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Pay For Seniority: Do Back-Loaded Retirement Benefits Retain Government Employees?*

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Abstract

This study explores the effect of seniority pay on employee retention in the U.S. public sector. State-government employees in Michigan transitioned from a defined-benefit pension with 10-year vesting to a defined-contribution plan with immediate vesting. Participation in either plan depends on date of hire, permitting a regression-discontinuity research design. The shift away from back-loaded retirement benefits caused an eight percentage-point decrease in the probability of remaining in state service to earn 10 years of tenure. The probability of leaving with four to nine years of tenure increased commensurately. Older, highly educated workers were highly responsive to retirement-plan incentives, whereas younger workers did not adjust their labor supply.

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1 Introduction

Most civil servants in the United States participate in a generous employer-provided defined-benefit pension, but must remain in the government for many years in order to receive benefits. Since the mid 1990s, nearly 20 state employers partially or totally converted to defined-contribution retirement savings accounts that travel with employees through all career transitions (Munnell et al., 2014). The financial crisis of 2008 and ensuing recession intensified the debate around defined-benefit versus defined-contribution. Although financial health varies enormously across the more than 6,000 state and local defined-benefit pensions (U.S. Census Bureau, 2016), a number of government employers face large unfunded liabilities.¹ For example, pension costs could exceed 15 percent of own-source revenue in Illinois, New Jersey, Connecticut, and Kentucky if these states calculated their liabilities with semi-conservative discount rates and adhered to strict funding schedules (Munnell and Aubry, 2016).² Many county governments, particularly those in California, face a much greater cost burden. In contrast, defined-contribution plans do not guarantee benefit levels and thus are always fully funded.

Recent debate has paid little attention to the effect of pension design on the composition of the civil service, despite implications for employer cost and employee productivity. Workers who participate in a defined-benefit pension, but who are not yet eligible for retirement, earn benefits that increase exponentially with each additional year of tenure at the firm (Beshears et al., 2011; Costrell and Podgursky, 2009; and Poterba et al., 2007). In contrast, workers who save for retirement in a defined-contribution account often accrue a substantial portion of the final account balance in the early years of employment, since contributions earn interest over a long time horizon regardless of the worker's career trajectory. Hence, defined-benefit pensions are deferred compensation, encouraging workers to remain with one employer (Coile and Gruber, 2001; Lazear, 1986;

¹Immediately after the financial crisis of 2008, analysts valued the nation-wide unfunded pension liability at 0.5 trillion (eight percent discount rate) to 2.9 trillion (four percent discount rate). See Munnell et al. (2010) and Pew Center on the States (2010).

²The authors calculate pension costs assuming a six percent nominal discount rate and amortize unfunded liabilities over a closed 30-year period.

Stock and Wise, 1990; and Yellen, 1984). If workers value this seniority pay, then defined-benefit pensions should not only increase retention in the civil service, but also attract workers who are predisposed to long careers in government.

The empirical relationship between pension design and employee behavior is much less clear. Workers who are covered by defined-benefit pensions are also more likely to persist in their jobs (Allen et al., 1988; Ippolito, 1991; Mitchell, 1982; Munnell et al., 2012; and Stock and Wise, 1990). Government employers with generous defined-benefit pensions are better able to attract and retain highly skilled workers (Frazis and Loewenstein, 2013; and Munnell et al., 2015). However, pension design may correlate with unobserved aspects of personnel policy that also influence recruitment and retention.³ To address this issue, a number of studies estimate structural models where the probability of separation is related to discontinuous “kinks” in the amount of additional pension benefits earned for an additional year of service (Costrell and McGee, 2010; Costrell and Podgursky, 2009; Koedel et al., 2013; Ni and Podgursky, 2017). These analyses find that retirement spikes around the ages that workers become eligible for normal and early retirement, but that back-loaded benefits have little effect on mid-career labor supply.

Meanwhile, quasi-experimental evidence remains inconclusive. Brown (2013) and Koedel and Xiang (2017) both find no labor supply response to policies that improved the generosity of defined-benefit pensions (and hence increased the back-loading of compensation).⁴ Yet, Liebman et al. (2009) show that older workers adjust their labor supply in response to the Social Security benefit formula. Two recent studies reach opposite conclusions after examining policies that shifted employees from a defined-benefit pension to a defined-contribution plan. Clark et al. (2016) find that state employees in Utah were *less* likely to earn three years of tenure after the government scaled back its defined-benefit pension and added a defined-contribution component. Conversely, Goda et al. (2016) argue that employees were *more* likely to earn three years of tenure after

³For example, Gustman and Steinmeier (1993) find no difference in retention after controlling for detailed firm characteristics.

⁴Fitzpatrick (2015) estimates that teachers are only willing to trade 20 cents in wages for an additional dollar of pension benefits. Her results suggest that teachers may not value their pension benefits enough to alter career decisions.

their employer shifted from a defined-benefit to a defined-contribution plan. Thus, the effect of back-loaded compensation over the long run remains an open question worth investigating.

This paper examines how back-loaded retirement benefits affect employee retention over the long run. On April 1, 1997 the state government of Michigan closed its defined-benefit pension to new entrants and transitioned to a defined-contribution system. Members of the traditional pension were only permitted to collect benefits in retirement if they had earned 10 years of tenure in state government, whereas defined-contribution participants owned the contents of their savings accounts almost immediately. A simple accounting exercise indicates that older employees could have left the government after 10 years of service having earned (discounted) pension wealth equal to twice their salary at separation in either plan. Younger workers who left after a decade would have earned pension wealth worth a year's salary. As pension design in Michigan is based on date of hire, I identify the effect of seniority pay with a regression-discontinuity design and the detailed personnel records of all state-government employees. I assume that workers hired within a few months of each other would have turned-over similarly if they faced the same pension incentives.

I find that the shift to front-loaded retirement benefits increased the rate of employee turnover by at least 5 percentage points. Specifically, the probability of leaving state service with at least 10 years of tenure decreased by eight percentage points, on average, the probability of leaving with four to nine years of tenure increased commensurately, and the probability of leaving with less than four years remained the same (although the short-tenure result is only suggestive). Older workers – those in the top half of the age distribution of new hires – drove the entire effect, and older workers with college degrees were the most responsive to pension incentives.

These results suggest that governments seeking to restructure their pension should anticipate a younger workforce with increased turnover and less employer-specific human capital. Governments are likely to incur productivity losses as they recruit and train new

employees, particularly in highly skilled occupations. However, governments may also realize productivity gains as they encourage burned-out civil servants to leave for the private sector (Fitzpatrick and Lovenheim, 2014). The effect of seniority pay on agency-level productivity is thus an empirical question for future research.

2 Conceptual Framework and Empirical Context

Observers have long recognized that traditional pensions contain strong retention and retirement incentives. Defined-benefit pensions promise workers an annuity upon retirement – the value of which is set by plan provisions – contingent on a minimum period of employment. This tenure requirement is called the “vesting period,” and ranges from zero to 10 years in the public sector.⁵ Vested workers may collect an annuity once they reach the normal retirement age, which is usually age 65.⁶ The annual annuity payment is calculated:

$$A_t = \begin{cases} 0 & \text{if } s_t < v \\ b * w_t * s_t & \text{if } s_t \geq v \end{cases} \quad (1)$$

where b is a “benefit multiplier,” typically around 2 percent, w_t is the employee’s salary in year t , s_t is the total number of years that the employee served with the pension-granting employer as of year t , and v is the vesting period.⁷

Most public-sector employees make annual contributions to pre-fund their pension benefits.⁸ Non-vested workers who choose to leave the pension may reclaim their contributions, having earned a statutorily set, annual interest rate. Thus, defined-benefit pension wealth is determined by a step function that changes suddenly at the service requirement for

⁵The modal state/local vesting period is five years. Center for Retirement Research at Boston College and Center for State and Local Government Excellence (2014).

⁶Depending on the plan, workers may retire earlier if they satisfy age and service requirements. For example, several public plans allow workers to collect full benefits at age 50 if the workers attain 30 years of service.

⁷In practice, public pensions often define w_t as the average of the employee’s five largest annual salaries – typically those earned in the last five years of employment.

⁸Center for Retirement Research at Boston College and Center for State and Local Government Excellence (2014).

vesting. Were the worker to quit her job before vesting, she would earn the sum of her contributions plus interest. Were she to quit after vesting, she would receive the sum of a series of annuity payments.

In contrast, defined-contribution plans operate like savings accounts. Workers and employers contribute a set percentage of salary each year, which grows over time according to the return on a portfolio of investments chosen by the employee.⁹ Early-career contributions to a defined-contribution account increase in importance if the average long-run investment return exceeds the annual percent growth of contributions.

Consider a specific case to clarify the differences between defined-benefit pensions and defined-contribution plans. In 1997, the state government of Michigan closed its traditional defined-benefit pension and enrolled new hires in a defined-contribution retirement savings plan. The new defined-contribution plan significantly reduced the financial rewards for long tenure. In particular, members of the old defined-benefit pension needed to remain employed with the state government for at least 10 years in order to earn any retirement benefits. In contrast, defined-contribution participants vest incrementally over a four-year period. Otherwise, the two plans are fairly representative of their types; Table 1 details their provisions.

Figure 1 demonstrates pension incentives in Michigan by simulating the retirement wealth of two hypothetical state workers.¹⁰ Although they enter state service in the same year, one worker participates in the defined-benefit pension and the other saves in a defined-contribution account. Each year of employment, the workers calculate the present value of the total pension wealth earned to date in their respective plans. For comparison, I vary the age of the workers at hire (ages 30 and 40), but always assign a \$20,000 starting salary.¹¹ Each year, salaries increase with inflation, an additional year of tenure is credited

⁹Contributions removed from the account before age $59\frac{1}{2}$ incur a federal tax penalty, which is typically 10 percent, but is subject to exemptions. After retirement, distributions from defined-contribution plans that were funded with pre-tax assets are taxed as income. Benefits from a public defined-benefit pension are also subject to federal taxes. See www.irs.gov for more information.

¹⁰See Poterba et al. (2007) for a sophisticated simulation of defined-benefit and defined-contribution wealth that accounts for investment risk.

¹¹Changing the workers' starting salary does not greatly affect the simulation.

to the defined-benefit pension, and 10 percent of salary is contributed to the defined-contribution plan (the default employee and employer total contribution rate).¹² The defined-contribution member invests her savings in a safe portfolio yielding a two-percent real return. I assume that wage inflation is three percent and that workers discount future wealth by a nominal five-percent rate.¹³ Figure 1 displays retirement wealth as a fraction of annual salary net of employee contributions. Given the assumptions, workers who separate with 9 years of tenure earn approximately one year’s salary from their defined-contribution accounts, but nothing from the defined-benefit pension. However, the defined-benefit plan is substantially more generous to long-tenure workers; those who persist with the State of Michigan until age 60 earn twice as much from the defined-benefit pension as from the defined-contribution plan.¹⁴

Differences in retiree health-insurance benefits somewhat attenuate the incentives generated by pension design. All state employees in Michigan receive employer-provided health insurance after retirement, premiums for which are subsidized by the state after 10 years of tenure.¹⁵ Although the exact value of this subsidy is difficult to calculate due to rising health costs and negotiations between providers and the state, vested defined-benefit members are all offered the same subsidy regardless of tenure at retirement.¹⁶ Conversely, defined-contribution members receive a back-loaded subsidy: 30 percent after 10 years of tenure, increasing linearly to 60 percent after 20 years of tenure (Michigan Office of Retirement Services (d), 2005). However, the subsidy for long-tenured defined-contribution members is still less generous than the subsidy for defined-benefit members. Defined-contribution members can also choose to forgo the subsidy in favor of a Personal Healthcare Fund, a portable savings account to which employees and employers both contribute.¹⁷ Hence, defined-benefit members who left state government without vesting

¹²Employees do not contribute to Michigan’s defined-benefit pension, but do fund their defined-contribution accounts.

