Pensions to Personnel: The Incentive Effects of Retirement Benefits on Retention and Workforce Composition

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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 mid-to-late career 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.
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1 Introduction

Workplace retirement benefits are an important component of lifetime savings in the U.S., with over half of all active workers participating in some kind of employer-sponsored retirement program.[2] However, the type of benefits people have typically received has significantly shifted over time: in the last 50 years, defined contribution (DC) membership has risen nearly ninefold to over 96 million workers, while defined benefit (DB) participation has fallen by approximately 60 percent, to fewer than 12 million workers (U.S. Department of Labor, 2025).[3]

Economists have long argued that the design of these plans can shape when and where workers choose to supply their labor both near retirement but also more broadly over the lifecycle (Kotlikoff and Wise, 1987; Lumsdaine et al., 1990). DB pensions tend to link a worker's benefit to their tenure such that the continuation value of work rises steeply with tenure, encouraging long careers at a single employer. However, once workers reach retirement eligibility, the opportunity cost of not claiming the pension acts as a substantial tax on work, incentivizing workers to immediately retire. In contrast, DC plans offer portable retirement savings accounts that continue to grow when workers leave for other jobs, weakening tenure-based incentives and allowing greater mobility throughout their career. As employers have shifted from DB to DC systems, the rewards to staying in a single firm have declined, and may have affected both retention and the timing of separations.

In addition to changes in the total quantity of labor supplied to a firm, retirement programs may also impact workforce composition if workers' preferences for these benefits are correlated with productivity. For example, DB pensions can generate advantageous selection by retaining workers who have lower propensities to quit (Salop and Salop, 1976) and who are incentivized to invest in firm-specific human capital (Lazear, 1985). On the other hand, workers who value workplace amenities may be adversely selected on unobserved productivity, causing firms to underprovide amenities (Nekoei, 2026). Many economists and policymakers have advocated for reforming retirement systems in public service, where pensions are both contentious and prevalent, arguing that DB plans may attract lower quality workers at a higher cost. Understanding these selection effects are central to the debates over how overall compensation should be efficiently structured and how benefit design affects the quality of service in the public sector.

This paper attempts to address both questions by estimating the effects of the changes to retirement benefits on (1) retention across the lifecycle of workers and (2) workforce composition. We

[2]The U.S. Bureau of Labor Statistics (2025) estimates that about 75 percent of workers had access to retirement benefits through their workplace. Among those, 75 percent took up these benefits. These estimates are consistent from 1989. Going back to 1984, U.S. Bureau of the Census (1991) estimates that 53-55% of workers were participating in some employer-sponsored retirement plan.

[3]In addition to the expansion of benefits, pension underfunding and the desire to reduce uncertainty in costs have resulted in many firms shrinking or completely freezing their DB offerings in favor of DC programs. 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.

study a representative retirement reform using 50 years of data at the largest U.S. employer, the federal government, leveraging a quasi-experimental setting in which a 1984 policy retroactively changed retirement coverage for newly hired federal workers.

Like many pension reforms since the 1980s, the government reduced the DB annuity and increased portable retirement benefits with a DC plan and Social Security. The benefit change was determined by a worker's starting date and was retroactively applied to the first few cohorts of the new benefit structure; thus, workers were unaware of the structure of the new retirement policy when they joined the government workforce. We validate this by examining the differences in characteristics of new workers around the discontinuity that determined their retirement plan and find no significant changes. Notably, workers were also not compensated for changes in retirement benefits with wages: salary levels remained the same around the policy change as well. This institutional feature allows us to employ a regression discontinuity design with local randomization where 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 lifecycle, with up to 35 years of observations per worker.

We find that the shift from DB pensions to portable DC and Social Security benefits significantly reduced workforce attachment. Consistent with the loss of DB accruals that were significantly backloaded, we find negligible effects early in a worker's 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 be separated during their mid-to-late career. 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 in the assignment of retirement plans.

Our setting also provides a unique opportunity to study how implicit taxes embedded in DB plans 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, we find that the policy change shortened the average federal career by three quarters, or nine months, and decreased the likelihood of staying until retirement by 3 percentage points. These findings imply that the government saved about $42k-132k per labor-year lost and $56k-177k per *experienced* labor-year lost, defined as those with at least ten years of tenure. Thus, while the change

in the program saved money for the federal government, it came at the cost of reduced retention.

However, whether or not the government savings had downside in the public workforce depends the selection of workers who left. Policymakers at the time of the reform debated this point, with some arguing that loosening the "golden handcuffs" generated by DB plans could improve workforce quality by allowing less-motivated employees to leave voluntarily. In practice, we find that DB plans are advantageously selected: 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 their private-sector peers—-account for most of the aggregate response. Using incentive pay and rapid promotion within occupation–education-age-tenure 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 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, reducing the pension benefits made it harder to retain highly educated and productive employees, amplifying existing challenges in competing with private-sector employers.

Overall, reducing DB generosity and increasing portable benefits like DC plans and Social Security raises the likelihood of separation, with the largest effects concentrated among more productive workers and those with better outside options. We structure our findings in the remainder of the paper as follows. Section 2 summarizes the contributions of this paper. Section 3 describes compensation in the public sector and outlines how the reform changed retirement benefits. Section 4 presents a simple framework for understanding the work incentives underlying DB and DC benefits. Section 5 details the empirical strategy. Sections 6–9 present the data, empirical strategy, and main results. In Section 10, we conclude.

2 Contributions

Measuring the responses to changes in employer-sponsored retirement incentives has been historically difficult, despite extensive economic and policy attention. First, 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. Hence, most research on private employer plans examines how retirement benefits affect labor supply near retirement. What little is known about the effects of retirement systems on retention earlier in a worker's career focuses on vesting schedules, which

typically occur within a few years of employment (Carranza and Goodman, 2024).

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, like 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 effects of benefit changes.

Prior studies have examined labor supply effects of DB-to-DC shifts using earnings-based national programs (e.g., French et al., 2026; 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. This paper overcomes the above three challenges by identifying the *incentive effects* using data on a large-scale retirement reform that occurred over 50 years ago and quasi-experimentally varied retirement benefits across cohorts of workers.

Our paper follows studies that have used the same reform to examine the option value of defined benefit pensions (Falk and Karamcheva, 2018) and correlates of worker retention patterns in the Department of Defense (Ippolito, 2002). In contrast to those papers, we employ a regression discontinuity design to estimate the causal effects of the reform on retention and workforce composition across a full career cycle.

We also contribute to the literature that studies DB program designs, like changes benefit schedules, amounts, and claiming ages (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). This research examines a change in a DB plan, where most attributes of the policy stayed the same, with an exception to the generosity of the pension, allowing us to isolate financial 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) provides a theoretical framework in which adverse selection leads firms to under-provide 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.

3 Institutional Details

3.1 The History of Retirement Benefits at the Federal Government

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.[4]

In 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 were intended to reduce future expenditure 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 the 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.

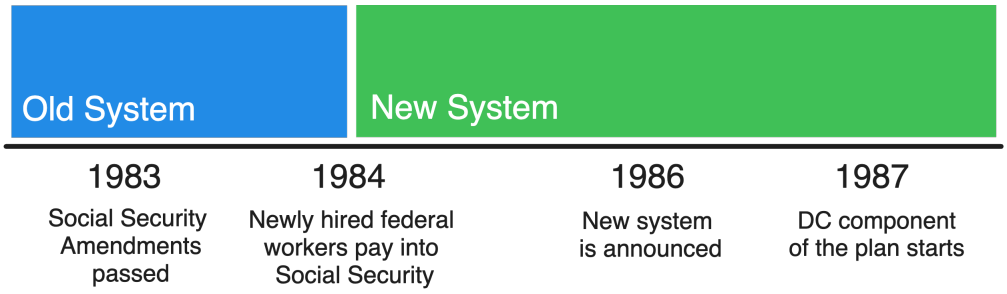
Crucially, the law applied retroactively for workers who began their federal career between 1984 and 1986.[5] Publicly available action on the retirement plan was first proposed in October 1985 (S. 1527) by the Committee on Governmental Affairs, which outlined a preliminary plan that was ultimately rejected. Prior to this, little was known regarding the new retirement system.[6] Hence, this

[4]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.

[5]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.

[6]The Office of Management and Budget (OMB) and the Office of Personnel Management (OPM) had consid-

Figure 1: Historical Timeline



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

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.

3.2 Comparing the Old and New System

The reform left vesting and broad retirement eligibility largely unchanged, but it substantially changed the composition of retirement compensation. Most importantly, it reduced the generosity of the DB pension and replaced part of that compensation with Social Security and an employer-matched DC savings plan.

Under the old system, the DB annuity replaced 1.5-2 percent of the average of a worker's highest three earning years ("high-3" pay) for each year of service. Under the new system, that rate fell to 1 percent, increasing to 1.1 percent only for workers retiring at age 62 or older with at least 20 years of service. Consequently, DB accumulation rates fell by 30 to 50 percent. A hypothetical worker retiring at age 62 with 30 years of service would receive a pension worth about 56.25 percent of high-3 pay under the old system, compared with 32 percent under the new system.

With the addition of the DC plan and Social Security, The new system supplemented the loss of DB benefits with more portable benefits. A retirement benefit is portable if the value of the benefits from a current employer can be transferred to a new 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 DC contributions are owned by the employee even if they leave their current employer. All new system workers were enrolled in Social Security and received employer matches for DC contributions, while old system workers did not.[7] Under the new system,

ered 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 plan included a hybrid component similar to the new system that was eventually enacted.

[7]Workers under the old and new system could opt in to the DC savings and investment plan; however, workers

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, but they could receive up to 5% contribution by the employer if the worker contributed 5% or more to their DC plan.

For this project, we mainly focus on the shift from a more generous, back-loaded, employer-specific pension to a less generous but more portable retirement package. However, the reform also altered late-career incentives, which we highlight here. While the age a worker is eligible to claim unpenalized retirement benefits roughly stayed the same, claiming retirement benefits before eligibility became much less attractive: the penalty increased from 2 percent per year for retirement before age 55 in the old system to 5 percent per year for retirement before age 62 in the new system. The minimum retirement age also rose from 55 to 55-57, depending on birth cohort, which was not significantly different between the old and new system workers for our sample. At the same time, the new system added two provisions that reward longer careers: workers with at least 20 years of service who retire at age 62 or later receive the higher 1.1 percent accrual rate, and workers with at least 10 years of service can separate and defer benefit receipt until the minimum retirement age rather than waiting until age 62. For a detailed list of the changes in the two systems, see Appendix A.

4 Conceptual Framework

Retirement plans shape employer retention by embedding dynamic incentives throughout a worker's career. Traditional DB plans are typically back-loaded, 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 benefits that are portable and riskier, which weakens the relationship between retirement wealth and employment at a particular employer. Sections 4.1 and 4.2 outline these contrasting incentive structures and their implications for labor supply.

4.1 Features of the DB Plan: Back-loading

Traditional DB pensions typically exhibit a "back-loaded" 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 high-3 pay, and (2) DB formulas typically apply a benefit factor

under the old system were not eligible for employer matching. 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.

that rises with total years of service. Tenure increases both components, creating powerful incentives to remain with a specific employer until key retirement milestones and discouraging mid-career exits.

