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DO DEFERRED BENEFIT CUTS FOR CURRENT EMPLOYEES INCREASE SEPARATION?

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Abstract

This study examines whether deferred benefit cuts affecting current public employees encourage mid-career teachers and civil servants to separate from their employers. The analysis takes advantage of a 2005 reform to the Employees' Retirement System of Rhode Island (ERSRI) that dramatically reduced the generosity of benefits for current workers. Importantly, the cuts applied only to ERSRI members who had not vested by June 30, 2005. High-tenure ERSRI members and municipal government employees in Rhode Island were unaffected. This sharp difference in benefit levels permits a triple-differences research design in which low-tenure ERSRI members are compared, before and after the reform, to high-tenure members, and to low- and high-tenure members of the Municipal Employees' Retirement System of Rhode Island. The results show that the benefit cut caused a 2.4-percentage-point increase in the rate of separation, implying an elasticity of employer-specific labor supply with respect to deferred benefits of 0.28. Although state employees were more sensitive to benefit cuts than teachers, the low elasticities for both groups suggest that the labor market for public employees may not be highly competitive.

Introduction

One-third of state and local defined benefit pensions are so financially troubled that government sponsors may soon need to reduce the benefits promised to current employees (Aubry, Crawford, and Wandrei 2018). Until recently, public pension reforms rarely affected current workers, since state constitutions and statutes traditionally entitle future retirees to the pension formula in place on their date of hire (Monahan 2010; and Munnell and Quinby 2012). Cuts for current workers became more common after the 2008 financial crisis, when courts around the country judged that pensions were crowding out vital government services like K-12 education and police protection (Cloud 2011; and Monahan 2017).[1] Since then, 17 states have reduced the post-retirement cost-of-living adjustments (COLA) earned by current workers, and cuts to promised annuity payments have been successfully legislated in two states and are under discussion in two more (Munnell et al. 2016).[2] At the same time, public sector employers are scaling back the generosity of their retiree health insurance (RHI) benefits as they grapple with rising health costs (Lutz and Sheiner 2014; The Pew Charitable Trusts and the McArthur Foundation 2016). Will these cuts to deferred benefits for current state and local government employees encourage workers to leave for the private sector, and what can workers' response to such cuts teach us about public labor markets generally?

This project takes advantage of a 2005 reform to the Employees' Retirement System of Rhode Island (ERSRI) that extended the normal retirement age (NRA), reduced the annual pension benefit, and limited post-retirement COLAs for current public school teachers and state government employees. Most teachers and state employees also lost access to subsidized RHI before age 65.[3] Importantly, the cuts applied only to ERSRI members who had not vested by June 30, 2005 (had fewer than 10 years of government service on that date). Vested ERSRI members and municipal government employees in Rhode Island were unaffected. This sharp difference in the level of benefits, based on tenure at a specific date, permits a triple-differences research design in which non-vested members of ERSRI are compared, before and after the

[1] Over the course of several court cases, a consensus view has also emerged that cost of living adjustments are less protected by state statutes than the core benefits described by plan documents when the employee was hired (Reinke 2011).

[2] Rhode Island cut core benefits for current workers in 2005, 2009, and 2011; Ohio followed suit in 2012. Similar reforms are being discussed in Kentucky and Colorado. Several municipalities are also considering similar measures or have already enacted them (most famously Detroit following its 2013 bankruptcy).

[3] Eligibility for subsidized RHI is tied to the pension's normal retirement age.

reform, to vested members and to all members of the Municipal Employees' Retirement System (MERS).[4]

Rhode Island is an excellent setting for the analysis for both conceptual and pragmatic reasons. Substantively, it was the first state government to enact major pension cuts for current workers. Practically, data for the analysis was readily available as ERSRI provided comprehensive personnel records of state and local government employees (except police officers and firefighters) between 2003 and 2017. Importantly, the data show that Rhode Island's public workforce seems representative of state and local governments across the country, so that lessons learned might translate to future pension reforms in other settings.[5]

To generalize the findings from Rhode Island's specific reform, the analysis scales the effect of the cut by the present value of benefits lost, arriving at an estimate of the separation response to a dollar change in deferred compensation. Specifically, the scaling procedure calculates "peak benefit wealth" for every employee in the data, which represents the maximum present value of benefits that an employee could earn given his current earnings trajectory.[6] Although this calculation follows a long literature, the current context requires a methodological innovation: including employer contributions to RHI in the definition of peak wealth.[7] For each employee, the magnitude of the cut equals the difference between pre-reform peak wealth and post-reform wealth assuming that the employee separates at pre-reform peak tenure.

The results show that the reform caused an immediate 2.4-percentage-point increase in the rate of separation, corresponding to a 12-percent increase in the baseline separation rate. For a typical non-vested member of ERSRI, the reform decreased lifetime expected present value of deferred benefits by 43 percent.[8] Hence, the results imply an employer-specific elasticity of

[4] The sharp discontinuity in exposure to the reform at 10 years of tenure might seem to lend itself to a regression discontinuity design. However, workers with *nearly* 10 years of tenure face strong incentives to remain in government service for a year or two more, even in the face of substantial benefit cuts, in order to vest in their pension, however reduced it may be. Consequently, workers just under and just over 10 years of tenure are not very comparable in their separation probabilities at baseline.

[5] This point will be discussed further in the background section.

[6] This peak arises because, upon attaining eligibility for claiming benefits, every year of continued work involves a forfeiture of a year's worth of benefits. Thus, the typical worker faces a lifetime-benefit-maximizing tenure.

[7] For examples of peak-wealth analyses that do not require accounting for RHI benefits see, for example, Coile and Gruber (2007); Costrell and McGee (2010); and Ni and Podgursky (2016).

[8] In 2005, Rhode Island's actuaries predicted that the reform would reduce the present value of future pension benefits for active members by $243 million (ERSRI Actuarial Valuation Report 2004), corresponding to a 48 percent reduction in lifetime benefits per employee, on average. That estimate by the actuaries was very close to what is yielded by the current peak wealth calculation.

labor supply with regard to deferred benefits of 0.28. This elasticity is consistent with a large literature on the wage elasticity of labor supply, but is somewhat higher than the elasticity found by a growing literature on teacher pensions.[9]

Consistent with expectations and past literature, teachers in Rhode Island were less responsive to the benefit cut than other occupations. Whereas general state employees were 4 percentage points more likely to separate due to the pension cut (a 19-percent increase in the baseline rate), teachers were only 1.7 percentage points more likely to separate (a 9-percent increase), and the difference between teachers and general state employees is statistically significant. Scaling by dollars of benefits lost permits the analysis to rule out that these differential effects are due to treatment intensity; teachers display an elasticity of separation of 0.22, while other state workers are twice as elastic, at 0.45. This finding implies that teachers' labor responses to benefit cuts may not generalize to other state and local occupations.

These results have broader implications for the competitiveness of public sector labor markets, and can be applied directly in cost-benefit analyses of public pension and RHI reforms.[10] Broadly, the analysis suggests that the labor market for public employees is far from perfectly competitive. Although state employees were more sensitive to benefit cuts than teachers, the elasticity of separation for all occupations was less than unitary, and decidedly less than the infinite elasticity that characterizes the competitive benchmark.[11] This result contributes to a growing body of evidence showing that certain labor markets behave as if employers face little competition, such as the markets for minimum-wage workers, nurses, teachers, and software engineers in Silicon Valley (Belman and Wolfson 2014; Council of Economic Advisors 2016; Merrifield 1999; Ransom and Sims 2010; and Staiger, Spetz, and Phibbs 2010).

Because Rhode Island is a small state embedded in a larger regional labor market, it likely provides an upper bound on the employer-specific elasticity of labor with respect to deferred benefits that other public employers might face. Whereas public employees in larger

[9] Chetty et al. (2011) and Peterman (2016) survey the literature on wage elasticities and place most estimates around 0.3. Fitzpatrick (2015) and Koedel and Xiang (2017) suggest that teachers are much less responsive to their pensions than to wages. The next section will review the literature in detail.

[10] The increase in separation due to the reform likely reflects a combination of income and substitution effects, as well as new information about Rhode Island's capacity to pay promised pensions, and feelings of spite.

[11] For a detailed discussion of monopsonistic labor markets see Ashenfelter, Farber, and Ransom (2010). A small elasticity may also reflect other factors, such as a low valuation of deferred compensation (as in Fitzpatrick 2015). However, such preference characteristics can only aggravate existing frictions in the market, and cannot on their own explain an inelastic employer-specific labor elasticity.

states may only be able to find substitutable employers by moving large distances (often to another state), many Rhode Island residents already commute to neighboring states for work. Therefore, public employees in Rhode Island can more easily respond to benefit cuts by taking comparable jobs elsewhere.

On the policy side, the results of this paper combined with prior literature on turnover costs imply that Rhode Island's benefit cut caused a one-time increase in direct costs of between $1.8 million and $8.1 million – small in magnitude relative to the pension savings. However, since government salaries did not compensate for lost pension benefits, highly skilled employees – such as teachers, nurses, and lawyers – may have selected out of public service. How the loss of skilled workers affects government productivity is difficult to quantify, but may prove important.

The remainder of this paper proceeds as follows. The next section provides an overview of related literature. The third section describes Rhode Island's history of pension reforms and details the natural experiment that occurred in 2005. The fourth section introduces the data and empirical methodology. The fifth section presents empirical results. The final section concludes that governments contemplating pension cuts should be prepared for moderate disruptions to their workforce, underscoring the market power government employers possess, particularly with respect to teachers.

Literature Review

Despite the increasing likelihood of pension and RHI reforms for current public sector workers, how benefit cuts affect employment decisions has so far been unanswered. Most studies of the public sector labor market focus on older workers' decisions to retire, with a particular emphasis on K-12 teachers. These studies rely either on structural models relating the probability of retirement to the pension accrual formula (Costrell and Podgursky 2009; Koedel et al. 2013; Kong et al. 2018; Ni and Podgursky 2017) or on natural experiments when benefits were suddenly enhanced during the 1990s (Brown 2013; and Fitzpatrick and Lovenheim 2014). Like similar literatures on private sector pensions and Social Security, these analyses find that

retirement spikes around the ages that teachers become eligible for normal and early retirement.[12] A similarly broad literature examines the impact of RHI on retirement behavior.[13]

Yet, 60 percent of state and local government employees were under age 50 in 2017, and therefore excluded from this growing literature on retirement (U.S. Census Bureau 2017a). Pension cuts should make working for the government a less attractive option relative to other employment, encouraging some mid-career employees to leave for the private sector. The magnitude of this outflow is not obvious, since workers may heavily discount future benefits and thus not be very responsive to cuts that will affect them far in the future (as implied by Fitzpatrick 2015). Furthermore, workers may not feel that other employers are close substitutes for government work, because of geographic preferences, a desire for public service, or other personal preferences (e.g., Merrifield 1999; Ransom and Sims 2010; and Staiger, Spetz, and Phibbs 2010).

To date, the most consistent predictions about how mid-career workers will likely respond to benefit cuts come from structural models that simulate behavior. These models suggest that mid-career teachers would respond modestly to changes in retirement ages, benefit multipliers, and COLAs (Costrell and McGee 2010; and Knapp et al. 2016). However, it is difficult to determine whether these estimates would play out in reality without exploiting a natural experiment and, to our knowledge, no one has taken this route.

Koedel and Xiang (2017) examine a benefit *enhancement* for teachers in the 1990s and are unable to detect a change in retention for mid-career employees. Two considerations, however, suggest caution when extrapolating from this study to benefit cuts for public sector workers more broadly. First, loss-averse public employees may have a stronger reaction to deferred benefit cuts than to enhancements, particularly if they view the reform as a harbinger of future compensation reductions. Second, the labor supply of K-12 teachers – who comprise only 30 percent of the state and local workforce nationwide – is likely to be less elastic than that of other public sector occupations because teachers have fewer private sector options and must

[12] For example, see Behaghel and Blau (2012); Coile and Gruber (2007); and Stock and Wise (1990). Some evidence also suggests that older teachers may be more responsive to the normal and early retirement ages in their defined benefit pensions than to other plan parameters with similar effects on lifetime wealth. See, for example, Brown (2013) and Ni and Podgursky (2017).

