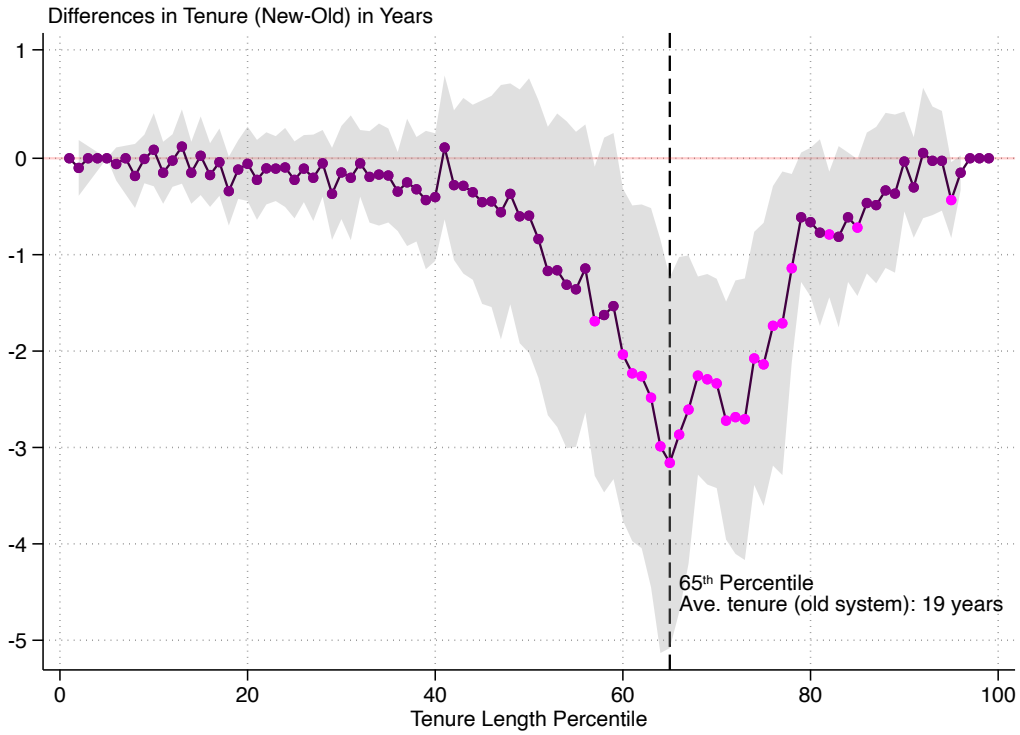
Donut regression discontinuity. To address concerns that the timing of hires may have been influenced by uncertainty around the policy threshold–such as pessimism about the new system potentially leading employers or employees to shift hiring into December–we conduct a donut regression discontinuity design using more detailed personnel data that we can link to a substantial subset of our sample. This dataset includes exact hire and separation dates of workers, which we use in constructing our main sample, but cannot link to every worker. For approximately 70% of the sample (over 68,000 employees), we can link a precise start date that exactly aligns with the hire date from our main sample.

Using the subsample of employees with precise hiring dates, we observe a greater increase in December hires relative to January between 1983 and 1984, relative to surrounding years. To mitigate potential bias from this, we run two donut RD specifications. First, we drop those hired in December and January from the main sample, and second, we restrict to the subset with exact matched start dates and then remove December and January hires. Across both specifications, found in Appendix Figure 24, the results are similar to our main findings: employees under the new retirement system separate mid- to late-career at higher rates than those under the old retirement system. As expected with a smaller sample, the results are noisier, though we find statistically significant increases in separations for later career workers that are very similar in magnitude to our baseline specification.

Quantifying the reduction in tenure

How much do workers adjust their tenure? We examine how the benefit changes affected total time spent in federal service across the distribution of tenure length. Consistent with the earlier results, we find negative effects concentrated among workers in the higher, above-median percentiles of the tenure distribution, with no detectable effects for workers in the lower percentiles or for percentiles that extend beyond full retirement eligibility (Figure 6). We estimate statistically significant declines in tenure from roughly the 60th to the 80th percentiles. These declines range from about 1 to 3 years, which is equivalent to reductions in tenure length of approximately 3 to 16 percent. For instance, the 65th percentile worker in the old system accumulated 19 years of tenure, whereas the corresponding worker in the new system accumulated about 3 fewer years. Thus, although most workers did not adjust their tenure in response to the change in retirement benefits, the most affected workers experienced substantial reductions, on the order of multiple years.

Figure 6: Differences in Tenure Centiles



Note: This figure reports the differences in years of tenure centiles. Lighter colored points represent coefficients which are statistically significant from zero at the 95% level. The gray shaded area are the 95% confidence intervals.

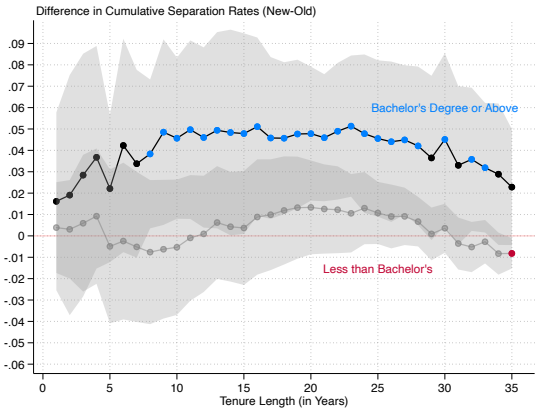
6.5 Outside Options

Our model predicts that only workers with better outside options in the private sector should respond to the reduction in pension benefits by leaving government employment. According to a Congressional Budget Office report, federal workers with no more than a high school education earn about 17 percent more, on average, than their private-sector counterparts, while those with a bachelor's degree or higher earn 10 to 29 percent less. To test whether outside options mediate the labor supply response, we estimate the reform's effects separately for workers with and without a bachelor's degree (Figure 7, Panel a). We find precise null effects for workers without a bachelor's degree, but significant reductions in tenure and retention for those with higher education; the effect size for college-educated workers is about twice the magnitude of our baseline estimates.

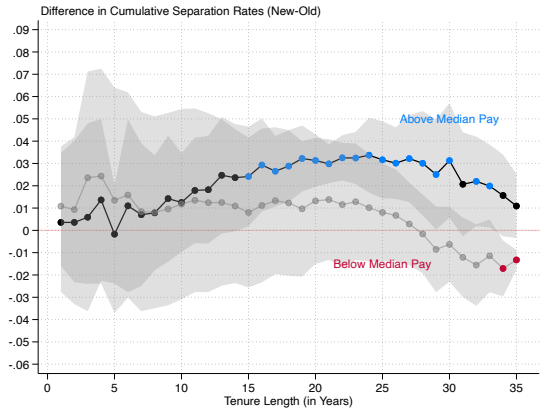
Furthermore, we test the outside-options mechanism using the overall compression of federal pay scales. Specifically, we split the sample by median starting pay, exploiting the fact that higher-paid federal employees are typically underpaid relative to private-sector counterparts, while lower-paid employees tend to earn more. Figure 7, Panel (b) reports the RD coefficients for these two subgroups.

Figure 7: Difference in Cumulative Separations by Tenure Length

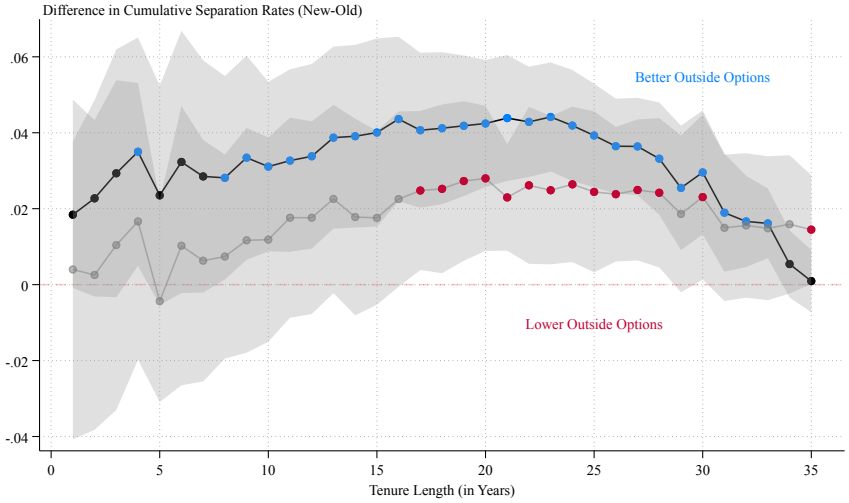
(a) By Starting Education



(b) By Starting Pay



(c) By Outside Option Measures



Note: This figure plots the RD coefficients on the cumulative separation rates for the tenure lengths in the x axis. Each point represents the difference in the cumulative separation rates between old system workers and new system workers. Panel (a) plots the RD coefficients by starting education: those with a Bachelor's degree or above vs. those with less than a Bachelor's. Panel (b) plots the RD coefficients by starting pay: those with above-median starting pay vs. those with below-median. Panel (c) plots the RD coefficients by above and below median outside option measures, adapted from Schubert et al. (2020). Light blue and red points represent coefficients which are statistically significant from zero at the 95% level.

Consistent with our model, workers who start with above-median pay are 2 to 3 percentage points more likely to separate after 14 years of tenure, comparable to our average effect. In contrast, workers who start with below-median pay show no meaningful change in separation behavior following the reform.

Lastly, we test the mechanism more directly by examining heterogeneity in workers' outside options. We measure outside options by adapting the occupation-to-occupation mobility framework in Schubert et al. (2020). For each state–occupation combination, we compute an expected outside-option measure by weighting the observed transition share from an origin occupation into each destination occupation by the destination occupation's employment share in that state. This captures both the empirical likelihood that workers in a given occupation move into alternative occupations and the local availability of those alternatives. We then sum these weighted transitions within each state–occupation cell to obtain a state-specific expected outside-option index. We then residualize this measure on occupation and state fixed effects and take those above the median across occupation–location observations as workers with higher outside options. The resulting measure reflects within-occupation, within-state variation in the strength of outside opportunities. The results are displayed in Figure 7, Panel (c). Again, we find that workers with better outside options are more sensitive to the change in retirement benefit and respond by exiting the government at higher rates than those with fewer outside options.

These results indicate that outside options are a key mechanism: workers with stronger opportunities in the private sector reduced their labor supply to the government following the benefit change. Taken together, these results indicate that the reduction in benefits lowered labor supply to the government primarily among workers with strong outside options. Those with higher education and higher starting pay were more likely to exit in response to reduced retirement benefits and increased portability, underscoring that the reform had the largest effect on workers with competitive private-sector opportunities.

6.6 Productive Workers

According to a Congressional Research Service report in 2019, the change in the retirement system reduced the employer's cost by nearly half, from 30% of employee wages to 17% of employee wages. We show that this cost reduction induced mid- and late-career workers, particularly those who were more highly educated and better paid, to reduce their labor supply to the government. At the time, policymakers argued that such exits could improve workforce quality by allowing less-motivated employees to leave voluntarily. While weakening the "golden handcuffs" of the old system did lead to higher separation rates among late-career workers, it was not clear ex ante whether those who left were more or less productive.

We test whether the policy change caused less productive workers to leave the government at

higher rates using two proxies for worker productivity: supplementary bonus pay and the speed of promotions. We take advantage of the fact that in the U.S., federal employee pay scales are structured into grades and steps, with each grade reflecting a level of responsibility and each step indicating a level of seniority or performance within that grade. Pay increases as employees move up in grade or step, and the scales are periodically adjusted for inflation and cost of living. We use these pay scales to construct our two productivity proxies:

1. **Workers who receive supplementary pay (non-overtime, regular, fixed payments) within their pay scales**. Workers receiving supplementary pay are given additional wages within their pay steps for retention and recruitment purposes, indicating that these positions and workers are valuable for the government to retain. In addition, this specifies workers with better outside options: workers who need greater pay to continue federal employment.