¹³I calculate the present value of an annuity using the RP-2000 mortality tables – specifically, a 50-50 combination of the male and female healthy annuitant tables.

¹⁴The results of this exercise are similar to Diamond et al. (2010).

¹⁵The Michigan Civil Service Commission administers the retiree health-insurance plan.

¹⁶In 2017, for example, vested defined-benefit members below age 65 received either an 80-percent subsidy or a 58-percent subsidy, depending on the provider; those above age 65 received either a complete subsidy or a 75-percent subsidy (Civil Service Commission Employee Benefits Division, 2018).

¹⁷Defined-contribution members re-hired after January 1, 2012 with at least 10 years of tenure also

still gave up a larger retirement benefit than defined-contribution members who leave with short tenures.

2.1 The Turnover Decision

This section illustrates how back-loaded retirement benefits could influence employee turnover. Imagine that employee i receives satisfaction from job j according to the utility function:

$$U_{i,j} = f[R_t] + M_{i,t} \quad (2)$$

where t denotes years of tenure, $f[\cdot]$ is a positive, concave function of monetary benefits (R_t). $M_{i,t}$ is a linear function that reflects the employee's taste for other amenities of the job, including the wage and enjoyment of daily activities. The slope of $M_{i,t}$ is employee-specific and drawn from a distribution. Positive values of this slope ($M'_{i,t}$) indicate that the employee enjoys the job and gains utility from time spent working. Negative values penalize the employee for remaining on the job.

In addition to a wage, the job offers monetary benefits including a retirement plan and health insurance. The job offers one of two types of monetary benefits: back-loaded (BL) benefits defer compensation until the employee has achieved long tenure; front-loaded (FL) benefits award compensation earlier in the employee's tenure. Concretely:

$$R_{BL} = 0 \text{ and } R_{FL} > 0 \text{ if } t = \textit{short}$$

$$R_{BL} = 0 \text{ and } R_{FL} > 0 \text{ if } t = \textit{medium}$$

$$R_{BL} > 0 \text{ and } R_{FL} > 0 \text{ if } t = \textit{long}$$

Employees who leave the job j receive utility from an outside option: U_o . The value of the outside option does not depend on the structure of the monetary benefits offered by job j . The outside option is either another job at a different firm or leisure, depending

qualify for a \$1,000 to \$2,000 employer top-up to a Health Reimbursement Account.

on the employee's age.

Employees decide whether to accept job j and, if so, the duration of their future tenure (t). For simplicity, assume that newly hired employees pick t from one of three options: short, medium, or long. The employee's problem is solved by first determining the optimal length of future tenure and then comparing the optimal utility from job j against the utility offered by the outside option. Of particular interest is how the employee's choice changes when R_t is back-loaded instead of front-loaded.

To begin, consider the employee's choice of t if monetary benefits are back-loaded (the current status quo in the public sector). If the employee enjoys the job ($M' > 0$) then $t = long$ dominates both $t = short$ and $t = medium$. If the employee dislikes the job ($M' < 0$) then the choice becomes a trade-off between the gains from compensation and the loss from tastes. In this case, $t = medium$ is dominated by either $t = short$ or $t = long$. Intuitively, the worst choice for the employee is to remain on the job for a substantial period of time, but not quite long enough to receive the deferred compensation. Whether $t = short$ ultimately dominates $t = long$ depends on the magnitude of M' . The conclusion from this exercise is that, when monetary benefits are back-loaded, employees have either very short or very long tenures at the firm. Assuming a symmetrical distribution of tastes for the job's activities, centered on indifference, then more employees have long tenures than short ones.

How does the conclusion change if the job instead offers front-loaded benefits? Employees who enjoy the daily activities of the job still prefer $t = long$. However, employees who dislike their daily activities are more likely to pick $t = medium$ than before because they receive some monetary benefits to compensate for the time spent working. Hence, the front-loading of monetary benefits smooths the turnover pattern among employees in job j .

Of course, rational employees will not accept the job j if it fails to deliver utility at least as great as the outside option. Assume that taste for a job ($M_{i,t}$) is uncertain in advance,

but learned immediately after starting the position.¹⁸ Prospective new hires compare the expected utility from job j with the utility of their outside option, U_o . Employees calculate the expected utility of job j based on subjective probabilities of ultimately having a short tenure ($\pi_{i,short}$), a medium-length tenure ($\pi_{i,medium}$), and a long tenure ($\pi_{i,long}$). The probabilities are derived from the employee’s perception of the distribution of $M_{i,t}$ and sum to one. Hence, the expected utility from job j may be written:

$$E[U_{i,j}] = \pi_{i,short}U_{i,j}(t = short) + \pi_{i,medium}U_{i,j}(t = medium) + \pi_{i,long}U_{i,j}(t = long) \quad (3)$$

Prospective new hires will only accept job j if the expected utility exceeds the certain utility of the outside option:

$$Accept \text{ if } E[U_{i,j}] \geq U_o \quad (4)$$

Employees with a high subjective probability of “mis-match” (large negative values of $M'_{i,t}$) are less likely to accept the job if monetary benefits are back-loaded than if benefits are front-loaded.¹⁹ Thus, not only do back-loaded benefits discourage medium-length tenure among already-hired employees, they also discourage employees who believe that they will likely want to leave the job from taking a risk and accepting it in the first place.

Together, these turnover and hiring dynamics imply that back-loaded benefits *increase* the probability that newly hired employees remain employed for long periods and *decrease* the probability of medium-length tenure. The effect of back-loaded benefits on the probability of short-tenure is ambiguous: on the one hand, some employees leave earlier than they would have otherwise; on the other hand, prospective new hires only accept the job if they anticipate a long tenure.

Finally, translate this conceptual framework into the present empirical context – retire-

¹⁸While monetary compensation is known with certainty in advance, future enjoyment of daily activities is less obvious.

¹⁹Because $U_{i,j,BL}(t = short) < U_{i,j,FL}(t = short)$.

ment benefits in the U.S. public-sector – and consider how the effects of back-loaded benefits might vary among employees of different ages and education levels. The tenure of middle-aged employees should be more responsive to the back-loaded or front-loaded structure of retirement benefits than the tenure of young new-hires. Middle-aged employees receive relatively high utility from retirement benefits because they discount the value of these benefits over a shorter time horizon.²⁰ Older new hires, however, should be less responsive to back-loaded retirement benefits than middle-aged employees. New hires who are already near the pension’s normal retirement age earn less retirement wealth than middle-aged colleagues for the same period of tenure because the older workers cede benefit payments by continuing to work.

Similarly, the tenure of highly educated civil servants might be more responsive to back-loaded benefits because their outside options are relatively more attractive. The national distribution of public-sector wages is compressed relative to the private sector. Less-educated employees in manual and clerical occupations often earn a wage premium in the public sector, while highly educated workers in professional and administrative occupations often suffer a wage penalty (Belman and Heywood, 1989; Borjas, 2002; and Katz and Krueger, 2000).²¹ Holding U_o constant, wage premiums and penalties enter the model by influencing $M'_{i,t}$. Highly educated civil servants have lower values of $M'_{i,t}$, all else equal. In this framework, highly educated employees are less likely to automatically choose $t = long$ and instead consider the utility from monetary benefits when making tenure and entry decisions.

3 Empirical Design

In practice, state employees in Michigan only participate in one type of retirement plan and the assignment depends on their date of hire. Employees hired before March 31,

²⁰Note that the date on which the benefits are available for consumption may be different from the period of tenure necessary to earn the benefits (vesting period).

²¹Mas (2014) shows that taxpayers are averse to paying high wages to public administrators irrespective of the administrators’ productivity.

1997 default into the defined-benefit pension, while those hired on or after March 31, 1997 receive the defined-contribution plan. Defined-benefit members could switch plan types during a four-month period in 1998, and a few workers hired after March 31, 1997 participate in the traditional pension due to past service with the state. Nevertheless, this statutory threshold for defined-contribution participation enables an empirical design similar in spirit to a regression discontinuity, where I ascribe differences in turnover among workers hired a few months apart to the design of their pension plans.

Specifically, I estimate the equation:

$$Y_i = \alpha + \beta_1 HireDate_i + \beta_2 Threshold_i + \beta_3 (HireDate_i * Threshold_i) + \epsilon_i \quad (5)$$

where Y_i is a dichotomous variable equal to one if worker i remains employed by the state of Michigan for at least 10 consecutive years. $HireDate_i$ measures the distance, in days, from the employee's date of hire to March 31, 1997. Employees hired prior to March 31, 1997 have negative values of $HireDate_i$, while those hired after have positive values. Coefficients β_1 and β_3 allow the linear relationship between hire date and persistence to change slope after March 31, 1997. β_2 captures any discontinuous change in the separation probability at $HireDate_i = 0$. Hence, β_2 identifies the causal impact of pension design from the behavior of workers hired in close proximity. I estimate the regression with Ordinary Least Squares, observing each employee only once.

Equation 6 explores how the effect of hire date on persistence varies according to demographic characteristics. Define an indicator variable, D_i , that equals one if worker i falls into a particular demographic category. The interaction of D_i with $Threshold_i$ separately estimates the regression discontinuity coefficient for each worker category:

$$Y_i = \alpha + \beta_1 HireDate_i + \beta_2 Threshold_i + \beta_3 (HireDate_i * Threshold_i) + \beta_4 D_i + \beta_5 (HireDate_i * D_i) + \beta_6 (Threshold_i * D_i) + \beta_7 (HireDate_i * Threshold_i * D_i) + \epsilon_i \quad (6)$$

This empirical design assumes that workers hired within a few months of each other would turnover similarly if they faced the same pension incentives. In particular, the design assumes that workers hired around the threshold for defined-contribution participation face the same working conditions in state government and labor market conditions outside of government at any point in time. Fortunately, defined-benefit and defined-contribution members enjoy similar workplace and pre-retirement compensation policies.²² Cyclical hiring could pose a problem, if the state government advertises different types of open positions at various points of the year, and position type is associated with subsequent tenure. To remove potential bias from cyclical hiring, the regressions control flexibly for employee age, gender, total annual salary in 2001, job category, and employer (agency) in 2001.²³ Of course, all of these employee characteristics could also be endogenous to retirement plan design. Fortunately, including the controls has almost no effect on the results.

Did the Great Recession suddenly shock the labor market in ways that could bias the results? According to the National Bureau of Economic Research (2017), the Great Recession began in December of 2007, reaching its nadir in June of 2009. Because workers hired into Michigan state government around April 1, 1997 achieved 10 years of tenure months before the recession commenced, the outcome variable Y_i should not shift discontinuously due to macro-economic conditions. Note, however, that this argument does not apply to workers hired far from the threshold. For example, employees hired in 1999 should have been more likely to earn 10 years of tenure than workers hired in 1995, since the dearth of private-sector opportunities in 2009 would have made state employment very attractive. Fortunately, I demonstrate in Section 5.1 that the conclusions do not depend on the exact sample of workers used to estimate the regression discontinuity.

