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# *Which Plan to Choose? The Determinants of Pension System Choice for Public School Teachers*

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## Abstract

This paper studies the pension preferences of Washington State public school teachers by examining two periods of time during which teachers were able to choose between enrolling in a traditional defined benefit plan and a hybrid plan with defined benefit and defined contribution components. Our findings suggest that a large share of teachers are willing to transfer from a traditional DB plan to a hybrid pension plan, and that the probability that a teacher will choose to transfer is related to financial incentives and factors related to risk preferences. Among new hires, observable teacher and job characteristics explain little of the pension decision, but there is some evidence that more effective teachers are more likely to enroll in the hybrid pension plan. The general popularity of the hybrid plan suggests that states could reduce the financial risk associated with DB pensions without sacrificing the desirability of pension plans to employees

# I. Introduction: Fiscal Sustainability and the Pension Structure Debate

In 1995 the Washington State Legislature adopted legislation that replaced the traditional defined benefit pension plan covering public educators with a new hybrid plan, consisting of a defined benefit component and a defined contribution component. The stated intent of the legislation creating the hybrid plan was to balance flexibility with stability, increase employee control over investments, and to accommodate greater career mobility among employees (HB 1206, Laws of 1995).[1] This paper examines teachers' pension preferences by looking at two periods of time during which Washington school teachers could choose between the state's hybrid and traditional defined benefit plans.

Teachers' pension preferences are relevant to two current public policy debates. The first is centered on concerns about the fiscal sustainability of state pension systems for public employees, for which numerous estimates peg the national shortfall in assets relative to liabilities at several trillion dollars (Barro and Buck, 2010; Bullock, 2010; Pew Center on the States, 2010; Novy-Marx and Rauh, 2011). The idea of shifting public sector employees from defined benefit (DB) pension systems to defined contribution (DC) systems has gained some traction as DC plans are, by definition, fully funded (Beshears et al., 2011; Hess and Squire, 2010; Olberg and Podgursky, 2011). The current prominence of this debate has been driven by the dire fiscal situation experienced by many states since the 2008 financial crisis and the common perception that public employees are overpaid, especially in terms of health and retirement benefits (Lewin et al., 2012).[2]

The second debate is centered on whether restructuring teacher compensation can be used as a lever for increasing the attractiveness of the profession and improving the quality of the workforce.

[1] The per-teacher cost of implementing the two plans is similar, but the financial risk associated with TRS3 is substantially lower because the state's per-teacher pension liability is approximately halved.

[2] Lewin et al. (2012) find that on balance, public-sector employees are undercompensated relative to their peers in the private sector.

Because pension benefits tend to form a large proportion of public educator compensation, they feature prominently in this debate. Studies have analyzed whether the proportion of compensation paid as retirement benefits is too high (Fitzpatrick, 2011), whether financial incentives imbedded in teacher pension plans produce undesirable patterns of attrition (Costrell and Podgursky, 2007, 2009; Koedel et al, 2011; Ni and Podgursky, 2011), and how pensions may influence the quality of the teacher workforce (Chingos and West, 2013; Fitzpatrick, 2011; Koedel et al., forthcoming; Weller, 2011; Wiswall, 2011). The incorporation of DC features into DB pension plans and offering teachers a choice between a DB and DC plan (which is common among public university systems) are among potential reforms.

A shift in the public sector toward a DC system would parallel what occurred in the private sector in the 1980s and 1990s: in 1981 over 55 percent of private sector wage and salary workers with pensions were covered by pure DB plans, but by 2003 fewer than 10 percent were covered by pure DB plans (Buessing and Soto, 2006). A similar shift occurred for federal employees, who have been enrolled into a DC plan and scaled down DB plan since Congress passed the Federal Employees' Retirement System Act of 1986. State-level employees, by contrast, remain primarily enrolled in DB plans. Among pension plans covering public educators, 83 percent of pension plans are pure DB plans and less than 4 percent are pure DC plans.[3]

The fundamental difference between DB and DC plans is the placement of investment risk. Under a DB system, an employee's retirement benefit is formulaically determined by years of service and salary. Under a DC system an employee's retirement benefit is determined by the contributions into (by the employee and/or employer), and the investment returns on, an individual retirement account. From the employee's perspective, the primary difference between the two types of systems is that the size of the retirement benefit is known and guaranteed under a DB system, and uncertain under a DC system. From

[3] See the 2010 National Education Association report, "Characteristics of Large Public Education Pension Plans" for more information about pension plan characteristics in each state.

an employer and taxpayer perspective, it is DB systems that create long-term uncertainty. State pension funds invest contributions from employers and/or employees to meet pension obligations and are thus exposed to investment risk as well as uncertainty related to employees' retirement timing and longevity. In other words, a move from a DB to DC type plan is tantamount to shifting the risk of uncertain returns on pension investments from employer to employee.[4]

As public agencies and employees consider the trade-offs between DB and DC pension systems, it is important to gain insights into how many and what types of employees are likely to prefer different types of plans, and why they prefer those plans. In this paper we report on research that examines two periods of time in which Washington State public school teachers (the largest constituency of state workers covered by Washington State's Department of Retirement Services) were able to choose between enrolling in a traditional DB plan and a hybrid DB-DC plan.[5] We investigate the factors predicting this choice, focusing on teacher-level estimates of the net benefits of each plan and teacher and school-level characteristics. Our analysis is one of the first studies to incorporate a direct measure of employee productivity—a student achievement-based measure of teacher effectiveness (or "value-added"), and the first to analyze an instance in which a large proportion of teachers transferred from one pension plan to another.

This study provides useful information to policy makers considering the creation of a new pension plan or the offering of pension choice to new teachers. Our findings suggest that teachers are willing to transfer from a traditional DB plan to a hybrid pension plan, and that the probability a teacher will choose to transfer to a new plan is related to financial incentives and factors related to risk preferences. Among

[4] Cash balance (CB) plans have been proposed as a compromise between DB and DC plans. CB plans are essentially a special case of a DB plan. They differ from traditional DB plans in that the retirement benefit is determined by the level of employee and employer contributions rather than by years of service and salary.

[5] Washington is the only state that offers its teachers a hybrid DB-DC plan. Several states offer DB plans with DC features (IN, OH, and OR), and others allow teachers to choose between enrolling in a DB or DC plan (FL, OH, SC, and WV). See National Education Association (2010).

new hires choosing between hybrid and traditional plans, observable teacher and job characteristics explain relatively little of the pension decision, but there is some evidence that more effective teachers are more likely to enroll in the hybrid pension plan. Perhaps most importantly, the experience in Washington State suggests that teacher pension systems can be reformed in a way that is desirable to teachers, while at the same time lowering states' exposure to future pension obligations.

## II. Background

The Washington State Teacher Retirement System (TRS) was established in 1938 and is operated by the Department of Retirement Services, which handles pension systems that cover state employees.[6] A teacher's enrollment into one of the three existing TRS plans depends on when he or she was hired. Prior to 1977 newly hired teachers were enrolled in TRS1, a traditional defined benefit plan. Between 1977 and 1996, all new hires were enrolled in TRS2, a traditional DB plan that increased the standard retirement age from 55 to 65. In 1996 the state created TRS3, a hybrid DB-DC plan, and all new hires between 1996 and 2007 were enrolled in the new plan. In 2007, TRS2 was reopened in compensation for ending gainsharing.[7]

### *Pension Choice in Washington*

Among Washington teachers, two groups of enrollees have been able to choose between enrolling in TRS2 and TRS3.[8] For the purposes of this paper we refer to them as the 1997 and 2007 choice cohorts.

[6] For a more detailed accounting of the TRS plans, see Goldhaber et al. (2012).

[7] Gainsharing was created in 1998 and increased benefits of teachers enrolled in TRS3. When the compound average of investment returns on the pension fund over the previous four fiscal years exceeded 10 percent, a calculation was performed to determine a dollar amount that would be distributed among employees based on their levels of service. Distributions were deposited into employees' individual retirement accounts.

[8] Washington is one of several states that offer teachers a choice between pension plans, including Florida, Ohio, and South Carolina. However, it is the only state that offers a hybrid DB-DC plan. See National Education Association (2010) for details on each state's pension plans.

*The 1997 Cohort*: The 1997 cohort consists of teachers hired between 1977 and 1996 who were automatically enrolled in TRS2. Since July 1996, these teachers have had an ongoing option to transfer to the new TRS3 plan. An important aspect of this opportunity is that between July 1996 and December 1997 teachers received a transfer bonus payment when switching to the new plan. Initially, the size of the transfer payment was equal to 20 percent of an employee's contributions to TRS2 plus accrued interest, but the size of the payment was increased by legislators to 40 percent on April 15, 1997, and to 65 percent in April 1998.[9] Ultimately, all teachers who transferred to TRS3 prior to 1998 received the 65 percent transfer payment. The option to transfer to TRS3 is ongoing, but the temporary offer of a transfer bonus payment concentrated the great majority of transfer decisions into the July 1996 – December 1997 time period. During the transfer bonus period, 18,535 teachers (75 percent of those eligible) transferred to TRS3. In the 12 years following the transfer bonus period, only 345 additional teachers transferred to TRS3.[10]

*The 2007 Cohort*: The 2007 cohort consists of teachers hired since July 2007. These teachers can choose to enroll in TRS2 or TRS3. If an active enrollment decision is not made within the first 90 days of employment, the teacher is defaulted into the TRS3 plan. All enrollment decisions are permanent. The data utilized in this study covers teachers hired in the 2007-2008 and 2008-2009 school years.

## *Features of TRS2 and TRS3*

[9] Teachers were informed in late November of 1997 that the Joint Committee on Pension Policy was recommending legislation that would increase the transfer payment to 65 percent of accumulated employee contributions. The same communication informed teachers that this legislation would create gainsharing for TRS3.

[10] Given the small number of teachers in the 1997 Cohort who transfer after the beginning of 1998, we focus on the July 1996 to December 1997 transfer window for this group.

*TRS2*: TRS2 guarantees an annual pension payment for life based on a teacher's accumulated service credit years (SCY) and average final compensation (AFC) at the time of retirement:

TRS 2 Annual Benefit = 0.02*SCY*AFC.

Service credit years are a measure of a teacher's years of service under the TRS and AFC is based on the teacher's salary during the 60 highest-paid consecutive months of employment. Teachers become eligible to claim retirement benefits (or become 'vested') under the plan after five years of service. Any vested employee may retire (i.e. begin collecting pension payments) at age 65. An employee with at least 20 years of service and 55 years of age is eligible for early retirement, but with reduced benefits. To accommodate increases in the cost of living during retirement, TRS2 guarantees an adjustment to benefits starting after the first year of retirement, up to a maximum of 3 percent per year.

Both employers and employees contribute a percentage of salary to the TRS2 pension fund. The contribution rate is set by the state based on the funding status of the plan. In general, contribution rates will tend to be lower when the pension fund's investments are performing well, and vice versa. Historically, TRS2 employee contribution rates have averaged approximately 4 percent.[11] Contribution levels have no bearing on the size of benefit payments.

*TRS3:* As a hybrid plan, TRS3 consists of DB and DC components. Participation in both components is mandatory, but in all other respects the two components operate independently. The DB component is very similar to the TRS2 plan, but with several important differences. The defined benefit is halved (Annual Benefit = 0.01*SCY*AFC) and only the employer contributes to the plan (at the same rate as under TRS2). The vesting period is longer (ten years), but fewer SCY (ten) are needed for early retirement eligibility. When a teacher has 20 or more SCY the defined benefit increases by approximately 3 percent during each year between separation and retirement, which guards the value of the benefit against inflation. Finally,

[11] Historical TRS2 contribution rates are available at Historical TRS2 contribution rates: www.drs.wa.gov/employer/EmployerHandbook/pdf/trs2elected.pdf.

under TRS3 a retirement-eligible teacher (with at least 10 SCY and 55 years of age) can delay receiving retirement benefits and remain eligible for health care coverage.[12]

Employees enrolled in TRS3 contribute exclusively to the DC component. Each teacher has control over how contributions are invested and bears the risk of those decisions. The value of a teacher's DC assets upon retirement is jointly determined by contribution levels and investment performance. Upon enrollment, teachers choose from among six different contribution plans, ranging between 5 percent and 15 percent of salary. An employee who does not make an active contribution rate choice defaults into the 5 percent plan.

