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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. There is evidence that more effective teachers are more likely to enroll in the hybrid pension plan, suggesting that states could reduce the financial risk associated with strict defined benefit pension systems without sacrificing the desirability of pension plans to employees.

1. Introduction

In 1995 the Washington State Legislature adopted legislation that replaced the traditional defined benefit pension plan covering public K-12 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). This paper examines teachers' pension preferences by looking at two periods of time during which Washington school teachers could choose between the traditional defined benefit plan and the hybrid plan.

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 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 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.

Teachers' pension preferences are relevant to two current public policy issues. The first arises due to concerns about the poor financial condition of many states' pension systems. Estimates peg the national shortfall in assets relative to liabilities at several trillion dollars (Barro and Buck 2010; Pew

Center on the States 2010; Bullock 2011; Novy-Marx and Rauh 2011), and as of the 2010 fiscal year, 34 states had less than 80 percent of their pension liabilities funded (Pew Center on the States, 2012). Addressing pension system shortfalls will require states to reduce spending and/or increase taxes.[1] This has begun to some extent as contributions to public pension systems by local and state governments have increased during the past decade, rising from 2.9 percent of total government expenditures in 2001 to 4.6 percent in 2010 (Johnson, Chingos and Whitehurst, 2013).

The financial condition of Washington State's pension systems is relatively good, but a large unfunded liability is currently associated with the state's Teacher Retirement System Plan 1 (TRS1) which closed new enrollment in 1977. To address this liability, the employers of teachers enrolled in TRS2 and TRS3 are projected to contribute 5.9 percent of those teachers' salaries to TRS1 during 2015-2017 as part of a plan to fully amortize the TRS1 unfunded liability within a rolling ten-year period, to the extent that this funding might have been used for current salaries, the teachers employed today (over 90 percent of whom are enrolled in TRS2 or TRS3) are subsidizing the retirement of those who have long since left the workforce.

Moving away from defined benefit (DB) and towards defined contribution (DC)-type pensions would do nothing by itself address existing shortfalls, but it would lower the likelihood that shortfalls such as the unfunded TRS1 liability in Washington State would occur in the future because DC plans are, by definition, fully funded (Hess and Squire 2010; Beshears et al. 2011; Olberg and Podgursky 2011). But while a shift towards DC pension would make states' finances more predictable, calls for such reform have also been controversial. One reason is that it would shift the risk associated with uncertain investment returns from states onto individuals. Randi Weingarten, President of the American Federation of Teachers, and influential voice in pension system debates, references these concerns in

[1] See for example, Johnson, Chingos, and Whitehurst (2013) and Zeehandelaar and Winkler (2013).

opposing the push away from defined benefit pension systems, noting that "a lot of the defined contribution plans don't provide enough for retirement security." (Institutional Investor, 2013).

The second debate is centered on whether restructuring teacher compensation can be used as a lever for increasing the attractiveness of the profession and hence improving the quality of the workforce. 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 may be too high from an efficiency standpoint (Fitzpatrick 2012), whether financial incentives imbedded in teacher pension plans produce undesirable patterns of attrition (Costrell and Podgursky 2007; Costrell and Podgursky 2009; Koedel et al. 2011; Ni and Podgursky 2011), and how pensions may influence the quality of the teacher workforce (Weller 2011; Wiswall 2011; Fitzpatrick 2012; Chingos and West 2013; Koedel, Podgursky, and Shi 2013). This line of research suggests that the current structure of many state DB systems could be improved if the end goal is the quality of the teacher workforce.

A shift in the public sector toward DC pension systems 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 are pure DB plans and less than 4 percent are pure DC plans. As a form of compensation, pensions are used as a tool to attract and retain effective employees, and a question for any state considering pension reform is how restructuring compensation might affect workforce composition. This is particularly important in the case of public school teachers, a workforce of over 3 million, representing the largest share of government employees

by job description. Teachers' pension preferences have received relatively little empirical attention, largely because there have been so few instances in which a choice between two different types of plans was offered.[2] In this paper we report on research that examines two periods of time in which Washington State public school teachers were able to choose between enrolling in a traditional DB plan and a hybrid DB-DC plan. 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 research provides useful information to policy makers considering the creation of a new pension plan or the offering of pension choice to new teachers. In particular, our findings suggest that a significant proportion of 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 relative financial value, and some teacher and school-level characteristics. Among 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.

[2] This is in contrast to state university systems, many of which offer their employees a choice between different types of pension plans. Two previous analyses of pension choice have looked at such systems: Clark, Ghent, and McDermed (2006), and Brown and Weisbenner (2009).

2. Background

The Washington State Teacher Retirement System (TRS) was established in 1938 and is operated by the Department of Retirement Systems (DRS), which handles pension systems that cover state employees. 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 similar 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 gain-sharing.[3]

A. Pension Choice in Washington State

Among Washington teachers, two groups of enrollees have been able to choose between enrolling in TRS2 and TRS3;we will refer to them as the 1997 and the 2007 choice cohorts.

The 1997 cohort consists of teachers hired between 1977 and 1996 who as new hires 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 1, 1996 and December 31, 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.[4] The size of the payment was increased by legislators to 40 percent on April 15, 1997, and to 65 percent in April 1998. Ultimately, all teachers who transferred to TRS3 prior to 1998 received the 65 percent transfer payment. While the option to transfer to TRS3 for the 1997 cohort is

[3] Gain-sharing is a mechanism created in 1998 to increase the benefits of Plan 3 members when "extraordinary investment returns" are experienced by the Plan. When the average compound investment returns exceed 10 percent during the previous four fiscal years, a member receives a retirement account deposit proportional to her level of service credit. For example, in 2000 TRS3 members received $254 per service credit year. We incorporate gain-sharing into our empirical analysis because the occurrence and size of future payments was highly uncertain, and there is little heterogeneity across teachers. Furthermore, gain-sharing was not established until after the 1997 choice period ended.

[4] TRS2 contributions earn 5.5 percent interest, compounded quarterly.

ongoing, the transfer bonus payment was only available to those who opted to transfer before the end of 1997 so, not surprisingly, the overwhelming majority of transfer decisions (over 98%) occurred between the July 1996 and December 1997. During the transfer bonus period, 18,535 teachers (75 percent of those eligible) transferred to TRS3.[5] DRS used the term "bonus payment" in reference to how much money would be transferred in each teacher's defined contribution account, but the bonus was intended to be fiscally neutral at the state level.[6]

The 2007 cohort consists of teachers hired since July 2007. These teachers can choose to enroll in TRS2 or TRS3, but there is no bonus payment associated with enrollment choice. 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.

B. Features of TRS2 and TRS3

The features of the TRS2 and TRS3 are described in Table 1 below, but the basic elements of the two systems are as follows:

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

[5] In the 12 years following the transfer bonus period only 345 additional teachers transferred to TRS3.
[6] In a letter to TRS Plan 2 members from the DRS informing them transfer bonus payment had been increased to 40 percent of accrued contributions, "This legislative change was made because recent actuarial data indicated that the larger transfer payment was required to maintain the neutral fiscal impact that Plan 3 legislation was intended to have."

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.[7] 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.[8] 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, 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.[9]

Employees enrolled in TRS3 contribute exclusively to the DC component. Each teacher has discretion 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

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

[8] The vesting period for teachers in the 1997 cohort was grandfathered in, such that it was 5 years for both those who chose TRS2 and TRS3.

[9] Under TRS2, a retirement-eligible teacher (at least 20 SCY and 55 years of age) must begin receiving retirement benefits immediately after separation 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.

between 5 percent and 15 percent of salary. An employee who does not make an active contribution rate choice defaults into the 5 percent contribution plan.

[TABLE 1]

3. 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, Ghent, and McDermed (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 (in terms of 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 teacher preferences for these three options. 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 those beliefs are inaccurate. 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 different pension plans in a 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, and 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) paper is, to our knowledge, the first study of pension choice among K-12 public school teachers. The study analyzes the enrollment decisions of newly hired teachers in

Florida who have been able to choose between a traditional DB plan and a pure 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 and fell to just over 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 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, a key feature of our study. They do, however, compare the value of the two plans for tenures of between 1 and 30 years and show that the DC plan is most 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 are most likely to enroll in the DB plan, and teachers in the second and fourth (top) quartiles are most likely to enroll in the DC plan.

4. Data

Confidential data on teacher retirement system choices that are maintained by the Washington State DRS are used to model teachers' pension choice between TRS2 and TRS3. 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.[10] 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.

[10] 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.

The proportions of teachers choosing TRS3 are summarized in Table 2 for different subgroups defined by teacher, school and regional characteristics.[11] 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 make an active 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 various teacher subgroups defined in Table 2 for both choice cohorts with the exception of teachers close to retirement (the 55-65 age group) and Native Americans teachers in the 2007 cohort. The pattern, however, is a bit different when we focus on the teachers reported to be active choosers (in the 2007 cohort). Here we see that majorities of the following groups choose TRS2: teachers hired in the 2009 school year, teachers older than 45, African American and Native American teachers, and teachers at schools in urban 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 choose TRS3 and older teachers are substantially less likely to choose TRS3. There are also significant differences in system choice across ethnic groups in both choice cohorts, but the

[11] The descriptive statistics reported in Table 2 are taken over the sample used in the empirical analysis presented in Section V. In order to estimate the relative financial value of TRS2 and TRS3 some teachers are restricted from the sample due to outlying values of age and salary. Teachers aged 65 and older and 60 and older are restricted from the 1997 and 2007 choice cohorts respectively. The assumption of retirement at age 65 is inconsistent with employment after age 65 and for those who would be unvested at 65 (i.e., those newly hired after the age of 60). Teachers with reported total salaries lower than $25,000 and $32,000 and higher than $100,000 and $75,000 are restricted from the 1997 and 2007 choice cohorts respectively. It is possible to earn additional salary through extra-curricular or summertime employment, for example, but these salary ranges are inconsistent with teachers' base salary schedules. We only report the proportions choosing TRS3 because the numbers in each row for each choice group always add up to 1 so the TRS2 proportions can be inferred.

patterns are inconsistent between 1997 and 2007. Higher-than-average proportions of teachers with advanced degrees and credentials to teach math or science subject areas choose TRS3 in both cohorts. At the school level, teachers of lower grade levels are more likely to choose TRS2.

[TABLE 2]

5. A Model of Pension Choice

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

A. Tradeoffs between TRS2 and TRS3

Relative Financial Value - Central to a teacher's choice between TRS2 and TRS3 is comparison of the level of financial benefit the two plans are likely to provide in retirement. Numerous analyses have in fact found that employees (including public educators) respond to the financial incentives embedded in retirement benefits (see, for example, Ippolito 2002; Chan and Stevens 2004; Asch, Haider, and Zissimopoulos 2005; Furgeson, Strauss, and Vogt 2006; Koedel et al. 2011; Ni and Podgursky 2011). As such, we expect estimates of the relative financial benefits of the two plans to be significant predictors of pension choice. We estimate (described below) and control for the relative financial value of TRS2 and TRS3 for each teacher.

Several factors are likely to diminish the ability of calculations 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. 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 (Chan and Stevens 2008; Brown and Weisbenner 2012). 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., Yang 2005; Chingos and West 2013). Finally, as described below, the pension wealth calculations utilized in this study make a number of economic assumptions that are uniformly applied to the study population when in reality, the assumptions held by teachers may be quite heterogeneous.

Teachers are provided with resources to help them compare the two plans. Specifically, the Department of Retirement Services 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 estimate future benefits. 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.[12] Teachers are also able to estimate the cost of the two plans in terms of employee contributions to the plans.

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 TRS3 has a longer vesting period than TRS2 (5 years vs. 10 years).[13] 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.[14] For teachers expecting to separate with between 5 years and 10 years of experience, TRS2 is likely to provide greater value than TRS3 because of the shorter vesting period (for the 2007 cohort). 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

[12] 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.

[13] Note again that the vesting period for teachers in the 1997 cohort was grandfathered in, such that it was 5 years for both TRS2 and TRS3.

[14] 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.

TRS2) provides inflation protection to teachers who separate before retirement: the defined benefit increases by 3 percent each year between separation and retirement. TRS3 also makes it easier to maintain health care coverage eligibility.[15]

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 identify several teacher and work-environment characteristics that are strongly related to tenure length. Stinebrickner (2002), for instance, finds that changes in family situations, particularly the birth of a child, explain a large amount of teacher attrition. And, those with better labor market opportunities outside of teaching, such as those with math and science training, are less likely to enter the teaching profession (Goldhaber and Liu 2003), or, having become a teacher, more likely to leave the profession (Murnane and Olsen 1989). A number of studies also show that the kind of school in which teachers are employed matters: the demographics and achievement levels of students in a school have been found to be important determinants of teacher mobility (Hanushek, Kain, and Rivkin 2004; Boyd et al. 2005; Scafidi, Sjoquist, and Stinebrickner 2007; Borman and Dowling 2008; Goldhaber, Gross, and Player 2010).

Finally, a number of studies show that teacher mobility and attrition from the profession varies along the effectiveness distribution (Hanushek, Kain, and Rivkin 2004; Krieg 2006; Boyd et al. 2007; Goldhaber, Gross, and Player 2010; Chingos and West 2012), with the general finding that more effective teachers are less likely to leave the profession. This is somewhat contradictory to more general labor market evidence that higher ability employees are more likely to change occupations (Groes, Kircher, and Manovskii, 2009).

Given these empirical findings, we might expect a number of teacher and workplace characteristics related to tenure length to be correlated with pension choice. Teachers working at challenging schools,

[15] 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.

such as those with a large proportion of minority students or students receiving free or reduced price lunch, might 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 better access to alternative careers.

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, as described above, neither pension plan is unambiguously more portable across a teacher's entire career: while TRS3 provides more flexibility in the medium-to-long term, it has a significantly longer vesting period for new hires. 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 the difference between the plans' vesting rules is moot.[16] The 2007 cohort consists of newly hired teachers, who may be more likely to focus on the different vesting periods than on the inflation protection provided by TRS3.

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.[17] Risk aversion has also been found to increase with age (Hallahan, Faff, and McKenzie, 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

[16] As stated above, the five-year vesting period was grandfathered in for teachers in the 1997 cohort who transferred to TRS3.

[17] Consistent with this, 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.

lower probability of the 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 (Clark, Ghent, and McDermed 2006; Chingos and West 2013), and there is evidence that risk aversion varies with ethnicity (Gutter, Fox, and Montalto, 1999; Yao, Gutter, and Hanna, 2005). There is inconsistent evidence as to whether teachers' risk preferences mirror those of employees generally (Wagner 2001; Perez 2011).