2. **Workers who advance through pay steps and promotions a year prior to the event**. Government pay steps and promotions are often the primary mechanisms through which workers advance their careers. By examining how quickly workers advance through the pay scales, we can identify those who may have been particularly valuable to the government and assess the potential trade-offs of the retirement policy change.

We compare workers in the same occupation, location, or office and determine productive workers as those that have a higher pay within their pay band or receive promotions faster. To do this, we remove standard factors which would determine pay level and pay grade by residualizing the following hedonic regression specification:

$$\text{pay}_{i,t} = X_{i,t}\beta + \alpha_t + \varepsilon_{i,t}$$

where $\text{pay}_{i,t}$ is the salary of person i at time t, $X_{i,t}$ is a vector of job characteristics for person i at time t (i.e. pay grade, pay plan, supervisory status, tenure, age, location, education, subagency, occupation, quarter); and α_t are time t fixed effects. To identify workers who are promoted quickly, we run the following regression:

$$\text{grade}_{i,t} = X_{i,t-1}\beta + \alpha_{t-1} + \varepsilon_{i,t}$$

where $\text{grade}_{i,t}$ is the pay grade of person i at time t, $X_{i,t-1}$ is a vector of job characteristics for person i at lagged time $t-1$ (i.e. pay grade, pay plan, supervisory status, tenure, age, location, education, subagency, occupation, quarter); and α_{t-1} are time $t-1$ fixed effects. We use a one-year lag to address endogeneity concerns.

We then take the average residual pay and grade level for each person i at time t:

$$\text{supplementary pay}_i = \frac{1}{T}\sum_{p=1}^{T}\left[pay_{i,p} - \hat{pay}_{i,p}\right]$$

$$\text{promotion residual}_{i,t} = \frac{1}{t}\sum_{p=1}^{t}\left[grade_{i,p} - \hat{grade}_{i,p}\right]$$

The size of the residuals provides information on whether a salary or pay grade is smaller or larger than typically associated with their experience and job characteristics. When analyzing supplemental pay, we take the average of the residuals across all period Ts for each worker. We assume those with above-median residuals, or those with a large portion of pay that is non-attributable to typical factors, are workers that are more productive and may have low attachment to federal work; in contrast, those with below-median residuals are workers that are less productive and with high attachment to federal work. When analyzing the speed of promotions, we take the running average of the residuals lagged by one year. We assume those with above-median residuals are those who advance quicker and are more productive, and workers with below-median residuals are workers who advance slower and are less productive. We take the lagged indicator to lessen endogeneity concerns over career advancement and separation behaviors.

In contrast to the hopes expressed by policymakers, we find that the reform disproportionately led more valuable or productive workers to exit the the federal government. Figure 8, Panel (a) shows that workers receiving higher supplementary pay are 4 to 6 percentage points more likely to separate under the new system. In contrast, workers with below median levels of supplementary pay are unresponsive to the change in benefits.

We estimate similar effects when we use the speed of promotions as our measure of productivity. When splitting the sample by lagged promotion speed, we find that workers who are promoted faster are 3 to 4 percentage points more likely to separate after about 10 years, while workers who are promoted slower are unaffected. We find similar results when using variables with a three year lag in Appendix G. Note that because we use the lag indicator at each tenure length, the sample is not balanced, and so each point represents a different sample split.

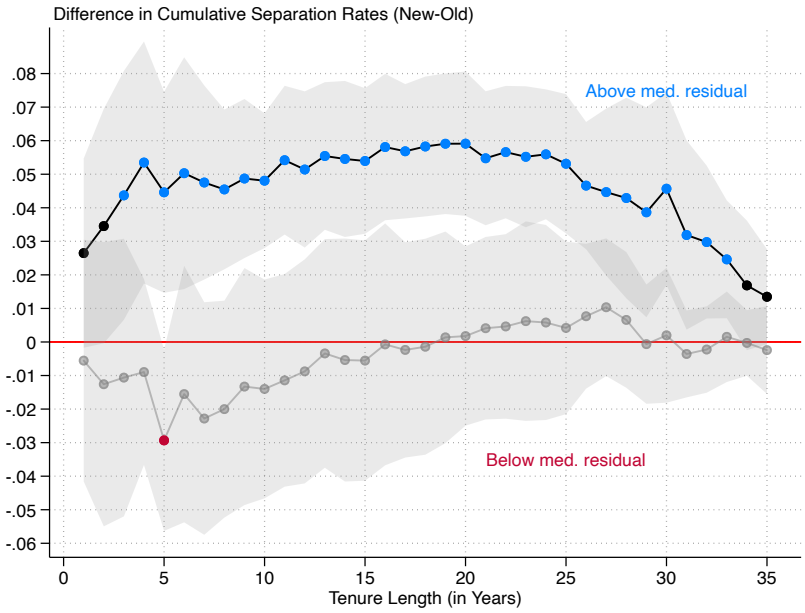
6.7 Dynamic Selection

We quantify the effects of this disproportionate exit of highly skilled government workers by tracking the mean of the supplementary pay in a cohort over time. This approach quantifies the selective attrition within the cohort. Given that highly productive workers receiving supplemental compensation were more likely to leave the firm, we expect a declining average residual over time.

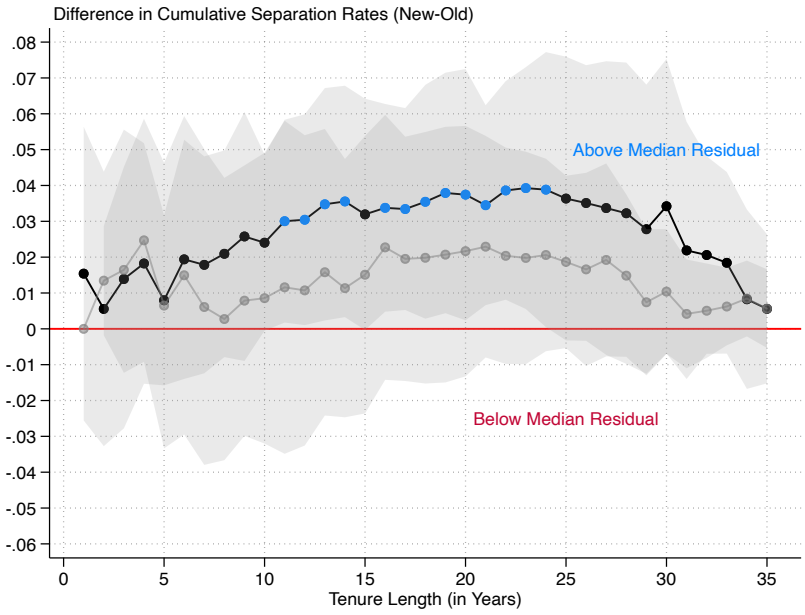
We first normalize each cohort's average supplementary pay to zero at entry and plot its evolution

Figure 8: Difference in Cumulative Separations by Tenure Length

(a) By Supplementary Pay

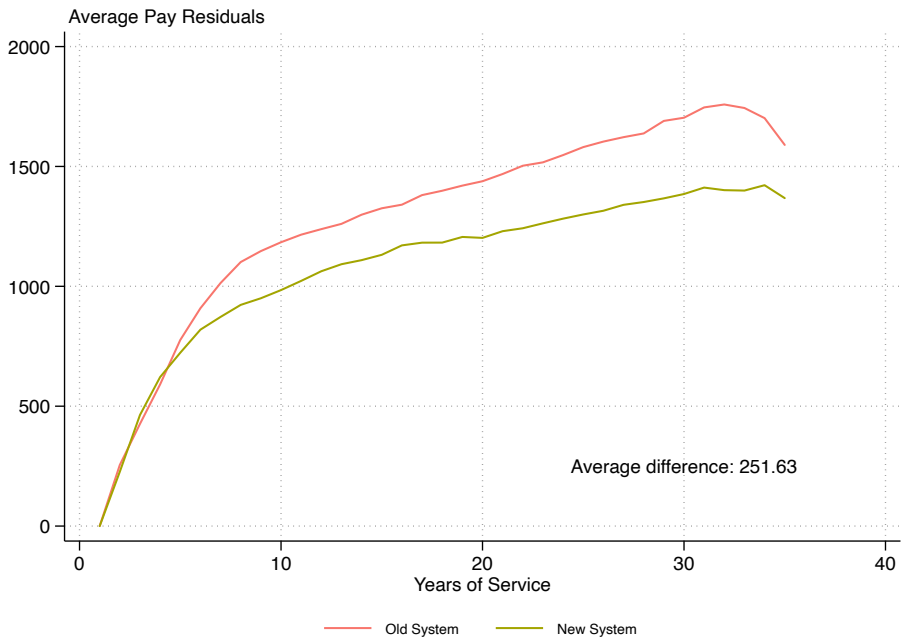


(b) By Lagged Promotion



Note: This figure plots the RD coefficients on the cumulative separation rates for the tenure lengths in the x axis. Each point represents the difference in the cumulative separation rates between old system workers and new system workers. Panel (A) plots the RD coefficients by supplementary pay: those that receive extra wages within their pay bands vs. those that do not or receive less. Panel (B) plots the RD coefficients by lagged promotion speed: those with above-median promotion speed in the year prior vs. those with below-median promotion speed. The 95% confidence interval is shaded in gray. Light blue and red points represent coefficients which are statistically significant from zero at the 95% level.

Figure 9: Dynamic Selection



Note: This figure reports the average normalized supplementary pay, by years of service, for workers under the old and new retirement systems. To construct this measure, we first set each cohort's average supplementary pay to zero at the start date, then track how the mean evolves over time. The resulting lines capture differences in dynamic selection.

for both systems in Figure 9. For the first five years the paths are similar. Thereafter, as more productive workers leave under the new system, its mean supplemental pay grows more slowly than under the old system. By roughly 5 to 7 years, the average worker in the old system has $251 more in supplementary pay. This is equivalent to roughly one to three months of typical experience-based raises. Because workers under the new system also had higher overall separation rates, these stayers' averages likely understate the full compounding effect of differential attrition.

We find that the loss of defined benefits, combined with the increase in portable benefits, prompted unusually productive and valuable workers to leave the federal government, reducing overall workforce productivity in the public sector. Our results demonstrate how changes in firm-level non-wage benefits can reshape the composition of the workforce and the distribution of human capital within a firm. Notably, Emanuel and Harrington (2024) and Palmer (2025) document negative correlations between skill and preferences for amenities, suggesting that adverse selection may lead firms to underprovide benefits such as remote work or transportation. In contrast, we find evidence consistent with advantageous selection: highly skilled workers were disproportionately likely to exit in response to reduced pension benefits. We further show that outside options mediate this response, as departing workers are those best positioned to obtain higher-paying jobs in the private sector.

6.8 Labor Supply Response to Implicit Taxes

A key feature of defined benefit pensions is that the associated annuity creates a substantial implicit tax on work once a worker reaches pension eligibility. Economists have long argued that this implicit tax is a major determinant of labor supply among older workers eligible to receive defined benefit pensions. In our setting, separation rates under the new and old systems converge in the final years of workers' careers. One reason is that a larger share of old-system workers reach full pension eligibility. Another potential explanation is that, because workers under the old system face a steeper implicit tax, they respond more strongly to retirement eligibility through increased retirements.

Our setting provides a unique opportunity to estimate the labor supply response to both implicit and explicit taxes. Prior research has documented strong aggregate responses to retirement ages in national programs such as Social Security, but it is difficult to disentangle monetary incentives from social norms surrounding statutory retirement ages or from concurrent changes in eligibility for other policies (Seibold, 2021a; Saez et al., 2024). In our context, workers under both systems face the same retirement ages, employment protections, and institutional environment, yet the difference in pension generosity creates sharply different implicit taxes on continued work. As a result, we can isolate the pure effect of monetary incentives while holding social and institutional factors constant.