²²Employees of the State of Michigan belong to collective bargaining units that negotiate occupation-specific labor contracts. The contracts in effect for 2016 do not appear to differentiate between workers based on pension participation. Contracts are available on the website of the Office of the State Employer.

²³I control for total annual salary by assigning each employee a percentile position in the 2001 distribution of state salaries and then indexing deciles with binary indicators. Job categories are determined by the Michigan Civil Service Commission. “Highly educated” occupations include those classified as administrative, professional, and technical.

4 Data and Descriptive Statistics

The State of Michigan Office of Retirement Services provided longitudinal personnel records for members of the State Employees Retirement System. The data include all defined-benefit and defined-contribution members employed by state government agencies between 2001 and 2014.²⁴ Personnel information includes: retirement plan, age, gender, employer name, position title, total salary, date of hire (by employer and position title), and date no longer active in the pension system. Workers hired near the threshold for defined-contribution participation have already accrued four years of tenure when I begin observing them in 2001. Hence, the main results focus on the probability that short-tenured workers remain employed by the government over the long run. Whether back-loaded benefits increase turnover overall also depends on the probability that newly hired employees remain with the government over the short run. I defer further discussion of newly hired workers until Section 6, which examines separation probabilities published in the state’s *Actuarial Valuation Reports*.

All told, the personnel data track nearly 120,000 employees in 52 State Government agencies. Figure 2 reveals that the number of state employees in Michigan has been declining over time. To reduce noise from part-time and contingent employment spells, I exclude workers filling multiple positions or employed by the State Legislature (Senate or House of Representatives).²⁵ Among workers who satisfied these restrictions, defined-contribution membership rose from 30 to 70 percent between 2000 and 2014 (Figure 3).

I define separation as ceasing to participate actively in either of the state plans.²⁶ Workers who separate often return to state service at a later date; I consider returns to be independent employment spells. To the 60 percent of employment spells lacking official separation dates, I assign the last day of the last fiscal year in which the employment spell is observed in the dataset.²⁷ The rate of separation from employment spells aver-

²⁴The Office of Retirement Services no longer maintains records prior to 2001.

²⁵The analysis sample includes protective service and corrections workers, but excludes university faculty and staff who participate in the Public School Employees’ Retirement System.

²⁶This definition is functionally equivalent to: “cease to receive a salary.”

²⁷I define each employment spell as a combination of worker and hire date.

aged around 10 percent between 2001 and 2014, with noticeable increases in 2001, 2002, 2009, and 2010 due to early retirement incentive programs (Figure 4).²⁸ Figure 5 shows that workers were most likely to separate within the first two years of employment and after becoming eligible for retirement.²⁹ The average age of new hires ranged from 33 to 35.

The regression-discontinuity analysis focuses on workers hired within two years of the threshold for participation in the defined-contribution plan (April 1, 1995 through April 1, 1999). A two-year bandwidth ensures sufficient support to control for potential bias from cyclical hiring.³⁰ Table 2 displays summary statistics for the main analysis sample, approximately 9,000 workers in total.³¹ Defined-benefit and defined-contribution members have similar ages, gender, and salaries. Note that salaries in 2001 appear unusually low. I suspect an error in the personnel records because the median employee received a 90-percent raise between 2001 and 2002. Fortunately, there is a strong correlation between salaries in the two years, and substituting 2002 salaries for the faulty 2001 records does not alter any conclusions.³² As expected, defined-benefit members were hired earlier, on average, and show signs of enhanced persistence, being 7.8 percentage points more likely to remain with the state for 10 consecutive years.

Table 2 also compares worker characteristics across two education groups. The first group, which I label “highly educated,” contains workers whose position titles in 2001 were classified as Officials/Administrators, Professionals, or Technicians by the Michigan Civil Service Commission. Typically requiring at least a college degree, the most common occupations in this group include: Social Services Specialist, Parole Officer, Family Independence Agency Specialist, Information Technology Programmer/Analyst,

²⁸National Association of State Retirement Administrators (2013).

²⁹Current tenure is measured from the date of hire to the end of the current fiscal year (September 30). Total tenure is measured from the date of hire to the date of separation. Note that I underestimate the tenure of workers who transitioned in and out of government service before 2001, since I do not observe their previous employment spells. Occasional errors in the hire and separation dates produce negative tenure; between 2001 and 2014, fewer than one percent of person-year observations were awarded negative tenure.

³⁰Section 5.1 replicates the analysis using alternate bandwidths without changing the conclusions.

³¹The sample size drops precipitously due to the restriction on hire dates.

³²The correlation coefficient exceeds 0.87.

Nurse, and Attorney. The “less educated” group encompasses workers considered to be Protective Service, Para-Professionals, Administrative Support, Skilled Craft, and Service/Maintenance. These occupations require fewer years of formal training, and include: Corrections Officer, Word Processing Assistant, Assistant Payments Worker, and Secretary.

To obtain the education classifications, I merged position titles in the personnel records with a database of job-category codes available on the website of the Michigan Civil Service Commission. These codes categorize each position as either: Administrative, Professional, Technical, Peace Officer, Para-Professional, Administrative Support, Skilled Craft, or Maintenance. Position titles change over time and the earliest archived database of job codes covers the 2003-04 fiscal year. I extended the database back to 2001-02 by examining historical job descriptions on the Civil Service Commission’s website, preserved by the Internet Archive in 2002.³³ To reduce reliance on subjective coding, I only imputed job categories for position titles in the personnel records that exactly matched an archived job description.³⁴ The archived descriptions typically listed a skill category, but I was occasionally forced to deduce the category from education requirements and responsibilities.³⁵ Of the 9,079 workers in the main analysis sample (Table 2), 798 could not be found in the 2003-04 classification database and 304 were still missing classification codes in the final data set (most often due to imprecisely-abbreviated position titles in the personnel records). Table 2 shows that employees in the highly educated group earned around \$5,000 more, on average, than their counterparts in the less-educated group despite being similarly aged.

If job candidates strategically altered their hire dates to participate in a preferred retirement-benefits package, then worker characteristics might vary discontinuously around the

³³Historical job descriptions cover the universe of civil service positions in that year. I impute missing job categories for workers in the Retirement Systems data who were hired between April 1, 1993 and April 1, 2000 and were still employed in fiscal year 2001.

³⁴I also imputed codes for position titles in the Retirement Systems data that contained obvious typos or abbreviations.

³⁵The Michigan Civil Service Commission publishes job-category definitions on its website. Job descriptions missing a category but requiring the applicant to have at least some college credits were coded as “professional.”

March 31, 1997 threshold (McCrary, 2008). For example, younger candidates might expect a shorter tenure and wait to apply for state employment until eligible for the defined-contribution plan. Figure 6 plots the total number, mean age, mean salary, and fraction less-educated of workers in the main analysis sample against employment start date. Hiring was clearly restrained in the months leading up to April 1, 1997 (panel a). Workers either preferred the front-loaded benefits package, or employers implemented a hiring freeze in anticipation of the pension legislation. Although the distribution of employee age is smooth around the threshold (panel b), panels (c) and (d) reveal a clear spike in the average salary of those hired right before April 1, 1997 as well as a dip in the probability that these workers are less educated. To check for bias from a potential hiring freeze, I replicate equation (5) with a donut-hole regression-discontinuity sample that drops workers who were hired within three months of March 31, 1997. As a robustness check, I also extend the donut hole to workers hired within six months of the threshold – the entire period of depressed hiring. The regression-discontinuity coefficients are remarkably insensitive to the size of the donut hole.

5 Results

Before examining employee retention, first confirm that defined-contribution membership depends on date of hire. Panel (a) of Figure 7 plots the fraction of employees participating in the defined-contribution plan against date of hire. Workers hired after March 31, 1997 are about 60 percentage points more likely to participate in the defined-contribution plan than the defined-benefit pension. To formalize this result, columns (1) and (4) of Table 3 reports the regression-discontinuity coefficient, β_2 , estimated by equation 5. Table 3 presents two sets of estimates for each outcome variable: the first draws on the full sample of workers described in Table 2, while the second also drops workers hired between January 1, 1997 and July 1, 1997 (three months on either side of the threshold). Unsurprisingly, crossing the hire-date threshold increased the probability of defined-contribution membership by a highly significant 71 percentage points.

Turning to the main analysis, panel (b) of Figure 7 displays the probability of persisting with the state of Michigan for at least a decade based on date of hire. Ten-year persistence dropped by about seven percentage points when workers crossed the threshold for defined-contribution participation – from around 82 percent to 75 percent. Columns (2) and (5) of Table 3 measure this effect as 7.2 or 5.9 percentage points, depending on the sample. Columns (3) and (6) account for workers who switch pensions by instrumenting for defined-contribution membership with date of hire using Two-Stage Least-Squares. The instrumental variables estimates suggest that pension portability decreased 10-year retention by eight to 10 percentage points, depending on the sample.

Who was the marginal employee? The conceptual framework in Section 2 predicted heterogeneous treatment effects by age and education. In particular, younger workers should be less responsive to pension incentives because they are further from retirement and discount future benefits over a longer time horizon. Highly educated workers should be more responsive than less-educated colleagues because their public-sector salary is low relative to private-sector alternatives.

To simplify the presentation, I define a “younger worker” to be younger than the median age in 2001. An examination of the age distribution reveals the median age to have been 37 (hired at age 33), with 95 percent of employees hired younger than age 51.³⁶ I interact the $HireDate_i$ and $Threshold_i$ variables with a binary indicator equal to one if the worker met the “younger” definition. Columns (1) and (5) of Table 4 present the ensuing regression discontinuity coefficients, also displayed graphically in panels (c) and (d) of Figure 7. Crossing the hire-date threshold decreased the 10-year retention of older workers by 10 percentage points. Conversely, younger workers did not adjust their labor supply.

Columns (2) and (6) of Table 4 exchange the “younger” indicator for a binary variable equal to one if the worker’s occupation classified as highly educated in 2001: administrative, professional, or technical. We see weak evidence that highly educated workers

³⁶Since most “older” workers were hired 10 years prior to the normal retirement age, their pension accruals resemble Figure 1.

were more sensitive to pension portability than their less-educated colleagues. However, workers who earned salaries in the top half of the government’s 2002 distribution were equally likely to become more mobile than their below-median colleagues (columns 3 and 7).³⁷ High-earners include not only highly educated workers, but also managers in less-educated occupations.

Did the mobility of older workers depend on education level? To explore this question, I re-estimate the regressions in columns (2) and (6) of Table 4 on the sub-sample of workers age 37 and above in 2001. Table 5 exhibits the first stage, reduced form, and instrumental variables estimates for this specification, while panels (e) and (f) of Figure 7 depict the regression graphically. Front-loaded retirement benefits caused a 34 to 38 percentage-point decrease in 10-year retention among highly educated older workers. Less-educated older workers were only seven percentage points less likely to remain. The difference in magnitude between these two effects is highly statistically significant.