Default Setting - There is substantial evidence that the choices (or non-choices) that people make can be greatly influenced by default settings (Thaler and Sunstein, 2008). In the context of pension decisions, for instance, Madrian and Shea (2001) find that 401(K) participation rates are significantly higher when employees are automatically enrolled into their companies' pension plans. Neither choice cohort was required to make an active pension plan choice, but the default was different for each cohort: staying in TRS2 was the default setting for the 1997 cohort and enrolling in TRS3 the default setting for the 2007 cohort. For the 2007 cohort, the DRS data show whether or not an individual indicated a choice to the DRS within the first three months of employment.[18]

Approximately 18 percent of teachers in the 2007 choice cohort defaulted into TRS3. This rate appears low compared to, for instance, Brown and Weisbenner (2009), who find that over 50 percent of newly hired employees of the state university system of Illinois defaulted into the system's traditional defined benefit plan. In general, however, there is relatively little empirical evidence on what predicts defaulting behavior. Choi et al. (2004) find that lower compensation, less tenure, and (to a lesser extent) younger age, are determinants of the proportion of employees who participate at default settings.

[18] We cannot distinguish between those who preferred TRS3 and did not send in the paperwork and those who were willing to accept whichever plan was the default. In other words, there are likely some "active choosers" among the "defaulters." That said, there are several reasons for individuals to indicate a choice to DRS when TRS3 is the preferred plan: 1) The paperwork is brief (2 ½ pages); 2) You can choose a contribution rate; 3) You can choose an investment program; 4) You can designate beneficiaries.

There is also some evidence that employer practices can affect default rates. Clark and Schieber (1998) find that improving communications concerning a company's pension plan has a large effect on the proportion of employees who participate.

All teachers receive the same set of information from DRS about pension options, but it appears that some districts may be more proactive about encouraging new hires to make a decision.[19] Among the 2007 choice cohort, the district-level variation in the proportion of teachers who default into TRS3 is substantial. For instance, the proportion of teachers who defaulted into TRS3 in districts for whom we have 50 or more observations ranges from less than 2 percent to over 47 percent. Figure 1shows the considerable heterogeneity across districts in terms of the proportion of teachers in the 1997 Choice Cohort transferring to TRS3 (Figure 1a) and the proportion of teachers in the 2007 Choice Cohort defaulting into TRS3 (Figure 1b).

B. The Relative Financial Value of TRS2 and TRS3

Following several recent analyses of retirement incentives in defined benefit pensions (e.g., Yang 2005; Chan and Stevens 2008; Costrell and Podgursky 2009), we approach the comparison of relative pension plan value in terms of the net present value (NPV) of pension wealth provided by selecting TRS2 or TRS3. Putting pension value in NPV terms 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. We calculate the NPV of TRS2 and TRS3 for each teacher and each potential tenure length and solve for the internal rate of return on DC assets that would equate the NPV of the two plans.[20] These calculations 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 financial planning

[19] New hires submit pension choice paperwork to their employer (i.e. the school district) and an administrator could identify those who had not yet indicated a choice.

[20] Tenure is assumed to be earned during a period of continuous employment. That is, we assume that a teacher does not separate and then return to employment.

tools allow teachers to generate pension value estimates based on their own economic assumptions, we must apply assumptions more uniformly. Following, are descriptions of the NPV pension wealth calculations performed for the TRS2 and TRS3 pension plans.

TRS2 - An enrollee earns the right to an annual defined benefit, the size of which is a function of the level of experience accrued at the time of separation (SCY_S) and average final compensation at the time of separation (AFC_S):

$$(1) \qquad B_t(TRS2) = 2\% \cdot SCY_S \cdot AFC_S \cdot \prod_{65}^{A_t}(1 + COLA_t),$$

where the size of the benefit is increased by a cost of living adjustment indexed to inflation ($COLA_t$). The NPV of the benefit is equal to the total stream of benefits received in retirement (discounted by inflation and mortality probability) less the stream of contributions paid into the plan (also discounted by inflation):

$$(2) \qquad NPV(TRS2) = \sum_{t=65}^{110} B_t(TRS2) \cdot P_{A_t|A_0} \cdot (1 + r)^{(A_0 - A_t)}$$

$$- \sum_{t=A_0}^{A_S} Contr_t \cdot Sal_t \cdot (1 + r)^{(A_0 - A_t)}.$$

The variable A_0 is age during the pension decision, A_S is age at separation, r is the rate of inflation, and $P_{A_t|A_0}$ is the probability of surviving to age t given one's current age.[21] The contribution rate, $Contr_t$, is determined by the state, and contributions made prior to the pension decision (1997 cohort only) are considered a sunk cost and excluded from the calculation. Teachers are assumed to begin collecting retirement benefits at age 65.[22]

[21] Equation 2 uses projected mortality tables for men and women from the Office of the State Actuary (2011) to calculate teacher survival probabilities.

[22] There are several reasons to assume a retirement age of 65. Teachers with less than 10 (TRS3) or 20 (TRS2) service credit years cannot begin retirement before the age 65. Teachers with more service credit who retire early receive a reduced benefit. Finally, the modal retirement age of teachers enrolled in TRS2 and TRS3 is 65 (Goldhaber et al. 2012). Actual retirement dates do exhibit some heterogeneity, but for a teacher estimating pension

TRS3 - The NPV of TRS3's defined benefit is calculated similarly to the TRS2 benefit, but with two important differences. First, the multiplier on the defined benefit portion of the pension plan is 1 percent rather than 2 percent. Second, when a teacher separates with 20 or more SCY the size of the TRS3 defined benefit increases by approximately 3 percent during each year between separation and retirement as a protection against inflation:

$$(3) \qquad B_t(TRS3) = 1\% \cdot SCY_S \cdot AFC_S \cdot \prod_{65}^{A_t}(1 + COLA_t) \text{ if } SCY_S < 20$$

$$B_t(TRS3) = 1\% \cdot SCY_S \cdot AFC_S \cdot (1 + 0.03)^{(65-A_S)} \cdot \prod_{65}^{A_t}(1 + COLA_t) \text{ if } SCY_S \geq 20.$$

The NPV of TRS3's DC component is evaluated at age 65 (discounted by inflation and survival probability) and the contributions are evaluated in the time period in which each is made:

$$(4) \quad NPV(DC) = \left[\sum_{t=A_0}^{64} Contr_t \cdot Sal_t \cdot (1 + inv)^{65-t}\right] \cdot (1 + r)^{(A_0-65)} \cdot P_{A_{65}|A_0}$$

$$- \sum_{t=A_0}^{64} Contr_t \cdot Sal_t \cdot (1 + r)^{(A-A_t)}.$$

The contribution rate is set to 5 percent of total salary (the default option), which is assumed to grow at a rate of 3 percent. The variable inv is the constant annual rate of return on investments.[23]

The value of TRS3 is more complicated for teachers in the 1997 cohort. For these teachers we must incorporate the value of accrued contributions made to the TRS2 account that are transferred into the DC component of TRS3 along with 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:

$$(5) \quad NPV(DC)_{1997} = \left[\sum_{t=A_0}^{64} Contr_t \cdot Sal_t \cdot (1 + inv)^{65-t} + trans \cdot (1 + inv)^{(65-A_0)}\right] \cdot$$

value in the context of plan choice (as opposed to retirement timing), it would be natural to use 65 as an assumed retirement age.

[23] 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.

$$(1+r)^{(A_0-65)} \cdot P_{A_{65}|A_0} - \sum_{t=A_0}^{64} Contr_t \cdot Sal_t \cdot (1+r)^{(A-A_t)}.$$

where

$$(6) \qquad trans = (1+Bonus) \cdot \sum_{t=A_0-A_H}^{A-1} Contr_t \cdot Sal_t \cdot \left(1+\frac{0.055}{4}\right)^{4(A-t)},$$

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 compounded quarterly. The size of the transfer can be calculated with some precision using individual salary data from the S275 administrative data (which dates back to the 1985 school year).[24]

Pension Value Parameters - A number of parameters that enter into the pension wealth calculations are not directly observable. In our teacher-level estimations of pension value we make assumptions about these parameters 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).[25] In the table below, we refer to these documents as ET (1996), DRS (2011), and ICMA (2012).

[TABLE 3]

Relative Financial Value - Two measures of relative financial value are calculated for each teacher-separation year, producing an $[n\ x\ 1]$ vector of relative pension values for each teacher, where $n = 65 - A_0$. The first measure of relative financial value is the difference between the estimated net

[24] Hire dates prior to 1985 are shown in DRS records, and for these teachers the 1985 salaries reported in the S275 are extrapolated backwards.
[25] See www.icmarc.org/washingtonstate/plan-choice/financial-modeling-software.html.

present values of TRS3 and TRS2: $NPV_{Diff} = NPV_{TRS3} - NPV_{TRS2}$. As noted in Table 3, NPV_{Diff} is calculated under assumptions of 8 and 10 percent returns on the plan's DC assets.

The second measure we use is the 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: $NPV_{TRS3} = NPV_{TRS2}$.[26] Teachers for whom the IRR is high should be relatively less likely to select TRS3 since they would have to assume a high return on the DC portion of TRS3 to equate it to the discounted value of TRS2, and vice versa.

Expected relative values of the pension plans are obtained by calculating the weighted sum of the vector of relative financial values for each teacher and financial measure. Following Koedel et al. (2013), the value measure for each teacher-separation year is weighted by the probability the teacher will separate in that year, given his or her current age and level of experience. To calculate the probability of exiting at a given age, we first estimate a hazard model of teacher attrition from Washington State public schools using data on teachers from 1989 – 1996 for the 1997 cohort and 1989 – 2007 for the 2007 cohort. We model teachers' first spell teaching in Washington state public schools using the binary outcome model:

$$(6) \qquad Pr(Y_{at} = 1 \mid A = a, T = t) = F(\lambda_a + \gamma_t + \epsilon_{at}),$$

where Y is an indicator that the teacher exits the Washington public school system at the end of the school year, T is an indicator for preparation program, S is a vector of school and teacher assignment characteristics, γ_t is an experience fixed effect, and λ_a is an age fixed effect. We assume a constant hazard for 11 and greater years of experience and for teachers aged 25 or less. We then calculate the probability of separation at each age for teachers in each cohort with the assumption that all remaining teachers retire at age 65.

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

Distributions of the expected relative financial value calculations are presented in Figures 2A-2D and Figures 3A and 3B. Figure 2A is a scatterplot of expected NPV_{Diff} and Age for teachers in the 1997 cohort. Within age, a large amount of variation in relative value is a result of there being many combinations of age, salary, experience, and transfer amounts (i.e. accrued contributions to TRS2) across teachers.

Not surprisingly, the assumed rate of return has a large effect on relative value, though its influence diminishes with age as the number of years in which investment returns are earned decreases.[27] Figure 2B presents the distribution of expected IRR across age. The rate of return on DC assets required to equate the net present values of TRS2 and TRS3 tends to increase with age because there is less time for investment returns to close any disparity between NPV_{TRS2} and NPV_{TRS3}. The contrasting distribution of expected IRR among some teachers under the age of 40 is driven by differing levels of experience and attrition probability. Those with very low values of IRR tend to be both relatively young and experienced, meaning they benefit from a long investment time horizon, a large amount of transfer wealth, and lower probability of attrition.[28]

Figures 1C and 1D present the same scatter plots for the 2007 choice cohort. There is less within-age variation of relative value because all teachers in the 2007 cohort are new hires and thus have zero experience and no accrued pension wealth. This is particularly true for the IRR measure, for which salary level is not a source of variation. The NPV_{Diff} measure approaches zero as new hires near retirement age primarily because the absolute value of both plans is small.

The shapes of the 2007 NPV_{Diff} plots demonstrate that the financial value measure is sensitive to the assumed rate of return, and that adjusting the rate of return does not simply affect magnitude. When plotted against age, NPV_{Diff} will be downward sloping under a high rate of return and be

[27] For example, if one invests $100 for a one-year period, the difference in earnings under 8 percent and 10 percent returns will be small: only $2. However, if one invests $100 for a 30-year period, the difference in earnings under 8 and 10 percent returns will be relatively large: $739.

[28] The probability of separating is highest during the first few years of employment.

relatively flat or upward sloping under lower rates of returns, with the plots pivoting around zero and age 60. In general, NPV_{Diff} is sensitive to the assumed rate of return at younger ages of enrollment and insensitive at older ages of enrollment. For this reason, and the fact that the IRR measure does not require one to assume a specific rate of return, the empirical results presented in Section V focus on the expected IRR measure of relative financial value rather than the NPV_{Diff} measures.

[FIGURES 2A-2D]

We find that on average, the expected IRR is lower among teachers who choose to enroll in TRS3 and that NPV_{Diff} is higher. In Figure 3A, kernel density distributions of IRR among teachers in the 1997 cohort exhibit substantial differences between TRS2 and TRS3 enrollees. Among the 2007 cohort, a higher density of TRS3 choosers have a low IRR, but the overall distributions are relatively similar. It is also worth noting that in both choice cohorts many teachers' enrollment decisions are inconsistent with our estimates of the expected financial benefits of the two plans.[29] For example, among those with an expected IRR of less than 6 percent, 17 percent chose TRS2 in the 1997 cohort and 37 percent chose TRS2 in the 2007 cohort. Given these distributions, we expect relative pension wealth to be predictive of pension choice among the 1997 cohort, but to have less predictive power among the 2007 cohort.

[FIGURE 3]

C. Empirical Specification

As discussed above, factors related to relative financial value, portability, and risk are likely to influence an individual's choice between TRS2 and TRS3, and these factors are likely to be related to a number of teacher and work-environment characteristics. But while empirical links between our control variables and risk preferences and teacher mobility may justify the inclusion of these variables in the empirical model, it does not fully support the interpretation of the coefficients on these variables as

[29] This is not to say that all of these individuals made a "wrong" decision. We do not observe all parameters related to relative financial value and some individuals' assumption and expectations may differ substantially from the ones used in our calculations.

evidence of *why* teachers choose a particular plan.[30] That said, an important question for any policymaker considering teacher pension reform is how reform might affect the composition of the teacher workforce. In this sense, the relationship between teacher characteristics and pension choice are of interest in and of themselves, even if the mechanisms underlying these relationships cannot be illuminated by the available data.