[13] For examples see Leiserson (2013); Nyce et al. (2013); Shoven and Slavov (2014); and Wettstein (2019).

often leave the state in order to switch pensions while remaining in education.[14] Looking beyond K-12 education, Goda, Jones, and Manchester (2017) explore how mid-career faculty and staff at a public university respond to a new defined contribution plan, but argue that this reform could have been viewed as a benefit enhancement, rather than a cut, because the new plan is portable across employers.[15]

Meanwhile, studies of private sector firms have long found a large negative correlation between the presence of fringe benefits and employee separations (see, for example, Alan, Clark, and McDermed 1993; Dale-Olsen 2006; Frazis and Lowenstein 2013; Gustman and Steinmeier 1993; Madrian 1994; Mitchell 1982 and 1983; and Rabe 2007). However, much of this literature cannot fully account for the potential of workers with high quit propensities to sort into firms with fewer benefits. Looking beyond employer pensions, Gelber, Isen, and Song (2016) evaluate how older workers reacted to the Social Security "notch" – a similar reform to the Rhode Island pension cut, but in a very different national setting – and find an elasticity of labor force participation of 0.7.[16] Of course, labor force participation is a very different object than the elasticity of labor supply faced by a given employer.

Background on the 2005 Rhode Island Benefit Reform

Despite being a small state, Rhode Island hosted 40 defined benefit plans for public employees in 2016. K-12 teachers (who are employed by local school districts), general state government employees, nurses in state hospitals, and corrections officers each had their own plans within the Employees' Retirement System (ERSRI). Additionally, state police officers had their own system, and 116 local government units voluntarily participated in the state-administered Municipal Employees' Retirement System (MERS).[17] Rhode Island's larger cities and towns administered the remaining 34 plans (U.S. Census Bureau 2017c).[18] This study

[14] U.S. Census Bureau (2017b). Most teachers participate in large state-administered pensions that set benefit levels equally across all school districts (*Public Plans Database* 2017). A few large districts administer their own pensions, such as the Teachers' Pension and Retirement Fund of Chicago and the Teachers' Retirement System of the City of New York.
[15] A related strand of literature estimates how retention changes after governments implement a defined contribution plan for new hires only (Clark et al. 2016; and Quinby 2018).
[16] How the generosity of Social Security benefits affects labor supply has historically proven hard to pin down. See Feldstein and Liebman (2002) and Krueger and Meyer (2002) for detailed reviews of this literature.
[17] Municipal Employees' Retirement System (2016).
[18] The local pensions often cover just police officers and firefighters, with other municipal employees participating in MERS.

focuses on the two largest state-administered systems, ERSRI and MERS.[19] The members of these two retirement systems resemble their counterparts across the country. A simple comparison of the state and local sectors in Rhode Island with those in other states, based on the 2017 *Current Population Survey*, reveals similar demographic characteristics, although teachers make up a larger share, and minorities a smaller share, of the state and local government workforce in Rhode Island than in other states (see Table 1).[20]

Due to persistent underfunding in ERSRI, Rhode Island has an unusual history of benefit reductions, even for current employees. The first set of cuts occurred in 2005 (Article 7 Sub. A), when ERSRI and MERS were 59 percent and 93 percent funded, respectively (*Public Plans Database* 2004). This legislation targeted ERSRI members who had not yet vested in the pension, and thus did not yet have a claim to future benefits, by extending the NRA, reducing the annual benefit, and cutting the COLA. The second set of cuts for current employees took place in 2009 (Article 7 Sub. B), extending the NRA and reducing the annual benefit of ERSRI members who had been unaffected by the prior reform in 2005, but who were not yet eligible to retire in 2009. Finally, in 2011, the Rhode Island Retirement Security Act (RIRSA) fundamentally altered the structure of benefits for all ERSRI and MERS members by dramatically cutting the defined benefit pension and adding a defined contribution component.

The remainder of this study focuses on the 2005 reform. The Rhode Island state legislature passed this benefit cut in conjunction with the annual appropriations bill, which was signed by Governor Donald Carcieri on June 30, 2005.[21] Public employees learned about the reform during fiscal year 2005; the reform went into effect at the beginning of fiscal year 2006. Hence, the proposed reform could have altered labor supply as early as 2005, with the full effects observed in 2006 after the reform passed and was fully communicated to ERSRI members.

The specifics of the 2005 reform are as follows: it increased the NRA from 60 to 65; decreased the benefit multiplier; and reduced the COLA from 3 percent compounded to the CPI

[19] Within ERSRI, the study further focuses on teachers and general state employees because nurses and corrections officers comprise a small fraction of plan membership but receive slightly different pension benefits.
[20] Rhode Island's small land mass also sets it apart from other states and forces it to compete with Connecticut and Massachusetts. It is interesting to note, however, that many large public employers on the East Coast have pension funding difficulties as great as Rhode Island, including the states of Connecticut, Massachusetts, and New Jersey, as well as the cities of New York and Philadelphia (*Public Plans Database* 2017).
[21] The last day of fiscal year 2005.

or less, commencing on the third anniversary of retirement.[22] Importantly, the benefit cuts applied only to teachers and state employees who were not yet vested in the pension system on June 30, 2005, meaning that they had fewer than 10 years of government tenure in Rhode Island. Vested teachers and state employees were unaffected by the reform, as were all members of the well-funded MERS.[23]

These changes significantly reduced the present value of future benefits for the affected workers. In 2004, Rhode Island's actuaries reproduced their 2003 valuation report using the new benefit rules in order to recalculate the state government's contribution requirements in 2005.[24] The actuaries estimated a $251 million decrease in the present value of future retirement benefits for active members of ERSRI, but an $8 million increase in the present value of disability benefits, for a total savings of $243 million.[25]

To quantify the value of the lost pension benefits from an employee's perspective, this analysis follows an approach similar to the "peak wealth" methodology commonly used in the existing literature on Social Security and defined benefit pensions.[26] Peak wealth is defined as the maximum *potential* present value of future pension benefits, where maximum potential is a function of age at hire and tenure at separation. Intuitively, employees accrue benefits with each additional year of tenure. Once they reach the pension's retirement age, they forego benefit payments in order to keep working. Consequently, accrued pension wealth rises with tenure until the retirement age, at which point wealth typically peaks and then starts to decline as benefits foregone become more valuable than further accruals.

The analysis estimates peak wealth for public employees in Rhode Island by coding the provisions of each employee's pension plan (which vary by occupation); assuming future earnings trajectories, economic conditions, and mortality risk; and then calculating the expected

[22] Appendix Table A1 details the benefit provisions of both ERSRI and MERS. Recall that defined benefit pensions calculate annual benefits as *Final Average Salary * Benefit Multiplier * Years of Tenure*. ERSRI members with 28 years of tenure could retire at any age before the reform; after the reform, members with 29 years of tenure could retire at age 59.

[23] MERS members were always allowed to retire earlier than ERSRI members– at age 58 versus 60 – but received a lower stipend and were not guaranteed an equally generous COLA in retirement. See Appendix Table A1 for details.

[24] See ERSRI Actuarial Valuation Report (2004). Government sponsors contribute annually to the pension system in order to prefund future benefits. State contributions to Rhode Island's system are set two years in advance to facilitate budgeting.

[25] Before the reform, the unfunded liability in ERSRI was approximately $3.1 billion.

[26] See, for example, Coile and Gruber (2007); Costrell and McGee (2010); and Ni and Podgursky (2016).

present value of accrued benefits at every potential future tenure. To assess the loss of benefits due to the reform, the accrued wealth of each employee is also calculated *under the post-reform benefit structure* at the tenure at which peak wealth was attained *under the pre-reform benefit structure*; this procedure sidesteps the question of the relative disutility of public-sector work relative to the outside option.[27] The details of this calculation are described in Appendix B.

Although the 2005 reform did not make any direct changes to the state's RHI plan, eligibility for subsidized insurance was tied to the pension's NRA. Specifically, in 2005, Rhode Island maintained two retiree health programs for ERSRI members (State of RI Retiree Health Care Benefits Plan 2005). The first allowed retirees under age 65 and their spouses to access the state's health plan for active workers.[28] Although teachers were eligible to participate in this program, most received RHI directly from their school districts. The second program subsidized insurance premiums for the duration of retirement, with the amount of the subsidy dependent on age at retirement and years of tenure in the government.[29] Vested employees who separated without immediately receiving pension benefits had to wait until their NRA to access either of the state's RHI programs.[30] Hence, some employees affected by the pension reform also lost five years of subsidized insurance.

Many teachers may have fared better on this front than their colleagues in state government. The cut to benefits implicit in the increased eligibility age for RHI was smaller for teachers, on average, because some school districts did not have as a generous an RHI subsidy to begin with, while others set RHI eligibility at a fixed age independent of the pension's NRA. Research as shown that employees' separation decisions can be quite responsive to the availability of RHI.[31] For this reason, teachers may display a smaller reduced-form response to the pension reform than their state colleagues. To account for this facet of the benefit cut, the peak wealth calculation models the lifetime discounted value of employer contributions to RHI alongside the pension benefits.[32] Coding the district-level rules governing RHI eligibility proved

[27] Naturally, for employees unaffected by the reform, the pre- and post-reform benefits and peak wealth are identical by definition.
[28] The program's cut-off is age 65, when retirees were expected to go on Medicare. A minority of employees without Medicare coverage (mostly teachers) remained in the state health plan after age 65.
[29] This subsidy only applied to state government employees, not teachers. Teachers nevertheless could, and often did, receive a subsidy with a similar structure from their school district rather than from the state.
[30] A 2008 reform of the RHI program dramatically reduced the generosity of benefits.
[31] See, for example, Leiserson (2013); Nyce et al. (2013); Shoven and Slavov (2014); and Wettstein (2019).
[32] The methodology is similar to that described above for pension wealth, and is described more fully in Appendix B.

challenging, since school districts are not required to publicly disclose these provisions in a consistent manner. The analysis therefore tests two extreme scenarios for teachers: that their RHI eligibility was fully linked to their pension's NRA, and that is was not linked at all. To be conservative, this latter case serves as the benchmark elasticity reported throughout the paper because the estimated elasticity of separation is largest when the magnitude of the benefit cut is smallest.

The peak wealth modeling described above reveals that Rhode Island's 2005 reform constituted a very large cut to accrued benefits. Indeed, the average non-vested employee saw a $120,000 decline in the present value of lifetime benefits (a 43-percent cut).[33] This was composed of a $102,000 cut for state employees (from a pre-reform base of $238,000), and a $130,000 cut for teachers (from a base of $299,000), a 43-percent cut for both groups.[34]

It is important to note that, besides the pension reform, workforce and compensation policies do not appear to have changed suddenly in 2005. In particular, one might be worried that general budgetary stress led the state government to reduce wages and benefits in a way that particularly hurt short-tenure employees, confounding the empirical analysis despite the presence of control groups. Indeed, the growth of total revenue slowed in the years leading up to pension reform, from 6.7 percent in fiscal year 2003 to 6.2 percent in 2004 and 4.9 percent in 2005. Nevertheless, neither wages nor workforce size show discontinuous changes around the time of the reform.[35] It seems more likely that the reform was a targeted attempt to reign in ERSRI's large unfunded liabilities. The next section describes the data and quasi-experimental strategy used to estimate the effect of these benefit cuts.

Data and Methodology

As mentioned previously, the 2005 pension reform reduced benefits only for employees who had not yet vested on June 30, 2005. The empirical analysis exploits this sharp discontinuity in benefit levels, based on years of service, to compare the separation of affected employees to that of their unaffected but otherwise similar colleagues. ERSRI facilitated access

[33] Under the baseline assumption that teacher RHI claiming was not linked to the pension's NRA.
[34] Assuming the other extreme scenario for teachers, that their RHI eligibility is fully linked to their NRA, yields a 50 percent benefit cut for all workers on average, composed of the same cut for non-teachers and a larger cut for teachers of $162,000 (54 percent of their counterfactual benefit).
[35] Specifically, empirical analysis in Appendix Table D1 shows a statistically precise zero effect of the reform on salaries. The results section discusses this analysis in more detail.

to a detailed dataset of employment records for all ERSRI and MERS members between 2003 and 2017.[36] For each employee in each year, the records document: first and last name, employment status (active, inactive vested, or retired), employment status last year, date of hire, date of separation, date of benefit claiming (if applicable), pension plan name (ERSRI or MERS), employer, years of service, gender, birth year, broad occupation category, annual salary, and annual salary last year.[37]

The empirical analysis ultimately follows four groups of workers who were on government payroll in 2003 and who choose each year after that whether to remain in their job. The treated group consists of ERSRI members whose tenure in 2003 disqualified them from vesting before 2005 – i.e. those with fewer than eight years of tenure in 2003.[38] The analysis compares these treated employees to three different control groups unaffected by the reforms: 1) members of ERSRI who could potentially vest by 2005 (those with at least eight years of tenure in 2003); 2) members of MERS who will not vest by 2005; and 3) members of MERS who could potentially vest by 2005.