To illustrate this back-loading 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 pay. Formally, let $PDV^{\mathrm{DB}}(a,s,w_f)$ 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

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

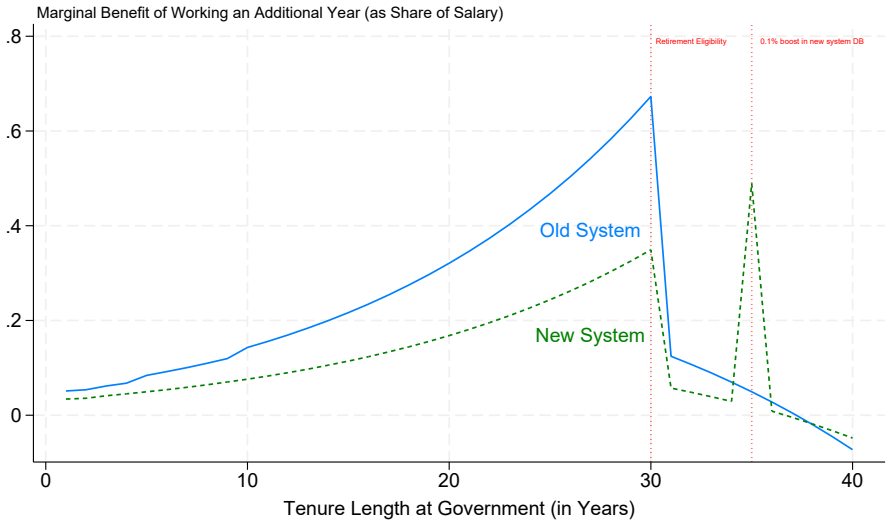
Figure 2, Panel (A) plots ΔPDV_s^{DB} as a share of salary for a hypothetical worker whose real wages do not change over timeNote, we are only accounting for increases in the benefit factor in our example; we do not account for the growth in the benefit base as real wages are held fixed. and who begins federal work at 25 years old, so retirement eligibility occurs at 30 years of service. Panel (A) shows that the PDV marginal benefit increases steeply with tenure, demonstrating the back-loaded 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[8] by retirement eligibility. Thus, as workers under the old system increase their tenure, they face stronger and stronger incentives to remain with their employer. Under the new system, the annuity reduction will lower the back-loading 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 back-loading in turn generally lowers the retention incentives by tempering the marginal benefit to work.

However, while back-loaded 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 work drops sharply after eligibility, even becoming negative when the PDV of the pension increase from an additional year off work is less than the PDV of receiving the pension today. Thus, DB plans create 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.

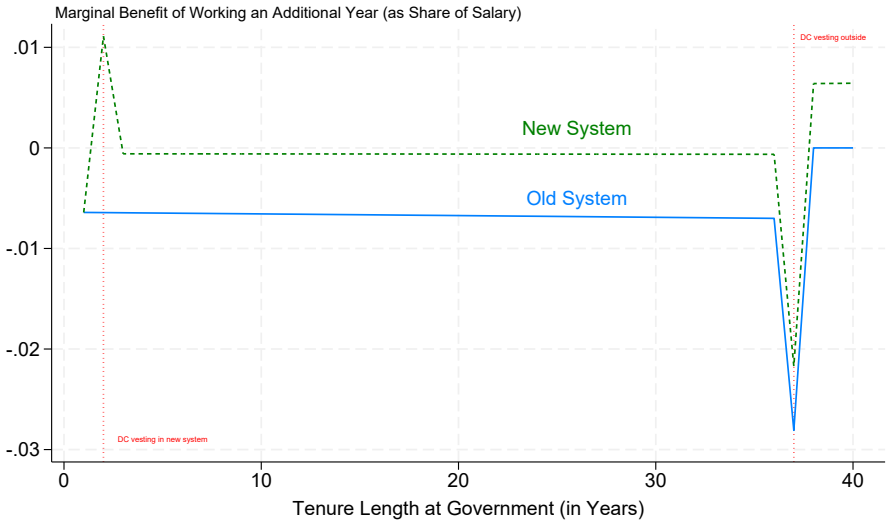
[8]The new system provides an additional benefit when turning 62 with at least 20 years of service (35 years of service in our example): the benefit factor increases from 1.0% to 1.1% for all years of service, creating an additional jump after retirement eligibility.

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

(a) Defined Benefit



(b) Portable Benefits



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.

4.2 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. One of the key features is portability: employees can transfer and grow benefits from one job to another. In the case of a DC plan, the worker's savings account, like a 401(k), can be transferred to other employers or to a personal account. Likewise, Social Security is calculated using any formal employment, so leaving a particular employer does not inhibit the growth of the payout. Since workers can continue to grow benefits after switching jobs without significant penalties, portable do not generate the incentives to stay at a particular firm like DB plans do.

To illustrate this difference, Figure 2, Panel (B) plots the marginal PDV gain in portable benefits 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 portable retirement benefits when 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

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

Panel (B) of Figure 2 shows that this marginal benefit is roughly flat over time, reflecting the absence of back-loading. The only difference between staying and leaving arises under the old system because 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 changes appear around vesting thresholds. The upward spike occurs when the worker reaches the federal vesting requirement after 3 years of service; the downward spike near 38 years of service reflects the vesting requirement at a new employer's DC plan after switching jobs. Beyond these discontinuities, the flat marginal PDV underscores the lack of dynamic incentives under portability. Portable benefits weaken employer-specific attachment by eliminating gains that are contingent upon tenure.

Although portability does not affect dynamic incentives, the marginal PDV level can change depending on the quality of outside options. Workers with access to higher-paying alternatives face a negative marginal PDV of remaining in federal service; they gain from switching today versus tomorrow because they would save more in the DC plan and accumulate higher Social Security benefits. For similar reasons, workers with weaker or more uncertain outside options face a higher marginal PDV across the board. Thus, the reform amplifies pre-existing differences in outside options, incentivizing larger separation responses among workers with stronger job alternatives.

5 Empirical Strategy: 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 3, 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). We aggregate worker-level outcomes by their starting cohort and estimate the following specification:

$$\bar{Y}_c = \beta_0 + \beta_1 NS_c + \delta_1(start_c - 1984Q1) + \delta_2 NS_c(start_c - 1984Q1) + \varepsilon_c. \tag{1}$$

where c indexes starting cohorts; $start_c$ is the quarter where worker in cohort c began federal employment; NS_c is an indicator equal to one when the starting cohort is in the new system; and $\bar{Y}_c$ is the average outcome for that cohort. Each entry cohort receives equal weight in estimation. 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. 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 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 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 of 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 used both the earliest observed appearance of the worker in the data and also looked at changes in the tenure variable, which is recorded in coarse bins. We also used 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 too extensively in our analysis.[9] 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.[10]

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.[11]

Table 1 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. 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%).

[9] 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.

[10] 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.

[11] As discussed in Section 3, this creates a balanced set of cohorts who would not have been aware of the new policy at the time they began work.

Table 1: 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.

7 Selection in Hiring and Benefit Changes

To validate our empirical strategy, 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 hiring characteristics in a neighborhood of the cutoff. Then, using the same strategy, we also document changes to the average retirement benefits before and after the reform. We show that the present discounted value of the annuity benefit drops sharply while portable benefits significantly increase, with ambiguous effects on total benefits.

7.1 Changes to Hiring Characteristics

Table 2, 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 characteristics, 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 to compensate for any changes in benefit levels.

7.2 Changes to Retirement Benefits

The policy created large changes in both the level and structure of workers' retirement benefits. Figure 3 reports the average PDV (in 2022 dollars) of retirement benefits, incorporating real separation behavior. The most striking change is the large increase in portable wealth: Panel (B) shows roughly a $167,000 increase in the PDV of Social Security and the agency's mandatory 1% DC contribution under the new system.[12] 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. Offsetting this, Panel (A) shows a $150,000 decline in annuity PDV, reflecting the roughly $11,000 lower annual annuity (a 55% reduction) under FERS. Netting the two, Panel (C) yields a statistically insignificant $15,000 increase in total benefit PDV. The overall effect on benefit levels is therefore ambiguous. Workers are approximately as well off in expectation, but the composition changed dramatically.

Beyond the level effects, the reform substantially reduced the back-loading of retirement incentives by flattening the growth profile of the benefit. Panel (D) illustrates this by plotting the marginal

[12]To estimate Social Security contributions, we assume wages contribute towards the first dollar of Social Security. Results are similar conditioning on the average or last dollar. For DC contributions, we include only the mandatory 1% employer contribution and assume a 9% annual return. All PDV calculations use a 3% discount rate.

Table 2: 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)

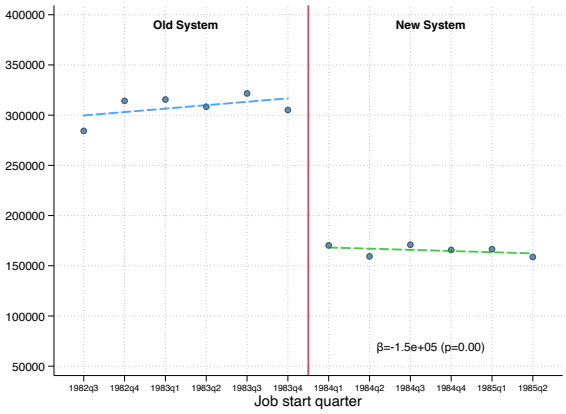
Note: This figure reports the RD coefficients that relate to the change in hiring characteristics under the new retirement system. The running variable is the quarter in which an employee begins federal government work, and the regression contains the six quarters before and after the policy change. 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. $*p < 0.1, **p < 0.05, ***p < 0.01$.

change in annuity PDV attributable to each additional year of tenure, where each point is estimated from a separate regression discontinuity for each tenure year comparing workers under the old and new system. The figure shows that the marginal annuity PDV difference is close to zero at short tenures and becomes increasingly negative at longer tenures, reaching its most negative around year 30.

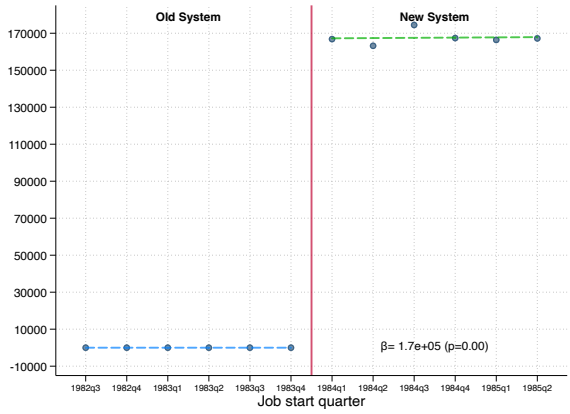
In Appendix C, we also show the difference in predicted potential DB, portable, and net benefits between the old system and the new system workers. To calculate counterfactual benefits for workers who separate, we interpolate wages and assume no prior employment.

Figure 3: Change in PDV Retirement Benefits

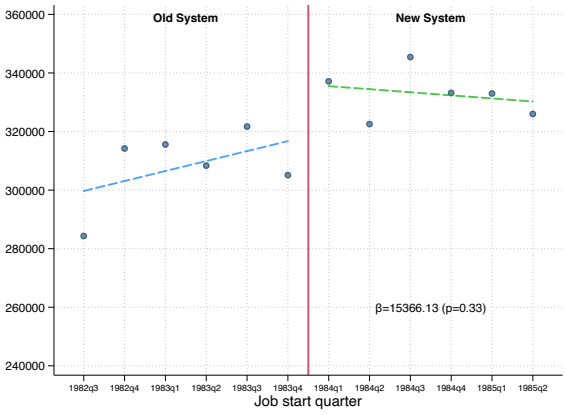
(a) PDV Annuity



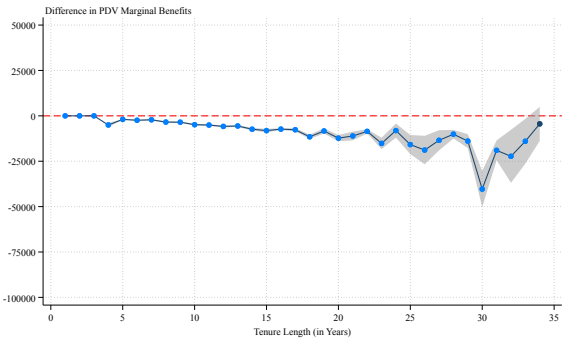
(b) PDV Portable Benefits



(c) PDV Total Benefits

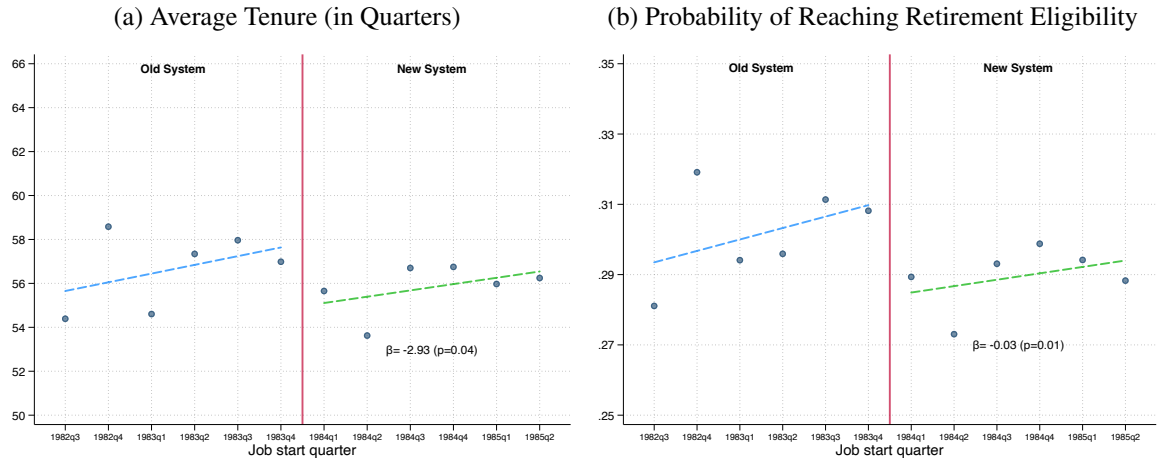


(d) PDV Marginal Annuity



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



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.

