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Evidence on the Relationship between Pension-Driven Financial Incentives and Late-Career Attrition: Implications for Pension Reform

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Abstract

Retirement plans can create strong financial incentives that have important labor market implications, and many states have adopted alternative plan designs that significantly change these incentives. The authors use longitudinal data to investigate the impact of Washington State's 1996 introduction of a hybrid retirement plan on late-career attrition. The unique setup of Washington's plans allows them to provide empirical evidence on the influence of financial incentives created by statutory retirement eligibility thresholds. Findings show that despite facing very different financial incentives, teachers enrolled in the hybrid and traditional plans respond similarly to reaching a key retirement eligibility threshold. The authors hypothesize that teachers are anchoring to the eligibility thresholds, muting the influence of the financial incentives. They also provide evidence that, in the presence of bright-line eligibility thresholds that can anchor workers' separation behavior, commonly used structural models may overpredict workers' responsiveness to the financial incentives embedded in retirement plans.

Keywords: employer-provided pension coverage, retirement, empirical analysis, personnel data, public sector, retention

Most state and local public sector employees in the United States are enrolled in final-average-salary defined benefit (DB) pension plans under which retirement benefits are based on an employee's years of service and average salary over their last few years of work. These plans create strong incentives for employees to continue working or exit employment that depend, in large part, on their proximity to their plans' retirement eligibility thresholds. Changes to these incentives have the potential to substantially impact the public sector workforce by altering attrition patterns, especially among experienced, late-career workers.

In response to rising costs driven by large funding shortfalls, many state governments have made significant changes to their pension plans over the past two decades (National Association of State Retirement Administrators, 2022). And while there is a well-developed literature documenting workers' responsiveness to DB plan incentives (e.g., Brown, 2013; Chan & Stevens, 2008; Costrell & McGee, 2010), there is little evidence on how large changes to pension incentives might affect the employees' end-of-career exit patterns.

The primary reason for this is that pension reforms tend to be applied exclusively to new enrollees. Therefore, few employees enrolled under substantially altered pension plans or alternative retirement plan structures have reached the ends of their careers, resulting in a paucity of empirical evidence on employees' end-of-career exit behavior under alternative pension structures.

Another challenge is that changes to financial incentives are almost always paired with other changes that may influence exit behavior, like adjustments to age and service retirement eligibility thresholds. In fact, any change to eligibility thresholds will impact both the timing and magnitude of the financial incentives workers face. This link makes it difficult to isolate the impact of financial incentives. Much of the prior work around workers responsiveness to traditional pension plan financial incentives suffers from this issue. We overcome this challenge by focusing on reforms that substantially changed financial incentives but kept eligibility thresholds consistent across plans.

We leverage a unique situation created when, in 1996, Washington State introduced a hybrid pension plan with both DB and defined contribution (DC) features and gave members of the existing DB plan the option to transfer into the new plan. The new hybrid plan kept the same retirement eligibility thresholds as the existing DB plan but reduced the magnitude of the financial incentive at an important retirement eligibility threshold by roughly half. This allows us to isolate and provide empirical evidence on the impact of a large shift in financial incentives on retirement behavior in the context of public school teachers, who are the largest group of public employees in the United States. We also use parameter estimates from Ni et al. (2022) to model exit-probabilities under the two plans and compare these simulation-based results to our empirical estimates to understand how well structural model predictions perform in this context.

The Teacher Retirement System in Washington State

As noted above, we leverage the unique situation created by a 1996 Washington State pension reform law that introduced a hybrid DB-DC teacher pension plan (TRS3) and gave teachers in the existing DB plan (TRS2) the option to transfer into the new plan. Unlike more recent pension reforms in other states, the introduction of TRS3 was not a reaction to concerns about underfunded pension liabilities, so it was not designed to reduce benefits to cut costs. Rather, TRS3 was created with the intent of providing a pension plan that balanced flexibility with stability, increased employee control over investments, and was more accommodating of professional mobility (Goldhaber and Grout, 2014; HB 1206, Laws of 1995). The legislation that established TRS3 was designed to be revenue neutral and had the support of the teacher workforce, as evidenced by the fact that roughly three-quarters of eligible teachers opted to transfer from TRS2 to TRS3 (Goldhaber and Grout, 2016a).[1]

The TRS2 teachers who were eligible to transfer to TRS3 were hired between 1977 and 1995, when all new teachers were enrolled in TRS2. Our analysis focuses on this transfer-eligible cohort because they are in a unique position to shed light on how a major change to pension plan financial incentives affects end-of-career attrition patterns. While they were hired at the same time and faced similar economic and labor market conditions, the two retirement plans in which they participate create very different financial incentives. Since TRS3 was introduced in 1996, most transfer-eligible teachers would have been able to accrue enough service credit to reach key retirement eligibility thresholds during our study period, which spans 2011 to 2017.

Table 1 describes the key features of the two retirement plans. As noted above, TRS2 is a traditional DB plan while TRS3 includes both a traditional DB plan and a DC plan. TRS2 has a benefit formula with a 2% multiplier, which pays a TRS2 teacher who retires with 30 years of service (YOS) an annual annuity equal to 60% of their final average salary (FAS). If enrolled in TRS3, which has a 1% multiplier, that same teacher would receive an annuity equal to 30% of their FAS in addition to retirement income withdrawn from their DC account.[2] TRS 3 also provides members who exit with 20 or more YOS with inflation protection that increases their

[1] The fact that our study population self-selected into either TRS2 or TRS3 must be considered when comparing the behavior of members of these two plans. We discuss how sample selection affects the interpretation of our analyses in the Empirical Approach section below.

[2] All contributions to TRS3 made by employees are placed in a personal investment account. Employees can choose from a discrete menu of contribution rate options ranging from 5% to 15%.

FAS by approximately 3% each year between their exit year and the year they begin drawing retirement benefits.[3]

Feature	***TRS2***	***TRS3***	
Type	Traditional DB Plan	DB component	DC component
Employee contributions	Set by the legislature	N/A	5%–15% (employee's choice)
Employer contributions	Set by the legislature	Set by the legislature	N/A
Benefit formula	$0.02*(FAS)*(YOS)$	$0.01*(FAS)*(YOS)$	N/A
FAS period	5 consecutive highest paid years	5 consecutive highest paid years	N/A
Retirement eligibility	Full Benefit • Age 65 • Age 62 & 30 YOS Reduced Benefit • Age 55 & 30 YOS* Further Reduced Benefit • Age 55 & 20 YOS	Full Benefit • Age 65 • Age 62 & 30 YOS Reduced Benefit • Age 55 & 30 YOS* Further Reduced Benefit • Age 55 & 10 YOS	Withdrawal ages and penalties for early withdrawal dependent on federal tax rules.

Table 1. Key Features of Washington State's Teacher Retirement System
Notes: DB is defined benefit; DC is defined contribution; FAS is final average salary; YOS is years of service. *With 30 YOS, a member's benefit is reduced by a factor of 0.98 if she retires at age 61 and by an additional 0.03 for each year between retirement age and age 61 (e.g., the early retirement factor for age 55 is 0.80).

The TRS2 member contribution rate is set by the WA legislature and since 1977, has ranged from a low of 0.15% in 2002 to high of 8.05% in 2022. When TRS3 was introduced in 1996, the TRS2 contribution rate was 6.59%.[4] TRS3 members do not contribute to the DB

[3] For example, a teacher with 20 YOS and an FAS of $50,000 who exited employment at age 50 and began collecting retirement benefits at age 65 who receive an annual benefit of $0.01 * 20\ YOS * \left(50{,}000 * 1.03^{(65-50)}\right) = \$15{,}580$ rather than an unadjusted benefit of $0.01 * 20\ YOS * 50{,}000 = \$10{,}000$.
[4] For further details, see https://www.drs.wa.gov/employer/ch6/ (accessed April 5, 2023).

portion of their benefit and can choose from a menu of DC contribution rates ranging from 5% and 15%.[5] Employer contributions to TRS2 and TRS3 fund the defined benefit components of each plan; the contribution rates are identical and are set by the legislature based on the funding status of the pension fund.[6] Teachers who transferred from TRS2 into TRS3 received the value of their previous TRS2 contributions plus interest (5.5%, compounded quarterly) in their new DC accounts. Teachers who transferred to TRS3 prior to 1998 also received an additional transfer bonus payment equal to 65% of the value of their TRS2 contributions deposited in their DC account.[7]

The rules defining retirement eligibility are nearly identical between TRS2 and TRS3. The normal retirement age for both plans is 65 regardless of service, and members can retire as early as age 55 with reduced benefits at 20 YOS (for TRS2) or 10 YOS (for TRS3). Early retirement factors are used to determine how much benefits are reduced for TRS2 and TRS3 members who opt to retire early. Under both plans, these factors become more generous when a member reaches 30 YOS, at which point members can draw unreduced benefits as early as age 62.[8] Our analysis will focus on the 30 YOS eligibility threshold.