**Table 1. Key Features of Washington State TRS Retirement Plans**

| | TRS2 | TRS3 | |
|---|---|---|---|
| **Membership Definition** | Hired 1977 – 1996 (*default*)<br>Hired 2007 – pres. (*opt in*) | Hired 1977 – 1996 (*option to transfer*)<br>Hired 1996 – 2007 (*mandated*)<br>Hired 2007 – pres. (*default*) | |
| **Type** | Traditional Defined Benefit | **DB Component** | **DC Component** |
| **Vesting Period** | 5 years | 10 years | N/A |
| **Employee Contributions** | Set by legislature depending on status of pension fund[13] | N/A | 5% - 15% (employee's choice) |
| **Employer Contributions** | Set by legislature depending on status of pension fund | Identical to TRS2 contributions | N/A |
| **Annual Benefit Formula** | *0.02* *(AFC)*(SCY) | *0.01* *(AFC)*(SCY) | N/A |
| **Retirement Eligibility** | 65 yrs. of age, or<br>62 yrs. of age & 30 SCY (full benefit), or<br>55 yrs. of age & 20 SCY (reduced benefit) | 65 yrs. of age, or<br>62 yrs. of age & 30 SCY (full benefit), or<br>55 yrs. of age & 10 SCY (reduced benefit) | Withdrawal ages and penalties for early withdrawal dependent on Federal tax rules. |

[12] Under TRS2, a retirement-eligible teacher (at least 20 SCY and 55 years of age) must immediately begin receiving retirement benefits to be eligible for health care coverage. Teachers who separate prior to being eligible for retirement do not qualify for any health care coverage under either plan.

[13] In the decade preceding 1997, when employees enrolled in TRS2 could choose to switch to TRS3, the employee contribution rate averaged 6.6 percent, ranging between 6.9 percent and 6.03 percent. In the decade preceding 2008, employee contribution rates ranged between 0.15 percent and 4.26 percent.

## III. Previous Analyses of Pension Choice

Several recent studies have taken advantage of instances where employees were offered a choice between a traditional DB pension and a DC pension to study employee preferences for the two types of plans. Two studies have looked at pension choices at public university systems, many of which offer pension choice to their employees. Clark et al. (2006) analyze faculty pension choices between DB and DC plans in the North Carolina University System during 1982–2001. They estimate a probit model of faculty choice, finding that new hires that are female and non-white are more likely to enroll in the DB plan. Older employees are also more likely to choose the DB plan; a finding that is consistent with the authors' financial comparison of the two plans (by age of enrollment and retirement) and with the notion that older employees are more risk averse. During the study period, the proportion of university faculty who chose the DC plan increased in spite of increasing life expectancies (which increases the financial value of the DB relative to the DC plan). The authors suggest that this trend, which is also observed in other public university systems, is explained by a preference for the greater flexibility provided by the DC plan.

Brown and Weisbenner (2009) analyze the enrollment decisions of new hires to the State University Retirement System (SURS) of Illinois during 1994–2004, who could choose between a traditional DB plan, a "portable" version of the DB plan, and a DC plan. The authors estimate a multinomial logit model to analyze these three choices in reference to defaulting into the DB plan. They find that low-earners who are young, single, and male are most likely to default into the DB plan. High earning, well-educated, married professors, and employees in their thirties are disproportionately likely to choose the DC plan. Building on their 2009 study, Brown and Weisbenner (2012) use a survey of Illinois SURS participants to better understand their choices between DB and DC plans. The survey includes information about participants' attitudes towards risk, self-assessment of investment skills, and beliefs about pension plan parameters. They find that participants' beliefs are particularly important to explaining plan choice,

even when they are incorrect. Adding variables derived from the survey to the choice model nearly tripled its explanatory power compared to using standard economic and demographic controls alone.

Yang (2005) uses administrative data from a large non-profit firm that transitioned from providing employees a traditional DB plan to providing a DC plan. The firm offered its current employees a one-time opportunity to switch to the DC plan, and approximately half did so. Economic and demographic factors were found to be determinants of the decision to switch, with female, white, higher-income, and shorter-service employees being more likely to switch. The default option was important; as a group, the employees who defaulted into the DB plan were more similar to the DC choosers than the DB choosers. To our knowledge, Yang's is the only previous study to directly account for the relative value of the two pension choices in the choice model. She uses estimates of the difference between the net present values of the two plans that were generated by the employer as well as the internal rate of return on DC assets required to equate the net present value of the two plans in retirement. The coefficient on the difference in net present value was significant and of the wrong sign, which is attributed to several potential factors: non-zero turnover probabilities (the difference measure assumed employment until age 65); the assumption that each employee vested; and the assumption of 7 percent investment returns). The estimated effect of the internal rate of return, which accounted for the probability of changing jobs prior to retirement, was significant and of the expected sign.

A Chingos and West (2013) working paper is, to our knowledge, the first study of pension choice among public school teachers. This study analyzes the enrollment decisions of newly hired teachers in Florida who have been able to choose between a traditional DB plan and DC plan since 2002 (teachers who do not make a choice default into the DB plan). During the school years ending between 2002 and 2008, the percentage of new hires choosing to enroll in the DC plan increased from about 10 percent to 30 percent but fell to just over a 25 percent in 2008-2009. The authors find a number of teacher

characteristics to be significantly predictive of enrollment in the DC plan, including ethnicity (white), holding an advanced degree, teaching in math or science subject areas, and teaching at a charter school. The regression model is estimated with district fixed-effects, but school and district-level variables are not otherwise accounted for. The teacher characteristics predictive of DC pension choice are interpreted as being indicators of shorter anticipated tenures.

Chingos and West do not directly account for the relative financial value of the two plans in their choice model, but they do compare the value of the two plans for tenures of between 1 and 30 years and show that the DC plan is mostly likely to be advantageous to teachers who separate well before retirement. Finally, a specification that includes a value-added estimate of teacher effectiveness finds an irregular relationship between productivity and the choice of pension system: teachers in the first and third quartiles of the effectiveness distribution were most likely to enroll in the DB plan, and teachers in the second and fourth (top) quartiles were most likely to enroll in the DC plan.

## IV. Data

To model teachers' choices between TRS2 and TRS3 we utilize confidential data on teacher retirement system choices that is maintained by the Department of Retirement Services (DRS). These data are merged with administrative records from the Washington State Office of Superintendent for Public Instruction (OSPI) S-275 personnel reporting system and the Professional Education Standards Board (PESB). The administrative records are supplemented with school- and district-level information from the National Center for Education Statistics' Common Core of Data (CCD).

The S-275 data include information on teacher demographics, position assignment, salary, and experience. Data on teacher endorsements (e.g., English, math, science) and certifications are from PESB records. The DRS data provide record of every transaction between a teacher and DRS between the

beginning of his or her career and 2010. The CCD provides school-level data on size, demographics, passage rates of standardized tests, Title I status, and the percentage of students receiving free lunch. District-level data include test-passage rates, size, and type of locale (e.g., rural or urban).

The two populations of interest for this study are the two cohorts of teachers who were able to choose between the TRS2 and TRS3 pension plans in 1997 and in 2007–2010. Full time classroom teachers are identified using the S-275 personnel data on the basis of duty codes, activity codes, and the percentage of FTE employment classified as a certificated position.[14] DRS administrative data is used to identify when a teacher was hired, and by extension, whether he or she belongs to the 1997 or 2007 choice cohort. The 1997 cohort is defined as teachers enrolled in TRS2 prior to July 1996; the 2007 cohort is defined as teachers hired after July 1, 2007.

Because we are interested in the pension choice, we focus on the period of time in which a decision was made. For the 1997 choice cohort, we are interested in the variables that reflect a teacher's status as of the 1997-1998 school year because the great majority of transfer decisions were made during the last six months of 1997. For the 2007 cohort, we focus on the school year in which a teacher was hired.

The proportions of teachers choosing TRS2 and TRS3 are summarized in **Table 2** for different subgroups defined by teacher, school and regional characteristics. Overall, teachers in both choice cohorts were more likely to choose TRS3 than TRS2, but the proportion of teachers choosing TRS3 is substantially higher in the 1997 cohort (75 percent vs. 60 percent). This is not surprising given the transfer payments offered in 1997, but it is notable because the plan a teacher defaults into if not making an active choice is TRS2 in 1997 and TRS3 in 2007. When considering only those in the 2007 cohort who made an active

[14] Employees whose average certificated FTE (taken over all years of recorded employment) is less than 85 percent are dropped. We also drop employees whose highest assignment percentage is less than 50 percent. These teachers may have positions at two or more schools and/or districts, and school and district-level control variables are less likely to be representative of a teacher's situation.

choice, TRS3 is still favored, but by a substantially narrower margin (52 percent vs. 60 percent). In the 2008-2009 school year, following the financial crisis of 2008, the proportion of active choosers selecting TRS3 fell to 48 percent.

The pattern of a majority of teachers favoring TRS3 holds across all subgroups defined below with the exception of Native Americans and teachers older than 65 years of age in the 2007 cohort. However, among active choosers (2007) majorities of the following groups chose TRS2: teachers older than 45, African American and Native American teachers, and teachers located at elementary schools and schools in cities and rural areas. We observe some differences in the proportion of teachers choosing TRS3 that are correlated with teacher characteristics. In both choice cohorts smaller percentages of women than men chose TRS3 and older teachers were substantially less likely to choose TRS3. There are also significant differences in system choice among ethnic groups in both choice cohorts, but the patterns are inconsistent between 1997 and 2007. Greater proportions of teachers with advanced degrees and credentials to teach math or science subject areas chose TRS3 in both cohorts.

At the school level, teachers of lower grade levels were more likely to choose TRS2. In the 1997 cohort, the percentage of white students is higher among TRS3 choosers, but lower among TRS3 choosers in the 2007 cohort. At the district level, vote shares for Republican presidential candidates (1996 and 2004) are slightly higher among TRS3 choosers in the 1997 cohort. We do see variation in the proportion of teachers choosing TRS3 across different levels of urbanicity, but the patterns are not consistent across choice cohorts.

