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Cash on the Table? A Behavioral Analysis of Refund Claimants and Annuitants in the Illinois Teachers' Retirement System

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by

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Abstract

This dissertation documents pension benefit choices made by public school teachers enrolled in the Illinois Teachers' Retirement System (TRS), where they choose between taking a lump-sum withdrawal of their refundable contributions and deferring a pension benefit. The analysis explores the extent to which vested teachers enrolled in TRS separate from service with positive pension wealth, estimates how much money is "left on the table" at a conventional discount rate, and investigates what types of teachers display higher or lower discount rates as indicated by cashout patterns. To control for the relative attractiveness between choices, the analysis relies on three central measures: the pension-wealth-to-cash-out-ratio, net pension wealth, and the internal rate of return.

Thirty-six percent of classroom teachers in TRS choose to withdraw their refundable contributions, and this estimate arguably provides a lower bound for similar "final salary" defined benefit pension plans in other states. Results from behavioral models find higher cashout rates among male, African American, and Hispanic teachers; teachers who work in rural districts; and teachers who did not receive a degree from an elite institution in Illinois. These results indicate higher discount rates among these groups. I find no evidence in the data of a relationship between subject endorsements and cashout decisions. Behavioral findings are consistent across models that assume different discount rates.

The analysis concludes with an estimate of the aggregate leakage that occurs among TRS members who take a refund claim. Leakage is defined as *NetPW* for refund claimants who quit when the value of their pension wealth outweighs their refundable contributions. Leakage that refund claimants experience since 1980, adjusted for taxes and penalties, amount to $34,120 per

refund claimant among all members and $35,229 per refund claimant among classroom teachers. Over four-fifths of this leakage, however, occurred since 2000. Annuitants incur about $9,000 per member. Relative to the overall fiscal health of TRS, total leakage by members since 1980 as a percentage of pension debt is 0.2 percent. The findings in this analysis suggest a set of policy implications, both for retirement security and for how some teachers value their retirement benefits.

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Dedication

For my family.

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Chapter 1 – Introduction

Over 3.3 million K-12 public school teachers nationwide (Snyder & Dillow, 2012) comprise the largest proportion of covered workers in state pension plans, with 88 percent of all teachers enrolling in defined benefit (DB) retirement plans (Bureau of Labor Statistics, 2013). These systems impose large capital losses on young and mobile teachers who leave a system before reaching retirement eligibility (Costrell & Podgursky, 2010). Less understood, however, is the extent that teachers cash out of their pension plans even though they may be eligible for a deferred retirement benefit payable for life and the extent of leakage that occurs as a result of these decisions. Because 92 percent of teacher-covered public pension plans exclude employer contributions from refund distributions,[1,2] important questions pertain to the extent that teachers make decisions impacting their retirement security and whether current systems are equitable and fair for teachers. Moreover, the choices directly observed in the data may be indicative of how much teachers value their retirement benefits. That is, the data may reveal teachers' preferences for deferred compensation over up-front compensation and vice-versa.

[1] Teachers in Alaska, Colorado, Iowa, Michigan, Ohio, Oregon, South Dakota, and Utah may receive some portion of their employer contributions. Colorado, Iowa and South Dakota are the only plans with "final salary" defined benefit plans that credit a portion of employer contributions to refunds. The other five states offer a defined contribution plan, a hybrid plan, or some set of plan choices, and employer contributions in these cases are specifically earmarked for individual retirement accounts associated with the defined contribution portion of the plans. Notably, vested teachers in Arizona could collect a portion of the employer contributions before July 1, 2011. The state eliminated this provision for new teachers hired on or after this date.

[2] Employer and employee contributions fund public defined benefit pension plans. Typically, but not always, employee contributions are set at a fixed rate while employer contributions are actuarially determined on an annual basis. Combined, the employer and employee contributions are sufficient to cover the normal costs of a pension plan and amortize a plan's unfunded liabilities (assuming the fund meets its assumed investment rate and other assumptions about plan experience). By cashing out, an employee gives up all rights to any future pension payments that she accrued up to the point of separation. In this event, granting an employee only her portion of the contributions provides one way to keep the plan's costs down. If a plan credits employer costs to refunds as well, then contributions to the pension fund (the employer portion, the employee portion, or both) will also need to increase in order to adequately fund the plan.

Some studies have taken unique approaches to examine how much teachers value their retirement benefits. Fitzpatrick (2012) exploits a policy change in Illinois that allowed teachers to upgrade their benefits from service accrued prior to 1998 to estimate the value that Illinois public school teachers place on deferred compensation by comparing the cost for this upgrade with teachers' willingness to pay for this enhancement. She estimates that, on average, teachers are willing to pay 19 cents on the dollar for this benefit. Goldhaber and Grout (2014a), on the other hand, find that teachers in Washington are generally willing to contribute a higher portion of earnings to the defined contribution portion of the hybrid plan than the minimum level of five percent. Their lower-bound estimate of the average marginal value of one dollar of retirement investment by teachers is over fifty cents, larger than Fitzpatrick's estimate.

Aldeman and Rotherham (2014) use state annual financial reports to estimate the proportion of teachers in each state who remain in the system long enough to start receiving a retirement benefit. Only 44.5 percent of teachers in the median state, for instance, will stay in their retirement system long enough to qualify for a deferred retirement benefit while only 19.7 percent in the median state reach normal retirement eligibility. Thus, despite the magnitude of resources that states allocate to deferred compensation,[3] the majority of teachers choose not to remain in a system long enough to even qualify for a minimum benefit, and substantially fewer will work long enough in one system to qualify for normal retirement benefits, which can potentially reach several hundred thousand dollars in pension wealth.[4]

[3] By their own measures, state teacher-covered retirement systems plus the District of Columbia owe about $1.9 trillion in retirement benefits. This figure excludes liabilities facing local pension plans, such as Chicago and Saint Louis, which operate independently of state systems.
[4] Pension wealth is the present discounted value of the stream of annuity payments a retiree receives from the first day of retirement for the rest of his or her life.

Public employees in so-called "final average salary" defined benefit (FAS DB) plans[5] who separate from service before reaching retirement eligibility typically face a choice between deferring a pension, payable once she reaches pension eligibility, and a lump sum distribution of her refundable contributions. The value of the tradeoffs between collecting a pension and foregoing this lifetime benefit is less known, however. While a body of research examines cash-out decisions, few studies have examined distribution choice in public pension plans, and none have systematically examined K-12 public school teachers' decisions. This paper addresses this research gap by examining refund-related choices by K-12 public school teachers in the Illinois Teachers' Retirement System (TRS).

Important differences between private and public FAS DB pension plans affect refund/annuity decisions and warrant an examination of plans in both sectors. The Pension Protection Act of 2006 governs methods for computing the value of lump sum benefits under FAS DB plans in the private sector. A lump sum distribution must equal the present value of the annuity benefit, and the Internal Revenue Code specifies the interest rate and mortality tables required for computing the minimum amount for a refund (Purcell, 2007).[6] In the public sector, on the other hand, methods for determining lump sum distributions are not regulated and are largely based on the value of contributions rather than annuities. Figure 1 gives the distribution of refund types for teacher-covered public pension plans and shows that the value of refunds ranges from less than a teachers' overall contributions to an amount that includes both member

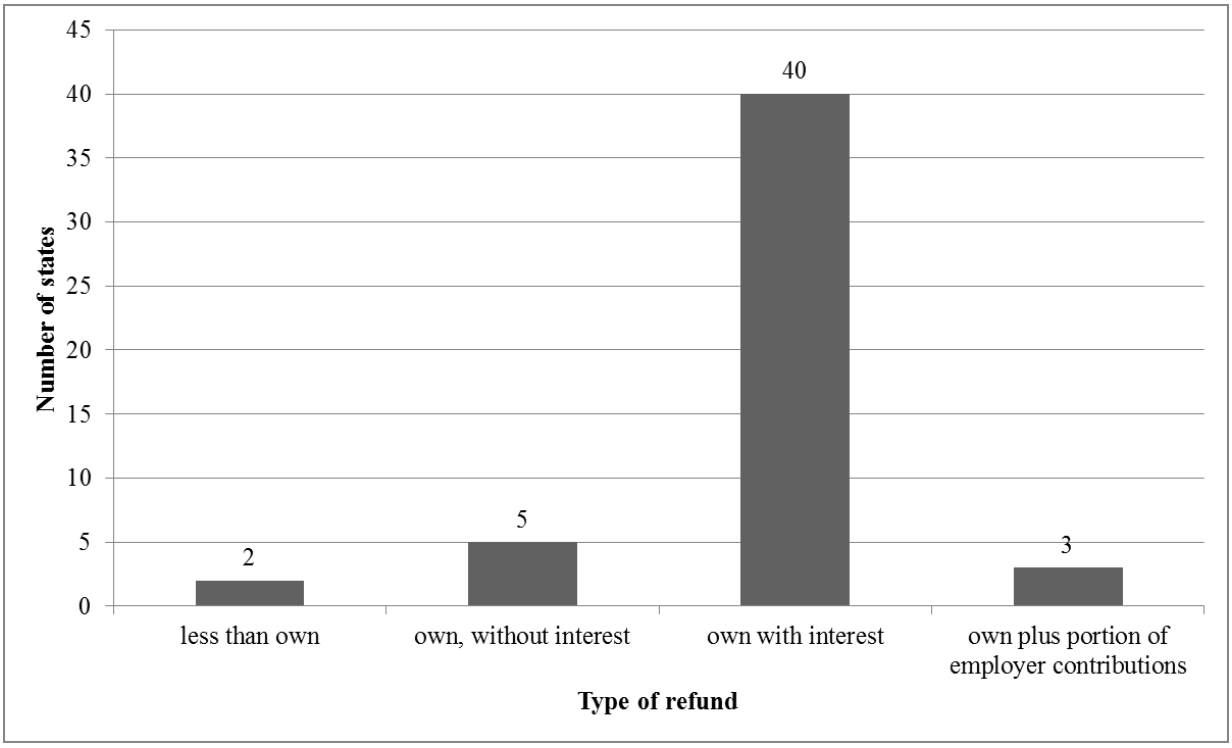
[5] These plans are sometimes also referred to as traditional DB plans. The value of a benefit under this plan depends on some average of her salary, an accrual factor, and creditable service.
[6] Changes to the law enacted in 2008 required plans to use new mortality tables and interest rates. Changes in mortality assumptions, reflecting increases in life expectancy, alone increased the value of lump sum refunds by 1 percent to 2 percent. Assumptions about the interest rate shifted from rates based on 30-year U.S. Treasury bonds to rates based on corporate bonds. Corporate bonds tend to be higher than U.S. Treasury bonds and, therefore, will tend to reduce the refund benefit.

and employer contributions. Of 50 teacher-covered state retirement plans plus the District of Columbia, 47 plans exclude employer contributions for funding FAS DB plans from refund credits. Teachers vested in TRS who retire before reaching retirement-eligibility choose between a lump sum withdrawal (LSW) and a deferred lifetime annuity. Illinois provides an interesting case because, like most states, teachers enroll in a FAS DB plan, and those who opt to receive a LSW do not collect the employer's portion of contributions to the pension fund.[7] In addition, Illinois does not subscribe to Social Security, thus removing a source of endogeneity inherent in retirement decisions.[8] Unlike most states, however, teachers collect less than their cumulative contributions. TRS members do not receive contributions earmarked for survivor benefits, equal to one percent of earnings. Moreover, Illinois does not credit interest on teachers' refundable contributions. Thus, refund claimants receive significantly less than if they initially did not contribute anything to TRS and instead put their money in a savings account. Finally, while public FAS DB plans like Illinois's vary across states, the general structure and behavior of these plans are very similar. Thus, results from an analysis on one state will arguably generalize to a much wider set of systems. Because refund rules in Illinois are less favorable for teachers than any other state, the rate of withdrawals in Illinois likely set a lower bound estimate for potential cashout rates in other states.

[7] Teachers contribute 9.4 percent of their earnings while the employer rate (paid by the state) is 35.41 percent for FY 2014. The employer rates for the prior two fiscal years were 24.91 percent and 28.05 percent in FY 2012 and FY 2013, respectively (Teachers Retirement System of the State of Illinois: Contribution Rates, http://trs.illinois.gov/employers/payments/contributions.htm, accessed 4/16/2014).

[8] The propensity for individuals or households to cash out is increasing in retirement income, such as from secondary sources like Social Security. Adding Social Security as an additional source of retirement income for Illinois teachers, for instance, might increase teachers' sense of security about their retirement. In turn, they may perceive greater freedom to cash out and direct how they invest their refunds. The state, on the other hand, might adjust retirement benefits by an amount equal to what teachers might receive by joining Social Security.

Figure 1: Type of refund disbursements for K-12 public school teachers (all state teacher-covered retirement systems plus the District of Columbia)



Less than own: Illinois and Kentucky

Own, without interest: District of Columbia, Florida, Louisiana, Oregon, and Rhode Island

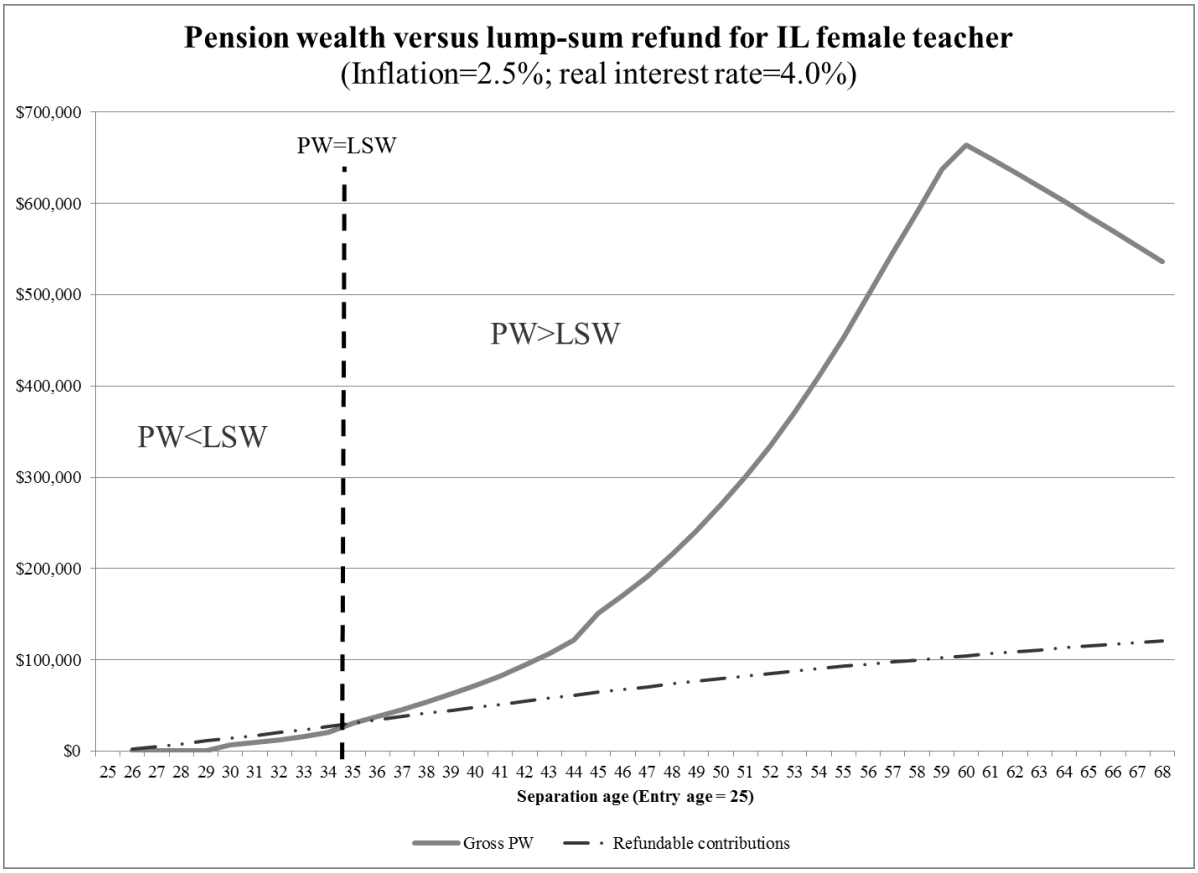
Own, with interest: Alabama, Arizona, Arkansas, California, Connecticut, Delaware, Georgia, Hawaii, Idaho, Indiana, Kansas, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, and Wyoming

Own plus at least a portion of employer contributions: Colorado, Iowa, and South Dakota

Omitted: Alaska, which does not offer a defined benefit component in its pension plan

Source: author's calculations from most recently available individual state actuarial valuation reports

Figure 2: Pension wealth and lump sum refund accrual for female teacher in Illinois TRS



Source: Author's calculations based on Tier I rules; the interest rate for refundable contributions is set at zero to reflect TRS rules

I illustrate the choice to take a refund or defer an annuity for a representative Tier 1 teacher in Figure 2, which depicts the year-over-year cumulative pension wealth (solid line) and lump sum refund (dashed line) patterns for a female teacher in Illinois who enters service at age 25.[9] Initially, this teacher's refund exceeds her expected pension wealth (PW), which is zero until she vests after 5 years of service (YOS). At 9 YOS, she reaches a crossover point (marked by the vertical dashed line) where PW surpasses the value of her refund benefit. Because defined benefit plans are "back-loaded," the rate that the gap widens quite rapidly increases until she reaches age eligibility for a pension. This gap exceeds $100,000 in her mid-40's and continues to grow thereafter until PW reaches its peak. I refer to this gap as net pension wealth, denoted *NetPW* and discussed in detail in Chapter 3, throughout this paper. It is simply the difference between pension wealth and lump sum refund evaluated at the same point in time.