The introduction of TRS3 has been the subject of prior research. Goldhaber and Grout (2016a) studied teachers' transfer preferences and found that age was the strongest predictor of transferring, with older teachers being significantly less likely to opt into TRS3. The estimated

[5] See Goldhaber and Grout (2016b) for an analysis of teachers' savings patterns under TRS3.
[6] The employer contribution rate was 12.4% when TRS3 was introduced in 1996 and have subsequently ranged between 1.3% (in 2002) and 15.7% (in 2020).
[7] Over 98% of transfers into TRS3 occurred prior to the 1998 deadline (Goldhaber and Grout, 2016a).
[8] With 30 YOS, a member's benefit is reduced by a factor of 0.98 if she retires at age 61 and by an additional 0.03 for each year between retirement age and age 61 (the early retirement factor for age 55 is 0.80). For documentation on the early retirement factors for TRS2 and TRS3, see https://www.drs.wa.gov/plan/trs2/#early-retirement.

financial benefit of switching plans, having a higher salary, and being white were also predictive transferring. Goldhaber et al. (2017) examined whether the introduction of TRS3 led to higher levels of attrition and found little evidence that it did so.

Pension Wealth Accrual

As noted above, pension wealth accrual patterns under traditional DB plans create financial incentives to continue working until reaching retirement eligibility, at which point there is an incentive to leave employment to collect retirement benefits. Here, we consider how members of the TRS plans accrue pension wealth over the course of a career to better understand how the benefit formulas and retirement rules described above affect the magnitude and timing of the financial incentives embedded in the TRS plans.

Following Costrell & Podgursky (2009), we define pension wealth as the present value of the stream of future benefits a member is entitled to given their current age and years of service:

$$PV_{PW} = \sum_{A=A_S}^{110} \left(\frac{1}{1+r}\right)^{(A-A_S)} * f(A|A_S) * b * FAS * YOS * ERF * COLA_A, \qquad (1)$$

where A_S is age at separation, r is the discount rate, $f(A|A_S)$ is the probability of surviving to age A given separation age A_S, b is the benefit multiplier, and $COLA_A$ is a cost-of-living adjustment. We calculate PV_{PW} at each potential starting age and year of separation. The pension wealth calculations for a representative teacher starting her career at age 25 are presented in **Figure 1,**[9] which plots TRS3 DB pension wealth as well as total TRS3 pension wealth assuming

[9] We assume a 4% discount rate, a 2% COLA, and survival probabilities from the CDC. We discount to age of separation instead of starting age to reflect the perspective of the teacher deciding whether to retire in the current school year. Note that employees can choose to delay retirement after separating employment. Conditional on each potential point of separation, we assume that employees choose the retirement timing that maximizes pension wealth, and generally refer to separation instead of retirement.

the representative teachers makes the minimum 5% contribution to her DC account and a earns a 5.5% annual rate of return on DC account assets.[10]

In **Figure 1**, we see that the rate of pension wealth accrual increases as the teacher gains experience so that the additional pension wealth earned during an additional year of service becomes quite large as an employee approaches eligibility for retirement.[11] In comparing the defined benefits provided by TRS2 and TRS3 (represented by the solid blue line and the dashed red line, respectively), there is relatively little difference in accumulated wealth between the two plans for teachers who separate with between 20 and 29 YOS; this is because of the inflation protection provision in TRS3 described above. However, end-of-career pension wealth – once the teacher has reached 30 YOS – is much larger under TRS2.

[10] The value of the DC component of TRS3 will vary according to employees' contribution rate choices and returns earned on their investments. Given the assumed contribution rate (5%) and rate of return (5.5%), **Figure 1** reflects a conservative estimate of total pension wealth accrual under TRS3.

[11] The DB + DC pension wealth accrual represented by the dashed red line in **Figure 1** understates the level of DC pension wealth that would have been held by a teacher immediately after transferring from TRS2 to TRS3 during the transfer bonus period. In **Figure 1**, we assume a 5% contribution rate and a 5.5% rate of return on DC assets. TRS2 members contributed at a greater rate prior to the transfer period (between 5.66% and 6.99%) and were able to transfer those contributions with 5.5% interest plus the one-time 65% transfer bonus.

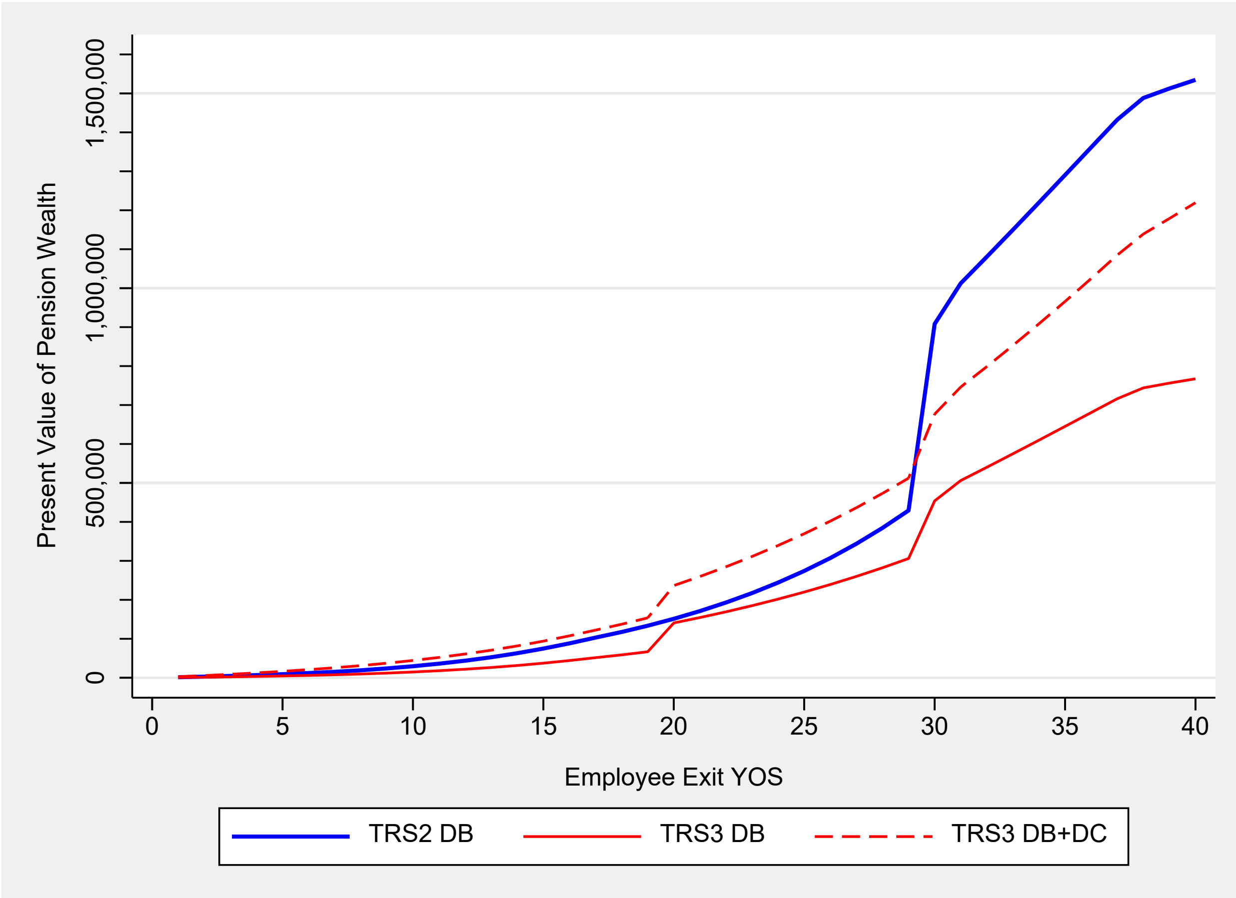

Figure 1. Pension Wealth Accrual for an Age 25 entrant in TRS2 and TRS3
Notes: Pension wealth calculations are derived from equation (1) for a representative teacher who enters employment at age 25. We assume a 5.5% discount rate and a 2.75 percent COLA based on the assumptions of the pension plan. We use the 2013 unisex static mortality table based on the RP-2000 Mortality Tables Report adjusted for mortality improvement using Projection Scale AA. The mortality table can be found at http://www.irs.gov/pub/irs-drop/n-08-85.pdf. For TRS3, we assume a 5% contribution rate to the DC plan, and a 5.5% rate of return. Lastly, salary values come from Washington teacher salary schedules in 2012-13 for a teacher with a master's degree.