How much longer did older workers remain in state service because of back-loaded benefits? If workers fully understood defined-benefit incentives, then those who were more than 10 years away from the normal retirement age should not only have persisted to vest, but also have been more likely to persist conditional on vesting. Consider the benefit accrual pattern of Michigan’s traditional pension – the shape of the curve in Figure 1. The worker earns exponentially more defined-benefit wealth from remaining with the state for another year, even relative to salary: $\frac{\partial(W^{(DB)}_t)}{\partial t} > 0$. Meanwhile, the additional pension wealth gained in the defined-contribution plan, due to an additional year of tenure, remains constant over the worker’s career: $\frac{\partial(W^{(DC)}_t)}{\partial t} = 0$. However, workers might not have understood the exponential growth of defined-benefit wealth and reacted solely to the vesting period – a plan provision that is clearly explained in pension documentation provided by the Michigan Office of Retirement Services. Moreover, employees who became eligible for normal retirement immediately after vesting were unlikely to persist longer in state service because they would have forfeited potential annuity payments.

³⁷I limit the regression sample to workers still employed in 2002 so as not to rely on the seemingly faulty 2001 salary data. The 2002 distribution of salaries includes all state employees. Workers who held positions in two agencies are counted twice.

I re-estimate equation 6 three times, changing the dependent variable to equal one if the worker leaves state service with fewer than 10 years of tenure, 10 to 11 years of tenure, or more than 12 years. I only report results from the donut-hole specification for ease of presentation. Table 6 documents the regression discontinuity coefficients, instrumenting for defined-contribution membership with date of hire. Older workers were 15 percentage points *more* likely to leave with four to nine years of tenure under the front-loaded benefit structure, equally likely to leave with 10 to 11 years, and 16 percentage points *less* likely to leave with 12 or more years. Since the median older worker was 15 years away from the normal retirement age, I conclude that the marginal worker remained in state service until eligible to receive pension and retiree-health benefits.

5.1 Robustness Checks

This section confirms that the results are not driven by misspecification of the regression discontinuity equation, a hiring freeze, or seasonal recruitment patterns that could affect retention. Since regression-discontinuity estimates can be sensitive to specification when the association between the outcome and running variables is non-linear, Table 7 examines how bandwidth affects the coefficients. Columns (1) through (3) all replicate column (5) of Table 4, the effect of hire date on the retention of older workers (donut-hole sample). Each iteration limits the sample to workers hired within a growing window of the March 31, 1997 threshold. The effect of hire date on retention is always negative and substantial in magnitude, ranging from a 14.7 percentage-point decrease with a bandwidth of one year to a 7.5 percentage-point decrease with a bandwidth of three years.

Density tests in Section 4 suggested worker sorting around the defined-contribution threshold because of weak hiring during the six months prior. If personnel policy – such as a hiring freeze – caused employers to only hire certain types of employees who also tended to remain longer in government, then the “causal” estimates are artificially large. Column (4) of Table 7 re-estimates the effect of hire date on the retention of older workers, but extends the donut hole to drop workers hired within the six months before

and after March 31, 1997. Since the new coefficient is nearly identical to prior estimates, I conclude that the state’s hiring policy is unlikely to have biased the results.

Removing or changing the control variables in equation 5 does not affect the story either. Continuing to focus on the 10-year retention rate of older workers (donut-hole sample), the first column of Table 8 removes all demographic controls, while the second column switches the salary decile indicators to log salary in 2001. The third column replaces potentially faulty 2001 salary data with log salary in 2002, limiting the sample to workers who were still employed in that year. Results from these specifications resemble previous estimates.

Lastly, I conduct a placebo test to ensure that the discontinuity around March 31, 1997 is not simply due to seasonal hiring or retention patterns. Table 9 considers the 10-year retention of older workers, as before, but changes the threshold for defined-contribution participation to April 1, 1995. Choosing a placebo year prior to 1997 prevents workers hired near the threshold from attaining 10 years of tenure during the Great Recession (2008 through 2010). For consistency with the main analysis, Table 9 considers workers hired during the two years before and after the placebo threshold, but not those hired from January to July, 1995. April 1, 1995 is the first point where a two-year bandwidth does not overlap the actual policy change. As expected, crossing the placebo threshold does not affect the probability of remaining in state service for a decade or more.

6 Short-Run Turnover of Newly Hired Employees

An unfortunate limitation of the personnel records is the lack of data prior to 2001, which has thus far prevented an analysis of retention during the first four years of employment. This section attempts to ameliorate the omission by offering suggestive evidence from *Actuarial Valuation Reports*. Recall that the conceptual framework in Section 2 predicted that back-loaded retirement benefits should decrease the frequency of long tenures at separation in favor of medium-length tenures, but was less clear about the frequency

of short tenures at separation. Given prior results, anything short of a decrease in the frequency of short tenures at separation would imply that turnover increased across the entire workforce as a result of the policy change.

Every year, the largest public pensions in Michigan publish *Actuarial Valuation Reports* where plan actuaries calculate the total liability owed to future retirees. In order to perform the valuations, actuaries must make assumptions about employee behavior, including the probability of separation at different tenures. These separation assumptions were updated in 1994, 1998, 2004, and 2010; they typically represent the average probability of separation over the previous five-year period.³⁸ I consider the separation probabilities adopted in 1998 (based on the years 1992 to 1997) to be reflective of turnover patterns among defined-benefit members in the years immediately prior to the switch to a defined-contribution plan. Since the retirement system's actuaries ceased to update the short-tenure turnover probabilities in subsequent valuations, I compare the official probabilities before 1997 to ones that I calculated from the personnel records after 1997.

The challenge is to understand how broader labor market conditions affected turnover during this period. To this end, Michigan's Public School Employees Retirement System (MPERS) serves as a reference point. MPERS was a traditional defined-benefit plan until 2010, when it converted to a hybrid defined-benefit/defined-contribution system.³⁹ The first set of post-1997 separation probabilities for MPERS that I can imitate with state personnel data concern the period 2002 to 2007.⁴⁰ With separation probabilities in hand for both retirement systems, before-and-after 1997, I calculate the cumulative probability of remaining in each retirement system for four years, conditional on the period of hire.

³⁸Michigan Office of Retirement Services (a) (1992-2012).

³⁹In 2012, school employees in Michigan were also offered a purely defined-contribution plan. Michigan's other large state-administered pension, the Municipal Employees Retirement System, has long offered participating employers the option of enrolling employees in a defined-contribution or hybrid plan, and so is not suitable as a reference point.

⁴⁰MPERS began to report the probabilities by occupation (teacher/non-teacher) and salary (over/under \$20,000) in 2010. Absent detailed demographic information, I assume that 50 percent of the plan's members are teachers and all earn more than \$20,000. Fortunately, the conclusions are robust to assuming that either zero percent of the workforce are teachers, or 100 percent are teachers.

Figure 8 plots the cumulative probability of remaining to earn four years of tenure, in each plan, against year of hire. The probability of persistence in the State Employees Retirement System barely changed before and after the shift to a defined-contribution plan, hovering around 57 percent. Conversely, the probability of remaining in MPSERS for four years increased by nearly 10 percentage points over the same period. Of course, the experience of MPSERS does not necessarily mean that state employees would have been 10 percentage points more likely to remain for four years had their retirement benefits not been front-loaded. Public-school employees may face unique external and internal labor market conditions that affect their decision to remain in government. Nevertheless, Figure 8 strongly suggests that newly hired state employees were *not more likely* to remain for four years after benefits were front-loaded. A finding of no change in turnover is consistent with the conceptual framework, since defined-contribution members must also remain employed for four years to vest fully in their benefits.

What would an assumption of no change in turnover, during the first four years of tenure, imply about the probability of new hires remaining in state government for at least 10 years? Estimate the overall probability as: $P(4 \text{ years tenure} \mid \text{new hire}) * P(10 \text{ years tenure} \mid 4 \text{ years tenure})$. Before benefits were front loaded, new hires had a 46.7 percent probability of remaining to earn 10 years of tenure (82 percent multiplied by 57 percent). After the policy change, new hires had a 42.2 percent chance of earning 10 years of tenure (74 percent multiplied by 57 percent). Hence, the probability that a newly hired state employee remained in state service for at least 10 years declined by approximately 4.5 percentage points.

7 Conclusion

Large unfunded liabilities in state and local defined-benefit pensions have prompted calls for a transition to the fully funded defined-contribution plans prevalent in the private sector. Less often discussed are the consequences for employee turnover. Whereas defined-benefit plans encourage tenure at a single firm, by granting generous benefits only to senior

workers, defined-contribution plans promote labor mobility. Turnover imposes costs on employers and proffers benefits. In addition to the direct cost of recruiting and training new workers to replace those who separate, the loss of firm-specific human capital may hurt productivity. However, in a setting with strong employment protections such as the civil service, encouraging burned-out employees to leave for the private sector should also enhance aggregate productivity. An empirical examination of worker quality is outside the scope of this paper; nevertheless, understanding the effect of seniority pay on turnover is a necessary first step to fully accounting for workforce composition in a cost-benefit analysis of pension reform.

I examine the case of Michigan, which in 1997 closed its defined-benefit pension to newly hired state employees and transitioned to a defined-contribution system. Members of the traditional pension were required to remain in state service for at least a decade in order to earn any benefits. Defined-contribution participants may switch to the private sector without any significant pension penalty. In either plan, workers who quit state service after 10 years earn pension wealth equal to at least their parting salary in present value terms.⁴¹ Membership in the different plans depends on the employee's date of hire, allowing me to identify the impact of front-loading retirement benefits with a regression-discontinuity design. I assume that workers hired within a few months of each other would have turned-over at similar rates if they had faced the same pension incentives.

I find that back-loading retirement benefits increased the probability that employees would remain in state service for a decade or more by 4.5 percentage points, on average. The effect was concentrated among older workers in occupations requiring a college degree; younger workers did not respond to pension incentives. Nearly half of workers hired by the Michigan state government fall into the age range affected by pension incentives. Nearly a quarter of state employees classify as both older and highly educated. If government employers replace workers who separate with new hires of average age, then front-loaded retirement plans create a younger workforce with less firm-specific human capital.

⁴¹ Assuming that defined-contribution members invest in safe assets.