8 Labor Supply Responses

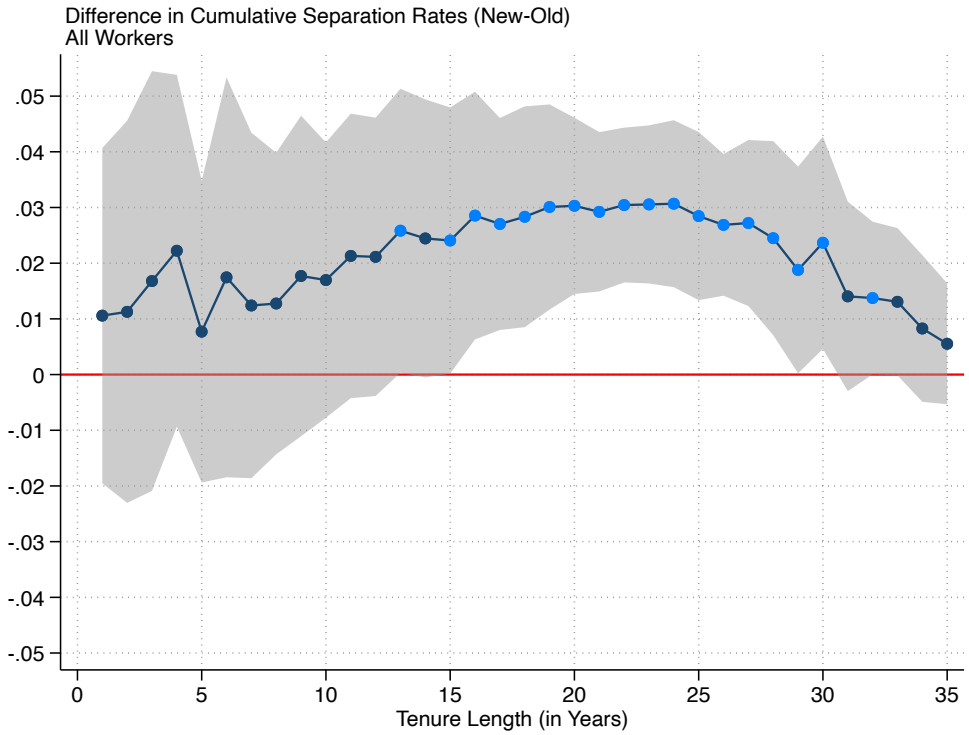
8.1 Across Tenure

Despite an insignificant change in total benefit levels, we find that the shift from the DB system to the mixed DB-DC system reduced average service with the federal government. Figure 4, Panel (A) reports 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, or 9 percent, less likely to reach full retirement eligibility.

We further discover that these effects differ substantially over the career cycle. We plot 35 separate RD coefficients for cumulative separation rates across tenure lengths in Figure 5. 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 probability that a new-system worker has separated at a given tenure length relative to an old-system worker. We find that workers with 15 to 30 years of tenure are roughly 2 to 3 percentage points more likely to be separated in any given year. Hence, the average tenure effects are driven by a lower stock of mid- and late- career workers.

This pattern aligns with the reduction in back-loaded retirement benefits induced by the reform. Early in a worker's career, the reform only slightly lowered the marginal value of work. However, as

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.

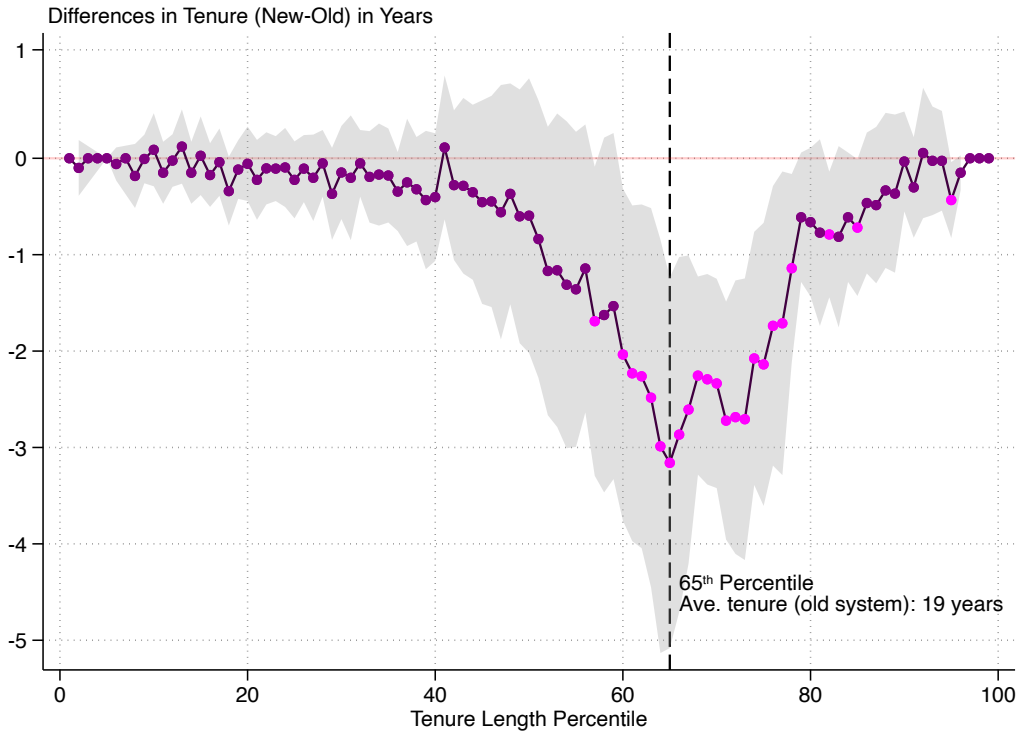
a worker accumulates tenure, the differences in the marginal value of work diverge significantly mid- to late-career. This pattern indicates that the reduction in pension benefits had a pronounced effect on labor supply, but primarily during the period when benefit losses tied to tenure were greatest in the federal system.

Beyond 30 years of tenure, we find 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 due to the implicit tax that the DB program generates at retirement eligibility (which is 30 years of service for most workers), "catching up" to the total separation rates of the new system workers. We discuss this further in Section 8.3.[13]

How much do workers adjust their tenure? We examine how the benefit changes affected total time spent in federal service across the tenure distribution. Consistent with the earlier results, we find

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

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.

negative effects concentrated among workers in the higher 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. The effect ranges 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.

8.2 Robustness

We conduct several robustness checks to assess the stability of our baseline results. Our exercises indicate that our results are not driven by bandwidth choice, mechanical tenure effects, seasonal hiring patterns, or strategic timing of hires around the reform threshold. Across all specifications, our main results hold. Details are reported in Appendix J.

We begin by varying the RD bandwidth to assess sensitivity to window choice. Although the baseline window is motivated by our institutional setting, Appendix J.1 shows that the estimates are similar when we use both wider (10-quarter) and narrower (4-quarter) windows. We next estimate a placebo RD centered on the second quarter of 1985 to test whether the tenure effects could arise mechanically. This specification compares two cohorts of the same size as in the baseline, both of whom were subject to the same retirement system before the reform was announced in 1987; as shown in Appendix J.2, the placebo estimates are close to zero. We also address the possibility that seasonal hiring patterns shift workforce composition and thereby affect labor supply outcomes.[14] In Appendix J.3, we residualize labor supply outcomes with respect to quarter fixed effects before estimating the RD and obtain results that are nearly identical to the baseline. Finally, to address concerns that hiring timing may have responded strategically to uncertainty around the policy cutoff, we estimate a donut RD using linked personnel records with exact start dates for roughly 70% of the sample (more than 68,000 employees). Excluding hires close to the cutoff yields estimates in Appendix Figure 24 that are consistent with the baseline, though less precise because of the smaller sample.

8.3 Implicit Taxes Near Retirement

The same back-loaded DB benefit that generates strong incentives to remain with a single employer also imposes an equally strong incentive to quit after retirement eligibility. Continuing to work beyond eligibility delays pension collection, imposing an implicit tax on labor supply that discourages work. By reducing the generosity of the DB annuity, the new system also reduced this implicit tax without significant changes to other parts of the retirement program design. As a result, we can isolate the effect of monetary incentives on the extensive margin of labor supply while holding social and institutional factors constant.

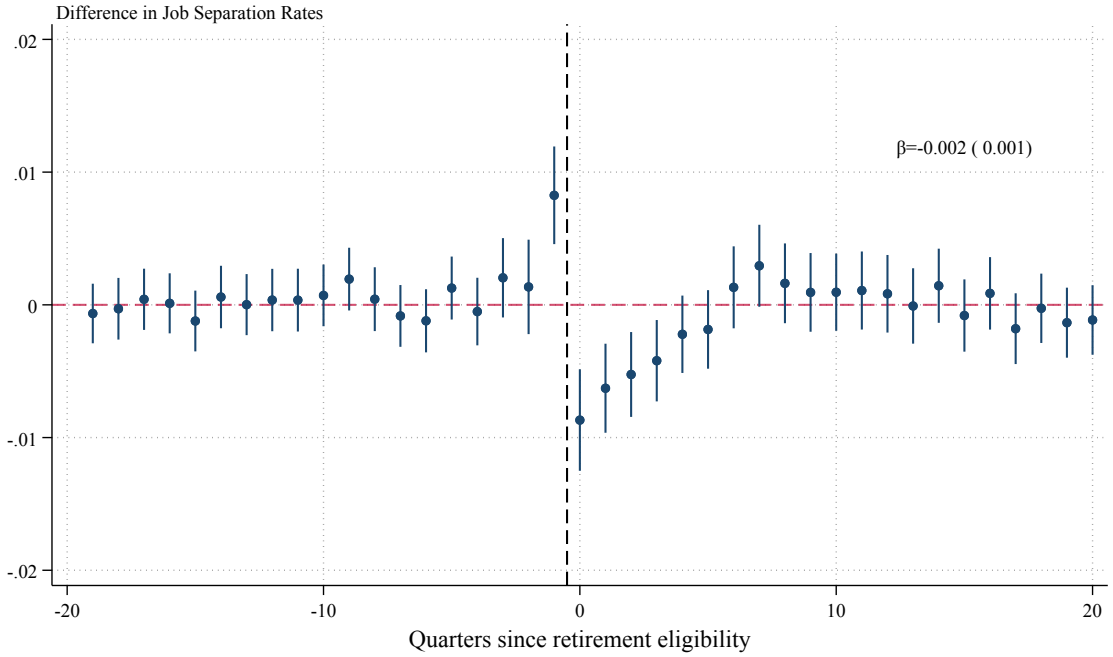
We have two sources of identification: the policy change, which altered the implicit tax rates across workers, and variation in the timing of eligibility, since full retirement depends on both age and tenure. We estimate the following difference-in-differences specification on a panel of workers observed within five years of full retirement eligibility:

$$\text{Separation}_{it} = \alpha + \gamma \text{Post}_{it} + \beta \text{Post}_{it} \times \text{NS}_i + \Gamma_i + \Omega_t + \varepsilon_{it}$$

where 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_i and Ω_t are individual and time fixed effects; and β is the difference in the effect of retirement eligibility between individuals in the old and new

[14] For example, the influx of new graduates entering the workforce in the third quarter may increase the educational composition of hires in that period relative to other quarters.