## Table 2. Plan Choice by Teacher and School Characteristics

| | 1997 | | | 2007 | | | 2007 Active Choice | | |
|---|---|---|---|---|---|---|---|---|---|
| | Count | TRS2 | TRS3 | Count | TRS2 | TRS3 | Count | TRS2 | TRS3 |
| All Teachers | 21,189 | 0.25 | 0.75 | 4,751 | 0.40 | 0.60 | 3,874 | 0.48 | 0.52 |
| Year 2008 | | | | 2,355 | 0.37 | 0.63 | 1,950 | 0.45 | 0.55 |
| Year 2009 | | | | 2,396 | 0.42 | 0.58 | 1,924 | 0.52 | 0.48 |
| Age: 25-30 | 1,960 | 0.23 | 0.77 | 2,436 | 0.38 | 0.62 | 2,015 | 0.46 | 0.55 |
| Age: 30-35 | 3,551 | 0.18 | 0.82 | 833 | 0.37 | 0.63 | 654 | 0.48 | 0.52 |
| Age: 35-45 | 8,532 | 0.19 | 0.81 | 850 | 0.42 | 0.58 | 681 | 0.52 | 0.48 |
| Age: 45-55 | 6,119 | 0.31 | 0.69 | 515 | 0.44 | 0.56 | 426 | 0.53 | 0.47 |
| Age: 55-65 | 1,027 | 0.60 | 0.40 | 117 | 0.55 | 0.45 | 98 | 0.65 | 0.35 |
| Gender: Female | 14,323 | 0.26 | 0.74 | 3,494 | 0.41 | 0.59 | 2,885 | 0.49 | 0.51 |
| Gender: Male | 6,866 | 0.21 | 0.79 | 1,256 | 0.37 | 0.63 | 988 | 0.47 | 0.53 |
| Ethnicity: Asian | 433 | 0.33 | 0.67 | 169 | 0.39 | 0.61 | 141 | 0.47 | 0.53 |
| Ethnicity: Black | 346 | 0.42 | 0.58 | 95 | 0.45 | 0.54 | 70 | 0.61 | 0.39 |
| Ethnicity: Hispanic | 472 | 0.33 | 0.67 | 209 | 0.35 | 0.65 | 169 | 0.43 | 0.57 |
| Ethnicity: Native American | 195 | 0.34 | 0.66 | 24 | 0.50 | 0.50 | 22 | 0.55 | 0.45 |
| Ethnicity: White | 19,743 | 0.24 | 0.76 | 4,250 | 0.40 | 0.60 | 3,468 | 0.49 | 0.51 |
| Experience: 0-4 yrs. | 4,576 | 0.30 | 0.70 | | | | | | |
| Experience: 5-9 yrs. | 7,050 | 0.23 | 0.77 | | | | | | |
| Experience: 10+ yrs. | 9,563 | 0.23 | 0.77 | | | | | | |
| Degree: Bachelors | 8,872 | 0.28 | 0.72 | 2,770 | 0.41 | 0.59 | 2,296 | 0.49 | 0.51 |
| Degree: MA/PhD | 11,390 | 0.22 | 0.78 | 1,934 | 0.38 | 0.62 | 1,545 | 0.48 | 0.52 |
| Endorsement: Math/Science | 3,386 | 0.22 | 0.78 | 676 | 0.36 | 0.64 | 560 | 0.43 | 0.57 |
| Endorsement: Elementary | 10,927 | 0.26 | 0.74 | 2,706 | 0.42 | 0.58 | 2,238 | 0.50 | 0.50 |
| Endorsement: PE/Health | 2,742 | 0.17 | 0.83 | 148 | 0.40 | 0.60 | 132 | 0.45 | 0.55 |
| Endorsement: Art | 2,023 | 0.28 | 0.72 | 198 | 0.41 | 0.59 | 174 | 0.47 | 0.53 |
| Endorsement: Special Ed | 3,760 | 0.28 | 0.72 | 573 | 0.37 | 0.63 | 441 | 0.48 | 0.52 |
| School: Elementary | 10,552 | 0.26 | 0.74 | 2,357 | 0.41 | 0.59 | 1,928 | 0.51 | 0.49 |
| School: Middle | 4,730 | 0.24 | 0.76 | 920 | 0.38 | 0.62 | 759 | 0.47 | 0.53 |
| School: High | 5,429 | 0.23 | 0.77 | 1,285 | 0.37 | 0.63 | 1,026 | 0.46 | 0.54 |
| School: Other | 478 | 0.27 | 0.73 | 189 | 0.39 | 0.61 | 161 | 0.46 | 0.54 |
| School: Percent White | 21,189 | 72.7 | 77.5 | 4,751 | 58.6 | 57.6 | 3,874 | 58.5 | 58.6 |
| School: Percent FRL | 21,189 | 36.3 | 32.6 | 4,751 | 45.2 | 44.3 | 3,874 | 45.2 | 44.2 |
| District: Rep. Vote Share | 21,189 | 38.5 | 40.4 | 4,751 | 49.3 | 48.0 | 3,874 | 49.3 | 49.3 |
| Locale: City | 7,095 | 0.29 | 0.71 | 1,336 | 0.39 | 0.61 | 1,005 | 0.51 | 0.49 |
| Locale: Suburb | 8,737 | 0.23 | 0.77 | 2,101 | 0.37 | 0.63 | 1,718 | 0.45 | 0.55 |
| Locale: Town | 2,455 | 0.20 | 0.80 | 610 | 0.42 | 0.58 | 520 | 0.49 | 0.51 |
| Locale: Rural | 2,902 | 0.23 | 0.77 | 704 | 0.47 | 0.53 | 631 | 0.53 | 0.47 |

# V. A Model of Pension Choice

Here we describe the pension choice faced by Washington teachers in 1997 and 2007–2010 in terms of trade-offs provided by the two plans, advance a measure of the relative financial benefits of TRS2 and TRS3, and specify an empirical model that is estimated in Section VI.

## *Tradeoffs between TRS2 and TRS3*

Relative Financial Value: Central to a teacher's choice between TRS2 and TRS3 is comparing the level of financial benefit the two plans are likely to provide in retirement. To help teachers compare the two plans, DRS provides teachers with handouts describing plan parameters, worksheets that can be used to estimate future retirement benefits, and computer software (on diskettes in 1997 and online in 2007) to calculate future benefit estimates. These materials focus on the monthly payments a teacher can expect to receive under the two plans given current age, separation and retirement age, and economic assumptions about wage growth, inflation, and investment returns on DC account assets.[15] Teachers are also able to estimate the cost of the two plans in terms of employee contributions to the plans.

Numerous analyses have found that employees (including public educators) do in fact respond to the financial incentives embedded in retirement benefits (see, for example, Asch et al., 2005; Chan and Stevens, 2004; Furgeson et al., 2006; Ippolito, 2002; Koedel et al., 2011; Ni et al., 2011). As such, we expect estimates of the relative financial benefits of the two plans to be significant predictors of pension choice. We estimate and control for the relative financial value of TRS2 and TRS3 for each teacher (described below).

[15] The materials provided to teachers in 1997 also included the tools to estimate the present value of future DB payments and the present value of total contributions to both plans. The current financial modeling software can be found at www.icmarc.org/washingtonstate/plan-choice/financial-modeling-software.html.

Several factors are likely to diminish the ability of relative pension value to predict pension choice. First, relative pension value will vary depending on individual preferences and circumstances that are not directly observable. In an analysis of pension plan choice, Brown and Weisbenner (2012) find that the ability to control for beliefs, preferences, and a measure of financial skills nearly tripled the amount of variation explained by their model of plan choice. Second, employees may hold inaccurate perceptions of their pensions. Studies have found that employees act on their beliefs about the financial benefits provided by pensions, regardless of whether those beliefs are accurate (Brown and Weisbenner, 2012; Chan and Stevens, 2008). Third, some employees may not make any active pension choice and default into a plan that is unlikely to provide them largest financial benefit (e.g., Chingos and West, 2013; Yang, 2005). Finally, as described below, the estimates of pension wealth utilized in this study make a number of assumptions that are uniformly applied to the study population when in reality, the assumptions held by teachers may be quite heterogeneous.

Portability: Because the relative value of TRS2 and TRS3 varies with length of tenure, a teacher's expectations about tenure may play a role in pension preference. Generally speaking, TRS3 provides more flexibility in terms of separation and retirement timing, but differences in the portability of the two systems are not completely straightforward since TRS3 has a longer vesting period than TRS2 (5 years vs. 10 years). Teachers who separate with less than 5 years of experience will not become vested in either plan and the net value of both plans (and therefore any difference between them) will be small.[16] If expecting to separate with between 5 years and 10 years of experience, TRS2 is very likely to provide greater value than TRS3. The features of TRS2 and TRS3 related to separation timing are not significantly different between 10 years' and 20 years' experience. With the accumulation of 20 SCY, TRS3 (but not TRS2) provides inflation protection to teachers who separate before retirement: the defined benefit

[16] Under TRS2, an unvested teacher leaves with her contributions to the plan plus accrued interest (5.5 percent compounded quarterly). Under TRS3, an unvested teacher leaves with her DC account assets.

increases by 3 percent each year between separation and retirement. TRS3 also makes it easier to maintain health care coverage eligibility.[17]

We do not observe teachers' expected tenures and cannot directly account for them in the model. However, teacher mobility has been the subject of labor market analyses that can identify proxies for teacher expectations. A number of studies show students' race and achievement levels, which may themselves proxy for placement in at challenging schools, to be important determinants of teacher mobility (Boyd et al., 2005;Borman and Dowling, 2008; Goldhaber et al., 2010; Hanushek et al., 2004; Scafidi et al., 2007). Teacher characteristics also play a role; Stinebrickner (2002), for instance, finds that changes in family situations, particularly the birth of a child, explain a large amount of teacher attrition. And, teachers with better labor market opportunities outside of teaching, such as those with math and science training, are more likely to leave the profession (Goldhaber and Liu, 2003; Murnane and Olsen, 1989).

We also expect that professional mobility may be related to teacher effectiveness. A number of recent studies show that the mobility of teachers varies along the effectiveness distribution (Boyd et al., 2007; Goldhaber et al., 2010; Hanushek et al., 2004; Krieg, 2006; Chingos and West, 2012), with the general finding that more effective teachers are less likely to leave the profession. However, there is also more general labor market evidence that higher ability employees are more likely to change occupations (Groes et al., 2009).

Given these empirical findings, we expect that a number of teacher and workplace characteristics related to tenure length may affect pension choice. Teachers working at challenging schools, such as those with a large proportion of minority students or students receiving free or reduced price lunch, might

[17] Teachers who work until qualifying for retirement are eligible for health care coverage. Under TRS2, a teacher must being drawing retirement benefits immediately after separation to maintain eligibility. Under TRS3, a teacher can delay receiving benefits. Delaying reception of retirement benefits can have a large financial effect because early retirement factors substantially reduce the size of benefit payments.

anticipate shorter tenures. Location in more populated geographic areas and/or endorsements in math and science subject areas may correspond with higher opportunity costs to staying in teaching due to greater access to alternative careers. Lastly, higher levels of ability may correspond with the anticipation of longer tenures.

Even if these variables are predictive of teachers' tenures, their effects on plan choice are complicated by several factors. First, teachers' *actual* tenures are not necessarily the same as their *expected* tenures. Second, while TRS3 provides more flexibility in the medium-to-long term, it has a significantly longer vesting period. Finally, we expect variables predictive of attrition to play different roles in the two choice cohorts. The 1997 cohort is relatively aged and experienced (approximately 75 percent have five or more years of experience) and for many, the difference between the plans vesting rules is moot.[18] The 2007 cohort consists of newly hired teachers, who may be more likely to focus on the different vesting periods of the two plans.

Risk: While both plans provide a guaranteed benefit for life, that benefit is half as large under TRS3 and the size of the benefit from its DC component is uncertain. As such, TRS3 is less likely to appeal to teachers who are more risk averse. A number of teacher characteristics may be related to risk aversion. Studies suggest that women are more risk averse than men in regards to the structuring of compensation (Croson and Gneezy, 2009; Dohmen and Falk, 2011). Higher income individuals are more able to accommodate financial risk and are likely to be less risk averse. Nadler and Wiswall (2011) find that teachers in districts with higher base salaries are more likely to approve implementation of performance-based pay structures, under which compensation levels are less certain. Risk aversion has also been found to increase with age (Hallahan et al., 2004). Analyses of the trade-offs between DB and DC plans have found that DB plans become relatively attractive as an employee ages due to the lower probability of the

[18] In the 1997 choice cohort, the vesting status of transferring teachers is grandfathered. The TRS3 vesting period for teachers who have earned 5 or more SCY under TRS2 is effectively 5 years. For others, it is 10 years.

employee changing jobs (Childs et al., 2002) and because it allows employees to increase diversification of financial assets by reducing exposure to financial market risk (McCarthy, 2003). Other analyses of pension choice find that minorities are more likely to choose DB plans (Chingos and West, 2013; Clark et al., 2006), and there is evidence that risk varies with ethnicity (Gutter et al., 1999; Yao et al., 2005).

## *The Relative Financial Value of TRS2 and TRS3*

Following several recent analyses of retirement incentives in defined benefit pensions (e.g., Chan and Stevens, 2008; Costrell and Podgursky, 2009; Yang, 2005), we approach the comparison of relative pension plan value in terms of the net present value of pension wealth. Putting pension value in terms of the net present value of pension wealth expresses estimated DB and DC pension benefits as lump sum values that are comparable at the point in time that teachers are making a pension choice. These estimates are intended to confer information that is comparable to that provided by the plan evaluation tools made available to teachers during the decision-making process. While tools allow teachers to generate pension value estimates based on their own economic assumptions, we must apply assumptions more uniformly.