Of particular interest is the relationship between pension choice and teacher quality, as a primary function of pension benefits is to recruit and retain the highest quality workers. There is significant policy concern about the overall quality of the teacher workforce and, in particular, whether the profession is drawing talented college graduates (Hanushek and Pace 1995; Goldhaber and Liu 2003; Lakdawalla 2001; Corcoran, Evans, and Schwab 2004; Goldhaber and Walch, 2014). Several studies suggest 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 (e.g. Hoxby and Leigh 2004; Goldhaber 2006; Chingos and West, 2012). In an analysis of the "push" and "pull" incentives created by DB pension structures in Missouri, Koedel and Podgursky (2013) conclude that these incentives have a negative, but small, influence on the overall effectiveness of the teacher workforce. However, by contrast, Weller (2011) simulates the trade-offs between higher turnover and higher current compensation associated with a transition to DC pensions and estimates that there is a 60 percent to 70 percent chance that overall teacher effectiveness would decrease.[31]

We estimate models that control for measures of teacher effectiveness, described in greater detail in the Online Appendix. Specifications that include these measures are estimated separately because the measure of teacher effectiveness is available for a relatively small subset of teachers, those

[30] In other words, analyzing whether and how teachers' preferences for risk and portability affects pension choice would likely require detailed survey data to elicit information from teachers about their perceptions at the point they are making choices.

[31] Generalizing empirical analyses of the incentive effects of DB pension systems can be problematic because they are dependent on rule structures of the systems, which are vary from system to system.

in grades 4–6 who can be matched to their students during the 2007–2010 school years. It is possible to estimate value-added job performance measures for this subset of teachers – 2,363 teachers in the 1997 cohort and 665 teachers in the 2007 cohort.[32] 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.[33] For the 2007 cohort, the value-added estimates roughly coincide with the choice period.

From a statistical standpoint, a teacher's pension choice is characterized as follows:

(7) $$Y_i^* = E[U_i(TRS3)] - E[U_i(TRS2)]$$

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

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 expected relative financial value of TRS2 and TRS3 and teacher and work-environment characteristics for teacher *i*:

(8) $$Y_i^* = \alpha + \beta_1' x_{1i} + \beta_2{}' x_{2i} + u_i \,,$$

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

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

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

[32] For more on the estimation of teacher value added models see Aaronson et al. (2007), Goldhaber et al. (2013), and McCaffrey et al. (2004).

[33] 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.

where F is the cumulative distribution function for u.

The binary choice model is estimated separately for each of the choice cohorts, with and without school district fixed effects. 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.[34] 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.

6. Results

The results for pension system choice are reported in Tables 4, 5, and 6. Table 4 presents the primary results for the 1997 Choice Cohort and the 2007 Choice Cohort in a reduced form that excludes the estimated measure of relative financial value (columns 1-2 and 4-5) and a specification that includes the expected IRR (columns 3-4 and 7-8). Both of these specifications are estimated with and without school district fixed effects.[35, 36] While we have chosen a specific measure of relative pension value, we show below in the "Robustness Checks" section that our findings are not sensitive to the choice of the

[34] 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.

[35] The fixed-effect results presented were estimated as unconditional maximum likelihood models, for which obtaining marginal effects is straightforward. As discussed by Katz (2001), are more sensitive to bias than the conditional MLE when the number of "within" observations is small. Therefore, we also estimated conditional logit models as a specification check and found that they produced nearly identical control variable coefficients.

[36] Note that the IRR is highly collinear with age for the 2007 choice cohort, since all teachers in that cohort are just entering the teacher workforce, so age dummies and IRR are not included in the same specification. This is not true for the 1997 cohort since teachers in that cohort were much more varied in age and experience (see Figures 2b and 2d).

financial measure. Table 5 presents results for the 2007 Choice Cohort's propensity to default (columns 1-2) and pension choice among active choosers, who indicated a pension choice to DRS (columns 3-6). [37]

Finally, in Table 6 we add a value-added estimate of teacher effectiveness for the 1997 choice (columns 1-4) and 2007 (columns 5-8) to the model. As noted above, the relationship between teacher pension choice and value added is of great policy interest given concerns that changes to the pension system could influence the quality of the teacher workforce. There are various ways that value added models can be specified (Goldhaber, Gabele, and Walch, 2014), but as we show in the Robustness Checks section, our findings are not sensitive to the specific value-added approach employed.

A. Factors Predicting System Choice

The results of the logit model estimations for the 1997 and 2007 cohorts are presented in Table 4 as average marginal effects. 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., Yang 2005; Brown and Weisbenner 2009; Chingos and West 2013) that do not include survey data (as in Brown and Weisbenner, 2012).[38] The explanatory power of the 2007 models is lower than what has been reported in other empirical studies. For both cohorts, the inclusion of school district fixed effects significantly improves model fit and has little impact on the magnitude of control variable coefficients. [39] While a number of teacher and school characteristics are significantly predictive of pension choice in the 1997 Choice Cohort, few are in the 2007 Choice Cohort. This is likely due in part to the smaller sample size of the 2007 Choice Cohort and the fact that there is less variation in many of the variables because the

[37] Note that the "Active Choosers" classification did not exist for the 1997 choice cohort.
[38] 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).
[39] In each fixed-effect model presented in Table 4, an F-Test of the joint-significance of the district controls is significant at the 0.0001 level.

2007 this cohort is comprised of new hires (as opposed to teachers with various levels of age and experience in the 1997 Choice Cohort).[40]

[TABLE 4]

Several demographic variables are predictive of pension choice. In both choice cohorts, age is significantly predictive of pension choice, with older teachers being less likely to choose TRS3. For the 1997 Choice Cohort, the magnitude of the age coefficients is quite large, but diminishes with the inclusion of the relative financial value measure.[41] The pattern of older teachers being more likely to prefer the traditional defined benefit plan is consistent previous analyses of pension choice (Brown and Weisbenner, 2009; Clark, Ghent, and McDermed, 2006) and consistent with the notion that older employees might seek to reduce exposure to financial market risk as they approach retirement. Males are more likely to choose TRS3 in both choice cohorts, but the effect of gender is insignificant for the 1997 Choice Cohort when controlling for relative financial value (see columns 3 and 4). In both choice cohorts, that African American teachers are less likely to choose TRS3. This finding is consistent with previous analyses of pension choice (e.g., Clark, Ghent, and McDermed, 2006), but it also interesting when one considers that whites have a longer life expectancy. We might expect white teachers, all else equal, to be more likely to choose TRS2 since they will, on average, live longer to collect a pension.[42] That said, there may be other unobserved differences between black and white teachers related to pension choice, such as expected tenure, household wealth, or family composition.

Teachers across both cohorts are more likely to choose TRS3 as their salary increases. The magnitudes of the estimated coefficients on the salary variables are relatively consistent across both cohorts, though they are less precisely estimated (and not statistically significant) for the 2007 choice

[40] Note that many of the coefficients reported in columns 5-8 of Table 4 are statistically insignificant because of large standard errors, not because the coefficients are very close to zero.
[41] Age and relative financial value variables cannot be included in the same model for the 2007 Choice Cohort due to collinearity.
[42] Note that the racial/ethnic differences in mortality have not been factored into the calculation of the IRR because the mortality tables used by the Office of the State Actuary do not account for ethnicity.

cohort for whom there is less salary variation. This finding is consistent with both theoretical models of risk aversion (Pratt, 1964), and empirical studies that show higher-income individuals are willing to accept greater risk (e.g., Hartog, Ferrer-i-Carbonell, and Jonker, 2002; Nadler and Wiswall, 2004).

The relationship between endorsement type and pension choice is inconsistent between the two choice cohorts. Teachers with math, science or elementary endorsements are not significantly more likely to choose one plan or the other, and the signs of the coefficients reverse between the 1997 and 2007 choice cohorts. Teachers with endorsements in the arts or special education are significantly less likely to choose TRS3 in the 1997 Choice Cohort, and we find positive but insignificant coefficients on these variables in the 2007 Choice Cohort. Teachers with physical education or health endorsements are more likely to choose TRS3 in both choice cohorts. School type and locale do not appear to be related to pension choice in the 1997 Choice Cohort, but we find that teachers at schools in urban or suburban locales are significantly more likely to choose TRS3 in the 2007 Choice Cohort. As discussed below, some of this relationship may be driven by a higher propensity to default into TRS3 in urban and suburban locales.

For the 2007 Choice Cohort, we observe the pension choices of newly hired teachers in two different years. Most teachers hired for the 2008 school year (2009 school year) would have been making a pension choice in fall 2007 (fall 2008). We find that teachers hired during the 2009 school year are significantly less likely to choose TRS3. The financial crisis, which came to a head in September and October of 2008, may have affected teachers' expectations about market returns and/or their risk preferences.[43]

Turning our attention to the measure of pension system value, we see that, for both choice cohorts, the coefficient on IRR is significant and negative, though its magnitude differs across cohorts: a one percentage-point increase in the IRR is estimated to decrease the probability of choosing TRS3 by

[43] While there may have been indicators of trouble ahead throughout much of 2007, the S&P 500 index, for example, peaked in October 2007, and did not fall precipitously until nearly a year later, in late September 2008.

about 2.2 percentage points for the 1997 choice cohort but only by about 1.4 percentage points for the 2007 cohort. Given this, we would characterize the responsiveness of teachers to the financial value of different pension options to be modest to small. Figures 4A and 4B plot the predicted probability of choosing TRS3 against the IRR (from specifications 3 and 7) in Table 4. Teachers in the 1997 Choice Cohort appear to be less responsive to changes in the IRR when the IRR is small, becoming more responsive as the rate or return required to equate the value of TRS2 and TRS3 moves beyond 4 to 5 percent.

As described in Section I, teachers in the 1997 Choice Cohort received a transfer bonus payment equal to the 65 percent of the their accrued contributions into TRS2, as of January 1996. Our results suggest that the size of the bonus payment (i.e., whether it was 20, 40 or 65 percent) might not have had a large influence on the proportion of teachers who transferred to TRS3. We calculate the IRR (as described in Section IV.B) for each teacher assuming no transfer bonus payment and use the parameters obtained from model (3) in Table 4 estimate the proportion who would have transferred to TRS3. The difference is small: the average predicted probability of transferring to TRS3 with the 65 percent transfer bonus payment is 75.2 percent and 71.9 percent with any transfer bonus payment.[44] While the marginal effect of the transfer bonus payment appears to be small, the mere existence of a "bonus" may have made transferring to TRS3 appear more attractive.

B. Default Behavior and Pension Choice among "Active Choosers"

While we can be certain that everyone identified as an "active chooser" did in fact make an active choice between TRS2 and TRS3, there are almost certainly some active choosers among the defaulters. For example, a teacher who preferred TRS3 may have let herself default into the plan rather than submit the paperwork indicating a choice. However, there are several reasons to indicate one's

[44] We calculate the total amount of bonus transfer payments made to teachers transferring to TRS3 as approximately $200 million.

choice of TRS3 rather than default: the paperwork is brief; it is an opportunity to choose a contribution rate and investment plan; it is an opportunity to identify beneficiaries.

As discussed in section IV.A, some types of teachers may be more likely to default into TRS3 rather than make an active choice between TRS2 and TRS3, and we observe a great deal of district-level variation in the proportion of teachers who default. To analyze whether different types of teachers have a greater propensity to default we estimate logit models with the same set of covariates as in models (7) and (8) of Table 4. The overall explanatory power of the model is low and few variables are predictive of default. Men are significantly more likely to default (6 percentage points with district fixed-effects), and teachers with endorsements in math or science subject areas are significantly less likely (-7.2 percentage points). In contrast to Choi et al (2004) we do not find any relationship between defaulting and compensation level or age.[45] We do not find evidence that teachers are strategically defaulting into TRS3 because it is likely to provide greater financial value: the coefficient on IRR is very close to zero.

It is not clear whether the overall proportion of teachers who defaulted (18 percent) is high or low. In their analysis of Illinois' State University Retirement System (SURS), Brown and Weisbenner (2009) report that 55 percent of women and 57 percent of men defaulted in SURS's traditional defined benefit plan, while 11 and 9 percent actively chose it. While the proportion of defaulters in those studies is much higher, the plan choices are not the same. Furthermore, the default choice is the defined benefit plan for which there are fewer within-plan decisions to be made (e.g., contribution rate or investment plan).

Regarding districts' influence on the propensity to default, we find significant district-level effects ($P > \chi^2 = 0.0000$) in model (2). However, it is unclear what mechanism(s) is driving this variation. There does appear to be some relationship between the proportion of defaulters and district size. The correlation between district size and default rate is 0.44 (0.32 when the largest district,

[45] Regressions including age rather than IRR were estimated, but are not presented in Table 5. We found no significant relationship between age and the probability of defaulting into TRS3.

Seattle,[46] is excluded) among districts for which we have at least 30 observations. But we do not find evidence that districts are influencing default rates in a way that appears to promote one plan over another. The correlation between the proportion of teachers defaulting and the proportion active choosers enrolling in TRS3 is -0.03. The observed district-level variation in default rates warrants further investigation in future research as districts appear to have a significant influence on overall pension choice patterns.

When the pension choice models limited to the sample of active choosers (columns 3-6 of Table 5), we find results similar to those obtained with the sample that includes defaulters and active choosers (columns 5-8 of Table 4). Few coefficients are statistically significant, and the explanatory power of the models is low. The coefficient on African American ethnicity becomes statistically significant and larger in magnitude, and the effects of being hired in the 2009 school year (vs. 2008) and relative financial value are also larger in magnitude.

C. Pension Choice and Teacher Effectiveness

The models in Table 6 add measures of teacher effectiveness for the subsample of teachers for whom they are available.[47] Two factors limit the interpretation of the coefficients on teacher 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

[46] Seattle is something of an outlier: it is approximately twice as large as the next biggest district and also has the highest proportion of defaulters.

[47] 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 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.

control variables of models (1) 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.

[TABLE 6]

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 for the 1997 Choice Cohort) is associated with an approximately 2-3 percentage point change in the predicted probability of choosing TRS3, depending on whether the choice model includes district fixed effects. Using quintile indicators, a teacher in the top quintile of effectiveness is approximately 5 to 8 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 and less statistical significance. A one standard deviation change in effectiveness (0.14 for the 2007 Choice Cohort) is associated with a 5 to 6 percentage point change in the predicted probability of choosing TRS3, depending on whether the choice model includes district fixed effects. When we specify the model with a quintile of measure of effectiveness, teachers in the top quintile are 8-10 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 3rd, 4th, and 5th quintiles diminishes, while the difference between those quintiles and the bottom quintile increases substantially. Among active choosers, a teacher in the top quintile is 11 percentage points more likely to choose TRS3 than is the bottom quintile, but the top 3 quintiles are not significantly different from one another. The relationship between teacher effectiveness quintiles and the predicted probability of choosing TRS3 is presented in Figure 5.