Figure 7: 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.

system.

Figure 7 plots the corresponding event-study estimates. We find no evidence that old and new system workers had differential separation rates prior to reaching retirement eligibility. After eligibility, separation rises under both systems, but more sharply under the old system, which imposed a larger implicit tax on work. The estimates imply that workers under the old system are about 0.2 percentage points more likely to separate after reaching eligibility, or about 20% of the baseline quarterly separation rate. Lower pension generosity increased late-career labor supply by lowering the implicit tax on work after retirement eligibility.

We can also estimate the labor supply elasticity with respect to the marginal benefit of working an additional year. We utilize the policy-induced shift in the DB accrual schedule, using $\text{Post}_{it} \times \text{NS}_i$ as an instrument, making our first stage:

$$\ln(\Delta PDV_s^{\text{DB}}(a,s,w_f)+w_f)_{it} = \alpha + \gamma \text{Post}_{it} + \beta \text{Post}_{it} \times \text{NS}_i + \Gamma_i + \Omega_t + \varepsilon_{it}.$$

In the second stage, we relate labor supply to the predicted incentive measure:

$$\Pr(\text{working})_{it} = \alpha + \beta \ln(\Delta PDV_s^{\widehat{\text{DB}}}(a,s,w_f) + w_f) + \gamma \text{Post}_{it} + \Gamma_i + \Omega_t + \varepsilon_{it}.$$

We then compute the extensive-margin elasticity as $\varepsilon = \delta / \bar{p}_{\text{pre}}$, where $\bar{p}_{\text{pre}}$ is the average pre-period probability of working.

The IV regression implies an extensive-margin elasticity of 0.15 with respect to the marginal benefit of working. Our estimate complements other work in this literature. The magnitude of our elasticity is close to the extensive-margin elasticities surveyed in a meta-study by Chetty et al. (2013), where they find an average estimate of 0.32 with a minimum of 0.18 and a maximum of 0.43. A closely related study by French et al. (2026) finds an employment elasticity of 0.51 with respect to the net return to work in a national pension reform in Poland.

8.4 Implied Government Savings

Because policy overall reduced retention, the government retained some savings from smaller retirement payouts. To express this, we compute "savings per labor-year lost" as the change in the government's retirement-related costs divided by our estimated reduction in years of service at the cutoff (taken from Figure 4). Government retirement costs include the employer cost of the DB pension, the employer Social Security payroll tax, and employer contributions to the DC plan. For the DB component, we use OPM's estimates that the government contributes about 29.6% of wages under the old system and 16% under the new system (Isaacs, 2019). Because employer contributions to the DC plan vary with employee participation, we report a low-cost scenario that assumes only the automatic 1% contribution and a high-cost scenario that assumes the maximum 5% employer contribution. We further bound the savings using two additional assumptions on labor responses. For the lower bound, we assume that labor supply is fixed, so we exclude any savings from leaving vacancies unfilled. The upper bound assumes attrition without replacement workers. Appendix E provides the exact formulas and assumptions.

Table 3 reports the results. Under the low DC assumption, the government saves about \$112k–\$133k per labor-year lost. Under the high DC assumption, the corresponding savings are smaller, at about \$42k–\$67k. We also report an alternative measure that scales savings by experienced years lost, where experience is defined as more than 10 years of service. On this margin, the government saves about \$149k–\$177k under the low DC assumption and \$56k–\$89k under the high DC assumption.

Table 3: Savings per labor-year lost (in 2022 USD)

	Low DC Contributions	High DC Contributions
Average years	[112,006.76, 132,978.48]	[42,002.53, 66,590.06]
Experienced years	[149,359.87, 177,325.44]	[56,009.95, 88,797.17]

Note: This table reports the implied government savings from the retirement reform per labor-year lost in 2022 dollars. Government retirement costs include employer contributions to the DB pension, Social Security payroll taxes, and employer contributions to the DC plan. In accordance to OPM's estimate, we assume the employer's DB contribution rates is approximately 29.6% of wages under the old system and 16% under the new system. The "Low DC Contributions" scenario assumes a 1% employer match in the DC plan, while the "High DC Contributions" scenario assumes a 5% match. Within each cell, our lower bound assumes labor supply is fixed, so that there are no additional savings from a separation because a worker is replaced; the upper bound assumes the employer does not replace the worker. "Average years" uses the estimated reduction in total years of service, while "Experienced years" scales savings by the reduction in years of service after 10 years of tenure.

9 Workforce Quality

To put the government savings from the retirement reform into context, we also examine the change in workforce composition. Beyond the cost component, DB pension plans are also highly contentious in what types of workers they may retain, in particular because DB pensions are prevalent in public sector. Economists, policymakers, and journalists have argued that DB pensions may attract workers who are less productive, hence reducing the quality of public service. If true, moving away from a pension system can improve workforce quality. This section explores whether DB benefits may be adversely or advantageously selected with two measures of worker quality: outside options and productivity.

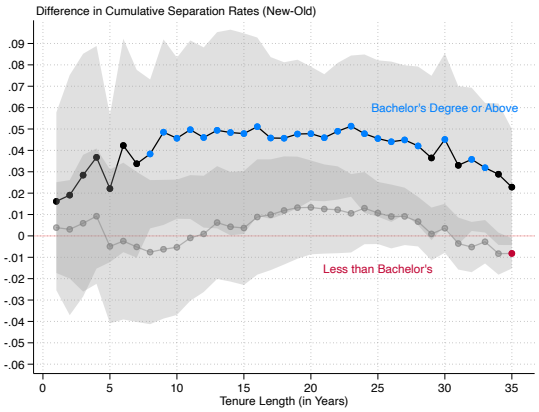
9.1 Outside Options

We identify variation in outside options in three ways. First, we utilize a report from the Congressional Budget Office that states college-educated federal workers earn 10–29 percent less than private-sector counterparts, while those without a bachelor's degree earn roughly 17 percent more. Splitting the sample by education in Figure 8, Panel (a), we find precise null effects for workers without a bachelor's degree but separation responses roughly twice the baseline magnitude for college-educated workers.

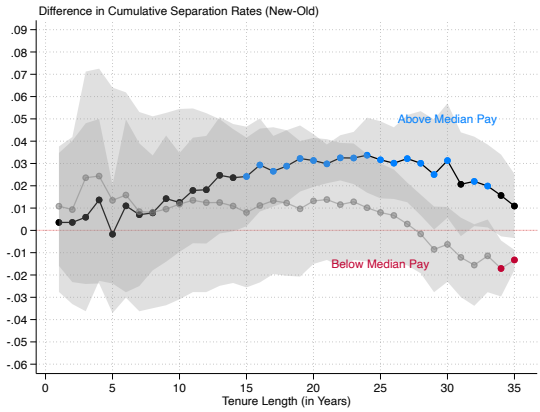
We run a second test by exploiting the compression of federal pay scales that result in higher-paid federal employees who are underpaid relative to private-sector counterparts and lower-paid employees who tend to earn more. Specifically, we split the sample by median starting pay. Workers above

Figure 8: Difference in Cumulative Separations by Tenure Length

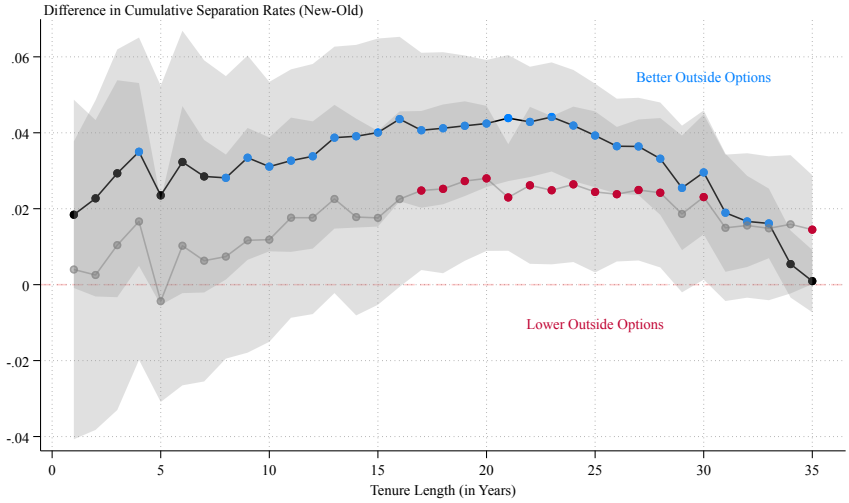
(a) By Starting Education



(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.

the median starting pay are 2–3 percentage points more likely to separate after 14 years of tenure, while those below the median show no meaningful response (Figure 8, Panel (b)).

Third, we construct a direct measure of outside options by adapting the occupation-to-occupation mobility framework of 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 method captures the probability that workers move into alternative occupations and the local availability of those alternatives for each occupation type. We then sum these weighted transitions within each state–occupation cell to obtain a state-specific expected outside-option index. This measure is residualized on occupation and state fixed effects and split by the median across occupation–location observations. The resulting measure reflects within-occupation, within-state variation in the strength of outside opportunities. Workers above the median of this index (i.e. those with better outside options) again exhibit significantly higher separation rates following the reform, while those below the median do not (Figure 8, Panel (c)).

9.2 Productive Workers

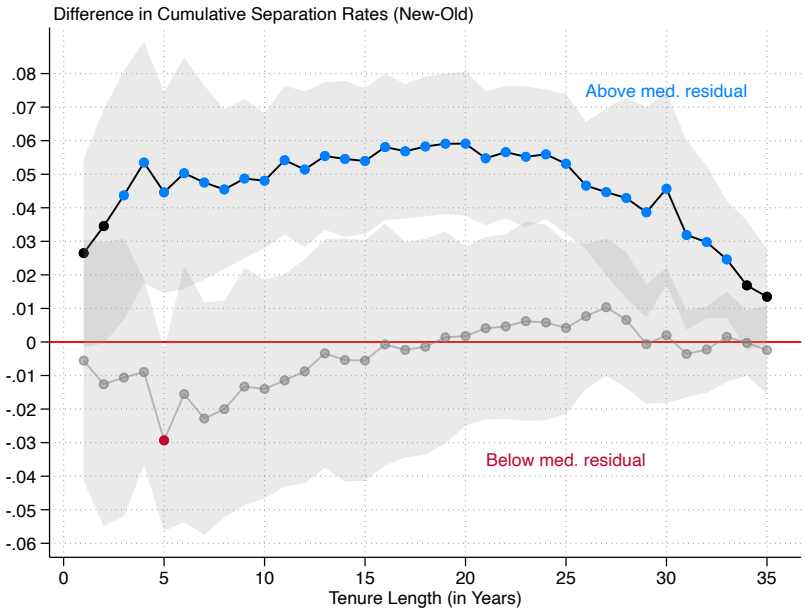
We examine this using two proxies for worker productivity: supplementary pay and promotion speed. In the federal pay system, workers are assigned to grades and steps, so observed pay reflects both worker characteristics and the pay schedule. We therefore compare workers within similar jobs and isolate pay and advancement that are high relative to their observable characteristics. First, we measure supplementary pay as residualized salary: we regress pay on grade, pay plan, supervisory status, tenure, age, location, education, subagency, occupation, quarter, and time effects, and then average each worker's residual over time. Workers with larger positive residuals receive pay above what is typical for otherwise similar workers, which likely reflects supplementary pay and, additionally, stronger outside options. Second, we measure promotion speed using residualized grade progression: we regress current grade on the same lagged characteristics and time effects, and use the running average of the residual, lagged one year to mitigate endogeneity concerns. Workers with higher residuals advance more quickly than observationally similar peers. In each case, we classify workers as above or below the median of the relevant residualized measure. Appendix F provides the exact specifications.

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 9, 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.