Of Illinois classroom teachers identified as refund claimants in the data, 24 percent exit with positive pension wealth (i.e. they separate after the crossover point). After accounting for taxes and penalties associated with non-rollovers and early withdrawal, 35 percent of refund claimants quit with positive NetPW. This group is the focus of my analysis. Table 1 presents the distribution of *NetPW* for refund claimants and reports rates based on unadjusted and adjusted values of pension wealth. Zero *NetPW* indicates the crossover point.[10] About 41 percent of

[9] The entry age assumption is close to the average entry age of 27 observed among refund claimants and inactive members in the Illinois data. Figure 2 assumes earnings according to the Springfield Public School District's salary schedule, 2.5 percent inflation, 4 percent real rate of return, and survival probabilities from the Center for Disease Control's *Life Tables* (Arias, 2007). This rate is comparable to interest rates assumed in other recent analyses. For instance, Coile and Gruber (2007) assume a 6 percent real rate of return while Koedel, Ni and Podgursky (2014) assume a 4 percent real rate. The median nominal rate assumed by state-based teacher-covered pension plans is 7.75 percent, or 125 basis points higher than the figure's assumption.

[10] The crossover point is sensitive to assumptions about the real rate of return and can have a significant impact on the proportion of teachers observed before and after this point. For instance, the share of teachers who separate after the crossover point is 78 percent under a 2

refund claimants who separate after the crossover point leave with less than $10,000 in *NetPW* while 20 percent leave with between $10,000 and $20,000 in *NetPW*. Thirty-nine percent separate with *NetPW* that exceeds $20,000. This group of refund claimants lends itself to the "annuity puzzle" and motivates the analysis at hand. I explore two questions:

1. To what extent do vested teachers enrolled in TRS separate from service with positive net pension wealth, and how much money is "left on the table" at a conventional discount rate?
2. As indicated by cashout patterns, what types of teachers display higher or lower discount rates?

Table 1: Distribution of net pension wealth for TRS classroom teacher refund claimants

	Unadjusted		*Adjusted*	
Net pension wealth	number	percent	number	percent
Less than $0	4,067	76.0%	3478	65.0%
$0 to $10,000	530	9.9%	826	15.4%
$10,000 to $20,000	259	4.8%	375	7.0%
$20,000 to $30,000	151	2.8%	205	3.8%
$30,000 to $40,000	102	1.9%	152	2.8%
$40,000 to $50,000	68	1.3%	90	1.7%
More than $50,000	175	3.3%	226	4.2%

Notes: NetPW values are reported in 2011 dollars and based on 4 percent real interest, 2.5 percent inflation, and gender- and race-specific survival probabilities from the CDC's 2007 Life Tables; statistics are based on a sample that includes all classroom teachers hired in or after 1980, all separation ages, and individuals who vested in the system; it excludes teachers who left TRS and continued work in another Illinois reciprocal retirement system.

percent real interest rate and 10 percent by assuming 6 percent interest. Table A.1 in Appendix A reports rates based on 2 and 6 percent discount rates.

Types of Pension Plans

Defined benefit plans

Pension plans fall into three categories: defined benefit, defined contribution, and cash balance plans. Traditional defined benefit plans, sometimes called "final average salary" defined benefit (FAS DB) plans, calculate a member's benefit as a function of years of service, an average of the highest salary of some number of years, and an accrual factor (or multiplier). Under FAS DB plans, a teacher must first vest in the system by working a minimum number of years in order to be eligible for a retirement benefit.

An individual teacher's retirement benefit is defined by the formula

$$Benefit_i = \pi * YOS_i * FAS_i \qquad \text{(i)}$$

where π is an accrual rate, *YOS* is the number of creditable years of service, and *FAS* is the average salary in the final few years of her career. The product of π and YOS is commonly referred to as the replacement rate and represents the percent of one's pre-retirement income she receives after retirement.[11] For example, the annuity for a teacher who retires after 25 years of service, exits with a FAS of $60,000, and works in a state that provides 2.5 percent of her FAS per year is

(0.025 per year) x ($60,000) x (25 years) = $37,500 per year

payable for life starting at her eligible retirement age. Many states add a cost-of-living adjustment on top of this base benefit.

[11] Some public retirement plans place a cap on the replacement rate. Members of the Illinois Teachers Retirement System, for example, can earn no more than 75 percent of their final average salary.

FAS DB plans do not allow portability like other types of retirement plans. That is, teachers typically cannot take both their member and employer contributions when they separate service. Moreover, few public plans allow their teachers to collect the employer's contributions if they cash out rather than defer a pension until retirement eligibility. While these features significantly disadvantage teachers who do not remain in a single retirement system until retirement eligibility, other types of plans such as defined contribution (DC) or cash balance (CB) plans offer more favorable features for these types of workers. Moreover, such plans are more transparent in that they tie benefits to contributions (Costrell & Podgursky, 2011).

FAS DB plans create political incentives that lead to substantial underfunding (McGee, no date). Despite every state constitution except Vermont's including some form of balanced budget requirement (Poterba, 1995), states are carrying substantial magnitudes of pension debt (a.k.a. unfunded liabilities, or the amount owed in benefits in excess of the assets on hand for payments.[12] Constitutional balanced budget requirements place states like California and Illinois with large fiscal imbalances in the unenviable position of making difficult financial choices, namely reducing retirement benefits, raising state and local property taxes, or cutting funding for public services. Moreover, although many state constitutions guarantee pension promises to public employees,[13] there are no guarantees in place for politicians to adequately fund pensions

[12] Estimates of unfunded liabilities for the nation's public pension plans range from $1.38 trillion (Pew Center on the States, 2012) to $4.43 trillion (Novy-Marx & Rauh, 2011). To put these estimates in perspective, the pension debt ranges from about $10,000 to $33,000 per U.S. household. By their own calculations, teacher-covered state-based pension plans alone face $532.5 billion in pension debt, excluding retiree health insurance.

[13] Pension reforms commonly target reductions in COLAs, increases in the retirement age or vesting requirements, raises in contribution rates, or establishing a defined contribution, hybrid, or cash balance plan. Lawsuits usually follow in almost every case. The most common claim is that pension reforms violate the Contracts Clause either in the U.S. Constitution or state constitution. Snell (2012) provides a summary of pension enactments around the country that

so that future promises can be met. That is, these rules do not prohibit states from making promises for future expenditures without commensurate allocations to pension funds. Such structural problems are a significant reason why most private sector firms moved away from FAS DB plans in favor of adopting defined contribution and cash balance plans.

Defined contribution plans

Under a defined contribution (DC) plan, a worker's retirement benefit depends on contributions into a retirement account and investment performance. Thus, whereas a FAS DB plan defines the level of retirement benefit, a DC plan defines the contributions made to a retirement account. Although there is variation across plans in how contributions are determined, employees usually contribute some percent of her earnings periodically into her account, and the employer typically matches this amount (usually up to a certain amount). Therefore, while employers (i.e. taxpayers) who fund FAS DB plans tend to incur most of the financial risk related to investment performance by the pension fund,[14] employees tend to incur most financial risk under DC plans because their benefits rely on investment performance. Employers make contributions under the plan's rules, which are independent of realized gains or losses. Employees usually have some measure of control over how their savings accounts are invested, and these accounts are portable for workers who leave a retirement system. Once an employee retires, her retirement benefit is based on the balance in her account. At retirement, an employee usually has the choice to take a withdrawal of her account as a lump sum or annuitize all or part of her retirement savings. Workers who rely on DC plans for retirement income and do not

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occurred in 2012 while Buck (2013) provides an excellent overview of pension litigation in the U.S.

[14] Workers enrolled in DB plans also face financial risk in the form of not receiving a pension in the event the system becomes insolvent.

annuitize can feasibly outlive their retirement savings while pensions under FAS DB plans are payable for life.[15]

Cash balance plans

By definition, cash balance (CB) plans comprise a subset of DB plans. They provide a revenue-neutral alternative to FAS DB plans that do not penalize worker mobility by combining components from FAS DB and DC plans.[16] For instance, by virtue of guaranteeing a fixed rate of return, they guarantee some level of retirement for employees, like a FAS DB plan, while offering the portability of a DC plan. Benefits are tied to contributions and are based on an employee's notional (or "hypothetical") account. An employee periodically receives a benefit credit and an interest credit. A unit of service earns a fixed benefit credit applied to the employee's account and is independent of investment experience. The interest credit is commonly fixed to an index such as U.S. Treasury bills (Elliott & Moore, 2000). Thus, a worker's account is built up in a smooth-accruing manner over the course of her career. Individual accounts are hypothetical and not administered at an individual level. Rather, assets are pooled into a single fund, as with FAS DB plans, and managed by the fund's trustees. Typically, when a worker separates, she can convert her account into an annuity or take a lump sum distribution, as under a DC plan. The different characteristics across these retirement plans arguably lead to differences in the kinds of workers they attract.

[15] An employee who separates from a DB plan and takes a lump sum withdrawal of her refundable contributions without annuitizing also faces the risk of outliving her refund.
[16] For this reason, CB plans are sometimes referred to as "hybrid" plans.

Shaping the workforce

From a labor market perspective, pensions provide tools for shaping the composition of a workforce and, by extension, the productivity of a firm or industry. Pension plans may offer incentives for workers with certain traits to take up employment with a firm, thus affecting the composition of the workforce along different dimensions (such as quality, risk preferences, discount rates, and propensity for changing jobs). Ippolito (1997) compares worker quit rates between federal and private employees and demonstrates that FAS DB plans offer effective instruments for incentivizing long-tenure among workers. Clark and Scheiber (2004) discuss how certain types of firms and workers in the private sector favor certain types of pensions. Firms and employees characterized by "firm-specific human capital" tend to favor FAS DB plans.[17] Many firms and industries, however, have shifted to using "general human capital" and are characterized by low-cost training and high-turnover.[18] These types of firms and employees would prefer DC and CB pensions because they do not penalize mobile workers as FAS DB plans do (Costrell & Podgursky, 2010). Retirement plans may also differentially affect turnover over different points in a career. Asch, Haider, and Zissimopoulos (2005), for instance, use data on federal workers covered by the Civil Service Retirement System to examine the role of financial incentives on retirement behavior. They find that workers time their retirements according to where it is financially optimal to do so.

[17] For example, some companies might use very specialized equipment that requires intensive (and costly) training for its employees to operate. These firms prefer low-turnover among its employees, and its employees prefer to stay with the company long-term because their specialized skills may not transfer easily to other firms or industries.

[18] Secretaries offer one example: a person who learns to type, operate a computer, and develop organizational skills can readily apply this set of skills across different firms and industries.

Throughout the 1970's, FAS DB plans were the most common type offered to workers in both the public and private sectors. During the 1980's and 1990's, however, most of the private sector closed their FAS DB plans in favor of opening DC and CB ones (Munnell, 2006) while total retirement coverage has stagnated (Munnell & Perun, 2006). Today, stark differences exist in retirement plan participation between public and private sector workers.

Participation in pension plans

Table 2 summarizes plan participation between private and public employees. Each panel provides access, participation, and take-up rates for all retirement plans, FAS DB-only plans, and DC-only plans. These categorical rates are defined as the percent of all workers with access to a plan, the percent of all workers who enroll in a plan, and the percent of workers who enroll in a plan conditional on having access, respectively. In general, public workers are more likely to have access to retirement plans than all private sector workers (89 percent versus 65 percent), and those with access are significantly more likely to participate (95 percent versus 75 percent). Higher access rates may be partially explained by the notion that politicians face greater political risk from raising pay than from increasing benefits because the latter is more opaque (Glaeser & Ponzetto, 2013). Furthermore, disconnect exists between politicians who enhance benefits and consequences linked to their actions. While today's politicians might enhance retirement benefits to gain favor with special interest groups such as teacher unions, future politicians will be stuck with raising revenue to foot the bills (Moe, 2011). The higher take-up rates observed in the public sector may be a reflection of union presence and automatic enrollment by most public

employees. Employees that do not automatically enroll may receive better information or stronger encouragement from unions to enroll.

Union influence on retirement access and enrollment is indicative by the jumps in access and take-up rates for private union workers. Union membership appears to increase access to FAS DB plans –69 percent of private-sector union workers have access to FAS DB plans, compared to just 14 percent for non-union private-sector workers. Nearly all public union workers have access to FAS DB plans, 22 percentage points more than public non-union workers.

Private-sector workers have greater access to DC plans than public workers – 59 percent compared to 31 percent, respectively. The take-up rates for DC plans are also higher for private-sector employees. Access was slightly higher for private non-union workers and about the same for public union and non-union workers. Take-up rates were higher for public non-union employees than union members, possibly reflecting a preference by union members for FAS DB plans over DC plans or differences in information obtained about retirement options between the two groups.

Although the BLS compiles information about public elementary, secondary, and special education teachers, it does not provide data on this group of workers in the private sector explicitly. It includes a category for private-sector management, professional, and related workers, which includes education occupations. Access to retirement is nearly universal for public school teachers, compared to 79 percent for their private-sector counterparts. About 95 percent of all public school teachers participate in FAS DB plans while only 24 percent of similar private workers participate. While only 24 percent of public school teachers have access

to DC plans, only 7 percent participate. Their private-sector counterparts, on the other hand, are substantially more likely to have access and participate. I now discuss the pension system for teachers in Illinois.