The empirical strategy relies on a dynamic triple-differences research design. Intuitively, the design first performs a difference-in-differences (DID) analysis of separation behavior in ERSRI, comparing the treated and control groups before and after the 2005 benefit cut. Since the strong private sector labor market at the time of the benefit cut could have disproportionately encouraged less-attached government workers to seek outside opportunities, the design also conducts a DID analysis of separation from MERS, which did not cut benefits for any of its workers. The DID results for MERS estimate how macroeconomic changes during the analysis period differentially affected employees with different tenures, allowing these differential trends to be netted out of the DID for ERSRI.

The difference between the DID results for ERSRI and those for MERS reflects the effect of the benefit cut on separation.[39] This triple-differences design also has the advantage that it

[36] Personnel data prior to 2003 are maintained in a different file format that is difficult to link with later records.
[37] Unfortunately, the employment records made available do not contain an employee-specific numerical identifier that remains constant over time. Hence, the first task in this study was to construct the required identifier based on time-invariant demographic characteristics. A detailed description of the matching procedure is described in Appendix C.
[38] Assigning treated status based on tenure in 2003 ensures that workers do not endogenously sort into the control group or out of the sample in response to the reform.
[39] An alternate approach would perform the DID analysis only on non-vested ERSRI and MERS employees. Unfortunately, this approach still shows evidence of pre-trends, likely due to the different occupational mix of the two pensions.

performs an implicit placebo test on a group that was legally unaffected by the reform. Thus, the DID analysis of separation from MERS should display no substantial change immediately before and after 2005.

Specifically, the analysis runs the following Ordinary Least Squares regression on a balanced panel of employment records:

$$Separate_{i,t} = \alpha + \boldsymbol{\beta_0 Year_t} + \beta_1(Non\ Vested_i) + \boldsymbol{\beta_2}(Non\ Vested_i * \boldsymbol{Year_t}) + \beta_3 ERSRI_i + \boldsymbol{\beta_4}(ERSRI_i * \boldsymbol{Year_t}) + \beta_5(ERSRI_i * Non\ Vested_i) + \boldsymbol{\beta_6}(ERSRI_i * Non\ Vested_i * \boldsymbol{Year_t}) + \boldsymbol{X_i} + \varepsilon_{i,t} \quad (1)$$

where $Separate_{i,t}$ is a binary variable equal to one if employee *i* separates on or before fiscal year *t*.[40] $\boldsymbol{Year_t}$ represents a vector of year fixed effects, $Non\ Vested_i$ is a binary variable equal to one if the employee did not have eight years of tenure in 2003, and $ERSRI_i$ is another binary variable equal to one if the employee was a member of ERSRI in 2003. The first three terms on the right-hand side of this equation (ignoring the constant) perform a DID analysis on MERS members only. The next two terms check whether vested ERSRI members separate at a different rate than vested MERS members, and the vector of coefficients $\boldsymbol{\beta_6}$ are the triple-differences estimates, which this study interprets as the effect of the benefit cut on separation in each year following the reform, and as tests of the parallel pre-trend assumption in the years prior to the reform. The vector $\boldsymbol{X_i}$ improves statistical precision by controlling for employees' demographic characteristics in 2003.[41] The analysis tracks workers through 2008 in order to avoid Rhode Island's subsequent pension reform in 2009. Standard errors are clustered at the individual employee level.

Estimating occupational differences in labor supply requires a slight modification to equation (1). Namely, the triple-differences regression includes a binary variable equal to one if

[40] Separation is defined as ceasing to receive tenure credit toward future pension benefits. Separation is an absorbing state, so that workers who return to their 2003 pension system are treated the same as employees who leave permanently.

[41] These controls include age and service fixed effects, as well as the employee's salary, gender, and occupation (teacher, general state government, corrections officer, or nurse). The results are also robust to the inclusion of individual fixed effects. The results with individual fixed effects are not reported, but available from the authors upon request, since it is difficult to interpret individual fixed effects when the outcome is an absorbing state.

the employee is a teacher in 2003, and interacts this teacher dummy with the other key variables (recall that teachers are all members of ERSRI):

$$Separate_{i,t} = \alpha + \boldsymbol{\beta_0 Year_t} + \beta_1(Non\ Vested_i) + \boldsymbol{\beta_2}(Non\ Vested_i * \boldsymbol{Year_t}) + \beta_3 ERSRI_i + \boldsymbol{\beta_4}(ERSRI_i * \boldsymbol{Year_t}) + \beta_5(ERSRI_i * Non\ Vested_i) + \boldsymbol{\beta_6}(ERSRI_i * Non\ Vested_i * \boldsymbol{Year_t}) + \beta_7 Teacher_i + \boldsymbol{\beta_8}(Teacher_i * \boldsymbol{Year_t}) + \boldsymbol{\beta_9}(Teacher_i * Non\ Vested_i) + \boldsymbol{\beta_{10}}(Teacher_i * Non\ Vested_i * \boldsymbol{Year_t}) + \boldsymbol{X_i} + \varepsilon_{i,t} \quad (2)$$

In equation (2), the vector of triple-differences coefficients $\boldsymbol{\beta_6}$ reflects the effect of the benefit cut on state government employees, while the vector of coefficients $\boldsymbol{\beta_{10}}$ estimates the difference in effect size between state workers and teachers. Hence, the linear combination of $\boldsymbol{\beta_6}$ and $\boldsymbol{\beta_{10}}$ measures the effect of the benefit cut on teacher separation. Once again, elements of vectors $\boldsymbol{\beta_6}$ and $\boldsymbol{\beta_{10}}$ from the years prior to the reform serve as tests of the parallel pre-trend assumption for state workers and for the difference in trends between state workers and teachers.

The preceding estimation approaches are binary, indicating the effects of being treated by the reform on separation. However, as described in the previous section, different workers experienced benefit cuts of different magnitudes. To scale the response of individual workers (and occupations) to the size of the cut they face, the analysis estimates Two-Stage Least Squares (TSLS) regressions. These regressions have the same form as equation (1); however, their main independent variable is the peak wealth of individual *i*, and this peak wealth is instrumented by the interaction of $ERSRI_i * Non\ Vested_i * Post\ 2005_t$. When separating out the treatment effect for teachers and other occupations, the additional independent variable of interest is $Teacher_i * Peak\ wealth_i$, instrumented by $Teacher_i * Non\ Vested_i * Post\ 2005_t$. These regressions therefore yield the effect of $1 of benefit cuts on separation, with the cut determined mechanically by the reform's impact on each worker's peak deferred benefit wealth (inclusive of both pension and RHI benefits).

Because the pension reform discontinuously affected ERSRI members with fewer than 10 years of tenure, a regression discontinuity design (RDD) might seem like an appealing alternative to the triple-differences methodology adopted here. However, the RDD is difficult to implement in practice because nearly vested workers face very strong incentives to remain in government service over the short run, even in the face of substantial benefit cuts, in order to

vest in their pension. Since prior research has shown that state workers adjust their labor supply in response to this vesting incentive, the probability of separation would jump discontinuously at 10 years of tenure even absent the benefit cut.[42]

Results

The analysis follows 23,676 employees between 2003 and 2008. Table 2 summarizes their demographic characteristics in 2003, with the aim of highlighting differences between the four cohorts. In keeping with the emphasis on mid-career separation, the sample drops employees who are younger than 16 and older than 60 in 2003 because those who work past age 60 (the pre-reform NRA in ERSRI) are likely quite different from those who choose to retire on time.[43] Similarly, the analysis excludes employees with 20 or more years of tenure, so that no one in the sample is already working past their first eligibility for early retirement in 2003.[44] As expected, the non-vested ERSRI and MERS members are younger, on average, than the vested members, although the difference is more pronounced in ERSRI than in MERS. The average tenure in the non-vested and vested groups appears similar in both pension plans. Conversely, teachers and state government employees earn substantially higher salaries than do municipal employees.

Figure 1 presents the triple-differences research design graphically to add some intuition to the regression. The first set of bars in the figure, labeled DID ERSRI, focuses on teachers and state employees, subtracting the mean of $Separate_{i,t}$ in the vested group from that in the non-vested group each year between 2003 and 2008. Separation in the non-vested group rises over time relative to the vested group. Although the trend jumps in 2005, it is already apparent in 2004, before the pension reform. Changing labor market conditions in Rhode Island over this period may cause this pre-trend, and motivate the use of MERS as additional control groups. Hence, the second set of bars in Figure 1, labeled DID MERS, replicates the procedure used for ERSRI. The slight trend in 2004 is also apparent in MERS, but the jump in 2005 is smaller and

[42] See, for example, Clark, Hanson, and Mitchell (2016); and Quinby (2019).
[43] Only 12 percent of active workers in 2003 are over age 60.
[44] The sample also excludes employees with zero years of tenure in 2003, since 25 percent of these observations are purportedly born in 1900 and an additional 10 percent earn zero wages despite being coded as "active" employees. Together, these tenure-based sample restrictions eliminate 25 percent of observations under age 60. A robustness check will further limit the sample to employees younger than age 53 and with fewer than 15 years of tenure in 2003 so that no one becomes retirement eligible during the analysis period.

does not persist. The third set of bars, labeled Triple Difference, subtracts the difference for MERS from the difference for ERSRI. Reassuringly, the trend in 2004 disappears, highlighting a 2- to 3-percentage-point increase in separation from ERSRI that begins in 2005 and persists through 2008.

Equation (1) formalizes Figure 1 by checking for statistical significance and controlling for the pre-reform characteristics of employees. Figure 2 plots the vector of triple-differences coefficients by year ($\boldsymbol{\beta_6}$) as well as the 95-percent confidence interval on each.[45] The regression confirms a 1.7 to 3.2-percentage-point increase in cumulative separation that has stabilized at 2.1 percentage points by the end of 2006. The triple-differences estimates are almost all statistically significant at the 5-percent level or better, with the notable exception of 2003, which is a precisely estimated zero (see Table 3 for detailed regression results).

Furthermore, in line with expectations for the low-tenure MERS employees who are, in fact, untreated by the reform, this group displays no change in separation rates in the years immediately post reform. Instead, they show a significant decline in separations in 2008, likely reflecting the Great Recession, and further justifying use of this group as a control for ERSRI. A two-period triple-differences regression estimates the average effect across all the years to be 2.4 percentage points, statistically significant at the one-percent level.[46]

Given that much of the existing literature on public sector labor supply focuses on K-12 education, the next question is whether teachers respond less to benefit cuts than do state government employees. Figure 3 presents triple-differences estimates for each occupation by calculating the sum of $\boldsymbol{\beta_6}$ and $\boldsymbol{\beta_{10}}$ from equation (2). The effect on teachers is about half as large as the effect on state employees – slightly under 2 percentage points compared to 4 percentage points – and is not always statistically different from zero.[47] Detailed regression results in Table 4 reveal that these occupational differences are statistically significant. However, given that the dynamic effects are imprecisely estimated for teachers (due to the smaller sample size), Table 5 replicates the analysis using a two-period triple-differences regression with 2005 as the first year post reform. This model again shows that the size of the

[45] The regression normalizes all of the coefficients relative to the difference between the treated and control groups in the year before the reform.
[46] This regression is presented in the next section as a robustness test.
[47] The overall effect is calculated from Table 4 as the effect on state government employees plus the additional effect on teachers.

effect is statistically different between the two occupations, and that the overall estimate for teachers is 1.7 percentage points, but that the estimate for teachers is only marginally statistically significant at the 10-percent level (a p-value of 0.065).