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.

7. Robustness Checks

The findings from the prior section rely on estimates of two key variables: the measure of the relative financial value of the two pension systems, and the measure of teacher effectiveness. In this section we assess how sensitive our findings are to alternative methods of estimating these variables.

In Table A1 in the appendix we illustrate how robust our findings are to different assumptions about the relative financial value of the two pension options; for comparison we report our preferred specifications from Table 4 for the 1997 Choice Cohort (column 1) and the 2007 Choice Cohort (column 5). Consistent with the prior literature (Koedel et al., 2013), we weight the value of TRS2 and TRS3 pension wealth in each year by the probability that an individual remains in the labor market. This makes sense to the degree that teachers facing the TRS2-TRS3 choice also consider the likelihood that they may separate prior to retirement when making their pension system decisions. This assumption, however, might be unrealistic, particularly for younger teachers who could be idealistic about their prospects for staying in the teaching profession over the long-term and unaware of the relatively high early-career attrition that is common in the teacher workforce (Keigher and Cross, 2010; Goldhaber et al., 2011; Kaiser and Cross, 2011). In columns 2 (for the 1997 Choice Cohort) and 6 (for the 2007 Choice Cohort) of Table A1 we report the coefficient estimates when we utilize an IRR measure that has not been weighted by the estimated probability of teacher attrition. For both cohorts the estimated responsiveness to relative pension value is qualitatively similar, though smaller than with the weighted

IRR measure in the case of the 2007 Choice Cohort, and the other coefficient estimates are strikingly similar.[48]

One reason to use the IRR rather than NPV_{Diff} is that the IRR does not require assumptions about the rate of return. But, it may be that NPV_{Diff} is more consistent with the way teachers think about pension value comparisons.[49] In columns 3 and 4 (for the 1997 Choice Cohort) and 7 and 8 for the 2007 Choice Cohort, we report the estimated coefficients with models that substitute NPV_{Diff}, calculated at assumed returns of 8 and 10 percent,[50] for the IRR measure.[51] The findings from the models that include NPV_{Diff} are consistent with those that include the IRR measure in that teachers are more likely to choose TRS3 as NPV_{Diff} rises (i.e. the value of TRS3 – TRS2 increases), but the fit of the models is slightly better using IRR rather than NPV_{Diff}. In practice, it makes relatively little difference what measure we use as the correlation in the predicted probability that individuals choose TRS3 in the specification with IRR is over 0.8, regardless of whether the assumed rate of return is 8 or 10 percent.

As a final check of whether we are actually capturing teachers' perceptions of the relative financial value of the two different pension options, given that these are greatly dependent on when separations occur, we focus on the choices made by a group of teachers who arguably have greater information about their likely separation behavior. In general, we do not include information about the actual tenures of teachers in estimating the choice models because separations occur *after* the pension choice and are endogenous, as TRS2 and TRS3 have features that may differentially affect separation timing (e.g., inflation protection). However, it is plausible that a significant proportion of those teachers

[48] This is also the case when we focus on the 2007 "Active Choosers".
[49] It is arguably more consistent with the pension calculator they can use to assess different options since the calculator provides information in terms of pension wealth and monthly benefits rather than rates of return. That said, a teacher could adjust the assumed rate of return on the pension wealth calculator to get a sense of what rate would equate the value of the two plans.
[50] The assumption of 8 or 10 percent annual returns may sound optimistic, but it is worth noting that the average annual return on Washington State Investment Board assets over the three years preceding 1998 was over 16 percent, and the state, at the time, assumed an annual return on its invested assets of 8 percent (Office of the State Actuary, 2010).
[51] These values are also weighted by the probability of teacher attrition. Models that include unweighted measures of NPV_{Diff} are qualitatively similar, though the magnitude and significance of the NPV_{Diff} coefficient is reduced.

who left soon after making a choice anticipated their separation at the time the pension choice was made.

Our data does not permit us to determine precisely when teachers separate, but we identify the last year in which a teacher is employed by a Washington State school district. We use the likelihood that a significant proportion of teachers separating soon after making a choice were aware of impending separation to see whether they appear to make pension choices that are financially advantageous. Specifically, we calculate $NPV_{Diff1998}$ given a tenure length of $SCY + 1$ for teachers who do not return to the profession following the 1998 school year. Among these teachers, 36 percent make a pension choice inconsistent with the sign of $NPV_{Diff1998}$ (the percentage is the same whether we assume 8 or 10 percent returns) by choosing TRS2 when $NPV_{Diff1998} > 0$ or TRS3 when $NPV_{Diff1998} < 0$. When using the value of NPV_{Diff} as calculated in Section IV.B, which does not assume separation in 1998, we find a very similar pattern. Among teachers who do not return following the 1998 school year 39 percent and 37 percent make a pension choice that is inconsistent with the sign of NPV_{Diff}, assuming 8 and 10 percent returns, respectively. Hence, as a measure of relative financial value, NPV_{Diff} appears to be fairly robust to assumptions about expected length of tenure.

Next we assess the degree to which our findings on the choice of teachers of varying effectiveness might be sensitive to the value added measure of effectiveness. As we describe above, there is not universal agreement about how value added models ought to be specified in order to get the best causal estimates of teachers' contributions to student learning.[52] The results presented use value-added estimates from a model specification that includes student and school variables.

Appendix Table A2 shows the coefficients on teacher effectiveness in the pension system choice models for a number of different value-added formulations. To facilitate comparison, the value added measure used in Table 6 (columns 4 and 8), is presented in columns 1 (for the 1997 Choice Cohort) and 5

[52] For more discussion on the validity of value added models, see Kane and Staiger (2008), Rothstein (2010), Goldhaber and Chaplin (2012,), Goldhaber et al. (2013), Chetty et al. (2011), and Guarino et al. (2012).

(for the 2007 Choice Cohort). The other columns show the results when value added is estimated based on models that include: only student background variables (i.e. excludes classroom and school level variables) in columns 2 (for the 1997 Choice Cohort) and 6 (for the 2007 Choice Cohort); a specification that substitutes school fixed effects for school level variables (i.e. measures teacher performance within schools), which is in columns 3 (for the 1997 Choice Cohort) and 7 (for the 2007 Choice Cohort); and a specification that includes student fixed effects in place of student covariates, which is in columns 4 (for the 1997 Choice Cohort) and 8 (for the 2007 Choice Cohort).

The estimated relationship between value added and pension choice is similar regardless of how value added is derived, with the exception of the student fixed effects value added specification. For instance, across both cohorts, the likelihood of selecting TRS3 tends to be increasing with value added, with statistically significant differences between the top quartile and bottom quartiles of estimated teacher effectiveness for the 2007 Choice Cohort. This pattern is similar for the specification with student fixed effects, but the difference between the top and bottom quartiles of teacher effectiveness is far smaller for the 1997 Choice Cohort, and far larger for the 2007 Cohort. And for both choice cohorts, the student fixed effects formulation of value added is not statistically significant, but there is some evidence that this value added specification yields biased estimates of teacher effectiveness (Kane and Staiger, 2008).

8. Policy Implications and Conclusions

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 hence would be expected to affect the composition 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 (TRS3) 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 in 1997 is notable for the fact that the default (i.e. the result of taking no action) was to remain in TRS2, but is perhaps unsurprising given that TRS3 was designed with the interest of addressing some perceived shortcomings of TRS2.[53] Furthermore, the bull market in the mid-1990s may have positively influenced expectations 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 (and 50 percent of active choosers), despite the fact that new hires face a longer vesting period under TRS3 and returns on stock market investments were considerably poorer as compared to the prior period.[54]

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 consistent with what has been reported in other empirical studies of pension choice (e.g., Yang 2005; Brown and Weisbenner 2009; Chingos and West 2013). A number of teacher characteristics were statistically significant for the 1997 Choice Cohort. Teachers who are younger, white, more

[53] As stated in the Final Bill Report "The Joint Committee on Pension Policy surveyed employers and employees in 1991 and 1992 on the issue of retirement age in the Plan 2 systems and found three prevailing concerns. Employees felt that leaving service before age 65 would not yield a good return on their contributions. Younger employees felt they were making contributions to a plan from which they would not benefit. The general sentiment was that the Plan 2 system was paternalistic and inflexible in the form and timing of retirement benefits." (HB 1206, Laws of 1995)

[54] 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.

experienced, hold an advanced degree, or earn a higher salary, are more likely to transfer to TRS3. But with the exception of age and male gender, teacher characteristics are not significantly predictive of pension plan choice among the 2007 Choice Cohort. We do not find consistent patterns of pension choice related to teachers' subject areas or school levels. For the 2007 Choice Cohort, teachers hired during the 2008-2009 school year were significantly less likely to choose TRS3 than teachers hired the previous years, suggesting that the 2008 financial crisis may have negatively influenced perceptions about the value of the hybrid plan.

We find that teachers are responsive to the relative financial value of the plans, but the average marginal effects, while statistically significant, are modest (particularly for the 2007 choice cohort). It is somewhat speculative to consider what would have happened had the state not offered a transfer bonus, to teacher in 1997 to move from TRS 2 to TRS3, since the publicity and discussion of the bonus might have generated interest in TRS3 apart from any impact on transferring to TRS3 because of the financial benefits associated with the bonus itself. Still, simulating what would have occurred in the absence of a bonus is instructive. In the aggregate the state spent about $200 million on the transfer bonus payment.[55] Setting the value of the transfer bonus to zero suggests only a small change in the proportion of the workforce that would transfer, from 0.75 to about 0.72.[56] It is likely that many of those teachers who transferred from the traditional DB to the hybrid DB-DC plan would have done so even in the absence of the transfer bonus.

Finally, there is evidence that districts can have a significant influence on the proportion of teachers who make an active choice (as opposed to defaulting). For the 2007 Choice Cohort we are able to distinguish between teachers who actively choose TRS3 and those who do not indicate a choice and

[55] Recall that teachers in the 1997 Choice Cohort, who received a transfer bonus payment equal to 65 percent of accrued contributions to TRS2. The median level of accrued contributions among those transferring to TRS3 in 1997 was about $17,800.

[56] The expected IRR (weighted by the probability of attrition) was calculated for each teacher with and without the 65 percent transfer bonus payment. Pension choice parameters were obtained from estimating the specification in column (4) of Table 4. These parameters were used to obtain predicted values, with values of IRR had there been no transfer bonus.

thus default into TRS3, and we find substantial variation across districts in the proportion of teachers who default. It is not clear what is driving the district-level variation, but it is possible that some districts are more proactive about encouraging teachers to indicate a pension plan choice. These findings suggest that changing the default option, or requiring teachers to indicate a choice, could have a large effect on the proportions of teachers enrolled in TRS2 or TRS3.

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 only able to measure teacher productivity well after a pension decision was made, we find that teachers in the top quintile of effectiveness are approximately 5 to 8 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 less likely to choose TRS3 than those in the top quintiles. 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 relative financial value and a number of teacher characteristics. 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;[57] for the state, the legislation creating TRS3 and enabling the transfer process (including the provision of transfer bonus payments) was intended to be cost neutral. 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 in the restructuring of the pension system.

[57] 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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Figures

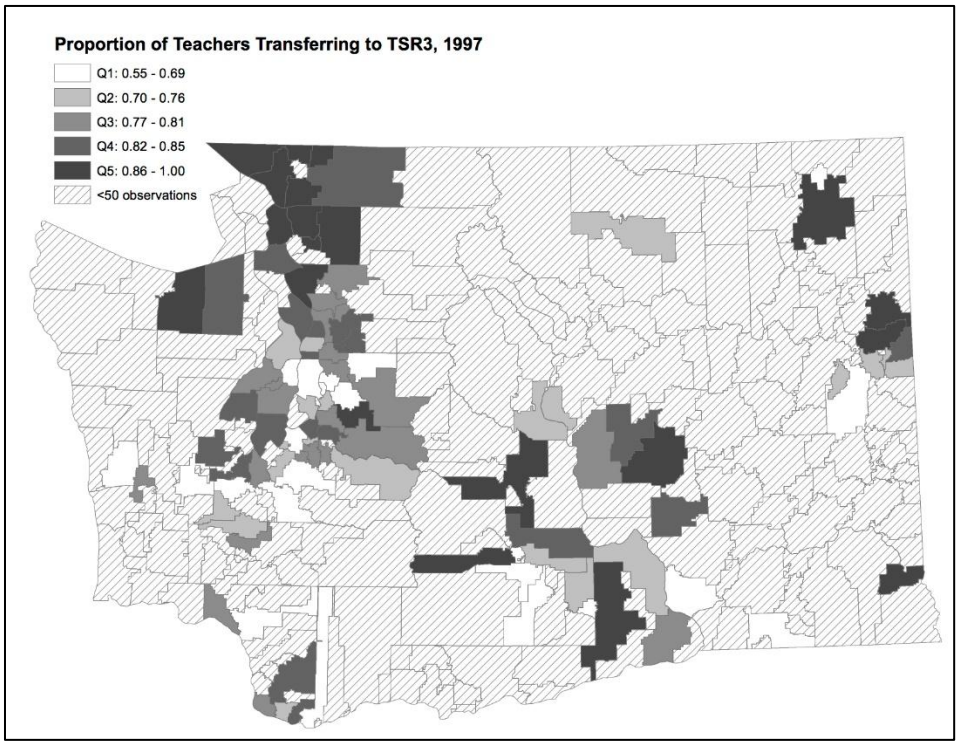

FIGURE 1A.PROPORTION OF TEACHERS TRANSFERRING TO TRS3 BY DISTRICT (1997 CHOICE COHORT)