Table 2: Access, take-up, and participation rates for retirement plans by private and public sector employees, 2012

	all retirement plans			DB			DC		
	access	take-up	participation	access	take-up	participation	access	take-up	participation
All workers									
private (all)	65%	75%	48%	19%	89%	17%	59%	70%	41%
private (> 500 employees)	86%	88%	76%	46%	92%	42%	78%	78%	61%
public	89%	95%	84%	83%	94%	78%	31%	48%	15%
Union									
private	92%	92%	85%	69%	96%	66%	57%	78%	45%
public	97%	95%	92%	95%	94%	89%	31%	36%	11%
Non-union									
private	62%	72%	45%	14%	85%	12%	60%	69%	41%
public	83%	95%	78%	73%	94%	68%	31%	58%	18%
Profession									
private (mgt., prof., and related)	79%	86%	68%	26%	90%	24%	76%	81%	61%
public (primary, secondary, and sped teachers)	99%	97%	96%	98%	97%	95%	24%	30%	7%

Source: BLS, National Compensation Survey - Benefits Database, http://www.bls.gov/ncs/ebs/

NOTES: access rates and participation rates indicate the percentage of all workers in each group who have access to and participate in a retirement plan. Take-up rates indicate the percentage of workers with access who choose to participate. Participation rates equal access times take-up.

The Illinois Teachers' Retirement System

The Illinois Teachers' Retirement System (TRS) is a publicly funded defined benefit plan for public school employees and one of several retirement systems in Illinois that cover state and local public employees.[19] In 2010 Illinois lawmakers enacted Senate Bill 1946, dramatically changing the parameters of its public retirement systems while keeping the FAS DB structure intact.[20] Many lawmakers perceived Illinois's fiscal situation as so drastic that Senate Bill 1946 "raced through the General Assembly in a matter of hours" in March 2010 (Finke, 2010). As a result, a two-tier system was created. Table 3 summarizes the plan provisions for Tier 1 and Tier 2 members. New employees starting on or after January 1, 2011 enrolled in the new plan (Tier 2) while employees who started before enrolled under the original retirement plan (Tier 1). The differences between the two plans are remarkable.

Tier 2 significantly reduces retirement benefits for employees by doubling the vesting requirement to 10 YOS and number of years for computing the FAS to 8 years. The COLA is tied to an inflation index and is not compounded (versus 3 percent annual and compounded under Tier 1). The age required to receive full benefits increases to 67, while a teacher with 10 YOS can retire at age 62 at a 6 percent annual discounted rate. It is no longer possible for

[19] Teachers in Chicago Public Schools enroll in a separate system, the Chicago Teachers' Pension Fund (CTPF). Parameters for determining teacher benefits under CTPF and TRS are similar. Notably, charter schools are required to join TRS. Certified teachers in Chicago must join CTPF while non-certified teachers are exempt from this requirement (Olberg & Podgursky, 2011). Consequently, charter schools must make statutory contributions, which are actuarially determined on an annual basis. This requirement arguably makes financial planning more difficult given the uncertainty about future contribution requirements.

[20] In December 2013, the General Assembly enacted another law to its pension plans that applies to all active, inactive, and retired Tier 1 members. Tier 2 members are not affected. Lawsuits were subsequently filed, and Illinois courts are currently deliberating on the constitutionality of the new law. If upheld, provisions will include diminishing COLA adjustments for current retirees, imposing a cap on earnings, and reducing the contribution rate from 9.4 percent to 8.4 percent for Active Tier 1 members.

teachers to retire in their 50's and receive a benefit. The FAS calculation now includes a cap on salary at $106,800 for new members, but this limit will more likely affect administrators rather than teachers.

Table 3: Provisions for 2010 Pension Reform in Illinois Public Act 96-0889

	Tier I	Tier II
Member Eligibility	Members who contributed prior to January 1, 2011	Members who contributed on or after January 1, 2011
Vesting years	5 YOS	10 YOS
Member contributions	9.0 percent of creditable earnings between 7/1/1998 and 7/1/2005; 9.4 percent of creditable earnings beginning 7/1/2005	9.4 percent of creditable earnings
Retirement Eligibility	- age 55 w/ 35 YOS if employee chose to have pension determined by 2.2 percent formula and paid a fee; - age 55 w/ 20 YOS, benefit reduced by 6 percent each year member under age 60; - age 60 w/ 10 YOS - age 62 w/ 5 YOS	- age 67 to receive full benefits; - age 62 w/ 10 YOS, benefits reduced by 6 percent for each year under age 67
FAS	highest average salary during 4 consecutive years out of last 10 YOS	highest average salary during 8 consecutive of last 10 YOS
Cap	benefits capped once, 75 percent of FAS	capped in two ways: 1) max benefit is 75 percent FAS; 2) in FAS calc, no salary will exceed a limit tied to CPI (currently $106,800 as of 2010)
COLA	3 percent compounded annually	adjustments based on less of 3 percent or 0.5 times CPI; not compounded
Post-retirement employment	Currently, cap on service is 120 days (600 hours); from July 1, 2011 cap reduced to 100 days (500 hours)	Retirement benefits suspended if member works full-time in other pension that has reciprocal rights with TRS

Table based on information from: *EZ Guide to Tier I and Tier II Retirement under Public Act 96-0889*, https://trs.illinois.gov/pubs/EZguide.pdf (accessed 3/24/2014)

The current funding position of the system cannot guarantee that future pension obligations will be met. Years of "pension holidays" from meeting its fiscal obligations, coupled with benefit enhancements without commensurate increases in funding over the evolution of the plan, puts the system at risk of not being able to meet its obligations in the future. By its own measures, TRS assets currently cover 41 cents for every dollar of benefit owed (TRS, 2014). By far, the largest portion of Illinois's public pension debt derives from obligations to TRS members.

Benefit Distribution Choice

Vested TRS members who separate from service prior to attaining retirement eligibility face a choice to take a refund of their contributions or defer collecting a lifetime pension starting at a later date. This choice is common in public sector FAS DB plans. Teachers who do not file for a refund claim leave their contributions in the pension fund and collect an annuity upon reaching retirement eligibility. Teachers must also file a form before they can start collecting an annuity. If they do not file a claim, then they receive nothing until age 70-½, when Federal law pertaining to mandatory disbursements kicks in. Thus, receiving no benefit is the default benefit choice for teachers.[21]

For Tier 1 members, a refund withdrawal amounts to 7 percent of creditable earnings earned up to June 30, 1998; 8 percent of creditable earnings earned between June 30, 1998 and

[21] This practice is similar to North Carolina's, where the default choice is receiving no benefit. Public workers must file a claim to receive either a lump sum refund or an annuity. Workers do not receive any benefit if they do not file a request for their benefits to be paid (Clark, Morrill, & Vandermeade, 2013).

June 30, 2005; and 8.4 percent of creditable earnings earned thereafter.[22] Unlike many FAS DB plans in other states, refund claimants under IL TRS do not receive any interest accrued from their contributions.[23] Once a refund claim is processed, a member foregoes any claim to a deferred annuity. Members who do not vest in the system may not collect an annuity at any point later in their life. Members with fewer than five years of creditable service, however, have a choice between two different lump sum disbursements. The first is a conventional refund of their contributions (without interest). Alternatively, she may receive a "Single Sum Retirement" benefit. Under this option, a member may receive a lump sum disbursement actuarially equivalent to an annuity starting at age 65 based on the formula 0.0167x(FAS)x(YOS).[24]

Refund claimants forego one percent of their contributions earmarked for survivor benefits.[25] Once a teacher cashes out, anyone they designate as a beneficiary becomes ineligible for survivor benefits; yet, refund claimants do not regain the one percent of earnings from their contributions that is designated for survivor benefits. Moreover, a claimant's distribution may be subject to additional taxes or penalties depending on whether they roll over their benefit into a tax-sheltered retirement account. If a member's refund can be rolled over into another retirement account and the claimant elects to take a cash distribution, then TRS will withhold 20 percent of the refund amount, as required by law (TRS, 2013b).[26] Withdrawing before age 59-½ without rolling over her refunds may subject an individual to an additional 10 percent early withdrawal

[22] Starting July 1, 2005, refunds for members who do not retire under the Early Retirement Option includes an additional 0.4 percent of creditable earnings, thus boosting the rate on creditable earnings to 8.4 percent.
[23] Of 47 states that refund only member contributions, 40 states credit teachers' contributions with interest credit, either at a fixed rate or a fair market rate.
[24] About 0.49 percent of TRS members hired since FY 1980 avail themselves of a Single-Sum Retirement benefit.
[25] The survivor benefits program was enacted in 1959 (TRS, 2013a).
[26] Participants in private 401(k) plans who cash out are also subject to a 20 percent employer withholding (GAO, 2009).

penalty. Thus, refund claimants face potential short-term and long-term costs associated with cashing out: 1) costs associated with early withdrawals, and 2) costs later in life associated with lower levels of retirement savings and foregone accumulation of compounding interest.

About 30 percent of all TRS members and 33 percent of classroom teachers arranged for TRS to roll over at least a portion of their distribution to a retirement account. While it is possible that members deposit their refunds in a retirement account themselves, research finds that people tend to be much less pro-active in retirement decisions. Thus, it is likely that roughly 70 percent of refund claimants had their distributions reduced by the tax penalty. This rate is lower than findings from Clark, Morrill, and Vanderweide (2013), who state that over 90 percent of all public workers in North Carolina who opt for a lump sum distribution take their refund as cash rather than rolling it over into a retirement account.

An analysis of benefit choice that examines teachers exclusively is especially warranted given that teachers tend to be highly mobile and separate a system at young ages and/or with low YOS.[27] FAS DB plans by design disadvantage these groups in favor of veteran, full-career teachers, though only a small proportion of teachers remain in one system for a full career. Illinois is no exception. Consider Figure 3, which pictorially depicts the separation rates for all TRS members by age by YOS. Table 4 complements the figure, providing separation rates for age and YOS bins. Notably, over three-quarters of observed separations occur prior to vesting.[28] Half of all separations occur before a member vests in the system (less than 5 YOS) and before age 40 (mid-career for many workers). On the other hand, only 17 percent of these exits occur at

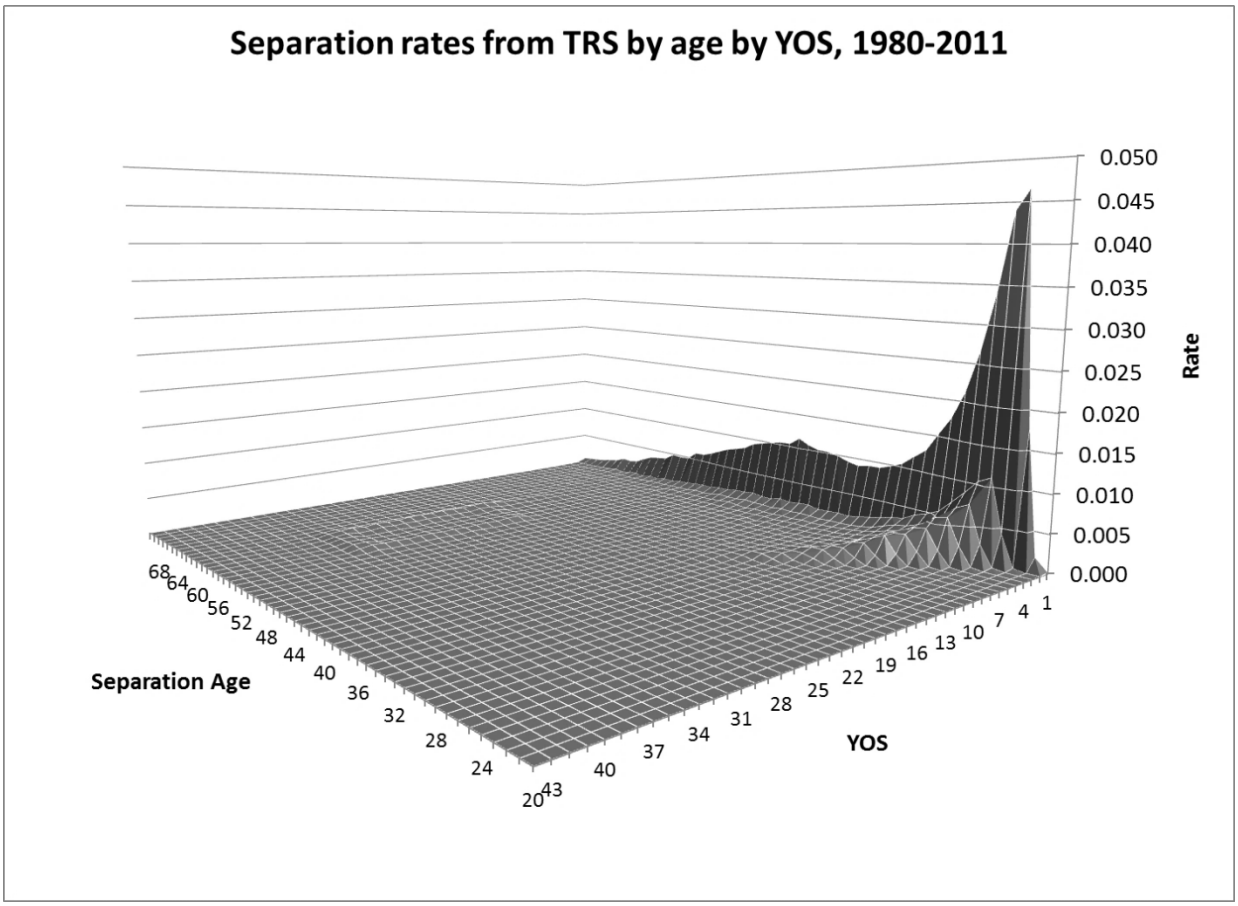
[27] Analyses that illustrate high teacher turnover within the context of retirement include McGee and Winters (2013) and Aldeman and Rotherham (2014), where they show that separations are heavily skewed towards teachers with low years of service.

[28] This rate is about 9 percentage points higher than the 68 percent reported by Aldeman and Rotherham (2014), who derive their rates from actuarial withdrawal tables.

age 55 or later. Furthermore, separations from age 55 by members who have accrued at least 20 YOS (requirements for qualifying for a reduced early retirement benefit) comprise only 6 percent of separations.[29] Thus, despite enrolling in a plan that heavily favors longevity within the system, only a very small proportion of members stay long enough to qualify for full or reduced pension benefits.

[29] Early retirement benefits are discounted 6 percent per year under age 60. Members with 35 YOS can collect a full pension starting at age 55.

Figure 3: Separations from TRS by age by YOS, 1980-2011



NOTES to Figure 3: I define a separation as a member who retires, takes a full refund, takes a Single-Sum refund, or is classified as inactive. This sample consists of 170,447 members and includes separations during 1980-2011 and between ages 20 and 70 by all TRS members hired from 1980. It excludes Tier 2 and deceased members and inactive members observed moving to a reciprocal retirement system in Illinois. A teacher must be absent from the system for one full year before TRS classifies her as inactive.

Table 4: TRS separation rates by age by YOS

	Separation age										
	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	Total
YOS											
0-5	0.13	0.21	0.10	0.07	0.08	0.07	0.05	0.03	0.02	0.01	0.77
5-10	0.00	0.02	0.03	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.10
10-15	.	.	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.04
15-20	.	.	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.02
20-25	.	.	.	.	0.00	0.00	0.00	0.01	0.01	0.00	0.03
25-30	.	.	.	.	0.00	0.00	0.00	0.01	0.01	0.00	0.02
30-35	.	.	.	.	.	.	0.00	0.01	0.01	0.00	0.02
35-40	.	.	.	.	.	.	.	0.00	0.00	0.00	0.00
40-45	.	.	.	.	.	.	.	.	0.00	0.00	0.00
Total	0.13	0.23	0.14	0.09	0.09	0.08	0.07	0.08	0.06	0.02	1.00

Notes: Table is based on a sample (n=170,447) that includes all TRS members (including non-teachers) who were hired on or after 1980, separated by 2011, and left between ages 20 and 70; sample excludes Tier 2, deceased members, and individuals who left TRS and re-entered service in a reciprocal Illinois retirement system; I define a separation as a member who retired, took a full refund, took a Single-sum refund (applicable to non-vested members), or who TRS identifies as inactive. A teacher must be absent from the system for one full year before TRS classifies her as inactive.