Robustness Tests

Any empirical analysis must make design choices that could influence the results. This section conducts several robustness checks to confirm that the main results are not overly sensitive to model specification or the sample selection criteria. As a first robustness check, Column (1) of Table 6 demonstrates that the main triple-differences coefficients do not depend on the demographic control variables. Column (2) of Table 6 limits the sample to employees ages 53 and younger with no more than 15 years of tenure, so that no one becomes eligible for normal or early retirement during the analysis period. Similarly, column (3) drops employees with fewer than two years of tenure in 2003, due to concerns about data quality (see the discussion in Appendix B), while column (4) drops corrections officers and nurses with occupation-specific benefit provisions. The main conclusion remains unchanged, even though shrinking the sample attenuates the coefficients slightly and reduces statistical power.

A final robustness check trades the OLS model in equation (1) for a logistic regression.[48] Because the estimated coefficients from a logistic model are difficult to interpret, this analysis uses the model to calculate the predicted probability of having separated for the four groups of employees, with all control variables held constant at their means. It then takes a linear combination of these predicted probabilities to produce DID and triple-differences estimates. Table 7 compares the DID and triple-differences estimates from the logistic regression with their OLS counterparts. To simplify the exposition, Table 7 shows results for the two-period research design rather than the dynamic triple-differences design. The two sets of estimates are nearly identical.

[48] Although a Cox proportional hazard model might seem appealing in this setting, the model relies on a restrictive assumption of constant proportional treatment effects at all points in time. Rather than support this assumption, the OLS estimates suggest that Rhode Island's benefit cut caused a sudden outflow of employees that subsided a couple years after the reform.

Scaling the Effect of the Reform by the Magnitude of the Benefit Cut

How should one interpret the magnitude of the labor supply response generally, outside the context of this particular reform? The answer to this question depends on the responsiveness of public employees to a one-dollar cut in deferred benefits. To that end, the next set of results scales the estimates by the decrease in the present value of deferred benefits. A further advantage of this scaling is to probe why teachers were less responsive to Rhode Island's reform than state employees. Teachers may respond less because they enjoy their jobs more, because they lack competitive outside options, or because the cut itself was less severe for them. Estimating the effect per dollar of benefits cut can help rule out the latter possibility.

Table 8 presents TSLS estimates of the effect on separation of a $100,000 increase in the present value of deferred compensation.[49] As described in the background section, this scaling roughly corresponds to the actual size of the average benefit cut due to the reform ($120,000). The results in column (1) indicate that cutting deferred compensation by $100,000 would increase separations by 1.7 percentage points overall.

Columns (2) and (3) allow for differential treatment effects for teachers versus other public employees, assuming that RHI eligibility is completely divorced from the NRA or fully linked to it, respectively. The results do not very substantially across the two columns, with the responsiveness of teachers only slightly greater in the (conservative) baseline case. The estimates indicate that state employees would separate by an additional 4 percentage points ($p<0.01$) in response to a $100,000 reduction in their deferred compensation. However, in the baseline case, teachers would only increase their separation rate by 1.3 percentage points in response to a cut of the same magnitude (only marginally different from 0, $p<0.065$). These estimates rule out the possibility that teachers were less responsive to the reform because they faced a smaller loss of benefits.

Of course, women are known to have more elastic labor supply than men, and teachers are much more likely to be women than other public employees are.[50] To confirm that

[49] For ease of interpretation, this estimation is conducted in the two-period framework, however results are very similar when estimates are dynamic. The first stage of the TSLS is not displayed as it is mechanical, with treated observations seeing a decline in their peak wealth in accordance with the new parameters of the pension and RHI systems.

[50] For evidence of women's labor supply being more elastic than men's see, for example, Blundell and Macurdy (1999). In the analysis sample of this paper in 2003, 76 percent of teachers were women, compared with 55 percent of state employees.

occupational differences in separation are not simply due to gender, Figure 4 shows how a $100,000 deferred benefit cut differentially affects the separation rate of four groups: male state employees, male teachers, female state employees, and female teachers. As expected, within each occupation men are less responsive to the cut than women.[51] Yet, within each gender, teachers are less responsive than other occupations.[52] In total, even female teachers are less responsive than male state workers, and male teachers display essentially no response to the cut.

Elasticity of Employer-Specific Labor Supply with Respect to Deferred Compensation

Although teachers and state employees seem to face different labor market conditions, it is unclear whether either group experienced an economically meaningful change in separation. One possible reference point is the overall probability of separation, which makes the effect of deferred benefit reform appear moderately large. Among the non-vested ERSRI members employed in 2003, 22 percent had separated from active service by 2008. Hence, a 2.4-percentage-point increase in the separation rate corresponds to a 12-percent increase in the baseline (no reform) rate. By occupation, the benefit cut caused a 19-percent increase in the baseline separation rate for general state employees and a 9-percent increase in the baseline rate for teachers.

The elasticity of separations with respect to the benefit cut is then easy to calculate. This exercise yields additional perspective on the responsiveness of public employees to deferred benefit cuts, and further generalizes the results from this paper to other settings where pre-reform benefits may be different from those in Rhode Island. Evaluating the elasticity of separations is also helpful in assessing whether teachers respond less to a fixed $100,000 of lost benefits because that fixed cut is a smaller share of their total expected benefits.

Recall that Rhode Island's 2005 reform cut $120,000, on average, relative to pre-reform lifetime benefits of $277,000 across all public workers, which equates to a 43-percent cut. Thus, the elasticity of separations for public workers with respect to deferred benefits is: 12-percent decrease in employer-specific labor supply / 43-percent reduction in benefits = 0.28. Furthermore, teachers and state employees each happened to experience a 43 percent cut.

[51] This difference is significant for state employees ($p<0.01$), but not for teachers.
[52] This difference is significant for women ($p<0.01$), but only marginally for men ($p<0.06$).

Consequently, the elasticity for teachers is 9/43=0.22, while the elasticity for state employees is twice as large, at 19/43=0.45.[53]

The Implications of the Results

This section discusses some implications of the results above. In particular, the results yield some insight into the existence of competitive public-sector labor markets. In a narrower sense, they also provide a measure of the potentially overlooked costs of benefit reform in terms of increased turnover. Finally, the employee preferences and other considerations that might drive the results are briefly discussed.

The Structure of Public Sector Labor Markets

Neither teachers nor state employees display elastic employer-specific labor supply, at least regarding deferred compensation. In a perfectly competitive labor market, the prediction for such an elasticity would be infinite, as any cut to compensation would lead workers to quickly find substitute employers who did not cut compensation, provided that the government did not increase wages or other benefits as a compensating differential (Ashenfelter, Farber, and Ransom 2010).[54] Clearly, infinite elasticity is inconsistent with even moderate job-search frictions, however the estimates found here are decidedly inelastic.

This low elasticity can be attributed to a combination of non-exclusive factors. The first is that deferred compensation may not be highly valued by employees (as found in, for example, Fitzpatrick 2015). The second is that government employees may be motivated by the intrinsic value of public service. While neither of these possibilities can explain a deviation from the competitive benchmark case, they could contribute to a low elasticity in the presence of some market imperfections. The third option is that public employers are only imperfectly substituted by other employers.[55] This latter possibility is particularly striking in the context of Rhode Island, which is a small state embedded in a wider regional labor market. To the extent that

[53] All these calculations assume the upper bound elasticity for teachers, where teachers' eligibility for RHI is not tied to their pension's NRA.

[54] The analysis finds no evidence that Rhode Island increased wages to compensate for the benefit cut. Table D1 in the Appendix performs the triple-differences analysis for salaries and shows that the reform had a statistically precise null effect.

[55] Part of this imperfect substitution may well be due to the fact that only public employers can provide the intrinsic satisfaction of public service.

Rhode Island's government acts as a monopsonist in the labor market, the estimates in this paper may provide a lower bound on the market power of other state governments.[56]

Cost-Benefit Implications for Governments Contemplating Benefit Reforms

The 2005 reform of ERSRI caused a large increase in separation, despite small elasticities, because the benefit cut was also considerable. Conceptually, workers who leave their jobs impose two types of costs on employers (Ronfeldt, Loeb, and Wyckoff 2013). First, employers must hire and train replacements, at an estimated cost of $4,000 and $18,000 per employee.[57] Assuming that government employers in Rhode Island expended a similar amount for each separated employee, the 2005 pension cut caused a one-time increase in direct turnover costs of between $1.8 million and $8.1 million – small in magnitude relative to the pension savings.

Second, increased turnover may hurt the quality of public services if new hires are less skilled than those who leave. In Rhode Island, where government salaries do not appear to have increased to compensate for lost pension benefits, the concern is that highly skilled employees – such as teachers, nurses, and lawyers – may have selected out of public service and chosen careers in the local private sector or the public sectors in neighboring states.[58] While the impact of the loss of more skilled workers is difficult to measure, it may be the larger cost associated with pension cuts.

[56] In any case, the fact that teachers are less responsive to deferred benefit cuts than other public-sector workers suggests that the combination of intrinsic value of public service and the monopsonistic nature of public labor markets play a large role in the low elasticity of employer-specific labor supply, since it is unlikely that teachers have a lower valuation of deferred benefits than other public workers.

[57] Attempts to quantify these direct costs produce widely differing estimates depending on the employer studied and the research methodology. Two studies of K-12 education place the direct costs between $4,000 and $18,000 per separating teacher, with large urban districts experiencing higher costs (Barnes, Crowe, and Schaefer 2007; and Watlington et al. 2010). Graef and Hill (2000) estimate the cost of replacing a child protective services worker at $10,000. Meanwhile, four studies of registered nurses estimate costs ranging from $24,000 to $67,000 per nurse (Jones 2005; Nursing Solutions Inc. 2016; The Lewin Group, Inc. 2009; and Waldman et al. 2004).

[58] See, for example, Bacolod (2007); Corcoran, Evans, and Schwab (2004); Figlio (1997); and Nagler, Piopiunik, and West (2015). Separation could also reduce staff cohesion and community, with adverse effects on agency performance (Bryk and Schneider 2003; and Johnson, Harrison, and Donaldson 2005). A large body of literature in the public and private sectors finds that organizations with high turnover also have lower productivity (see Hausknecht and Trevor 2011; and Park and Shaw 2012 for a review of this literature). However, one should be cautious when assigning a causal interpretation to the negative correlation because of reverse causality: unproductive organizations could suffer from systemic human resource problems that cause the high turnover.

Public Employees Preferences

The retroactive nature of the pension cut implies a mixture of income and substitution effects that varied across individuals. The cut to accrued benefits is a pure wealth shock that primarily hit medium-tenured workers who had not yet vested, but who anticipated vesting with substantial accruals within the next few years. Reductions in future accruals created both income and substitution incentives for all employees; the income effect could have spurred employees to try to recover the lost wealth by seeking outside jobs with higher pay (perhaps in exchange for fewer amenities); while the substitution effect made outside options appear more attractive than they used to. In addition to the standard income and substitution effects, benefit cuts are an information shock, which could change employee beliefs about the likelihood of future cuts.[59] Finally, cuts for current employees – even more than ex nunc reductions – might inspire feelings of spite, particularly among employees who have nearly vested.

Although these theoretical mechanisms suggest that medium-tenure employees may respond differently to the cut than their short-tenure colleagues, the analysis uncovers no evidence of differential effects by tenure.[60] On its face, this finding is consistent with negligible income effects. However, the complex interaction of income, substitution, information, and spite channels, along with the inherent statistical imprecision of heterogeneity analysis on small subsamples, renders firm conclusions about mechanisms challenging in the current context. This analysis is further complicated by the option value of remaining in public employment when employees are just a year or two away from vesting, which would itself have disparate impacts on short- and longer-tenure workers (see Quinby 2019 for a detailed explanation of this phenomenon).

Conclusion

In 2017, one-third of the large state and local pension systems in the United States were so poorly funded that sponsors may soon attempt to scale back the benefits promised to current employees. RHI systems in the public sector, while typically not prefunded, are similarly facing fiscal strain leading to increasingly prevalent cuts in generosity. This study demonstrates that

[59] Indeed, public employees in Rhode Island would have been correct to assume that future cuts were coming.
[60] Results not shown, but available from the authors upon request.

deferred benefit cuts for current workers encourage mid-career civil servants and teachers to leave their jobs.