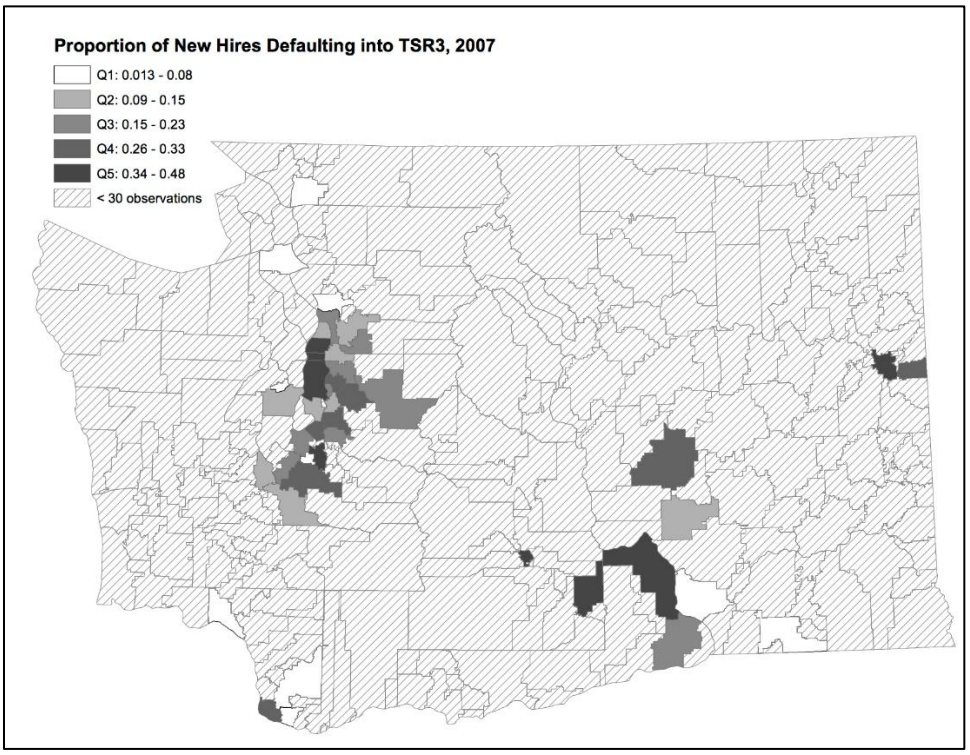

FIGURE 1B.PROPORTION OF TEACHERS DEFAULTING INTO TRS3 BY DISTRICT (2007 CHOICE COHORT)

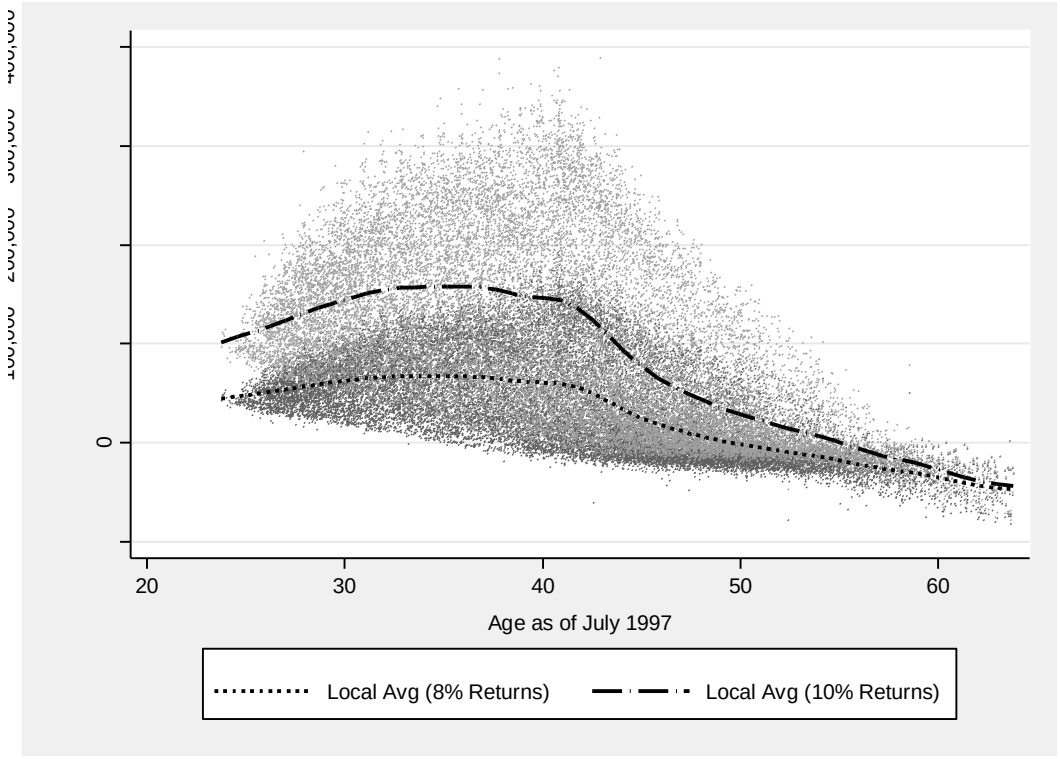

FIGURE 2A.DISTRIBUTION OF ESTIMATED RELATIVE PENSION WEALTH BY AGE: NPV(TRS3)-NPV(TRS2), 1997 CHOICE COHORT

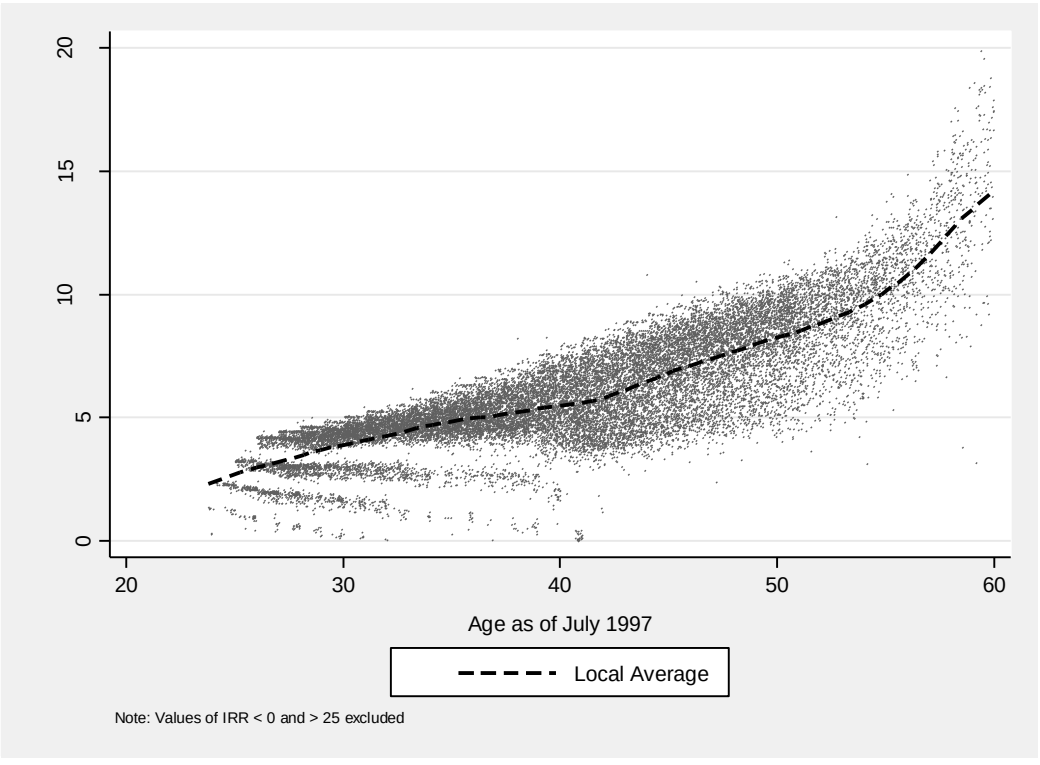

FIGURE 2B.DISTRIBUTION OF ESTIMATED RELATIVE PENSION WEALTH BY AGE:

INTERNAL RATE OF RETURN, 1997 CHOICE COHORT

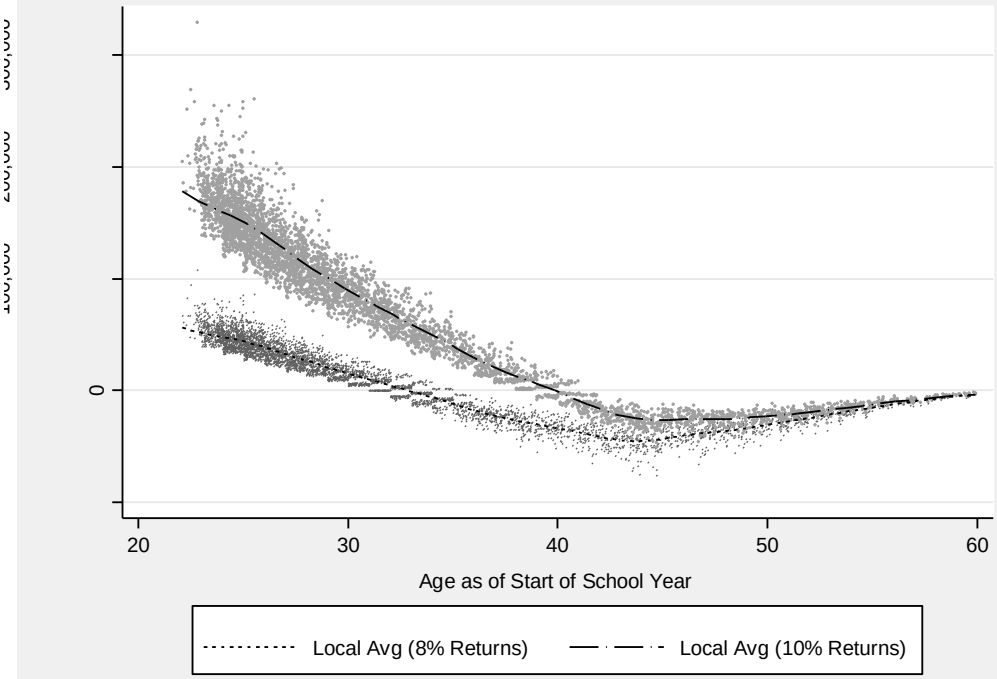

FIGURE 2C.DISTRIBUTION OF ESTIMATED RELATIVE PENSION WEALTH BY AGE: NPV(TRS3)-NPV(TRS2), 2007 CHOICE COHORT

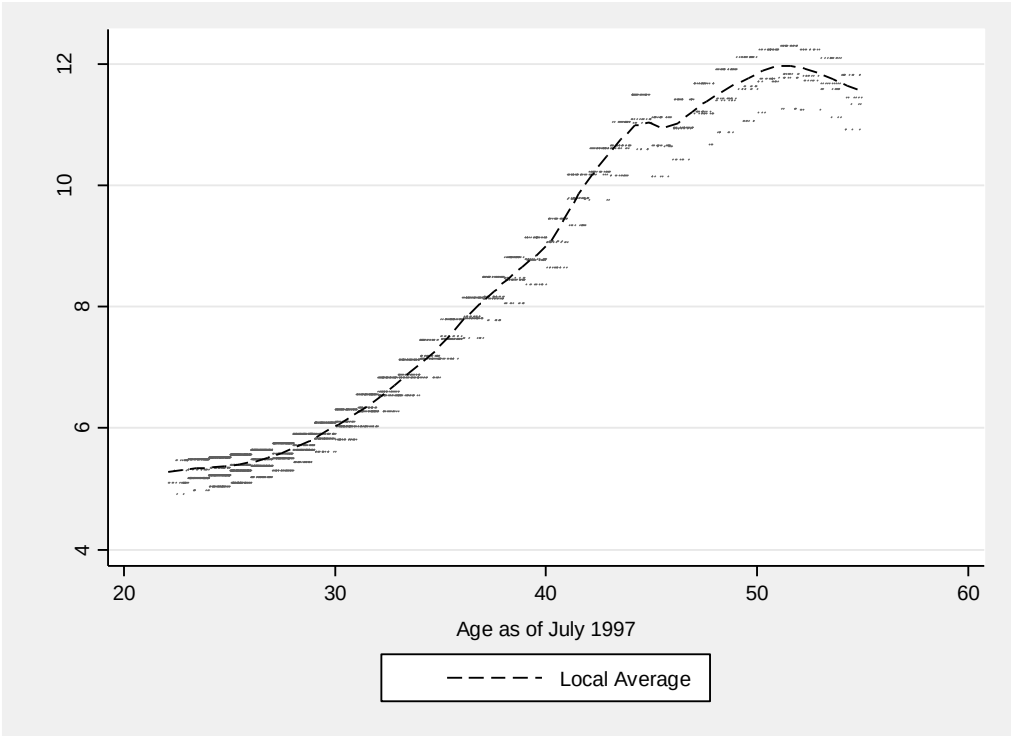

FIGURE 2D.DISTRIBUTION OF ESTIMATED RELATIVE PENSION WEALTH BY AGE:

INTERNAL RATE OF RETURN, 2007 CHOICE COHORT

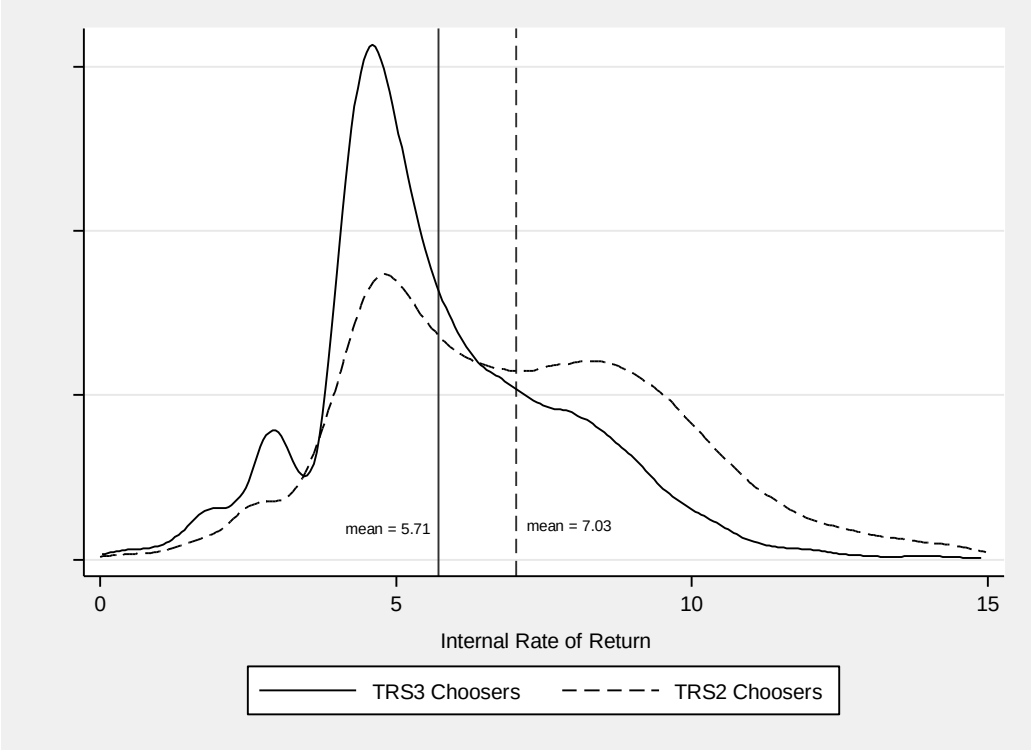

FIGURE 3A.DISTRIBUTION OF RELATIVE PENSION VALUE BY PLAN CHOICE:
INTERNAL RATE OF RETURN, 1997 CHOICE COHORT

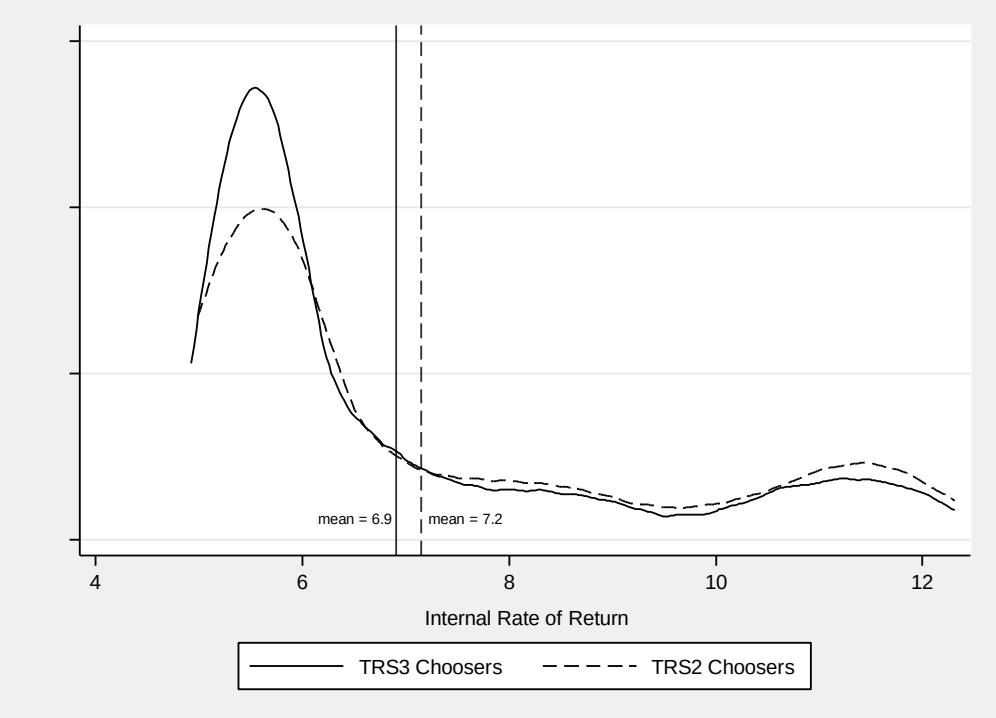

FIGURE 3A.DISTRIBUTION OF RELATIVE PENSION VALUE BY PLAN CHOICE:
INTERNAL RATE OF RETURN, 2007 CHOICE COHORT

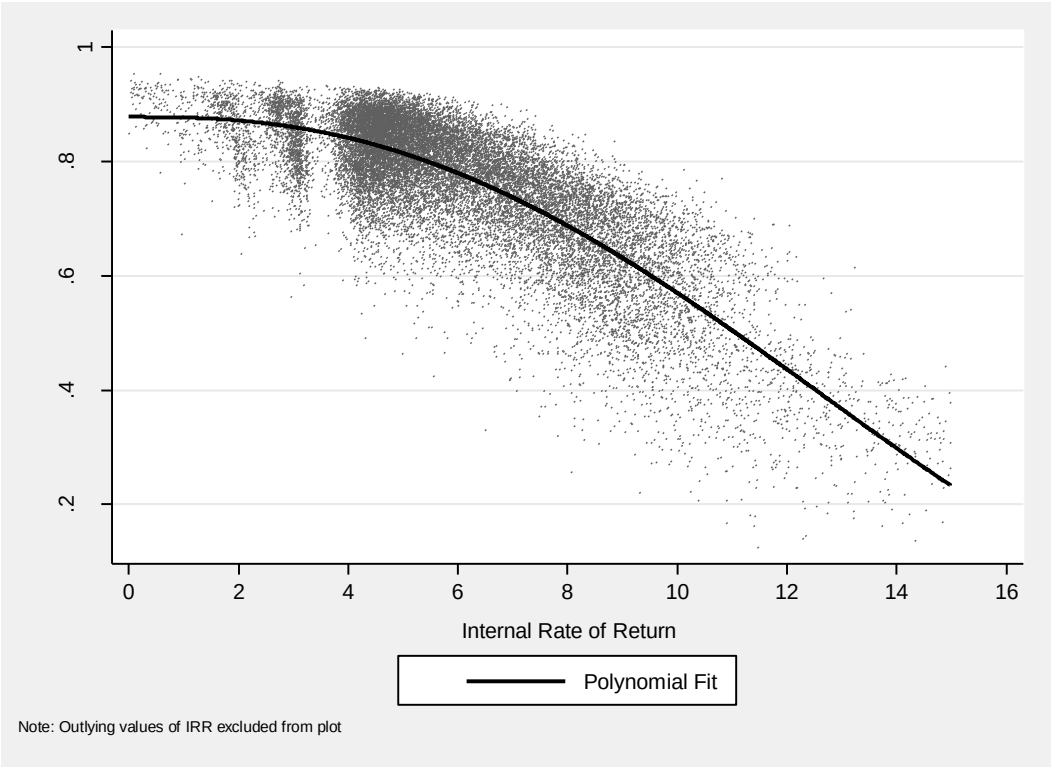

FIGURE 4A. PREDICTED PROBABILITY OF CHOOSING TRS3 AND THE INTERNAL RATE OF RETURN, 1997 CHOICE COHORT

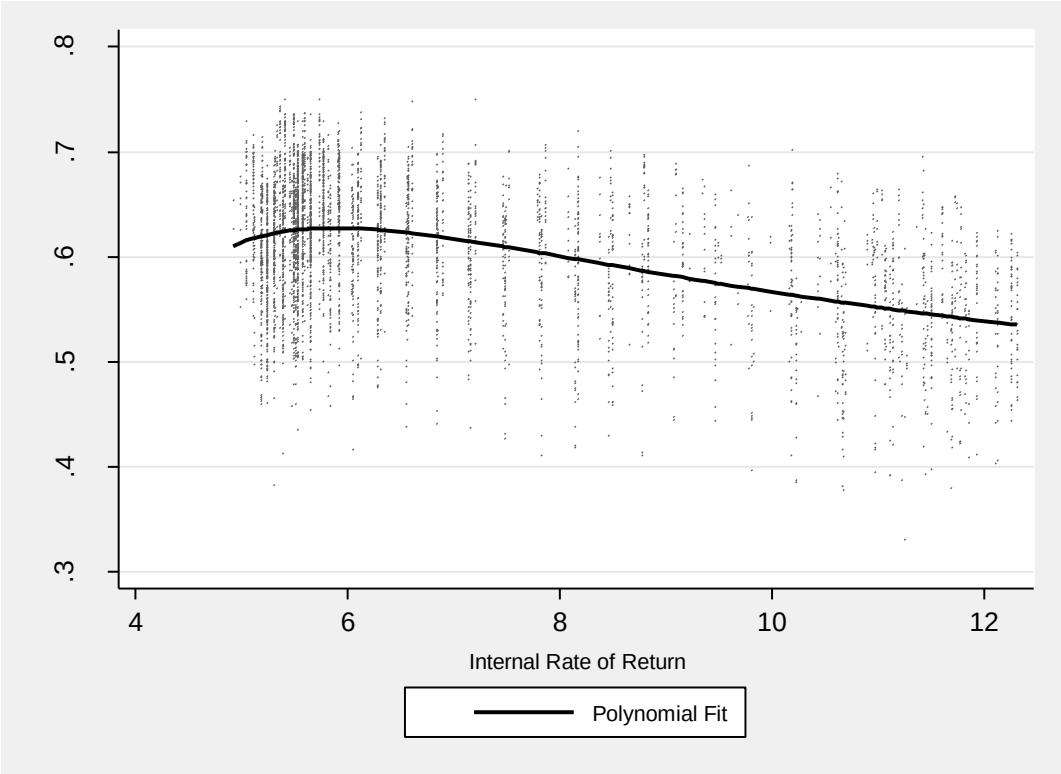

FIGURE 4B. PREDICTED PROBABILITY OF CHOOSING TRS3 AND THE INTERNAL RATE OF RETURN, 2007 CHOICE COHORT

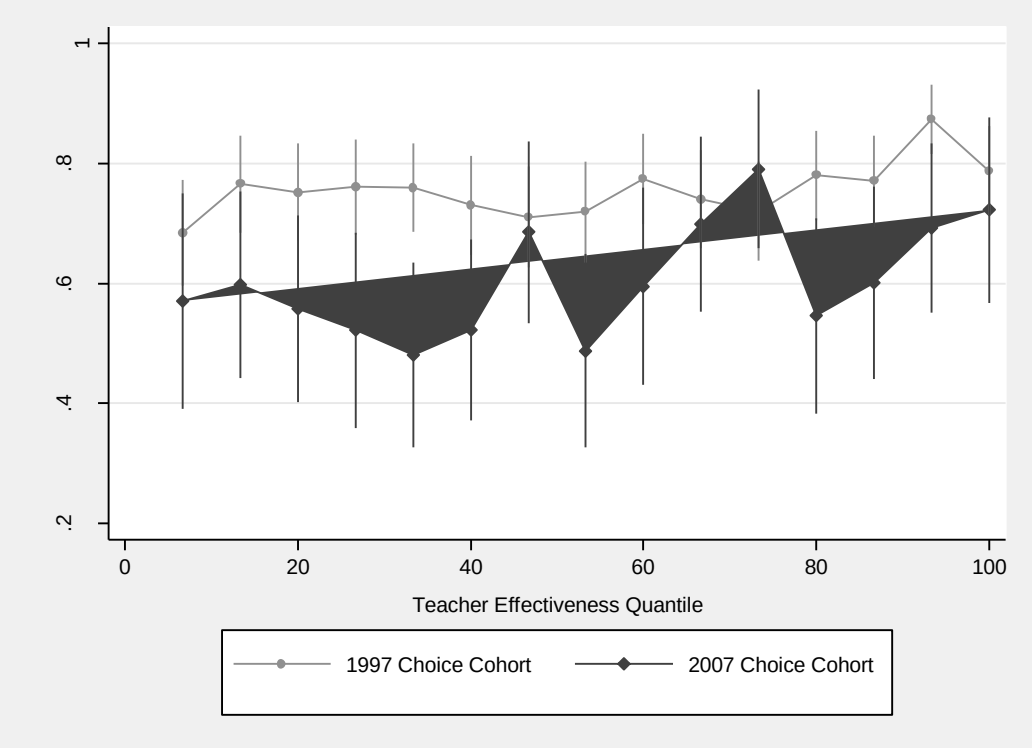

FIGURE 5. PREDICTED PROBABILITY OF CHOOSING TRS3 BY EFFECTIVENESS QUANTILE WITH 95 PERCENT CONFIDENCE INTERVALS

Tables

TABLE 1. KEY FEATURES OF WASHINGTON STATE TRS RETIREMENT PLANS

	TRS2	TRS3	
Membership Definition	Hired 1977 – 1996 (*default*) Hired 2007 – pres. (*opt in*)	Hired 1977 – 1996 (*option to transfer*) Hired 1996 – 2007 (*mandated*) Hired 2007 – pres. (*default*)	
Type	Traditional Defined Benefit	DB Component	DC Component
Vesting Period	5 years	10 years[b]	N/A
Employee Contributions	Set by legislature depending on status of pension fund [a]	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 62 yrs. of age & 30 SCY (full benefit), or 55 yrs. of age & 20 SCY (reduced benefit)	65 yrs. of age, or 62 yrs. of age & 30 SCY (full benefit), or 55 yrs. of age & 10 SCY (reduced benefit)	Withdrawal ages and penalties for early withdrawal dependent on Federal tax rules.

[a] 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.

[b] The 5 year vesting period was grandfathered in for those in the 1997 cohort so that the vesting period is 5 years for both TRS2 and TRS3. For the 2007 cohort, an employee is vested with 5 SCY if at least one SCY has been earned after the age of 44.

TABLE 2. PROPORTION CHOOSING TRS3 BY TEACHER AND SCHOOL CHARACTERISTICS

	1997		2007		2007 (Active Choosers)	
	TRS3	Obs.	TRS3	Obs.	TRS3	Obs.
Overall	0.75	22,649	0.61	4,706	0.52	3,841
Age: < 30	0.81	2,682	0.62	2,558	0.54	2,104
Age: 30-35	0.82	3,608	0.64	774	0.54	609
Age: 35-45	0.81	8,937	0.57	808	0.47	652
Age: 45-55	0.68	6,353	0.54	489	0.46	412
Age: 55-65	0.33	1,069	0.55	77	0.45	64
Gender: Male	0.78	7,494	0.64	1,248	0.54	971
Gender: Female	0.74	15,155	0.60	3,457	0.51	2,869
Ethnicity: Asian	0.66	461	0.62	159	0.54	131
Ethnicity: Black	0.59	380	0.56	90	0.38	64
Ethnicity: Hispanic	0.68	495	0.64	190	0.56	156
Ethnicity: Native American	0.66	193	0.48	25	0.43	23
Ethnicity: White	0.76	21,120	0.61	4,238	0.52	3,463
Service Credit: < 5 years	0.70	5,893				
Service Credit: 5-10 years	0.76	8,731				
Service Credit: 10+ years	0.78	8,025				
Degree: Bachelors	0.73	10,006	0.60	2,786	0.51	2,311
Degree: MA/PhD	0.77	12,643	0.62	1,920	0.53	1,530
Endorsement: Math/Science	0.78	3,496	0.63	374	0.56	320
Endorsement: Elementary	0.74	11,199	0.58	1,902	0.50	1,587
Endorsement: PE/Health	0.83	2,877	0.64	116	0.59	102
Endorsement: Arts	0.72	2,124	0.63	132	0.57	113
Endorsement: Special Ed	0.72	3,858	0.61	275	0.53	225
School Level: Elementary	0.74	11,240	0.58	2,340	0.49	1,923
School Level: Middle	0.76	4,871	0.62	886	0.54	728
School Level: High	0.77	5,811	0.64	1,261	0.55	1,008
School Level: Other	0.72	727	0.60	219	0.52	182
Locale: City	0.71	7,392	0.62	1,329	0.49	999
Locale: Suburb	0.77	9,270	0.64	2,061	0.55	1,681
Locale: Town	0.78	2,716	0.58	605	0.51	520
Locale: Rural	0.76	3,271	0.53	711	0.48	641
Year: 2008			0.62	2,755	0.54	2,265
Year: 2009			0.59	1,951	0.49	1,576

TABLE 3. ASSUMPTIONS IN CALCULATION OF THE NPV OF TRS2 AND TRS3 PENSION WEALTH

Parameter	1997 Cohort	2007 Cohort
Sal_t	Teachers' future salary are not observed. Nominal salary is assumed to grow at a rate of 3 percent per year, as assumed by ET (1996).[a]	
r	We discount by a 3 percent inflation rate, as assumed by ET (1996).[b]	
$Contr_t$ (TRS2)	We adopt the contribution rate as of 1997 (6.59 percent), 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 percent in 2008, 4.26 percent in 2009.
$Contr_t$ (TRS3)	We assume the default contribution rate of 5 percent.	
$P_{A_t\|A}$	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 percent, equal to inflation.	
inv	ET (1996) provides teachers the figures needed to estimate DC benefits with investment returns equal to 6, 8, 10, and 12 percent. In each of the examples it gives, it uses the 10 percent assumption. We run estimates levels of 8 and 10 percent.	ICMA (2012) allows teachers to choose an assumed rate of return on investments. The default is set at 8 percent. We estimate benefits with returns of 8, and 10 percent.