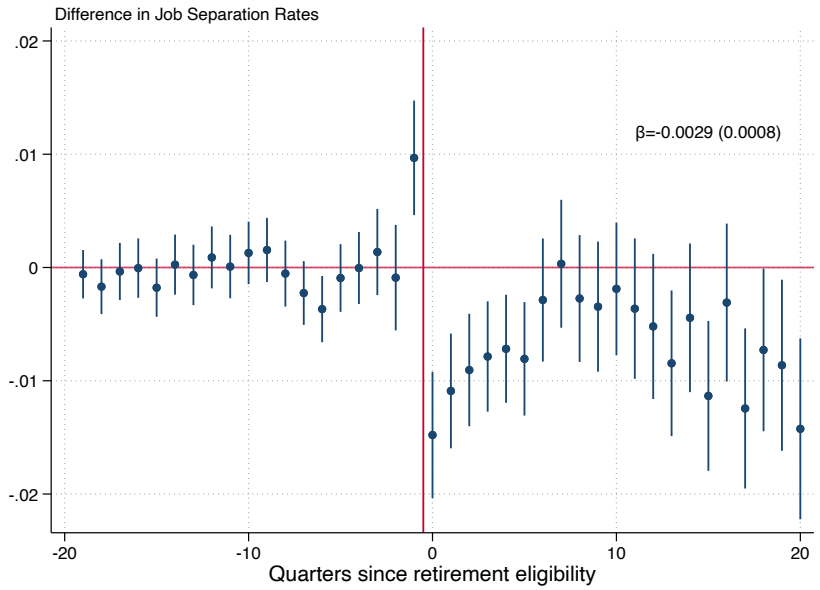
We estimate the response to these implicit taxes by estimating how labor supply to the federal government evolves around eligibility for full retirement. We exploit two sources of variation to examine how labor supply responds to implicit taxes. First, we use the change in policy to generate variation in implicit tax rates across workers. Second, we use the fact that workers become eligible for their pension at different times, due to the fact that eligibility is determined by a combination of tenure and age. We estimate the following difference-in-differences specification on a panel of workers who are still working for the government within 5 years of eligibility for full retirement:

$$\text{Separation}_{it} = \alpha + \beta_1 \text{Post}_{it} + \beta_2 \text{NS}_i + \beta_3 \text{Post}_{it} \times \text{NS}_i + \gamma D_i + \omega Z_t + \varepsilon_{it}$$

In this specification, Post_{it} is a dummy variable for if person i is at or beyond full retirement eligibility at quarter t; NS_i is a dummy variable for whether the worker is under the new system; D_i is a person fixed effect; Separation_{it} is whether or not person i separates at t; γ and ω are individual and time fixed effects; and β_3 is the difference in the effect of retirement eligibility between individuals in the old and new system.

We find that the smaller implicit taxes due to the lower pension increased labor supply after retirement eligibility. Thus, we find that workers respond strongly to implicit taxes, and that the move to the DC plan increased labor supply to the firm in the last years of a worker's career, after they become eligible to receive their pension. We plot corresponding event-study coefficients, which

Figure 10: Labor Supply Responses to Implicit Taxes Generated by Retirement Eligibility



Note: This figure presents the event study provided in equation 2 for our RD sample. The coefficient is reported as β with standard errors in parenthesis. We include the quarter prior to eligibility in the Post_i coefficient as workers seem to be responding to retirement benefits prior to the event. The sample is restricted to workers who work within 5 years of their full retirement eligibility. The red vertical line signifies the time in which workers become eligible. The navy dots are differences in worker separation rates between the old and new system. Vertical bars represent the 95% confidence interval, which is clustered at the individual level.

represent the difference in separation rates across the two systems, in Figure 10.[16] Prior to becoming eligible for retirement, we see no evidence of pre-trends, implying that old and new system workers had similar trends in separation rates. However, after eligibility we find that old system workers become much more likely to leave employment. Prior to eligibility, workers under both systems were separating at a rate of 1 percentage point per quarter. After eligibility, workers under both systems separate at higher rates. However, that rate is larger initially and remains at a higher rate for old system workers. The event study estimate suggests that workers are 0.3 percentage points more likely to leave after eligibility under the old system.[17] This is about 33% of the baseline separation rate.

In conclusion, we find a significant catch-up effect driven by an increasing number of old system workers reaching retirement eligibility and their greater response to larger implicit taxes generated by the retirement system. We estimate large firm-level labor supply responses to implicit taxes, which suggest that the move from DB to DC pensions has significantly increased labor supply among

[16] For the separate event studies with the baseline separation for the old and new system, see Appendix I.

[17] Because we see individuals reacting to the retirement eligibility a quarter prior to the event, we include the quarter prior to eligibility in our Post_i variable.

older workers past retirement age, by reducing the implicit tax on work they face due to retirement incentives.

7 Conclusion

In this project, we use a regression discontinuity design to characterize firm-level labor supply responses to changes in one of the largest parts of workers' non-wage compensation: retirement benefits. We provide some of the first and largest pieces of empirical evidence on labor supply responses to the shift from DB to DC private employer benefits. We leverage our institutional setting to compare similar workers who are sorted into different retirement systems, thus isolating the response to incentives generated by these different plans rather than capturing sorting across firms offering different types of plans.

Our results reveal that there was a large decrease in the DB pension backloading and a large increase in portable retirement benefits, resulting in a reduction in tenure-based incentives. This translated into a reduction in average tenure of a few quarters and a lower probability that a worker stays with the federal government until they reach full retirement. However, the effects are concentrated among mid- to late-career workers, consistent with the reduction in retirement benefits being largest at those stages of tenure. In contrast, we find no meaningful effects early in the career, when the flatter, tenure-invariant DC plan actually increased the present discounted value of retirement benefits for federal employees. An important implication of our findings is that employees placed substantially higher value on defined benefit pensions than on defined contribution benefits, underscoring the importance of benefit design in determining employee retention.

The new retirement system increased cumulative separation rates by 2 to 3 percentage points among workers with 15 or more years of tenure. Workers in this range reduced their labor supply by 1 to 3 years. The effects were strongest for more educated and higher-paid employees with better outside options, suggesting that outside options are a key mediator of labor-supply responses to firm-level changes in amenities. We also find that the results are concentrated among more productive workers, indicating that the reduction in pension generosity changed the composition of the workforce and reduced productivity of the average worker within the firm. The new system's less generous pension benefits drove valuable employees to seek opportunities elsewhere. Finally, we find strong labor supply responses to the implicit taxes embedded in defined benefit pensions. The reform's reduction in these implicit taxes made workers under the new system more likely to remain employed after reaching retirement eligibility.

These findings emphasize that workers are responsive to changes in retirement benefits. While the shift to a mixed DB and DC system achieved cost savings, it also influenced employee retention patterns, particularly among long-tenured and highly productive workers.

Similar reforms have occurred throughout the country, with employers increasingly moving away from traditional DB pensions. Many state governments, including Pennsylvania, South Carolina, and Tennessee, converted to hybrid DB-DC systems in response to fiscal challenges after the Great Recession. University systems have also restructured their retirement offerings, with mostly public institutions like the University of California system adopting a mixed system (as opposed to eliminating the DB portion altogether); public teacher pensions have seen similar rollbacks. Today, the topic remains relevant as major unions, including those representing autoworkers and Boeing employees are negotiating over the return of the traditional DB program. This study contributes to a deeper understanding of these dynamics, informing future policy and economic understanding of labor supply responses to a evolving retirement landscape.

References

Akerlof, G., Rose, A., and Yellen, J. (1988). Job Switching and Job Satisfaction in the U.S. Labor Market. *Brookings Papers on Economic Activity*, 19(2):495–594. Publisher: Economic Studies Program, The Brookings Institution.

Arora, A. and Dell, M. (2024). LinkTransformer: A Unified Package for Record Linkage with Transformer Language Models. arXiv:2309.00789 [cs].

Asch, B., Haider, S. J., and Zissimopoulos, J. (2005). Financial incentives and retirement: evidence from federal civil service workers. *Journal of Public Economics*, 89(2):427–440.

Bergolo, M. and Cruces, G. (2014). Work and tax evasion incentive effects of social insurance programs. *Journal of Public Economics*, 117(C):211–228. Publisher: Elsevier.

Biasi, B. (2024). Salaries, Pensions, and the Retention of Public-Sector Employees: Evidence from Wisconsin Teachers.

Brown, K. (2013). The link between pensions and retirement timing: Lessons from California teachers. *Journal of Public Economics*, 98(C):1–14. Publisher: Elsevier.

Card, D., Mas, A., Moretti, E., and Saez, E. (2012). Inequality at Work: The Effect of Peer Salaries on Job Satisfaction. *American Economic Review*, 102(6):2981–3003.

Cattaneo, M. D., Titiunik, R., and Vazquez-Bare, G. (2016). Inference in Regression Discontinuity Designs under Local Randomization. *The Stata Journal*, 16(2):331–367. Publisher: SAGE Publications.

Chen, M. K., Chevalier, J. A., Rossi, P. E., and Oehlsen, E. (2018). The Value of Flexible Work: Evidence from Uber Drivers.

Clark, A. E. (2001). What really matters in a job? Hedonic measurement using quit data. *Labour Economics*, 8(2):223–242.

Cole, A. and Taska, B. (2023). Worker Valuation of Retirement Benefits.

Costa, D. L. (1995). Pensions and Retirement: Evidence from Union Army Veterans. *The Quarterly Journal of Economics*, 110(2):297–319. Publisher: Oxford University Press.

Emanuel, N. and Harrington, E. (2024). Working remotely? selection, treatment, and the market for remote work. *American Economic Journal: Applied Economics*, 16(4):528–59.

Falk, J. and Karamcheva, N. (2018). Comparing the Effects of Current Pay and Defined Benefit Pensions on Employee Retention: Working Paper 2018-06 | Congressional Budget Office.

Feinmann, J., Hsu Rocha, R., and Lauletta, M. (2022). Payments Under the Table.

Fetter, D. K. and Lockwood, L. M. (2018). Government Old-Age Support and Labor Supply: Evidence from the Old Age Assistance Program. *American Economic Review*, 108(8):2174–2211.

Finch, J. C. (1995). Overview of Federal Retirement Programs.

French, E., Lindner, A., O'Dea, C., and Zawisza, T. (2022). Labor Supply and the Pension-Contribution Link.

Friedberg, L. and Webb, A. (2005). Retirement and the Evolution of Pension Structure. *Journal of Human Resources*, XL(2):281–308. Publisher: University of Wisconsin Press Section: Articles.

Goda, G. S., Jones, D., and Manchester, C. F. (2017). Retirement Plan Type and Employee Mobility: The Role of Selection. *Journal of Human Resources*, 52(3):654–679. Publisher: University of Wisconsin Press Section: Article.

Hall, R. E. and Mueller, A. I. (2018). Wage Dispersion and Search Behavior: The Importance of Nonwage Job Values. *Journal of Political Economy*, 126(4):1594–1637. Publisher: The University of Chicago Press.

Ippolito, R. A. (2002). Stayers as "Workers" and "Savers": Toward Reconciling the Pension-Quit Literature. *The Journal of Human Resources*, 37(2):275–308. Publisher: [University of Wisconsin Press, Board of Regents of the University of Wisconsin System].

Kotlikoff, L. J. and Wise, D. A. (1987). The Incentive Effects of Private Pension Plans. *NBER Chapters*, pages 283–340. Publisher: National Bureau of Economic Research, Inc.