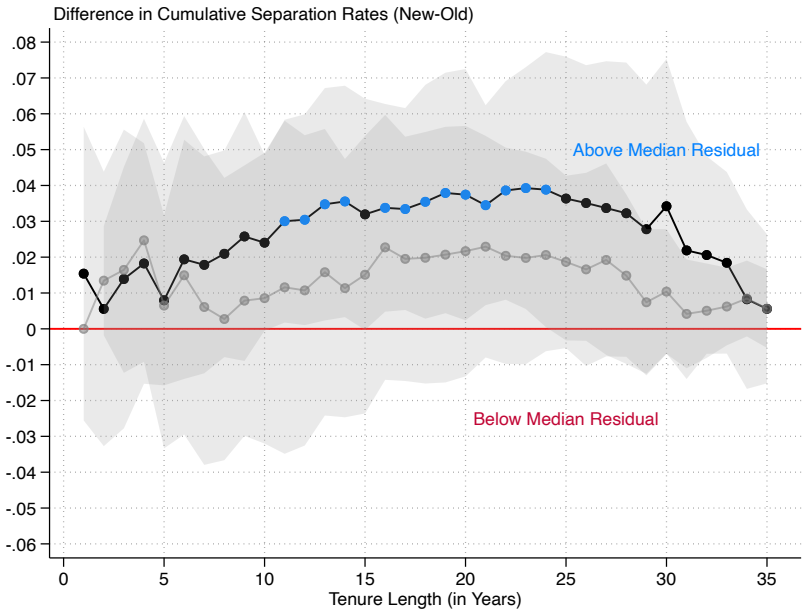
We estimate similar effects when we use the speed of promotions as our measure of productivity. When splitting the sample by lagged promotion speed, we find that workers who are promoted faster are 3 to 4 percentage points more likely to separate after about 10 years, while workers who are promoted slower are unaffected. We find similar results when using variables with a three year lag in Appendix F.1. 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.

Figure 9: 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.

9.3 Dynamic Selection

We quantify selective attrition by tracking average supplementary pay within entry cohorts over time. We normalize each cohort's mean supplementary pay to zero at entry and compare its evolution across the two systems in Figure 10. The paths are similar for the first five years, but then diverge: under the new system, mean supplementary pay grows more slowly, consistent with the disproportionate exit of higher-value workers. By about years 5 to 7, the average worker in the old system has roughly $251 more in supplementary pay, or about one to three months of typical experience-based raises. Since overall separation rates are also higher under the new system, these differences among stayers likely understate the full cumulative effect of differential attrition.

Taken together, the results suggest that replacing part of the old DB pension with more portable benefits induced disproportionately productive workers to leave federal employment, reducing the average quality of the remaining workforce within a cohort. More generally, changes in non-wage compensation can alter workforce composition by changing who it retains. 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 under-provide 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.

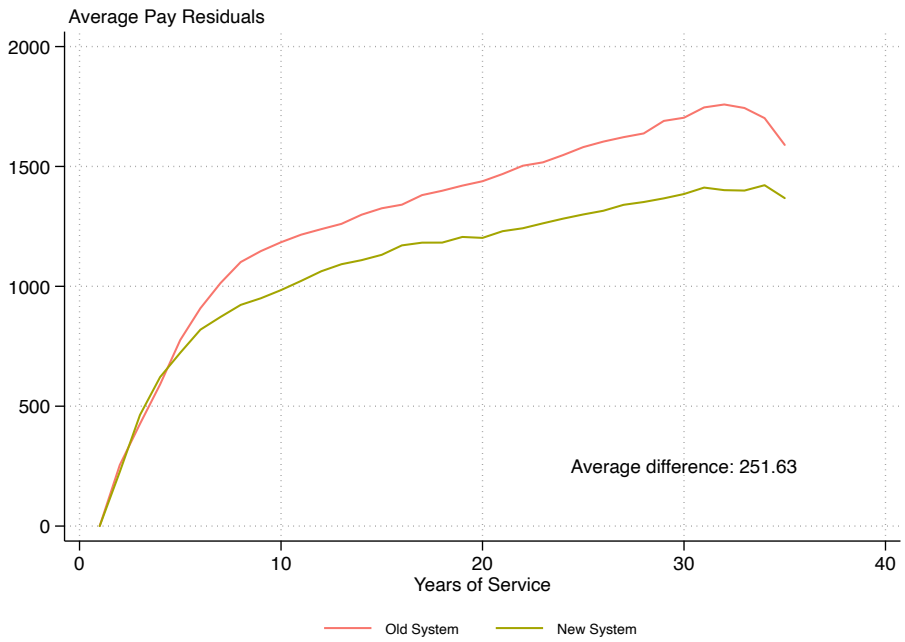
10 Conclusion

In this project, we use a regression discontinuity design to characterize firm-level labor supply responses to changes in av crucial component 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 back-loading 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. However, workers respond strongly to implicit taxes after retirement eligibility in DB pensions.

Our results also suggest that DB programs are advantageously selected and that reducing the pension genersoity drove valuable employees to seek opportunities elsewhere. The separation ef-

Figure 10: 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.

fects were strongest for more educated and higher-paid employees with better outside options. We additionally find that the results are concentrated among more productive workers.

An important implication of our findings is that employees placed substantially higher value on DB pensions than on DC benefits, underscoring the importance of benefit design in determining employee retention.

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 an evolving retirement landscape.

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Appendix Figures and Tables

Appendix A Comparing the Old and New System

A.1 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.

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%.[15] 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 4 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.

[15] 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 4: 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.

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 a specific employer. The full annuity formula can be found in Appendix A.2 and A.3, and a graphical example is shown in Appendix B.

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.[16] A retirement benefit is portable if the value of the benefits from a current 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;[17] however, workers under the old system were not eligible for employer matching.[18] 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.

[16] 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.

[17] 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.

[18] 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.

A.2 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%.

A.3 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:

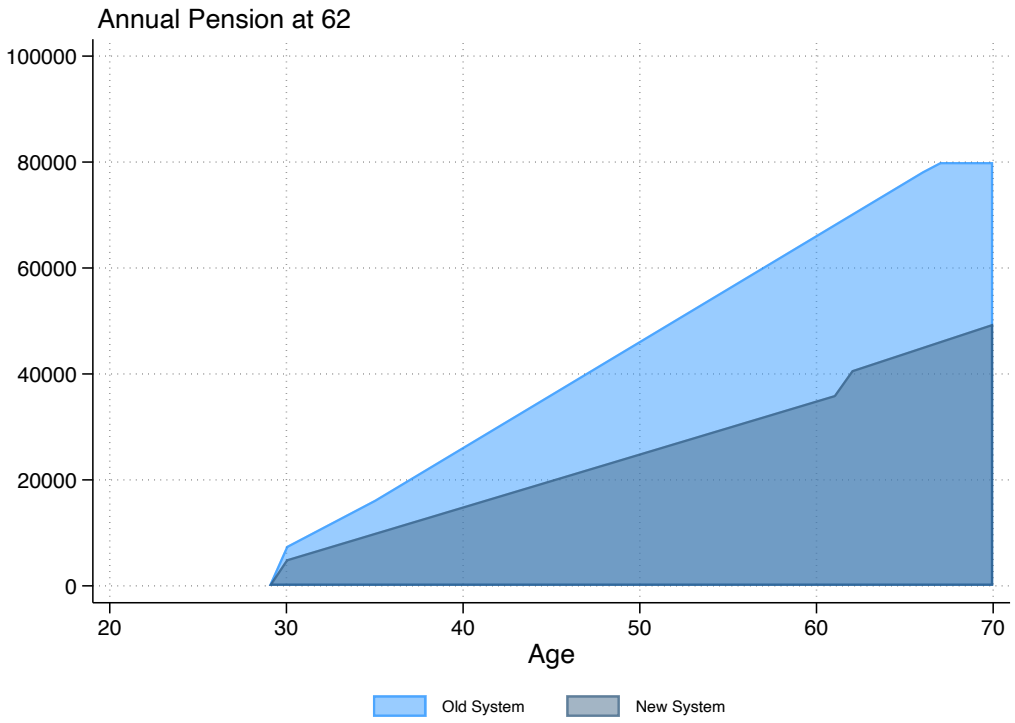
$$b_{it}^{FERS} = \underbrace{1\% \times h_{it} \times \delta_{it}}_{\text{basic benefit}} + \underbrace{\mathbb{1}\{t \geq 62 \wedge \delta_{it} \geq 20\}}_{\text{eligibility for extra benefits}} \times \underbrace{0.1\% \times h_{it} \times \delta_{it}}_{\text{extra 0.1\% bump}}$$

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 B 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 C Potential Benefits

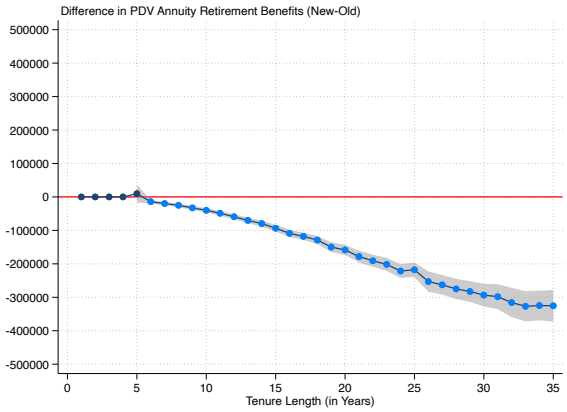
We illustrate the effects of the policy change on retirement benefits in Figure 12. This figure displays 35 separate regression discontinuity (RD) estimates of retirement benefit differentials across 35 years of tenure. For each year (from 1 to 35), we estimate the total retirement benefits under the 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 component falls sharply under the new system, such that 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.

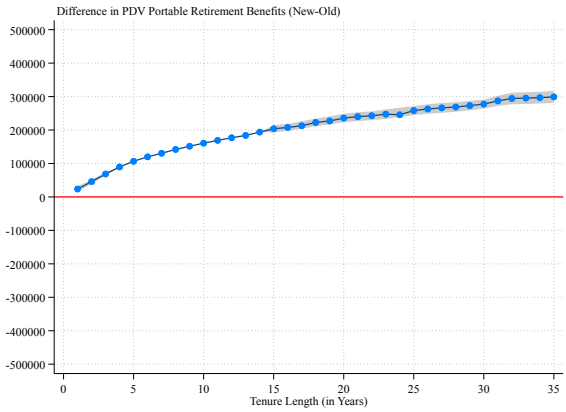
Taken together in Panel (C), portability reduces the back-loadedness the benefit profile by increas-

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

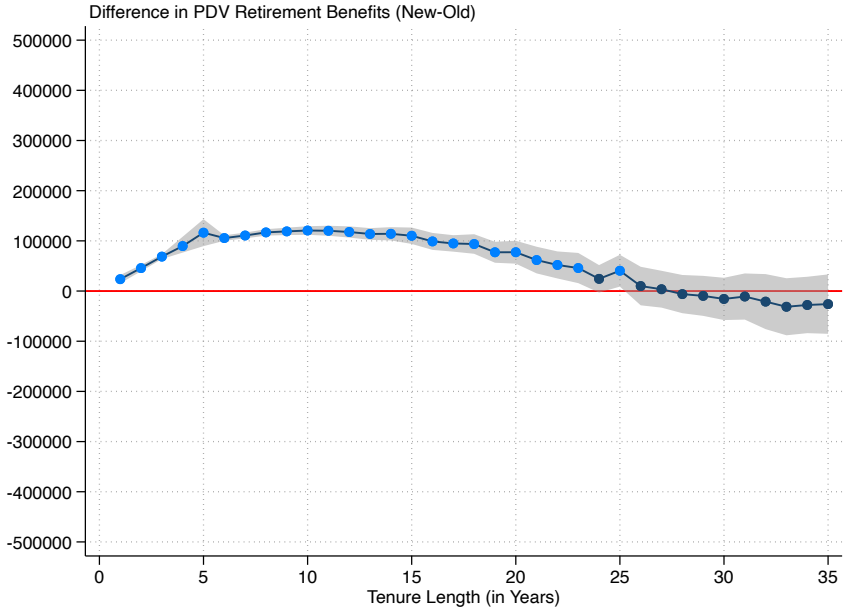
(a) Non-Portable Benefits



(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.