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

[b] 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.

TABLE 4. PENSION CHOICE LOGIT MODELS: AVERAGE MARGINAL EFFECTS

	1997 Choice Cohort				2007 Choice Cohort			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable: Choice = TRS3								
Age: 30-35	-0.0390***	-0.0406***	-0.0070	-0.0090	0.0051	0.0072		
	(0.0116)	(0.0116)	(0.0121)	(0.0118)	(0.0204)	(0.0204)		
Age: 35-45	-0.0935***	-0.0915***	-0.0199	-0.0186	-0.0508*	-0.0477*		
	(0.0106)	(0.0110)	(0.0136)	(0.0124)	(0.0198)	(0.0199)		
Age: 45-55	-0.2163***	-0.2134***	-0.0905***	-0.0885***	-0.0857***	-0.0732**		
	(0.0107)	(0.0130)	(0.0182)	(0.0158)	(0.0242)	(0.0243)		
Age: 55-65	-0.4764***	-0.4699***	-0.2238***	-0.2190***	-0.1007	-0.0970		
	(0.0144)	(0.0215)	(0.0303)	(0.0267)	(0.0549)	(0.0548)		
Gender: Male	0.0128*	0.0155*	-0.0009	0.0017	0.0368*	0.0482**	0.0346*	0.0462**
	(0.0064)	(0.0065)	(0.0066)	(0.0065)	(0.0171)	(0.0171)	(0.0170)	(0.0171)
Ethnicity: Asian	-0.0644***	-0.0541**	-0.0659***	-0.0560**	-0.0003	-0.0039	0.0004	-0.0032
	(0.0177)	(0.0177)	(0.0177)	(0.0177)	(0.0397)	(0.0383)	(0.0398)	(0.0383)
Ethnicity: Black	-0.0909***	-0.0710***	-0.0890***	-0.0696***	-0.0787	-0.0959	-0.0795	-0.0967
	(0.0199)	(0.0192)	(0.0202)	(0.0191)	(0.0516)	(0.0499)	(0.0516)	(0.0499)
Ethnicity: Hispanic	-0.0290	-0.0260	-0.0273	-0.0246	0.0382	0.0290	0.0386	0.0297
	(0.0174)	(0.0174)	(0.0173)	(0.0173)	(0.0371)	(0.0368)	(0.0371)	(0.0368)
Ethnicity: Native Amer.	-0.0623*	-0.0511	-0.0626*	-0.0520	-0.1148	-0.0892	-0.1155	-0.0879
	(0.0280)	(0.0270)	(0.0278)	(0.0267)	(0.0987)	(0.0977)	(0.0986)	(0.0978)
Service Credit: 5-10 yrs.	0.0740***	0.0726***	0.0588***	0.0576***				
	(0.0075)	(0.0078)	(0.0077)	(0.0078)				
Service Credit: 10+ yrs.	0.1104***	0.1096***	0.0616***	0.0612***				
	(0.0094)	(0.0101)	(0.0109)	(0.0105)				
Degree: MA or PhD	0.0304***	0.0307***	0.0309***	0.0314***	0.0020	0.0120	0.0035	0.0134
	(0.0059)	(0.0061)	(0.0059)	(0.0061)	(0.0191)	(0.0195)	(0.0190)	(0.0194)
Salary Quartile								
2	0.0382***	0.0382***	0.0384***	0.0385***	0.0296	0.0234	0.0296	0.0238
	(0.0090)	(0.0090)	(0.0090)	(0.0090)	(0.0209)	(0.0212)	(0.0209)	(0.0212)
3	0.0478***	0.0449***	0.0514***	0.0484***	0.0443	0.0250	0.0455	0.0266
	(0.0103)	(0.0104)	(0.0102)	(0.0104)	(0.0240)	(0.0248)	(0.0240)	(0.0249)
4	0.0742***	0.0702***	0.0740***	0.0700***	0.0458	0.0039	0.0461	0.0055
	(0.0116)	(0.0120)	(0.0115)	(0.0120)	(0.0272)	(0.0291)	(0.0271)	(0.0291)
Endorsement: Math/Science	0.0041	0.0054	0.0060	0.0069	-0.0032	-0.0133	-0.0029	-0.0128
	(0.0081)	(0.0081)	(0.0081)	(0.0081)	(0.0273)	(0.0275)	(0.0273)	(0.0275)
Endorsement: Elementary	0.0071	0.0082	0.0128	0.0139*	-0.0135	-0.0067	-0.0135	-0.0065
	(0.0071)	(0.0070)	(0.0071)	(0.0071)	(0.0166)	(0.0167)	(0.0166)	(0.0167)
Endorsement: PE/Health	0.0536***	0.0545***	0.0542***	0.0551***	0.0141	0.0530	0.0152	0.0541
	(0.0094)	(0.0095)	(0.0093)	(0.0094)	(0.0465)	(0.0475)	(0.0464)	(0.0475)
Endorsement: Arts	-0.0249**	-0.0234*	-0.0234*	-0.0217*	0.0110	-0.0094	0.0100	-0.0098
	(0.0093)	(0.0092)	(0.0092)	(0.0091)	(0.0438)	(0.0438)	(0.0436)	(0.0438)
Endorsement: Special Ed.	-0.0319***	-0.0336***	-0.0328***	-0.0346***	0.0288	0.0145	0.0268	0.0133
	(0.0073)	(0.0073)	(0.0072)	(0.0073)	(0.0309)	(0.0305)	(0.0308)	(0.0305)
School Level: Middle	-0.0026	-0.0015	-0.0004	0.0012	0.0306	0.0393	0.0305	0.0391
	(0.0077)	(0.0078)	(0.0077)	(0.0077)	(0.0202)	(0.0205)	(0.0202)	(0.0205)
School Level: High	0.0025	0.0038	0.0050	0.0064	0.0401	0.0420*	0.0391	0.0408
	(0.0084)	(0.0085)	(0.0084)	(0.0084)	(0.0208)	(0.0214)	(0.0208)	(0.0213)
School Level: Other	-0.0377*	-0.0187	-0.0358*	-0.0152	0.0342	0.0818	0.0332	0.0815
	(0.0155)	(0.0193)	(0.0155)	(0.0192)	(0.0349)	(0.0418)	(0.0348)	(0.0418)
School: Percent White	0.0012***	0.0004	0.0012***	0.0003	-0.0003	0.0012	-0.0003	0.0012
	(0.0001)	(0.0003)	(0.0001)	(0.0003)	(0.0003)	(0.0006)	(0.0003)	(0.0006)
Locale: City	-0.0184*	0.0477	-0.0158	0.0503	0.0667**	0.0159	0.0657**	0.0152
	(0.0088)	(0.0308)	(0.0088)	(0.0306)	(0.0236)	(0.0430)	(0.0236)	(0.0430)
Locale: Suburb	0.0099	0.0500	0.0114	0.0531	0.0903***	0.0408	0.0889***	0.0403
	(0.0086)	(0.0285)	(0.0086)	(0.0283)	(0.0215)	(0.0352)	(0.0215)	(0.0352)
Locale: Town	0.0152	-0.0526	0.0142	-0.0436	0.0370	-0.0802	0.0367	-0.0827
	(0.0110)	(0.0932)	(0.0109)	(0.0925)	(0.0269)	(0.0511)	(0.0269)	(0.0511)
Year: 2009					-0.0407**	-0.0374*	-0.0455**	-0.0420**

	1997 Choice Cohort				2007 Choice Cohort			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable: Choice = TRS3								
					(0.0147)	(0.0149)	(0.0148)	(0.0150)
Internal Rate of Return			-0.0218***	-0.0217***			-0.0141***	-0.0133***
			(0.0026)	(0.0021)			(0.0034)	(0.0034)
School District Fixed-Effects?	N	Y	N	Y	N	Y	N	Y
Observations	22,649	22,344	22,649	22,344	4,706	4,604	4,706	4,604
Log-likelihood	-11608	-11021	-11531	-10944	-3111	-2880	-3112	-2880
Psuedo-R^2	0.0850	0.122	0.0911	0.128	0.0132	0.0657	0.0128	0.0656

*** Significant at the 0.1 percent level.

** Significant at the 1 percent level.

* Significant at the 5 percent level.

TABLE 5. THE PROPENSITY TO DEFAULT AND PENSION CHOICE AMONG ACTIVE CHOOSERS: AVERAGE MARGINAL EFFECTS

	2007 Choice Cohort		2007 Choice Cohort: Active Choosers			
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	Default = 1		Choice = TRS3			
Age: 30-35			-0.0104	-0.0060		
			(0.0232)	(0.0234)		
Age: 35-45			-0.0711**	-0.0759**		
			(0.0228)	(0.0231)		
Age: 45-55			-0.0968***	-0.0881**		
			(0.0276)	(0.0280)		
Age: 55-65			-0.1103	-0.1216		
			(0.0634)	(0.0640)		
Gender: Male	0.0491***	0.0606***	0.0158	0.0267	0.0125	0.0238
	(0.0129)	(0.0142)	(0.0195)	(0.0197)	(0.0195)	(0.0197)
Ethnicity: Asian	-0.0314	-0.0482	0.0168	0.0197	0.0170	0.0200
	(0.0313)	(0.0345)	(0.0448)	(0.0434)	(0.0450)	(0.0434)
Ethnicity: Black	0.0382	0.0198	-0.1478*	-0.1513*	-0.1507*	-0.1546*
	(0.0353)	(0.0376)	(0.0652)	(0.0637)	(0.0652)	(0.0636)
Ethnicity: Hispanic	-0.0170	-0.0457	0.0572	0.0670	0.0570	0.0675
	(0.0290)	(0.0314)	(0.0414)	(0.0412)	(0.0415)	(0.0412)
Ethnicity: Native Amer.	-0.1205	-0.0824	-0.0882	-0.0845	-0.0897	-0.0831
	(0.1069)	(0.1060)	(0.1076)	(0.1086)	(0.1075)	(0.1088)
Service Credit: 5-10 yrs.						
Service Credit: 10+ yrs.						
Degree: MA or PhD	0.0135	0.0068	-0.0041	0.0133	-0.0034	0.0142
	(0.0148)	(0.0169)	(0.0219)	(0.0225)	(0.0218)	(0.0225)
Salary Quartile						
2	0.0106	0.0056	0.0316	0.0283	0.0316	0.0288
	(0.0165)	(0.0195)	(0.0231)	(0.0240)	(0.0232)	(0.0240)
3	0.0214	0.0082	0.0435	0.0286	0.0443	0.0298
	(0.0190)	(0.0224)	(0.0269)	(0.0285)	(0.0269)	(0.0285)
4	0.0108	-0.0172	0.0513	0.0148	0.0507	0.0150
	(0.0207)	(0.0250)	(0.0306)	(0.0332)	(0.0305)	(0.0331)
Endorsement: Math/Science	-0.0608**	-0.0739**	0.0277	0.0193	0.0292	0.0216
	(0.0225)	(0.0245)	(0.0302)	(0.0308)	(0.0301)	(0.0308)
Endorsement: Elementary	-0.0197	-0.0096	-0.0047	0.0007	-0.0045	0.0010
	(0.0134)	(0.0149)	(0.0188)	(0.0191)	(0.0188)	(0.0191)
Endorsement: PE/Health	-0.0808	-0.0869	0.0511	0.1019	0.0523	0.1035*
	(0.0419)	(0.0446)	(0.0508)	(0.0524)	(0.0507)	(0.0524)
Endorsement: Arts	-0.0383	-0.0340	0.0277	-0.0105	0.0280	-0.0094
	(0.0367)	(0.0388)	(0.0483)	(0.0492)	(0.0481)	(0.0492)
Endorsement: Special Ed.	0.0051	-0.0146	0.0337	0.0193	0.0325	0.0188
	(0.0246)	(0.0274)	(0.0349)	(0.0348)	(0.0348)	(0.0347)
School Level: Middle	-0.0042	0.0141	0.0397	0.0392	0.0397	0.0390
	(0.0162)	(0.0180)	(0.0228)	(0.0233)	(0.0229)	(0.0233)
School Level: High	0.0088	0.0190	0.0455	0.0463	0.0449	0.0456
	(0.0161)	(0.0180)	(0.0234)	(0.0244)	(0.0234)	(0.0243)
School Level: Other	0.0117	0.0749*	0.0347	0.0667	0.0343	0.0682
	(0.0291)	(0.0352)	(0.0392)	(0.0484)	(0.0391)	(0.0483)
School: Percent White	-0.0454	0.0620	-0.0103	0.1069	-0.0121	0.1011
	(0.0243)	(0.0493)	(0.0347)	(0.0734)	(0.0346)	(0.0732)
Locale: City	0.1485***	0.1073*	-0.0011	-0.0306	-0.0020	-0.0320
	(0.0212)	(0.0436)	(0.0266)	(0.0491)	(0.0266)	(0.0491)
Locale: Suburb	0.1004***	0.0842*	0.0618**	0.0128	0.0610*	0.0122
	(0.0207)	(0.0369)	(0.0238)	(0.0399)	(0.0238)	(0.0399)
Locale: Town	0.0527*	-0.0486	0.0251	-0.0712	0.0250	-0.0749
	(0.0251)	(0.0552)	(0.0298)	(0.0587)	(0.0298)	(0.0587)
Year: 2009	0.0153	0.0163	-0.0597***	-0.0579***	-0.0657***	-0.0643***

	(0.0116)	(0.0132)	(0.0167)	(0.0171)	(0.0168)	(0.0172)
Internal Rate of Return	-0.0014	0.0006			-0.0166***	-0.0169***
	(0.0028)	(0.0031)			(0.0039)	(0.0039)
School District Fixed-Effects?	N	Y	N	Y	N	Y
Observations	4,706	4,063	3,841	3,739	3,841	3,739
Log-likelihood	-2180	-1859	-2623	-2428	-2624	-2429
Psuedo-R^2	0.0291	0.115	0.0136	0.0622	0.0133	0.0619

*** Significant at the 0.1 percent level.

** Significant at the 1 percent level.

* Significant at the 5 percent level.

