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Do Pensions Enhance Worker Effort and Selection? Evidence from Public Schools

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Abstract

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1 Introduction

Why do employers provide pensions? We empirically investigate two rationales considered in the theoretical literature. Both rationales stem from the notion that pensions may enhance productivity by influencing the decisions of workers.

First, pensions may increase worker *effort*. The logic is that, like other deferred compensation, pensions raise the stakes of dismissal. Workers facing premature termination lose substantial pension wealth, thus curbing a worker's temptation to shirk costly effort (Lazear, 1979; Hutchens, 1987; Ruhm, 1994; Gustman et al., 1994). Pensions may also increase effort through reciprocity—part of the theory of efficiency wages. Workers may increase their effort to satisfy a reciprocity motive in years where they receive large accruals of pension wealth (Akerlof, 1982; Katz, 1986; Fehr et al., 1993; Mas, 2006).

The second rationale is that pensions may improve worker *selection* by differentially attracting and retaining better workers. Workers who are diligent, conscientious, or especially committed to a long career with the organization may have a stronger preference for pension compensation. If so, establishments that provide pensions may benefit from endogenously attracting and retaining better workers (Gustman et al., 1994; Morrissey, 2017; Weller, 2017). Typically, employers can only screen workers based on observed characteristics. The hope of this theory is that unobservably better workers will self-select into an organization and self-select into retention on the basis of the pension. If true, a pension would do automatically what attentive screening could not.

Notice that the two rationales—that pensions may increase worker *effort* and worker *selection*—are mutually inclusive.[1]

These theoretical claims are common in public discourse about whether employers should maintain their pensions, or replace them. A management consulting firm advises its

[1] Other important rationales exist, including the tax advantage of pensions over private savings, that pensions may improve retention among young workers, and that pensions may encourage retirement among older workers, which may be especially important in physically taxing professions like military service and fire fighting. (Indeed, pensions began as a way for the Roman Empire to ease aging soldiers into retirement.) A thorough cataloging of rationales can be found in Gustman et al. (1994). Others have put forward a rationale for modern pensions based on the political economy. In it, politicians seek to win support from public workers, a politically powerful group, with benefits whose costs are shrouded to taxpayers (Glaeser and Ponzetto, 2014).

clients that "pension plans can increase staff productivity in your business" (BP Consulting, 2022), implicitly citing the "effort" hypothesis of pensions. Citing the "selection" hypothesis, Economist Monique Morrissey writes that "pensions are the single most important tool for recruiting and retaining [excellent workers]" (Morrissey, 2017).[2] These sentiments are echoed by policymakers, too. Rick Cost, a district manager of public schools, states that pensions are a "valuable tool in attracting and retaining outstanding teachers" (Badertscher, 2013). We assess these important claims with new data and designs.

Assessing the impact of pensions on effort and selection is key to understanding their benefits for organizations and society more broadly. Measuring these causal effects, however, is quite challenging. Pension enrollment is not random, and there are few natural experiments to shed light on the problem. Data on pension eligibility and worker productivity, moreover, are not normally and readily accessible.

Examining pensions within the context of public schools addresses these data-related obstacles and provides distinct advantages to understanding the effects of pensions on personnel and productivity. First, pensions are far more common among public-sector workers and a majority of public-sector workers are educators. Public schools, therefore, provide researchers with large administrative records, providing statistical power and a policy-relevant population (Papay and Kraft, 2015; Chetty et al., 2014b; Gilraine and Pope, 2021).[3] Second, whereas data for private sector employers are scattered and largely inaccessible, public schools collect centralized and accessible records on employment and pension eligibility. Third, in contrast to most professions, public schools lend themselves to excellent, standardized measures of worker output on a large scale, offering a unique lens through which to inspect the effects of pensions on productivity.

We exploit these advantages by assembling administrative staffing records and constructing an array of effort and output measures for teachers in North Carolina. In addition

[2]Similarly, researcher Christian Weller argues that employers "offer [pension] benefits to achieve labor management goals, such as recruiting and retaining the best people for the job" (Weller, 2017). BP consulting argues that offering a pension will "helps you recruit the finest personnel [and] retain your high-performers" (BP Consulting, 2022).

[3]94 percent of public employees have access to pensions whereas just 15 percent of private employees do (Bureau of Labor Statistics, 2023; Urban Institute, 2022). 52 percent of state and local public employees work in education (Brock, 2001).

to estimating each teacher's effect on math and reading skills each year, we also estimate each teacher's effect on important behavioral skills, captured by future disciplinary infractions and future truancy (Jackson, 2018; Petek and Pope, 2023). We measure a worker's yearly output using student human capital gains, and we use these estimates to construct forecast-unbiased measures of predictable worker productivity, following (Chetty et al., 2014a). Together, these measures allow us to examine "effort" (which we conceptualize as the potentially *transient* component of productivity) and "quality" (which we conceptualize as the *predictable* component of productivity).

Teachers in North Carolina's public schools are enrolled in the state's pension plan as part of their employment. Teachers become eligible to receive their pension annuity when they meet age and years-of-service criteria. These rules create notches at which teachers can start drawing their retirement benefits, which provide empirical leverage on the questions at hand. In the years before retirement eligibility, workers garner large increases in pension wealth. These implicit payments may elicit effort through a worker's reciprocity motive or greater incentives to avoid shirking because of deferred compensation. A decline in teacher productivity upon reaching eligibility, therefore, would imply that reciprocity or the pension's early-dismissal penalty encouraged greater effort, supporting the "effort" hypothesis of pension provision. A stronger retentive effect of pensions on highly productive workers compared to less productive workers would, in a like fashion, support the "selection" hypothesis of pension provision.

We employ a notch design that exploits the sharp drop in pension incentives and implicit payments that occurs when a teacher crosses the threshold of retirement eligibility. A model of reciprocity or delayed compensation both imply that this drop will reduce teacher effort. The logic of delayed compensation works like this: Pensions incentivize effort by placing at risk pension wealth if the employee is dismissed prematurely. As teachers near retirement eligibility, pension incentives to remain employed intensify because the return to an additional year of service is especially large. These act as incentives that motivate additional effort according to the "effort" hypothesis of pension provision. The pension-based penalties of dismissal undergo a sharp and pronounced decrease once a teacher qualifies for retirement. At this point, a teacher can be let go without incurring a significant penalty to her pension wealth. If pensions indeed spur effort through this channel, we would therefore expect teachers who are on the brink of retirement eligibility to work harder due to these incentives than teachers after these incentives have disappeared.

One consideration is how the dismissal risk in public schools compares to other employers. We examine this question in the Current Population Survey. The dismissal rate is 2 percent for the private sector, 1 percent for public school teachers, and 1 percent for government employment more generally. Interestingly, the dismissal rate is no lower for senior teachers than for young teachers in the CPS.[4] This context implies a few things for our study. First, because public school teachers do face dismissal risk, the deferred compensation channel affecting effort is theoretically plausible. Second, because teachers have the same dismissal risk as other government employers, the results likely generalize to other government employment, where pensions are common (Zook, 2023). Third, while the private and public sectors have different dismissal rates, they are of the same order of magnitude, suggesting similar motivational dynamics could be at play.

Reciprocity motives—part of the theory of efficiency wages—do not rest on dismissal threat and may also cause pensions to increase worker effort (see, for example, Akerlof, 1982; Katz, 1986; Fehr et al., 1993; Mas, 2006). Workers accrue significant pension wealth in the years leading up to the retirement notch. These large payments, according to a theory of reciprocity, may increase worker effort and reduce shirking. When pension accruals fall significantly as workers cross the notch and become eligible for retirement, worker effort that was driven by reciprocity will fall at the same time. Therefore, a reduction in effort at the notch may be explained either by deterring shirking with the promissory note of future compensation or by drawing out additional effort through reciprocity.

[4] We compare layoff rates of public school teachers in the Current Population Survey (2010–2019) to those of other public-sector workers and the private workforce in the United States. The layoff rate in the private sector is 2.1 percent. Dismissal rates among private-sector workers with pensions are not readily available as the same respondents are not asked about both benefits and the reason for dismissal in the CPS. Pensions are often associated with settings that enjoy strong labor protections and low dismissal. Public school teachers and other public-sector workers share an identical layoff rate. Both public school teachers and public-sector workers have a dismissal rate of 1.0 percent. The dismissal rate for senior government workers (over 50 years of age) is, similarly, 1.0 percent and the dismissal rate for senior public school teachers is 1.2 percent.

We illustrate the evolution of teacher productivity as teachers cross the eligibility threshold in transparent event-study figures. Implicitly these figures compare the productivity of individual workers *with* pension incentives (to resist shirking or reciprocate payment) to the productivity of the same individuals *without* those pension incentives, effectively controlling for unobserved factors that differ across workers. We find that productivity evolves smoothly across the retirement threshold despite a sharp drop in pension incentives at the notch. This pattern implies that the pension does not stimulate additional effort from workers. Attendance (another marker of effort) actually increases somewhat as teachers cross the retirement threshold, counter to the effort hypothesis. In this context, it seems pension incentives do not increase effort, either by raising the stakes of dismissal or by appealing to a worker's reciprocity.