Paper Organization

This dissertation is divided into five chapters. In Chapter 2, I review the literature on teacher pensions, discuss the annuity puzzle, and review the general literature that pertains to benefit distribution choice. In Chapter 3, I discuss the data and methods used to analyze teachers' choices between cashing out and deferring a lifetime annuity. The chapter includes summary statistics. Chapter 4 discusses the results of the behavioral models and sensitivity checks, and it finishes with estimations of the amount of leakage that occurs among TRS members. Chapter 5 concludes and includes policy recommendations.

Chapter 2 – Literature Review

Teacher Pensions

Informing good pension policy requires a sound understanding of the structure of pension systems and incentives embedded in them, especially plans that cover the largest group of public employees in the U.S., teachers. Research specifically on teacher pensions, however, is somewhat slim, though it has begun to blossom over the last several years. Studies on teacher retirement include examinations of the incentives embedded in pension plans (Costrell and Podgursky, 2009), timing of retirement decisions and implications for mobility (Costrell & Podgursky, 2010; Costrell & McGee, 2010; Ni & Podgursky 2011; Koedel et al. 2012; Koedel et al., 2013), projections of retiree health care costs (e.g. Costrell & Maloney, 2013), transition costs (Costrell, Podgursky, & Weller, 2011; Costrell, 2012; Biggs, 2014), plan choice (Chingos and West, 2013; Goldhaber and Grout, 2014b) and relationships between pension benefits and teacher quality (McGee, 2011; Munnell, and Fraenkel, 2013; Koedel, Podgursky, & Shi, 2013; Mahler, 2013).

Seminal work by Costrell and Podgursky (2009) discuss the mechanics of how final average salary defined benefit (FAS DB) pension plans work and demonstrate how the back-loading nature inherent in FAS DB plans create peculiar incentives for teachers to time their retirements at purely arbitrary points in their careers. They examine six state-level teacher-covered retirement systems and illustrate the highly arbitrary and nonlinear fashion in which the annual accrual of pension wealth occurs from an additional year of work. Spikes in pension wealth from an additional year of work serve to "pull" teachers into teaching up to that point, regardless of personal, household, or work circumstances. The valleys represent negative pension

wealth accrual and occur when pension wealth from an extra year of work no longer outweighs the marginal benefit one would receive during that year by retiring, thus serving to "push" teachers into retirement, including individuals who may wish to continue working and may still have productive years to devote to teaching.

Costrell and Podgursky (2010) show how FAS DB plans impose substantial losses in pension wealth on teachers who separate from a system before retirement eligibility. This phenomenon stems from back-loading. Early leavers effectively transfer substantial portions of pension wealth to teachers who remain in the system long enough to reach retirement eligibility. Teachers who leave a pension system before reaching retirement eligibility incur considerable losses in their pension wealth, up to half in some cases, relative to teachers who remain in one system until retirement eligibility. Lack of portability and reciprocity among pension systems essentially amounts to an implicit tax on teacher mobility and partial careers, and they can have important implications for two-earner households. Research on career hierarchy by Winkler and Rose (2001) implies another consideration to the efficacy and fairness of these systems. They find that low earnings by women relative to men are partly attributable to the husband of a household being the dominant earner. Indeed, if husbands are dominant earners in the majority of households, and given that most teachers are women, then it is likely that many teachers in two-income households, as secondary earners in their families, face the threat of large losses in pension wealth if their husbands switch to another job located outside of the pension system.

A significant body of work examines worker responsiveness to pension incentives in general. Yet, although Costrell and Podgursky's work illustrates the peculiar incentives embedded in teacher FAS DB plans, the literature on teachers' behavioral response to these incentives in particular is slim, though growing. Using econometric behavioral models to

examine retirement behavior by Arkansas teachers and modeling pension incentives after Coile and Gruber (2000), Costrell and McGee (2010) confirm the presence of the pull-push incentives inherent in FAS DB systems by finding that teachers respond to the financial incentives underlying the pension plan. Ni and Podgursky (2011) estimate structural models to simulate the effect of policy changes to Missouri's teacher pension plans from a FAS DB plan to a DC one. As predicted, enhancements made to the pension plan during the 1990's lowered the overall retirement age, suggesting that teachers responded to these enhancements by retiring earlier. Moving to a smooth-accrual plan would even-out the spikes in retirement that occur in response to the FAS DB plan's incentives and possibly raise the overall retirement age. Mahler (2013) finds that the probability of exit at retirement eligibility in North Carolina is 17 percentage points greater than for teachers who are two years away from eligibility, indicative of the presence of a "pull" force in the pension plan.

A couple of studies directly examine the effect of pension borders (and non-reciprocity) on the mobility in Missouri's education sector. Koedel et al. (2012) study school leaders in Missouri[30] to analyze the effect that "pension borders" have on the flow of these employees across schools. Using a rich 18-year data panel, they present evidence that pension borders introduce significant inefficiencies into the labor market for school leaders. School leaders who become heavily vested in a pension system face a large incentive to remain within their pension system rather than crossing over and, consequently, incurring huge losses in pension wealth. The authors estimate that removing pension borders will double the flows of leaders across borders. Koedel, Ni, and Podgursky (2013) use a difference-in-differences approach to study effects of

[30] Teachers and school leaders in Missouri belong to one of three retirement plans: the state-level plan or local plans in Saint Louis and Kansas City. There is no reciprocity among these plans, meaning that service accrued in one system does not transfer to retirement benefits accrued under another system. Thus, they penalize mobility.

pension borders around the Saint Louis City school district on teacher mobility and find similar patterns as with school leaders – ultimately, pension borders lower their mobility. These findings suggest important implications for personnel policy where under-served and difficult-to-staff districts like St. Louis cannot simply coax teachers from outside by raising pay. Without reciprocity across pension plans, public school personnel are stuck within their pension boundaries. Moreover, an individual who takes a job in St. Louis or Kansas City is implicitly making a full-career commitment. This serves as a disincentive for individuals to teach in these areas in the first place.

These effects raise questions about how pensions affect the teaching workforce's quality. Several studies attempt to ascertain the role that pensions play in affecting teacher value-added. McGee (2011), Mahler (2013), and Koedel, Podgursky, and Shi (2013) use administrative data from Arkansas, North Carolina, and Missouri, respectively, and find weak to no evidence that suggests pensions have a significant influence on teacher value-added. Munnell and Fraenkel (2013) employ data from the Center for Retirement Research's Public Plans Database and NCES's School and Staffing Survey to examine how compensation, including deferred compensation, affects teacher quality, defined by the average SAT score at a teacher's undergraduate institution. They find a significant and positive relationship between their measure of quality and deferred compensation. Their measure of deferred compensation, defined by an employer's normal cost as a percentage of payroll, does not adequately capture the financial incentives inherent in each individual public pension plan, however, thus rendering comparisons at the plan-level rather than at the teacher level.

Rather than addressing the structure of their retirement systems directly, states usually respond to able teachers' early departures by adding incentives for them to remain on board for

several more years after their retirement. For instance, in 1997 San Diego implemented the Deferred Retirement Option Program (DROP) which allow employees who agree to work an additional five years to simultaneously continue earning a salary while collecting retirement pay from special accounts (Hess & Squire, 2010). Similarly, Arkansas offers the Teacher Deferred Retirement Option Plan, or T-DROP. Such plans, however, are expensive for inducing workers with good years left to stay. On the other hand, alternative retirement designs can offer more neutral incentives with potential to induce workers, who might otherwise be pushed out early under a FAS DB plan, to stay at lower cost. Some experts advocate a cash balance (CB) plan as one option that deserves serious consideration (Costrell and Podgursky, 2011). A defined contribution plan (DC) offers another viable option. Opponents to these reforms, however, cautiously point to "transition costs" from changing plans from FAS DB to DC or CB. Some use simulations to cite a fall in overall teacher effectiveness (Weller, 2011), while public retirement systems themselves point to rules by the Governmental Accounting Standards Board (GASB) that require front-loading amortization payments in the event that a system closes its FAS DB plan. Others have thoroughly debunked these arguments (Costrell, Podgursky, & Weller, 2011; Costrell, 2012). In particular, Costrell demonstrates in rigorous detail that GASB rules pertain to public reporting only, and pension systems may individually determine their own amortization schedules.

The teacher pension literature largely points out the inefficiencies inherent in FAS DB plans. Such plans were originally designed for firms to retain workers for a full career and can levy potentially large costs on individuals who exit the system early. Teachers who leave early and choose to cash out their contributions are especially prone to huge costs. Unless they roll over their funds into a tax-sheltered retirement account such as a 401(k) or IRA, public

retirement systems by law withhold 20 percent of their refunds. Moreover, the Federal Government levies a 10 percent penalty for distributions taken without a rollover before an individual reaches age 59-½. Although the teacher pension literature has ventured into numerous areas important for informing policy decisions, no studies have examined teachers' choices that pertain to the type of benefits they receive. There may be reasons to suspect that teachers' retirement behavior differs from other public employees, however, thus warranting a closer examination of teachers. For instance, teachers purportedly enter their profession mostly for non-pecuniary reasons and, therefore, may be motivated to continue working after reaching retirement eligibility. Research suggests that teachers are also risk averse (Bowen et al., 2013). In addition, because teachers comprise the largest group of public employees, studying their retirement behavior exclusively is a worthwhile avenue to follow. I now turn to the general retirement literature, which has examined this topic somewhat extensively.

The Annuity Puzzle

Economic theory predicts that teachers without bequest motives will choose to collect an annuity with certainty (Yaari, 1965) because of uncertainty about one's lifespan.[31] Converting all or most of one's retirement savings into a lifetime annuity enhances utility because individuals do not have to worry about running out of savings regardless of how long they live. More recent work by Davidoff, Brown, and Diamond (2005) relax some assumptions in Yaari's model and show that individuals remain better off by converting all or most of their retirement portfolios to an annuity, thus suggesting the importance of lifetime annuities in retirement planning. Given the

[31] Individuals may prefer to leave all or a portion of their funds to heirs. They cannot do so if they fully annuitize because payments drop to zero when an annuitant dies.

optimization problem of determining the decumulation rate of retirement savings plus the prospect of outliving those savings, it follows that risk-adverse individuals would prefer holding at least most of their savings in annuitized assets.[32] A wide body of empirical research, however, contradicts this conclusion, giving rise to the so-called "annuity puzzle." This phenomenon is borne out in my data, where up to 35 percent of refund claimants cash out when the expected pension wealth they would receive by deferring a pension exceeds their refund distribution.[33] Table 5 summarizes annuity rates reported in the literature and displays considerable variation in annuitization over various settings. Annuity rates found in the public and private sectors, for instance, range from 15 percent to 85 percent and from 27 percent to 88 percent, respectively. I discuss these studies in detail later in this chapter.

[32] The decision of when to begin retirement poses a highly complex problem as it involves forecasting one's life expectancy, investment outcomes, and health.
[33] This observation occurs under a 4 percent real rate of return used to compute pension wealth.

Table 5: Annuitization rates found in the general retirement literature

Study	sector	sample	FAS DB plan	DC plan	CB plan
Illinois teachers (this paper)	public	6,072 classroom teachers vested in IL TRS	64%	n/a	n/a
Clark, Morrill, & Vanderweide (2013)	public	11,368 terminated vested workers younger than age 50 in North Carolina, quit during 2007-2009; all NC public pension plans	67%	n/a	n/a
Chalmers & Reuter (2012)	public	32,060 retirements in the Oregon Public Employees Retirement System during 1990-2002	85%	n/a	n/a
Warner & Pleeter (2001)	public	11,000 military officers and 55,000 enlisted personnel	15%†	n/a	n/a
Cunha & Menichini (2014)	public	80,000 enlisted personnel and 9,000 officers in the U.S. military	38%	n/a	n/a
Benartzi, Previtero, and Thaler (2011)	private	i) 18,761 IBM employees, payout decisions during 2000-2008	88%	n/a	n/a
		ii) 103,000 benefit distribution decisions during 2002-2008	53%	n/a	41%
Mottola & Utkus (2007)	private	Almost 30,000 distribution in a FAS DB plan and CB plan for two Fortune 500 companies	27%	n/a	17%
Banerjee (2013)	private	Over 118,000 payout decisions from 84 ERISA-qualified plans, 2005-2010	66%*	n/a	n/a
Hurd & Panis (2006)	both	3,651 respondents in the Health and Retirement Survey	61%**	n/a	n/a
Butler & Teppa (2007)	both	4,544 workers from 10 public and private Swiss companies	85%***	56%***	n/a

† Annuitization rates for officers and enlisted personnel are 49 percent and 8 percent, respectively.

* Figure includes qualified CB plans.

** This figure is calculated by Benartzi, Previtero, and Thaler (2011), who incorporate an assumption that 45.2 percent of respondents have access to a lump-sum option in their retirement plans.

*** Figures are based on my calculations.

Explanations for the annuity puzzle include risk-sharing within households, existence of bequest motives, excessively high prices for annuities, and adverse selection. The economic principle of supply and demand dictates that high prices for annuities (perhaps due to administrative costs) reduce demand. Moreover, the existence of a primary income stream in retirement (such as Social Security or spouse's retirement) may reduce demand for annuities by allowing more flexibility with retirement income so that households can take on increased investment risk. Adverse selection may play an important role where individuals with higher mortality risk may cash out at higher rates because their expected payoff will be less than individuals expecting to live longer. Mitchell et al. (1999) cite adverse selection as the standard explanation for the restricted size of the private annuity market and explain that "insurance premium therefore must be set high enough to compensate insurers for the longer life expectancies of purchasers" (p. 1299).

Heterogeneous risk preferences offer another explanation for the annuity puzzle. Theory predicts that individuals with higher levels of risk aversion will prefer an annuity over a lump sum refund. Given research that documents sorting across public and private sectors along levels of risk aversion (Bellante & Link, 1981; Bonin et al., 2007; Pfeifer, 2011), one may expect to observe larger proportions of retirees choosing pensions over refunds in the public sector. Moreover, findings by Bowen et al. (2013) suggest that prospective teachers display weaker preferences for risk than students pursuing other professions, thereby implying that teachers in particular may have strong preferences for annuities.

Heterogeneity in time preferences may also explain observed annuitization patterns. Economic theory predicts that individuals borrow or lend money until their internal discount rate equals the market interest rate. If different individuals face different interest rates in the market,

then it may be the case that internal discount rates correlate with background factors. For example, a field experiment in Denmark conducted by Harrison, Lau, and Williams (2002) finds that individuals with longer investment in education, higher income, and older age exhibit lower internal discount rates. This may reflect more favorable borrowing or lending market interest rates offered to individuals with these characteristics. For instance, high-income individuals tend to have higher credit scores, which affect an individual's borrowing rate of interest. Furthermore, discrimination may play a role where certain minority groups tend to face higher interest rates than whites. On the other hand, certain characteristics may shape an individual's time preferences. More education may make an individual more forward-looking and teach them to delay gratification, thereby reducing her internal discount rate. It may also be the case that more patient individuals or individuals from higher-income households tend to obtain more education. In this sense, personal discount rates will inversely relate to educational attainment or income.