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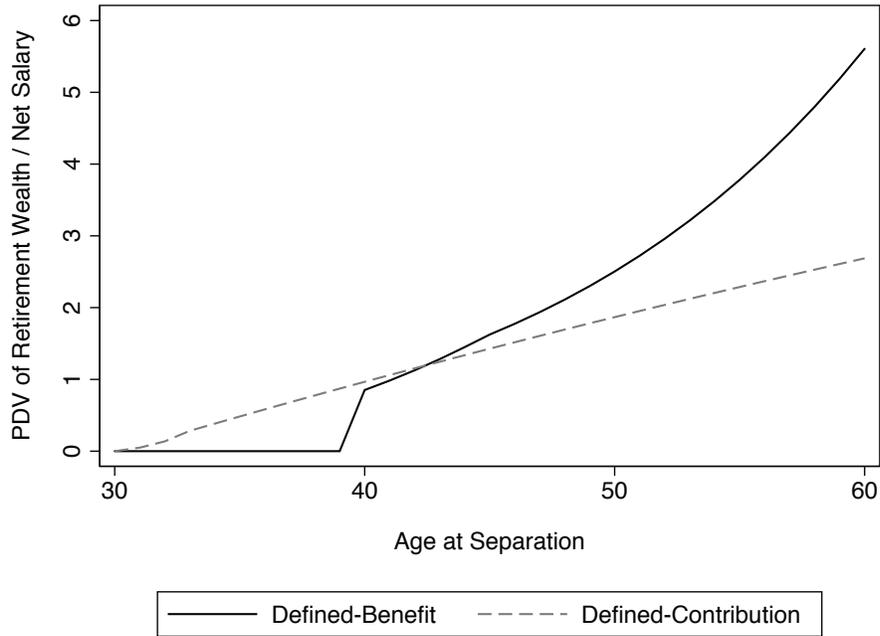
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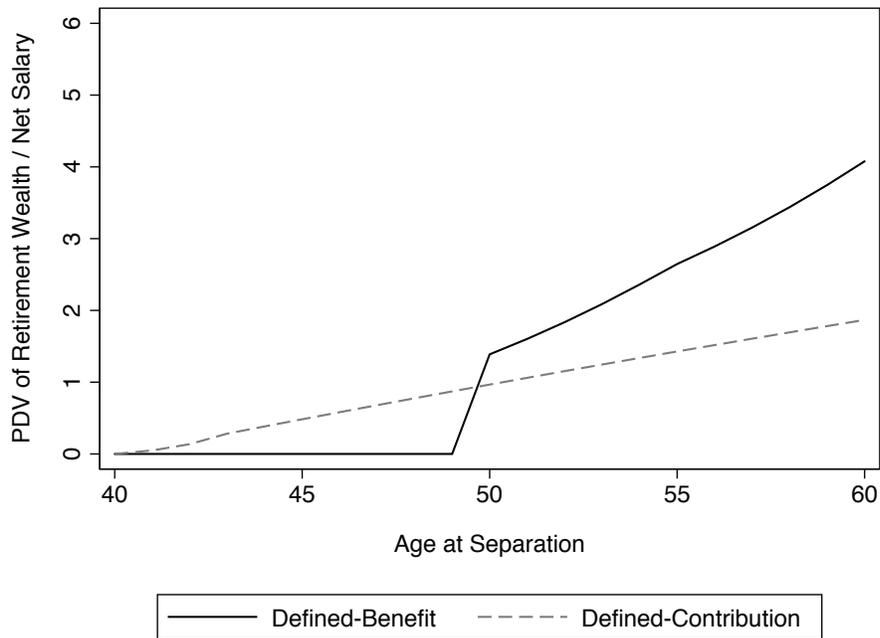
9 Figures and Tables

Figure 1: Present Discounted Value of Pension Wealth at Time of Separation

(a) Hired at Age 30



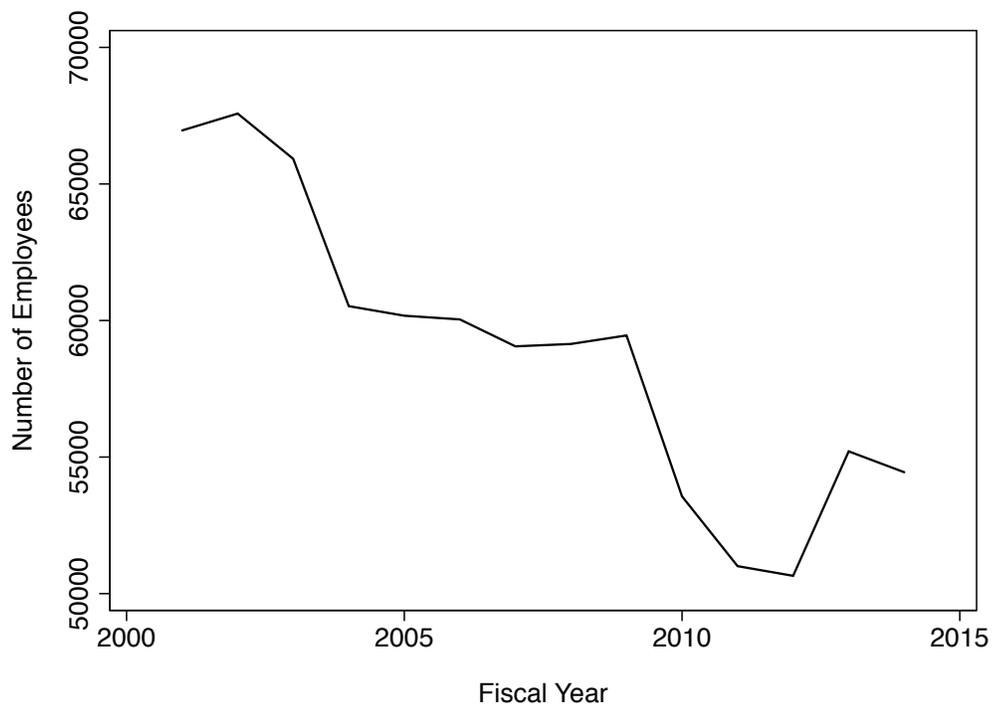
(b) Hired at Age 40



Source: author's estimates from provisions cataloged by the Michigan Office of Retirement Services (2015).

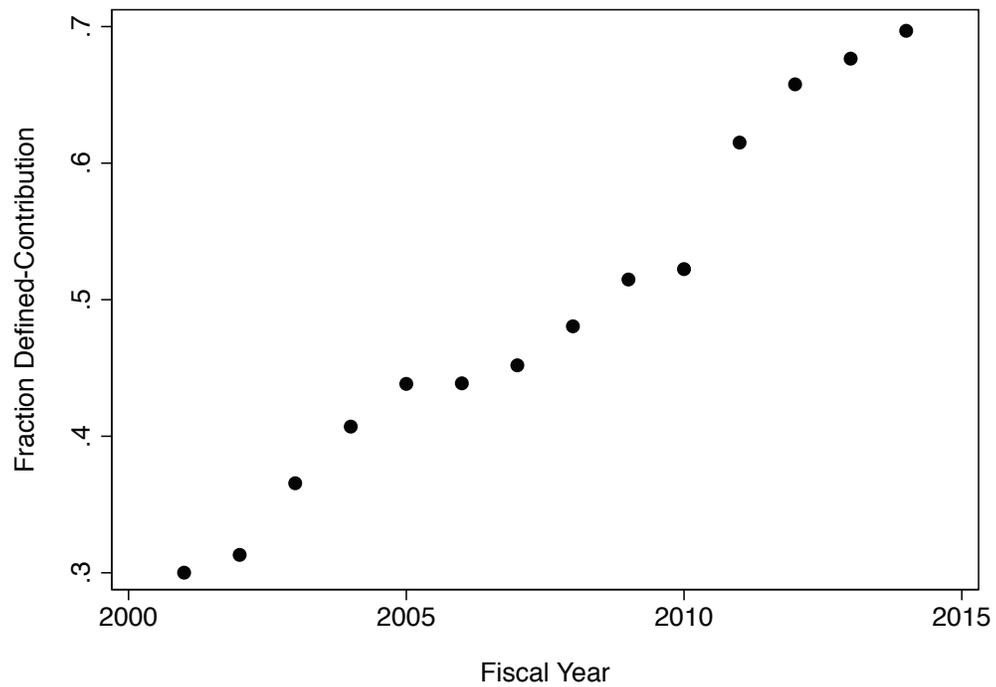
Note: simulations assume a three-percent inflation rate, two-percent real return on defined-contribution savings, and five-percent nominal discount rate. Salaries start at \$20,000 and increase annually with inflation. Employees contribute three percent of salary to the defined-contribution plan, but nothing to the defined-benefit plan. Mortality probabilities are calculated according to a 50-50 split of the RP-2000 male/female healthy annuitant tables.

Figure 2: Number of Michigan State Employees on Payroll



Source: author's calculations from personnel records provided by the Michigan Office of Retirement Services.

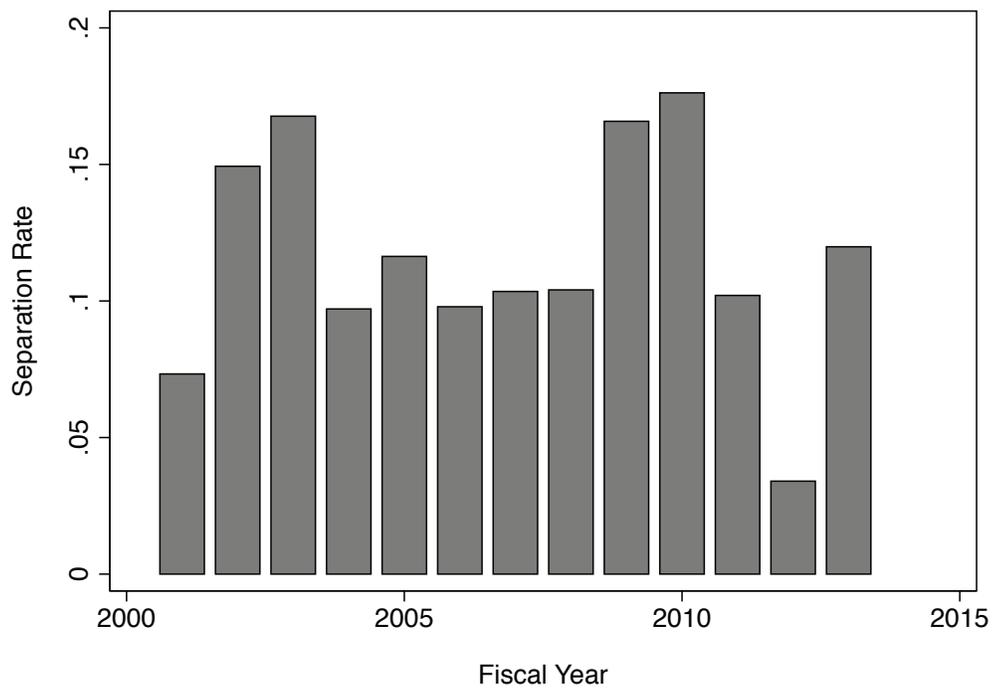
Figure 3: Fraction of Employees Participating in the Defined-Contribution Plan



Source: author's calculations from personnel records provided by the Michigan Office of Retirement Services.

Note: employees in the sample held only one position in 2001 and were not employed by the State Legislature.

Figure 4: Fraction of Employees Separating Within the Year

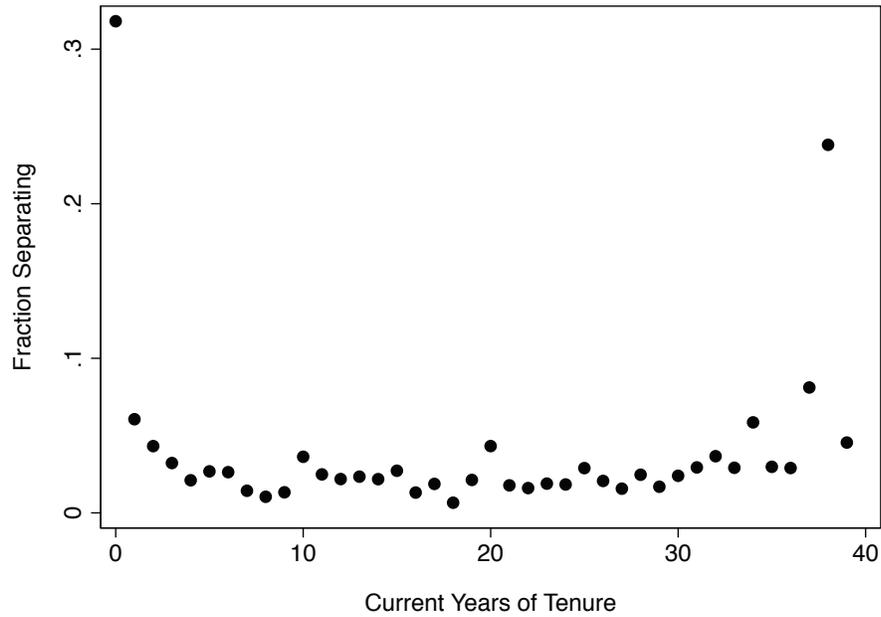


Source: author's calculations from personnel records provided by the Michigan Office of Retirement Services.