To examine the effect of pensions on selection, we measure the retentive effect of pensions on both high- and low-performing teachers. To form a test, we compare retention rates before and after the notch for teachers of different value-added as a measure of the retentive effect of pensions for each group. We find very similar retention probabilities around the notch for workers with different productivity levels, and their retention odds change in the same way at the notch, whether or not they are highly productive workers. This dynamic suggests that pensions exert the same retentive effect on low-performing, middle-performing, and high-performing teachers. The absence of selection effects of pensions suggests that highly productive and less productive workers have similar preferences for pension income. If so, pensions likely have a similar selective influence on teachers' labor supply decisions throughout their careers.

This paper advances the literature on human resources management, especially on how pensions shape effort, selection, and productivity (Lazear and Oyer, 2007; Hoffman and Tadelis, 2021). Past work has focused on the effects of pensions on public finance and worker turnover. For instance, Novy-Marx and Rauh (2014) calculate the cost of unfunded pension liabilities for governments and taxpayers; Anzia (2019) and Koedel et al. (2019) show that when pension liabilities come due, governments cut back investments in education and infrastructure to finance the shortfall; Fitzpatrick (2017) examines the effect of a reform to curb incentives that prompted schools to run up additional pension liabilities. Several authors have examined how pensions, or reforms to pensions, affect labor supply (Brown, 2013; Manoli and Weber, 2016; Ni et al., 2021; Johnston and Rockoff, 2022).

Closest to our work is that examining the effect of pensions on worker selection by various means. Koedel et al. (2013) compares the value-added of workers who retire at different points in their careers; Goldhaber and Grout (2016) finds that higher-output workers are significantly less likely to select the defined-benefit pension plan. Mahler (2018) finds that highly productive workers have lower turnover than less productive workers when pensions' retentive force is greatest. Ni et al. (2022) estimate a structural model and find that defined benefits plans tend to lower workforce quality while defined contributions plans raise quality. Fitzpatrick and Lovenheim (2014) examine the effect of an early retirement program, and find that the inducement eased less effective teachers into retirement.

While there has been a stream of work on how pensions shape selection, we believe that our paper is the first to directly test the effort hypothesis. We find no studies for comparison.

Our paper contributes to this line of work by transparently showing how effort and selection are affected by pension incentives. Our effort measures are especially searching, leveraging an array of measures including absences and state-of-the-art value-added measures in both cognitive and behavioral output.

Though past theoretical work has posited that pensions improve worker effort and selection, we have found little empirical work that directly investigates these claims, especially those for effort. In this paper, we help address that gap with quasi-experimental designs and administrative data tailored to the task. Because modern pensions are increasingly the purview of the public sector, moreover, the results are likely representative of where pensions are usually found.

2 Retirement System for Teachers in North Carolina

The pension program for teachers in North Carolina follows a pattern shared by most if not all pension systems across the country. In broad strokes, employees accrue service credits increase their pension annuity and qualify them for retirement benefits when they meet service requirements. Teachers become eligible to receive a pension annuity when they reach age and service requirements. These requirements form the notches that serve as an empirical instrument for identification. Teachers in North Carolina become eligible for their pension annuity when

(1) they have 30 years of experience at any age,

(2) they are 60 years old and have at least 25 years of experience, or

(3) they are 65 years old with at least 5 years of experience.

The relevant threshold for 76 percent of teachers is 30 years of experience. The relevant threshold for another 16 percent of teachers is age 60 and 25 years of experience. To confirm that this notch has not changed over time, we examine biennial pension records published by the national teachers' union from the Library of Congress. At least since 1982 through the end of our observation period, the eligibility notches have remained the same.[5]

Once a teacher is eligible to retire and claims her retirement benefit, she receives a yearly payment of an amount calculated in equation 1:

$$P_{js} = FAS_j \times (1.82\% \times s) \tag{1}$$

That is, an eligible teacher j with years of service s, receives a pension annuity P that is the product of her final average salary calculated at retirement (FAS_j), her year's of service (s), and a multiplier parameter determined by the state (1.82%). At retirement, her replacement

[5]Teachers also have notches for early retirement eligibility. Under early retirement, a teacher can claim a pension annuity, but her annuity is penalized for claiming early. In North Carolina, a teacher can claim early retirement at age 60 with at least 5 years of service or at age 50 with at least 20 years of service. This again has been constant since 1982. If a teacher takes early retirement before age 60, her yearly pension annuity is usually penalized by 5 percent per year that she is shy of 30 years of service credit. (the penalties are determined by a table that seems to lack a simple, systematic rule) (North Carolina Department of State Treasurer, 2023). If a teacher claims early retirement in her 60s, she faces a 3 percent penalty for each year she is short of 65. We do not observe a measurable retentive effect for the early-retirement notch so we focus the analysis on the normal-retirement notch.

rate will be (1.82% $\times s$) and she will receive that share of her final average salary each year in retirement. States and programs calculate the final average salary by slightly different formulas. In North Carolina, "final average salary" (FAS_j) is calculated as the average of a teacher's highest consecutive four years of salary prior to retirement. As an example, if a teacher retires with 30 years of experience, and her final average salary is $80,000, her replacement rate would be 30 $\times$ 1.82% = 54.6% and she would therefore receive 54.6% $\times$ $80,000 = $43,680 per year in retirement each year for the rest of her life.[6]

We consider how pension rules shape a worker's incentive to maintain employment. We first compute the claiming age that maximizes the present value (PV) of benefits for retirees at each level of experience. We calculate the present value of pension wealth accrued over time for an archetypal worker who begins employment at age 24 (the modal start age in our data), works continuously, and uses the optimal claiming age.[7] The optimal claiming age may differ between teachers depending on their discount rate. Impatient workers tend to maximize their present value by claiming earlier but reducing their total benefits in retirement. We show the returns at two plausible discount rates, 3 and 5 percent.[8] We calculate the marginal pension incentives for retention each year, presented in Figure 1. We express incentives as the percent of a teacher's final average salary (FAS) that she earns in present-value pension wealth by working one additional year. As an example, we find that in the year a teacher vests, her pension incentive is "25," meaning that the teacher accrues 25 percent of her FAS in present-value pension wealth by working in the year she vests.

As seen in Figure 1, pension wealth spikes at five years of service, when workers vest, and again at twenty years when workers become eligible for early retirement.[9] Marginal returns are especially high between 21 years and 25 years of experience as the penalties for early retirement phase out. Workers can claim full retirement at age 60 when they complete

[6]That amount is normally adjusted each year for cost of living based on the consumer price index and whether investment returns of the fund would cover the expense increase calculated by the state's actuaries.

[7]When calculating the present value of pension wealth, we assume a life expectancy of 85 (the relevant life expectancy for college-educated women). Varying life expectancy produces similar results—teachers who expect to live longer behave like those who have smaller discount rates.

[8]See Giglio et al. (2015) , Best et al. (2018), Ericson and Laibson (2018), and Johnston (2024) for evidence on discount rates. Authors tend to find discount rates of 5 percent per annum with Giglio et al. (2015) finding long-run discount rates closer to 3 percent per annum.

[9]If a teacher has 20 years of experience, she can claim early retirement at age 50.

25 years of experience. This reduces the marginal incentive somewhat because workers do not need to work 30 years of service or wait until age 65 to claim. After teachers reach 30 years of experience, they experience a "pension cliff" in which the marginal benefits of work drop from high positive values to small and falling returns, as workers accrue slightly greater annuities while forgoing pension income they could have received by retiring.

The key takeaway for our purposes is that the returns to non-dismissal are strongest in the years before workers reach the retirement eligibility notch and the returns to non-dismissal fall precipitously when workers reach the notch.

North Carolina allows workers to cash in unused sick and personal days to increase their years-of-service credits by up to two years. The exchange rate requires 20 unused sick days for each month-of-service credit. Because teachers in North Carolina receive up to 40 days of leave each year and use 22.5, the modal retirement is two years in advance of the posted service requirement. We confirm this claim by the timing of departures which jumps at 28 years of experience, two years before the posted 30-year requirement. We incorporate data on absences to help predict which teachers are eligible to claim early, which we describe in greater detail below.