We estimate the net present value of the TRS2 plan for each teacher, assuming separation and retirement at age 65:

$$NPV(TRS2) = \sum_{t=65}^{110} B_{A_t} \cdot P_{A_t|A} \cdot (1+r)^{(A-A_t)} - \sum_{s=A}^{64} Contr_s \cdot Sal_s \cdot (1+r)^{(A-A_s)}, \quad 1)$$

where

$$B_{A_t} = 2\% \cdot SCY_{65} \cdot AFC_{65} \cdot \prod_{t=65}^{A_t} (1 + COLA_t), \quad 2)$$

and $A_t$ is age in time period $t$, $A$ is age at the point in time a pension choice is made, $B_{A_t}$ is the annual DB payment received in time period $t$, $P_{A_t|A}$ is the probability of surviving to age $A_t$ given current age $A$, $r$ is the discount rate, $Contr_t$ is the contribution rate in time period $t$, and $Sal_s$ is salary in time period $s$.[19] The DB payment is calculated as 2 percent multiplied by service credit years ($SCY$) and average final compensation ($AFC$) at the time of retirement. The DB payments are increased by a cost of living adjustment ($COLA_t$) each year based on the change in the consumer price index for Seattle, up to 3 percent per year.

We estimate the net present value of the TRS3 DC component for each teacher upon reaching the age of 65, assuming a constant annual rate of return on investments:

$$NPV(DC) = P_{A_t|A} \cdot \sum_{t=A}^{64} Contr_t \cdot Sal_t \cdot (1+inv)^{65-t} - \sum_{t=A}^{64} Contr_t \cdot Sal_t \cdot (1+r)^{(A-A_t)}, \quad 3)$$

where $inv$ is the constant annual rate of return on investments.[20] The total value of the TRS3 pension for a newly hired teacher is then: $NPV(TRS3) = NPV(DC) + \frac{1}{2}PV(TRS2)$.[21] The value of TRS3 is more complicated for teachers in the 1997 cohort. For each of these teachers we must incorporate an estimate of accrued contributions made to the TRS2 account that could be transferred into the DC component of TRS3, as well as the transfer bonus payment. In the choice-period year, where $t = A$, we modify the calculation of $NPV(DC)$ for teachers in the 1997 cohort:

[19] It could be argued that the present value of employer contributions should also be included in the calculation of the NPV of the pension plans. However, the employer contribution rates are the same for both TRS2 and TRS3, and their incorporation into the NPV estimates would not change the relative values of the two plans. Furthermore, employer contributions are not incorporated into the financial evaluation tools that have been provided to teachers.

[20] Note that a constant rate of return is different than an average rate of return. An average annual rate of return will produce various wealth outcomes depending on the magnitude and ordering of the annual rates of return.

[21] $PV(TRS2)$ is calculated as the first component of **Equation (1)**.

$$NPV(DC)_{1997} = \sum_{t=A}^{64} Contr_t \cdot Sal_t \cdot (1+inv)^{65-t} + trans \cdot (1+inv)^{(65-A)} - \sum_{t=A}^{64} Contr_t \cdot Sal_t \cdot (1+r)^{A-A_t}, \quad 4)$$

where

$$trans = (1+Bonus) \sum_{s=A-A_H}^{A-1} Contr_s \cdot Sal_s \cdot (1+0.055)^{A-s}, \quad 5)$$

and $Bonus$ is the size of the transfer bonus payment (paid as a percentage of accrued teacher contributions), and $A_H$ is the teacher's age when hired. Teacher contributions into TRS2 accrue interest at a fixed rate of 5.5 percent and we adopt the 65 percent bonus rate.

Using the above equations to obtain specific estimates of the net present values of TRS2 and TRS3 requires one to make assumptions about the expected values of a number of variables. In our teacher-level estimations of pension value we make assumptions about these variables based on what we think teachers' expectations may have been when choosing a pension plan. **Table 3** lists assumed values for the 1997 and 2007 choice cohorts. We rely on several documents provided to teachers by DRS to inform our assumptions: *TRS2 to TRS3? A Guide to Your Transfer Decision* (Educational Technologies, 1996), *Plan Choice Booklet: 90 Days to Choose your Plan* (Washington DRS, 2011), and an online pension wealth calculator (ICMA-RC, 2012).[22] In the table below, we refer to these documents as ET (1996), DRS (2011), and ICMA (2012).

[22] See www.icmarc.org/washingtonstate/plan-choice/financial-modeling-software.html.

We focus our financial analysis on two metrics of relative pension value. First, is the difference between the estimated net present values of TRS3 and TRS2: $NPV_{Diff} = NPV_{TRS3} - NPV_{TRS2}$. Second is an internal rate of return ($IRR$), which is calculated for each teacher as the constant rate of return earned on DC assets required to satisfy the equality: $NPV_{TRS3} = NPV_{TRS2}$.[23]

Two primary determinants of the relative value of the TRS2 and TRS3 plans are teacher age and the expected rate of return in invested DC assets. This is evident in the plots of relative financial value and $Age$ in **Figure 1**. In **Panels (1C)** and **(1D)**, as enrollee age increases, the internal rate of return increases because less time is available for assets to accrue. The 2007 plot of $NPV_{Diff}$ and $Age$ in **Panel (1B)** shows the advantage of enrolling in TRS3 falling as age increases from the twenties into the forties. As age increases further, $NPV_{Diff}$ trends towards zero as the value of both plans becomes small. There is more variation in the 1997 plots which incorporate various combinations of salary, experience, and accrued contributions; in the 2007 plots, experience is zero for all teachers and salary is primarily determined by whether the teacher holds and advanced degree. In **Panel (1A)**, the relative value of TRS3 tends to increase slightly with age, until beginning to decrease around age 43. Younger teachers in the 1997 cohort benefit from having a long time horizon over which compounding returns can accrue, and those with more experience benefit from receiving larger bonus transfer payments. The relative financial value of TRS3 is highest among those with a combination of relatively young age and a high level of experience (including many teachers in their mid-30s to mid-40s).

The **Figure 1** plots also show how a teacher's assumptions about the rate of return earned on DC assets can influence which plan is expected to provide greater retirement benefits. Assuming 10 percent returns, enrollment in TRS3 produces larger estimated returns for 76 percent of teachers in the 1997 cohort. However, assuming 8 percent returns, enrollment in TRS3 produces larger estimated returns for

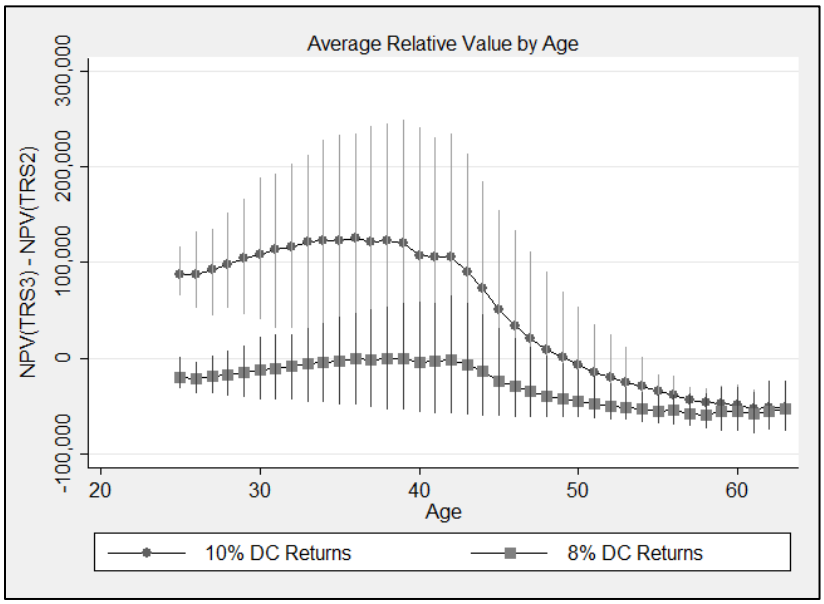
[23] Yang (2005) estimates a similar quantity in her analysis of pension choice.

only 34 percent of teachers. For the 2007 cohort, assuming 10 percent and 8 percent returns produces larger estimated benefits under TRS3 for 56 percent and 5 percent of teachers respectively.

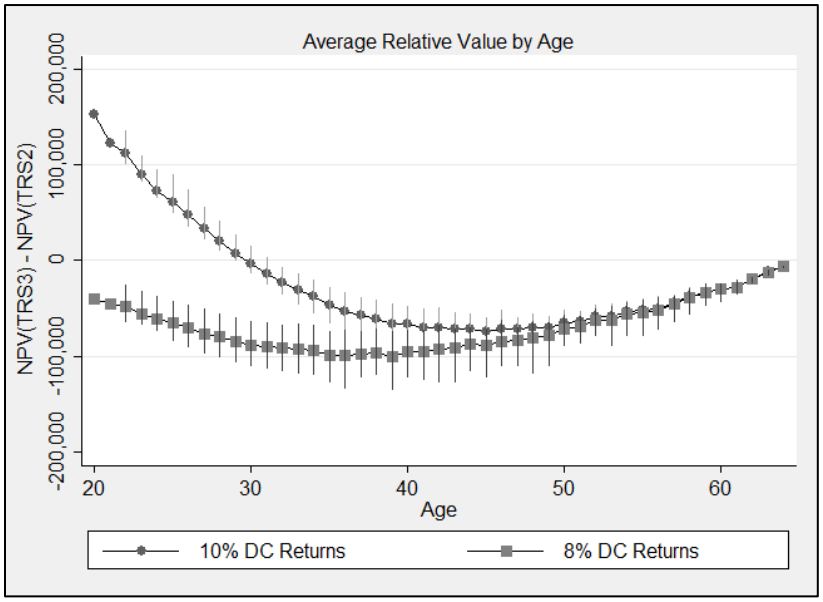
**Figure 1. Distribution of Estimated Relative Pension by Age**

*Note: Vertical spikes indicate the spread between the 5th and 95th percentile observation for each age