Specifically, the study evaluates a 2005 reform of Rhode Island's ERSRI that dramatically reduced benefits for K-12 teachers and state employees. The benefit cut caused a 2.4-percentage-point increase in the cumulative probability of separating before 2008, or a 12-percent increase in the pre-reform separation rate. Since the reform reduced lifetime pension wealth by 43 percent for a typical non-vested member of ERSRI, the results imply an employer-specific elasticity of labor supply of 0.28. This finding that the separation behavior of public employees is highly inelastic suggests that government employers may have substantial bargaining power in the labor market.

Teachers – an important group of government employees – were less responsive to cuts than were state government employees, with the two groups being 1.7-percentage-points and 4-percentage-points more likely to separate, respectively, following the reform. Similarly, teachers demonstrated an elasticity of separation with respect to the present value of lifetime benefits of only 0.22, compared with 0.45 for state employees. It is possible that state employees (such as lawyers, accountants, clerks, and maintenance workers) have alternative employment opportunities in the private sector that K-12 teachers lack. This interpretation suggests that policymakers should be cautious when extrapolating from studies of teacher labor markets to the broad state and local government workforce, of which teachers only comprise 30 percent (U.S. Census Bureau 2017b).

Since Rhode Island is a small state integrated into a larger New England labor market, the elasticity of employer-specific labor supply estimated here might be larger than that in more isolated states. Nevertheless, it seems generalizable to the other Northeastern governments that are in financial difficulty, as well as to municipal governments with troubled pensions nationwide. Lessons learned from Rhode Island could soon apply in Connecticut, Illinois, New Jersey, Philadelphia, Kentucky, Massachusetts, and New York City, among other jurisdictions where one or more pension systems for teachers or civil servants were less than 60 percent funded in 2017. In short, benefit cuts for current workers may be considered to shore up troubled systems, but sponsors might want to prepare for their likely effects on the government workforce.

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Table 1. *Characteristics of State and Local Government Workers in 2017*

Mean characteristic (Percent)	Rhode Island	All other states
Teachers	37.4%	22.9%
Protective service workers	10.2	9.0
State employees	39.7	40.5
Female	58.0	59.6
Black	3.1	14.0
White	84.6	78.2
Hispanic origin	9.2	12.3
Age (years)	43.4	44.3

Note: Racial and ethnic categories do not sum to one because employees of Hispanic origin may also classify as "white."
Source: Authors' calculations from the U.S. Census Bureau, *Current Population Survey* (2017).

Table 2. *Demographic Characteristics of Public Sector Employees in Rhode Island, 2003*

	ERSRI: Non-vested				
Variable	N	Mean	SD	Min	Max
Age	8,839	38	9	18	59
Tenure	8,839	4	2	1	8
Teacher	8,839	0.63	0.48	0	1
Salary	8,839	$40,969	$13,656	$7	$158,064
Female	8,839	0.68	0.46	0	1
	ERSRI: Vested				
Variable	N	Mean	SD	Min	Max
Age	9,774	46	7	20	59
Tenure	9,774	13	3	8	20
Teacher	9,774	0.51	0.5	0	1
Salary	9,774	$52,657	$15,457	$7	$153,885
Female	9,774	0.66	0.47	0	1
	RI MERS: Non-vested				
Variable	N	Mean	SD	Min	Max
Age	2,890	44	8	20	59
Tenure	2,890	4	2	1	8
Teacher	2,890	0	0	0	0
Salary	2,890	$24,441	$11,896	$57	$101,961
Female	2,890	0.63	0.46	0	1
	RI MERS: Vested				
Variable	N	Mean	SD	Min	Max
Age	2,173	48	7	28	59
Tenure	2,173	13	3	8	20
Teacher	2,173	0	0	0	0
Salary	2,173	$29,852	$11,875	$194	$110,675
Female	2,173	0.58	0.49	0	1

Note: ERSRI is the Employees' Retirement System of Rhode Island, which covers state government employees and public school teachers. MERS is the Municipal Employees' Retirement System of Rhode Island.
Source: Authors' calculations from employment records provided by the Employees' Retirement System of Rhode Island (2003-2017).

Table 3. *Difference-in-Differences and Triple Differences Estimates of the Effect of Benefit Cuts on the Cumulative Probability of Separation*

	DID MERS	DID ERSRI	Triple Diff
	(1)	(2)	(3)
Variables	Separated	Separated	Separated
Effect of low tenure 2003	-0.0106*	-0.0123***	
	(0.0059)	(0.0026)	
Effect of low tenure 2005	0.0026	0.0193***	
	(0.0066)	(0.0029)	
Effect of low tenure 2006	-0.0112	0.0209***	
	(0.0083)	(0.0036)	
Effect of low tenure 2007	-0.0030	0.0180***	
	(0.0095)	(0.0043)	
Effect of low tenure 2008	-0.0271**	-0.0053	
	(0.0107)	(0.0049)	
Effect of cut 2003			-0.0017
			(0.0065)
Effect of cut 2005			0.0167**
			(0.0071)
Effect of cut 2006			0.0321***
			(0.0091)
Effect of cut 2007			0.0210**
			(0.0105)
Effect of cut 2008			0.0218*
			(0.0118)
Constant	1.7965***	1.5519***	1.6908***
	(0.2680)	(0.1023)	(0.2439)
Observations	30,378	111,666	142,044
R-squared	0.096	0.084	0.087
Year FE	Yes	Yes	Yes
Service in 2003 FE	Yes	Yes	Yes
Age bracket in 2003 FE	Yes	Yes	Yes
Teacher in 2003 dummy	Yes	Yes	Yes
Corrections in 2003 dummy	Yes	Yes	Yes
Nurse in 2003 dummy	Yes	Yes	Yes
Log salary	Yes	Yes	Yes
Female dummy	Yes	Yes	Yes
ERS dummy			Yes
ERS * year FE			Yes
Low tenure			Yes
Low tenure * year FE			Yes
Low tenure * ERS			Yes

Notes: Standard errors in parentheses are clustered at the employee level. *** p<0.01, ** p<0.05, * p<0.1. Column (1) presents a dynamic difference-in-differences analysis of the Municipal Employees' Retirement System. Column (2) shows a similar analysis of the Employees' Retirement System of Rhode Island. Column (3) displays the triple-differences results.

Source: Authors' estimates from employment records provided by the Employees' Retirement System of Rhode Island (2003-2017).

Table 4. *Dynamic Triple Differences Estimates of the Effect of Benefit Cuts on the Cumulative Probability of Separation by Occupational Group*

Variables	(1) Separated
Effect of cut 2003	-0.0023
	(0.0074)
Effect of cut 2005	0.0293***
	(0.0083)
Effect of cut 2006	0.0477***
	(0.0103)
Effect of cut 2007	0.0424***
	(0.0119)
Effect of cut 2008	0.0381***
	(0.0134)
Differential effect on teachers 2003	-0.0007
	(0.0054)
Differential effect on teachers 2005	-0.0178***
	(0.0061)
Differential effect on teachers 2006	-0.0236***
	(0.0076)
Differential effect on teachers 2007	-0.0324***
	(0.0090)
Differential effect on teachers 2008	-0.0201**
	(0.0102)
Constant	1.7069***
	(0.2444)
Observations	142,044
R-squared	0.088
Year FE	Yes
ERS dummy	Yes
Low tenure	Yes
ERS * year FE	Yes
Low tenure * year FE	Yes
Low tenure * ERS	Yes
Teacher in 2003 dummy	Yes
Teacher * low tenure	Yes
Teacher * year FE	Yes
Service in 2003 FE	Yes
Age bracket in 2003 FE	Yes
Corrections in 2003 dummy	Yes
Nurse in 2003 dummy	Yes
Log salary	Yes
Female dummy	Yes

Notes: Standard errors in parentheses are clustered at the individual employee level. *** p<0.01, ** p<0.05.
Source: Authors' estimates from employment records provided by the Employees' Retirement System of Rhode Island (2003-2017).

Table 5. *Two-Period Triple Differences Estimates of the Effect of Benefit Cuts on the Cumulative Probability of Separation by Occupational Group*

Variables	(1) Separated
Effect of cut	0.0405***
	(0.0102)
Differential effect on teachers	-0.0233***
	(0.0077)
Constant	1.6688***
	(0.2444)
Observations	142,044
R-squared	0.088
Year FE	Yes
ERS dummy	Yes
Post dummy	Yes
Low tenure	Yes
ERS * Post	Yes
Low tenure * Post	Yes
Low tenure * ERS	Yes
Teacher in 2003 dummy	Yes
Teacher * low tenure	Yes
Teacher * post	Yes
Service in 2003 FE	Yes
Age bracket in 2003 FE	Yes
Corrections in 2003 dummy	Yes
Nurse in 2003 dummy	Yes
Log salary	Yes
Female dummy	Yes

Notes: Standard errors in parentheses are clustered at the individual employee level. *** p<0.01.
Source: Authors' estimates from employment records provided by the Employees' Retirement System of Rhode Island (2003-2017).

Table 6. *Robustness Checks on Triple Differences Estimates of the Effect of Benefit Cuts on the Cumulative Probability of Separation*

Variables	(1) Separated	(2) Separated	(3) Separated	(4) Separated
Effect of cut 2003	-0.0017	0.0033	-0.0022	-0.0016
	(0.0065)	(0.0071)	(0.0066)	(0.0065)
Effect of cut 2005	0.0167**	0.0145*	0.0152**	0.0158**
	(0.0072)	(0.0083)	(0.0074)	(0.0072)
Effect of cut 2006	0.0320***	0.0210**	0.0278***	0.0310***
	(0.0091)	(0.0099)	(0.0095)	(0.0091)
Effect of cut 2007	0.0211**	0.0118	0.0173	0.0197*
	(0.0105)	(0.0111)	(0.0109)	(0.0105)
Effect of cut 2008	0.0219*	0.0214*	0.0198	0.0202*
	(0.0118)	(0.0124)	(0.0123)	(0.0118)
Constant	0.0805***	1.6918***	1.6515***	1.7027***
	(0.0058)	(0.2502)	(0.2478)	(0.2444)
Observations	142,056	107,748	131,070	136,218
R-squared	0.039	0.082	0.081	0.087
Year FE	Yes	Yes	Yes	Yes
ERS dummy	Yes	Yes	Yes	Yes
ERS * year FE	Yes	Yes	Yes	Yes
Service in 2003 FE		Yes	Yes	Yes
Age bracket in 2003 FE		Yes	Yes	Yes
Teacher in 2003 dummy		Yes	Yes	Yes
Corrections in 2003 dummy		Yes	Yes	
Nurse in 2003 dummy		Yes	Yes	
Log salary		Yes	Yes	Yes
Female dummy		Yes	Yes	Yes

Notes: Standard errors in parentheses are clustered at the individual employee level. *** p<0.01, ** p<0.05, * p<0.1. Column (2) drops workers older than 53 in 2003 and those with more than 15 years of tenure. Column (3) drops workers with fewer than 2 years of tenure in 2003. Column (4) drops nurses and corrections officers.
Source: Authors' estimates from employment records provided by the Employees' Retirement System of Rhode Island (2003-2017).