3 Data and Sample Construction

3.1 Data

We use records from the North Carolina Education Research Data Center (NCERDC) that contain administrative data on schools, staffing, and students in North Carolina from 2000 through 2018. We use a few core components of the data in our analysis. First, we use staffing records that document which teachers were employed in public schools each year. These records allow us to pinpoint the year in which a teacher stopped teaching in public schools. The data comprise the yearly employment records for 28,077 individual teachers. To ascertain each teacher's distance to the relevant pension-eligibility notch, we use information on the teacher's age and her years of experience based on the experience level of her pay code. We use information on teacher absences to calculate how many days of unused sick leave each teacher likely has. Unused sick leave is transformed into experience credit when teachers claim retirement. Finally, we examine output using detailed achievement and behavioral records for students that are linked to their teacher assignments.

3.2 Constructing Value-Added Measures

Student i is assigned to classroom $c = c(i,t)$ in school $k = k(i,t)$ in year t. Each classroom has a single teacher $j = j(c(i,t))$, though teachers may have multiple classrooms. We model student achievement as depending on observed student characteristics, X_{it}, his teacher's value-added VA_{jt}, school effects, μ_k, time effects, μ_t, classroom effects, θ_{ct}, and a randomly distributed error term, $\tilde{\epsilon}_{it}$.[10] Formally:

$$\begin{aligned} A^*_{it} &= \beta_s X_{it} + \nu_{it}, \\ \nu_{it} &= f(Z_{jt};\alpha) + \mu_{jt} + \mu_k + \mu_t + \theta_{ct} + \tilde{\epsilon}_{it}. \end{aligned} \tag{2}$$

We model teachers' value added as a flexible function, $f(\cdot)$, of teacher experience, Z_{jt}, and μ_{jt} is teacher j's value-added in year t, excluding the return to experience.[11] We follow Chetty et al. (2014a) in allowing a teacher's effectiveness to "drift" over time. We use math and English test scores (standardized at the state-level to have a mean of 0 and standard deviation of 1 in each grade-by-year) to measure academic achievement in each subject. Teachers may also impact students' behavioral outcomes like truancy and disciplinary infractions, markers of important so-called non-cognitive skills (Jackson, 2018).[12] We measure teachers' impact on the first principal component of a behavioral index including students' log absence rate, an indicator for in-school suspensions, and an indicator for out-of-school suspensions. As teachers may have some direct control over current discipline enforcement,

[10]Specifically, we include ethnicity, gender, gifted designation, disability designation, whether the student is a migrant, whether the student is learning English, whether the student is economically disadvantaged, test accommodations, age, and grade-specific cubic polynomials in lagged math and lagged reading scores.

[11]We model the experience return function as a vector of experience indicators for each of the first 6 years of teaching and an indicator for years of experience beyond that.

[12]"Non-cognitive" skills are called such in an attempt to distinguish them from traditional academic skills like reading and mathematics. The term is somewhat imprecise since all human skills are mediated by cognition, whether they be intellectual, behavioral, social, attitudinal, or physical. In this paper, we tend to use "behavioral" skills to draw the contrast with traditional measures of achievement, sometimes lapsing into the well-understood lexicon of cognitive and non-cognitive.

we follow Gilraine and Pope (2021) and also use the lead of this behavioral principal component when the focal teacher no longer mediates discipline enforcement. To avoid the possibility of the future teacher impacting our measure we net out the students' subsequent class' current average of the same measure.

We estimate our model in three steps. In the first, we estimate the coefficients on student characteristics by regressing academic or behavioral achievement on a set of student characteristics and classroom fixed effects. In the second step, we project the residuals ($\hat{\nu}_{it}$) onto teacher fixed-effects, school fixed-effects, year fixed-effects, and the teacher experience return function. In the final step, we form our estimate of teacher j's value-added in year t (VA_{jt}) as the best linear predictor based on the prior data in our sample (this prediction includes the experience function). When examining effort, we use yearly student residuals associated with each teacher to capture the part of productivity that, like effort, can potentially change from year to year. When examining quality selection, we use forecast-unbiased predicted teacher VA to capture our conception of teacher quality.

3.3 Unused Absences

Teachers in North Carolina need 30 years of service to be eligible for full retirement at any age. In practice, however, they can exchange unused leave for up to two years of credit towards their years-of-experience requirement.

Teachers in North Carolina receive each year up to 26 days of vacation leave, 12 days of sick leave, and 2 personal days. In total, young teachers are credited 28 full-day absences each year, and those with at least 20 years of experience are credited 40 full-day absences each year. We predict each teacher's full retirement eligibility date using her years of service and their absence history which we observe for 2000–2008. We sum absences each year and calculate the average number of absences teachers have over the years we observe them. On average, teachers take 22.4 full days off per year (where the school year has 185 days), which means that the average teacher accrues 360 unused absences by their 28th year.

It takes 20 unused absences to generate one month of credit towards their years-of-experience requirement, so the average teacher has enough saved absences to retire 18 months before they have accrued 30 years of experience by classroom teaching. We cannot make a precise mapping from observed absences over the nine years we observe absences to stored credit since the work history of teachers near retirement is mostly unobserved. We find that teachers with no more than 25 absences per year are most likely to leave the workforce with 28 years of work experience and those with more than 25 absences are most likely to leave the workforce with 29 years of experience. Even when we look at teachers with absences above the 90th percentile, they are most likely to retire with 29 years of service. We use our measures of absences for each teacher to impute her expected retirement eligibility date. The results are robust to alternative imputations.

4 Design and Results

4.1 Effort Effects of Pensions

Remember that one of the theoretical rationales for pension provision is that pensions elicit additional effort from employees by magnifying the downside of dismissal or appealing to reciprocity motives (Lazear, 1979; Gustman et al., 1994; Ruhm, 1994; Akerlof, 1982; Katz, 1986; Fehr et al., 1993; Mas, 2006). The panel dimension of our data allows us to observe yearly measures of effort and output for public school teachers in North Carolina. If a worker's effort slackens when she reaches retirement eligibility, it implies that pension incentives—to avoid premature dismissal or reciprocate large payments—successfully elicit additional effort.

Using the age and experience of each worker, we calculate her distance to the relevant retirement-eligibility notch. To do so, we calculate three values: (1) the employee's distance beyond the 30-years-experience cutoff, (2) the employee's distance beyond the age-60-and-25-years-experience cutoff, and (3) the employee's distance beyond the age-65-and-5-years-experience cutoff. The worker need only meet one notch to be eligible for retirement, so a worker's effective distance to retirement eligibility is the most positive distance to any notch. Those with a distance greater or equal to zero are retirement eligible and those with negative values are not yet eligible to retire.

We model the outcome variable E_{jt} (measures of effort for teacher j in year t) as a function of the teacher's distance to the retirement eligibility notch while accounting for teacher fixed-effects (α_j):

$$E_{jt} = \alpha_j + \sum_{m \in PRE} \pi_m \times \mathbf{1}(t - t_i^* = m) + \sum_{m \in POST} \pi_m \times \mathbf{1}(t - t_j^* = m) + \varepsilon_{jt} \tag{3}$$

Here, the indicators $\mathbf{1}(t - t_i^* = m)$ refer to event-time dummies that equal one if a teacher is exactly m years from retirement eligibility, and zero otherwise. (The variable t_i^* represents the time at which a teacher becomes eligible for retirement.) The first sum includes pre-eligible event years so that the π_m coefficients capture pre-eligible trends in the outcome. The second sum includes post-eligible event years. We exclude dummies for the period $m = -1$ so that period is the omitted category and the implicit reference for comparison.

If pensions elicit greater effort by workers, we would expect that the π_m coefficients would be negative for $m > 0$ when the outcome is positively related to effort (yearly value-add) and positive when the outcome is negatively related to effort (absences). We use the average of teacher j's students' residuals from equation 2 in year t to measure her productivity that year in our primary analysis, as they do not directly depend upon that teacher's past effort.[13] Functionally, rather than include year fixed-effects, which are collinear with event-time within most teachers, we demean E_{jt} by year to handle possible year effects.

To show how measures of effort and productivity evolve as workers cross the retirement eligibility threshold, we present the estimates from equation **??** in figure 2. Specifically, we present how teachers' math value-add, reading value-add, behavioral value-add, and absences evolve around the retirement eligibility notch. In each of the value-added measures, we see teachers value-add evolving smoothly as they gain experience. At the threshold, we do not see any significant deviation in the trend, suggesting that effort does not fall at retirement eligibility. We find that teachers have, likewise, a smooth evolution of yearly absences as they approach the eligibility notch, and we do not find an increase in absences as teachers become retirement-eligible. In total, this suggests that pensions do not elicit

[13] In table A1 we show the results from a similar exercise using teachers' value-added as estimated according to Chetty et al. (2014a) using only past years of data.

additional effort ether through deferring compensation or through reciprocity.