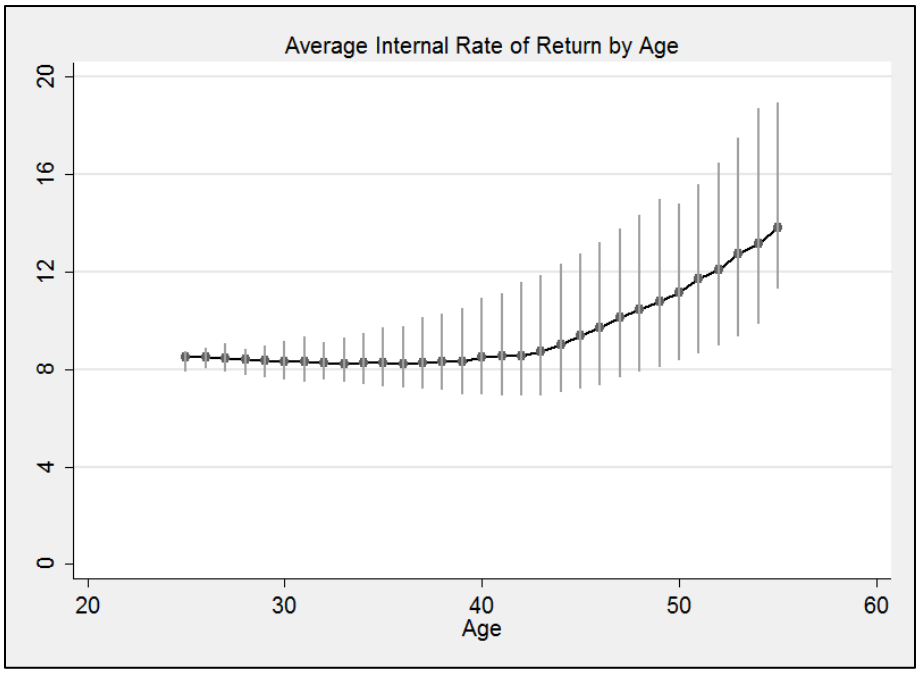
(1A) $NPV_{Diff}$ – 1997 Choice Cohort



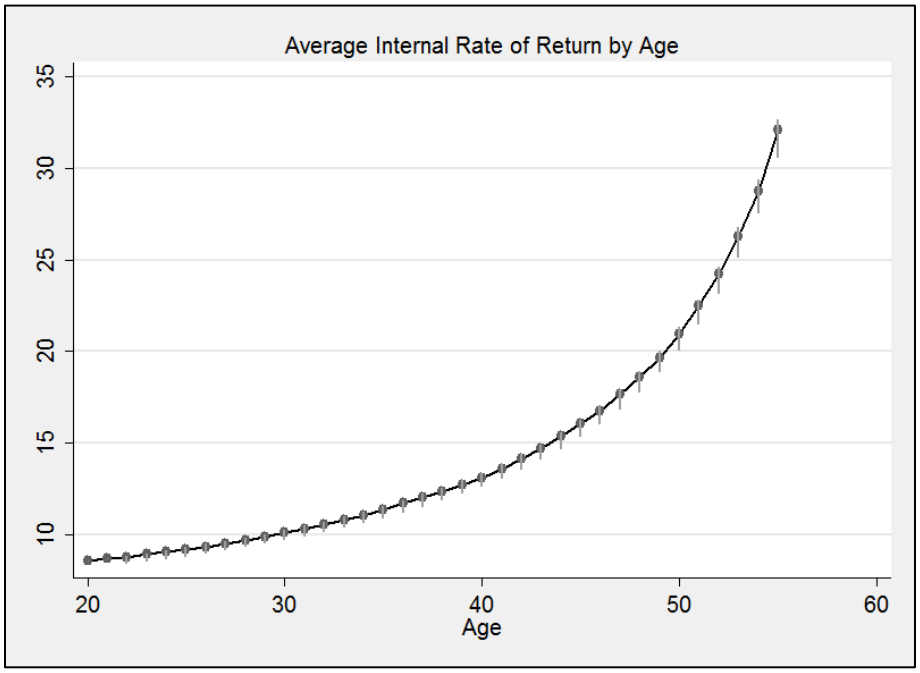

(1B) $NPV_{Diff}$ – 2007 Choice Cohort



(1C) $IRR$ – 1997 Choice Cohort



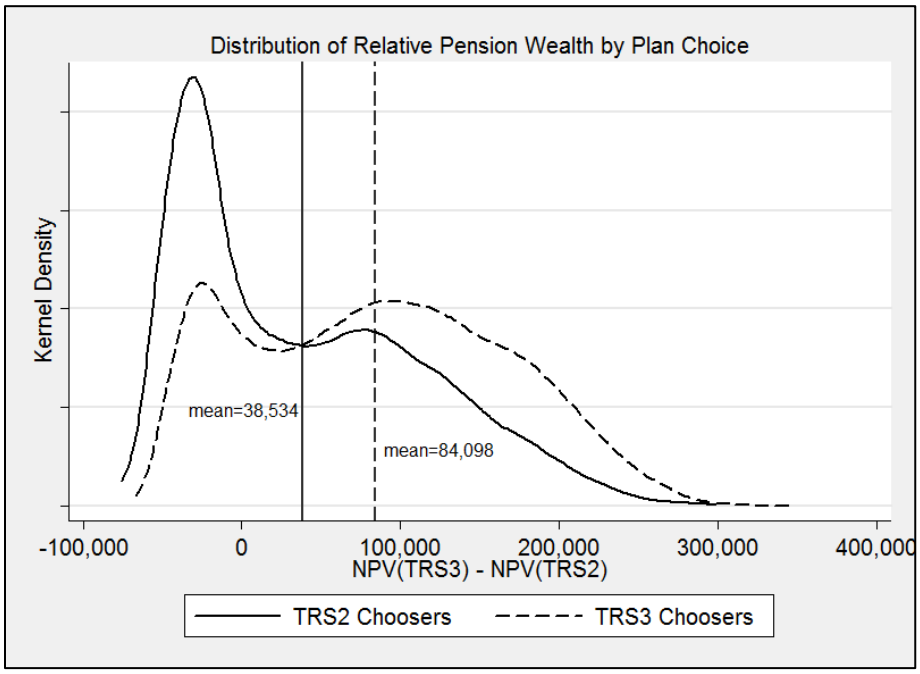

(1D) $IRR$ – 2007 Choice Cohort



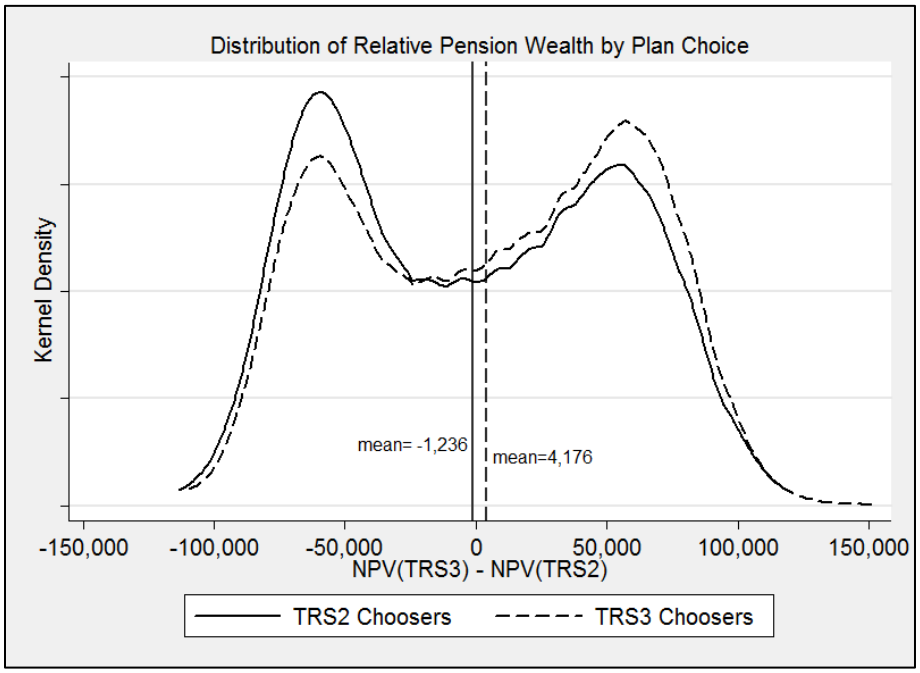
We find that on average, $NPV_{Diff}$ is higher among teachers who chose to enroll in TRS3 and that $IRR$ is lower. In **Figure 2**, kernel density distributions of $NPV_{Diff}$ and $IRR$ among teachers in the 1997 cohort exhibit substantial differences between TRS2 and TRS3 enrollees: greater densities of TRS3 enrollees have higher estimated values of $NPV\_Diff$ and lower values of $IRR$. The same is true for the 2007 cohort, but the magnitude of the differences is much smaller; TRS2 and TRS3 enrollees have approximately the same distributions of $NPV_{Diff}$ and $IRR$. In both choice cohorts many teachers' enrollment decisions are inconsistent with our estimates of the expected financial benefits of the two plans. Given these distributions, we expect relative pension wealth to be moderately predictive of pension choice among the 1997 cohort, and to have little predictive power among the 2007 cohort.

**Figure 2. Distributions of Relative Pension Wealth by Plan Choice**

(2A) $NPV_{Diff}$ – 1997 Choice Cohort



(2B) $NPV_{Diff}$ – 2007 Choice Cohort




In considering our measures of relative pension wealth, it is important to keep in mind that they represent estimates of expected pension wealth at the age of 65 under a specific set of assumptions. While an effort was made to adopt assumptions that are consistent with the educational materials provided to teachers, we do not observe teachers' actual assumptions and expectations about the relative financial value of the two pension plans.

## *Empirical Specification*

As discussed above, several tradeoffs between TRS2 and TRS3 extend a teacher's decision beyond simply maximizing the expected net present value of pension wealth. As such, a teacher's pension choice is characterized as follows:

$$Y_i^* = E[U_i(TRS3)] - E[U_i(TRS2)] \quad 6)$$

$$Y_i = \begin{cases} 1, & Y_i^* \geq 0 \\ 0, & Y_i^* < 0 \end{cases},$$

where $Y_i^*$ is a latent variable equal to the difference between employee *i*'s expected utility under TRS2 and her expected utility under TRS3, and $Y_i$ is the observed pension choice (equal to one if the employee chooses TRS3). $Y_i^*$ is assumed to be a function of the relative financial value of TRS2 and TRS3 and teacher and work-environment characteristics for teacher *i*:

$$Y_i^* = \alpha + \beta_1' x_{1i} + \beta_2{}' x_{2i} + u_i \,, \tag{7}$$

where $x_{1i}$ is a measure of employee *i*'s relative pension wealth and $x_{2i}$ is a vector of teacher, work-environment, and regional characteristics. From these equations, we obtain a binary choice model:

$$Prob(y_i = 1) = Prob(u_i > -(\beta_1' x_{1i} + \beta_2' x_{2i}))$$

$$= 1 - F(\beta_1' x_{1i} + \beta_2' x_{2i}), \tag{8}$$

where F is the cumulative distribution function for $u$.

The effect of the covariates in $x_{1i}$ and $x_{2i}$ on pension choice is complicated by the fact that a number of teacher and work-environment characteristics are expected to influence pension choice both through, and independently of, pension value. The plots in **Figure 1** demonstrate that age has an effect on relative financial value, but age may also be related to risk aversion. Our measures of relative financial value assume that a teacher works until retirement at age 65. Hence, there is measurement error in these estimates associated with a teacher's expected tenure, which is problematic because covariates related to teacher attrition are likely to be correlated with the measurement error. For this reason, we also estimate

models for the 1997 choice cohort using the value of the transfer bonus payment (which is not sensitive to expected teacher tenure) as a proxy for relative pension value.

The binary choice model is estimated separately for each of the choice cohorts. There are several reasons for modeling pension choice separately for these two groups. First, the plan a teacher defaults into is different (TRS2 in the 1997 cohort and TRS3 in the 2007 cohort), and there is substantial evidence that which choice is the default option is important (Thaler and Sunstein, 2008). Second, the contexts under which choices were made are different: teachers in the 1997 cohort chose whether or not to switch plans, while those in the 2007 cohort made first-time enrollment decisions. Finally, there are significant differences between the two time periods in terms of the teacher labor market and the investment environment.[24] All of these factors suggest that teachers in each cohort might respond very differently to a DB-DC choice, arguing for allowing for flexibility in terms of how teachers in the two cohorts respond.

We also estimate models that control for various measures of teacher effectiveness, described in greater detail in the **Appendix**. There is significant policy concern about the overall quality of the teacher workforce and, in particular, whether the profession is drawing talented college graduates (e.g., Corcoran et al., 2004; Goldhaber and Liu, 2003; Hanushek and Pace, 1995; Henke et al., 1996; LakDawalla, 2001). There is speculation that the decline over time in the academic caliber of the teacher workforce may be related, at least in part, to compensation structures in the teaching profession (Goldhaber, 2006; Hoxby and Leigh, 2004). In an analysis of the "push" and "pull" incentives created by DB pension structures in Missouri, Koedel and Podgursky (2012) conclude that these incentives have a negative, but small, influence on the overall effectiveness of the teacher workforce. In contrast, Weller (2011) simulates the trade-offs between higher turnover and higher current compensation associated with a transition to DC

[24] For example, under the Bush Administration's No Child Left Behind legislation, the teaching profession has faced greater scrutiny, particularly in the form of pressure for more accountability for student outcomes.

pensions and estimates that there is a 60 percent to 70 percent chance that overall teacher effectiveness would decrease.[25]

A measure of teacher effectiveness is available for a subset of teachers. Those in grades 4–6 can be matched to their students during the 2007–2010 school years, permitting the estimation of value-added job performance measures for 2,296 teachers in the 1997 cohort and 560 teachers in the 2007 cohort. We average standardized value-added estimates for student performance on the WASL reading and math tests (estimates are described in greater detail in the appendix). For teachers in the 1997 cohort, these value-added measures post-date the pension choice period by 10–13 years.[26] For the 2007 cohort, the value-added estimates roughly coincide with the choice period.