Kotlikoff, L. J. and Wise, D. A. (1988). Pension backloading, wage taxes, and work disincentives. *Tax policy and the economy*, 2:161–196.

Lalive, R., Magesan, A., and Staubli, S. (2023). How Social Security Reform Affects Retirement and Pension Claiming. *American Economic Journal: Economic Policy*, 15(3):115–150.

Lauletta, M. and Bérgolo, M. (2022). *Pension Privatization, Behavioral Responses, and Income in Old Age: Evidence from a Cohort-Based Reform in Uruguay*. PhD Thesis, PhD thesis.

Lavetti, K. and Schmutte, I. M. (2018). Estimating Compensating Wage Differentials with Endogenous Job Mobility.

Le Barbanchon, T., Rathelot, R., and Roulet, A. (2021). Gender Differences in Job Search: Trading off Commute against Wage*. *The Quarterly Journal of Economics*, 136(1):381–426.

Lee, J. M. and Taylor, L. O. (2019). Randomized Safety Inspections and Risk Exposure on the Job: Quasi-experimental Estimates of the Value of a Statistical Life. *American Economic Journal: Economic Policy*, 11(4):350–374.

Liebman, J. B., Luttmer, E. F. P., and Seif, D. G. (2009). Labor supply responses to marginal Social Security benefits: Evidence from discontinuities. *Journal of Public Economics*, 93(11):1208–1223.

Lumsdaine, R. L., Stock, J. H., and Wise, D. A. (1990). Efficient windows and labor force reduction. *Journal of Public Economics*, 43(2):131–159.

Maestas, N., Mullen, K. J., Powell, D., von Wachter, T., and Wenger, J. B. (2023). The Value of Working Conditions in the United States and the Implications for the Structure of Wages. *American Economic Review*, 113(7):2007–2047.

Mas, A. and Pallais, A. (2017). Valuing Alternative Work Arrangements. *American Economic Review*, 107(12):3722–3759.

Mastrobuoni, G. (2009). Labor supply effects of the recent social security benefit cuts: Empirical estimates using cohort discontinuities. *Journal of Public Economics*, 93(11):1224–1233.

Munnell, A. H., Haverstick, K., and Sanzenbacher, G. (2006). Job Tenure and the Spread of 401(K)s.

Nekoei, A. (2024). Will markets provide humane jobs? Working paper.

Ouimet, P. and Tate, G. A. (2023). Firms with Benefits? Nonwage Compensation and Implications for Firms and Labor Markets.

Palmer, B. (2025). Job amenities, adverse selection, and women's labor supply in jordan.

Rich, S. (1984). Civil Servants Face Possible Revamping Of Retirement Plan. *Washington Post*.

Rosen, S. (1986). Chapter 12 The theory of equalizing differences. In *Handbook of Labor Economics*, volume 1, pages 641–692. Elsevier.

Saez, E., Schoefer, B., and Seim, D. (2024). Deadwood labor? the effects of eliminating employment protection for older workers. Working Paper.

Schubert, G., Stansbury, A., and Taska, B. (2020). Monopsony and outside options. *SSRN Electronic Journal*.

Seibold, A. (2021a). Reference points for retirement behavior: Evidence from german pension discontinuities. *American Economic Review*, 111(4):1126–65.

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

Sockin, J. (2021). Show Me the Amenity: Are Higher-Paying Firms Better All Around?

Spenkuch, J. L., Teso, E., and Xu, G. (2023). Ideology and Performance in Public Organizations. *Econometrica*, 91(4):1171–1203. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.3982/ECTA20355.

Staubli, S. and Zweimüller, J. (2013). Does Raising the Early Retirement Age Increase Employment of Older Workers? *Journal of Public Economics*, 108.

Wiswall, M. and Zafar, B. (2018). Preference for the Workplace, Investment in Human Capital, and Gender*. *The Quarterly Journal of Economics*, 133(1):457–507.

Appendix Figures and Tables

Appendix A Old System Annuity Formula

The computation for the annuities involve age, tenure and salary. The full retirement benefit is calculated by averaging the high-3 salaries and multiplying it by 1.5% for each year of service in the first five years of one's tenure, 1.75% for each year of service in the next five years of one's tenure, and 2% for each year of service after the first ten years of one's tenure. Specifically, the formula for the annuities (without any penalty) is as follows:

$$b_{it}^{CSRS} = \underbrace{1.5\% \times h_{it} \times 5}_{\text{first 5 years of service}} + \underbrace{1.75\% \times h_{it} \times max(0, min(5, \delta_{it} - 5))}_{\text{next 5 years of service}} + \underbrace{2\% \times h_{it} \times max(0, \delta_{it} - 10)}_{\text{years of service over 10 years}}$$

where b_{it} is the yearly annuity benefits person i receives for retiring at age t; h_{it} is the high-3 average salary of person i at age t; and δ_{it} is the number of years person i has worked by age t ("years of service").

Federal workers under the old system are eligible for the immediate disbursement of the full retirement annuity as long as they have worked under the old system within the two years before retirement and have either (1) reached the MRA of 55 years and at least 30 years of service, or (2) reached 60 years of age and at least 20 years of service, or (3) reached 62 years of age and at least 5 years of service. Those who opt to retire under the MRA will receive a penalty amounting to one-sixth of 1 percent for each full month under the age 55. For example, if an employee decides to retire 12 months prior to her 55th birthday, then her annual annuity will be reduced by 2%.

Appendix B New System Annuity Formula

The full retirement benefit under the new system is calculated by averaging the high-3 salaries and multiplying it by 1% or 1.1% for each year of service. Those who retire at or above the age 62 with at least 20 years of service are eligible for the additional 0.1% benefit. Specifically, the formula for the annuities (without any penalty) is as follows:

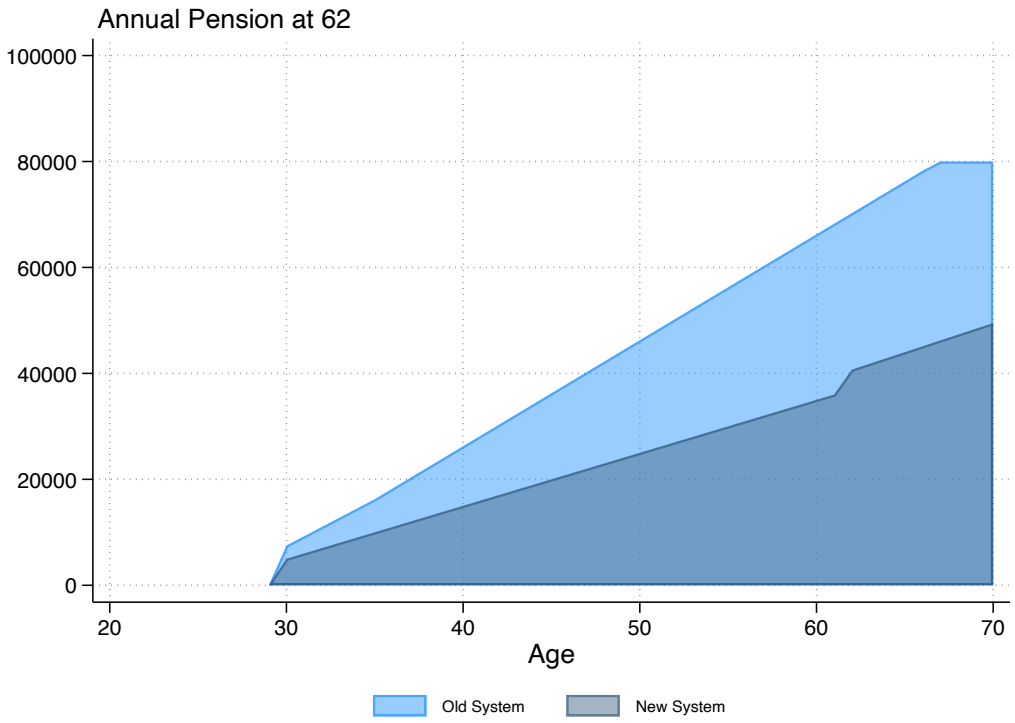
$$b_{it}^{FERS} = \underbrace{1\% \times h_{it} \times \delta_{it}}_{\text{basic benefit}} + \underbrace{\mathbb{1}\{t \geq 62 \wedge \delta_{it} \geq 20\}}_{\text{eligibility for extra benefits}} \times \underbrace{0.1\% \times h_{it} \times \delta_{it}}_{\text{extra 0.1\% bump}}$$

Federal workers under the new system are eligible for the immediate disbursement of the full retirement annuity as long as they have worked under the new system within the two years before retirement and have either (1) reached the MRA and at least 30 years of service, or (2) reached 60 years of age and at least 20 years of service, or (3) reached 62 years of age and at least 5 years of service. If an employee retires at the MRA with at least 10, but less than 30 years of service, their benefit will be reduced by 5% a year for each year under 62, unless she is eligible for retirement

under a different age-service year cut off. In contrast to the old system, the MRA under FERS will depend on one's birth year. The full schedule of MRAs can be found here.

Appendix C Illustrative Example of Pension Growth

Figure 11: Example of Annuity Growth



Note: This is an example of an employer pension growth of a federal worker under both retirement systems. We assume this worker begins work at the age of 25 years and has an MRA of 55 years under both systems. We also assume static annual wages at $100,000. For ages under the MRA, we assume the annuity would be claimed at 62.

Figure 11 provides an illustrative example of the pension growth of a worker who begins full-time federal work at the age of 25 and receives their annuity at separation or 62 years old if under the MRA. For simplicity, we assume a worker whose wages amount to $100,000 annually and whose MRA occurs at 55 years old under both systems. Under the old system, the benefits vest at 5 years of tenure and grow at a steeper rate, facing a larger benefit factor after 5 and 10 years of service. Our example worker reaches MRA at 55 years old and obtains full retirement eligibility because they have reached 30 years of tenure simultaneously. Then the pension flattens after 42 years of service because the old system caps annuities at 80% of the high-3 wages. Under the new system, this individual also

vests after 5 years but faces a slower growth in pension, by a magnitude of around half of the benefit factor under the old system. This pension steadily grows until the worker completes at least 20 years of tenure at 62 years old, in which case they are eligible for an extra 0.1% boost in their annuity formula. This will cause an additional jump for the value of pension benefits for this worker.

In comparison to the old system, the new system pension is significantly less generous across a given tenure length. For example, our worker at 55 years old faces approximately a $56,000 annual annuity under the old system and a $30,000 annual annuity under the new system. This amounts to a little over half of the annuity for the same age, tenure, and wage combination. Furthermore, the worker faces jumps in their annuity growth if they achieve full retirement eligibility before 62 and at the additional 0.1% boost in annuity.

This figure does not account for penalties for early withdrawal. If we account for those who may claim benefits early, the pension growth may contain kinks or jumps at key milestones, especially those under the new system. Workers under the old system tend to face a smoother growth in benefits because penalties are processed gradually fazed out at the MRA. In our analysis, we consider the trade-offs of early retirement penalities and assume workers choose benefits based on the largest present discounted value of the benefits.

In summary, the restructuring of the retirement system did not affect key age or tenure milestones in the retirement benefit accrual; however, it introduced significant changes in the level and the type of benefit. The new system reduced the pension benefit, enhanced the portability of retirement savings with the inclusion of Social Security and the Thrift Savings Plan (TSP), and introduced new incentives for extending careers.