We pool the estimates to summarize the results statistically with a simple regression of the form:

$$E_{jt} = \alpha_j + \tau_t + \pi \times POST_{jt} + \varepsilon_{jt}, \tag{4}$$

Again, α_j denotes teacher fixed-effects and τ_t denotes year fixed effects. In essence, we measure how worker effort and productivity change after they become retirement-eligible on average. The estimate makes careful comparisons using individual fixed effects, essentially measuring how an individual's effort changes, controlling for cross-sectional differences in effort. Because the values evolve smoothly over time, we also include a time trend control in one robustness specification and a teacher-specific pre-eligibility trend in a third specification. We find no statistically significant change in measures of effort and productivity. Becoming eligible is associated with a 0.0021 (0.0067) effect on math value-add, a -0.0048 (0.0057) effect on reading value-add, a 0.0003 (0.0091) effect on contemporaneous behavioral value-add, and a 0.0048 (0.0136) effect on persistent behavioral value-added. We find a -1.04 (0.323) day effect on teacher absences which does not correspond to value-add increases and runs counter to the effort hypothesis of pension provision.

One potential explanation for the observed non-effect of pensions on worker effort is the lower dismissal rates within the public sector. One economic model motivating the "effort" rationale of pensions is that workers discipline their temptation to shirk because early dismissal comes at a magnified financial cost—the worker will lose significant pension wealth if their shirking is discovered. We use the Current Population Survey to understand how common layoffs are in public-school teaching, in government employers more generally, and in the private sector. About 2.1 percent of the private sector workers reported dismissal from 2010 to 2019. The dismissal rate is 1.0 percent for public school teachers and also 1.0 percent for government employees more generally. Though public-sector employees face a smaller risk of dismissal, dismissal risk is of a similar order of magnitude. Moreover, since the dismissal rate in public schools and other government employers is similar, we might expect the effort effects estimated in this setting to apply to other settings where pensions are often found.

The results also suggest that the reciprocity theory for effort enhancement is unlikely. Teachers don't appear to increase their effort in response to large increases in pension wealth prior to becoming eligible for retirement (Akerlof, 1982; Katz, 1986; Fehr et al., 1993; Mas, 2006).

4.2 Selection Effects of Pensions

The second rationale for pensions is to foster positive selection in the workplace, where pensions may be more attractive to conscientious and committed employees (Gustman et al., 1994). The notch provides empirical light to observe whether pensions have a positive effect on selection, by examining which teachers are most likely to be retained around the pension threshold. Pensions are structured to provide workers incentives to remain with an employer until the worker is eligible for retirement. Recalling back to figure 1, pensions reward those who stay and the incremental rewards for staying are especially large in the years just before a worker reaches retirement eligibility. For this reason, attrition odds are relatively low before workers reach the notch and relatively high after.

To see whether pensions foster positive selection, we test whether high-value-added teachers are more likely to be retained through the pension incentive than low-value-added teachers. To operationalize this approach, we separate teachers into three bins based on the predictable part of teacher value-added. We use value-added measures up to the year prior to eligibility to predict the teacher's value-added and use that measure to categorize teachers into three bins: a high-performing bin (the top third), a middle-performing bin (the middle third), and a low-performing bin (the bottom third). Then, within each of those groups, we plot the departure hazard over time to retirement eligibility.

For a typical teacher, attrition starts at 2 percent per year in the decade leading to retirement eligibility with attrition rising somewhat just before full eligibility. At retirement eligibility, attrition rates vault to about 20 percent where the change in retention at eligibility describes the retentive effect of the pension. What is important for our purposes is that the attrition patterns of the three groups are very similar around the notch. This is true regardless of which measure of value-added we employ (value-added for math, for reading, or for behavioral skills). This implies that the retentive effects of the pension are similar for low-value-added and high-value-added teachers. If pensions promoted positive selection, we would have expected that the retentive effect of pensions for high-value-added teachers would be significantly higher than that for low-value-added teachers. Intuitively, high-value-added teachers would have larger increases in attrition at the notch than low-value-added teachers if the incentive was more effective at retaining high-value-added teachers. The similarity of the retention patterns for the three groups suggests that they have similar preferences for pension income and therefore that pension benefits have similar effects on their labor supply decisions.

We gauge the retentive effect of pensions to compare the attrition rate pre- and post-retirement eligibility in a regression to test statistically what we observe visually. We estimate the following equation:

$$Ret_{jt} = \alpha_k + \tau_t + eligible_{jt}\beta + \mathbf{1}[\mathbf{K} = \mathbf{k}] \times eligible_{jt}\boldsymbol{\delta}_k + f(TTE_{jt}) + \epsilon_{jt}, \qquad (5)$$

where $K = k$ indicates teacher type, α_k is a fixed effect for being a high- or low-value-added teacher and τ_t is a year fixed-effect. The term $f(TTE_{jt})$ represents a local-linear function of time-to-eligibility for retirement which we allow to be different by teacher type prior to and after becoming eligible for retirement benefits. The coefficient β is the discontinuous effect of becoming eligible for retirements for average-quality teachers and $\boldsymbol{\delta}_k$ reflects the differential magnitude of the discontinuities of eligibility for low- and high-value-added teachers. We conduct this analysis at bandwidths of 5 and 10 years around the retirement eligibility notch.

Like the figures, we find large impacts of the retirement notches on attrition. When teachers hit their retirement notch, they become 12 (2.29) to 17 (2.26) percentage points more likely to retire.[14] We find statistically identical retentive effects for the three groups, regardless of how value-added is constructed. This suggests that pensions do not shape

[14]Consistent with Mahler (2018) in some specifications we find that highly effective teachers have lower attrition rates

selection in retention. Our analysis does not rule out the possibility that pensions endogenously attract different workers at the beginning of a career, but the implied similarity of preferences makes this possibility less likely. In a converging literature, Johnston (2024) similarly finds no difference in pension preferences by teacher quality.

Some models suggest that financial incentives of pensions may be second order. Goldhaber et al. (2024), for instance, find that retention patterns are similar across pension plans with different retention incentives in Washington state, suggesting that eligibility notches form what amounts to a behavioral anchor or social norm that guides workers selecting their retirement date.[15] The basic results of our paper have a similar takeaway under this model of human behavior. If the incentive effects are social or psychological rather than financial, what matters to the employer is whether those intangible incentives operate more powerfully on high-quality workers than low-quality workers, and we find they do not.

5 Conclusion

In the theoretical literature around personnel management, the rationales for pension provision include the role pensions might play in spurring worker effort and the role pensions might play to foster positive selection among workers. In this paper, we examine these claims with detailed records on worker output, effort, and retention in a setting that is important in its own right—the institution charged with forming human capital in the public sphere.

Despite sharp drop in pension incentives for effort, we find no discernible drop in teacher productivity or absences when teachers become retirement-eligible. This suggests that, at least in the context of public schools, pensions don't elicit additional effort from workers. Our analysis also does not find support for the selection hypothesis—the idea that pensions might selectively retain more productive workers. Pensions exert similar retentive force on teachers regardless of their quality or performance. This contrasts with claims by some advocates that pensions are instrumental in retaining a higher proportion of high-performing workers.

[15] This may be particularly powerful if most individual workers don't carefully optimize their retirement date but instead rely on what others tend to do.

Two important questions remain unanswered. First, it would be useful to examine whether pension programs influence selection on entry. One could imagine testing preferences for pensions in a choice experiment among college students and see whether willingness-to-pay for pensions is correlated with skills and attributes that predict productivity (e.g., ability, conscientiousness, social skills, etc.). Second, it would be helpful to understand whether pensions elicit additional effort in contexts where employees are at elevated risk of dismissal for low performance. While this question is theoretically interesting, it may have limited practical applicability due to the high concordance of pensions and job protections. Many settings with pensions also enjoy high levels of job security, suggesting our analysis may generalize to many other pension settings.