## VI. Results

The results of the logit model estimations for the 1997 and 2007 cohorts are presented in **Table 4** as average marginal effects.[27] That is, the average change in the predicted probability of choosing TRS3 given a one-unit change in the explanatory variable. The base model includes all teacher, school, district, and regional-level control variables. **Model (2)** adds the transfer bonus as a measure of relative financial value. **Models (3)**, **(5)** and **(7)** add the teacher-level estimates of $NPV_{Diff}$, assuming 10 percent constant returns.[28] In models (**5**) and **(7)**, the age variable is dropped due to multicollinearity with relative pension

[25] Generalizing the incentive effects of DB pension systems can be problematic because they are dependent on rule structures of the systems, which are variable.

[26]This creates problems with interpretation given that a significant number of 1997 teachers would have left the workforce by 2007. Thus the effectiveness findings for this earlier cohort are only suggestive in nature.

[27] As we described above, there are good theoretical reasons to estimate the models separately for the two cohorts, but this decision is also confirmed by a very significant Chi-squared test (194), indicating that allowing the coefficients to be different across the two cohorts is preferred.

[28] The model was also estimated assuming 8 percent returns and with the $IRR$ measure of relative pension wealth, with very similar results.

wealth. In models (**6**) and **(7)** we restrict the sample to teachers who made an active choice, dropping those who defaulted into TRS3.

## Table 4. Pension Choice Logit Model: Average Marginal Effects

| | 1997 Choice Cohort | | | 2007 Choice Cohort | | | |
|---|---|---|---|---|---|---|---|
| Dep. Var.: Choice = TRS3 | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Age: 30-35 | -0.0143 | -0.0048 | 0.0130 | -0.0015 | | -0.0220 | |
| | (0.0125) | (0.0125) | (0.0125) | (0.0199) | | (0.0225) | |
| Age: 35-45 | -0.0499 *** | -0.0591 *** | 0.0046 | -0.0403 * | | -0.0652 ** | |
| | (0.0120) | (0.0119) | (0.0125) | (0.0195) | | (0.0223) | |
| Age: 45-55 | -0.1590 *** | -0.1752 *** | -0.0334 * | -0.0584 * | | -0.0757 ** | |
| | (0.0121) | (0.0121) | (0.0150) | (0.0236) | | (0.0269) | |
| Age: 55-65 | -0.3737 *** | -0.4007 *** | -0.2035 *** | -0.1700 *** | | -0.2019 *** | |
| | (0.0154) | (0.0157) | (0.0197) | (0.0452) | | (0.0539) | |
| Vested in TRS2 | 0.1112 *** | 0.0743 *** | 0.0444 *** | | | | |
| | (0.0079) | (0.0089) | (0.0091) | | | | |
| Gender: Male | 0.0191 ** | 0.0176 ** | -0.0008 | 0.0320 | 0.0247 | 0.0174 | 0.0056 |
| | (0.0067) | (0.0067) | (0.0068) | (0.0170) | (0.0170) | (0.0194) | (0.0194) |
| Ethnicity: Asian | -0.0470 * | -0.0502 ** | -0.0528 ** | -0.0094 | -0.0080 | 0.0177 | 0.0188 |
| | (0.0188) | (0.0187) | (0.0188) | (0.0386) | (0.0386) | (0.0437) | (0.0436) |
| Ethnicity: Black | -0.0901 *** | -0.0915 *** | -0.0921 *** | -0.0817 | -0.0820 | -0.1153 | -0.1155 |
| | (0.0206) | (0.0205) | (0.0204) | (0.0498) | (0.0499) | (0.0610) | (0.0612) |
| Ethnicity: Hispanic | -0.0552 ** | -0.0537 ** | -0.0492 ** | 0.0510 | 0.0556 | 0.0599 | 0.0642 |
| | (0.0180) | (0.0177) | (0.0178) | (0.0359) | (0.0361) | (0.0401) | (0.0404) |
| Ethnicity: Native American | -0.0606 * | -0.0606 * | -0.0598 * | -0.0995 | -0.0959 | -0.0678 | -0.0625 |
| | (0.0281) | (0.0281) | (0.0281) | (0.0995) | (0.0992) | (0.1065) | (0.1063) |
| Advanced Degree | 0.0445 *** | 0.0375 *** | 0.0360 *** | 0.0185 | 0.0230 | 0.0217 | 0.0271 |
| | (0.0058) | (0.0058) | (0.0058) | (0.0150) | (0.0151) | (0.0170) | (0.0172) |
| Endorsement: Math/Sci. | 0.0019 | 0.0078 | 0.0050 | 0.0198 | 0.0181 | 0.0427 | 0.0409 |
| | (0.0083) | (0.0083) | (0.0083) | (0.0220) | (0.0221) | (0.0246) | (0.0245) |
| Endorsement: Elementary | -0.0159 * | 0.0010 | -0.0033 | -0.0122 | -0.0116 | -0.0050 | -0.0036 |
| | (0.0073) | (0.0076) | (0.0074) | (0.0177) | (0.0177) | (0.0201) | (0.0201) |
| Endorsement: PE/Health | 0.0491 *** | 0.0520 *** | 0.0473 *** | -0.0195 | -0.0134 | 0.0144 | 0.0221 |
| | (0.0096) | (0.0096) | (0.0096) | (0.0551) | (0.0550) | (0.0600) | (0.0597) |
| Endorsement: Art | -0.0315 ** | -0.0279 ** | -0.0295 ** | -0.0450 | -0.0471 | -0.0034 | -0.0062 |
| | (0.0096) | (0.0096) | (0.0096) | (0.0495) | (0.0489) | (0.0540) | (0.0532) |
| Endorsement: Special Ed. | -0.0395 *** | -0.0386 *** | -0.0410 *** | -0.0054 | -0.0121 | -0.0157 | -0.0217 |
| | (0.0074) | (0.0073) | (0.0073) | (0.0357) | (0.0354) | (0.0410) | (0.0405) |
| School: Middle Sch. | -0.0165 * | -0.0113 | -0.0124 | 0.0273 | 0.0271 | 0.0327 | 0.0328 |
| | (0.0079) | (0.0079) | (0.0079) | (0.0200) | (0.0200) | (0.0225) | (0.0225) |
| School: High Sch. | -0.0150 | -0.0058 | -0.0098 | 0.0364 | 0.0336 | 0.0347 | 0.0321 |
| | (0.0088) | (0.0089) | (0.0088) | (0.0202) | (0.0201) | (0.0229) | (0.0229) |
| School: Other Non-primary | -0.0391 * | -0.0321 | -0.0371 | 0.0442 | 0.0455 | 0.0468 | 0.0492 |
| | (0.0191) | (0.0191) | (0.0191) | (0.0371) | (0.0371) | (0.0415) | (0.0415) |
| School: Percent White | 0.0010 *** | 0.0010 *** | 0.0010 *** | -0.0003 | -0.0003 | -0.0003 | -0.0003 |

| | 1997 Choice Cohort | | | | | | 2007 Choice Cohort | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dep. Var.: Choice = TRS3 | **(1)** | | **(2)** | | **(3)** | | **(4)** | | **(5)** | | **(6)** | | **(7)** | |
| | (0.0001) | | (0.0001) | | (0.0001) | | (0.0003) | | (0.0003) | | (0.0003) | | (0.0003) | |
| District: R-Vote Share | 0.0031 | *** | 0.0030 | *** | 0.0029 | *** | -0.1339 | | -0.1359 | | 0.0693 | | 0.0700 | |
| | (0.0004) | | (0.0004) | | (0.0004) | | (0.0704) | | (0.0703) | | (0.0822) | | (0.0819) | |
| Area: City | 0.0018 | | 0.0012 | | 0.0010 | | 0.0596 | * | 0.0598 | * | 0.0215 | | 0.0213 | |
| | (0.0097) | | (0.0097) | | (0.0097) | | (0.0251) | | (0.0251) | | (0.0281) | | (0.0281) | |
| Area: Suburb | 0.0135 | | 0.0124 | | 0.0105 | | 0.0836 | *** | 0.0828 | *** | 0.0788 | ** | 0.0782 | ** |
| | (0.0092) | | (0.0091) | | (0.0091) | | (0.0220) | | (0.0220) | | (0.0245) | | (0.0244) | |
| Area: Town | 0.0319 | ** | 0.0316 | ** | 0.0287 | * | 0.0464 | | 0.0456 | | 0.0347 | | 0.0338 | |
| | (0.0119) | | (0.0118) | | (0.0118) | | (0.0271) | | (0.0271) | | (0.0299) | | (0.0299) | |
| Year: 2009 | | | | | | | -0.0482 | ** | -0.0501 | *** | -0.0690 | *** | -0.0711 | *** |
| | | | | | | | (0.0148) | | (0.0148) | | (0.0168) | | (0.0167) | |
| Transfer Bonus (in $1000s) | | | 0.0026 | *** | | | | | | | | | | |
| | | | (0.0003) | | | | | | | | | | | |
| NPV(TRS3) - NPV(TRS2) (in $1000s) | | | | | 0.0008 | *** | | | 0.0004 | ** | | | 0.0006 | *** |
| | | | | | (0.0001) | | | | (0.0001) | | | | (0.0002) | |
| Observations | 21,189 | | 21,189 | | 21,189 | | 4,751 | | 4,751 | | 3,874 | | 3,874 | |
| Pseudo $R^2$ | 0.072 | | 0.075 | | 0.080 | | 0.013 | | 0.012 | | 0.015 | | 0.014 | |
| AIC | 21997 | | 21926 | | 21811 | | 6341 | | 6346 | | 5335 | | 5337 | |

The explanatory power of the 1997 models is modest, but consistent with what has been reported in other empirical studies of pension choice (e.g., Brown and Weisbenner, 2009; Chingos and West, 2013; Yang, 2005).[29] The exception is Brown and Weisbenner (2012), who nearly triple the explanatory power of their choice models by including survey data that accounts for individual attitudes, preferences, and financial sophistication. In general, coefficients are of the expected sign and consistent with previous analyses. The explanatory power of the 2007 models is low, and while most coefficients are of the expected sign, few are statistically significant. While we do not report the findings, we also estimated

[29] The pseudo-$R^2$ statistic cannot be interpreted as the proportion of total variation explained by the model (as the traditional $R^2$ statistic can), but when the 1997 models are estimated as linear probability models, we obtain similar $R^2$ values (between 0.071 and 0.094).

model specifications that include district fixed effects, and the inclusion of district effects had little impact on magnitudes and statistical significance of the other included covariates.[30]

## *Responsiveness of Choice to Financial Value*

Recall that teachers in the 1997 cohort were offered a transfer bonus of 65 percent of their contributions to TRS2 plus accrued interest. While this inducement is found to have a statistically significant effect on the choice (Column 2), the magnitude of the effect is small: a $10,000 increase in the bonus is associated with about a 2.5 percentage point increase in the probability of selecting TRS3. We also find the relative financial value of TRS3 to TRS2 as measured by $NPV_{Diff}$ is statistically significant (Column 3), but again the magnitude of the estimated effect is small. For the 1997 cohort, a $10,000 change in $NPV_{Diff}$ corresponds with an increase of less than a percentage point in the likelihood of choosing TRS3. The effect of $NPV_{Diff}$ is about half as large for the 2007 cohort as a whole (column 5), but increases somewhat when defaulters are dropped (column 7). These modest marginal effects reflect the density plots in **Figure 2**: on average teachers choosing TRS3 have higher values of relative pension wealth, but there is a great deal of overlap in the distributions of teachers who choose TRS2 and those who choose TRS3. This is particularly true among the 2007 cohort.