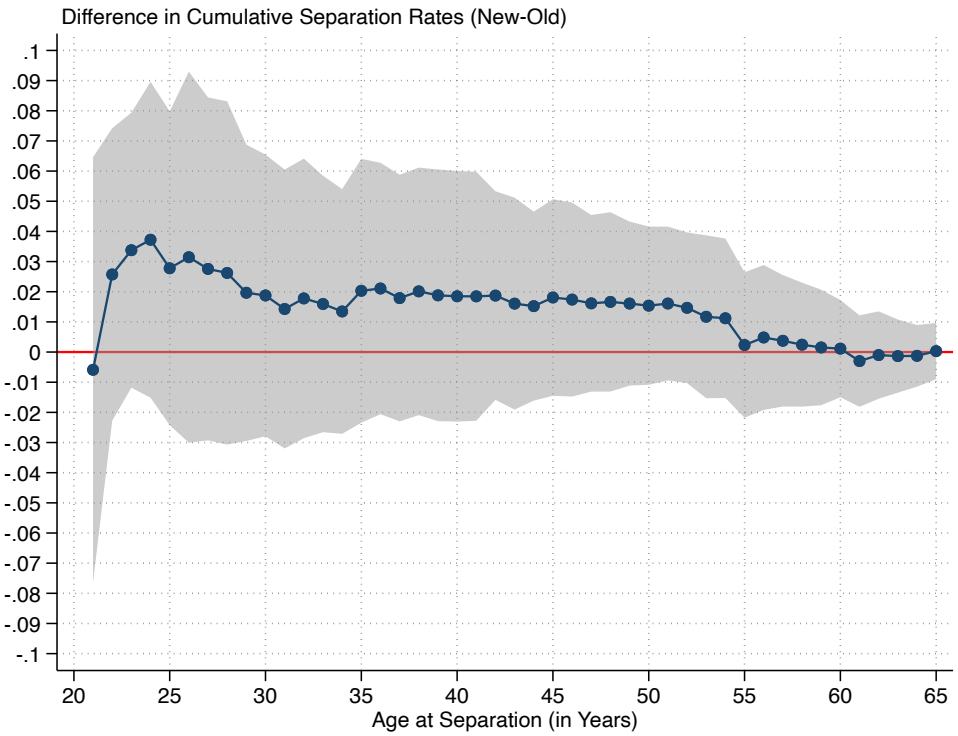
ing front-loaded benefits. New-system workers receive more early in the career, but the advantage diminishes with tenure. Beyond 25 years of tenure, the old system provides larger benefits, although

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.

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 D 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 E Savings Per Labor-Year Lost

To assess whether the change in retirement systems benefited the federal government, we express the policy's retirement savings in dollars per unit of labor lost. Specifically, we measure the "savings per labor-year lost," defined as the ratio of the increase in the government savings under the new system to the RD-estimated reduction in service years per worker at the cutoff, shown in Figure 4.

We construct the savings numerator from the differences in the government's retirement-related cost between the new and old system. This cost measure aggregates employer-side retirement compensation, including the defined-benefit component, the employer payroll tax for Social Security (6.2% of wages), and the employer contribution to the DC plan (1-5% of wages) where applicable. For the DB portion, we use OPM's estimates that the government pays approximately 29.6% of wages to the DB pension under the old system and 16% under the new system (Isaacs (2019)). A key input under the new system is the employer DC contribution rate, so we report results in (a) a low scenario with only the automatic 1% contribution and (b) a high scenario with a 5% contribution.

We further bound the savings using two additional assumptions on labor responses. For the lower bound, we assume labor supply is fixed, so we exclude any savings from leaving vacancies unfilled. The upper bound assumes attrition without replacement workers. Formally,

$$\text{Savings per labor-year lost} = \frac{(c_{old} - c_{new})\bar{w}\bar{L}}{l_{new-old}} + (1-\lambda)c_{new}l_{new-old}$$

where c_n is the per-person cost associated with the retirement system n; $\bar{w}$ is the average wage under the old system; $\bar{L}$ is the average service years under the old system; $l_{new-old}$ is the average tenure effect of the change in policy; and λ is an indicator for whether there are endogenous labor supply responses, which provide the upper and lower bound.

Appendix F Productive Workers

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:

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

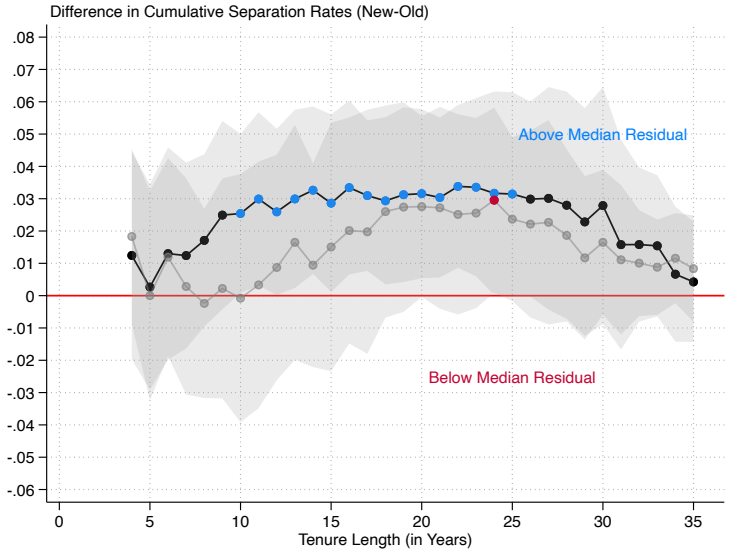
$$\text{promotion residual}_{i,t} = \frac{1}{t}\sum_{p=1}^{t}\left[grade_{i,p} - \hat{grade}_{i,p}\right]$$

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.

F.1 Robustness

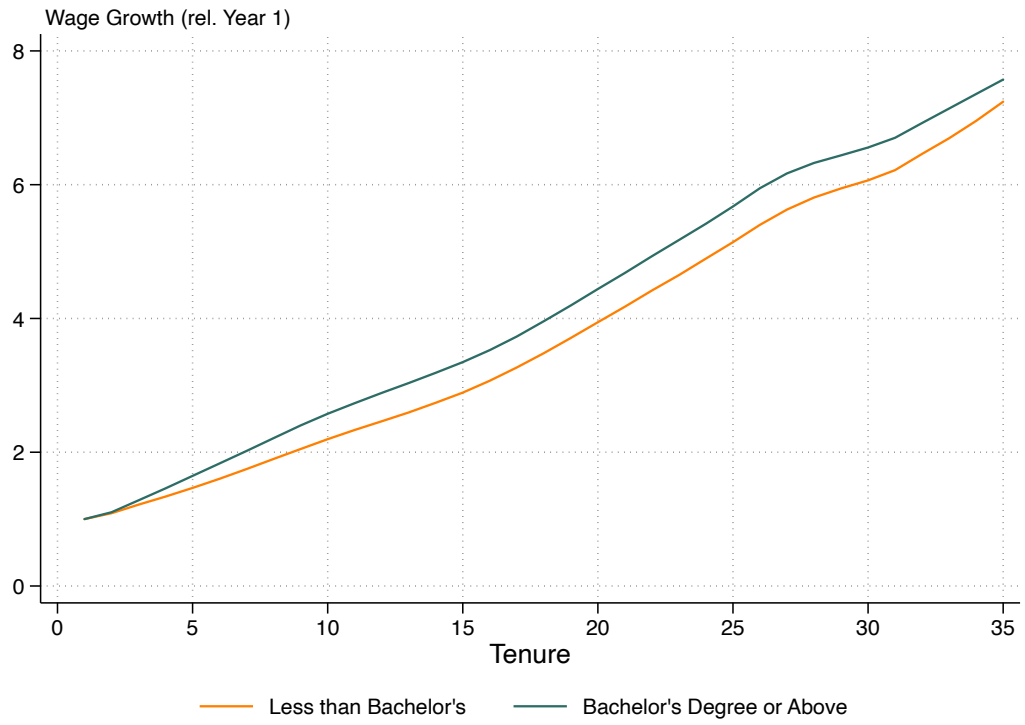
Figure 14: Difference in Cumulative Separations by Promotion Speed (3 Year Lag)



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 G 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 H Separation Event Studies

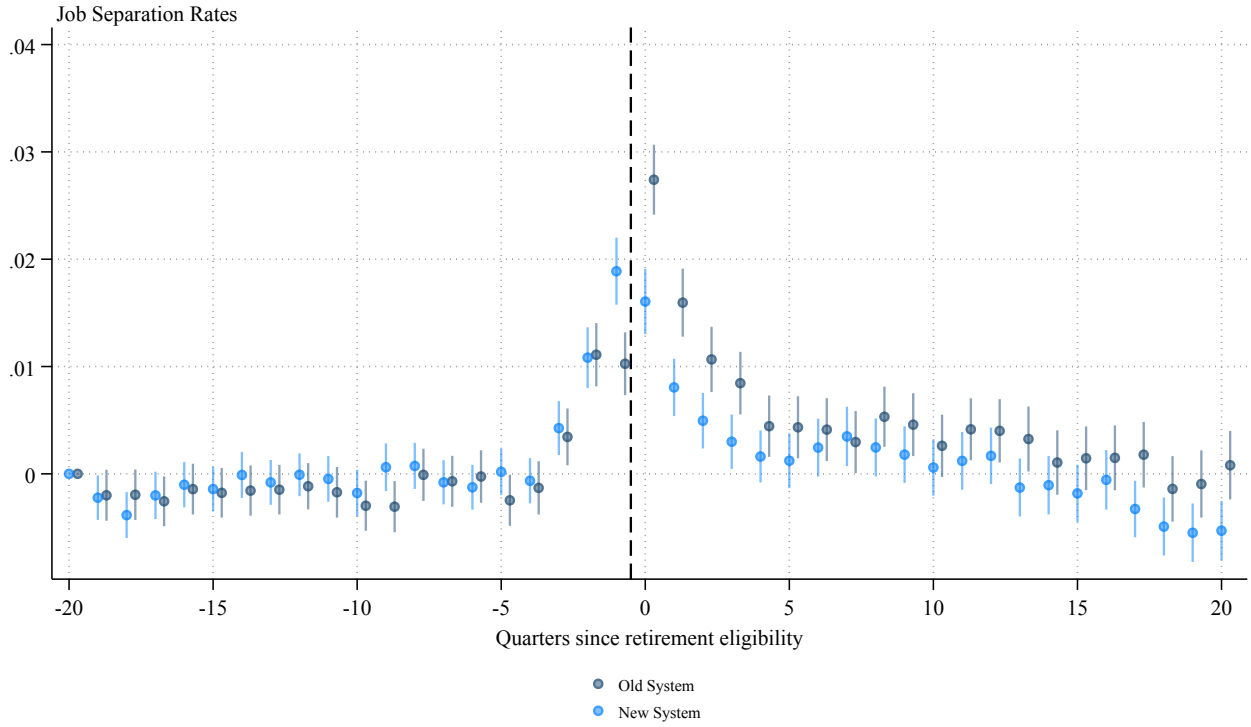
Using the variation in the annuity growth before and after retirement eligibility, we can utilize an event study to examine how labor supply responds to changes in financial incentives around full retirement eligibility:

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

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 H, which show similar but noisier effects.