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Table 1: Summary statistics

	Full Sample	Within 10 years	Within 5 years
Math VA (mean)	0.00	0.01	0.01
Math VA (sd)	0.147	0.156	0.157
Math VA (N)	22,028	6,705	3,808
Reading VA (mean)	0.00	0.01	0.01
Reading VA (sd)	0.070	0.074	0.075
Reading VA (N)	23,181	7,143	4,068
Behavioral VA (mean)	0.00	0.00	0.00
Behavioral VA (sd)	0.070	0.078	0.080
Behavioral VA (N)	21,975	6,693	3,800
Behavioral VA (t+1) (mean)	-0.00	0.00	0.00
Behavioral VA (t+1) (sd)	0.108	0.119	0.121
Behavioral VA (t+1) (N)	21,994	6,690	3,797
Math student resid. (mean)	-0.04	-0.04	-0.04
Math student resid. (sd)	0.253	0.252	0.252
Math student resid. (N)	22,028	6,705	3,808
Reading student resid. (mean)	-0.00	0.00	0.00
Reading student resid. (sd)	0.190	0.193	0.192
Reading student resid. (N)	23,181	7,143	4,068
Behavioral student resid. (mean)	0.01	-0.00	-0.01
Behavioral student resid. (sd)	0.290	0.288	0.291
Behavioral student resid. (N)	21,975	6,693	3,800
Behavioral student resid. (t+1) (mean)	-0.00	-0.01	-0.01
Behavioral student resid. (t+1) (sd)	0.526	0.525	0.522
Behavioral student resid. (t+1) (N)	21,994	6,690	3,797
Days absent (mean)	23.12	22.86	22.43
Days absent (sd)	12.027	10.228	9.834
Days absent (N)	17,016	3,866	2,199
Notch at experience=28 (mean)	0.44	0.43	0.48
Notch at experience=29 (mean)	0.32	0.23	0.22
Notch at experience=25 (mean)	0.09	0.12	0.11
Notch at age=60 (mean)	0.07	0.09	0.09
Notch at age=65 (mean)	0.08	0.13	0.10
Attrition(mean)	0.03	0.05	0.08
Number of teachers	25,798	9,010	5,591

Notes: This table presents summary statistics for various samples including the full sample of teachers as well as analytic samples of teachers observed within five or ten years of the retirement notch. Math VA is the forecast-unbiased predicted VA based on yearly residuals for each teacher. Current behavioral VA is calculated by principal component analysis using student truancy and disciplinary actions (in-school suspensions and out-of-school suspensions) using the outcomes in the year the student is assigned the teacher of measurement. Persistent behavioral VA is the same but uses as the outcome the behavior of the students in the future, specifically in the year after they have left the teacher of measurement. We show which notch is relevant for the sample with an indicator for being at the notch at different experience and age profiles. Finally, we show the average attrition rate for each sample. Number of teachers is provided several times to explain the sample available for different measures.

Table 2: Teacher effort across the retirement notch

	(1) Math VA	(2) Reading VA	(3) Behavioral VA	(4) Behavioral (t+1) VA	(5) Teacher Absences
Eligible	0.00206	-0.00475	-0.000336	0.00476	-1.044***
	(0.00672)	(0.00566)	(0.00910)	(0.0136)	(0.323)
Control for pre-trends	No	No	No	No	No
Teacher pre-trends	No	No	No	No	No

(a) Basic specification

	(1) Math VA	(2) Reading VA	(3) Behavioral VA	(4) Behavioral (t+1) VA	(5) Teacher Absences
Eligible	0.00611	-0.00351	0.000831	0.00465	-0.753**
	(0.00683)	(0.00583)	(0.00955)	(0.0142)	(0.344)
Control for pre-trends	Yes	Yes	Yes	Yes	Yes
Teacher pre-trends	No	No	No	No	No

(b) Controlling for pre-trends

	(1) Math VA	(2) Reading VA	(3) Behavioral VA	(4) Behavioral (t+1) VA	(5) Teacher Absences
Eligible	0.00561	-0.00848	0.0145	0.00864	-1.491*
	(0.0135)	(0.0111)	(0.0205)	(0.0293)	(0.787)
Control for pre-trends	No	No	No	No	No
Teacher pre-trends	Yes	Yes	Yes	Yes	Yes
Depvar sd	0.167	0.142	0.242	0.302	9.826
N	41476	43203	41339	37055	33806

(c) Including teacher-specific pre-trends

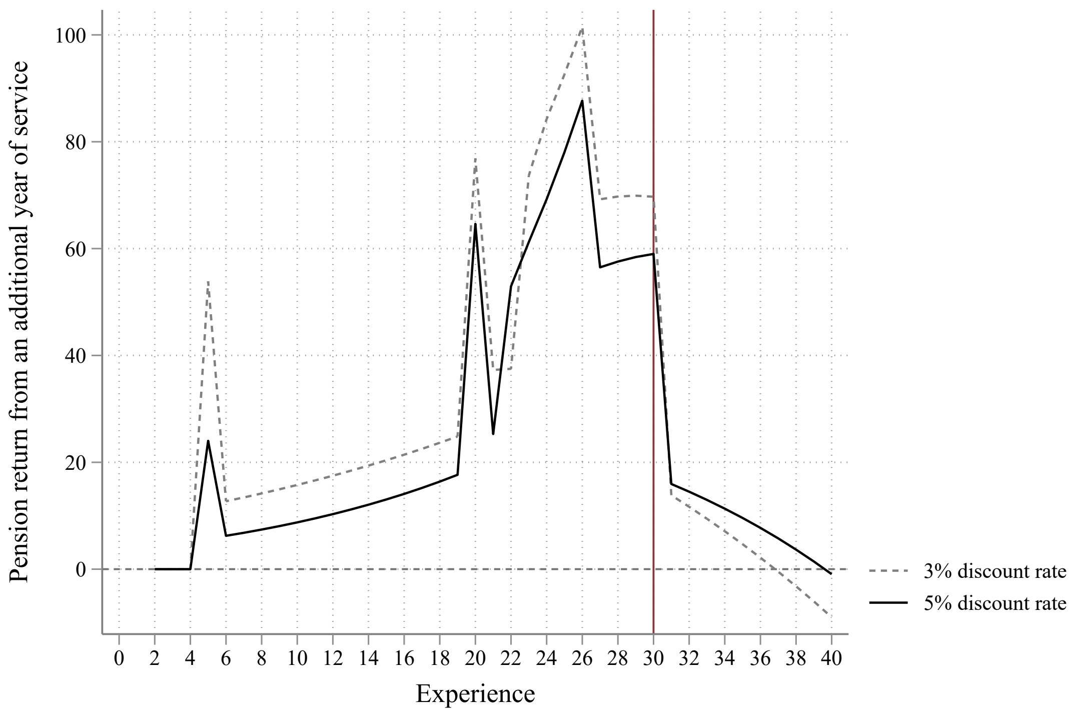
Notes: In this table, we present estimates of how much the pension eligibility notch corresponds to changes in teacher productivity and effort, using equation 4. In short, we regress measures of teacher output on an indicator for pension eligibility with controls for teacher fixed-effects and time fixed-effects. The design compares the effort of retirement-eligible teachers to their own effort before they were eligible. In general, we find that eligibility has little to no impact on productivity. While theory predicts teachers will exert less effort after the notch, we find that teacher attendance increases without a corresponding increase in productivity. All regressions include teacher and year fixed-effects. Standard errors are clustered at the teacher level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: Differential attrition by teacher value-add at retirement notch

	Quality by Math VA		Quality by Reading VA		Quality by Behavioral VA		Quality by Behavioral VA (t+1)	
	Attrition	Attrition	Attrition	Attrition	Attrition	Attrition	Attrition	Attrition
Eligible	0.163***	0.171***	0.145***	0.141***	0.148***	0.120***	0.126***	0.151***
	(0.0183)	(0.0226)	(0.0183)	(0.0233)	(0.0181)	(0.0229)	(0.0196)	(0.0238)
Low-quality	0.0135	0.0224	-0.00607	-0.0114	0.000566	-0.0147	-0.00489	0.00995
	(0.0101)	(0.0188)	(0.00994)	(0.0188)	(0.00968)	(0.0182)	(0.0117)	(0.0199)
Low × eligible	-0.0249	-0.0286	0.00807	0.0123	-0.0126	0.0280	-0.00107	-0.0119
	(0.0266)	(0.0331)	(0.0260)	(0.0326)	(0.0258)	(0.0321)	(0.0272)	(0.0334)
High-quality	-0.00716	0.0159	-0.0203**	-0.0168	-0.00988	-0.0194	-0.0217**	-0.0147
	(0.00891)	(0.0168)	(0.00901)	(0.0173)	(0.00941)	(0.0179)	(0.0110)	(0.0187)
High × eligible	-0.00103	-0.0434	0.0160	0.000752	0.0272	0.0465	0.0337	0.0197
	(0.0246)	(0.0306)	(0.0241)	(0.0304)	(0.0250)	(0.0315)	(0.0264)	(0.0325)
Bandwidth	10	5	10	5	10	5	10	5
Depvar mean	0.0515	0.0948	0.0513	0.0940	0.0515	0.0947	0.0743	0.109
N	26444	11548	27917	12183	26330	11491	18252	10036

Notes: This table presents estimates of how much pension eligibility corresponds to increases in attrition for teachers of different output, using equation 5. Intuitively, we measure whether the change in retention at the notch differs for highly productive workers when compared to less productive workers. If attrition increases more for highly productive workers, it implies that the pension incentives for retention acted more powerfully on high value-add workers and improved *selection*. We do not find that pensions are more likely to retain high-performing teachers, suggesting that pensions do not promote positive selection. Robust standard error are in parentheses with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