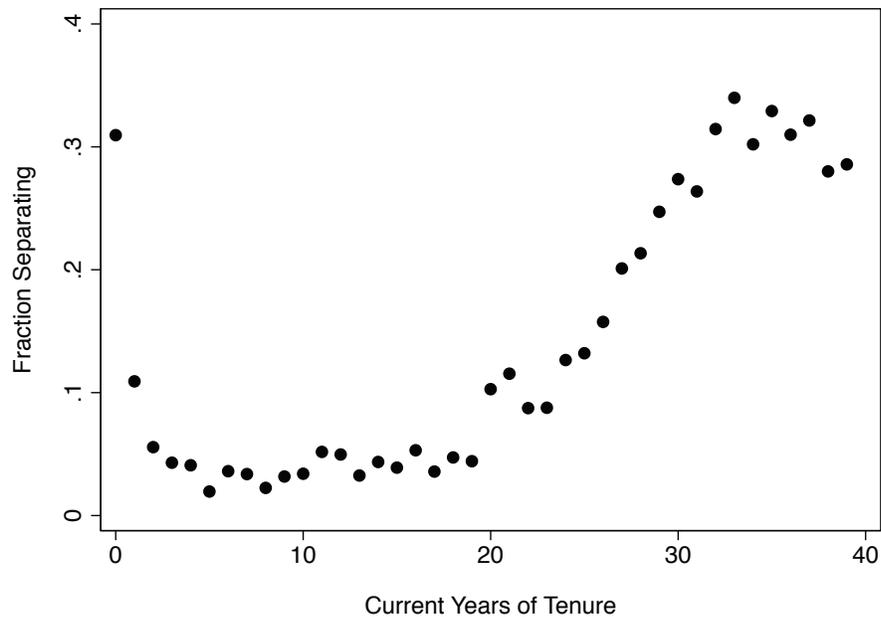
Note: separation is defined as ceasing to participate actively in the state retirement plan, either temporarily or permanently. Transient increases in the separation rate are due to state policies encouraging early retirement. Employees in the sample held only one position in 2001 and were not employed by the State Legislature.

Figure 5: Separation Rate By Current Tenure

(a) Fiscal Year 2001



(b) Fiscal Year 2002

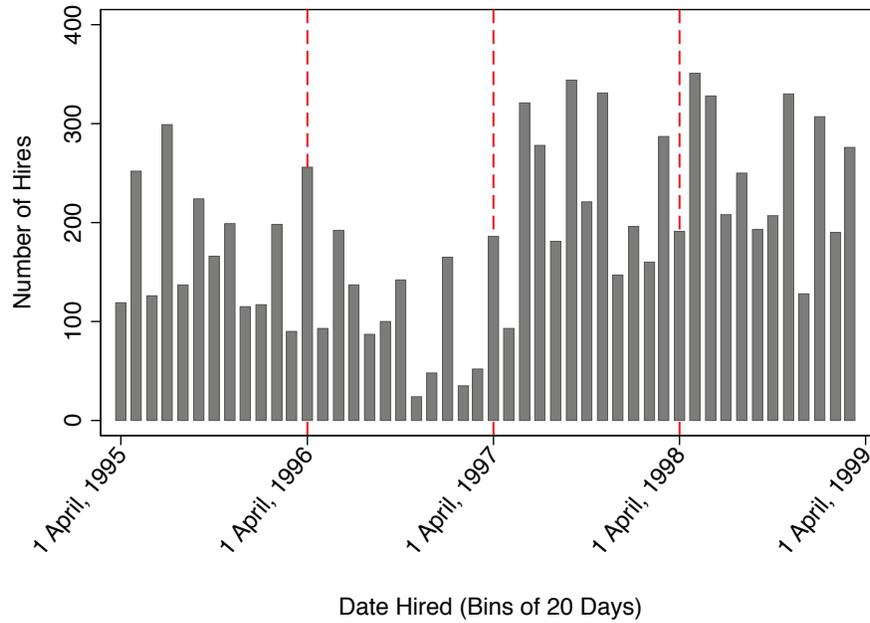


Source: author's calculations from personnel records provided by the Michigan Office of Retirement Services.

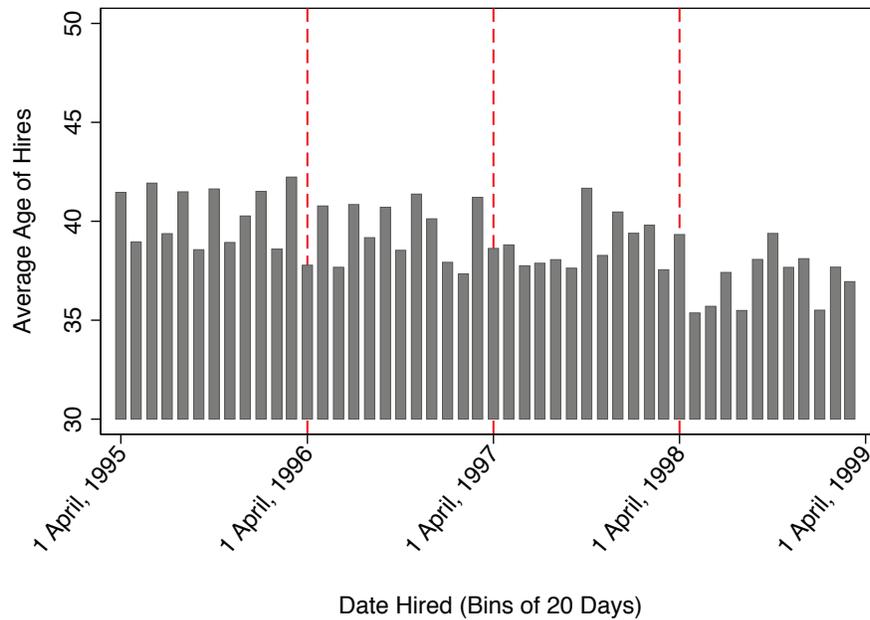
Note: separation is defined as ceasing to participate actively in the state retirement plan, either temporarily or permanently. Tenure is estimated as the number of days between the date of hire and the end of the current fiscal year. Tenure is underestimated for employees who left state employment prior to 2001 and re-entered after that year. Employees in the sample held only one position in 2001 and not employed by the State Legislature.

Figure 6: Worker Characteristics in 2001 (Continued on Next Page)

(a) Number of Employees



(b) Mean Age of Employees

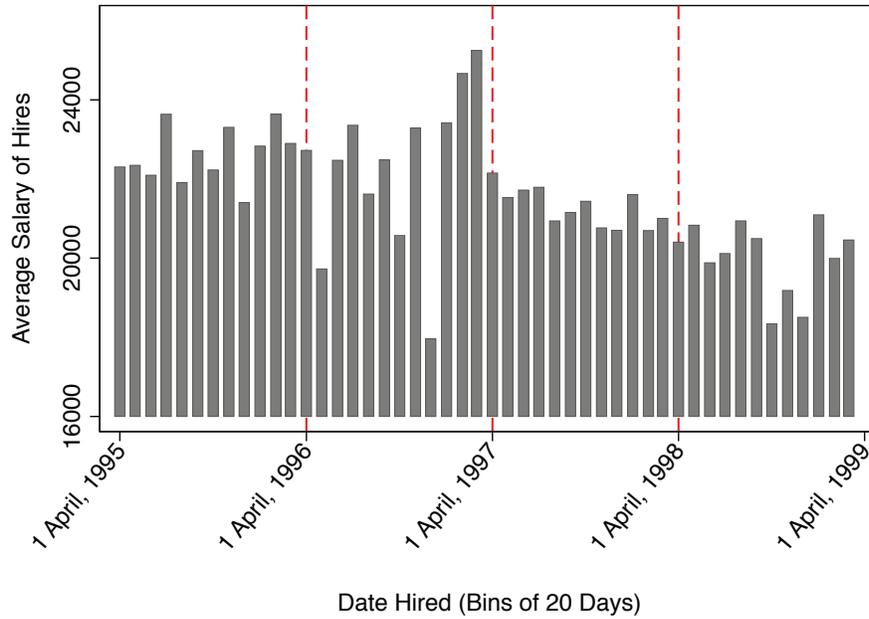


Source: author's calculations from data provided by the Michigan Office of Retirement Services and the Michigan Civil Service Commission.

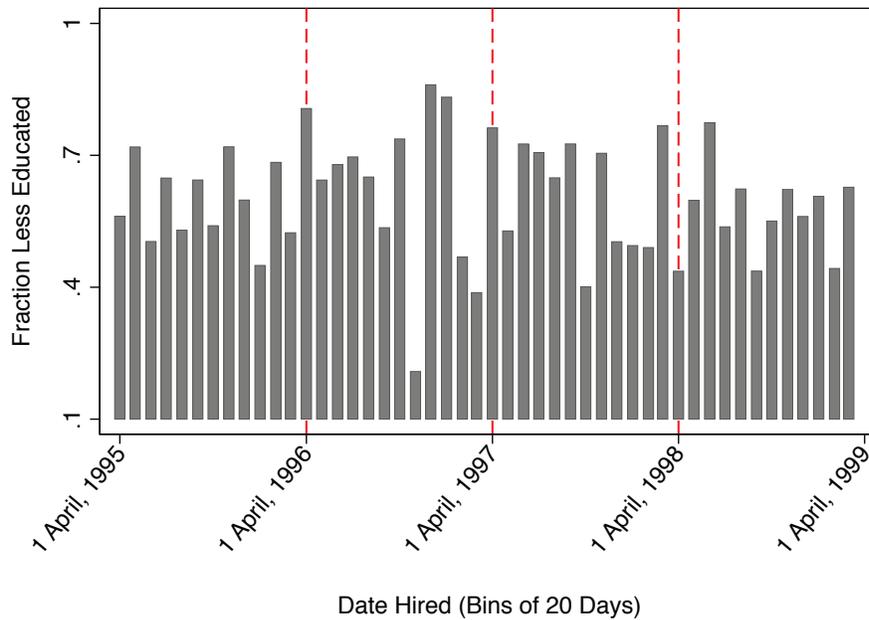
Note: employees in the sample held only one position in 2001 and were not employed by the State Legislature.