Appendix D Solving for the Decision Rules

We have a generalized CRRA utility in the form:

$$\Sigma_{t=0}^{T}\beta^{t}\left[\frac{c_t^{1-\sigma}}{1-\sigma}-\alpha 1\{\text{working}\}\right]$$

Thus our first order conditions are: $c_3 = kc_2$ where $k = (\beta(1+r))^{\frac{1}{\sigma}}$

We can solve for optimal consumption under the three different choices through the first order con-

ditions above:

$$c_2^f = \frac{w_f + a_2 + \frac{(\tau_1+\Delta\tau)w_f}{1+r}}{1+\frac{k}{1+r}}$$
$$c_2^p = \frac{w_p + a_2 + \frac{\tau_1 w_f}{1+r}}{1+\frac{k}{1+r}}$$

Thus, the decision rule to Work for the federal government over going to an outside employer is $U^f > U^p$:

$$\frac{c_2^{f\,1-\sigma} - c_2^{p\,1-\sigma}}{1-\sigma}(1+\beta k^{1-\sigma}) > 0$$

If $c_2^f > c_2^p$ then $U^f > U^p$ regardless of σ, and vice versa. Hence, we can just compare if $c_2^f > c_2^p$. Since they contain the same denominator, we can simply compare the budget constraints. We have intertemporal substitution in consumption σ, but the trade off in consuming today vs tomorrow is the same across the choices of different employment options.

Appendix E Potential Benefits

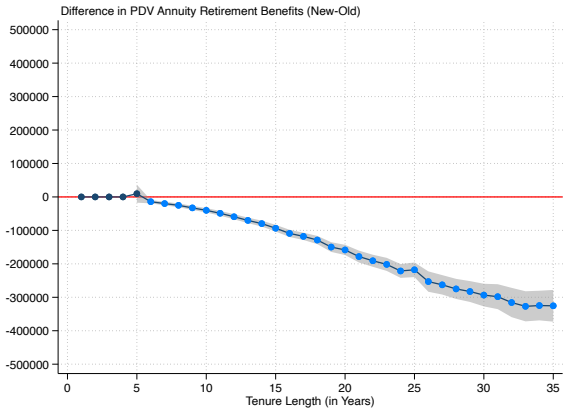
We illustrate the effects of the policy change on retirement benefits in Figure 12. This figure displays 35 separate regression discontinuity (RD) estimates of retirement benefit differentials across 35 years of tenure. For each year (from 1 to 35), we estimate the total retirement benefits under the new system relative to the old system. Specifically, for each point on the graph, we run the RD regression using interpolated wages for all workers to project both the annual annuity and the portable benefits, assuming a 35-year career. Thus, these estimates do not reflect actual separation behavior but instead illustrate the hypothetical net change in benefits at each potential tenure length.

Figure 12 quantifies how the policy change trades off back-loaded, employment-tied annuities against portable wealth. Panel (A) shows that the back-loaded (non-portable) component falls sharply under the new system: by 35 years, annuity wealth is more than $300,000 lower than under the old plan. Panel (B) shows the mirror image for portability. Social Security plus automatic DC contributions rise, yielding roughly $300,000 more portable wealth by 35 years.

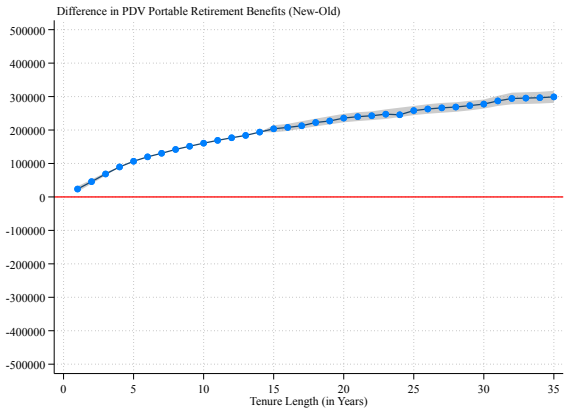
Taken together in Panel (C), portability reduces the backloadedness the benefit profile by increasing front-loaded benefits. New-system workers receive more early in the career, but the advantage diminishes with tenure. Beyond 25 years of tenure, the old system provides larger benefits, although the estimates are not statistically significant. If we adjust the benefits for risk aversion, the old system can provide statistically significant larger benefits for a long career.

Figure 12: Difference in Retirement Benefits by Tenure Length in the Old vs. New System

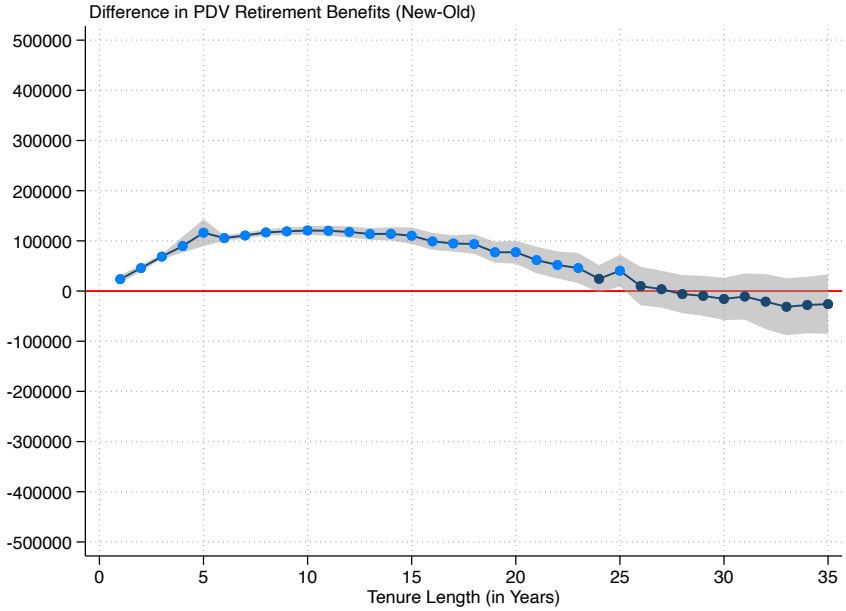
(a) Non-Portable Benefits



(b) Portable Benefits



(c) Total Benefits



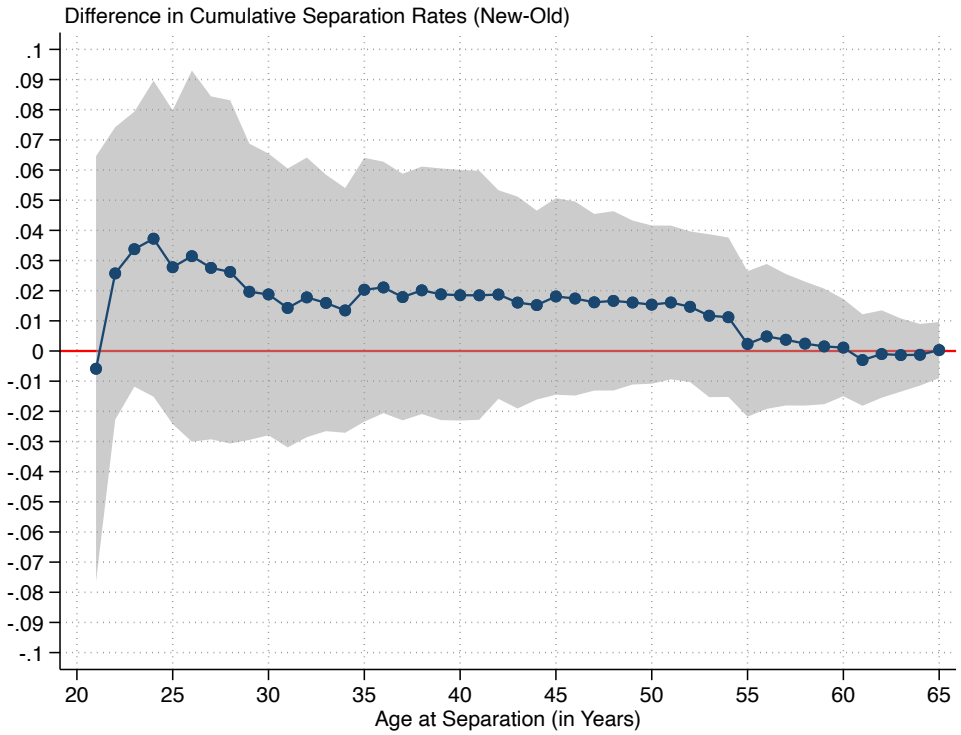
Note: This figure plots the RD coefficients on the benefit amount for 35 years of tenure, using interpolated wages to project benefits for workers who have separated prior to 35 years in our sample. Each point represents the difference in the benefits between old system workers and new system workers. Panel (A) displays the change in total retirement benefits, Panel (B) displays the change in non-portable retirement benefits (i.e. the annuity), and panel (C) displays the change in portable retirement benefits (i.e. Social Security and DC savings match). The 95% confidence interval is shaded in gray. Light blue points represent coefficients which are statistically significant from zero at the 95% level.

However, unambiguously, the new system will reduce the price of staying at the federal government across the lifecycle, as shown with the reduction in tenure-contingent, non-portable in Panel

(A). According to our framework, this reduction should guide the labor supply to exit.

Appendix F Heterogeneity Analysis on Separation Rates by Ages

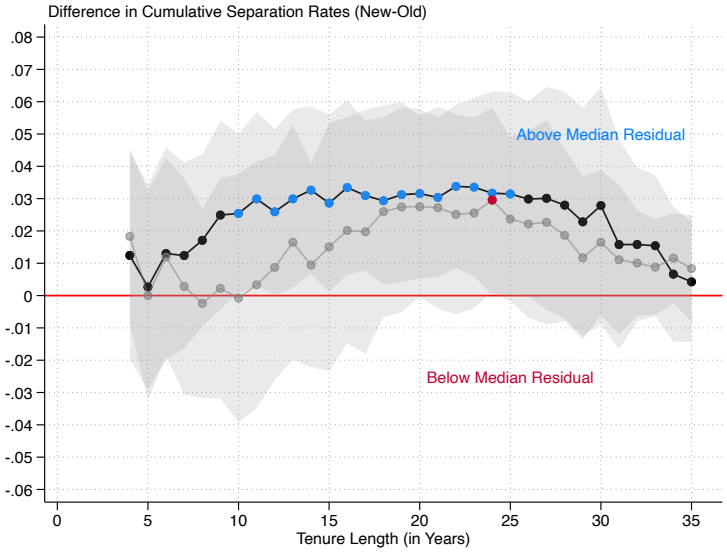
Figure 13: Difference in Cumulative Separations by Age in the Old vs. New System



Note: This figure plots the RD coefficients of the cumulative separation rates for different ages in the x axis. Each point represents the difference in the cumulative separation rates between old system workers and new system workers. The 95% confidence interval is shaded in gray. Light blue points represent coefficients which are statistically significant from zero at the 95% level.