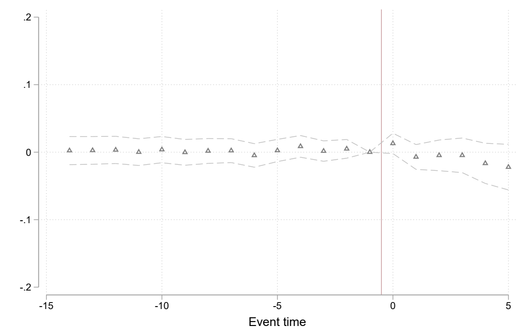
Figure 1: Pension Returns from Experience as Teachers Approach a Retirement Notch



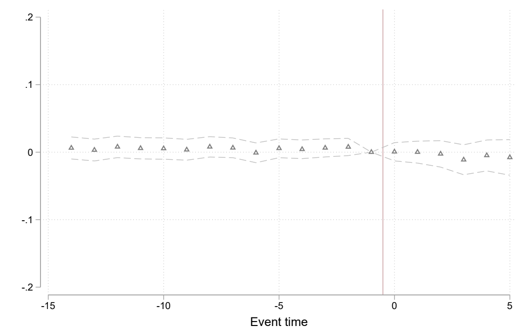
Notes: The figure shows the pension-wealth returns to experience for an archetypal teacher. The archetypal teacher begins her career at age 24 and is therefore not eligible for retirement until she reaches 30 years of service credit. The vertical scale measures how large the return is for an additional year of experience, where the y-axis is a measure of what percent of her final average salary (FAS) she accrues by an additional year of experience in terms of the present-discounted value of her lifetime pension income. In years 22–30, she receives a large present-discounted return, up to 100 percent of her FAS, from each additional year of service. This return falls precipitously when she crosses the retirement-eligibility notch at 30 years of experience .

Figure 2: Effort and output across the retirement notch

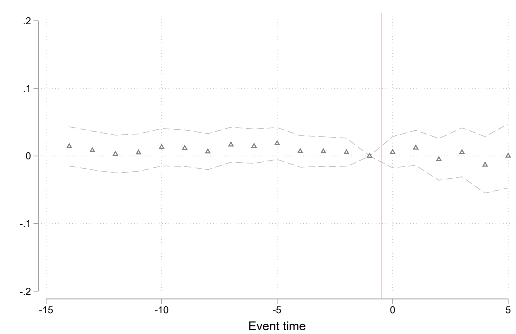
(a) Math



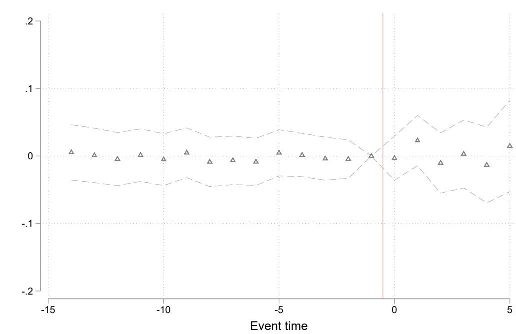
(b) Reading



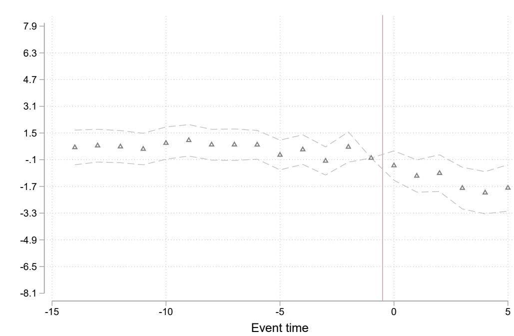
(c) Behavioral



(d) Behavioral (t+1)



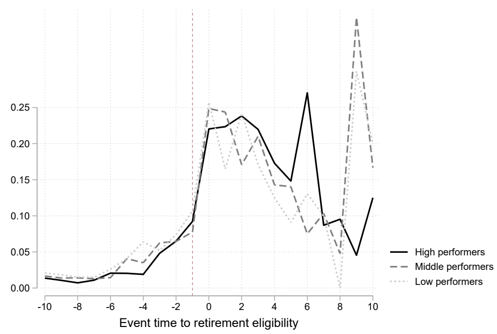
(e) Teachers' days absent



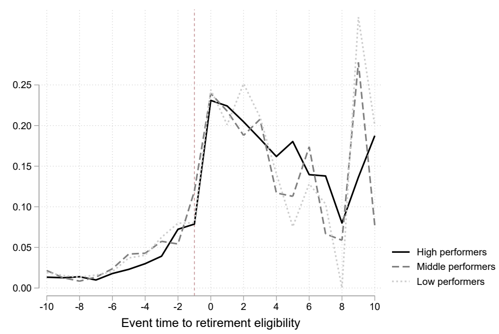
Notes: The figures are plots of the coefficients from equation 3, showing teachers-associated student achievement gains (residuals) and teachers' absences as they cross the retirement-eligibility notch. Because the estimates are conditioned on teacher fixed-effects, the estimates compare a teacher's output to her own output in other years. We calculate student residuals in each year so that they can change from one year to the next as incentives change. We plot the coefficients on event-study dummies here to show transparently how teacher performance changes in the run-up to eligibility, as teachers become eligible, and their dynamics while teachers are eligible to retire but remain working. The y-axis is scaled to approximately reflect 1 SD of the mean student residuals.

Figure 3: Attrition rates around pension notch, by teacher quality

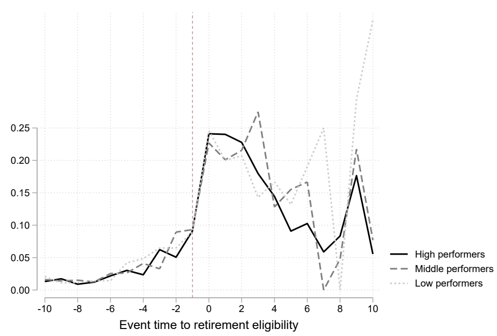
(a) Math



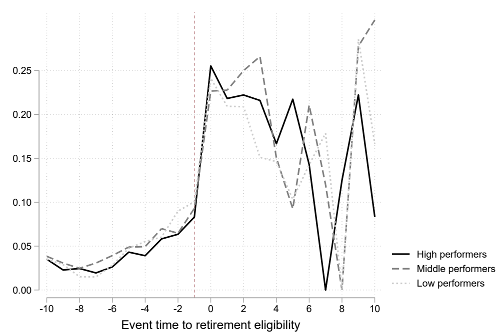
(b) Reading



(c) Behavioral



(d) Behavioral (t+1)

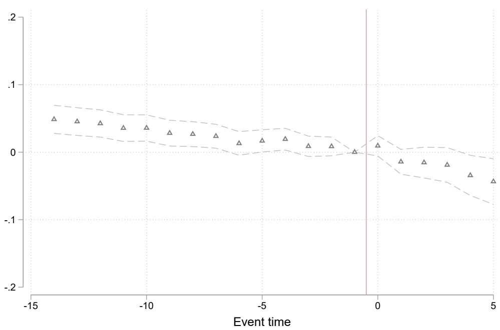


Notes: This figure presents how attrition evolves around the notch for different VA groups (the top third, the middle third, and the bottom third of value-added). We find that attrition increases significantly at the notch. We find no meaningful differences in attrition rates by teacher-effectiveness, meaning that high-VA teachers were not more likely to be retained by the pension than low-VA teachers. This suggests that pensions do not promote positive selection.

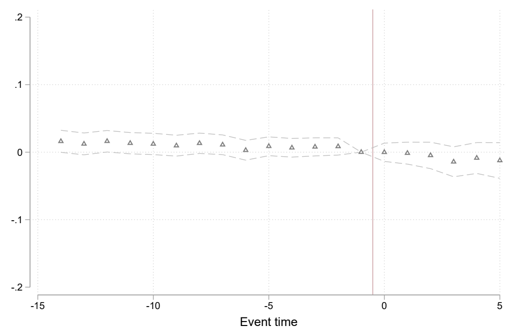
A Appendix: Supporting Figures

Figure A1: Effort and output across the retirement notch, excluding pre-trend controls

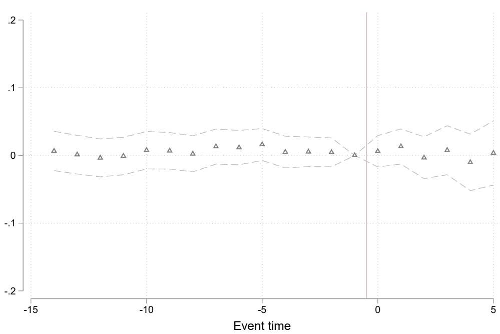
(a) Math



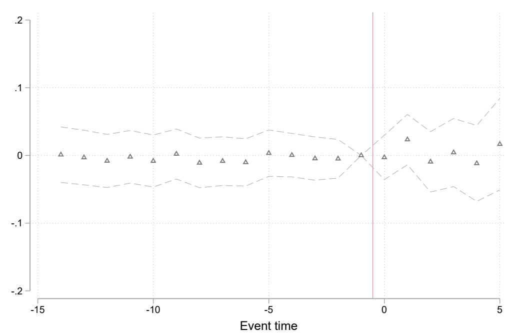
(b) Reading



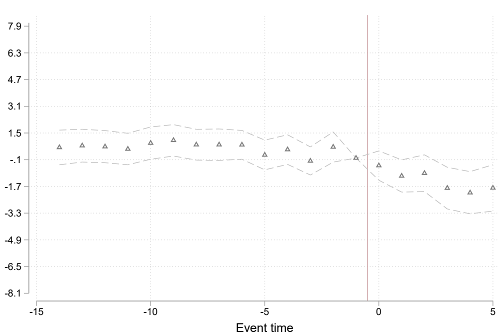
(c) Behavioral



(d) Behavioral (t+1)