It is the 30-YOS retirement eligibility threshold that is the focus of our empirical analysis. Under both TRS2 and TRS3, a member who begins employment at a young age experiences a large increase in pension wealth when she accrues 30 YOS (note the kink in both the TRS2 and TRS3 pension wealth accrual lines). Reaching 30 YOS allows her to retire with full benefits 3 years earlier (at age 62) than if she had separated from employment with 29 YOS (at age 65).[12] Key to our analysis is the fact that *the magnitude of the increase in pension wealth when an employee crosses the 29-30 YOS threshold is much larger for TRS2 than for TRS3*. In the case of the representative employee depicted in **Figure 1**, pension wealth increases by $478,635 upon reaching 30 YOS under TRS2 compared to an increase in the value of the DB component of TRS3 of $147,898.[13] A limitation of the representation in **Figure 1** is that it reflects the pension wealth effects of crossing the 29-30 YOS threshold at a specific age.

Figures 2A and **2B** illustrate how pension wealth accrual patterns differ across a range of starting ages. We see that the peak level of pension wealth is much larger for employees who enter the system at a younger age; for instance, a TRS2 member starting at age 25 can accrue a maximum of about $1.6 million in pension wealth, while a TRS2 member starting at age 50 can accrue a maximum of around $500,000. Moreover, for both TRS2 and TRS3, the pension wealth effect of crossing the 29-30 YOS threshold decreases with entry age and is a non-factor for members who enter at age 35 or later – they will be eligible for full retirement (age 65) before they accrue 30 YOS. The rate of pension wealth accrual begins to plateau when an employee reaches eligibility for full retirement (age 65, or age 62 with 30 or more YOS).

[12] In fact, because the early retirement factors for employees who separate with 30 or more YOS are relatively generous (see discussion in preceding sub-section), it is optimal for those exiting teachers to begin collecting a reduced benefit as soon as possible (as early as age 55) rather waiting to collect an unreduced benefit at age 62.
[13] The value of crossing this threshold for TRS3 employees is estimated to be $164,272 in total, but this includes the DC component which is not affected by the retirement eligibility rules associated with the 29-30 YOS threshold.

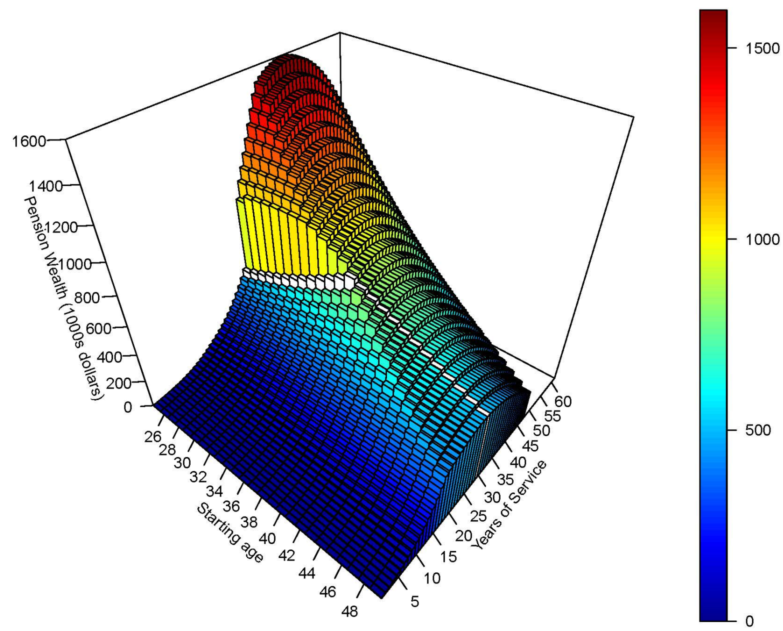

Figure 2A. Pension Wealth Accrual TRS2 by Starting Age and YOS

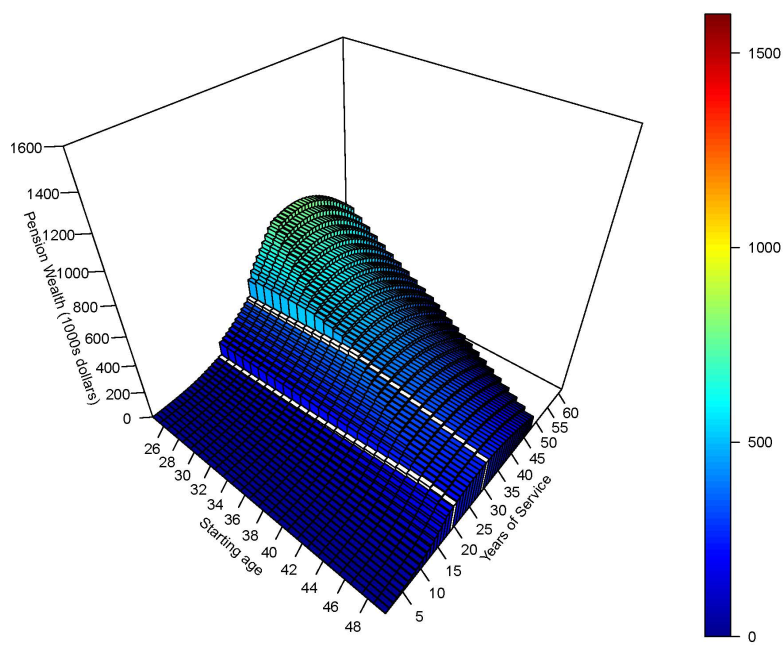

Figure 2B. Pension Wealth Accrual TRS3 by Starting Age and YOS

Notes: Pension wealth calculations are derived from equation (1) for a representative set of teachers. These figures are effectively 3-D representations of Figure 1. Here, the employee's entry age is allowed to vary between 25 and 50 whereas it is fixed at age 25 in Figure 1. Each point represents the level of pension wealth accrued at a given combination of starting age and YOS. We assume a 5.5% discount rate and a 2.75 percent COLA based on the assumptions of the pension plan. We use the 2013 static mortality table based on the RP-2000 Mortality Tables Report adjusted for mortality improvement using Projection Scale AA. The mortality table can be found at http://www.irs.gov/pub/irs-drop/n-08-85.pdf. For TRS3, we assume a 5%

contribution rate to the DC plan, and a 5.5% rate of return. Lastly, salary values come from Washington teacher salary schedules in 2012-13 for a teacher with a master's degree.

There are two key takeaways from the above discussion. First, the increase in pension wealth as one crosses the 29-30 YOS threshold is much larger for TRS2 than it is for TRS3 – over 3 times larger for a 25-year-old entrant.[14] Second, the change in pension wealth upon reaching 30 YOS decreases as entry age increases. Therefore, how employees respond to the 29-30 YOS threshold would also be expected to vary according to age. As described below, we focus on this variation around the 29-30 YOS threshold to examine how end-of-career exit patterns were affected by the introduction of an alternative pension plan structure in the form of TRS3.

Methods

Data and Sample

Our analysis relies on two data sets. The first consists of records maintained by the Department of Retirement Services (DRS) on active (i.e., currently employed) members of TRS, obtained through a public records request. The active member records span the fiscal years 2010-11 to 2017-18 and provide data on member name, employer (i.e., school district), pension plan, total- and in-year accrual of YOS, and each employee's status at the start and end of the fiscal year. The second data set consists of personnel records from the Washington State Office of the Superintendent of Public Instruction (OSPI) S-275 personnel reporting system for public school employees. The S-275 records include information on teacher characteristics (including age and experience), position type, position location (school and district), and salary. The DRS and OSPI

[14] Note that while exiting at 30 YOS versus 29 YOS yields higher pension wealth for younger entrants, it does not yield peak pension wealth. In fact, the year-over-year rate of pension wealth accrual at 30 YOS (if the employee continues working) is greater than at most other points (the rate at 29 to 30 YOS being a notable exception).

data are linked by matching on school district ID and individuals' full names.[15] We also link the DRS records to district and school-level data maintained by OSPI.