Figure 6: Worker Characteristics in 2001 (Continued from Previous Page)

(c) Mean Salary of Employees



(d) Fraction Less Educated

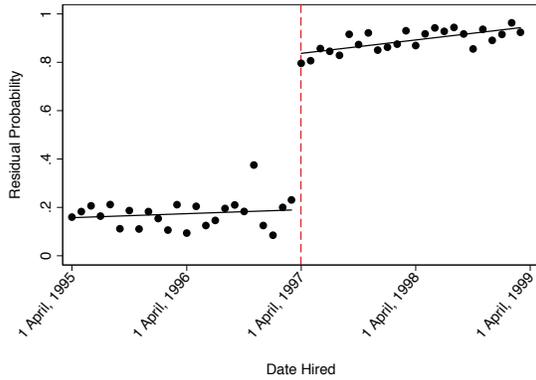


Source: author's calculations from data provided by the Michigan Office of Retirement Services and the Michigan Civil Service Commission.

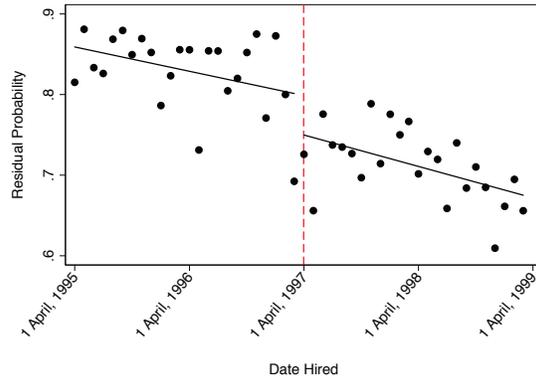
Note: employees in the sample held only one position in 2001 and were not employed by the State Legislature.

Figure 7: Behavior of State Employees with Four Years of Tenure

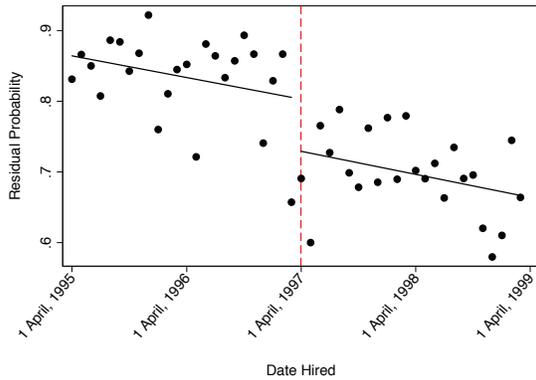
(a) Rate of DC Membership



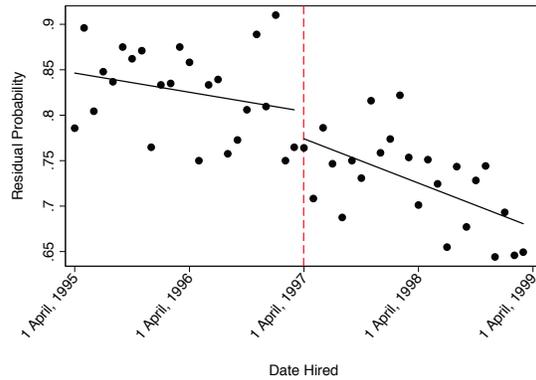
(b) Retention Rate Next 6 Years



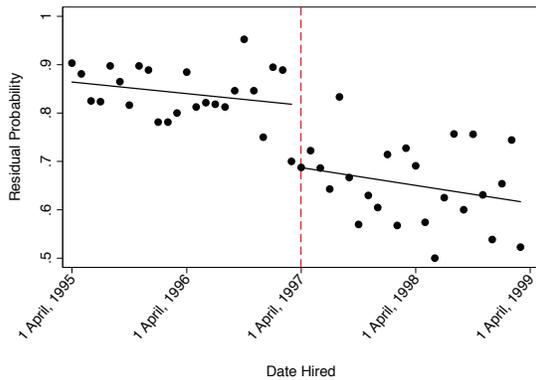
(c) Retention Rate Next 6 Years
Workers Hired Age 33 or Older



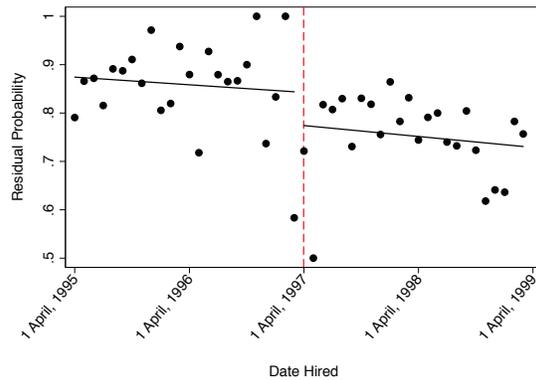
(d) Retention Rate Next 6 Years
Workers Hired Age 32 or Younger



(e) Retention Rate Next 6 Years
Highly Educated Older Workers



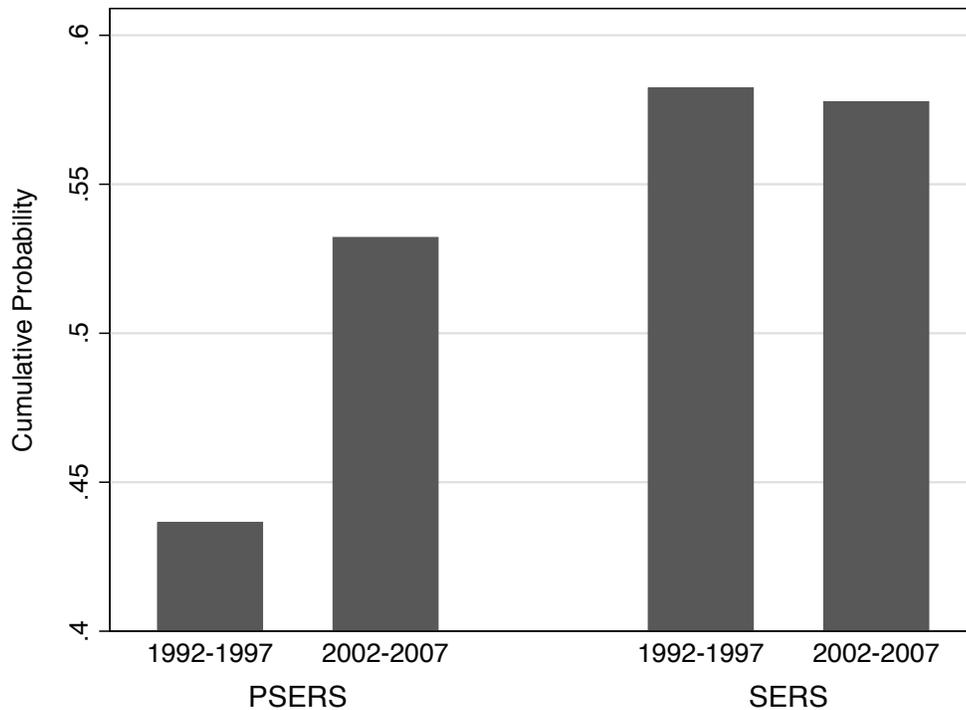
(f) Retention Rate Next 6 Years
Less-Educated Older Workers



Source: author's estimates from data provided by the Michigan Office of Retirement Services and the Michigan Civil Service Commission.

Note: each circle indicates the mean outcome among workers hired that month. "Older" refers to workers hired at age 33 or older. "Less educated" refers to workers in protective service, para-professional, support, craft, and service/maintenance occupations. Employees in the sample held only one position in 2001 and were not employed by the State Legislature.

Figure 8: Probability that Newly Hired Public Employees Earn Four Years of Tenure



Source: author’s calculations from *Actuarial Valuation Reports* (1999-2012) and personnel records provided by the Michigan Office of Retirement Services.

Note: “PSERS” refers to the Michigan Public School Employees Retirement System. “SERS” refers to the State Employees Retirement System. Cumulative probabilities of retention were calculated from the separation rates published in plan *Actuarial Valuation Reports*. They represent the average rate of employee retention over the five-year period indicated on the x-axis. The rates of separation from Michigan SERS between 2002 and 2007 were calculated from personnel records. The rates of separation from Michigan PSERS between 2002 and 2007 assume that 50 percent of plan members were teachers and that all earned over \$20,000.

Table 1: Michigan Employees' Retirement System Provisions in 2016

Provision	Defined-Benefit Pension	Defined-Contribution Plan
Benefit Multiplier	1.5 percent.	NA.
Final Average Salary	3 highest years.	NA.
Vesting Period	10 years.	Full vesting after 4 years. Partial vesting after two years.
Contribution Rate	Employer: set by the legislature, depends on pension-fund performance. Employee: None.	Employer: 4 percent with a 3 percent match of default employee contributions. Employee: varies depending on the desired savings rate. Default is 3 percent.
Normal Retirement	Age 60 with 10 years of tenure. Age 55 with 30 years tenure.	Age 59 $\frac{1}{2}$.
Early Retirement	Age 55 with 15 years of tenure, receives a reduced benefit.	Any age, incurs a federal tax penalty.
COLA	3 percent annually, not compounded, with a 300 dollar maximum.	NA.
Eligibility	Hired before March 31, 1997.	Hired after March 31, 1997.

Source: Michigan Office of Retirement Services (c) (2015) and (e) (2016).

Table 2: Characteristics of Michigan State Government Employees in 2001
Hired Between April 1, 1995 and April 1, 1999

VARIABLES	N	Mean	SD	Min	Max
Defined-Benefit Participants					
Current Age	3,433	40.11	9.581	22	100
Year Hired	3,433	1996	0.987	1995	1999
Persist 10 Years	3,433	0.812	0.391	0	1
Total Current Salary	3,433	22,235	7,745	8.850	100,715
Female	3,433	0.516	0.500	0	1
Defined-Contribution Participants					
Current Age	5,646	37.43	9.817	20	100
Year Hired	5,646	1998	0.929	1995	1999
Persist 10 Years	5,646	0.734	0.442	0	1
Total Current Salary	5,646	20,862	7,711	0.030	97,857
Female	5,646	0.530	0.499	0	1
Officials, Professionals, Technicians					
Current Age	3,264	39.16	9.901	20	78
Year Hired	3,264	1997	1.267	1995	1999
Persist 10 Years	3,264	0.729	0.445	0	1
Total Current Salary	3,264	24,598	8,630	21.37	100,715
Defined-Contribution Plan	3,264	0.667	0.471	0	1
Female	3,264	0.562	0.496	0	1
Police, Para-Prof., Support, Craft, Service					
Current Age	5,511	37.71	9.465	20	76
Year Hired	5,511	1997	1.223	1995	1999
Persist 10 Years	5,511	0.801	0.400	0	1
Total Current Salary	5,511	19,419	5,513	12.61	51,450
Defined-Contribution Plan	5,511	0.592	0.491	0	1
Female	5,511	0.503	0.500	0	1

Source: author's calculations from data provided by the Michigan Office of Retirement Services and the Michigan Civil Service Commission.

Note: employees in the sample held only one position in 2001 and were not employed by the State Legislature.