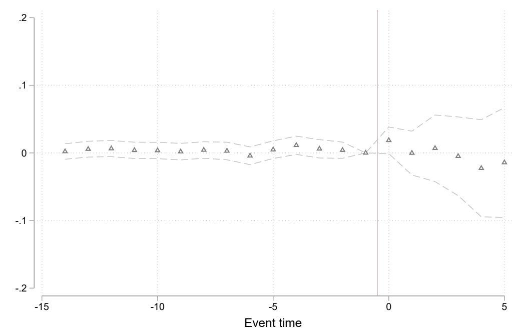
(e) Days absent



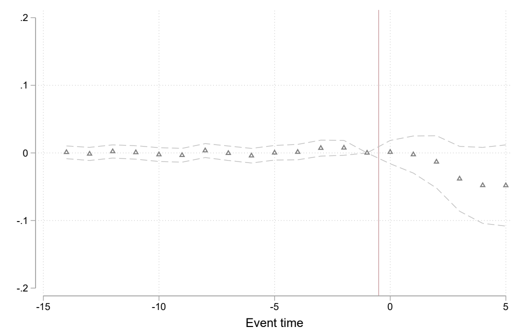
Notes: These figures show teachers' average student residuals as teachers cross the retirement-eligibility notch excluding controls for pre-notch trends. We calculate average student residuals in each year we observe her. We plot the coefficients on event-study dummies here to show transparently how teacher value-added changes in the run-up to eligibility, as teachers become eligible, and their dynamics while teachers are eligible to retire but remain working. The y-axis is scaled to approximately reflect 1 SD of the outcome measure.

Figure A2: Effort and output across the retirement notch, controlling for teacher-specific pre-trends

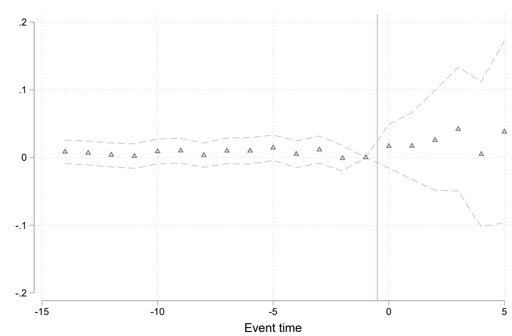
(a) Math



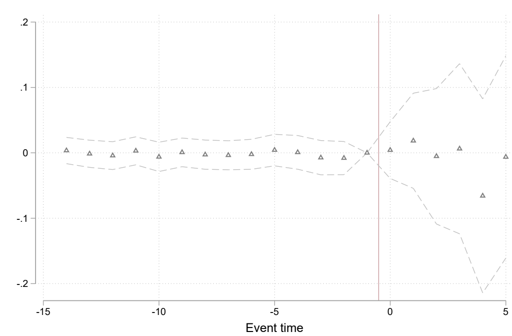
(b) Reading



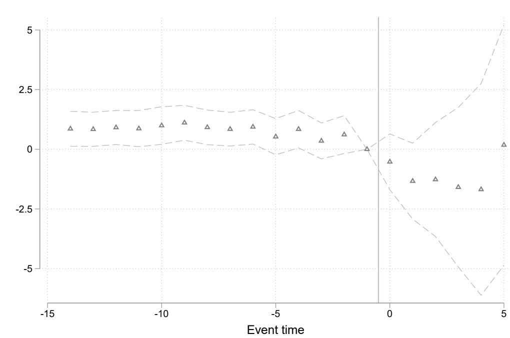
(c) Behavioral



(d) Behavioral (t+1)

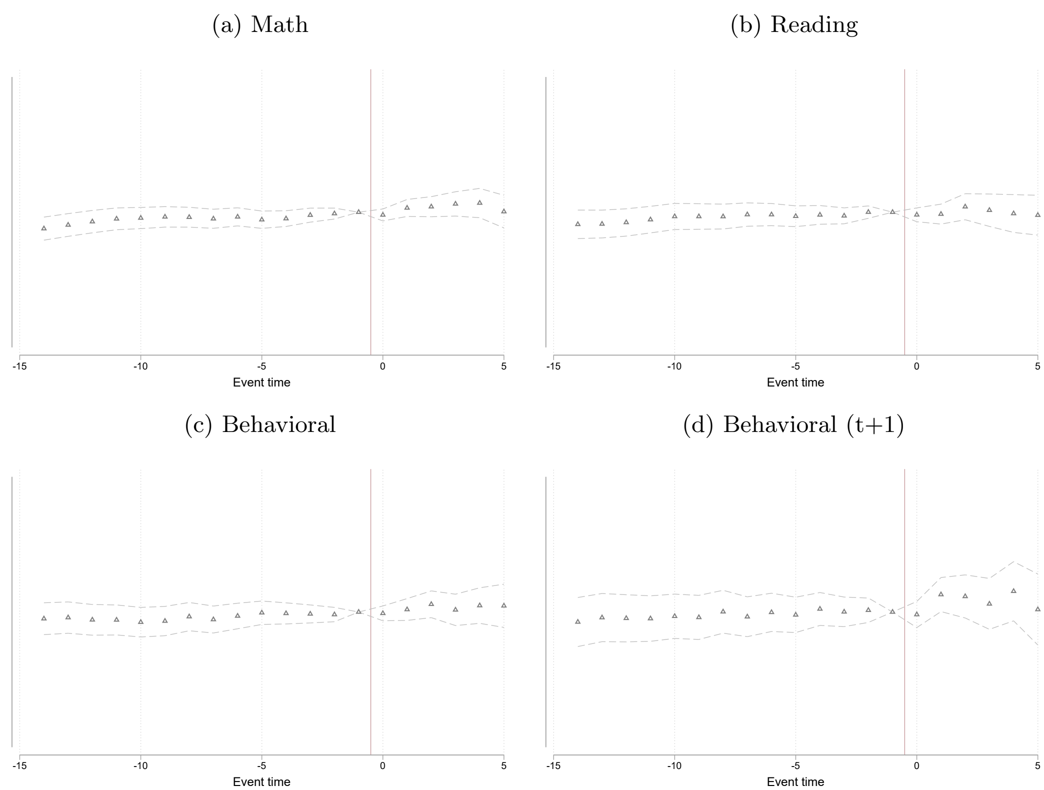


(e) Days absent



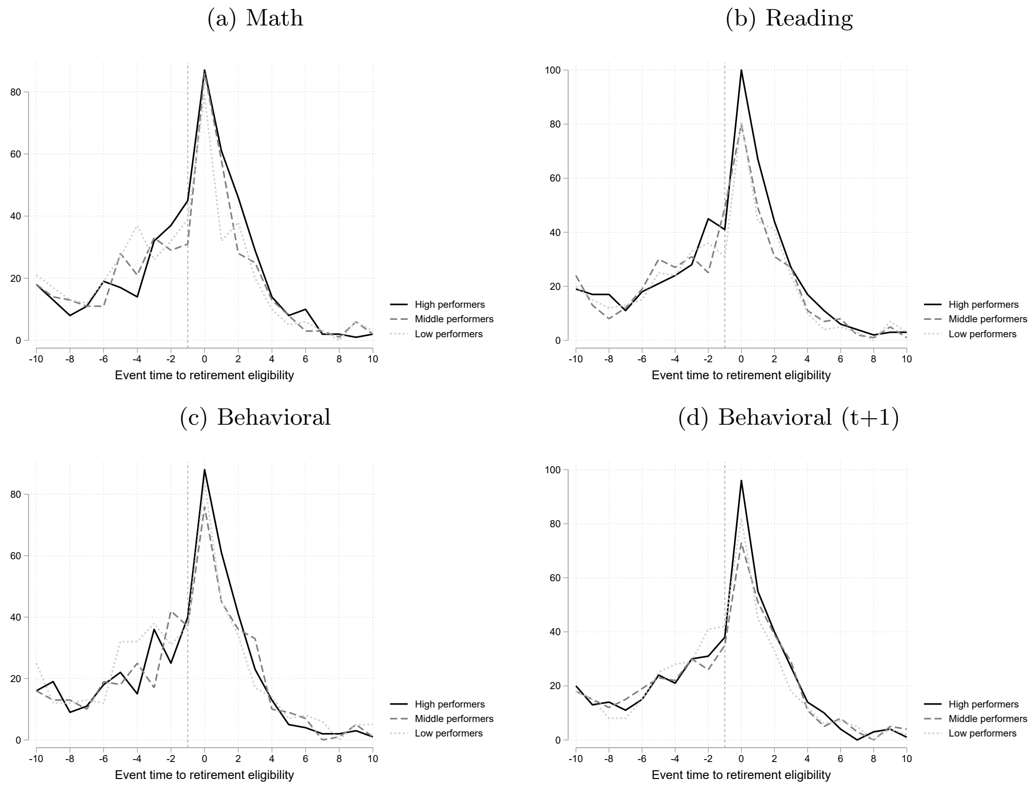
Notes: These figures show teachers' average student residuals as teachers cross the retirement-eligibility notch with teacher-specific detrended data. While the estimates in the post-period are noisier, they still do not show a drop in teacher productivity following the notch. The y-axis is scaled to approximately reflect 1 SD of the outcome measure.