The modest estimated effect of relative pension wealth on pension choice suggests several possibilities. One is that teachers are more heavily influenced by their attitudes about different types of pension plans than by estimations of future pension wealth, as suggested by the findings of Brown and Weisbenner (2012). One indication of the influence of attitudes towards risk and expectations about returns is the indicator variable for the year 2009 in models (4) – (7). The average predicted probability of choosing TRS3 is 4.8 to 7.1 percentage points lower in 2009 than in 2008. Another possibility is that the

[30] Estimated with school fixed effects the coefficient on $NPV_{Diff}$ becomes insignificant in model (5), and is significant and of similar magnitude in model (7).

assumptions we made in estimating relative pension wealth were not representative of those held by teachers, particularly in terms of teachers' anticipated tenure. Or, it is possible that many teachers did not incorporate estimates of future pension wealth into their decisions and relied on other heuristics to make a decision.

## *Portability and Teacher Mobility*

We do not directly observe a teacher's expected length of tenure, but hypothesize that several teacher and work-environment characteristics may correspond with a greater degree of workforce mobility: qualifications that are more likely to provide employment opportunities outside of teaching, challenging work environments, and location in more populated geographic areas. As discussed in the previous section, the features of TRS3 that afford greater flexibility in separation and retirement timing provide more portability to teachers who anticipate medium-to-long tenures, while the shorter vesting period of TRS2 provides greater portability to teachers who anticipate short tenures (i.e. less than 10 years). The interpretation of controls related to attrition is complicated by this ambiguity.

The results are mixed for the 1997 cohort. Factors related to more challenging work environments (percent white and special education endorsement) do not correspond with higher probabilities of choosing TRS3. Teachers at schools with a higher percentage of white students are more likely to choose TRS3 (the marginal effect is small), and teachers with special education and art endorsements are more likely to choose TRS2. Regarding career opportunities outside of teaching, the marginal effect of a math or science endorsement is positive but insignificant, and urban or suburban location is not significantly different than rural location. However, teachers at schools located in towns were approximately 3 percentage points more likely to transfer to TRS3. Teachers vested in TRS2, whose 'vested' status would

have transferred to TRS3, are significantly more likely to transfer to TRS3, suggesting the shorter vesting period under TRS2 was important to many teachers.[31]

Among the 2007 cohort, which consists of new hires, TRS2 is more likely to appear portable due to its shorter vesting period. Factors related to more challenging work environments are related to a higher probability of choosing TRS2, but are statistically insignificant. Regarding career opportunities outside of teaching, the average marginal effect of suburban location is positive and significant under each model specification. Urban location is positive and significant, but not when defaulters are excluded. The effect of holding a math or science endorsement is positive but insignificant. Holding other endorsements associated with higher attrition in Washington State are associated with choosing TRS2, but the effects are all insignificant.

### *Risk Aversion*

Teachers with higher incomes and less aversion to risk are expected to prefer TRS3, and possession of an advanced degree is used as an indicator. Male gender is used as an indicator of being less risk averse and preferences for financial risk are expected to vary with ethnicity. Older teachers are expected to prefer the DB plan, which lowers exposure to investment risk as retirement approaches. Our results are generally consistent with these notions.

Among the 1997 cohort, the effect of holding an advanced degree is significant and positive, which is consistent with the findings of other analyses of pension choice (e.g., Brown and Weisbenner, 2009; Chingos and West, 2013). The marginal effect of male gender is positive and statistically significant in models (1) and (2). That it is insignificant in model (3) is likely due to the fact that $NPV_{Diff}$ accounts for differing survival probabilities between men and women, lowering the relative value of TRS2 for men.

[31] We find that the $pr(choose\ TRS3|SCY = 4)$ is significantly lower than $pr(choose\ TRS3|SCY = 5)$ and that the difference between each other consecutive-value-pair is not statistically significant.

Non-white teachers are significantly less likely to transfer to TRS3, particularly African American teachers. This is a finding consistent (Chingos and West, 2013; Clark et al., 2006), and interesting given differences in life expectancy.[32] Age is a very significant determinant of pension choice. However, when $NPV_{Diff}$ is included, the marginal effect of age is substantially smaller because it accounts for the effect of age on the relative financial value of TRS2 and TRS3. Model (3), suggests that it is teachers in the 55+ age group who are significantly more risk averse.

Among the 2007 cohort, neither male gender nor holding an advance degree is a significant predictor of choosing TRS3, though the coefficients are of the expected sign. Ethnicity based differences are not statistically significant; the magnitude of the effect of African American ethnicity is similar, while the coefficients on Hispanic and Asian ethnicities change signs.[33] As in the 1997 cohort, age has large marginal effects on pension choice, with older teachers being significantly less likely to choose TRS3. However, we are unable to differentiate between the effect of age on relative financial value and the effect of age on risk aversion because the age and financial value controls are not included in the same models due to multicollinearity.

## *Teacher Effectiveness*

The models in **Table 5** add measures of teacher effectiveness for the subsample of teachers for whom they are available.[34] Two factors limit the interpretation of the coefficients on teacher

[32] That African Americans are more likely to choose the traditional defined benefit suggests they are particularly risk averse because life expectancy is lower, which lowers the relative financial value of TRS2 for them compared with other ethnicities. For example, the remaining life expectancies of a 35 year-old white woman and a 35 year-old black woman are 47.2 and 44.7 years respectively (Hoyert and Xu, 2012). Assuming both retired with 30 SCY and $60,000 AFC, the present value of the 2.5 additional years of TRS2 pension benefits ($36,000 per year) would be roughly $23,000.

[33] In the 2007 cohort, the coefficient on Asian and Hispanic ethnicities is positive.

[34] We estimate the choice models with value-added scores several specifications of value-added models (VAMs) (see Appendix). The results presented in Table 5 control for school and classroom variables. When we estimate value

effectiveness. First, the measure of effectiveness is available for a small proportion of teachers (10 percent of the 1997 cohort and 14 percent of the 2007 cohort). Among the 1997 cohort, score availability is restricted by the grade-levels at which students are tested as well as by teacher attrition and retirement during the time period between 1997 and 2007. Second, the value-added estimates were determined after teachers' pension choices. The 1997 and 2007 models are estimated using the control variables of models (2) and (4) respectively. For the 1997 model in particular, this introduces potential selection problems related to the relationship between teacher effectiveness, pension choice, and attrition.

In the 1997 cohort, the coefficient on the continuous measure of teacher effectiveness is statistically significant. A one standard deviation change in teacher effectiveness (0.14) is associated with an approximately 2.5 percentage point change in the predicted probability of choosing TRS3. Using quintile indicators, a teacher in the top quintile is approximately six percentage points more likely to choose TRS3 than a teacher in the bottom quartile. There is little variation in the predicted probability of choosing TRS3 among the bottom four quintiles.

In the 2007 cohort, a similar pattern is observed, but with larger marginal effects. A teacher in the top quintile is approximately 8 percentage points more likely to choose TRS3 than a teacher in the bottom quintile. The results are sensitive to the inclusion of teachers who defaulted into TRS3. When defaulters are dropped, the magnitude and significance of the effects increase. Regarding the quintile specifications, the difference between the 3$^{rd}$, 4$^{th}$, and 5$^{th}$ quintiles diminishes, while the difference between those quintiles and the bottom quintile increases substantially. Among active choosers, the top quintile is 14 percentage points more likely to choose TRS3 than is the bottom quintile, but the top 3 quintiles are not

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added using models that include school or student fixed effects the coefficients are similar, but generally insignificant. This is not surprising given the high correlation between estimates obtained from different VAMs and the fact that the school and student fixed effects scores are estimated with less precision.

significantly different from one another. The relationship between teacher effectiveness quintiles and the predicted probability of choosing TRS3 is presented in **Figure 3**.

Chingos and West (2013) find a weaker relationship between pension choice and teacher effectiveness, with teachers in the 2nd and 4th quartiles the most likely to choose the DC plan. However, they do not differentiate between teachers who make an active pension choice and those who default into Florida's DB plan. Furthermore, Florida's plans are quite different from Washington's plans, and the default choice in Florida is the DB plan rather than the DC plan.

## Table 5. Average Marginal Effects of Teacher Effectiveness on Pension Choice

| | **1997 Choice Cohort** | | **2007 Choice Cohort** | | | |
|---|---|---|---|---|---|---|
| | | | All Observations | | Active Choosers | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Teacher Effectiveness | 0.0256 ** | | 0.0386 * | | 0.0564 ** | |
| | (0.0086) | | (0.0189) | | (0.0215) | |
| Effectiveness Quintiles | | | | | | |
| 1 | | Ref. Cat. | | Ref. Cat. | | Ref. Cat. |
| 2 | | 0.0095 | | -0.0877 | | -0.0248 |
| | | (0.0278) | | (0.0603) | | (0.0680) |
| 3 | | 0.0118 | | 0.0621 | | 0.1315 |
| | | (0.0281) | | (0.0599) | | (0.0672) |
| 4 | | 0.0188 | | 0.0163 | | 0.0964 |
| | | (0.0278) | | (0.0602) | | (0.0680) |
| 5 | | 0.0643 * | | 0.0823 | | 0.1333 |
| | | (0.0269) | | (0.0604) | | (0.0702) |
| Observations | 2,296 | 2,296 | 675 | 675 | 561 | 561 |
| Pseudo $R^2$ | 0.057 | 0.057 | 0.020 | 0.026 | 0.034 | 0.038 |

Note: Models (1) and (2) are estimated with the covariates in Model (2) of Table 4. Models (3) – (6) are estimated with the covariates in Model (4) of Table 4

## VII. Conclusion

Understanding teacher preferences for alternative pension plans is central to debates about whether suggested reforms to public pensions, such as shifting them from traditional defined benefit structures towards defined contribution structures, would be desirable to teachers and would affect the quality of the teacher workforce. We study two periods of time during which public school teachers in Washington have been able to choose between a hybrid plan and the state's traditional DB plan, TRS2. Of primary interest are the determinants of pension choice, including teacher characteristics, conditions related to work environment and locale, and the relative financial value of the two plans.

At a basic level, we find substantial support for the notion that teachers are willing to consider a move from a traditional DB to a hybrid DB-DC system: approximately 75 percent of teachers in the 1997 choice cohort transferred from the traditional DB plan to the hybrid plan. The overall popularity of the hybrid plan is notable for the fact that the default (i.e. the result of taking no action) was to remain in TRS2, but it is perhaps not surprising given that teachers were offered a large financial inducement to opt into this new system. Furthermore, the bull market in the mid-1990s likely influenced perceptions about future investment returns. Perhaps more surprising is the fact that the hybrid plan remained popular with the 2007 choice cohort. Approximately 60 percent of teachers enrolled in TRS3 during the study period, despite the fact that there was no financial inducement offered for choosing TRS3 over TRS2 and returns on stock market investments were considerably poorer as compared to the prior period.[35]

Looking more closely at the pension decision, we estimate logit regressions controlling for teacher characteristics, work environment, locale, relative financial value, and (for a subset of teachers) teacher effectiveness as measured by value-added scores. The explanatory power of the models is modest, but

[35] The Dow Jones Industrial Average, for instance, increased by nearly 150 percent in the five years preceding the Dec 31, 1997 opt-in window provided to the 1997 choice cohort, but only by about 45 percent in the five years preceding July, 2007, when choice between TRS2 and TRS3 was again offered.

consistent with what has been reported in other empirical studies of pension choice (e.g., Brown and Weisbenner, 2009; Chingos and West, 2013; Yang, 2005). We find that teachers are responsive to the relative financial value of the plans, but the average marginal effects are small (particularly for the 2007 choice cohort). It is likely that unobserved expectations related to tenure and investment returns, and unobserved attitudes towards investment choice and risk are significant drivers of pension choice (see Brown and Weisbenner, 2012). Our findings are consistent with the notion that teachers who are less risk averse are more likely to choose the hybrid plan, with younger age, white ethnicity, male gender, and holding an advanced degree corresponding with a higher probability of choosing TRS3. However, with the exception of age, the significance of these controls falls away among the 2007 cohort.