Appendix G Productive Workers

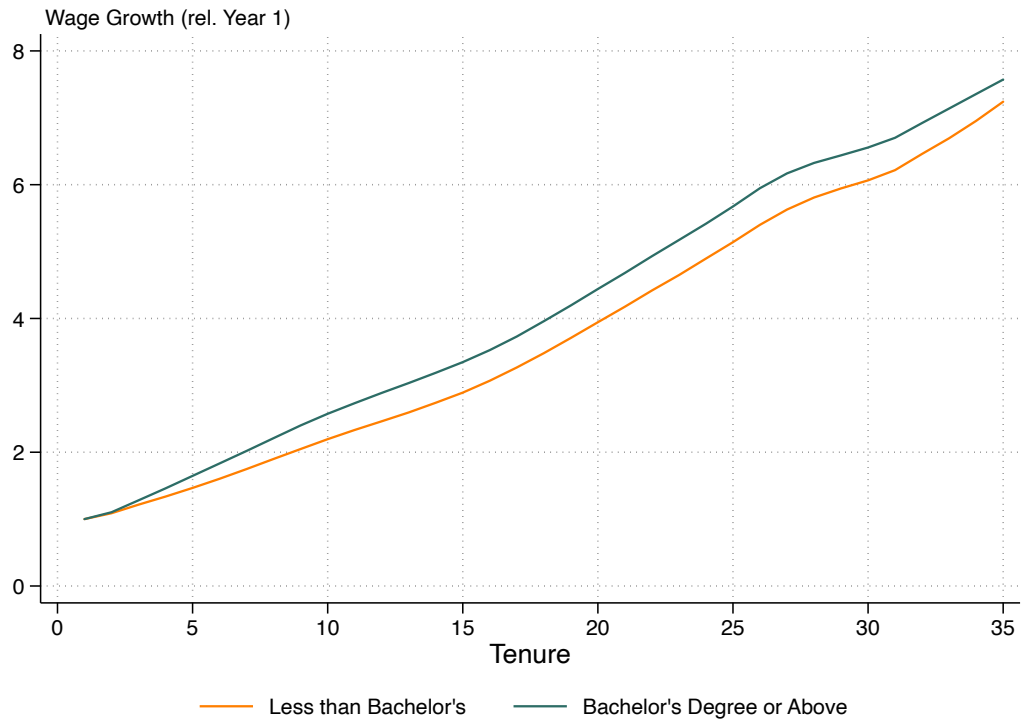
Figure 14: Difference in Cumulative Separations by Promotion Speed (3 Year Lag)



Note: This figure plots the RD coefficients on the cumulative separation rates for the tenure lengths in the x axis. Each point represents the difference in the cumulative separation rates between old system workers and new system workers. We plot the RD coefficients by promotion speed: those that are above median residuals are workers who are promoted faster than their peers; those that are below median residuals are workers who are promoted slower than their peers. Promotion speed is determined by the residuals of a hedonic regression of pay grade on job characteristics and time fixed effects, lagged by three years. Light blue and red points represent coefficients which are statistically significant from zero at the 95% level.

Appendix H Wage Growth by Education Level

Figure 15: Wage Growth relative to year 1 salary



Note: This figure plots the wage growth relative to the first year of employment. The orange line represents those who started with less than a Bachelor's degree, and the teal line represents those who started with a Bachelor's degree or more.

Appendix I Separation Event Studies

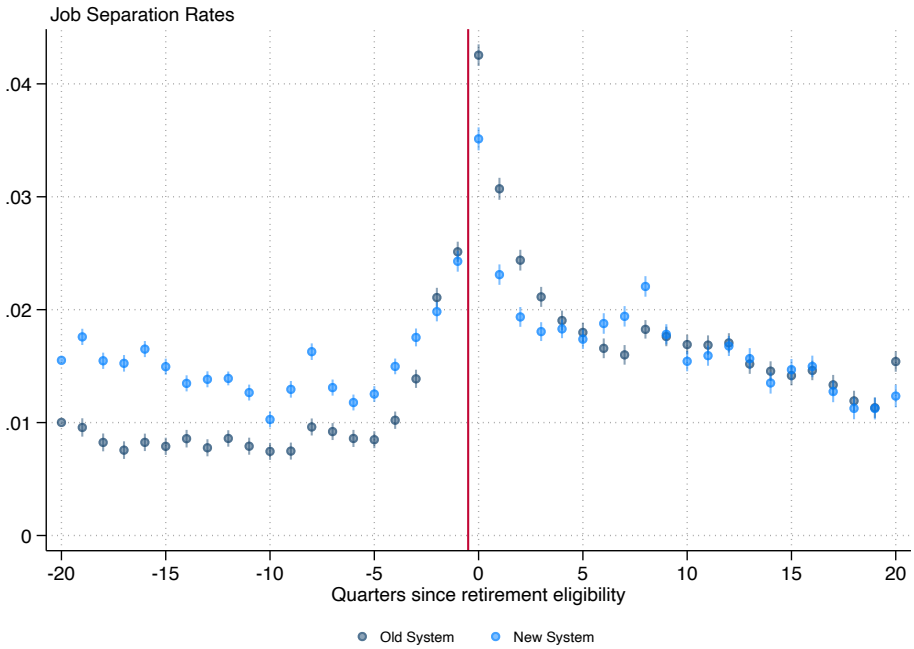
Using the variation in the annuity growth before and after retirement eligibility, we can utilize an event study to examine how labor supply responds to changes in financial incentives around full retirement eligibility:

$$Y_{it} = \alpha + \Sigma_{n=k}^{K} \beta_n X_{in} + \gamma D_{it} + \varepsilon_{it} \tag{2}$$

where X_{in} is a dummy variable for if person i is n quarters away from full retirement eligibility; D_{it} is a vector of rich fixed effects (i.e. subagency, occupation category, location, education level, pay status, appointment status, and age); Y_{it} is whether or not person i separates at quarter t; and β_n is the average separation rate when n quarters away from full retirement eligibility. We condition

to workers within 5 years of retirement eligibility. Because we are able to control for a variety of characteristics and time, we include all workers that have started between 1980 and 2000. For the event study on our RD sample, see Appendix I, which show similar but noisier effects.

Figure 16: Event study: separations around full retirement eligibility

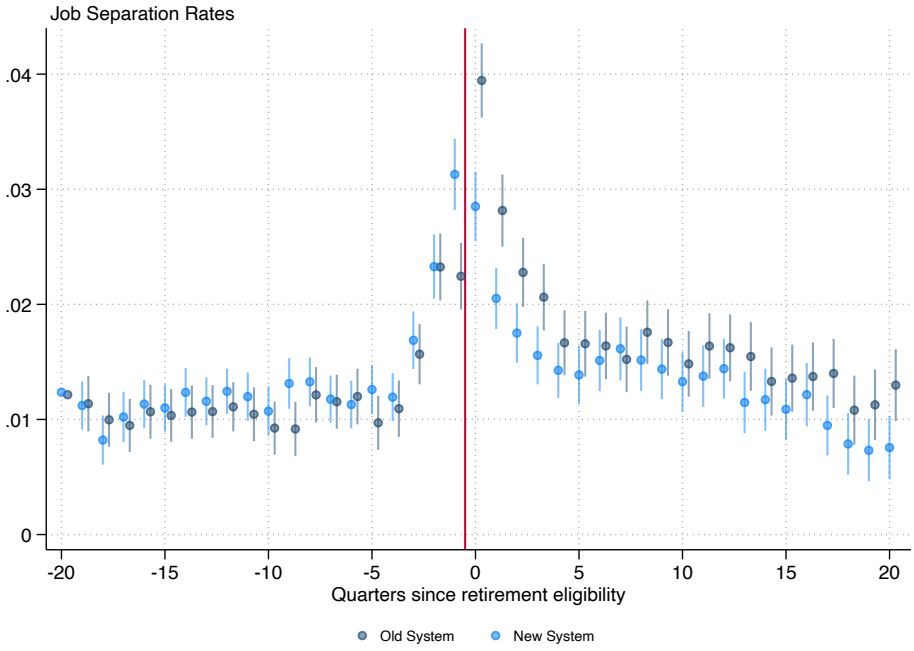


Note: This figure presents the event study coefficients provided in equation 2, for all workers who began between 1980-2000. The sample is restricted to workers who work within 5 years of their full retirement eligibility. The red vertical line signifies the time in which workers become eligible. The navy dots are workers under the old system and the light blue dots are workers under the new system. Vertical bars represent the 95% confidence interval.

The figure highlights two facts about old versus new retirement system workers: old system workers are much more sensitive to retirement eligibility, and they are also more willing to intertemporally substitute work to when (retirement) benefits are low. Under the old system, workers are separating at a 1 percentage point rate prior to eligibility; however, following retirement eligibility, that rate increases four fold to 4 percentage points. Then, workers remain at a higher 1.5 percentage point separation rate following the event. The new system workers, on the other hand, leave at a rate of 1.5 percentage points before and after eligibility. At eligibility, they separate at a rate of 3.5 percentage points, or about two to three fold of the baseline.

Below we run the same event study but for our RD sample.

Figure 17: Event study: separations around full retirement eligibility



Note: This figure presents the event study coefficients provided in equation 2. The sample is restricted to workers who work within 5 years of their full retirement eligibility. The red vertical line signifies the time in which workers become eligible. The navy dots are workers under the old system and the light blue dots are workers under the new system. Vertical bars represent the 95% confidence interval.

Under the old and new system, workers are separating at a 1 percentage point rate prior to eligibility; however, following retirement eligibility, that rate increases four fold to 4 percentage points for old system workers and three fold to 3 percentage points for new system workers. Then, old system workers remain at a higher 1.5 percentage point separation rate on average following the event. The new system workers, on the other hand, separate at a rate closer to baseline around 1 percentage point after eligibility. This highlights two facts about old versus new retirement system workers: old system workers are more sensitive to retirement eligibility, and they are also more willing to intertemporally substitute work to when (retirement) benefits are low.

Appendix J Early career workers

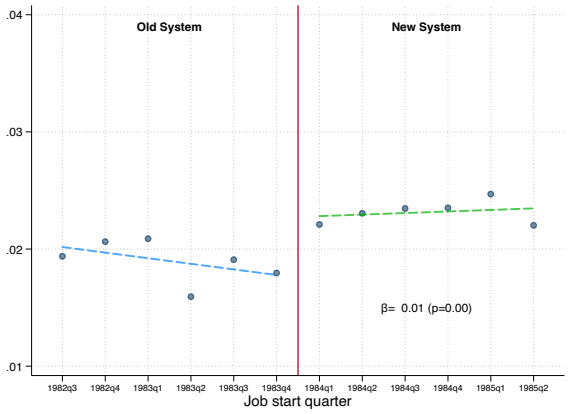
Table 4: Changes in Hiring Characteristics Around New System Announcement

	Announcement 1986Q2
Quarters Needed for Full Retirement	-0.14
	(1.72)
ln(Starting Salary)	0.03
	(0.02)
Starting Age (in Quarters)	0.13
	(2.22)
No. Hires in Subagency	4.52
	(15.22)
Education	
High School or More	-0.00
	(0.00)
Bachelor's Degree or More	0.02
	(0.02)
Higher Educ. Degree or More	0.02
	(0.02)
Years of Educ.	0.04
	(0.09)
Occupation Category	
White-Collar	-0.00
	(0.00)
Blue-Collar	0.00
	(0.00)
Other	-0.01
	(0.02)

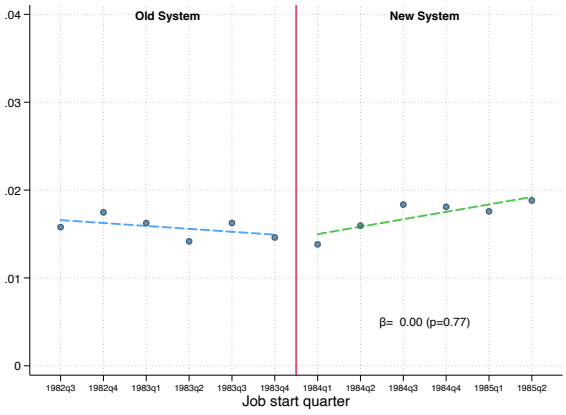
Note: This figure reports the RD coefficients that relate to the change in hiring characteristics after the announcement of the new system. The running variable is the quarter in which an employee begins federal government work, and the regression contains the six quarters before and after the announcement (second quarter in 1986). Standard errors are reported in parenthesis. $*p < 0.1, **p < 0.05, ***p < 0.01$.