Figure A3: Productivity across the retirement notch, as measured by teachers' VA



Notes: These figures show teachers' value-added as teachers cross the retirement-eligibility notch. We calculate teacher value-added in each year we observe her. We plot the coefficients on event-study dummies here to show transparently how teacher value-added changes in the run-up to eligibility, as teachers become eligible, and their dynamics while teachers are eligible to retire but remain working. The y-axis is scaled to approximately reflect 1 SD of the value-added measure.

Figure A4: Attrition counts around pension notch, by teacher quality



Notes: This figure shows how much pension eligibility corresponds to increases in attrition separately for teachers in the lowest, middle, and highest tertile of teacher effectiveness. In general, we find that eligibility increases attrition significantly. Of interest in this study is whether low-performing workers are less likely to be retained by pension incentives, but we find no meaningful differences by teacher quality in the number of teachers who leave once eligible for retirement. This suggests that pensions do not promote positive selection.

B Appendix: Supporting Tables

Table A1: Teacher effort across retirement notch, measuring productivity by teachers' VA

	(1) Math VA	(2) Reading VA	(3) Behavioral VA	(4) Persistent Behav. VA	(5) Teacher Absences
eligible	0.000525	-0.000747	0.000781	0.000979	-1.044***
	(0.00263)	(0.00168)	(0.00176)	(0.00266)	(0.323)
Fixed effects	Teacher, year	Teacher, year	Teacher, year	Teacher, year	Teacher, year
Depvar mean	0.00707	0.00592	0.000121	0.000744	23.17
Depvar sd	0.154	0.0728	0.0762	0.116	10.33
N	42930	44674	42898	38372	33806

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents estimates of how much pension eligibility corresponds to productivity and effort. In general, we find that effort remains strikingly constant across the threshold. As measures of effort here, we include teacher value-added on math tests, reading tests, current student behavior, future student behavior, and teacher attendance. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A2: Teacher effort across the retirement notch, separating notches

	(1) Math VA	(2) Reading VA	(3) Behavioral VA	(4) Behavioral (t+1) VA	(5) Teacher Absences
Eligible	0.000308	-0.00741	-0.0000552	0.0136	-0.748**
	(0.00562)	(0.00511)	(0.00973)	(0.0139)	(0.352)
Observations	42553	43934	33257	30353	22713

(a) 30-year notch

	(1) Math VA	(2) Reading VA	(3) Behavioral VA	(4) Behavioral (t+1) VA	(5) Teacher Absences
Eligible	-0.0104	-0.0140*	0.00680	0.00335	-1.013
	(0.0104)	(0.00849)	(0.0147)	(0.0214)	(1.001)
Observations	22111	23027	18026	16618	10975

(b) lower-experience notches

Notes: This table presents estimates of how much pension eligibility corresponds to changes in teacher productivity and effort. In general, we find that eligibility has little impact on productivity. While the incentive structure might induce teachers to exert less effort after the retirement notch, we find that teacher attendance increases after the notch without a corresponding increase in productivity. All regressions include teacher and year fixed-effects. Standard errors in parentheses are clustered at the teacher level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A3: Differential attrition by teacher value-add at 30-year retirement notch

	Quality by Math VA		Quality by Reading VA		Quality by Behavioral VA		Quality by Behavioral VA (t+1)	
	Attrition	Attrition	Attrition	Attrition	Attrition	Attrition	Attrition	Attrition
Eligible	0.149***	0.163***	0.145***	0.145***	0.137***	0.120***	0.128***	0.148***
	(0.0198)	(0.0252)	(0.0196)	(0.0258)	(0.0189)	(0.0244)	(0.0214)	(0.0264)
Low-quality	0.0128	0.0181	-0.0123	-0.0187	-0.0131	-0.0218	-0.0119	0.00000280
	(0.0107)	(0.0206)	(0.0100)	(0.0193)	(0.00960)	(0.0182)	(0.0123)	(0.0206)
Low × eligible	-0.0100	-0.0176	-0.00450	-0.00191	-0.00620	0.0212	0.0110	-0.00682
	(0.0289)	(0.0370)	(0.0270)	(0.0347)	(0.0264)	(0.0333)	(0.0284)	(0.0354)
High-quality	-0.0108	-0.00724	-0.0150	-0.0173	-0.00540	-0.0177	-0.0200*	-0.0241
	(0.00886)	(0.0171)	(0.00917)	(0.0182)	(0.00972)	(0.0189)	(0.0117)	(0.0197)
High × eligible	0.0122	-0.0204	0.0123	0.00425	0.0448*	0.0634*	0.0403	0.0297
	(0.0254)	(0.0323)	(0.0254)	(0.0329)	(0.0264)	(0.0340)	(0.0282)	(0.0352)
Bandwidth	10	5	10	5	10	5	10	5
Depvar mean	0.0402	0.0725	0.0397	0.0718	0.0402	0.0726	0.0587	0.0832
N	17558	7875	18507	8329	17543	7869	12016	6867

Notes: This table presents estimates of how much pension eligibility at 30 years of experience corresponds to increases in attrition using equation 5. The logic is that we measure whether the change in retention at the notch differs for highly productive workers when compared to less productive workers. If attrition increases more for highly productive workers than less productive workers, it implies that the pension incentives acted more powerfully on high value-add workers and pensions improve *selection*. In general, we find little evidence of differential selection at the 30-year pension eligibility, though teachers with few behavioral infractions and good student attendance are marginally statistically significantly more likely to attrit when looking only at this threshold. We note that this finding may be an artifact of the number of hypotheses that are tested here. Robust standard error are in parentheses with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A4: Differential attrition by teacher value-add, at lower experience notches

	Quality by Math VA		Quality by Reading VA		Quality by Behavioral VA		Quality by Behavioral VA (t+1)	
	Attrition	Attrition	Attrition	Attrition	Attrition	Attrition	Attrition	Attrition
Eligible	0.182***	0.165***	0.150***	0.129***	0.172***	0.120***	0.135***	0.162***
	(0.0336)	(0.0412)	(0.0327)	(0.0413)	(0.0363)	(0.0461)	(0.0355)	(0.0432)
Low-quality	0.0104	0.0211	0.0132	0.00442	0.00308	-0.0232	0.0117	0.0303
	(0.0186)	(0.0348)	(0.0193)	(0.0367)	(0.0191)	(0.0368)	(0.0223)	(0.0389)
Low × eligible	-0.0365	-0.0173	0.0432	0.0632	0.000287	0.0476	-0.0118	-0.0222
	(0.0496)	(0.0604)	(0.0507)	(0.0628)	(0.0506)	(0.0629)	(0.0530)	(0.0644)
High-quality	0.0162	0.0635*	-0.0122	0.00329	-0.0196	-0.0383	-0.00581	0.0175
	(0.0181)	(0.0349)	(0.0174)	(0.0333)	(0.0188)	(0.0362)	(0.0208)	(0.0364)
High × eligible	-0.0127	-0.0531	-0.00373	-0.0163	-0.0171	0.0160	0.000892	-0.0128
	(0.0486)	(0.0607)	(0.0466)	(0.0567)	(0.0503)	(0.0617)	(0.0498)	(0.0613)
Bandwidth	10	5	10	5	10	5	10	5
Depvar mean	0.0690	0.129	0.0681	0.128	0.0690	0.129	0.0970	0.148
N	10331	4321	10897	4533	10331	4321	7322	3754

Notes: This table presents estimates of how much pension eligibility at 25 and 5 years of experience at ages above 60 and 65 corresponds to increases in attrition. In general, we find that eligibility increases attrition significantly, but does not appear to do so differentially by tertiles of teacher quality. Robust standard error are in parentheses with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.