Table 7. *Predicted Probability of Separation by Pension Plan and Time Period*

Treated mean - control mean	Logistic regression	OLS regression
ERSRI pre-reform	0.0322***	0.0372***
	(0.0028)	(0.0030)
MERS pre-reform	0.0229***	0.0284***
	(0.0058)	(0.0065)
ERSRI post-reform	0.0541***	0.0566***
	(0.0048)	(0.0048)
MERS post-reform	0.0246**	0.0240**
	(0.0105)	(0.0103)
Triple differences	0.0233***	0.0237***
	(0.0090)	(0.0089)

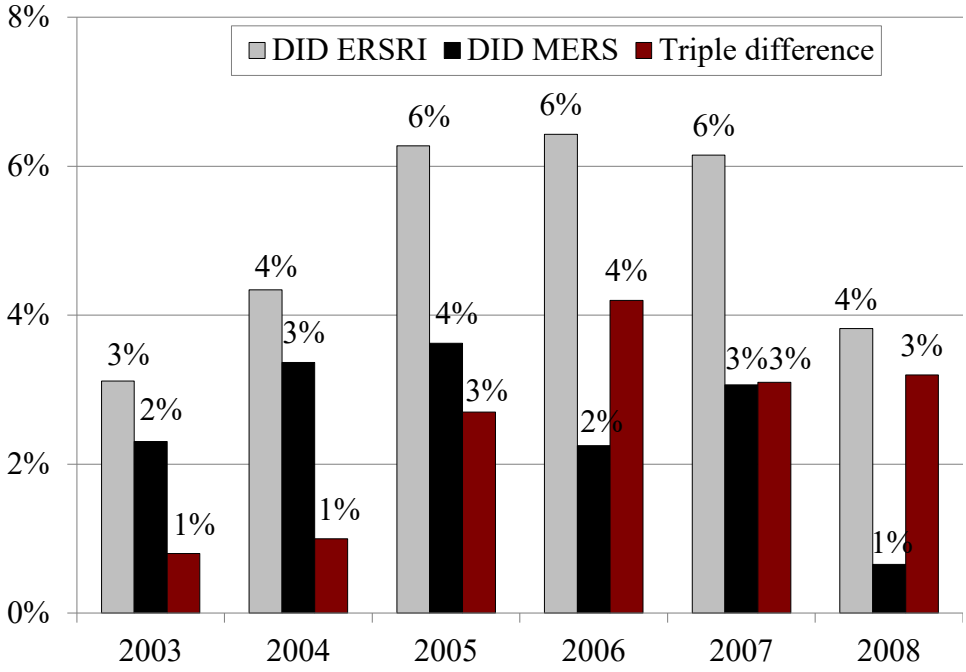
Notes: The table depicts predicted probabilities from the regression with control variables held constant at their means (see Table 2 for a list of the control variables). Standard errors in parentheses are clustered at the individual employee level. *** p<0.01, ** p<0.05.
Source: Authors' estimates from employment records provided by the Employees' Retirement System of Rhode Island (2003-2017).

Table 8. *Two-Stage Least Squares Estimates of the Effect of a $100,000 Cut in the Present Value of Deferred Benefits on the Cumulative Probability of Separation, Overall and by Occupational Group*

	(1)	(2)	(3)
Variables	Separated	Separated	Separated
Effect of a $100K increase in the present value of peak wealth	-0.017***	-0.0397***	-0.0397***
	(0.0064)	(0.01)	(0.01)
Differential effect on teachers of a $100K increase in the present value of peak wealth		0.0265***	0.0291***
		(0.0072)	(0.0073)
Observations	142,044	142,044	142,044
R-squared	0.085	0.083	0.083
Year FE	Yes	Yes	Yes
ERS dummy	Yes	Yes	Yes
Post dummy	Yes	Yes	Yes
Low tenure	Yes	Yes	Yes
ERS * Post	Yes	Yes	Yes
Low tenure * Post	Yes	Yes	Yes
Low tenure * ERS	Yes	Yes	Yes
Teacher in 2003 dummy	Yes	Yes	Yes
Teacher * low tenure	Yes	Yes	Yes
Teacher * post	Yes	Yes	Yes
Service in 2003 FE	Yes	Yes	Yes
Age bracket in 2003 FE	Yes	Yes	Yes
Corrections in 2003 dummy	Yes	Yes	Yes
Nurse in 2003 dummy	Yes	Yes	Yes
Log salary	Yes	Yes	Yes
Female dummy	Yes	Yes	Yes
Teacher RHI linked to pension NRA?	No	No	Yes

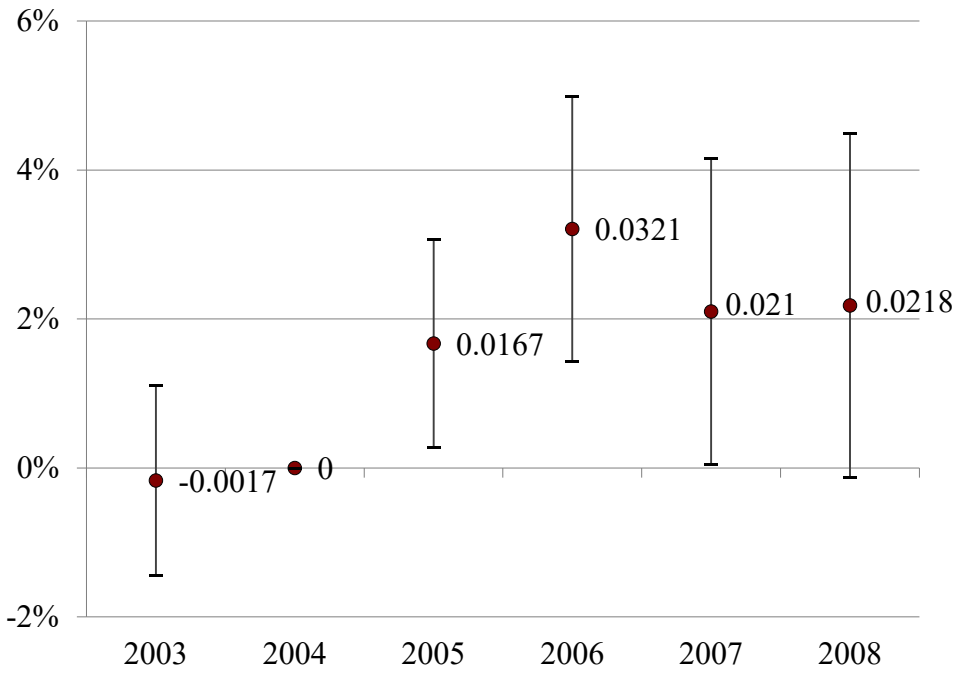
Notes: Standard errors in parentheses are clustered at the individual employee level. *** p<0.01.
Source: Authors' estimates from employment records provided by the Employees' Retirement System of Rhode Island (2003-2017).

Figure 1. *Development of the Triple Differences Estimates without Control Variables, 2003-2008*



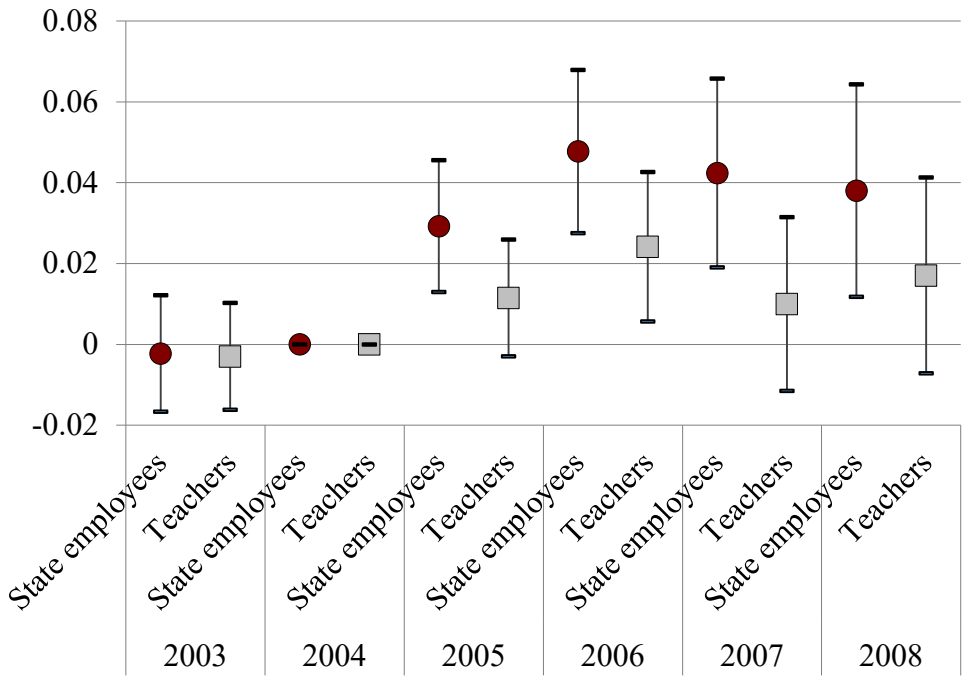
Notes: The figure follows members of ERSRI and MERS who were actively employed in 2003. The bars labeled DID ERSRI subtract the separation rate in the control group from the separation rate in the treated group. The bars labeled DID MERS subtract the separation rate in the placebo control group from the separation rate in the placebo treated group. The bars labeled Triple Difference subtract the bars labeled DID MERS" from those labeled DID ERSRI.
Source: Authors' estimates from employment records provided by the Employees' Retirement System of Rhode Island (2003-2017).

Figure 2. *Effect of Pension Cuts for Current Workers on the Cumulative Probability of Separation, 2003-2008*



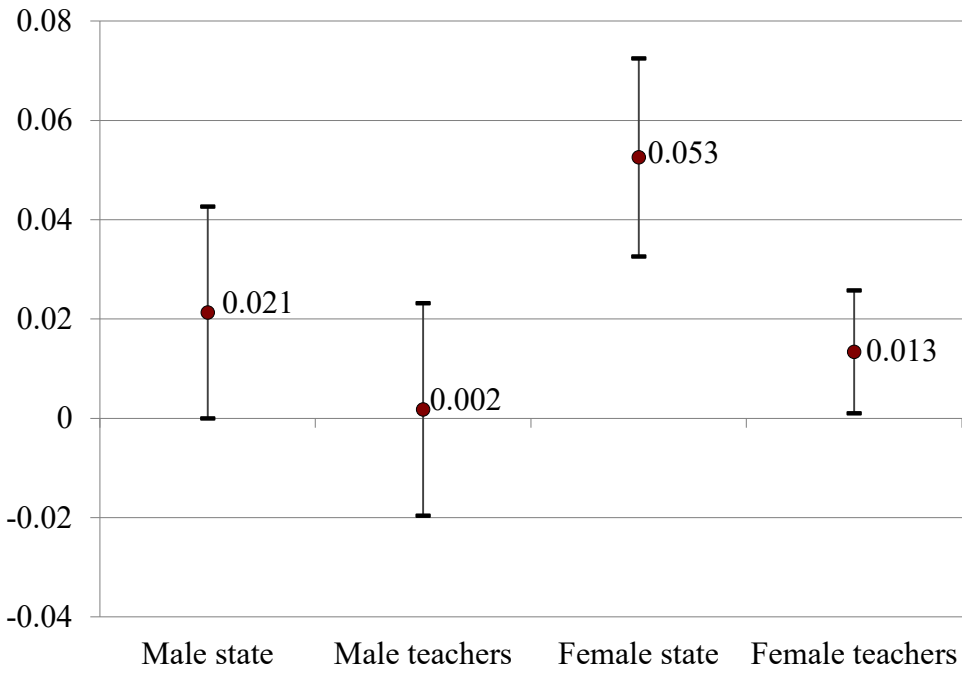
Notes: Dots represent the regression coefficients and whisker lines depict the 95-percent confidence interval. The regression analysis treats 2004 as the omitted reference year; hence the estimated effect in 2004 lacks a confidence interval by design.
Source: Authors' estimates from employment records provided by the Employees' Retirement System of Rhode Island (2003-2017).

Figure 3. *Effect of Pension Cuts for Current Workers on the Cumulative Probability of Separation, by Occupation, 2003-2008*



Notes: Dots represent the combinations of regression coefficients appropriate to the group, and whisker lines depict the 95-percent confidence interval of those linear combinations. Both groups' separation rates are normalized to 0 in 2004, the year prior to the reform. Despite being employed by local school districts, teachers participate in the same pension plan as state government employees.
Source: Authors' estimates from employment records provided by the Employees' Retirement System of Rhode Island (2003-2017).

Figure 4. *Effect on Separation of a $100,000 Cut in the Present Value of Deferred Benefits, by Gender-Occupation Groups, 2003-2008*



Notes: Dots represent the combinations of regression coefficients appropriate to the group, and whisker lines depict the 95-percent confidence interval of those linear combinations.
Source: Authors' estimates from employment records provided by the Employees' Retirement System of Rhode Island (2003-2017).