Our analysis is one of the first studies to incorporate a direct measure of employee productivity into pension choice and we find evidence that more effective teachers are more likely to choose the hybrid pension plan. In the 1997 choice cohort, for whom we are able to measure teacher productivity far into the future, we find that teachers in the top quintile of effectiveness are approximately six percentage points more likely to choose TRS3. The findings on teacher effectiveness and pension choice for the 2007 cohort, where the measure of productivity is more proximate, are broadly consistent: teachers in the bottom two quintiles are significantly less likely to choose TRS3 than those in the top quintile. These findings provide suggestive evidence that the hybrid DB-DC system is not seen as any less desirable by more effective teachers; whether the quality of the workforce is affected by pension choice will ultimately depend on how the two pension plans differentially affect teacher retention.

This study provides useful information to policy makers considering the creation of a new pension plan or the offering of pension choice to new teachers. Our findings suggest that teachers are willing to transfer from a traditional DB plan to a hybrid pension plan, and that the probability that a teacher will choose to transfer to a new plan is related to financial incentives and factors related to risk preferences.

Regarding the offering of choice to new teachers, our findings suggest that observable teacher characteristics explain little of the pension decision.

Perhaps most importantly, the experience in Washington State suggests that teacher pension systems can be reformed in a way that is attractive to both teachers and states. The financial costs associated with implementing TRS2 and TRS3 are similar, but the state significantly lowered its financial exposure by introducing the hybrid plan because its per-teacher pension liability is approximately half as large under TRS3 as it is under TRS2. From the perspective of the state (in 1997) and teachers in the 1997 choice cohort, the creation of TRS3 and the corresponding reallocation of risk and flexibility was a Pareto improvement: among teachers, the decision to transfer to TRS3 implies an improvement in utility, while declining to transfer implies maintenance of the status quo.[36] Furthermore, the large proportion of teachers who chose to transfer to the hybrid pension plan, (approximately 75 percent) suggests that prior to its creation, there was substantial space for Pareto improvement.

[36] This argument cannot be generalized further because teachers hired after 1996 did not have pension choice and some certainly would have preferred TRS2.

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## Tables

**Table 3. Assumptions in calculation of the NPV of TRS2 and TRS3 pension wealth**

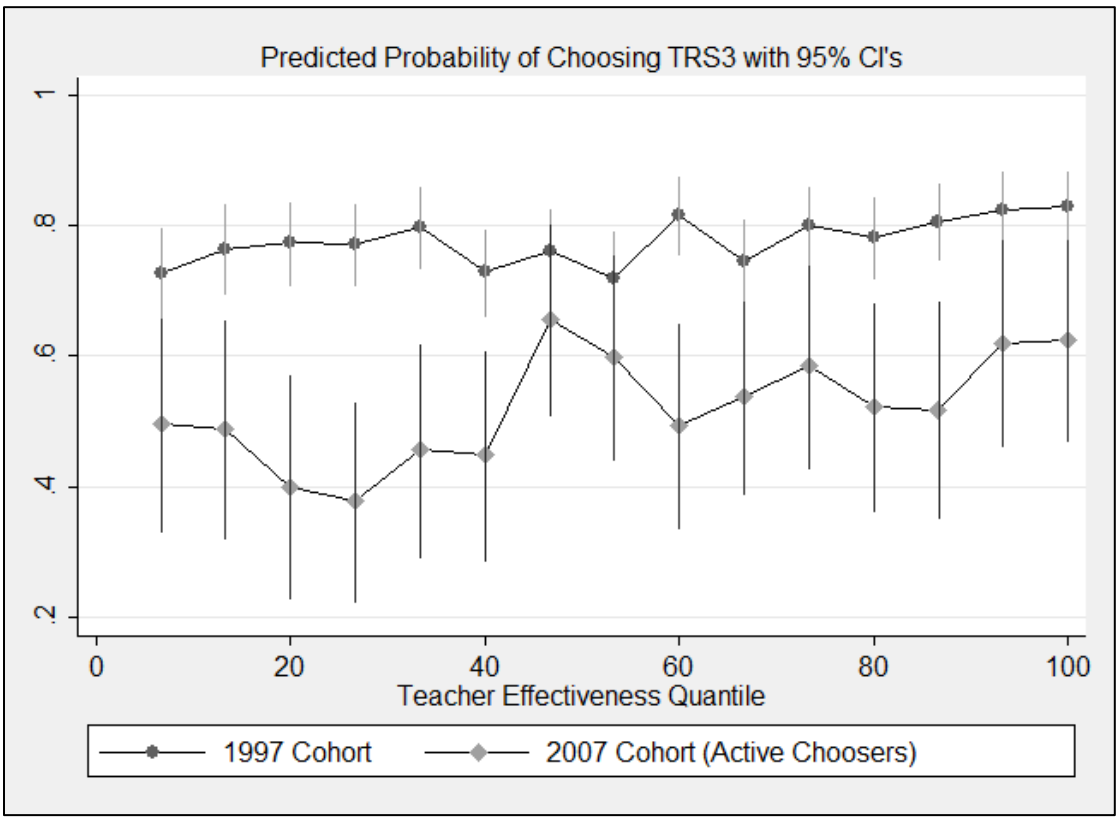
| Variable | 1997 Cohort | 2007 Cohort |
|---|---|---|
| $SCY$ | Teacher will separate and retire at age 65. All teachers are eligible for full benefits at this age. Teacher will earn one $SCY$ for each year between current age and age 65. | |
| $AFC/Sal$ | Teacher's nominal salary will grow at a rate of 3% per year, as assumed by ET (1996).[37] | |
| $r$ | We discount by a 3% inflation rate, as assumed by ET (1996).[38] | |
| $Contr$ (TRS2) | We use the contribution rate as of 1997 (6.59%), as assumed by ET (1996). | The DRS Guide reports the current contribution rate. We use rates current with the school year in which a teacher was hired: 2.90% in 2008, 4.26% in 2009. |
| $Contr$ (TRS3) | We assume the default contribution rate of 5%. | |
| $P_{A_t\|A}$ | We use the Projected Mortality tables for men and women from the Office of the State Actuary (2011) to calculate teacher survival probabilities. | |
| $COLA$ | We assume a cost of living adjustment of 3%, equal to inflation. | |
| $inv$ | ET (1996) provides the figures needed to estimate DC benefits with investment returns equal to 6%, 8%, 10%, and 12%. In each of the examples it runs through, it assumes 10% returns. We run estimates at each of these levels. | ICMA (2012) allows teachers to choose an assumed rate of return, though the default is set at 8%. We estimate benefits with returns of 6%, 8%, and 10%. |

[37] The ICMA calculator sets a default salary growth rate of 1 percent. Because inflation not accounted for, this reflects 1 percent growth in real salary.

[38] The materials provided to teachers in 1996 do not discount future benefits beyond accounting for inflation. The materials available 2007-present express all pension value estimates in nominal terms. We maintain an assumption of 3 percent inflation, which is consistent with long-term inflation rates in the U.S.

Figures

**Figure 3. Teacher Effectiveness and Pension Choice**



## Appendix

The models presented in **Table 5** utilize value-added scores estimated using the model described in equation (A1), with standard errors estimated using Empirical Bayes procedures as described in Aaronson et al. (2007).

$$A_{ijkst} = \alpha A_{i(t-1)} + X_{it}\beta + C_{jt}\gamma + \tau_j + G_{it} + \phi_t + \varepsilon_{ijkst} \quad \text{(A1)}$$

In (A1), *i* represents students, *j* represents teachers, *k* represents schools, *s* represents subject area (math or reading), and *t* represents the school year. Student achievement is normed within grade and year, and $A_{ijkst}$, is regressed against the following: prior student achievement in math and reading, $A_{i(t-1)}$; a vector of student and family background characteristics (e.g., race and ethnicity, special education status, gifted status, and free or reduced-price lunch status), $X_{it}$; class size ($C_{jt}$); grade effects ($G_{it}$); and year effects ($\phi_t$) The remaining teacher fixed-effect ($\tau_j$) is the VAM estimate for teacher *j* pooled across all years the teacher is observed in the dataset.

In Table A1 below, we present additional results utilizing value-added scores estimated using the models in equations (A2) – (A4). The model described by (A2) modifies (A1) by dropping school and classroom level variables, controlling only for student covariates. The estimates presented in Table A1 are from the earliest year available, which is the year closest to the point in time when a pension choice was made.

$$A_{ijkst} = \alpha A_{is(t-1)} + X_{it}\beta + \tau_{jt}^{n} + \varepsilon_{ijkst} \quad \text{(A2)}$$

The model described by (A3) modifies (A1) by adding a school fixed effect, $\lambda_k$. The teacher fixed effect is then measured relative to other teachers in the same school.

$$A_{ijkst} = \alpha A_{i(t-1)} + X_{it}\beta + C_{jt}\gamma + \tau_j + G_{it} + \phi_t + \lambda_k + \varepsilon_{ijkst} \quad \text{(A3)}$$

The model described by (A4) substitutes a student fixed effect for the observed student covariates in the first model.

$$A_{ijkst} = \alpha A_{i(t-1)} + \eta_i + C_{jt}\gamma + \tau_j + G_{it} + \phi_t + \varepsilon_{ijkst} \quad \text{(A4)}$$

The student achievement measures are test scores on the Washington Assessment of Student Learning within year and grade, which are standardized by year and grade.

## Table A1. Estimated Marginal Effects of Teacher Effectiveness on Pension Choice

| | | 1997 Choice Cohort | | 2007 Choice Cohort | | | |
|---|---|---|---|---|---|---|---|
| | | | | All Observations | | Active Choosers | |
| | | (1) | (2) | (3) | (4) | (5) | (6) |
| Single-year estimates (student controls only) | Teacher Effectiveness | 0.0309 * | | 0.0410 | | 0.0504 * | |
| | | (0.0099) | | (0.0222) | | (0.0248) | |
| | Effectiveness Quintiles | | | | | | |
| | 1 | | (Ref.) | | (Ref.) | | (Ref.) |
| | 2 | | 0.0285 | | -0.0970 | | -0.0487 |
| | | | (0.0290) | | (0.0597) | | (0.0676) |
| | 3 | | 0.0825 * | | -0.0334 | | 0.0042 |
| | | | (0.0270) | | (0.0560) | | (0.0679) |
| | 4 | | 0.0354 | | 0.0750 | | 0.0964 |
| | | | (0.0281) | | (0.0587) | | (0.0711) |
| | 5 | | 0.0867 * | | 0.0137 | | 0.0542 |
| | | | (0.0276) | | (0.0608) | | (0.0689) |
| Multiyear estimates with student and classroom controls and school fixed effects | Teacher Effectiveness | 0.0179 * | | 0.0305 | | 0.0382 | |
| | | (0.0086) | | (0.0188) | | (0.0216) | |
| | Effectiveness Quintiles | | | | | | |
| | 1 | | (Ref.) | | (Ref.) | | (Ref.) |
| | 2 | | 0.0241 | | -0.0016 | | 0.0154 |
| | | | (0.0277) | | (0.0606) | | (0.0683) |
| | 3 | | 0.0489 | | 0.0223 | | 0.0811 |
| | | | (0.0278) | | (0.0600) | | (0.0661) |
| | 4 | | 0.0391 | | 0.0339 | | 0.0812 |
| | | | (0.0270) | | (0.0612) | | (0.0691) |
| | 5 | | 0.0474 * | | 0.0831 | | 0.0694 |
| | | | (0.0272) | | (0.0601) | | (0.0692) |
| Multiyear estimates with student fixed effects | Teacher Effectiveness | 0.0053 | | 0.0043 | | 0.0010 | |
| | | (0.0086) | | (0.0194) | | (0.0225) | |
| | Effectiveness Quintiles | | | | | | |
| | 1 | | (Ref.) | | (Ref.) | | (Ref.) |
| | 2 | | 0.0168 | | -0.1155 | | -0.1241 |
| | | | (0.0269) | | (0.0617) | | (0.0671) |
| | 3 | | 0.0082 | | -0.0463 | | -0.0603 |
| | | | (0.0274) | | (0.0604) | | (0.0669) |
| | 4 | | 0.0087 | | -0.0049 | | -0.0585 |
| | | | (0.0272) | | (0.0615) | | (0.0701) |
| | 5 | | 0.0289 | | 0.0004 | | -0.0151 |
| | | | (0.0265) | | (0.0612) | | (0.0686) |