TABLE 6. AVERAGE MARGINAL EFFECTS OF TEACHER EFFECTIVENESS ON PENSION CHOICE

	1997 Choice Cohort				2007 Choice Cohort				2007 Choice Cohort: Active Choosers			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Teacher Effectiveness	0.0243*		0.0321**		0.0466*		0.0634*		0.0626*		0.0900**	
	(0.0097)		(0.0110)		(0.0215)		(0.0260)		(0.0244)		(0.0295)	
Effectiveness Quintiles												
1		Ref. Cat.		Ref. Cat.		Ref. Cat.		Ref. Cat.		Ref. Cat.		Ref. Cat.
2		0.0069		0.0174		-0.0751		-0.0707		-0.0221		0.0131
		(0.0271)		(0.0297)		(0.0606)		(0.0657)		(0.0670)		(0.0725)
3		0.0037		0.0026		-0.0117		0.0130		0.0511		0.1217
		(0.0272)		(0.0305)		(0.0619)		(0.0673)		(0.0689)		(0.0750)
4		0.0163		0.0140		0.0517		0.1006		0.1118		0.1793*
		(0.0268)		(0.0306)		(0.0603)		(0.0649)		(0.0684)		(0.0740)
5		0.0531*		0.0786**		0.0757		0.0972		0.1084		0.1652*
		(0.0263)		(0.0295)		(0.0610)		(0.0669)		(0.0704)		(0.0781)
School District Fixed Effects?	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y
Observations	2,363	2,363	2,068	2,068	665	665	591	591	554	554	477	477
Psuedo-R^2	0.0606	0.0602	0.131	0.132	0.0213	0.0248	0.106	0.111	0.0318	0.0322	0.141	0.142

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

*** Significant at the 0.1 percent level.

** Significant at the 1 percent level.

* Significant at the 5 percent level

Appendix
A1. Alternative Measures of Relative Pension Value

TABLE A1. ALTERNATIVE PENSION CHOICE LOGIT MODELS: AVERAGE MARGINAL EFFECTS

	1997 Choice Cohort				2007 Choice Cohort			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable: Choice = TRS3								
Age: 30-35	-0.0090	-0.0229*	-0.0298**	-0.0423***	0.0462**	0.0463**	0.0460**	0.0494**
	(0.0118)	(0.0115)	(0.0115)	(0.0116)	(0.0171)	(0.0171)	(0.0171)	(0.0171)
Age: 35-45	-0.0186	-0.0417***	-0.0419***	-0.0744***	-0.0032	-0.0058	-0.0008	-0.0017
	(0.0124)	(0.0114)	(0.0115)	(0.0110)	(0.0383)	(0.0383)	(0.0384)	(0.0383)
Age: 45-55	-0.0885***	-0.1075***	-0.1053***	-0.1616***	-0.0967	-0.0986*	-0.0969	-0.0968
	(0.0158)	(0.0146)	(0.0149)	(0.0134)	(0.0499)	(0.0498)	(0.0499)	(0.0499)
Age: 55-65	-0.2190***	-0.2153***	-0.3086***	-0.3922***	0.0297	0.0286	0.0314	0.0316
	(0.0267)	(0.0264)	(0.0226)	(0.0212)	(0.0368)	(0.0368)	(0.0368)	(0.0368)
Gender: Male	0.0017	0.0009	0.0024	0.0014	-0.0879	-0.0951	-0.0915	-0.0908
	(0.0065)	(0.0065)	(0.0065)	(0.0066)	(0.0978)	(0.0978)	(0.0978)	(0.0978)
Ethnicity: Asian	-0.0560**	-0.0552**	-0.0577**	-0.0568**	0.0134	0.0130	0.0165	0.0163
	(0.0177)	(0.0176)	(0.0177)	(0.0177)	(0.0194)	(0.0195)	(0.0195)	(0.0195)
Ethnicity: Black	-0.0696***	-0.0700***	-0.0682***	-0.0684***	0.0238	0.0238	0.0218	0.0203
	(0.0191)	(0.0191)	(0.0191)	(0.0191)	(0.0212)	(0.0211)	(0.0211)	(0.0211)
Ethnicity: Hispanic	-0.0246	-0.0260	-0.0203	-0.0211	0.0266	0.0242	0.0232	0.0205
	(0.0173)	(0.0173)	(0.0173)	(0.0174)	(0.0249)	(0.0248)	(0.0248)	(0.0247)
Ethnicity: Native Amer.	-0.0520	-0.0541*	-0.0479	-0.0480	0.0055	0.0033	0.0009	-0.0034
	(0.0267)	(0.0266)	(0.0268)	(0.0269)	(0.0291)	(0.0289)	(0.0290)	(0.0287)
Service Credit: 5-10 yrs.	0.0576***	0.0435***	0.0433***	0.0421***	-0.0128	-0.0130	-0.0159	-0.0152
	(0.0078)	(0.0080)	(0.0080)	(0.0083)	(0.0275)	(0.0275)	(0.0275)	(0.0275)
Service Credit: 10+ yrs.	0.0612***	0.0469***	0.0318**	0.0419***	-0.0065	-0.0067	-0.0071	-0.0063
	(0.0105)	(0.0109)	(0.0117)	(0.0121)	(0.0167)	(0.0167)	(0.0167)	(0.0167)
Degree: MA or PhD	0.0314***	0.0318***	0.0311***	0.0322***	0.0541	0.0564	0.0563	0.0558
	(0.0061)	(0.0061)	(0.0061)	(0.0061)	(0.0475)	(0.0474)	(0.0475)	(0.0475)
Salary Quartile	0.0385***	0.0398***	0.0306***	0.0371***	-0.0098	-0.0058	-0.0124	-0.0117
2	(0.0090)	(0.0091)	(0.0089)	(0.0090)	(0.0438)	(0.0438)	(0.0437)	(0.0437)
	0.0484***	0.0501***	0.0378***	0.0474***	0.0133	0.0175	0.0082	0.0101
3	(0.0104)	(0.0104)	(0.0102)	(0.0104)	(0.0305)	(0.0306)	(0.0304)	(0.0304)
	0.0700***	0.0724***	0.0600***	0.0749***	0.0391	0.0395	0.0392	0.0392
4	(0.0120)	(0.0120)	(0.0119)	(0.0120)	(0.0205)	(0.0205)	(0.0205)	(0.0205)
	0.0069	0.0076	0.0061	0.0056	0.0408	0.0434*	0.0396	0.0399
Endorsement: Math/Science	(0.0081)	(0.0081)	(0.0081)	(0.0081)	(0.0213)	(0.0213)	(0.0214)	(0.0213)
	0.0139*	0.0144*	0.0134	0.0113	0.0815	0.0818	0.0807	0.0808
Endorsement: Elementary	(0.0071)	(0.0071)	(0.0071)	(0.0071)	(0.0418)	(0.0418)	(0.0418)	(0.0418)
	0.0551***	0.0562***	0.0520***	0.0532***	0.1163	0.1117	0.1186	0.1185
Endorsement: PE/Health	(0.0094)	(0.0095)	(0.0094)	(0.0095)	(0.0616)	(0.0616)	(0.0617)	(0.0616)
	-0.0217*	-0.0198*	-0.0232*	-0.0239**	0.0152	0.0164	0.0140	0.0143
Endorsement: Arts	(0.0091)	(0.0091)	(0.0091)	(0.0092)	(0.0430)	(0.0430)	(0.0430)	(0.0430)
	-0.0346***	-0.0323***	-0.0371***	-0.0365***	0.0403	0.0404	0.0411	0.0407
Endorsement: Special Ed.	(0.0073)	(0.0072)	(0.0073)	(0.0073)	(0.0352)	(0.0351)	(0.0352)	(0.0352)
	0.0012	0.0015	0.0000	0.0006	-0.0827	-0.0819	-0.0807	-0.0801
School Level: Middle	(0.0077)	(0.0077)	(0.0078)	(0.0078)	(0.0511)	(0.0511)	(0.0511)	(0.0511)
	0.0064	0.0083	0.0054	0.0060	-0.0420**	-0.0394**	-0.0432**	-0.0413**
School Level: High	(0.0084)	(0.0084)	(0.0085)	(0.0085)	(0.0150)	(0.0149)	(0.0152)	(0.0150)
	-0.0152	-0.0132	-0.0156	-0.0152	0.0462**	0.0463**	0.0460**	0.0494**
School Level: Other	(0.0192)	(0.0192)	(0.0193)	(0.0193)	(0.0171)	(0.0171)	(0.0171)	(0.0171)
	0.0332	0.0334	0.0358	0.0370	-0.0032	-0.0058	-0.0008	-0.0017
School: Percent White	(0.0318)	(0.0318)	(0.0318)	(0.0318)	(0.0383)	(0.0383)	(0.0384)	(0.0383)
	0.0503	0.0511	0.0483	0.0483	-0.0967	-0.0986*	-0.0969	-0.0968
Locale: City	(0.0306)	(0.0306)	(0.0307)	(0.0307)	(0.0499)	(0.0498)	(0.0499)	(0.0499)

	1997 Choice Cohort				2007 Choice Cohort			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable: Choice = TRS3								
Locale: Suburb	0.0531	0.0543	0.0512	0.0511	0.0297	0.0286	0.0314	0.0316
	(0.0283)	(0.0282)	(0.0284)	(0.0284)	(0.0368)	(0.0368)	(0.0368)	(0.0368)
Locale: Town	-0.0436	-0.0457	-0.0354	-0.0391	-0.0879	-0.0951	-0.0915	-0.0908
	(0.0925)	(0.0925)	(0.0931)	(0.0932)	(0.0978)	(0.0978)	(0.0978)	(0.0978)
Year: 2009	-0.0090	-0.0229*	-0.0298**	-0.0423***	0.0134	0.0130	0.0165	0.0163
					(0.0194)	(0.0195)	(0.0195)	(0.0195)
Internal Rate of Return	-0.0217***				0.0238	0.0238	0.0218	0.0203
	(0.0021)				-0.0133***			
Internal Rate of Return (Unweighted)		-0.0223***			(0.0034)	-0.0062***		
		(0.0021)				(0.0015)		
NPV_{Diff} 8 Percent Returns			0.0012***				0.0007**	
			(0.0001)				(0.0002)	
NPV_{Diff} 10 Percent Returns				0.0008***				0.0004***
				(0.0001)				(0.0001)
School District Fixed-Effects?	Y	Y	Y	Y	Y	Y	Y	Y
Observations	22,344	22,344	22,344	22,344	4,604	4,604	4,604	4,604
Log-likelihood	-10944	-10938	-10958	-10951	-2880	-2879	-2882	-2881
Psuedo-R^2	0.128	0.129	0.127	0.128	0.0656	0.0658	0.0648	0.0652

*** Significant at the 0.1 percent level.

** Significant at the 1 percent level.

* Significant at the 5 percent level.

A2. Value-Added Measures of Teacher Effectiveness

The models presented in Table 6 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 (ϕ_t) The remaining teacher fixed-effect (τ_j) is the VAM estimate for teacher *j* pooled across all years the teacher is observed in the dataset.

In Table A2 below, we present additional results utilizing value-added scores estimated using the models in equations (A1) as well as (A2) – (A4). The estimates presented in Table A2 are from the earliest year available, which is the year closest to the point in time when a pension choice was made. The model described by equation (A2) modifies equation (A1) by dropping school and classroom level variables, controlling only for student covariates. This specification is used in columns 2 and 6 of Table A2.

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

The model described by equation (A3) modifies (A1) by adding a school fixed effect, λ_k. The teacher fixed effect is then measured relative to other teachers in the same school. This specification is used in columns 3 and 7 of Table A2.

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

The model described by equation (A4) substitutes a student fixed effect for the observed student covariates in the first model. This specification is used in columns 4 and 8 of Table A2.

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

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 A2. AVERAGE MARGINAL EFFECTS OF TEACHER EFFECTIVENESS ON PENSION CHOICE: ALTERNATIVE VALUE-ADDED SPECIFICATIONS

	1997 Choice Cohort				2007 Choice Cohort			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Effectiveness Quintiles								
1	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
2	0.0174	0.0323	0.0355	0.0125	-0.0707	-0.0906	-0.0824	-0.1823*
	(0.0297)	(0.0308)	(0.0301)	(0.0306)	(0.0657)	(0.0647)	(0.0668)	(0.0719)
3	0.0026	0.0675*	0.0404	0.0045	0.0130	-0.0259	0.0440	-0.1033
	(0.0305)	(0.0303)	(0.0301)	(0.0308)	(0.0673)	(0.0660)	(0.0631)	(0.0696)
4	0.0140	0.0471	0.0531	0.0170	0.1006	0.1007	0.0585	-0.0194
	(0.0306)	(0.0306)	(0.0301)	(0.0308)	(0.0649)	(0.0654)	(0.0645)	(0.0705)
5	0.0786**	0.0956**	0.0713*	0.0387	0.0972	0.0153	0.0622	-0.0058
	(0.0295)	(0.0301)	(0.0293)	(0.0304)	(0.0669)	(0.0684)	(0.0673)	(0.0692)
School District Fixed Effects?	Y	Y	Y	Y	Y	Y	Y	Y
Observations	2,068	2,063	2,068	2,068	591	589	591	591
Psuedo-R^2	0.132	0.134	0.130	0.128	0.111	0.113	0.107	0.112

*** Significant at the 0.1 percent level.

** Significant at the 1 percent level.

* Significant at the 5 percent level