Figure 18: Separating at 10 Years

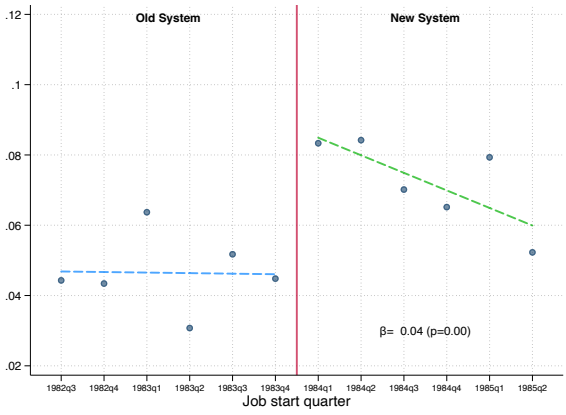
(a) All Workers



(b) Workers Eligible to Defer Only

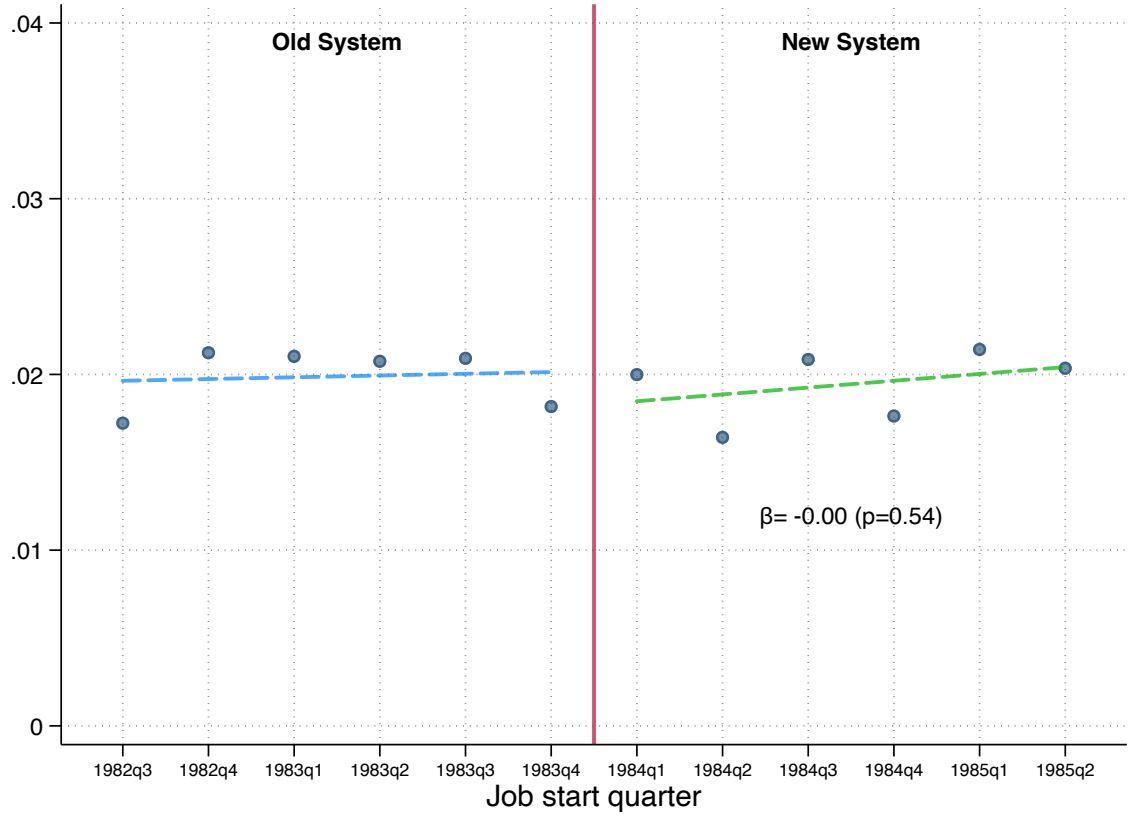


(c) Workers Eligible to Defer or Claim Early



Note: This figure reports the RD outcomes for separating at 10 of tenure. Panel (A) plots the percent separated with 10 years of service across the total sample, for each quarter around the 1984 policy change. Panel (B) plots the percent separated at 10 years of service for those who begin work under 40 years old and are thus only eligible to defer their benefits. Panel (C) plots the percent separated at 10 years of service for those who begin work at 45 years old or above and are thus eligible to claim their benefits early or defer their benefits until later. The RD coefficients are reported as the β and p-values are given in parenthesis.

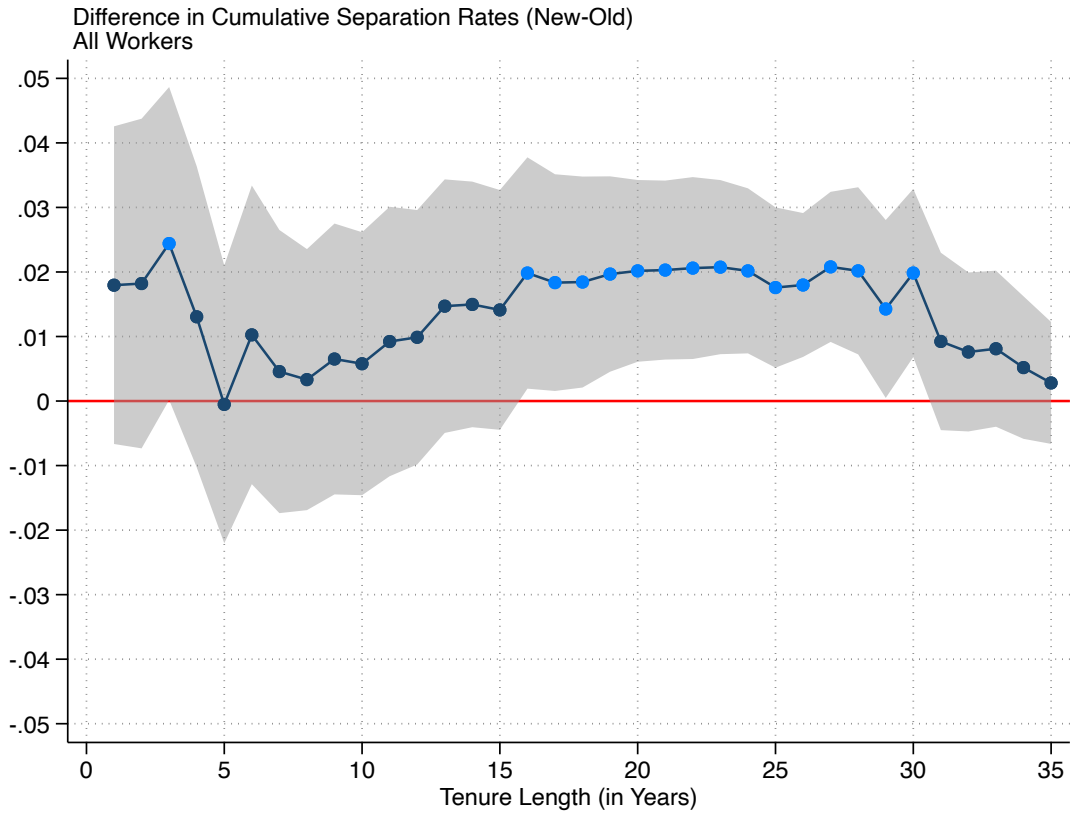
Figure 19: Separating at 9 Years



Note: This figure reports the RD outcomes for separating at 9 of tenure across the total sample, for each quarter around the 1984 policy change. The RD coefficients are reported as the β and p-values are given in parenthesis.

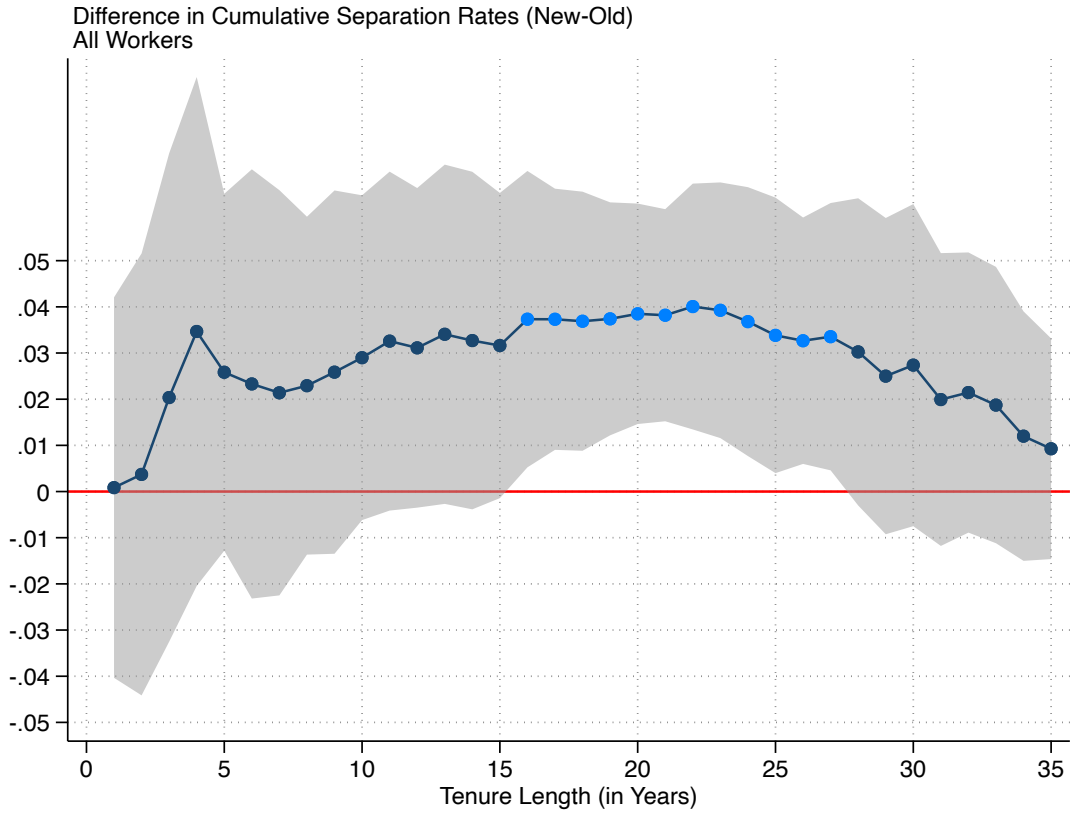
Appendix K Different RD Bandwidths

Figure 20: Long Window - Difference in Cumulative Separations by Tenure Length in the Old vs. New System



Note: This figure plots the RD coefficients, using 10 quarters before and after the policy change, on the cumulative separation rates for the tenure lengths in the x axis. Each point represents the difference in the cumulative separation rates between old system workers and new system workers. The 95% confidence interval is shaded in gray. Light blue points represent coefficients which are statistically significant from zero at the 95% level.