Appendix A: Benefit Provisions of the Employees' Retirement System of Rhode Island and the Municipal Employees' Retirement System

Table A1. *Benefit Provisions Pre-Reform (2003-2004) and Post-Reform (2005-2008)*

Provision	ERSRI pre reform	ERSRI post reform	MERS
Vesting period	10 years of tenure	10 years of tenure	10 years of tenure
Normal retirement age	• Age 60 • Or any age with 28 years of tenure	*If non-vested on 6/30/05:* • Age 65 • Or age 59 with 29 years of tenure *If vested on 6/30/05:* • No change	• Age 58 with 10 years of tenure • Or any age with 30 years of tenure
Early retirement age (actuarial reduction)	None	Age 55 with 20 years of tenure	Age 50 with 20 years of tenure
Benefit multiplier	Tenure 1-10: 1.7% Tenure 11-20: 1.9% Tenure 21-34: 3% Tenure 35+ : 2%	Tenure 1-10: 1.6% Tenure 11-20: 1.8% Tenure 21-25: 2% Tenure 26-30: 2.25% Tenure 31-37: 2.5% Tenure 38+: 2.25%	Tenure 1-20: 2% Tenure 20+: • 2% or 2.5% depending on the locality
Final average salary period	3 years	3 years	3 years
Benefit cap	80% of FAS	75% of FAS	75% of FAS
Cost-of-living adjustment	3% compounded annually	CPI capped at 3% compounded annually, commencing on the third anniversary of retirement.	Participating localities voluntarily choose between several COLA options, including no COLA.

Note: The provisions for ERSRI only reflect general state employees and teachers, who comprise the majority of members.
Source: Various Actuarial Valuation Reports and Plan Documents (2003-2008).

Appendix B: Methodology for Calculating Peak Benefit Wealth

Throughout the paper, "accrued pension wealth" and "accrued RHI wealth" refer to the present discounted value of pension and RHI benefits earned by each employee as of the reference year. "Peak wealth" denotes the highest level of wealth that an employee could receive from the plan given his earnings profile, and is associated with an optimal separation date.

Calculating Accrued Pension Wealth

Defined benefit pensions promise an annuity that commences at the employee's claiming age and continues until death. If employee *i* were to separate from government service in year *t*, he would be entitled to a future benefit determined by the following formula:

$$Benefit_{i,t} = \begin{cases} FAS_{i,t} * Tenure_{i,t} * Multiplier_i * EF_i & if\ Tenure_{i,t} \geq V \\ 0 & if\ Tenure_{i,t} < V \end{cases} \quad \text{(A1)}$$

Where $FAS_{i,t}$ equals the average of the employee's three highest salaries (typically the last three years of employment), $Tenure_{i,t}$ measures the employee's final tenure at separation, and $Multiplier_i$ is set by plan provisions. Note that an employee's final tenure must at least equal the vesting period (V). Benefits receive an actuarial penalty (EF_i) if claimed before the employee's normal retirement age, and are capped at a percentage of $FAS_{i,t}$ that is set by plan provisions.

In ERSRI, each year of tenure receives a different multiplier, so that the benefit formula becomes:

$$Benefit_{i,t} = \begin{cases} FAS_{i,t} * \left[\sum_{y=1}^{t} Tenure_{i,y} * Multiplier_{i,y}\right] * EF_i & if\ Tenure_{i,t} \geq V \\ 0 & if\ Tenure_{i,t} < V \end{cases} \quad \text{(A2)}$$

Pension wealth is calculated as the present value of future benefits, which are claimed at an employee-specific age determined by plan provisions ($R_{i,t}$) and continue until death (D).[61] Each year, the benefit receives an upward cost-of-living-adjustment (COLA) determined by plan

[61] Employees who are already older than the pension's statutory claiming age when they separate are assumed to claim benefits immediately.

provisions, a downward adjustment for the likelihood of continued survival, and a downward adjustment for the worker's personal discount rate:[62]

$$Accrued\ Pension\ Wealth_{i,t} = \sum_{a=R_{i,t}}^{D} \frac{Benefit_{i,t} * COLA_a * \Pr(Survival)_{i,a}}{(1+\delta_i)^{age\ in\ 2003-\ a}} \quad \text{(A3)}$$

Since the goal of this analysis is to calculate magnitude of Rhode Island's pension reform from the perspective of an employee in 2003, economic assumptions were chosen to reflect conditions in 2003. Specifically, inflation is 3 percent (consistent with both the 2003 ERSRI actuarial valuation report and the 2003 Social Security Trustees Report); survival probabilities are taken from the 2003 cohort life tables, by gender, adopted by the Social Security Administration; and the discount rate is 6 percent per year (the nominal return on Treasury bonds assumed by the Social Security actuaries in 2003).[63] For consistency across employees of different ages, future benefits are discounted back to the employee's age in 2003.

Calculating Peak Pension Wealth

Peak pension wealth is simply the maximum accrued pension wealth than an employee could possibly earn given his (assumed) wage profile. Formally:

$$Peak\ Pension\ Wealth_i = max\left\{\begin{matrix} Accrued\ Pension\ Wealth_{i,tenure=0}, Accrued\ Pension\ Wealth_{i,tenure=1}, \\ \ldots, Accrued\ Pension\ Wealth_{i,tenure=\infty} \end{matrix}\right\} \quad \text{(A4)}$$

If accrued pension wealth were to increase monotonically with tenure, then peak wealth would occur when the employee (having spent the remainder of his life working in government) finally dies. However, accrued pension wealth typically increases until the employee reaches the claiming age set by plan provisions, at which point accrued wealth begins to decrease because the employee foregoes a year of benefits for each additional year of work. Hence, employees

[62] The personal discount rate represents the employee's time value of money, and is lower than the sponsor's discount rate used to calculate the value of liabilities in financial statements.
[63] Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds (2003).

reach peak pension wealth by working for the government until first eligible to claim benefits ($R_{i,t}$), and then separating and claiming immediately.[64]

Calculating peak wealth requires projecting each employee's wage profile for the years in which he is not observed in personnel records. Since future salary growth may be endogenous to the pension reform, this paper only observes employee salaries in 2003 and projects the remaining years based on wage-growth assumptions from the 2003 ERSRI and MERS actuarial valuation reports.[65]

Calculating Accrued RHI Wealth

Public employees in Rhode Island are also eligible for RHI benefits through their state or local employers provided that they vest in the pension. The dollar value of RHI benefits depends on the premium charged by the plan and the degree to which employers subsidize the premium. This study defines RHI benefits as the portion of RHI premiums paid by the employer.

The first step in the calculation of RHI benefits is to determine the total RHI premium charged by the insurance provider for employee *i* at age *a*. Information on RHI premiums for Rhode Island public employees is difficult to obtain prior to 2005, when the state and its localities began performing actuarial valuations for their RHI programs.[66] Consequently, this study relies on premiums described in the state's 2005 actuarial valuation (State of Rhode Island Retiree Health Care Benefits Plan 2005). These premiums vary by gender and age, particularly after age 65 when retirees are required to enroll in Medicare Part B and a supplemental plan through the state.[67] Although teachers and municipal employees participate in separate RHI plans administered by their local employers, an examination of 22 municipal and school district actuarial valuation reports reveals that the premiums are similar to the state plan.[68]

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[64] If the benefit adjustment for early retirement (EF_i) is actuarially fair, then peak wealth is associated with two different claiming ages (early and normal). In Rhode Island, early retirement was not available prior to 2005, and the subsequent adjustment penalizes employees for claiming early.

[65] Rhode Island's actuaries assume high salary growth in the first few years of tenure, decreasing to inflation over time.

[66] The Governmental Accounting Standards Board began mandating actuarial valuations for Other Post-Employment Benefits in 2004 with statements 43 and 45. State and local RHI plans are not typically pre-funded.

[67] Medicare part B premiums are available in the Medicare Trustees Report (Board of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds 2005).

[68] Municipal and school district actuarial valuation reports are available at: http://www.municipalfinance.ri.gov/pension-plans/municipal-reports/. The timing and frequency of these reports varies across local jurisdictions, with the earliest reporting beginning in 2010. This study examined the earliest report from each jurisdiction, provided that the valuation was performed prior to 2013 (at which point ERSRI and

Since the future trajectory of RHI premiums is highly uncertain in advance, this analysis projects premiums in other years using the actual growth of private health premiums prior to 2005 and expected growth afterwards. Actual premium growth is available from the National Health Expenditure Accounts for private insurance (Centers for Medicare and Medicaid Services 1991-2005), while expected growth comes from Rhode Island's 2005 OPEB actuarial valuation.[69]

$$Premium_{i,a} = Premium_{i,a,2005} * \prod_{t=2005}^{year\ at\ age\ a} Premium\ Growth\ Rate_t \quad \text{(A5)}$$

With the premium in-hand, the next step is to calculate the dollar value of the employer subsidy. State employees in Rhode Island were offered two types of subsidies in 2003. The first allowed them to purchase RHI at the state's active group rate prior to age 65. The second provided that the state would pick up a fixed percentage of their premium for the duration of their retirement. Hence, the employee's RHI benefit at age *a* may be written as:

$$State\ RHI\ benefit_{i,a,t} = Premium_{i,a} - \left(Active\ Premium_{i,a} * State\ Subsidy\ \%_{i,t}\right) \quad \text{(A6)}$$

The active premium in equation (A6) is projected using the same methodology as the retiree premium in equation (A5). Historical data on active premiums for state employees in Rhode Island proved difficult to obtain, so the base premium in 2005 is assumed to match the national average among state and local government employers.[70] Reassuringly, 2019 premiums data, gathered from Rhode Island's employee benefits website, show that this assumption performs well in later years. The other input to the projection – the percentage rate of the state subsidy – is set by plan provisions and varies based on final tenure at separation (in year *t*) and the age at which employees first claim RHI benefits. As plan provisions prevent state employees from claiming RHI before they are eligible to claim their pension, this analysis assumes simultaneous claiming.

MERS both underwent major restructuring). The jurisdictions in the sample of municipal and school district valuations represent about 40 percent of Rhode Island's population, and include both large (e.g. Providence and Warwick) and small (e.g. Foster and Little Compton) municipalities.

[69] The calculations assume that RHI premiums grow at a nominal 8 percent rate from 1991 to 2000, with growth decreasing from 12 percent to 4.5 percent between 2001 and 2015.

[70] The Kaiser Family Foundation and Health Research and Educational Trust (2005).

The employer subsidy for teachers and municipal employees varies across jurisdictions, but most employers paid 80% of the base RHI premium in the sample of actuarial valuations examined:

$$Teacher\ and\ Municipal\ RHI\ benefit_{i,a,t} = Premium_{i,a} * Local\ Subsidy\ \% \quad \text{(A7)}$$

The last step is to calculate the present value of the RHI benefits in 2003. As before, future RHI benefits are adjusted downward for the probability of continued survival and for the employee's personal discount rate:

$$RHI\ Wealth_{i,t} = \sum_{a=R_{i,t}}^{D} \frac{RHI\ Benefit_{i,a,t} * \Pr(Survival)_{i,a}}{(1+\delta_i)^{age\ in\ 2003-\ a}} \quad \text{(A8)}$$

State employees are assumed to claim RHI benefits at the same time as their pension benefits ($R_{i,t}$). However, claiming rules for teachers and municipal employees vary across jurisdictions, with half linking RHI claiming to the pension and half setting an independent claim age for RHI benefits (most often age 55). Unable to pick a simple rule – and lacking complete data on all jurisdictions – this analysis performs two sets of calculations: first, assuming that teachers and municipal employees all claim RHI at the same time as their pension; and second, assuming that they claim at age 55 (or immediately upon separation if working past 55).

Calculating Peak Benefit Wealth

As with peak pension wealth, peak benefit wealth is simply the maximum pension and RHI wealth that an employee could earn given his assumed wage profile:

$$Benefit\ Wealth_{i,t} = Accrued\ Pension\ Wealth_{i,t} + RHI\ Wealth_{i,t} \quad \text{(A9)}$$

$$Peak\ Benefit\ Wealth_i = max\begin{Bmatrix} Benefit\ Wealth_{i,tenure=0}, Benefit\ Wealth_{i,tenure=1}, \\ \dots, Benefit\ Wealth_{i,tenure=\infty} \end{Bmatrix} \quad \text{(A10)}$$

Equation (A10) almost always has a unique solution that yields an optimal level of tenure in government. Ties are arbitrated by taking the lowest level of tenure associated with peak benefit

wealth. A few older employees have already worked past their optimal tenure when observed in 2003, in which case "peak tenure" equals their current tenure.