Finally, variation in financial literacy among individuals may help to explain the puzzle given the role that it plays in retirement planning. The level of financial literacy is alarmingly low among Americans nearing retirement (Lusardi & Mitchell, 2006) and young Americans (Lusardi, Mitchell, & Curto, 2010). Lusardi and Mitchell (2006) fielded a questionnaire to the 2004 Health and Retirement Study to gauge the financial literacy and extent to which respondents engage in retirement planning. This longitudinal survey is administered to a nationally representative group of individuals over age 50 (individuals on the verge of retirement if not already retired). The researchers find that only about half of the respondents were able to answer two very elementary questions correctly about inflation and compounding interest, and only one-third answered correctly these questions plus a third basic question about investment risk. These results are particularly alarming considering that these respondents have very likely

engaged these topics in every-day financial decisions. Findings suggest that financial literacy is highly correlated with minority group status and education level. Lusardi, Mitchell, and Curto (2010) find that just 27 percent of respondents from the nationally representative National Longitudinal Survey of Youth (NLSY) survey were able to answer very basic questions about inflation, interest rates, and risk diversification. The survey questions were the same as those employed in Lusardi and Mitchell (2006), and the patterns of these results are similar as well, where gender, race/ethnicity, and educational background correlate with financial literacy.

Distribution choice in the public sector

Clark, Morrill, and Vanderweide (2013) examine distribution decisions among public employees in North Carolina's Teachers' and State Employees Retirement System and Local Governmental Employees' Retirement System using administrative data during the period 2007-2009. They do not analyze benefit choice for teachers as a subset, however. The authors control for the value of the lump sum refund and the present discounted value of the annuity in a set of linear probability models to estimate the propensity to choose the refund benefit.[34] Results from choice models indicate that males exhibit a higher propensity to cash out. They are also more likely to take a cash distribution rather than rolling over their refund. As with this analysis, the authors exclude individuals who separate with eligibility for an immediate pension benefit and focus on separations that occur up to age 50. About 32 percent of North Carolina public workers requested a lump sum distribution within one year of separation (higher than the 23 percent rate

[34] Deferred benefits are computed by assuming a 5.8 percent nominal rate of return (3.0 percent real return, 2.8 percent inflation), compared to my assumption of 6.5 percent (4.0 percent real, 2.5 percent inflation).

among Illinois teachers). About 20 percent of K-12 teachers and other education professionals who vest choose to cash out,[35] much lower than groups from other public professions such as government, public safety, and health/social service.[36] One possible explanation points to differential levels of job security, where teachers, backed by strong unions, may leave their contributions in the pension fund with the expectation that they may easily re-enter the teaching force several years later. Notably, nearly 90 percent of all refund claimants opt to receive their refund in cash rather than rolling them over into a retirement account. This is remarkable considering the taxes and early withdrawal penalties associated with these decisions. Only 12 percent of refund claimants roll over their refund into another retirement account.

Chalmers and Reuter (2012) examine distribution choice among public employees in the Oregon Public Employees' Retirement System (OPERS) from 1990 to 2002. Under this plan, retirees must actively choose between two retirement benefits: a full annuity (no refund) and a lower-annuity with lump sum refund. About 15 percent of workers choose the lump sum refund benefit, implying that 85 percent of workers chose the full annuity. Thus, they observe higher annuity demand than documented in other settings. They also examine variation in pricing on annuity demand and find small effects. Notably, the authors test for the presence of adverse selection in annuity decisions by exploiting individual mortality data and find that workers who die within 2 years of retirement are almost 18 percentage points more likely to choose a lump sum. In addition, they find that females are less likely to choose the lump sum. These findings bolster the notion that individuals with longer life spans select the annuity benefit.

[35] This rate is close to the 23.38 percent cashout rate by Illinois teachers who separated during the same period.
[36] Cash out rates for government, public safety, and health/social service workers are 36 percent, 45 percent, and 27 percent, respectively.

Warner and Pleeter (2001) exploit the enactment of a military drawdown program to examine annuity decisions by military personnel and estimate individuals' personal discount rates. In 1992, the U.S. Department of Defense initiated the program where it offered military personnel a choice between a lump sum retirement benefit and an annuity. They find that military personnel display strong preferences for lump sum payments to annuities. For most enlisted personnel and officers, the present discounted value (PDV) of the annuity substantially exceeded the lump sum amount.[37] Despite the fact that the PDV of the annuity more than doubled the lump sum amount (under a 7-percent discount rate), over 90 percent of all enlisted personnel and more than half of all military officers choose the lump sum over an annuity. The authors estimate personal discount rates up to 30 percent. Warner and Pleeter also find variation in take-up decisions and discount rates for several factors. Blacks are more likely to take a lump sum than other minorities while whites are less likely to cash out than non-black minorities. Blacks also have a higher internal rate of return by over 0.063 than other nonwhites. This is not surprising given that blacks have a lower life expectancy than other groups. The level of education, scores on the Armed Forces Qualification Test, and age are inversely related with the take-up decision and time preference. These findings are consistent with notions that older individuals are less willing to take on risk and higher education levels may be indicative of greater financial literacy. Male enlisted personnel displayed higher discount rates and were more likely to take a lump sum benefit than their female counterparts, possibly due to lower life expectancy and higher tolerance of risk among males.

Cunha and Menichini (2014) build on Warner and Pleeter's work by estimating personal discount rates to examine benefit decisions by 80,000 enlisted personnel and 9,000 officers under

[37] The authors computed the PDV of the annuity using discount rates of 7, 10, 20, and 30 percent (Table 1 in their paper). The break-even discount rate ranges from 17.5 percent to 19.8 percent.

the National Defense Authorization Act of 2000. This act was passed in response to rising retirement costs in the military. Under the plan, service members reaching 15 YOS were required to choose between receiving a full annuity under the "High-3" plan and a $30,000 lump sum plus reduced annuity under the "Redux" plan. The High-3 plan was in place prior to the 2000 enactment and allowed service members to receive a full pension after 20 years of service. Although the value of the High-3 benefit exceeds the value of the Redux benefit for most individuals, 38 percent of all service members opted for the Redux benefit over the High-3 benefit. This reflects 42 percent of enlisted personnel and only 7 percent of officers choosing a Redux benefit. Choosing Redux is positively related to being male, Black, married or divorced, number of dependents, non-officer ranking, and younger age. In addition, estimates for individual discount rates exhibit positive relationships with being male, Black, divorced, number of dependents, and service in the Army or Marine Corps. They are negatively related to age at decision, single status, rank, and education level. These findings largely follow results in Warner and Pleeter's analysis. The researchers estimate the overall average discount rate at about 9 percent (or 10 percent and 6.5 percent for enlisted personnel and officers, respectively). These rates are lower than Warner and Pleeter's, who estimate internal discount rates for military personnel at 18 percent or more, implying that service members "are not making gross mistakes by choosing Redux over High-3" (p. 3).

Distribution Choice in the Private Sector

Hurd and Panis (2006) examine decisions to take refunds using 1992-1998 Health and Retirement Survey data. Unlike prior studies employing this data, they include individuals with

access to FAS DB plans. Of individuals enrolled in plans with refund options, 20 percent of participants elected to cash out. Of these withdrawals, most of the disbursements were put in savings or invested (5.6 percent of participants used at least some part of their refund for current consumption).

Mottola and Utkus (2007) examine participants in define benefit plans for two Fortune 500 companies. Of participants eligible for a lump sum disbursement, only 27 percent enrolled in a traditional (final average salary) FAS DB plan opt to annuitize while just 17 percent enrolled in a cash balance plan annuitize. In addition, regression results indicate that males, married couples, and wealth decrease the likelihood of annuitizing while older age is associated with a higher likelihood of annuitizing.

Benartzi, Previtero, and Thaler (2011) observe annuitization rates of 88 percent and 53 percent in payout decisions by IBM employees during 2000-2008 and employees from 112 FAS DB plans during 2002-2008, respectively. The authors note a caveat, however, with the annuity rate for IBM employees in which the company attempted to encourage early retirement by enhancing the annuity option for employees under age 65 by 15 to 20 percent. The annuitization rate for employees that did not receive this enhancement was 61 percent. Data on the second sample also includes employees covered by cash balance (CB) plans and indicate a 41 percent annuity rate. Thus, employees in this sample cash out at a higher rate if they belong to a CB plan. In addition, males, younger workers, and individuals with smaller retirement accounts are more likely to cash out.

Banerjee (2013) examines 118,000 payout decisions (annuity versus lump sum withdrawal) across 84 ERISA-qualified FAS DB plans during 2005-2010 and finds evidence that

annuitization is directly related to restrictions placed on taking lump sum disbursements. Overall, 66 percent of distributions analyzed were annuities. Plans without LS options experienced a 99 percent annuitization rate while plans without restrictions on LS withdrawals had the lowest annuitization rate (27 percent). Annuitization increases with age and tenure.

Finally, Butler and Teppa (2007) examine benefit decisions by workers from ten public and private companies in Switzerland. Nine of these companies offer an annuity as the default option. Of employees in the three companies covered by a FAS DB plan, 85 percent chose an annuity, compared to 56 percent of individuals in companies not covered by a FAS DB plan.

There is significant variation in annuitization rates across plans within public and private sectors. In the public arena, annuitization rates overall range from 15 percent to 85 percent. Military personnel, however, exhibit much lower annuity rates. This is particularly puzzling because the present discounted values of individuals' annuities in many cases exceeded the values of their lump-sum benefit options. Plans for non-military personnel experience fairly high annuitization rates, ranging from 67 percent to 85 percent. High annuity rates are consistent with expectations because refunds in these plans grant only employee contributions, which render them substantially less valuable than annuities.

As in the public sector, substantial variation occurs in annuitization rates overall in the private sector ranging from 27 percent to 88 percent. After excluding the portion of IBM employees examined in Benartzi, Previtero, and Thaler (2011) who faced an enhanced annuity option, however, the highest observed annuity rate becomes 66 percent. Taken as a whole, the studies discussed above suggest that workers covered by civilian public pension plans annuitize at higher rates than workers under private plans. The most likely explanation stems from

differences in how the values for refund distributions are determined, discussed in Chapter 1. While refunds must equal the present discounted value of the annuity in the private sector, this is not the case in the public sector, where most public pension plans include only the member's contributions while excluding the employer portion. Thus, refunds are considerably less lucrative in the public sector, which subsequently leads to higher annuity rates.

Retirement studies that control for internal rates of return

Studies on other areas of retirement employ similar methodologies used in this analysis by controlling for the internal rate of return. Behavioral research (Kahneman, Knetsch, & Thaler, 1991; Tversky & Kahneman, 1991) suggests that individuals facing alternative choices tend to consider what they already have as a reference point. If the alternative choice does not provide a benefit at least as generous as what they have, then a person may not choose that option. In the context of teacher public pension plans, a vested teacher in a FAS DB plan who separates before reaching retirement eligibility and therefore faces a choice between a lump sum refund and a deferred annuity may regard the annuity as her reference point. Economic theory predicts that she will choose the benefit at higher value. In order to control for individuals' reference points, researchers calculate the rate that equalizes the values of the choices and include them in their models. A couple of recent studies employ this method in analyzing the determinants of choice among pension plans.

Goldhaber and Grout (2014b) and Yang (2005) examine retirement plan choice and compute the internal rate of return (*IROR*) that equalizes the present discounted value of the stream of expected benefit payments accrued under the choice plans. Goldhaber and Grout

examine Washington public school teachers' choices between a FAS DB plan and Hybrid plan.[38] A teacher with a higher *IROR* will likely exhibit a lower propensity to choose DC or hybrid plans because these choices require her to assume a higher return by the DC component to produce the same benefit as under the FAS DB plan. Likewise, a teacher with a low *IROR* is more likely to choose the Hybrid plan because she requires a lower return from the DC portion to produce an equivalent benefit. The authors find that factors associated with a higher propensity to choose the hybrid plan include younger age, being male or white, higher salary, physical education/health endorsements, and working in urban/suburban locales. The finding that white teachers exhibit a higher propensity for choosing the hybrid plan than African American teachers is surprising when one considers differences in life expectancy between the two groups. Whites may arguably exhibit a higher propensity to choose the FAS DB plan because of a higher life expectancy. On the other hand, African Americans in general may have less trust in financial markets than whites, for understandable historical reasons. Finally, they include an indicator to account for the financial crisis in 2008. The estimated coefficient indicates that teachers are less likely to choose the hybrid plan, consistent with the notion that the economic recession dampened confidence in the financial markets and, subsequently, teachers' willingness to take on financial risk by choosing the plan with a DC component.

Yang (2005) analyzes choices between FAS DB and DC plans made by employees in a non-profit. On average, the *IROR* is 9 percent. Between the two comparison groups, DC-choosers exhibit a lower *IROR* than employees remaining in the FAS DB plan (7 percent versus 14 percent). The coefficient on *IROR* is negative and statistically significant in the choice models. Consistent with results from other studies, the authors find that factors associated with a

[38] A hybrid pension plan incorporates features from both DB and DC plans.

lower propensity to choose a DC plan include higher *IROR*, older age, having shorter tenure, being male or African American, and belonging to a union.

Studies that use survey data to estimate time preferences

Another body of retirement research employs survey methods to estimate personal discount rates, typically by asking respondents to choose between some amount of money or goods today and a larger amount in the future. DeArmond and Goldhaber (2010) survey teachers in Washington State in order to ascertain the determinants of preferences for pension plans. Although time preferences among teachers is not the focus of their study, the survey includes a question that asks teachers to choose between a large sum of money 20 years later and a smaller sum of money today. This question affords them an estimate of teachers' implicit discount rates, separable into three groups: less than 0.04, between 0.04 and 0.08, and more than 0.08. A larger implicit discount rate (being more present-oriented) is associated with stronger preferences for a DC plan than a FAS DB plan. Overall, the authors' results show that veteran teachers display stronger preferences for a FAS DB plan than a DC plan while new entrants exhibit stronger preferences for a DC plan than FAS DB plan. Similar to this study, several papers use survey data to analyze retirement decisions and estimate time preferences.

Brown, Casey, and Mitchell (2008) employ survey data from the 2004 Health and Retirement Study to examine preferences for choosing an annuity over a lump sum payment. Overall, three-fifths of respondents in the data indicated a preference to trade half of their Social Security payments throughout the remainder of their lives for a lump sum payment up front plus the lower annuity. Estimates from an ordered logit model indicate that factors increasing the

likelihood of an individual choosing a lump sum payment plus reduced annuity include younger age, poor health, unemployment (likely because of liquidity constraints associated with being unemployed), and more education. Conditional on education, more financially sophisticated individuals are more likely to prefer the full annuity.

Klawitter, Anderson, and Gugerty (2012) use survey responses to estimate the discount rates for a group of individuals eligible for a matched savings programs for low-income households. The survey presents three hypothetical loan amounts, each at 3-month, 6-month, or 1-year payment periods, and asks individuals to select the amount they would prefer to pay back given a set of choices. They find that discount rates vary with horizon – higher discount rates are elicited for shorter payment periods and for smaller loan amounts. In addition, discount rates are higher, on average, for respondents who are non-Black, are native English speakers, have children, have education to high school, and are younger.

Finke and Huston (2013) survey 6,812 undergraduate and graduate students to model time discounting as a predictor of importance that students place on retirement savings. The authors estimate time preference under four different methods. Two methods use numerical techniques common in the time discounting literature,[39] and two techniques are based on eight intertemporal behaviors as proxies for time discounting. The analysis finds that time preference is significantly predictive of students placing importance on retirement savings. Measures of time preference that employed intertemporal behaviors explained more variation in students' importance on retirement savings than more traditional measures.

[39] The numerical approach is based on the question, "If you were given the opportunity to either accept $150 now or a larger amount in one year, how much money would we need to pay for you to wait a year?" A respondent answering with a higher amount is assumed to exhibit a lower rate of time preference (and hence have a higher internal discount rate).