A technical challenge in linking this data is that the DRS and OSPI calendar years are not perfectly synchronized, so that it is common in the data for TRS members to have non-integer levels of YOS. This stems from teacher contracts tending to begin in September while DRS data are reported for the fiscal year running from July 1st to June 30th. For example, in their first year of service, teachers often accrue 10/12 months (i.e., September through June) = 0.83 years of service credit. Among TRS members in our study sample with $\text{YOS} \in [29, 30]$, 53% are reported as having precisely 29.83 YOS. It is also common for teachers who do not appear in the S-275 administrative in September of year t+1, and who are therefore identified as exiting employment in year t, to continue accruing service credit during July and August of year t+1 of the DRS data. Among the 186 teachers in our study sample who exit employment with between 29.83 and 29.99 YOS and are under age 64, 86% retire with 30+ YOS. Given these patterns in the data, we round up YOS values to the next integer when the decimal value of YOS is greater than or equal to 0.83.

In **Table 2**, we present summary statistics as of 2011 for members of TRS2 and TRS3 who were hired prior to 1996 – the first year in our panel of data. As noted above, the pre-1996 hires were able to choose whether to stay in TRS2 or transfer into TRS3 when TRS3 was introduced in 1996. We observe a number of differences in the characteristics of TRS2 and TRS3 members. TRS2 members are older but slightly less experienced, more likely to be female, less likely to hold an advanced degree, and more likely to hold an elementary teaching position. They

[15] We were able to match over 92% of classroom teachers in the S-275 data during the 2011-2017 study period to corresponding records for the same year in the DRS data. The match rate is 95% percent among retirement-age teachers (age 55+).

are also far less numerous – as noted above, roughly three quarters of teachers eligible to transfer to TRS3 did so (Goldhaber and Grout, 2016a).

Variables	TRS2	TRS3	TRS2-TRS3
Teacher characteristics			
Age	54.08	52.34	1.74***
Years of Service	18.79	22.07	-3.28***
Exits employment	0.07	0.05	0.02***
Female	0.74	0.66	0.08***
Advanced degree	0.67	0.77	-0.10***
Ethnicity			
American Indian	0.01	0.01	0.00*
Asian	0.02	0.02	0.01*
Black	0.02	0.01	0.01***
Hispanic	0.02	0.02	0.00
White	0.92	0.95	-0.03***
Position Type			
Elementary teacher	0.454	0.412	0.043***
Secondary teacher	0.324	0.354	-0.031***
Other teacher	0.103	0.066	0.037***
School characteristics			
Ethnicity			
American Indian	0.02	0.02	0.00***
Asian	0.07	0.06	0.01***
Black	0.05	0.04	0.01***
Hispanic	0.18	0.17	0.00**
White	0.62	0.65	-0.03***
Percent Free/Reduced Lunch	0.35	0.33	0.02***
Observations	4,276	14,286	

Table 2. Descriptive Statistics
Notes: Statistics are calculated as of the 2010-11 school year for teachers who were hired prior to 1996 and were eligible to transfer from TRS2 to TRS3. The "other teacher" position type includes teachers instructing students in unconventional classroom environments including special education, disadvantaged, and home/hospital. The stars represent the p-values of a t-test of the difference in the mean values for TRS2 and TRS3: * p < 0.05, ** p < 0.01, *** p < 0.001.

In **Figure 3**, we consider a descriptive comparison of the raw proportion of teachers who separate from employment under TRS2 and TRS3 conditional on having a given level of service.[16] We focus on "exits" rather than "retirements" because we are interested in teachers' decisions to remain in or exit from the public educator workforce; "retiring" in the context of TRS means a worker has begun drawing retirement benefits, which often occurs several years after exiting employment as a teacher. Each line in the figure depicts the separation rate: (number of teachers exiting with X YOS)/(number of teachers observed with X YOS). Note that these ratios are only computed for integer values of years of service (which have been rounded down) and that the figure shows smooth lines connecting the points for readability. Consistent with the financial implications associated with crossing the 29-30 YOS threshold, we see a large upward shift in the propensity to exit at 30 YOS and that the shift is larger among members of TRS2 than among members of TRS3. A limitation of this descriptive comparison (which will be addressed in the more formal analysis below) is that it does not account for an employee's age. As shown in **Table 2**, the average TRS2 member is older than the average TRS3 member and the gap in the exit probability at 30 YOS shown in **Figure 3** may be age-driven rather than plan-driven.

[16] We suppress output under 10 YOS and over 33 YOS. Few teachers hired prior to 1996 have fewer than 10 YOS during the period covered by our data (2011 to 2017) and cell sizes are small above 33 YOS.

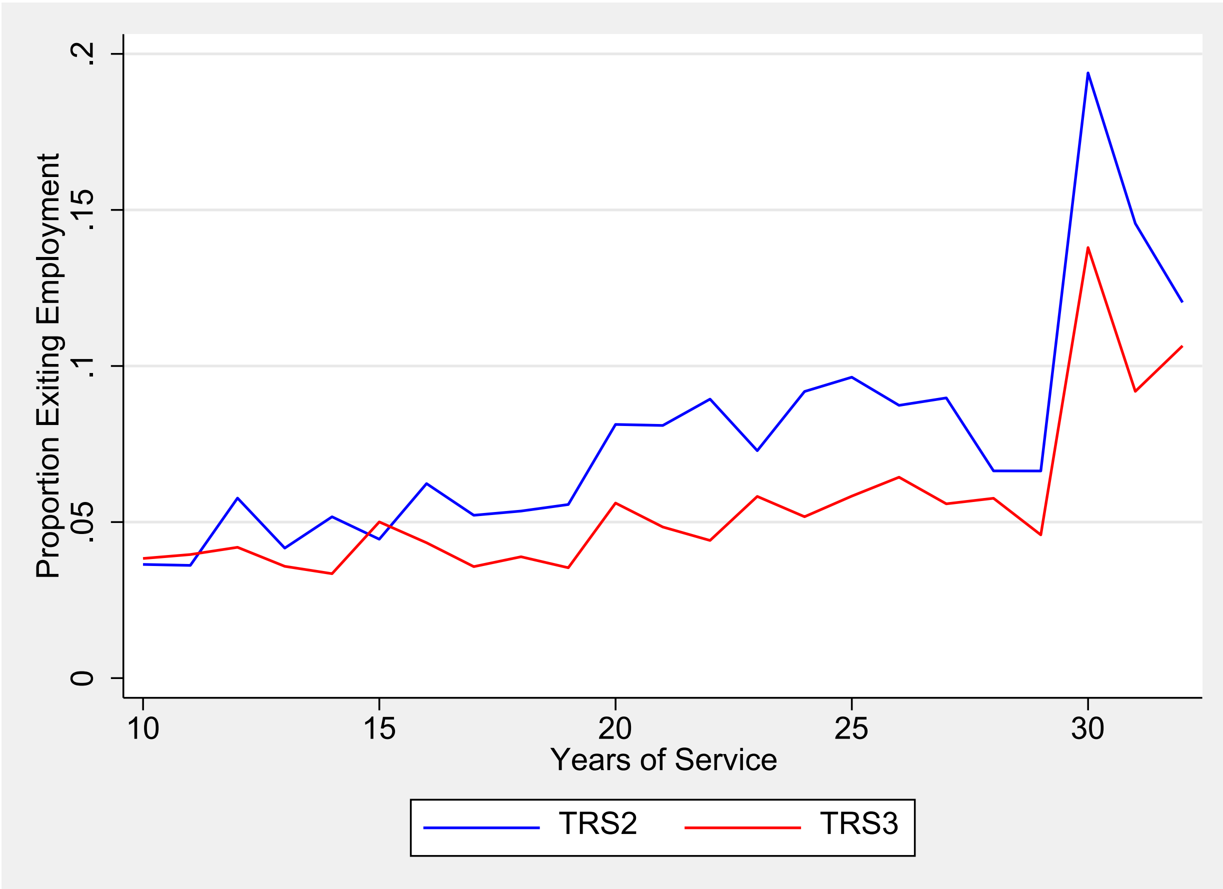

Figure 3. Separation Probabilities for Teachers, by YOS and Plan Type
Notes: Each line represents the ratio: (The number of teachers exiting with X YOS)/(The number of teachers observed with X YOS) during the period 2010-11 to 2016-17. These ratios are only computed for integer values of years of service (which have been rounded down). The figure shows smooth lines connecting the points for readability. Observations = 100,190.

Empirical Approach

We are interested in understanding how substantial differences in the financial incentives created by employer-sponsored pension plans may influence employees' end-of-career exit decisions. In comparing TRS2 and TRS3, we observe large differences in the magnitude of the opportunity cost of exiting. As discussed above, this difference is particularly stark around the 29-30 YOS threshold, which is the focus of our analysis.