Figure 16: Event study: separations around full retirement eligibility

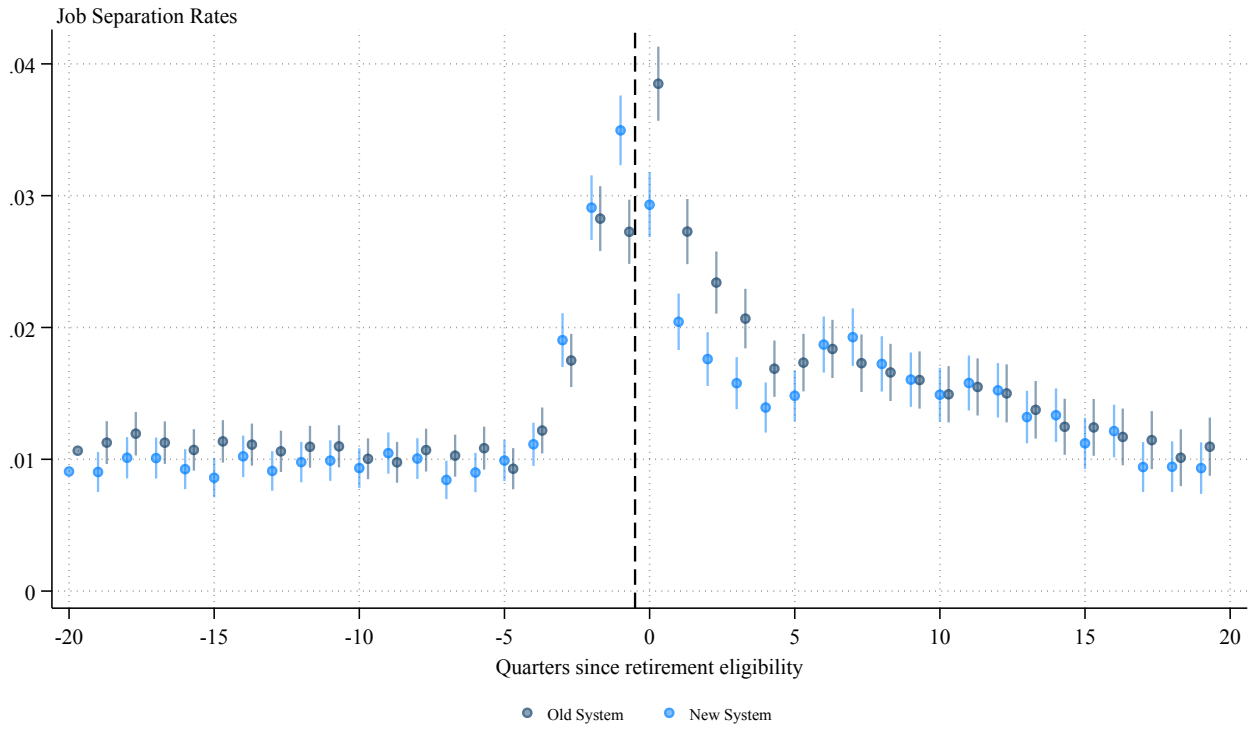


Note: This figure presents the event study coefficients provided in equation 2, for all workers who began between 1980-2000. The sample is restricted to workers who work within 5 years of their full retirement eligibility. The red vertical line signifies the time in which workers become eligible. The 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 I Early career workers

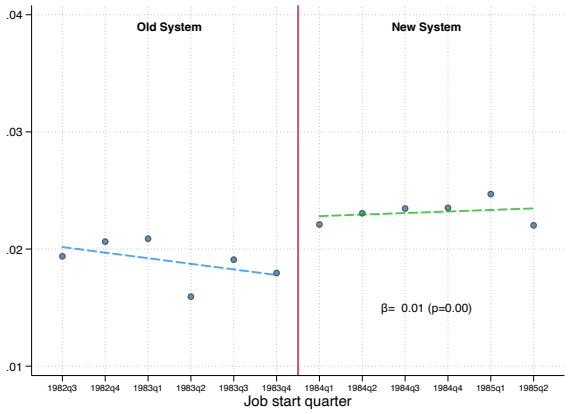
Table 5: Changes in Hiring Characteristics Around New System Announcement

	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)

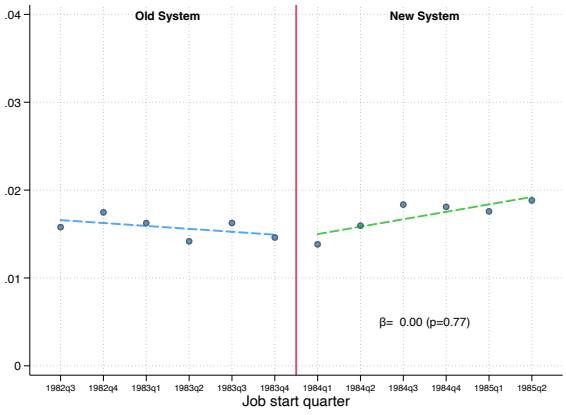
Note: This figure reports the RD coefficients that relate to the change in hiring characteristics after the announcement of the new system. The running variable is the quarter in which an employee begins federal government work, and the regression contains the six quarters before and after the announcement (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

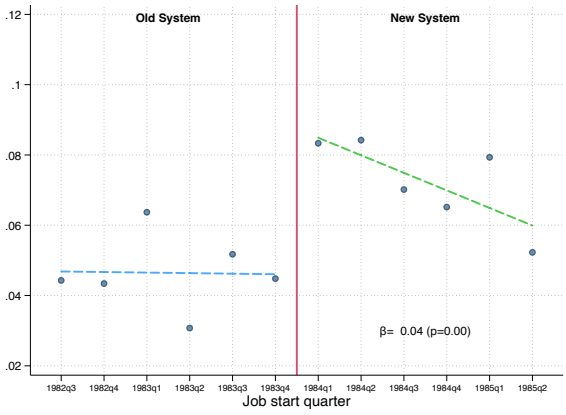
(a) All Workers



(b) Workers Eligible to Defer Only

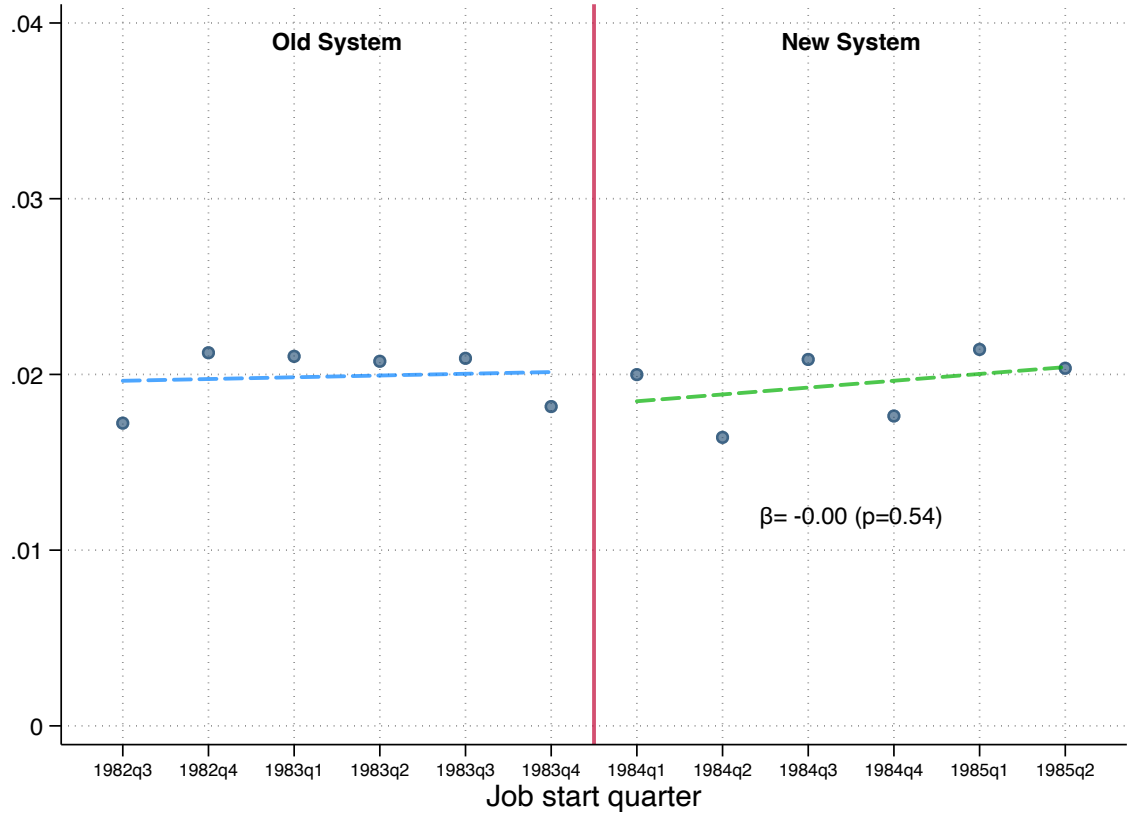


(c) Workers Eligible to Defer or Claim Early



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



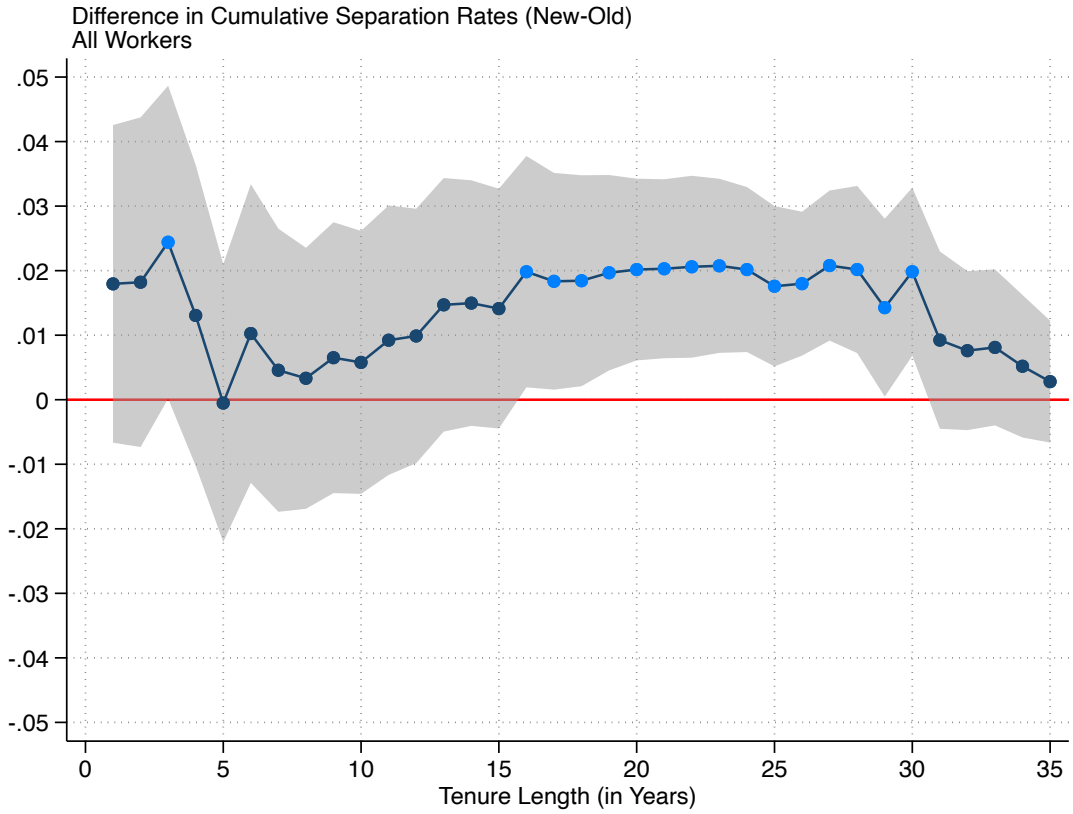
Note: This figure reports the RD outcomes for separating at 9 of tenure across the total sample, for each quarter around the 1984 policy change. The RD coefficients are reported as the β and p-values are given in parenthesis.