Beshears et al. (2013) conduct a survey that asks respondents about their willingness to annuitize based on a set of hypothetical factors. Five significant findings emerge from their work. First, individuals express three factors that play an important role in their annuitization decisions: a desire to have adequate retirement wealth later in life, flexibility in spending, and concern about whether their company will run out of resources to pay for retirement benefits down the line. Second, the proportion of individuals who decide to annuitize increases when given the option to annuitize a portion of their funds rather than an "all-or-nothing" ultimatum. This is particularly relevant to the design of FAS DB plans, particularly in the public sector, because most of these systems offer only two choices in this area: collect an annuity later in life or take a claim on their entire contributions as a lump sum. Third, respondents prefer annuities characterized by flat or increasing stream of payments, implying an important role for COLA adjustments. Fourth, framing the annuity decision in light of flexibility and control as well as discussing investment features decreases the likelihood of annuitizing. Finally, most respondents prefer to pick a month where they receive a bonus payment rather than the traditional level stream of payments. Although questions in these surveys base scenarios on companies offering retirement plans, this study certainly opens an avenue for future research to examine retirement preferences by public sector employees.

Brown (2001) employs data from the Health Retirement Survey and uses a life-cycle model to develop a utility-based measure of an agent's valuation of annuitization. This measure, called annuity equivalent wealth, represents the amount of money an individual in the annuities market would require to maintain the same level of utility when annuitization is unavailable. An increase in annuity equivalent wealth is significantly positively related to the probability that an individual plans to annuitize. Single individuals are more likely to annuitize than married

couples, lending credence to the notion that pooling mortality risk within households reduces the propensity to annuitize. An individual's health and time horizon for financial planning are positively related to an individual planning to annuitize. Contrary to previous research and Yaari's theory, however, Brown finds no evidence that bequest motives play an important role in decisions to annuitize.

Summary

The literature on teacher pensions thoroughly demonstrates the arbitrary incentives embedded in defined benefit plans. Economic theory predicts that pension plans characterized by smooth pension wealth accrual will lead to gains in efficiency in the labor market. Research on teacher pensions has yet to venture into exploring teachers' choices that pertain to benefit distributions, however, though a body of evidence in this area exists in the general retirement literature, where findings point to an "annuity puzzle." Although theory predicts high rates of annuitization, substantial variation occurs in actual take-up. The general literature is fairly consistent in its findings that pertain to the determinants of annuitization. Factors associated with higher cashout rates include lower education levels, young age, poor health, being minority or male, and low tenure. Workers in civilian public pension plans appear to annuitize at much higher rates than private sector workers. Examination of annuity decisions made by teachers as a standalone group is warranted, however, and this study aims to fill a gap in the teacher pension literature by exclusively studying a group of teachers covered by a typical state-level public pension plan in a large Midwestern state, Illinois.

Chapter 3 – Methodology and Data

Merely controlling for age, earnings, and service may be insufficient because they interact in ways that create highly idiosyncratic incentives embedded in FAS DB plans. In the context of benefit choice, developing a framework that controls for the relative attractiveness of plan options is important and requires incorporating these highly nonlinear incentives. Otherwise, their omission from behavioral models may generate biased estimates. I employ three different individual-specific measures that account for the tradeoffs in benefit options: teachers' pension-wealth-to-cash-out ratios (*PWCOR*), the difference between pension wealth and refund amount (*NetPW*), and internal rate of return (*IROR*). This chapter begins by considering the difficulties posed to this analysis. It then discusses the theoretical framework, followed by a description of the data and summary statistics with a focus on the key analytic variables.

Analytic challenges

At least two important factors affect retirement decisions and pose analytic challenges. First, financial incentives embedded in FAS DB pension plans are highly idiosyncratic; yet, these incentives play an important role in timing decisions, and studies demonstrate that workers respond to them (Chan and Stevens, 2004; Asch, Haider, and Zissimopoulos, 2005; Furgeson, Strauss, and Vogt, 2006; Costrell and McGee, 2010; Ni and Podgursky, 2011; Koedel et al., 2012). Second, heterogeneity in individuals' life circumstances shape time preferences and arguably impact retirement decisions in important ways.[40] While an advantage of this paper's

[40] Individuals may experience life events (such as medical emergencies) requiring immediate financial resources. In economic parlance, these individuals have high discount rates – they are

analysis lies in its ability to directly control for the first factor, an admitted shortcoming lies in its inability to estimate time preferences.

While several retirement studies rely on survey data to estimate personal discount rates (Brown, 2001; Brown, Casey, and Mitchell, 2008; Finke & Huston, 2013; Klawitter, Anderson, & Gugerty, 2013) a couple have been able to employ data on actual retirement-related decisions to generate estimates of personal discount rates (Warner & Pleeter, 2001; Cunha & Menichini, 2013). Studies that rely on survey data face several challenges. The first, "hypothetical bias," suggests that a respondent's answer differs from how she would actually behave if a scenario was real. Second, complex survey questions may confuse a respondent or cause her to give up, thus rendering responses invalid. Third, the existence of latent variables such as risk preference, impulsivity, or thrift may lead to bias if they are omitted from the model. Finally, respondent bias (selection bias) may pose a particular concern for analyses with low response rates. For these reasons, some researchers instead seek out observations of individuals' actual behavior *in lieu* of stated preferences.

Economists often assume that revealed preferences reflect an individual's true tastes (e.g. Trivitt & Wolf 2011). Beshears et al. (2008), however, argue several reasons why *normative preferences* (an individual's true preferences) may in fact differ from *revealed preferences* (an individual's observed behavior). For example, an individual may prefer to enroll in a defined benefit plan but, for some unobserved reason, may actually enroll in a defined contribution plan. This individual's choice is likely influenced by some kind of decision-making error. Reasons for normative preferences differing from revealed preferences include passive choice (common

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more present-oriented. Typical examples of behaviors by individuals having high-discount rates include unhealthy eating or pawning a valuable item.

when a default choice is involved), complexity, misinformation, limited personal experience, and third-party marketing. The analytic setting for this dissertation mitigates several of these issues.

One acknowledged limitation in this analysis includes occurrences when teachers make choices about their benefits that differ from their true, unobserved preferences that would be revealed under perfect information. Although teachers receive benefit statements that disclose the value of their refund benefits and monthly pension benefits, statements report refundable contributions as a lump sum amount but pension benefits as a monthly payment.[41] They do not report these benefits in a way that offers an apples-to-apples comparison (e.g. either both benefits as lump sums or both benefits as monthly payments). Nonetheless, complexity and misinformation are likely mitigated as sources of error because members can contact TRS to obtain an estimate of their benefits, and they receive annual benefit statements. TRS also provides its members with information on its web site, including an online benefits calculator. Moreover, discussions about refundable contributions as a benefit (e.g. on financial statements or in member guides) usually include words of caution stating that refund claims not only terminate all other TRS benefits, but purchasing service credit after re-entering service can be costly.[42]

While complexity increases with the number of choices, vested TRS members make just two choices – taking a lump sum disbursement of contributions and deferring an annuity. Finally, people often learn about what is in their best interest from experiences and feedback. Thus, limited personal experience with retirement income could potentially drive a wedge between normative and revealed preferences for TRS members. I believe that this potential obstacle is

[41] A redacted benefit statement is provided in Appendix B.

[42] To buy back service credit, TRS charges the required cost had an individual continued working under covered service, plus interest, usually 6 percent (TRS, 2013c). About 20 percent of all classroom teachers in TRS and 30 percent of refund claimants hired since 1980 separated from the retirement system for at least a full year and re-entered thereafter.

minimal, however, because TRS members have access to a wide set of resources to help them determine the course of action best suited to their circumstances.[43] These reasons lend confidence that revealed preferences offer an accurate depiction of normative preferences in this analysis's setting.

My data afford an examination of teachers' revealed preferences on cash-out decisions. I employ powerful measures to control for financial incentives in behavioral models. While studies on benefit decisions in FAS DB plans control for age, tenure, and wealth (Mottola and Utkus , 2007; Banerjee, 2013), they do not include measures that capture the highly nonlinear financial incentives typically embedded in the FAS DB plans. Estimating pension wealth is one powerful technique that captures these incentives and provides a key component for this analysis. I also develop measures that allow comparability between the values of a refund withdrawal and deferred annuity and include them in choice models to estimate the impact of individual, professional, school, and district characteristics on the propensity to cash out. The next section discusses the measures central to this analysis.

Dependent and key analytic variables

The dependent variable comprises an individual teacher's decision to cash out her refundable contributions or leave her contributions in the pension fund, presumably to defer an annuity when she becomes eligible to collect. This variable takes a value of zero if a teacher is categorized in the data as "Inactive" and one if she filed a claim on her refundable contributions

[43] Teacher unions provide another resource for teachers by actively engaging in informing members about benefits and how their retirement-related choices might affect them.

and took a disbursement.[44] Individual teachers' *PWCOR*, *NetPW*, and *IROR* comprise the key control variables.

Denoting $PWCOR_{is}$ as the pension wealth to cashout ratio observed in individual *i* who separates at age *s*, I can estimate $PWCOR_{is}$ by the equation

$$PWCOR_{is} = PW_{is}/LSW_{is} \quad (1)$$

where PW_{is} is the present discounted value of the pension wealth for an individual conditional on separation at age *s*, and LSW_{is} is the value of her lump sum withdrawal conditional on separation at age *s*. $NetPW_{is}$ is defined as

$$NetPW_{is} = PW_{is} - LSW_{is} \quad (2)$$

Pension wealth is employed widely in the teacher pension literature (e.g. Costrell and Podgursky, 2009; Costrell and McGee, 2010) and gives the present value of the stream of a teacher's annuity payments discounted for survival probabilities. I use gender-by-race survival rates to discount annuity payments. Discounting the stream of future payments back to the point of separation allows comparability between the values of both *PW* and *LSW* at a single point. Pension wealth is defined by:

$$PW(S) = \sum_{R \geq S} \frac{Ben(R|S) \cdot Surv(R|S)}{(1+r)^{(R-S)}} \quad (3)$$

where *Ben(R|S)* is the value of the annuity, collectible at age *R* conditional on separating at age *S*. In words, the pension wealth for a teacher eligible for an annuity at age *R* who separates from

[44] This claim refers to distributions of refundable contributions. It is possible for TRS members to file multiple refund claims during her career. I observe 13 individuals hired after 1980 that filed multiple claims and exclude them.

service at age *S* is the sum of the stream of annuity payments, weighted by conditional survival probabilities, *Surv(R|S)*, and discounted back to the present at rate *r*.

For most of the analysis, I assume the real rate of return at 4 percent and inflation at 2.5 percent.[45] TRS assumes a 5.0 percent real interest rate in its actuarial valuations.[46] It is important to note that PW depends on an assumption for the interest rate. A lower interest rate implies larger *NetPW* and *vice versa*. My assumption is the same rate employed by Koedel, Ni, and Podgursky (2014). Coile and Gruber (2007) and Coile et al. (2002) find that higher discount rates (they use 6 percent) are associated with early Social Security benefit claims. As this paper's analysis attempts to model behavior, discount rates higher than risk-free rates (e.g. 2 percent) are indicated in this setting.[47]

Computation of the second component of *PWCOR*, the refund amount, is straightforward. For a teacher separating at year *t* after *T* years of service, it is simply the sum of products of each year's observed salary ($salary_t$) and the effective refund rate (c_t):[48]

$$LSW_T = \sum_{t=1}^{T}(c_t)(salary_t) \quad (4)$$

It is important to note that the analysis does not account for the value of retiree health insurance (RHI). Clark, Morrill, and Vanderweide (2013) estimate the present discounted value of RHI for employees in North Carolina at between $37,000 and $48,000, depending on age and gender. Including RHI would raise the value of deferred benefits, and the gap between the values

[45] The average change in CPI over the sample period is 2.43 percent, close to the 2.5 percent I assume in this analysis.
[46] Starting in FY2014, TRS lowered its assumed nominal rate of return from 8.5 percent to 8.0 percent (TRS, 2012). The assumed real interest rate decreased from 5.0 percent to 4.75 percent.
[47] I also report results based on 2 percent and 6 percent assumptions.
[48] The effective refund rate increased from 8 percent to 8.4 percent after FY2005.

of total benefits and refund will likely be substantially larger than *NetPW* alone. Therefore, estimates of the key control variables in this analysis represent a lower-bound.

Finally, because *PWCOR* and *NetPW* depend on assumptions about the interest rate, I use an alternative measure of the relative values of benefit options, *IROR*. This measure computes the rate that equalizes the stream of annuity payments with the teacher's lump sum refund, conditional on separation at age *s*. In other words, *IROR* provides the rate that renders the net present value of all cash flows (i.e. both the refund distribution and the stream of annuity payments) to be zero. Thus, *IROR* solves the following equation:

$$-LSW_{is} + \sum_{t=s+1}^{100} \frac{Ben_{it} \cdot Surv(\cdot)}{(1+IROR)^{t-s}} = 0 \qquad (5)$$

where *s* denotes an individual's separation age. I consider cash flows up to age 100.[49] A higher *IROR* implies a more desirable annuity. Although an individual teacher's personal discount rate (denoted *PDR*) is unobserved, one may infer a general relationship between teachers' intertemporal tastes and *IROR*. If *IROR* > *PDR*, then theory predicts that she takes the annuity, *ceteris paribus*. If *IROR* < *PDR*, then one expects that she will take a lump sum refund.

Inactive teachers who cash out may do so with the intention of changing jobs and using at least a portion of their account to purchase additional service credit in another pension system. In this case, it is unclear if estimates of *PWCOR* and *NetPW* will be understated or overstated. They will be understated if she actually earns a larger benefit, which is possible if she continues

[49] Because the mortality tables used for this analysis indicate that the probability of dying between any age after 100 is 1, I assume that annuitized teachers receive payments until age 100.

service in a reciprocal system.[50] Estimates will be overstated if she earns a lower benefit from working in a different system, which is likely if there is no reciprocity across pension plans (Costrell & Podgursky, 2010). Unfortunately, my data do not allow me to observe this activity for teachers leaving the state, though I do observe movement from TRS to other reciprocal retirement systems within Illinois.

Because ratios possess idiosyncratic mathematical properties, I include *NetPW* as an alternative measure for quantifying the tradeoffs in benefit choices. Teachers who opt for a refund near or at retirement eligibility may experience significant or unusual life events that drive their decision. For instance, various life shocks or emergencies may necessitate immediate cash. Thus, I estimate choice models using samples that restrict separations up to age 50.

Behavioral Model

Studies show that earned service credit, separation age, and earnings are important predictors of cashout decisions (Mottola and Utkus, 2007; Banerjee, 2013). Thus, I include these variables in a series of choice models to estimate the propensity to cash out. I estimate the primary models using logit regression.[51] Defining CO_i=1 if teacher i takes a lump sum withdrawal and CO_i=0 if she leaves her refundable contributions in the pension fund, I express the behavioral model as:

$$CO_i = \alpha + \beta age_i + \gamma YOS_i + \delta salary_i + \rho \boldsymbol{X}_i + \theta \boldsymbol{T}_i + \kappa \boldsymbol{S}_i + \pi \boldsymbol{D}_i + \lambda after2008_i + \varepsilon_i \qquad (6)$$

[50] This assumes that her service credits transfer and she earns about the same salary as when she exited TRS. If she ends up with a lower final average salary than if she remained in TRS, her pension benefits will be lower under the same benefit formula.
[51] I also report results for probit and linear probability models.

where age_i is teacher i's age at separation, YOS_i indicates years of service, and $salary_i$ represents earnings for determining retirement benefits. The vectors $\boldsymbol{X}_i$, $\boldsymbol{T}_i$, $\boldsymbol{S}_i$, and $\boldsymbol{D}_i$, denote individual, professional, school, and district characteristics, respectively, and include gender, race/ethnicity, school level taught, endorsement areas, post-secondary education, a districts' urbanicity, and district level student demographics. The last term, ε_i, is a stochastic error term. I also include an indicator for years after FY2008, when the financial crisis occurred, because this economic shock impacted countless individuals' retirement accounts in the private sector and subsequently may have affected salaries, job prospects, and retirement decisions for workers in both private and public sectors. On one hand, the recession likely increased the pool of cash-constrained individuals and households and subsequently increased the demand for cash now (and the likelihood for cashing out). On the other hand, the recession may have dampened people's perceptions about financial markets, increased concern about putting money in financial institutions, or changed people's risk preferences. Because an annuity is generally much less risky than cashing out, the recession plausibly increased annuity demand.