We begin by considering whether the propensity to exit increases as employees cross the 29-30 YOS threshold, regardless of plan enrollment. We do this to determine whether teachers are in fact responsive to the corresponding increase in pension wealth; if they are not generally responsive, it would be difficult to interpret a finding of differential behavior between TRS2 versus TRS3 teachers. We estimate the following logistic regression model on the sample of teachers with 29 or 30 YOS:

$$Exit_{it} = \alpha_{Age,YOS} + X_{it}\beta + \gamma_t + \varepsilon_{it} \qquad (2)$$

where $Exit_{it}$ is an indicator for whether teacher i exits in year t. Because the financial implications of exiting with a particular level of YOS vary substantially with age, we fully interact indicators for Age and YOS to generate the vector of indicator variables α.[17] This allows us to compare $Pr(Exit = 1|YOS = 30)$ to $Pr(Exit = 1|YOS = 29)$ given employee age. The model controls for a vector of employee characteristics which prior work has shown to be predictive of retirement timing, including gender, having an advanced degree, and ethnicity (Coile & Gruber, 2007). We also include school characteristics (including percent FRL and the ethnic composition of the school) that have been shown to be related to teacher attrition (Lankford, Loeb, & Wyckoff, 2002), and school-year fixed effects (γ_t) to control for time-varying factors that may influence the odds of exiting (e.g., changing economic conditions or stock market fluctuations). Hence, the identification of the coefficients of interest (the vector of indicators $\hat{\alpha}$) comes from within-year variation in the propensity to exit.[18]

Our primary hypothesis is that, because the financial implications of the decision to stay or exit around the 29 to 30-YOS threshold are much larger under TRS2 than TRS3, exit patterns

[17] The variable Age represents an employees age as of June 30th in the current year. The variable YOS is rounded down to the nearest integer.
[18] Reaching important eligibility thresholds under Social Security and Medicare are also likely to influence employees' exit decisions. All employees in our study sample are subject to the same eligibility rules, which are age dependent and controlled for by the vector of indicators α.

around that threshold will differ according to plan enrollment. To test this, we modify the vector of indicators α in equation (2) by adding an interaction for plan enrollment:

$$Exit_{it} = \alpha_{Age,YOS,Plan} + X_{it}\beta + \gamma_t + \varepsilon_{it} \qquad (3)$$

We can then test whether the increase in the propensity to exit as employees move from 29 YOS to 30 YOS is greater under TRS2 than it is under TRS3:

$$[Pr(Exit = 1|TRS2, YOS\ 30) - Pr(Exit = 1|TRS2, YOS\ 29)] - \qquad (4)$$
$$[Pr(Exit = 1|TRS3, YOS\ 30) - Pr(Exit = 1|TRS3, YOS\ 29)] > 0.$$

It is important to note that differing exit behavior among members of TRS2 and TRS3 identified by these models is likely to reflect the influence of the financial incentives created by the pension plans as well as the self-selection of employees into each plan. As noted above, the members of TRS3 observed in our study sample opted to transfer from TRS2 to TRS3 when it was introduced in 1996 and the differing financial incentives created by the two plans would have played a role in the transfer decision. In the context of our analysis, the selection and financial incentive effects reinforce one another. For instance, a teacher who anticipated working in public education until retirement would have expected to fare better financially under TRS2. In contrast, a teacher who was less certain about whether they would spend their entire career in public education might prefer TRS3, which would be expected to provide greater financial benefits if they exit the plan mid-career (e.g., at age 45 with 20 YOS). Hence, we would interpret the finding of a positive difference in the inequality described in equation (4) as an upper bound on the true plan-driven difference (i.e., absent the influence of any sorting effects).

Results

In this section, we examine whether employees are generally responsive to the 29-30 YOS threshold and then explore the main research question of this paper: whether responsiveness to the 29-30 YOS threshold is different between TRS2 and TRS3.

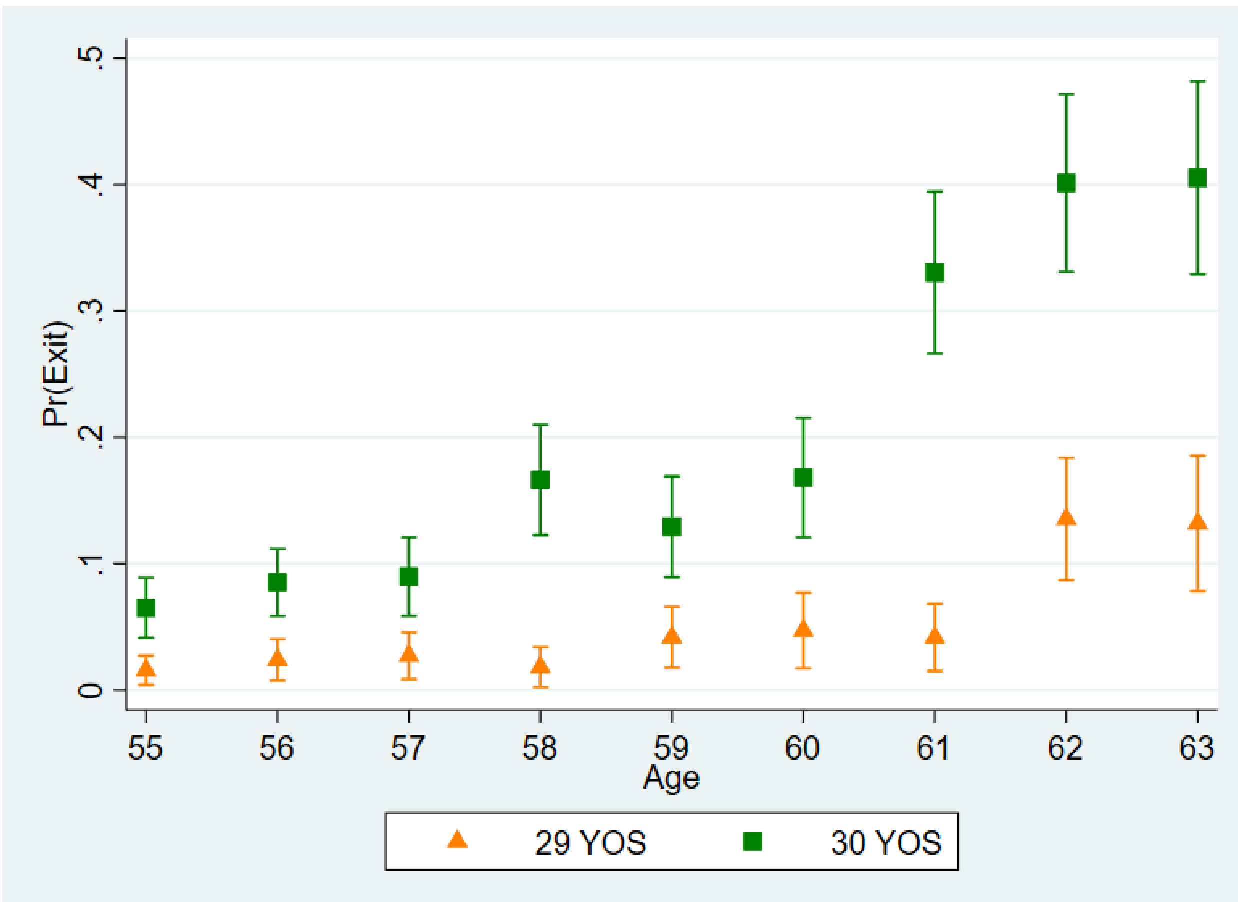

Figure 4. Marginal Exit Probabilities for Teachers With 29 and 30 YOS, by Age
Notes: The figure represents output generated from the estimation of equation (2). There are 5,459 teacher-year observations in the regression model, and standard errors are estimated using the delta method. Each point represents the average predicted probability of exit for the given level of age and YOS. The vertical lines represent the 95% confidence intervals around these predictions. The graphical output is restricted to the 55 to 63 age range for presentation purposes.

Figure 4 plots the predicted probability of exiting employment by age and YOS. We see a great deal of variation in the propensity to exit across both age and YOS. That said, at every age level, the probability of exit is higher among teachers with 30 YOS than among teachers with 29 YOS. This pattern likely reflects the high opportunity cost of exiting prior to reaching full retirement eligibility. To see this, consider the pension wealth plot in **Figure 2a**, which shows that a TRS2 member who reaches 30 YOS at age 55 can gain roughly $500,000 in pension wealth by staying in the workforce for an additional seven years.