Table 3: Effect of Front-Loading Retirement Benefits on Retention Over the Next 6 Years

Workers With Four Years of Tenure at the Outset

VARIABLES	Full Sample			Donut-Hole Sample		
	(1)	(2)	(3)	(4)	(5)	(6)
	DC Member (First Stage)	10 Yrs. Tenure (Reduced Form)	10 Yrs. Tenure (IV)	DC Member (First Stage)	10 Yrs. Tenure (Reduced Form)	10 Yrs. Tenure (IV)
Hired After 3/31/97 (DC)	0.709*** (0.018)	-0.072*** (0.019)	-0.101*** (0.027)	0.713*** (0.023)	-0.059** (0.024)	-0.082** (0.033)
Observations	8,775	8,775	8,775	7,953	7,953	7,953
R-squared	0.570	0.121	0.112	0.584	0.127	0.121
Number of Agencies	25	25	25	25	25	25
Hire Date	X	X	X	X	X	X
Hire Date * Threshold	X	X	X	X	X	X
Employer Fixed Effects	X	X	X	X	X	X
Age Fixed Effects	X	X	X	X	X	X
Gender	X	X	X	X	X	X
Salary Decile Bins	X	X	X	X	X	X
Less-Educated Group	X	X	X	X	X	X

Source: author's estimates from data provided by the Michigan Office of Retirement Services and the Michigan Civil Service Commission.

Note: the dependent variables equal one if the worker remained continuously employed for at least 10 years. Regressions are estimated with Ordinary Least Squares; IV estimates instrument for defined-contribution membership with date of hire using Two-Stage Least Squares. "Less educated" refers to workers in protective service, para-professional, support, craft, and service/maintenance occupations. Employees in the sample were hired between 4/1/95 and 4/1/99; held only one position in 2001; and were not employed by the State Legislature. The donut-hole sample drops workers hired between 1/1/97 and 7/1/97. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05.

Table 4: Effect of Hire Date on Retention Over the Next Six Years, by Demographics (Workers With Four Years of Tenure at the Outset)

VARIABLES	Full Sample			Donut-Hole Sample		
	(1)	(2)	(3)	(5)	(6)	(7)
	10 Yrs. Tenure	10 Yrs. Tenure	10 Yrs. Tenure	10 Yrs. Tenure	10 Yrs. Tenure	10 Yrs. Tenure
Hired After 3/31/97	-0.105*** (0.027)	-0.130*** (0.035)	-0.064** (0.030)	-0.103*** (0.032)	-0.121*** (0.043)	-0.058* (0.034)
Younger * After	0.068* (0.039)			0.095** (0.048)		
Less Educated * After		0.082* (0.042)			0.089* (0.051)	
Above Median Salary * After			-0.004 (0.038)			-0.022 (0.047)
Observations	8,775	8,775	8,475	7,953	7,953	7,672
R-squared	0.122	0.124	0.107	0.128	0.130	0.111
Hire Date	X	X	X	X	X	X
Hire Date * Threshold	X	X	X	X	X	X
Employer Fixed Effects	X	X	X	X	X	X
Age Fixed Effects	X	X	X	X	X	X
Gender	X	X	X	X	X	X
Salary Decile Bins	X	X	X	X	X	X
Less-Educated Group	X	X	X	X	X	X
Above Median Salary 2002			X			X

Source: author's estimates from data provided by the Michigan Office of Retirement Services and the Michigan Civil Service Commission.

Note: the dependent variables equal one if the worker remained continuously employed for at least 10 years. Regressions are estimated with Ordinary Least Squares. "Younger" refers to workers younger than age 37 in 2001. "Less educated" refers to workers in protective service, para-professional, support, craft, and service/maintenance occupations. "Above median salary" refers to the 2002 distribution. Regressions that control for "above median salary" only include workers still employed in 2002. Employees in the sample were hired between 4/1/95 and 4/1/99; held only one position in 2001; and were not employed by the State Legislature. The donut-hole sample drops workers hired between 1/1/97 and 7/1/97. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Effect of Front-Loading Retirement Benefits on Retention Over the Next Six Years (Workers Hired Age 33 or Older)

VARIABLES	Full Sample			Donut-Hole Sample		
	(1)	(2)	(3)	(4)	(5)	(6)
	DC Member (First Stage)	10 Yrs. Tenure (Reduced Form)	10 Yrs. Tenure (IV)	DC Member (First Stage)	10 Yrs. Tenure (Reduced Form)	10 Yrs. Tenure (IV)
Hired After 3/31/97 (DC)	0.495*** (0.050)	-0.193*** (0.047)	-0.381*** (0.097)	0.594*** (0.058)	-0.206*** (0.056)	-0.337*** (0.094)
Less Educated * After	0.196*** (0.069)	0.143** (0.063)	0.309*** (0.107)	0.088 (0.083)	0.161** (0.075)	0.271** (0.108)
Observations	4,389	4,389	4,389	3,980	3,980	3,980
R-squared	0.487	0.135	0.074	0.509	0.147	0.101
Number of Agencies	25	25	25	25	25	25
Hire Date	X	X	X	X	X	X
Hire Date * Threshold	X	X	X	X	X	X
Employer Fixed Effects	X	X	X	X	X	X
Age Fixed Effects	X	X	X	X	X	X
Gender	X	X	X	X	X	X
Salary Decile Bins	X	X	X	X	X	X
Less-Educated Group	X	X	X	X	X	X

Source: author's estimates from data provided by the Michigan Office of Retirement Services and the Michigan Civil Service Commission.

Note: the dependent variables equal one if the worker remained continuously employed for at least 10 years. Regressions are estimated with Ordinary Least Squares; IV estimates instrument for defined-contribution membership with date of hire using Two-Stage Least Squares. "Less educated" refers to workers in protective service, para-professional, support, craft, and service/maintenance occupations. Employees in the sample were hired between 4/1/95 and 4/1/99; held only one position in 2001; and were not employed by the State Legislature. The donut-hole sample drops workers hired between 1/1/97 and 7/1/97. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05.

Table 6: Effect of Front-Loading Retirement Benefits on Retention Over the Next Six Years (Workers Hired Age 33 or Older)

VARIABLES	(1) 4-9 Years	(2) 10-11 Years	(3) 12+ Years
Defined-Contribution Member	0.154*** (0.050)	0.010 (0.037)	-0.164*** (0.057)
Observations	3,980	3,980	3,980
R-squared	0.112	0.065	0.143
Number of Agencies	25	25	25
Hire Date	X	X	X
Hire Date * Threshold	X	X	X
Employer Fixed Effects	X	X	X
Age Fixed Effects	X	X	X
Gender	X	X	X
Salary Decile Bins	X	X	X
Less-Educated Group	X	X	X

Source: author's estimates from data provided by the Michigan Office of Retirement Services and the Michigan Civil Service Commission.

Note: the binary dependent variables equal one if the worker remained continuously employed for either: 4-9 years, 10-11 years, or at least 12 years. The regressions instrument for defined-contribution membership with date of hire using Two-Stage Least Squares. "Less educated" refers to workers in protective service, para-professional, support, craft, and service/maintenance occupations. Employees in the sample were hired between 4/1/95 and 1/1/97 as well as 7/1/97 and 4/1/99 (donut-hole specification); held only one position in 2001; were not employed by the State Legislature; and were at least age 37. Robust standard errors are in parentheses. *** p<0.01.

Table 7: Effect of Hire Date on Retention Over the Next Six Years (Workers Hired Age 33 or Older)

Varying the Number of Workers Admitted to the Sample Based on Hire Date

VARIABLES	(1)	(2)	(3)	(4)
	Bandwidth = 1 Yr. Donut Hole = 6 Mo.	Bandwidth = 18 Mo. Donut Hole = 6 Mo.	Bandwidth = 3 Yrs. Donut Hole = 6 Mo.	Bandwidth = 2 Yrs. Donut Hole = 1 Yr.
	10 Yrs. Tenure	10 Yrs. Tenure	10 Yrs. Tenure	10 Yrs. Tenure
Hired After 3/31/97	-0.147** (0.068)	-0.106** (0.042)	-0.0747*** (0.023)	-0.105** (0.041)
Observations	1,608	2,716	6,772	3,523
R-squared	0.149	0.143	0.143	0.143
Number of Agencies	25	25	25	25
Employer Fixed Effects	X	X	X	X
Age Fixed Effects	X	X	X	X
Gender	X	X	X	X
Salary Decile Bins	X	X	X	X
Less-Educated Group	X	X	X	X

Source: author's estimates from data provided by the Michigan Office of Retirement Services and the Michigan Civil Service Commission.

Note: the dependent variables equal one if the worker remained continuously employed for at least 10 years. A donut hole of six months drops workers hired during the three months before and the three months after April 1, 1997. Column (1) includes workers hired between 4/1/96 and 4/1/98. Column (2) includes workers hired between 10/1/96 and 10/1/98. Column (3) includes workers hired between 4/1/94 and 4/1/00. Regressions are estimated with Ordinary Least Squares. "Less educated" refers to workers in protective service, para-professional, support, craft, and service/maintenance occupations. Employees in the sample held only one position in 2001; were not employed by the State Legislature; and were at least 37 years old. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05.

Table 8: Effect of Hire Date on Retention Over the Next Six Years

Workers Hired Age 33 or Older

Alternate Demographic Control Variables

VARIABLES	(1) 10 Yrs. Tenure	(2) 10 Yrs. Tenure	(3) 10 Yrs. Tenure
Hired After 3/31/97	-0.0799** (0.034)	-0.0975*** (0.031)	-0.106*** (0.030)
Observations	4,166	3,980	3,860
R-squared	0.030	0.167	0.166
Number of Agencies	29	25	25
Hire Date	X	X	X
Hire Date * Threshold	X	X	X
Employer Fixed Effects		X	X
Gender		X	X
Less-Educated Group		X	X
Age Fixed Effects		X	X
Gender		X	X
Log Salary in 2001		X	
Log Salary in 2002			X

Source: author's estimates from data provided by the Michigan Office of Retirement Services and the Michigan Civil Service Commission.

Note: the dependent variables equal one if the worker remained continuously employed for at least 10 years. Regressions are estimated with Ordinary Least Squares. "Less educated" refers to workers in protective service, para-professional, support, craft, and service/maintenance occupations. Employees in the sample were hired between 4/1/95 and 1/1/1997 as well as 7/1/1997 and 4/1/99 (donut-hole specification); held only one position in 2001; were not employed by the State Legislature; and were at least 37 years old. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05.

Table 9: Effect of Hire Date Retention Over the Next Six Years

Workers Hired Age 33 or Older

Placebo Threshold

VARIABLES	(1)	(2)
	DC Member (First Stage)	10 Yrs. Tenure (Reduced Form)
Hired After 3/31/1995	-0.023 (0.025)	0.004 (0.025)
Observations	3,503	3,503
R-squared	0.102	0.107
Number of Agencies	25	25
Hire Date	X	X
Hire Date * Threshold	X	X
Employer Fixed Effects	X	X
Age Fixed Effects	X	X
Gender	X	X
Salary Decile Bins	X	X
Less-Educated Group	X	X

Source: author’s estimates from data provided by the Michigan Office of Retirement Services and the Michigan Civil Service Commission.

Note: the dependent variable in column (2) equals one if the worker remained continuously employed for at least 10 years. Regressions are estimated with Ordinary Least Squares. “Less educated” refers to workers in protective service, para-professional, support, craft, and service/maintenance occupations. Employees in the sample were hired between 4/1/93 and 1/1/1995 as well as 7/1/1995 and 4/1/97 (donut-hole specification); held only one position in 2001; were not employed by the State Legislature; and were at least 37 years old. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.