Specification (6) does not account for the idiosyncratic incentives typically found in FAS DB plans and, therefore, may yield biased estimates. For these reasons, I also estimate choice models that replace the set of controls age_i, YOS_i, and $salary_i$ with $PWCOR_i$, $NetPW_i$, or $IROR_i$, to capture these factors.[52] Moreover, controlling for *PWCOR, NetPW*, and *IROR* affords an economic interpretation for cashout-related decisions whereas *age, YOS*, and *salary* do not convey information about the tradeoffs related to distribution choices.

[52] Replacing the set {age, YOS, and salary} rather than adding them with PWCOR, NetPW, or IROR avoids over-controlling, as the latter group of variables are largely determined by age, YOS, and salary.

A simple illustration of distribution choice tradeoffs

PWCOR and *NetPW* quantify the financial tradeoffs that vested teachers face in making refund/annuity decisions and convey the extent to which deferring an annuity is financially favorable or unfavorable relative to cashing out, *ceteris paribus*.[53] Recall Figure 2, which illustrates these tradeoffs for a representative female teacher in Illinois who begins working in the Springfield public school district at age 25 under Tier 1. The solid line represents pension wealth accrual over the course of a career, and each point represents the present value of her annuity accrued up to that point in service. The dashed line gives the refund amounts for each separation age under the current plan. Differences between the benefits are striking.

This teacher does not accrue any PW until she vests after 5 years. Thus, LSW exceeds PW early in her career, though the gap between the two benefits is quite small. PW quickly overtakes the refund benefit, however, where the crossover point occurs after age 34 (9 YOS). The gap (or *NetPW*) after the crossover point widens at a very rapid rate. *NetPW* reaches nearly $25,000 by age 40 and doubles in three years after that. It doubles again to $103,000 three years later. By age 50, *NetPW* is over $190,000. The gap peaks at age 60, reaching $560,000. Individuals experiencing life events that require immediate cash face difficult choices and huge potential capital losses under this current plan.

[53] I do not claim that these decisions are irrational because I cannot view the life circumstances surrounding teachers' decisions. The extent to which households are cash constrained, expectations about life span, and bequest motives are all likely to weigh on decisions. The key measures used in this analysis offer an interesting and unique way to quantify the tradeoffs that teachers face when making refund/annuity decisions.

Data

This analysis relies on three sources of data: detailed individual-level longitudinal data obtained from the Illinois Teachers' Retirement System (TRS) and the Illinois State Board of Education (ISBE); and enrollment data from the National Center for Education Statistics (NCES). TRS and ISBE each provide unique identification numbers which enable reliable tracking of teachers over time. ISBE staffing records are necessary in order to identify classroom teachers because TRS does not track its members' employment positions. I merge TRS and ISBE data by matching on name, employer (school district), gender, creditable earnings, and years of creditable service. ISBE provides state-specific and NCES-specific district codes which allow me to link the main data with NCES data.

TRS data include detailed information including full name, employer (school district), gender, creditable earnings, years of service, member status, hire date and age, separation date and age, types of retirement benefits, final average salary, refund amount, service credit purchases, sick leave, disability claims, extra service credit, and individuals' full earnings histories. In addition, the data include detailed information on refunds including the type of refund claim, whether refunds are rolled over into a retirement account, and the type of account

(e.g. 401K, Roth IRA, 408A/408B, etc.).[54] Finally, TRS data identifies inactive members who separated from TRS and entered service in a reciprocal Illinois retirement system.[55]

ISBE administrative data includes each teacher's full name, employer, gender, creditable earnings, years of experience, position, type of employment, full-time equivalency, race/ethnicity, post-secondary education degrees, degree-granting institutions within Illinois, and teaching endorsements. NCES data at the district level include total enrollment, urbanicity, free-reduced lunch (FRL) program enrollment, English language learner (ELL) enrollment, Individual Education Plan (IEP) enrollment, and pupil-teacher ratios. I impute missing categorical enrollment data with a simple means imputation method. I also control for college quality where I define elite institutions within Illinois as those ranked in the Top-50 by U.S. News and World Report. Unfortunately, this measure is somewhat noisy because ISBE data do not identify attendance at colleges and universities outside of Illinois.

These data and the analytic setting lend several advantages to an analysis on the determinants of refund-related decisions. First, I directly observe the parameters that TRS uses for determining benefits and important factors that affect retirement decisions and benefits. Thus, I can precisely estimate an individual's pension wealth accrued up to any point in her career while accounting for survival probabilities. Moreover, because benefit choices involve large stakes, I expect teachers to spend more time and careful thought on their decisions than in a

[54] Data on rollovers and separation age allow me to adjust refund claims for taxes and early withdrawal penalties, thus arguably allowing a more precise estimate of the tradeoffs that face teachers when choosing a benefit. On the other hand, these adjusted refunds could be measured with error because teachers can still avoid the 20 percent non-rollover tax if they do not roll over their refunds through TRS. As long as a teacher makes his own arrangements to roll over a refund within 60 days of receiving it (which I do not observe), he will not incur the 20 percent tax by doing this.

[55] TRS classifies a member as "Inactive" if she leaves the system and does not return after one year.

laboratory setting. Second, while economic theory suggests additional sources of retirement income, such as lifetime payments from Social Security, as an important determinant of annuitization decisions, TRS does not contribute to Social Security. Thus, an analysis on retirement decisions by TRS members mitigates this source of endogeneity.[56,57] Finally, as no studies to date have systematically examined refund/annuity choices by public school teachers as a standalone group, this paper offers the first systematic examination of cash-out-related decisions by this important group.

Sample for Behavioral Analysis

This analysis focuses on vested teachers enrolled in TRS who quit service as a full-time teacher[58] and excludes teachers who entered the workforce under Tier 2 because they have not vested yet.[59] Teachers in the Chicago Public School District belong to a separate pension fund, the Chicago Teachers' Pension Fund. I do not observe the complete set of records for Illinois teachers that spent all or part of their time there and exclude them from the analysis as well. I also exclude movers, defined as inactive members who left TRS to continue working in a

[56] See Footnote 8 in Chapter 1 for details.
[57] I do not observe households with other sources of retirement income, including spouses with Social Security. For two-person households, retirement decisions are usually made at the household level rather than the individual level. Incomplete data that does not include information on spouses pose an obstacle for many analyses on annuity decisions, and I acknowledge this limitation.
[58] Teachers not vested do not receive an opportunity to choose a deferred lifetime annuity. TRS offers its non-vested members the option to collect a "Single-Sum Refund," a lump sum disbursement actuarially equivalent to an annuity starting at age 65 based on the formula

$$Annuity = (0.0167)*(FAS)*(YOS).$$

This analysis excludes the 0.24 percent of teachers who received this benefit.
[59] Members entering on or after January 1, 2011 are automatically enrolled under Tier 2. Under this plan, the vesting requirement doubles to 10 years.

reciprocal system because data pertains to members' time while working under TRS.[60] Because ISBE staffing data start in FY 1980, the analysis examines teachers hired in or after FY 1980. Finally, the sample includes teachers who quit during the period 2002-2011.[61] In the working sample, I observe 27 percent of teachers choosing to cash out, whereas the cashout rate for all vested classroom teachers is 36 percent.[62]

Summary Statistics

This section discusses summary statistics for the key control variables and demographic differences between refund claimants and annuitants. Table 6 provides rates of distribution choice by individual, professional, school, and district characteristics. Teachers who leave in their 20's annuitize at a 69 percent rate. This rate rises for teachers who separate in their 30's and 40's to about 75 percent, but then drops back to the 69 percent for teachers who leave after age 50. This latter decline, however, likely reflects teachers who entered service at an older age and left with fewer service accruals. Annuitization rates increase with service years. These patterns also reflect the fact that service years more directly determine the level of benefits rather than age.

[60] Data for teachers who move from a reciprocal system to TRS include service credits earned and reported under their previous plan. Identifying this group of movers is not necessary for the analysis.
[61] Data on FRL, a widely-used proxy for students' family incomes, is not available prior to 2002.
[62] The working sample represents 40 percent of TRS members who ever taught and are observed as inactive or refund claimants.
Of all TRS vested members (including non-classroom teachers) hired since 1980, I observe 21,379 members as inactive or claiming a refund. Within this group, 36 percent cashed out their refunds. This excludes 1,873 inactive members who left TRS for a reciprocal Illinois pension system.

About 60 percent of males annuitize, significantly lower than the 76 percent of females who do so. Lower annuity rates also occur among African American and Hispanic teachers, high school teachers, teachers with less post-secondary education, and teachers in rural districts. Higher annuity rates are observed among teachers who are female, white or Asian, teach in grades PK-8, graduated from an elite college in Illinois, and teach in a suburban and city school districts. Overall, these observations are consistent with other studies that observe higher cashout rates among males, minority groups, and individuals with less education (e.g. Warner & Pleeter, 2001; Klawitter, Anderson, and Gugerty, 2012; Mottola and Utkus, 2007). *Ceteris paribus*, members of a group that is more likely to cash out, on average, have higher discount rates. Thus, the findings above are also consistent with studies that find higher discount rates among individuals who are male, minority, and have less education (Warner & Pleeter, 2001; Cunha & Menichini, 2014).

Table 6: Distribution choice rates by individual, professional, school and district characteristics

	ANNUITANTS		REFUND CLAIMANTS	
	Rate	# obs	Rate	# obs
Overall	0.73	4,434	0.27	1,624
Separation age				
exit age 20-29	0.69	783	0.31	346
exit age 30-39	0.75	2,624	0.25	880
exit age 40-49	0.74	728	0.26	261
exit 50 and over	0.69	299	0.31	137
Tenure				
5-10 YOS	0.71	3,304	0.29	1,350
10-15 YOS	0.79	946	0.21	248
15-20 YOS	0.87	167	0.13	26
20 and up YOS	1.00	17	0.00	0
Gender and race/ethnicity				
Female	0.76	3,777	0.24	1,179
Male	0.60	657	0.40	445
White	0.74	4,172	0.26	1,457
Black or African American	0.46	69	0.54	81
Hispanic or Latino	0.63	120	0.37	69
Asian, Pacific Islander, or Hawaiian	0.81	71	0.19	17
School Level Taught				
PK-8	0.74	2,809	0.26	986
HS	0.71	981	0.29	410
SPED	0.74	644	0.26	228
Post-secondary school				
Bachelor's degree	0.73	3,839	0.27	1,412
Graduate degree	0.74	594	0.26	210
not IL elite college or out-of-state	0.72	3,997	0.28	1,521
IL elite college (Top 50 national)	0.81	437	0.19	103
out-of-state school	0.74	1,276	0.26	457
in-state school	0.73	3,158	0.27	1,167
Endorsements				
Art	0.73	301	0.27	111
ELA	0.75	1,035	0.25	351
Foreign language	0.73	290	0.27	106
Math or Science	0.74	574	0.26	204
Social Science	0.74	982	0.26	347
Vocational	0.75	104	0.25	35

Table 6: Distribution choice rates by individual, professional, school and district characteristics (Cont.)

	ANNUITANTS		REFUND CLAIMANTS	
	Rate	# obs	Rate	# obs
District urbanicity				
City	0.73	632	0.27	231
Suburb	0.75	2,657	0.25	881
Rural or town	0.69	1,145	0.31	512

Table 7: Summary statistics by distribution choice, individual, professional, and district characteristics

	Refund-claimants (n=1,624)				Annuitants (n=4,434)				
	mean	**SD**	**min**	**max**	**mean**	**SD**	**min**	**max**	t-test sig
PWCOR	0.87	0.62	0.29	4.42	0.88	0.59	0.34	5.08	
Net PW	-1,901	19,759	-28,355	187,856	-366	25,665	-28,083	427,207	**
PW at sep'n	25,603	25,944	2,414	254,525	30,065	34,578	5,048	531,891	***
LSW	27,504	12,127	6,356	151,912	30,431	14,019	8,493	137,926	***
IROR	0.037	0.029	0.011	0.284	0.037	0.024	0.013	0.364	
hire age	27.0	7.2	20.0	61.0	25.9	6.1	20.0	59.0	***
separation age	35.8	7.8	25.0	69.0	35.5	7.1	26.0	68.0	
YOS	7.7	2.5	5.0	19.8	8.3	3.0	5.0	23.3	***
earnings (2011 dollars)	39,090	7,495	2,572	70,768	39,099	7,805	1,786	104,994	
Dist enrollment	7,050	8,858	21	41,446	6,547	8,009	21	41,446	**
Dist pupil-teacher ratio	16.3	4.1	1.0	121.0	16.2	2.5	0.6	25.4	
Dist % IEP	0.157	0.036	0.000	0.358	0.156	0.034	0.000	0.322	
Dist % FRL	0.340	0.231	0.002	0.987	0.318	0.225	0.002	0.985	***
Dist % Native Am	0.002	0.004	0.000	0.070	0.002	0.008	0.000	0.288	
Dist % Asian	0.038	0.053	0.000	0.364	0.045	0.060	0.000	0.441	***
Dist % Hispanic	0.162	0.205	0.000	0.954	0.164	0.202	0.000	0.955	
Dist % Black	0.142	0.222	0.000	0.995	0.125	0.198	0.000	0.996	***
Dist % white	0.635	0.300	0.000	1.000	0.641	0.283	0.000	1.000	

The last column indicates the significance of t-test results where *** p<0.01, ** p<0.05, * p<0.1; pension wealth is computed in 2011 dollars and are based on 4 percent real rate of return and 2.5 percent inflation assumptions plus gender- and race-specific survival probabilities from the CDC's 2007 Life Tables; they are not adjusted for taxes or early withdrawal penalties; statistics are based on sample that includes all separation ages. Sample includes TRS members hired in or after 1980 who quit working as a full-time teacher during 2002-2011, who vested in the system, and who never worked in the City of Chicago Public Schools district; sample excludes teachers who left TRS and continued work in another Illinois reciprocal retirement system.

Table 7 provides summary statistics of retirement and district-level variables for the refund claimants and annuitants groups. Refund claimants, on average, accrue $25,603 in PW while annuitants accrue $30,065. The average refund credited to members, $27,504, is $1,901 more than the present discounted value of the annuity they could receive. The average *PWCOR* for refund claimants is 0.87, implying that the value of their refund is 13 percentage points more than pension wealth accrued. These numbers mask substantial variation across age and tenure, however, which I discuss later.

While *PWCOR* and *NetPW* provide estimates for the gap between one's PW and refund evaluated at the quit point, they do not allow for inferences about teachers' rationality. Decisions at the individual level are made according to one's personal discount rate, among other factors.[63] One interpretation of *PWCOR* relates individuals' time preferences to the assumption about the real rate of return. Teachers who cash out when *PWCOR*>1 reveal that their personal discount rate exceeds the assumed rate. One can also compare *PWCOR* and *NetPW* measures across teachers. For instance, a teacher who cashes out with a higher *PWCOR* (or higher *NetPW*) likely has a higher internal discount rate than teachers with lower *PWCOR* (*NetPW*) values. Thus, *PWCOR* and *NetPW* provide measures that relate teachers' time preferences to the assumed discount rate. A lower assumed rate will increase PW, thereby increasing *PWCOR* and *NetPW* for individuals. This will have the effect of increasing the number of teachers with positive *NetPW* and *vice versa*.