In **Table 3**, we look at the *increase* in the propensity to exit as employees cross the 29-to-30 YOS threshold and test the difference $\Pr(Exit = 1|YOS\ 30) - \Pr\ (Exit = 1|YOS\ 29)$. For example, at age 55, the probability of exit is 4.8 percentage points higher among teachers with 30 YOS than among teachers with 29 YOS. This difference in the probability of exit is statistically significant at every age level, ranging between 4.8 percentage points at age 55 and 28.7 percentage points at age 61. Broadly speaking, these results indicate that employees are generally responsive to the pension incentives present at the 29-30 YOS threshold and that the degree to which the propensity to exit increases upon reaching 30 YOS is highly dependent on age.

Estimated Effect and Standard Error for Pr(Exit = 1 | 30YOS) – Pr(Exit = 1 | 29YOS) = 0		Lower CI	Upper CI
Age 55	0.048*** (0.013)	0.023	0.074
Age 56	0.060*** (0.016)	0.029	0.091
Age 57	0.061*** (0.018)	0.026	0.097
Age 58	0.145*** (0.023)	0.099	0.191
Age 59	0.087*** (0.024)	0.041	0.133
Age 60	0.119*** (0.028)	0.063	0.174
Age 61	0.287*** (0.036)	0.217	0.356
Age 62	0.265*** (0.044)	0.179	0.351
Age 63	0.275*** (0.048)	0.182	0.369

Table 3. Difference in the Predicted Probability of Exit Between 29 and 30 YOS
Notes: Estimates test differences in predicted probabilities derived from the estimation of equation (3). The reported effect is (Pr(Exit = 1 | 30YOS) – Pr(Exit = 1 | 29YOS)). There are

5,459 teacher-year observations in the regression model. Standard errors are estimated using the delta method. * p < 0.05, ** p < 0.01, *** p < 0.001.

Turning to the question of whether the propensity to exit around the 29-30 YOS threshold varies by plan, **Figure 5** presents predicted probabilities derived from the estimation of equation (3), which interacts indicators for age and YOS with an indicator for plan enrollment. The left-hand panel shows the predicted probability of exit at 29 YOS for TRS2 and TRS3, and the right-hand panel shows an equivalent plot at 30 YOS. Generally, this figure suggests that the exit patterns among members of TRS2 and TRS3 are similar to one another (the confidence intervals for the two plans clearly overlap).

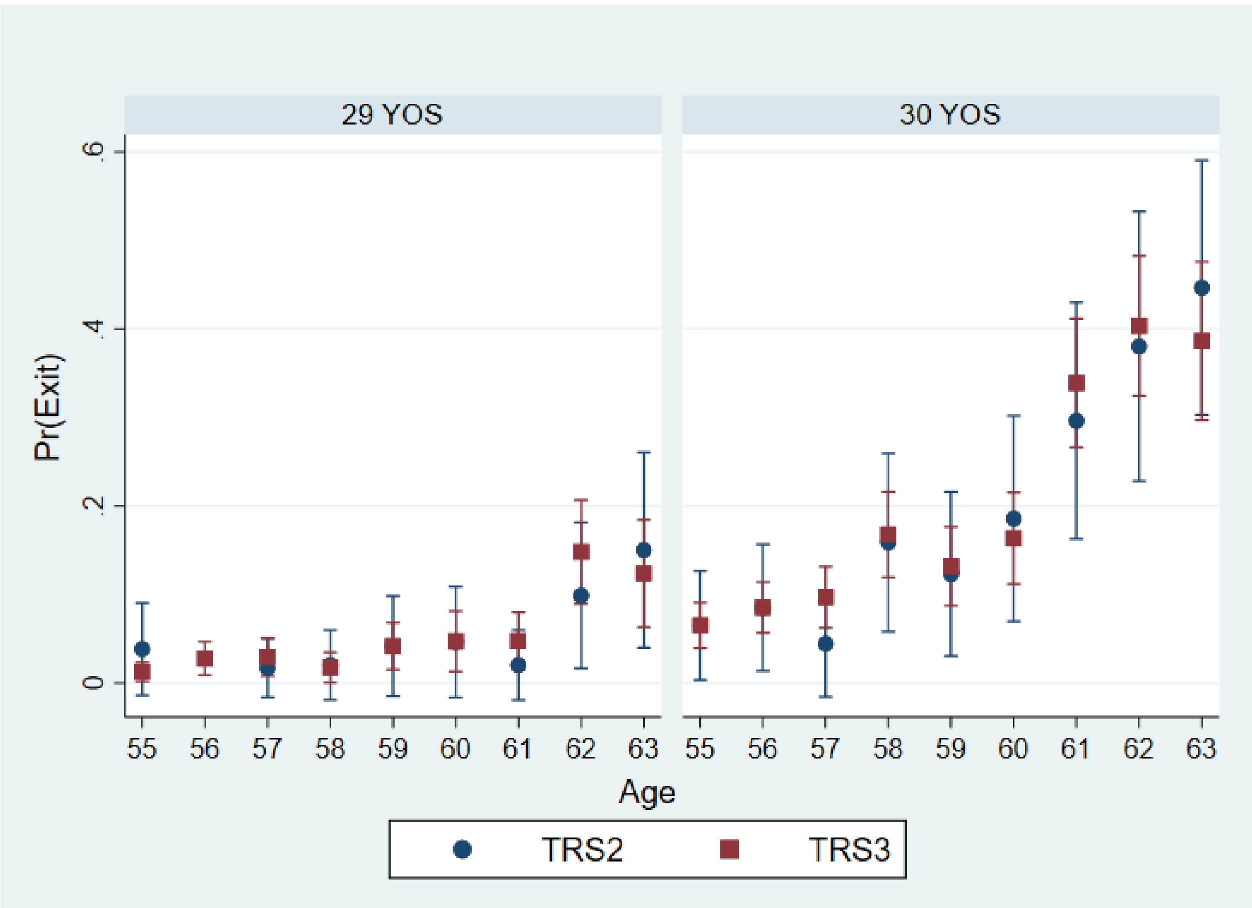

Figure 5. Marginal Exit Probabilities for Teachers With 29 and 30 YOS, by Age and Plan
Notes: The plots present predicted probabilities derived the estimation of equation (3). There are 5,400 teacher-year observations in the model, and standard errors are estimated using the delta method. Each point represents the average predicted probability of exit for the given levels of

age, YOS, and Plan. The vertical lines represent the 95% confidence intervals around these predictions. The graphical output is restricted to the 55 to 63 age range for presentation purposes.

In **Table 4**, we test whether the *increase* in the propensity to exit upon accruing 30 YOS is higher among members of TRS2 than it is among members of TRS3. Specifically, we perform a one-tailed test of significance on the inequality expressed in equation (4) by age level:

$[Pr(Exit = 1|TRS2, YOS\ 30) - Pr(Exit = 1|TRS2, YOS\ 29)] -$

$[Pr(Exit = 1|TRS3, YOS\ 30) - \Pr(Exit = 1|TRS3, YOS\ 29)] > 0.$[19] The estimated effect sizes are generally close to zero (ranging from -0.039 to 0.035) and contrary to expectations, the increase in the propensity to exit upon reaching 30 YOS is *smaller* for TRS2 than for TRS3 for six of the nine age levels considered. In no case do we find that the increase in exit propensity among TRS2 employees is significantly higher than among TRS3 employees.[20] However, at most age levels, the upper bound of the estimated effect is quite large, resulting in some ambiguity about what we can conclude from this model specification.

[19] Note that indicator coefficients for TRS2 29 YOS at ages 57 and 59 cannot be estimated because no teachers were observed exiting within these bins, and thus, are treated as precise zeros for calculating predicted probabilities. Age-YOS-Plan bin sizes range from 34 to 58 for TRS2 and from 90 to 413 for TRS3. The bins with no exits have 49 and 46 observations at age 57 and age 59, respectively.

[20] When we estimate the models without controls for teacher characteristics we obtain very similar results, suggesting the self-selection into the pension plans is not driving results.