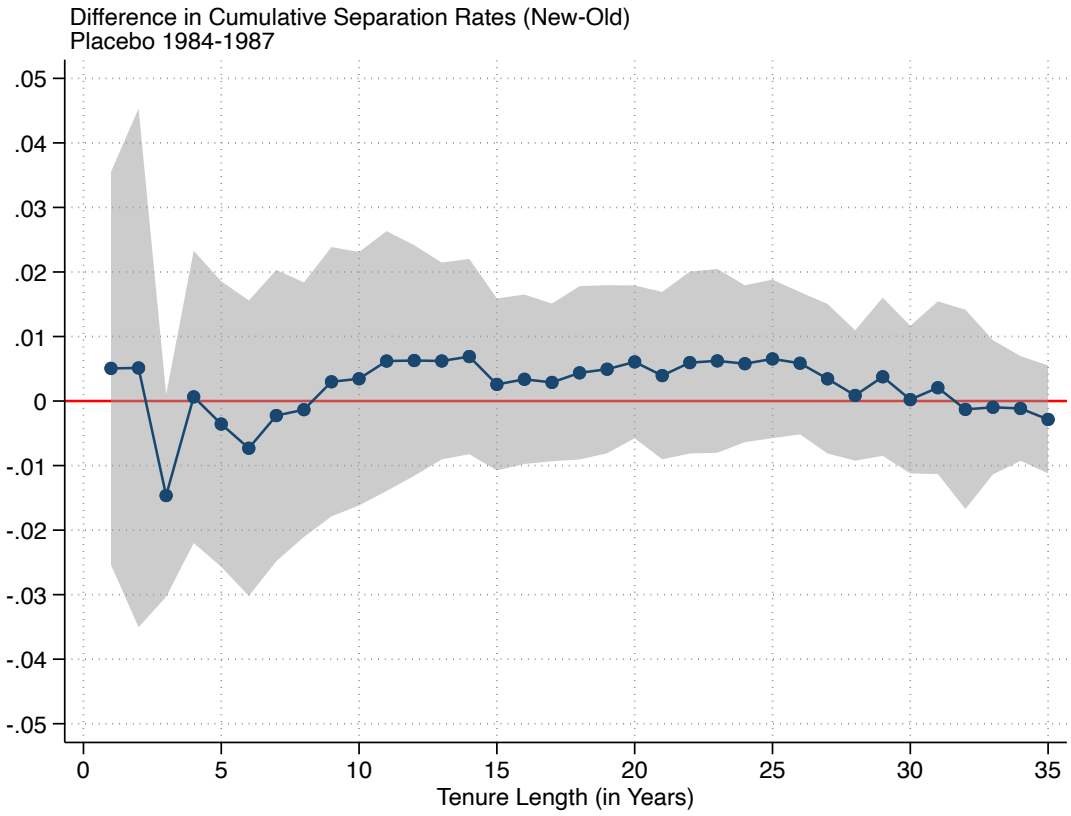
Figure 21: Short Window - Difference in Cumulative Separations by Tenure Length in the Old vs. New System



Note: This figure plots the RD coefficients, using 4 quarters before and after the policy change, on the cumulative separation rates for the tenure lengths in the x axis. Each point represents the difference in the cumulative separation rates between old system workers and new system workers. The 95% confidence interval is shaded in gray. Light blue points represent coefficients which are statistically significant from zero at the 95% level.

Appendix L Placebo Test

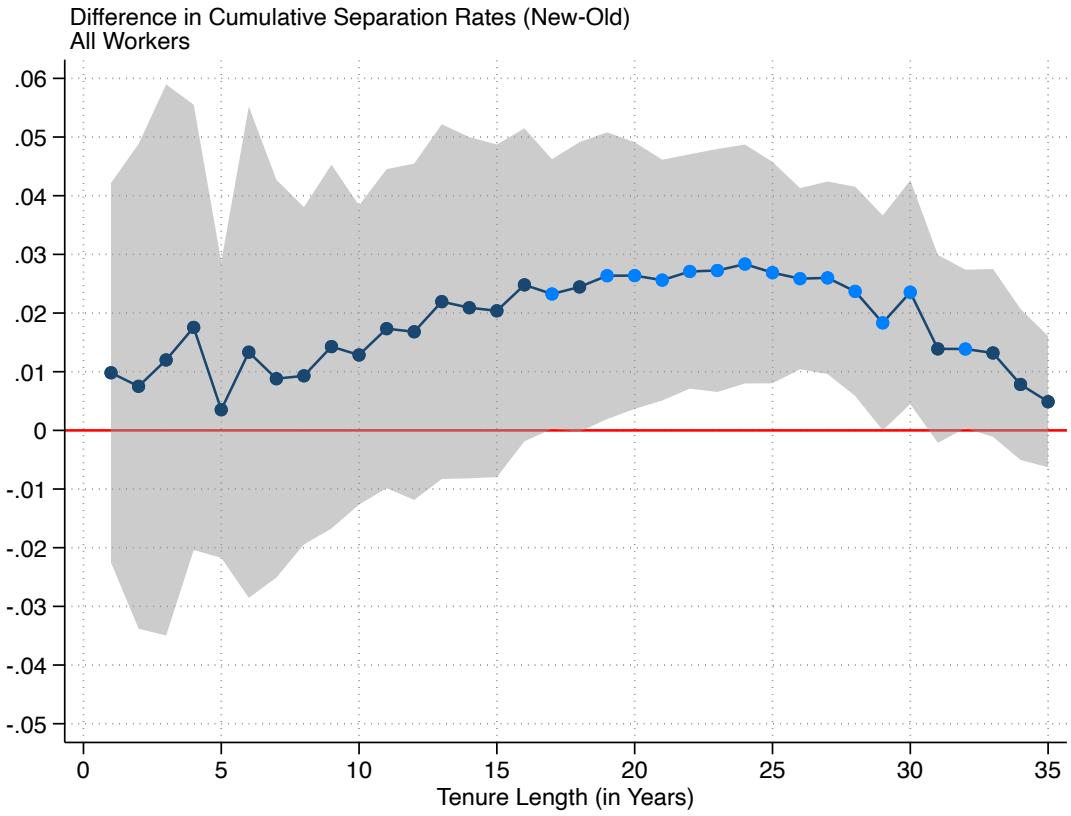
Figure 22: Placebo: Difference in Cumulative Separations by Tenure Length in the Old vs. New System



Note: This figure plots the RD coefficients of a placebo threshold (second quarter of 1985) on the cumulative separation rates for the tenure lengths in the x axis. Each point represents the difference in the cumulative separation rates between old system workers and new system workers. The 95% confidence interval is shaded in gray. Light blue points represent coefficients which are statistically significant from zero at the 95% level.

Appendix M Seasonal Effects

Figure 23: Removing Seasonal Effects: Difference in Cumulative Separations by Tenure Length in the Old vs. New System

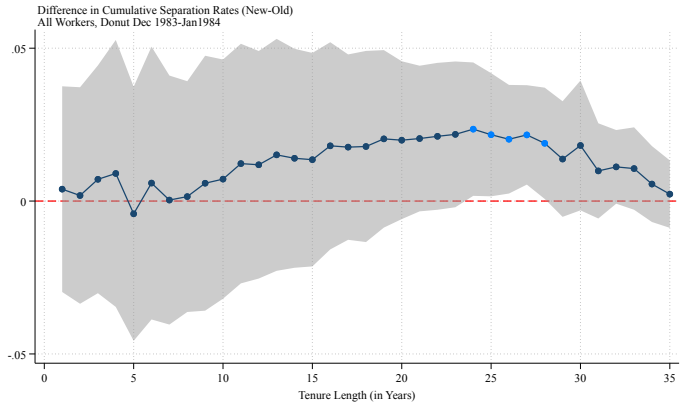


Note: This figure plots the RD coefficients, after residualizing for quarter fixed effects, on the cumulative separation rates for the tenure lengths in the x axis. Each point represents the difference in the cumulative separation rates between old system workers and new system workers. The 95% confidence interval is shaded in gray. Light blue points represent coefficients which are statistically significant from zero at the 95% level.

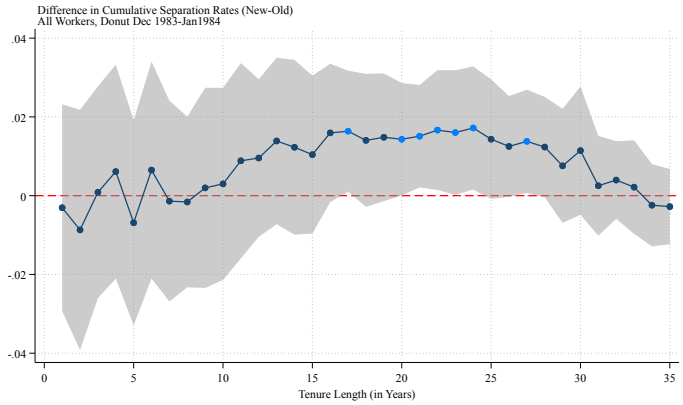
Appendix N Donut Analysis

Figure 24: Donutted Difference in Cumulative Separations by Tenure Length in the Old vs. New System

(a) Excluding Dec 1983 and Jan 1984



(b) Excluding Dec 1983 and Jan 1984 in the Subsample of Workers with Start Dates



Note: This figure plots the donut RD coefficients on the cumulative separation rates for 35 years of tenure. Each point represents the difference in the cumulative separation rates between old system workers and new system workers. The 95% confidence interval is shaded in gray. Light blue points represent coefficients which are statistically significant from zero at the 95% level. Panel (A) displays the coefficients from our main sample but excluding those with a start date in December 1983 to January 1984. Panel (B) displays the coefficients from the subsample of employees that have start dates and excludes those with a start date in December 1983 to January 1984.

Appendix O Selection on Sample Splits

Below are the balance tests for sample splits from the main analysis. We include all the sample splits with the exception of the promotion analysis because the sample is cut differently for each tenure length. We find marginal differences in education for some samples, most notably in the above median supplementary pay analysis.

Table 5: Changes in Hiring Characteristics

	(1) Starting Educ. Less than Bachelor's	(2) Starting Educ. Bachelor's or More	(3) Starting Pay Below Median	(4) Starting Pay Above Median	(5) Starting Age Below 40	(6) Starting Age 45 or Above	(7) Suppl. Pay Below Median	(8) Suppl. Pay Above Median
Quarters Needed for Full Retirement	1.16	-1.40	0.04	0.11	1.46	-0.45	0.38	-0.38
	(2.07)	(1.97)	(2.40)	(1.44)	(1.42)	(0.75)	(2.10)	(1.65)
ln(Starting Salary)	0.02	0.04	0.01	-0.00	0.01	-0.02	0.01	0.01
	(0.02)	(0.03)	(0.01)	(0.00)	(0.04)	(0.02)	(0.03)	(0.02)
Starting Age (in Quarters)	0.74	3.93	2.18	2.04	0.65	1.81**	1.71	2.52
	(2.63)	(2.90)	(3.65)	(2.03)	(1.96)	(0.78)	(2.99)	(2.57)
No. Hires in Subagency								
Education								
High School or More	-0.00		-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Bachelor's Degree or More			-0.05**	-0.03	-0.05*	-0.02	-0.04	-0.05***
			(0.02)	(0.04)	(0.03)	(0.02)	(0.04)	(0.02)
Higher Educ. Degree or More		0.06*	0.00	0.02	0.01	0.00	0.02	-0.00
		(0.03)	(0.00)	(0.04)	(0.03)	(0.00)	(0.04)	(0.00)
Years of Educ.	-0.04	0.11	-0.18***	-0.07	-0.16	-0.05	-0.12	-0.17***
	(0.06)	(0.08)	(0.07)	(0.14)	(0.10)	(0.12)	(0.14)	(0.06)
Occupation Category								
White-Collar	-0.01	-0.00	-0.02	-0.01	-0.02	0.00	-0.01	-0.02
	(0.03)	(0.00)	(0.04)	(0.01)	(0.03)	(0.00)	(0.02)	(0.03)
Blue-Collar	-0.00	0.00	-0.00	0.01*	0.00	-0.00	0.00	0.01
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)
Other	0.01	0.00	0.02	-0.00	0.01	-0.00	0.01	0.01
	(0.03)	(0.00)	(0.04)	(0.00)	(0.02)	(0.00)	(0.02)	(0.04)

Note: This figure reports the RD coefficients that relate to the change in hiring characteristics under the new retirement system. The running variable is the quarter in which an employee begins federal government work, and the regression contains the six quarters before and after the policy change. Column (1) and (2) report the coefficients, splitting the sample by starting education. Column (3) and (4) report the RD coefficients, splitting by starting salary. Column (5) and (6) report the coefficients when restricting by starting age. Column (7) and (8) report the RD coefficients, splitting by supplementary pay. Standard errors are reported in parenthesis. $*p < 0.1, **p < 0.05, ***p < 0.01$.