Appendix J Robustness of Main Results

J.1 Different RD Bandwidths

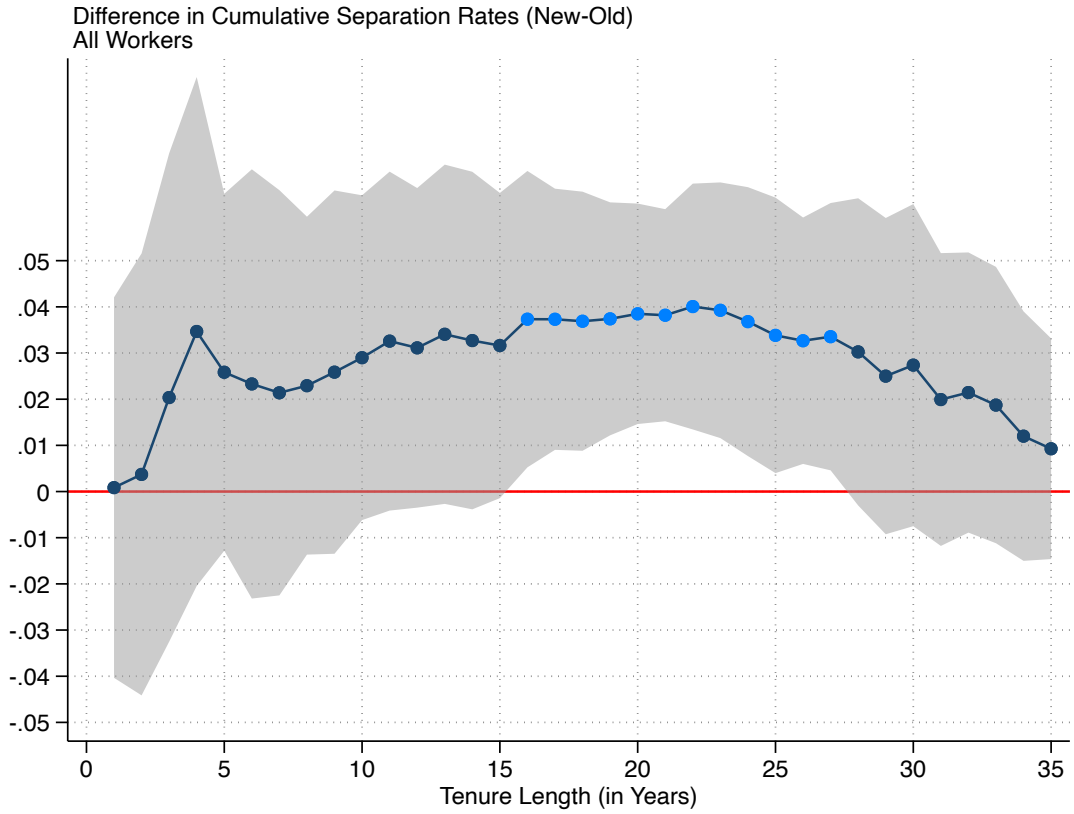
We test the sensitivity of the RD bandwidth. While the window in the primary analysis is determined by the institutional setting, we present estimates with both larger (10 quarters) and smaller (4 quarters) bandwidths. Across these different specifications, we observe results similar to our main analysis,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

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

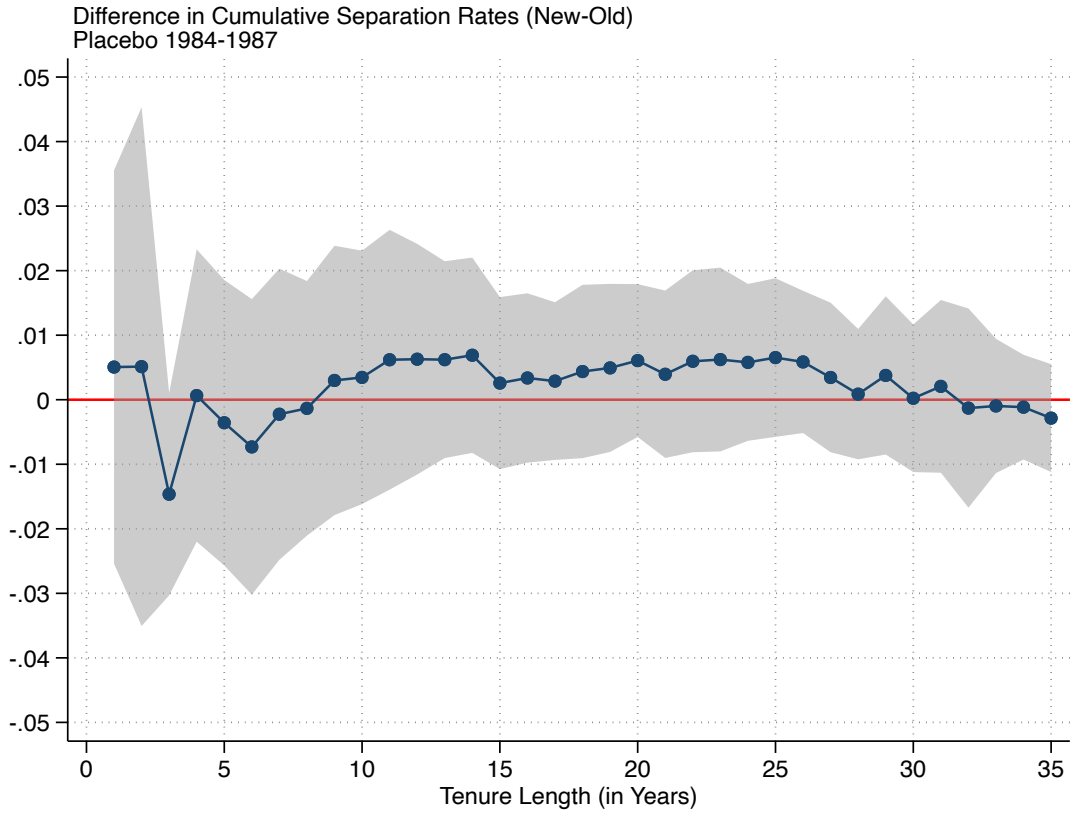


Note: This figure plots the RD coefficients, using 4 quarters before and after the policy change, on the cumulative separation rates for the tenure lengths in the x axis. Each point represents the difference in the cumulative separation rates between old system workers and new system workers. The 95%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

J.2 Placebo Test

We run our analysis on a placebo year to test whether tenure effects may be mechanical. We re-center our RD design around the second quarter of 1985, such that we can compare two cohorts of the same size as our baseline estimates, but who are both under the same retirement system prior to the announcement of the new system. We estimate null effects in our placebo specification.

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



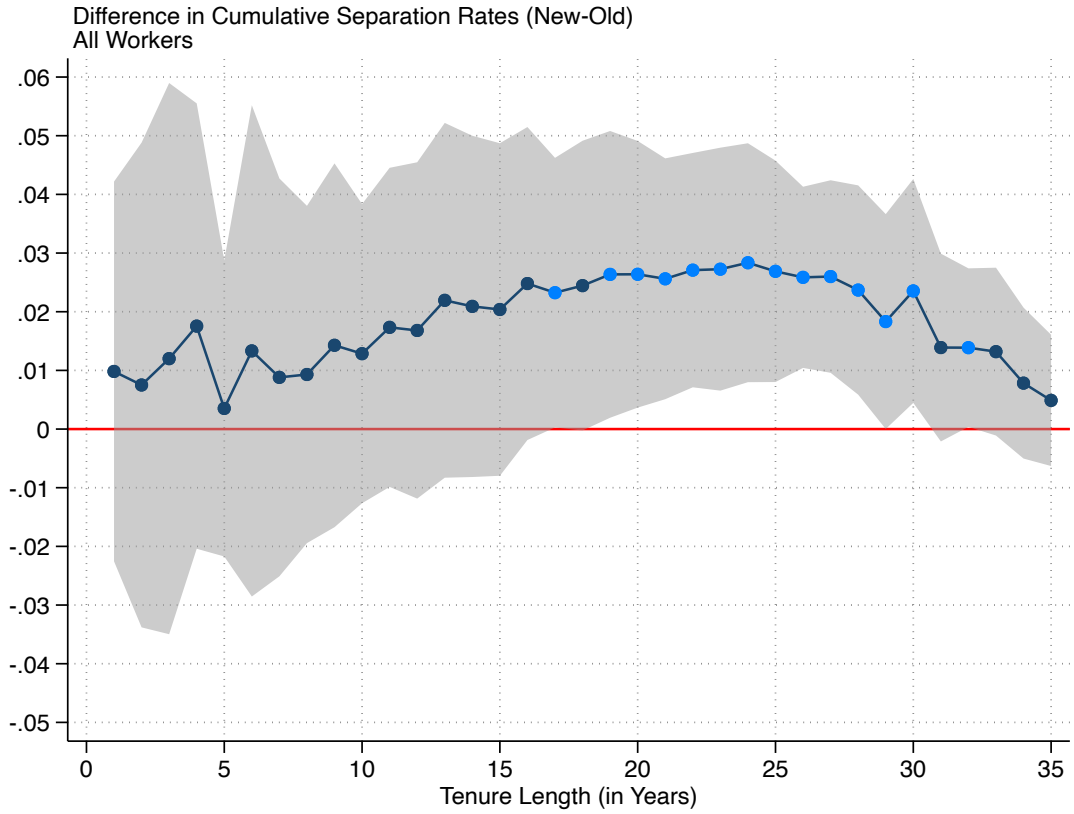
Note: This figure plots the RD coefficients of a placebo threshold (second quarter of 1985) on the cumulative separation rates for the tenure lengths in the x axis. Each point represents the difference in the cumulative separation rates between old system workers and new system workers. The 95% confidence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

J.3 Seasonal Effects

We control for seasonal variation. Hiring may follow seasonal patterns, stemming from job-specific hiring cycles or shifts in the applicant pool.[19] To account for this, we conduct a robustness check by residualizing our labor supply outcomes on quarter fixed effects before running the RD. Both the baseline specification and the fixed effects-adjusted estimates lead to very similar results.

[19]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.

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.

J.4 Donut Analysis

To address concerns that the timing of hires may have been influenced by uncertainty around the policy threshold–such as strategic hiring prior to the change in policy–we conduct a donut regression discontinuity design using more detailed personnel data that we can link to a subset of our sample. The underlying dataset is a subset of our main dataset, which includes precise hiring and separation dates of workers. For approximately 70% of the sample (over 68,000 employees), we can link a precise start date.

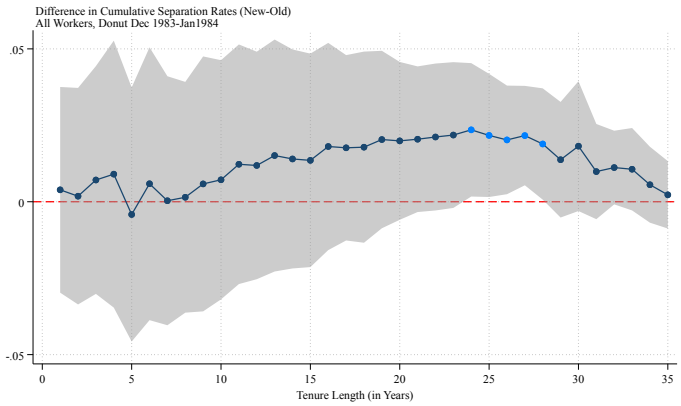
Upon examining this subsample, we observe a greater increase in December hires relative to January between 1983 and 1984, relative to surrounding years. To mitigate potential bias from this,

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.

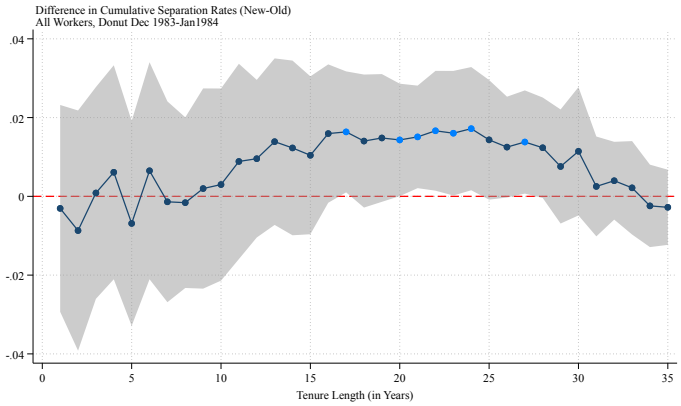
Our results are consistent with our main findings: employees under the new retirement system separate mid- to late-career at higher rates than those under the old retirement system. As expected with a smaller sample, the results are noisier, though we find statistically significant increases in separations for later career workers that are very similar in magnitude to our baseline specification.

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 K 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 6: 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. $*p < 0.1, **p < 0.05, ***p < 0.01$.