Estimated Effect and Standard Error for [Pr(Exit = 1 |TRS2 30YOS) – Pr(Exit = 1 | TRS2 29YOS)] – [Pr(Exit = 1 | TRS3 30YOS) - Pr(Exit = 1 | TRS3 29YOS)]		Upper Bound (95% level of confidence)
Age 55	-0.025 (0.043)	0.045
Age 56	-0.010 (0.047)	0.068
Age 57	-0.039 (0.04)	0.026
Age 58	-0.011 (0.06)	0.088
Age 59	-0.009 (0.06)	0.091
Age 60	0.023 (0.074)	0.144
Age 61	-0.016 (0.082)	0.119
Age 62	0.025 (0.102)	0.194
Age 63	0.035 (0.108)	0.213

Table 4. Difference in Probability of Exit between TRS2 and TRS3, by Age
Notes: Estimates test the difference represented in equation (4). Predicted exit probabilities are derived from the estimation of equation (3). There are 5,400 teacher-year observations in the model, and standard errors are estimated using the delta method. Output is truncated to the age 55-63 age range for presentation purposes. * p < 0.05, ** p < 0.01, *** p < 0.001.

To improve statistical power, we take advantage of a pattern exhibited in **Figure 5** – that the relationship between age and quit propensity is similar for TRS2 and TRS3. We modify equation (3) so that age is no longer interacted with plan:

$$Exit_{it} = \alpha_{Plan,YOS} + \delta_{Age,YOS} + X\beta + \gamma_t + \varepsilon_{it}. \qquad (5)$$

The estimated effect described by equation (4), now pooled across age levels, is presented in **Table 5** for the overall sample in column (1) and for teachers aged 60 to 63 in column (2).[21] In both models, the sample is restricted to teachers under the age of 64 because we estimate a single

[21] We also estimated specifications replacing the age indicators with a quadratic in age and found similar results.

pension plan effect across ages ($\hat{\alpha}$) and reaching 30 YOS does not have implications for retirement eligibility beyond age 64.

As before, we fail to find evidence that the increase in the propensity to exit upon reaching 30 YOS is greater for TRS2 than for TRS3. In the pooled models, the estimated effect sizes are close to zero (between -0.011 and 0.007) and are more precise. The upper bounds on these estimates exclude effect sizes of 4.7 percentage points (all ages) and 8.6 percentage points (age 60+). The *general* effect sizes of crossing the 29-30 YOS threshold (presented in **Table 3**) averages 15.0 percentage points (across all ages) and 23.7 (for ages 60+).

Measure	All Ages (1)	Age 60+ (2)
Estimated Effect	-0.011 (0.035)	0.007 (0.048)
Upper Bound (95% level of confidence)	0.047	0.086
Teacher-year Observations	4,873	1,534

Table 5. Pooled-model specifications
Notes: Each column reports results from a logistic regression reported in equation (5). In column (2), the sample is restricted to teachers age 60+. The model also includes controls for teacher characteristics (gender, ethnicity, and master's degree) and school characteristics (percent ethnicity and FRL), and school year fixed effects. The reported Estimated Effect is [Pr(Exit = 1 |TRS2 30YOS) – Pr(Exit = 1 | TRS2 29YOS)] – [Pr(Exit = 1 | TRS3 30YOS) - Pr(Exit = 1 | TRS3 29YOS)]. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Applying a Simulation Approach to Modeling TRS2 and TRS3 Exit Probabilities

As previously discussed, prior analyses of the relationship between pension structure and retirement timing have tended to adopt a simulation approach to studying the implications of changing pension plan structures. To help consider our findings in the context that literature, we apply a simulation-based approach to predicting exits under TRS2 and TRS3; for this we use the

Stock-Wise model and parameter estimates from Ni and Podgursky (2016) and Ni et al. (2022).[22] In this model, a teacher chooses to either continue working or exit by comparing their expected utility from leaving with their expected utility from continuing to work. When a teacher's expected utility from leaving exceeds their expected utility from continuing to work, the teacher leaves.[23] Our implementation of the model accounts for retirement wealth accrued under TRS2 and TRS3 as well as the value of Social Security benefits.[24]

We assume that teachers' pension benefits, salaries, and Social Security benefits are predictable. This leaves only two sources of uncertainty: mortality and preference shocks. For mortality, we use the tables dictated for use under the Employment Retirement Income Security Act (ERISA) that are compiled and updated by the IRS.[25] Following Ni et al. (2022), we model preference shocks as an AR(1) process with normally distributed annual errors.[26] Since traditional DB accrual varies based on entry age, we use the distribution of entry ages to match the population.To estimate the probability of exit using the structural model, we run 1,000,000 simulations for each plan and relevant polulation entry ages allowing for varying preference shocks and calculate the probability of exiting in each year across simulation runs. Each

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[22] Specifically, we use the parameters estimated pooled sample in Ni and Podgursky (2016). To improve the fit for Washington's teachers, we increased the disutility of work parameter, κ to equal one.
[23] See section 6 of Ni et al. (2022) for a detailed description of the model.
[24] The value of Social Security benefits is calculated using the method described in Equation 1 and the Social Security benefit formula described in the Social Security Annual Statistical Supplement in Appendix D.
[25] Specifically we use the 2013 static mortality table based on the RP-2000 Mortality Tables Report adjusted for mortality improvement using Projection Scale AA. The mortality table can be found at http://www.irs.gov/pub/irs-drop/n-08-85.pdf.
[26] See Section 6 of Ni et al. (2022) for a more thorough description of preference shocks.

individual simulation run represents a model for teacher's full career in a particular plan and with a particular entry age.[27]

We simulate exit probabilities for both TRS2 and TRS3 to understand how well the model predicts exit patterns for the traditional DB and hybrid DB-DC plans. We expect the structural model to peform well in predicting exit probabilities for TRS2 because previous research has demonstrated strong performance in DB plan contexts (Kim et al., 2021; Ni et al., 2022; Ni & Podgursky, 2016). For the hybrid plan, we expect the simulation model – which is primarily focused on the influence of financial incentives – to predict a response to crossing the 29-30 YOS threshold that is substantially smaller than that predicted for TRS2. And given our empirical results, which failed to find any significant difference in exit behavior between TRS2 and TRS3 around the 29-30 YOS threshold, we expect that the simulation model will not peform as well for TRS3.

In **Figure 6**, we compare the exit probabilities forecast by the simulation model to the actual exit probabilities presented in **Figure 5**. The upper panel compares simulated and actual exit probabilities for TRS2 and the lower panel does the same for TRS3. While there are moderate deviations between forecast and actual exit probabilities for both plans, the largest deviations between forecast and actual exit probabilities occur under TRS3.

[27] While our analysis focuses on particular ages and the 29-30 YOS threshold, our simulations model teachers' full careers, so account for earlier attrition.