Calculating the Dollar Value of Rhode Island's 2005 Pension Reform

The dollar value of lost benefit wealth due to Rhode Island's pension reform is calculated as the difference between peak benefit wealth under the pre-reform plan provisions and benefit wealth under the post-reform plan provisions at pre-reform peak tenure:

$$Lost\ Benefit\ Wealth_i = Peak\ Benefit\ Wealth_i - Post\ Reform\ Benefit\ Wealth_{i,tenure=pre\ reform\ peak\ tenure} \quad \text{(A11)}$$

Table A1 describes pre and post-reform provisions in ERSRI. In general, the reform reduced the benefit multipliers, extended the normal retirement age, and reduced the COLA. State nurses and correctional officers have slightly different benefit provisions than general state employees and teachers, and the reform did not affect them as severely. While Table A1 only describes provisions for general state employees and teachers (the majority of ERSRI members), the algorithm for calculating lost benefit wealth accounts for occupational differences. Lost benefit wealth is mechanically equal to zero for MERS members and ERS members with more than 10 years of tenure at the time of the 2005 pension reform, the groups that were not affected by the reform.

Appendix C: Methodology for Linking Personnel Records over Time

The personnel records provided by the Employees' Retirement System of Rhode Island did not include a unique numerical identifier that tracks individuals over time. This appendix provides a description of the matching procedure used create the missing identification number. The procedure employs three steps, described below.

Step 1: Match on Employee Name and Year of Birth

The majority of person-year observations receive an identification number based on a "naive" match of first name, last name, and year of birth. Names are cleaned to standardize inconsistencies across time by removing all spaces and punctuation, and changing Arabic numerals to Roman numerals (i.e. John Smith 111 became John Smith III). Because Rhode Island is a small state, less than one percent of observations in any given year have duplicate names and years of birth. Because they are so uncommon, the analysis drops these duplicate observations.

Step 2: Match Full-Time Employees Based on Prior-Year Wages and Tenure

Names occasionally change over time due to marriage or administrative misspellings, leading Step 1 to mis-identify a single employee as two separate people. This step attempts to rectify the problem by taking advantage of a variable in the dataset that records prior year wages. The dataset is cut to keep only the first and last observation of each identification number created in Step 1, as well as any observations surrounding a temporal discontinuity within the identification number (ie. an ID is observed in years 2004 and 2006, but not 2005). The remaining observations are then matched to each other if the following information aligns: 1) current and prior fiscal year; 2) current and prior-year wages; 3) current and prior-year tenure, where prior-year tenure is calculated as current tenure minus one; 4) sex; and 5) year of birth. Fortunately, these matching criteria are sufficiently detailed (and the Rhode Island public workforce is sufficiently small) that only three temporal discontinuities could potentially match to more than one other. In these rare cases, the algorithm does not attempt to assign a match.

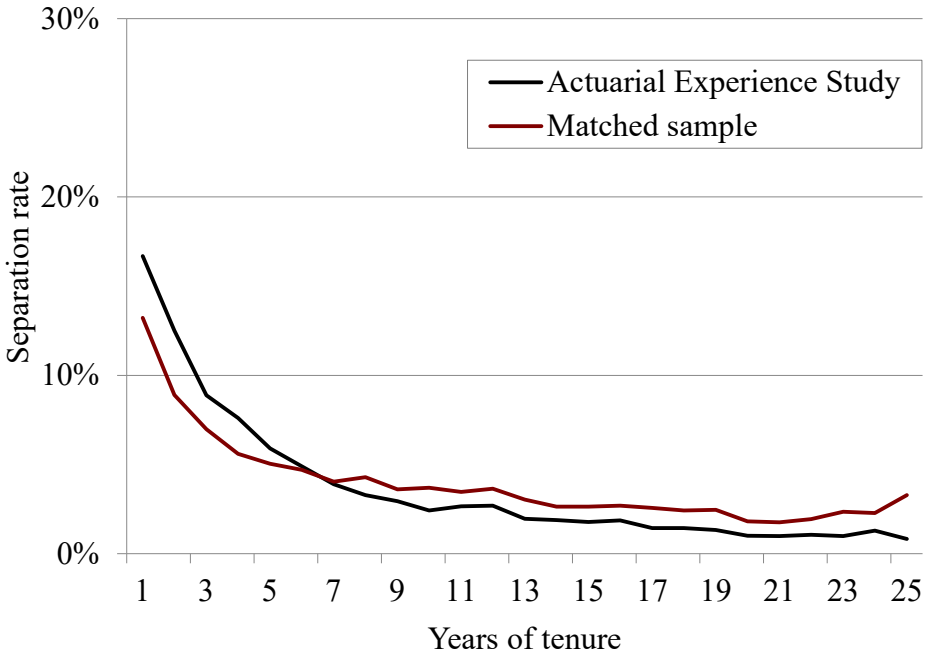
Steps 3: Match Part-Time Employees Based on Prior-Year Wages and Active Status

Step 2 only matches employees who earn a full year of service credit and ignores part-time employees. To rectify this omission, Step 3 replicates the procedure in Step 2 for any remaining temporal discontinuities, but only requires that tenure in the prior year be no greater than tenure in the current year. In order to limit the number of potential matches, Step 3 also requires that prior-year status (active, inactive, retired, etc.) be consistent with a current-year variable that records status in the prior year. As before, the matching criteria are sufficiently detailed that only four temporal discontinuities matched with multiple others; the algorithm does not assign a match when it detects duplicates.

Verify Accuracy

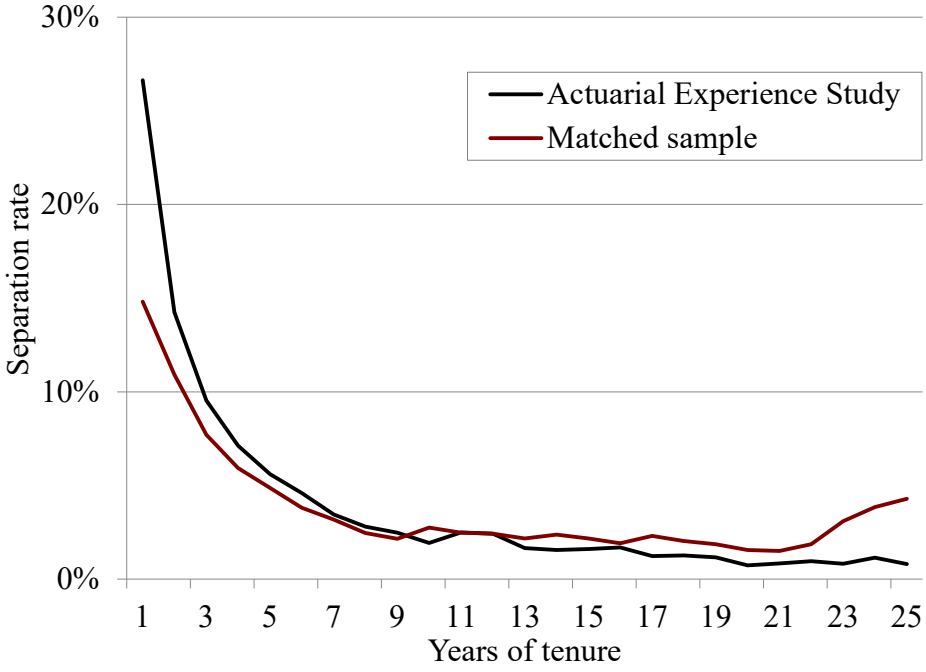
Ultimately, 91 percent of employees in the final dataset have identification numbers created by Step 1 only. An additional six percent receive identification numbers created by a combination of Steps 1 and 2, while the remaining three percent are assigned identification numbers based on a combination of all three steps. To check that the identification numbers are accurate, Figures B1-B3 display separation probabilities for member of ERSRI and MERS by occupation and years of accrued tenure. The figures contrast these probabilities with published termination rates from Rhode Island's most recent actuarial experience study (Employees' Retirement System of Rhode Island 2017). The two sources should produce the same rates because the official experience study is based on the same employment records employed in this analysis. However, the actuaries receive restricted data that contain employees' Social Security Numbers and so know exactly when an employee separates. In general, the rates calculated for this analysis are consistent those published by the actuaries, although this study tends to find less difference between short and long-tenured workers than the actuaries calculate. Importantly, deviations from the official rates are consistent across ERSRI and MERS.

Figure C1. *Separation Rates for State Government Employees by Accrued Tenure, 2007-2016*



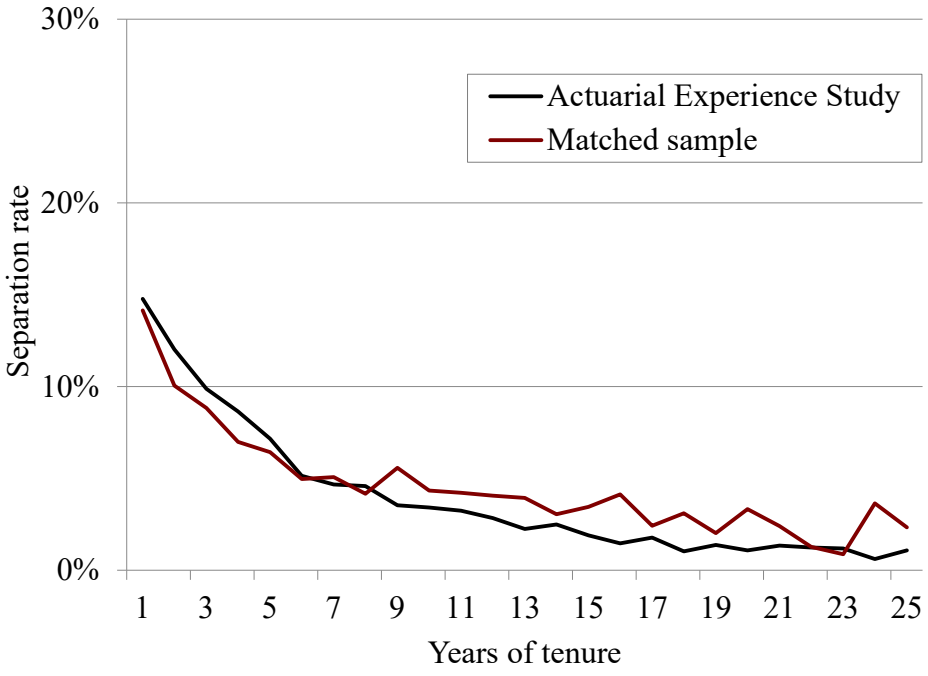
Sources: Authors' estimates from employment records provided by the Employees' Retirement System of Rhode Island (2003-2017); and published rates in Employees' Retirement System of Rhode Island (2017).

Figure C2. *Separation Rates for Teachers by Accrued Tenure, 2007-2016*



Sources: Authors' estimates from employment records provided by the Employees' Retirement System of Rhode Island (2003-2017); and published rates in Employees' Retirement System of Rhode Island (2017).

Figure C3. *Separation Rates for Municipal Employees by Accrued Tenure, 2007-2016*



Sources: Authors' estimates from employment records provided by the Employees' Retirement System of Rhode Island (2003-2017); and published rates in Employees' Retirement System of Rhode Island (2017).

Appendix D: Supplemental Results

Table D1. *Two-Period Triple Differences Estimates of the Effect of Benefit Cuts on Salary*

Variables	(1) Salary
Effect of cut	-2.27e-7
	(0.0001)
Constant	2934.736***
	(978.419)
Observations	142,044
R-squared	0.381
Year FE	Yes
ERS dummy	Yes
Post dummy	Yes
Low tenure	Yes
ERS * Post	Yes
Low tenure * Post	Yes
Low tenure * ERS	Yes
Service in 2003 FE	Yes
Age bracket in 2003 FE	Yes
Corrections in 2003 dummy	Yes
Nurse in 2003 dummy	Yes
Female dummy	Yes

Notes: Standard errors in parentheses are clustered at the individual employee level. *** p<0.01.
Source: Authors' estimates from employment records provided by the Employees' Retirement System of Rhode Island (2003-2017).