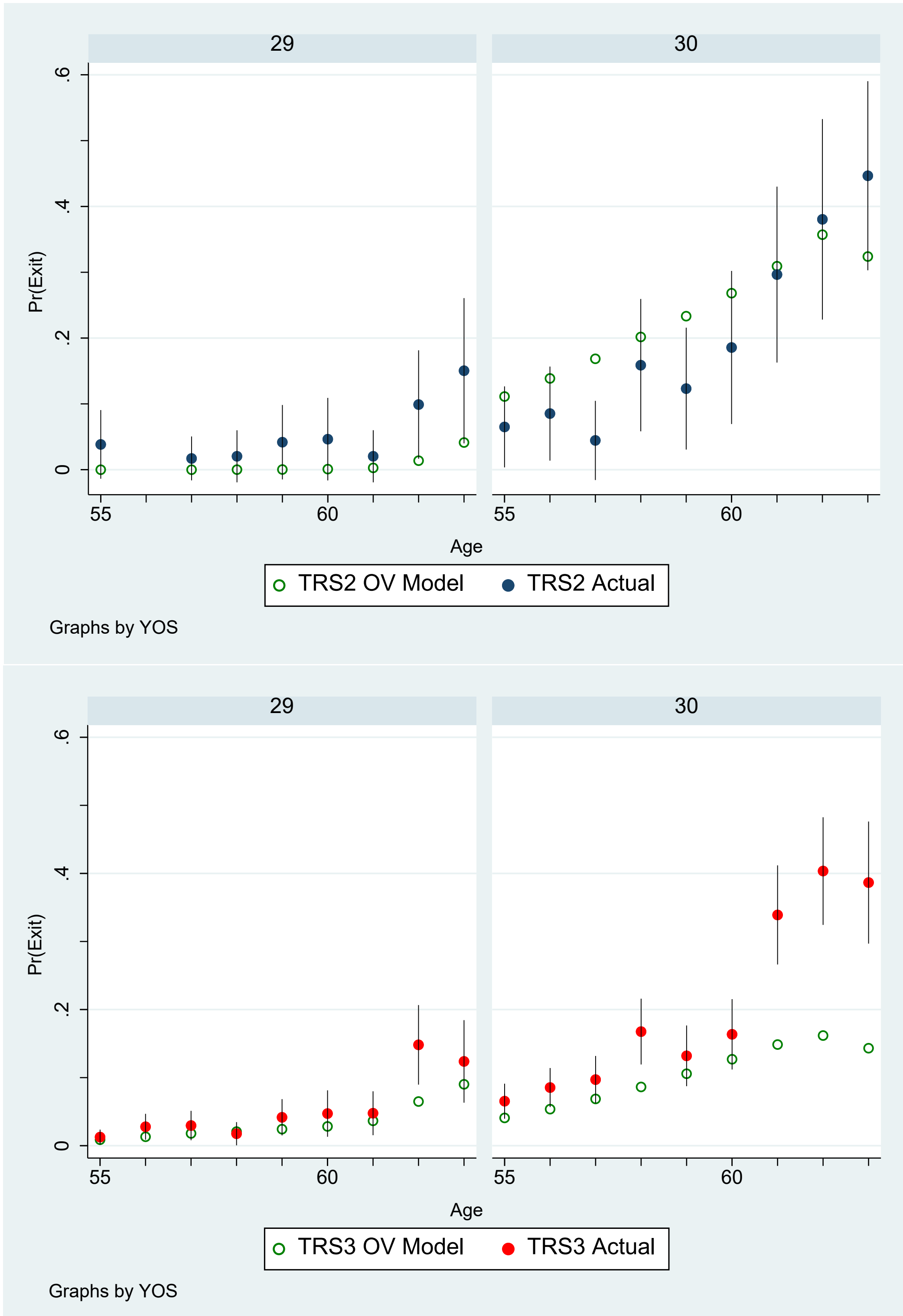

Figure 6. Comparison of Option Value Model and Actual Exit Probabilities
Notes: Hollow points represent a simulated probability of exit using the Stock-Wise OV model described above and solid points and vertical lines replicate the average predicted probabilities of exit and 95% confidence intervals presented in **Figure 5**.

To think about the simulation results in the context of our empirical analysis, it is worth revisiting the hypothesis motivating that analysis: *Because the financial implications of the decision to stay or exit around the 29 to 30-YOS threshold are much larger under TRS2 than TRS3, exit patterns around that threshold will differ according to plan enrollment*. In **Section 5**, we evaluated this hypothesis by testing the inequality expressed in **equation (4)**.

$$[Pr(Exit = 1|TRS2, YOS\ 30) - Pr(Exit = 1|TRS2, YOS\ 29)] - \tag{4}$$
$$[Pr(Exit = 1|TRS3, YOS\ 30) - Pr(Exit = 1|TRS3, YOS\ 29)] > 0.$$

Here, we calculate the quantity on the left-hand side of **equation (4)** using the exit probabilities forecast by the OV model for each age level between 55 and 63. The results are presented in **Table 6** alongside our primary empirical results from **Table 4**.

The exit probabilities forecast by the simulation model reflect an expectation that exit patterns around the 29-30 YOS threshold *will* differ according to plan enrollment, and substantially so. The simulation model forecasts that the shift in the propensity to exit as a teacher crosses the 29-30 YOS threshold will be 7.9 to 23.0 percentage points higher among TRS2 members than among TRS3 members, depending on age. This stands in contrast to our empirical results, which did not find any systematic difference between TRS2 and TRS3 on that measure.

Age Level	Empirical Estimates from Table 4		Option Value Model
	Difference	Upper Bound	Difference
Age 55	-0.025	0.045	0.079
	(0.043)		
Age 56	-0.010	0.068	0.098
	(0.047)		
Age 57	-0.039	0.026	0.118
	(0.04)		
Age 58	-0.011	0.088	0.136
	(0.06)		
Age 59	-0.009	0.091	0.152
	(0.06)		
Age 60	0.023	0.144	0.169
	(0.074)		
Age 61	-0.016	0.119	0.194
	(0.082)		
Age 62	0.025	0.194	0.250
	(0.102)		
Age 63	0.035	0.213	0.230
	(0.108)		

Table 6. Comparison of Empirical Estimates and Option Value Simulation Results
Notes: The reported "difference" refers to the left-hand quantity expressed in **equation (4)**: $[\Pr(Exit)_{TRS2,30\,YOS} - \Pr(Exit)_{TRS2,29\,YOS}] - [\Pr(Exit)_{TRS3,30\,YOS} - \Pr(Exit)_{TRS3,29\,YOS}]$. * p < 0.05, ** p < 0.01, *** p < 0.001.

In fact, the differences between TRS2 and TRS3 implied by the simulation results fall outside of the upper bounds of our empirical estimates at every age level. The discrepancy between the simulation results and those based on observed behavior suggest that simulation-based approaches to modeling exit behavior may struggle to predict how significant changes in pension plan structures will affect employee retention, especially in the presence of influential eligibility thresholds.

Discussion and Conclusions

Pension plans often create strong financial incentives for experienced employees to continue working or exit employment at specific points in their careers (Costrell & Podgursky, 2009). A growing number of state and local governments have made or are considering changes to their retirement plans that substantially alter these financial incentives, including adopting alternative pension plan structures (e.g., hybrid, cash balance, defined contribution, etc.). It is important to understand how such changes may impact the composition of the public sector workforce by altering attrition patterns, especially among experienced, late-career workers. However, direct empirical evidence on the relationship between retirement plan changes and late-career attrition is limited primarily because most changes, especially the adoption of alternative plan designs, have been made relatively recently and have exclusively enrolled new employees such that few employees enrolled in these plans have reached retirement age.

Washington State's 1996 introduction of a hybrid DB-DC plan (TRS3) for public school teachers provides a unique opportunity to empirically investigate how substantially changing financial incentives might influence end-of-career exit patterns. Our analysis focuses on 30 YOS when members of both TRS2 and TRS3 become eligible for early retirement. Members of both plans experience a large increase in pension wealth when they earn their 30th year of service, but the increase is nearly twice as large for TRS2 members compared to similarly situated TRS3 members, creating a stark difference in financial incentives between the two plans.

We show that employees in both plans are responsive to crossing the 29-30 YOS threshold – they are far more likely to exit after reaching 30 YOS than at 29 YOS. However, we do not find evidence that exit rates vary based on plan enrollment, despite the very different financial incentives. That is, the marginal impact of the much larger pensions wealth jump under TRS2 appears to have no impact on exit rates. Our findings suggest that while crossing the 30 YOS threshold has a large impact on employees' propensity to exit, the financial incentive created by the jump in pension wealth at that point is only part of the story and may be over-emphasized as a contributor to exit behavior.

Our results also provide evidence that employees may be anchoring to the 30 YOS retirement rule independent of the financial implications of that threshold. Such behavior is consistent with prior literature that has found workers are not particularly knowledgeable about their retirement plans (Chan & Stevens, 2008; DeArmond & Goldhaber, 2010; Fuchsman et al., 2023, 2021) and that, partially as a result, social norms, statutory retirement ages, and co-worker peer effects can influence retirement timing independent of any financial incentives (Behaghel & Blau, 2012; Brown & Laschever, 2012; Lumsdaine et al., 1996; Seibold, 2021; Vermeer et al., 2019).

While our analysis narrowly focuses on the 30 YOS retirement threshold, the findings are quite relevant to the broader debate around retirement plan design. Our results call further into question the efficiency of having large spikes in pension wealth at particular points in employees' careers. Taken at face value, our findings suggest that the magnitude of pension wealth increases created by retirement eligibility rules could be significantly reduced (in the case of TRS2 versus TRS3, by as much as half) while maintaining similar late-career turnover. If similar retention and exit behavior could be induced simply by setting eligibility thresholds, such large pension wealth spikes would not appear to have a clear policy purpose, while at the same time presenting significant downsides to employees who exit prior to reaching retirement eligibility (McGee & Winters, 2017, 2019).

Of course, this would represent a significant change to the system which could induce different behavioral responses due to new norms, or the messages that teachers receive (e.g., from labor groups) about the system. However, it does suggest that policymakers could explore retirement plans with smoother accrual, which help early- and mid-career workers earn more retirement wealth, while also maintaining late-career exit patterns through retirement eligibility rules.

We also present evidence that the observed pattern of exit behavior for TRS 3 differs substantially from structural model simulations, which predicted that TRS3 employees would be significantly less responsive to reaching the 30 YOS threshold than would TRS2 employees. Our findings suggest that simulation-based approaches, which have been proposed as a viable method for modeling how shifts in pension structure will influence employee exit patterns, may be misleading if they to fail account for the anchoring effects created by plan rules. More specifically, such models will tend to overstate the influence of changes in financial incentives that arise from shifts in pension plan features.

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