[63] In the case of two-income households, retirement decisions are commonly made at the household level where spousal and family circumstances influence retirement decisions. Unfortunately, data on marriage status is not collected by ISBE or TRS to allow control for household factors. I acknowledge this limitation in the analysis. TRS provided information about maternity leave credit purchases since 2004, though none of the teachers in the sample made these purchases.

Relative to annuitants, the average refund claimant starts teaching in Illinois about one year older and accrues about 0.7 fewer service credits. Although statistically significant, these differences are economically small. The average refund claimant also works in a slightly more challenging district characterized by a larger district enrollment and larger proportions of FRL and minority students. Again, these differences are significant but small.

Table 8 breaks down the proportions of annuitants and refund claimants by positive and negative pension wealth under different real rate of return assumptions (2 percent, 4 percent, and 6 percent).[64] As expected, the number of teachers with positive *NetPW* decline as the assumed interest rate increases. For each interest rate shown, mean *NetPW* for refund claimants is considerably higher than mean *NetPW* for annuitants. Mean *NetPW* varies little across interest rates for positive *NetPW* separations, though it varies considerably for the negative *NetPW* group. The magnitude grows with the discount rate, increasing from about -$1,700 at a 2 percent discount rate assumption to about -$17,000 at a 6 percent discount rate. A higher discount rate decreases PW which subsequently increases the gap in the negative *NetPW* region (i.e. the region to the left of the crossover point in Figure 2).

[64] Table 8 and Table 9 are based on a sample that includes all classroom teachers hired since 1980. This sample is larger than the one used for Table 6 and Table 7, which is based on classroom teachers who also have information about district factors.

Table 8: Cashout and deferral rates for teachers who separate with negative and positive net pension wealth under different real rate of return assumptions*

		r=0.02		r=0.04		r=0.06	
		Cashouts	Annuitants	Cashouts	Annuitants	Cashouts	Annuitants
Net PW>0	number	4,168	8,856	1,285	2,759	547	1,234
	rate	32.0%	68.0%	31.8%	68.2%	30.7%	69.3%
	mean NetPW	$25,909	$40,043	$28,067	$49,836	$28,719	$54,483
Net PW<0	number	1,184	904	4,067	7,001	4,805	8,526
	rate	56.7%	43.3%	36.7%	63.3%	36.0%	64.0%
	mean NetPW	-$1,692	-$1,501	-$9,124	-$9,183	-$15,019	-$16,696

* Pension wealth values are reported in 2011 dollars. The sample includes all classroom teachers (n=15,112) who were hired since 1980 and includes separations at all ages until 2011. It excludes teachers who left TRS and continued covered work under a reciprocal Illinois pension system. Under the assumptions of 4 percent and 6 percent interest, Chi-square contingency tests ($\chi 2$=31.99 and $\chi 2$=19.52, resp.; 1 degree of freedom) reject the null hypothesis at α=0.01 that the decision to cash out is independent of whether NetPW is positive or negative. Thus, the test result lends evidence of a relationship between the benefit decision and NetPW.

Economic theory predicts that teachers who separate from service with positive *NetPW* will choose to defer an annuity. Depending on assumptions about the discount rate, between 30.7 percent and 32.0 percent of teachers who quit with positive pension wealth choose to cash out.[65] This finding lends itself to the annuity puzzle observed in many settings. On average, the value of *NetPW* is roughly $26,000 to $28,000 for refund claimants. On the other hand, I expect that teachers who quit with negative *NetPW* choose to cash out; yet, the data indicate that between 43.3 and 64.0 percent of teachers who quit with negative *NetPW* opt to defer a pension (depending on the discount rate). These deferral rates are lower than those observed among vested public school teachers and other educational professionals in North Carolina, where about 80 percent leave their refunds with the pension fund (Clark, Morrill, & Vandermeade, 2013).

[65] Numerous reasons might explain why individuals may choose to cash out. For example, an individual or household may be credit-constrained, perhaps for unexpected medical reasons or debt, or other shocks may occur in life requiring immediate financial resources. Alternatively, preferences for current consumption may be stronger than preferences for future consumption.

NetPW for this group in TRS is somewhat modest, however, ranging up to about -$17,000 under a 6 percent real interest. A perhaps more interesting story unfolds after breaking down these tradeoffs for different age groups.

Table 9 breaks down *NetPW* by separation age and tenure groups and demonstrates the effect of backloading on the tradeoffs between benefit choices. Figure 4 provides a supplemental visual of this phenomenon by plotting *NetPW* against separation age (panel a) and YOS (panel b). Recall Figure 2, which graphs the PW accrual and refundable contributions over time for a stylistic teacher and clearly shows that the gap grows at an increasing rate at the back end of the teacher's career. That is, the gap is increasing in YOS. The mean unadjusted *NetPW* for teachers who exit in their 20's and 30's (72 percent of refund claimants combined) is -$10,136 and -$8,671, respectively. Mean *NetPW* increases to $12,538 for refund claimants leaving in their 40's (20 percent of refund claimants). For refund claimants separating at age 50 and after, or 8 percent of refund claimants, the cost is large. This group forgoes on average $50,700 in PW by taking a refund.

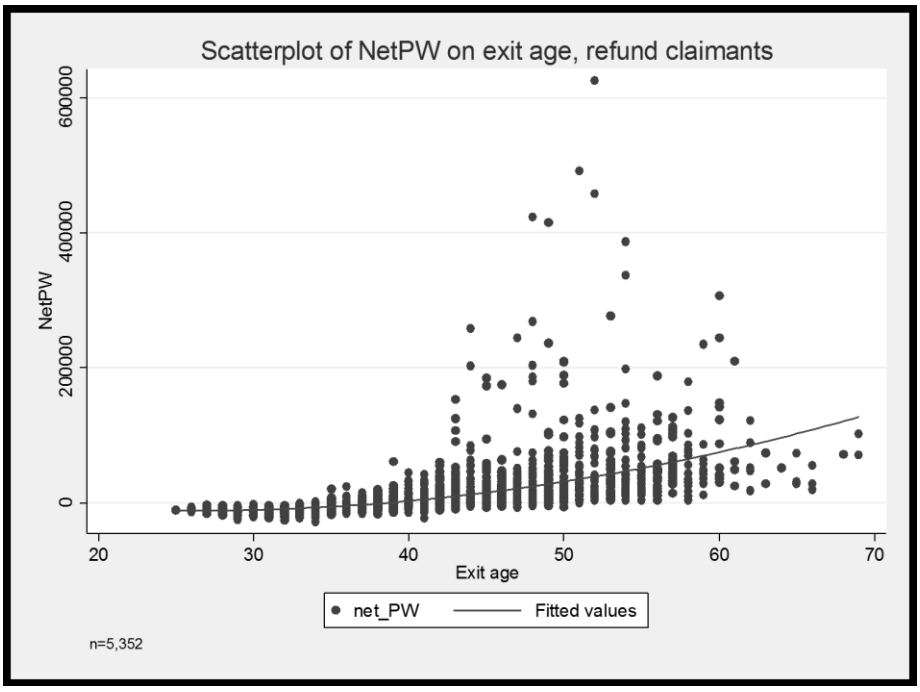
Almost all refund claimants leave TRS before reaching 20 YOS. Mean *NetPW* for the 16 percent of refund claimants who leave with 10 to 15 YOS is $10,619. Only 4 percent of refund claimants exit with longer service. Although teachers in this group comprise only a very small portion of refund claimants, they nonetheless opt for a benefit that is dwarfed by a deferred benefit. Teachers with 15 to 20 YOS average $33,556 in *NetPW* ($46,000 after adjusting for taxes).

Table 9: NetPW by separation age and tenure groups*

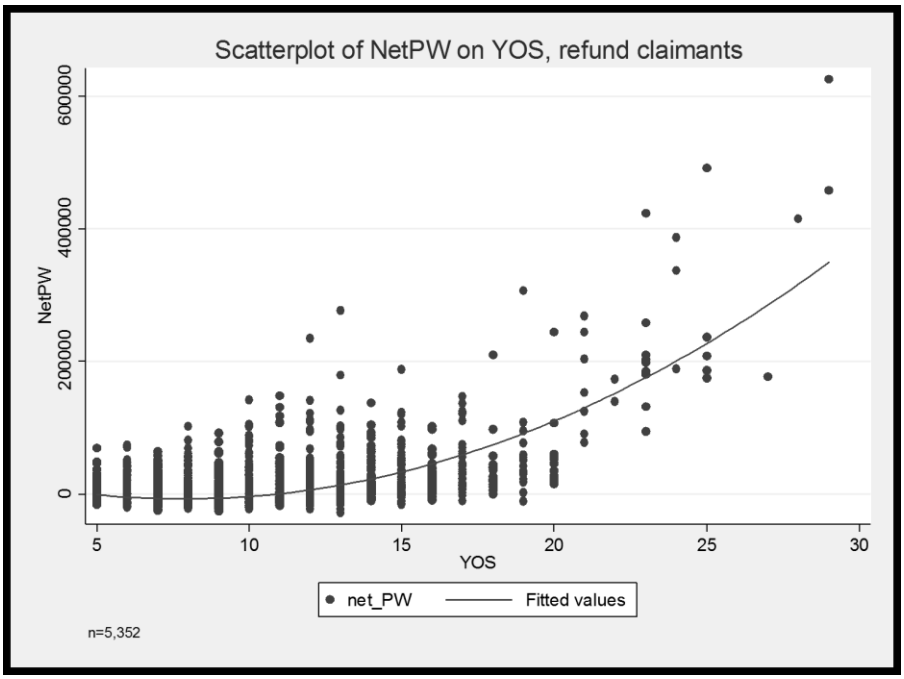
	Refund claimants (n=5,352)						Annuitants (n=9,760)			
			(1) Unadjusted		*(2) Adjusted*					
Age group	n	%	mean	sd	mean	sd	n	%	mean	sd
age 20 to 29	1,116	21%	-10,136	2,422	-6,783	3,260	1,548	16%	-10,798	2,489
age 30 to 39	2,754	51%	-8,671	5,100	-3,647	7,077	5,433	56%	-7,838	6,417
age 40 to 49	1,074	20%	12,538	32,190	19,610	34,957	2,025	21%	32,622	68,879
age 50 and up	408	8%	50,700	64,013	56,746	67,828	754	8%	88,125	129,092
Tenure group										
5-10 YOS	4,327	81%	-5,302	11,965	-1,037	12,546	6,743	69%	-6,099	11,769
10-15 YOS	830	16%	10,619	31,147	18,518	32,703	2,177	22%	10,231	31,745
15-20 YOS	162	3%	33,556	39,828	45,959	41,212	612	6%	47,564	57,177
20 and more YOS	33	1%	231,789	130,809	250,684	137,154	228	2%	276,083	169,777

* For refund claimants, panel (2) reports NetPW adjusted for taxes and penalties; pension wealth calculations are based on a 4 percent real interest rate, 2.5 percent inflation, and reported in 2011 dollars

Figure 4: Plots of net pension wealth on separation age and YOS



(a) Exit age



(b) Years of service

Table 10: Mean PWCOR, NetPW, and IROR by individual, professional, school, and district characteristics

	REFUND CLAIMANTS				ANNUITANTS			
	n	PWCOR	Net-PW	IROR	n	PWCOR	Net-PW	IROR
Full sample	1,624	0.87	-1,901	0.037	4,434	0.88	-366	0.037
Separation age group								
exit 20-29	346	0.46	-11,073	0.021	783	0.47	-11,113	0.022
exit 30-39	880	0.65	-9,042	0.028	2,624	0.69	-8,293	0.029
exit 40-49	261	1.27	10,064	0.049	728	1.36	17,116	0.052
exit 50 and up	137	2.51	44,338	0.113	299	2.46	54,777	0.104
YOS group								
5-10 YOS	1,350	0.79	-4,884	0.034	1,350	0.79	-4,884	0.034
10-15 YOS	248	1.23	10,256	0.050	248	1.23	10,256	0.050
15-20 YOS	26	1.58	37,007	0.063	26	1.58	37,007	0.063
Gender and race/ethnicity								
Female	1,179	0.87	-1,784	0.037	3,777	0.87	-786	0.036
Male	445	0.86	-2,211	0.037	657	0.93	2,051	0.038
White	1,457	0.84	-2,737	0.036	4,172	0.87	-704	0.036
Black	81	1.00	3,682	0.046	69	1.05	2,000	0.046
Hispanic	69	1.28	8,782	0.051	120	1.30	12,153	0.051
Asian, Pacific Islander, or Hawaiian	17	0.85	-223	0.036	71	0.77	-4,374	0.033
School level								
PK-8	986	0.85	-2,136	0.036	2,809	0.86	-1,202	0.036
HS	410	0.84	-3,307	0.036	981	0.92	1,538	0.038
SPED	228	1.00	1,645	0.043	644	0.91	379	0.039
Endorsement area								
art	111	0.82	-3,517	0.035	301	0.88	837	0.036
ELA	351	0.88	-755	0.038	1,035	0.90	80	0.037
foreign language	106	0.89	-93	0.038	290	0.87	-1,043	0.037
math or science	204	0.87	-2,438	0.038	574	0.86	-1,105	0.036

Table 10: Mean PWCOR, NetPW, and IROR by individual, professional, school, and district characteristics (Cont.)

	REFUND CLAIMANTS				ANNUITANTS			
	n	PWCOR	Net-PW	IROR	n	PWCOR	Net-PW	IROR
social science	347	0.87	-1,759	0.038	982	0.86	-1,109	0.036
vocational-related	35	0.96	299	0.043	104	0.93	1,435	0.039
Post-secondary education								
Graduate degree	210	1.08	4,347	0.047	594	1.15	9,882	0.047
Bachelor's degree	1,412	0.83	-2,861	0.035	3,839	0.84	-1,955	0.035
Degree from elite college in IL	1,521	0.88	-1,546	0.037	3,997	0.89	-26	0.037
Degree not from elite college in IL	103	0.71	-7,150	0.030	437	0.79	-3,475	0.034
out-of-state college	457	0.97	338	0.041	1,276	0.95	1,921	0.039
in-state college	1,167	0.83	-2,778	0.035	3,158	0.85	-1,290	0.036
Urbanicity								
City	231	0.88	-1,168	0.038	632	0.90	-288	0.037
Suburb	881	0.85	-2,631	0.036	2,657	0.85	-1,352	0.035
Rural or town	512	0.89	-976	0.037	1,145	0.94	1,878	0.039

Pension wealth calculations are based on 4 percent real rate of return, 2.5 percent inflation, and converted to 2011 dollars; all computations are based on gender-by-race survival probabilities from the CDC's 2007 Life Tables

Table 10 presents *PWCOR, NetPW*, and *IROR* means by subgroup for refund claimants and annuitants. For refund claimant groups with *PWCOR* values less than 1, average personal discount rates fall below 4 percent on average, and *vice versa*. As discussed above, *NetPW* is increasing in age and YOS (Figure 4). Similar patterns occur with *PWCOR* and *IROR*.[66] Female teachers have a slightly higher *PWCOR* than male teachers while African American and Hispanic teachers have a significantly higher *PWCOR* than white and Asian teachers. Black and Hispanic teachers on average cash out when the present discounted value of their annuity is equal to 100 percent and 128 percent of the value of their refund claim. Special education teachers, teachers with a graduate degree, teachers who attended college out of state, and teachers who work in rural and city districts also exhibit higher *PWCOR* scores than their respective counterparts.

I also include *IROR* as an alternative measure as it does not rely on assumptions for the interest rate. Among refund claimants, African American and Hispanic teachers display higher *IROR* values than white teachers. The rates for black and Hispanic teachers are about 1.0 and 1.5 percentage points greater than white teachers, respectively. The average *IROR* for special education teachers is about 0.7 percentage points higher than PK-8 teachers. Teachers working in suburban districts have lower *IROR*s than teachers in rural and city districts, possibly reflecting higher salaries or more favorable credit markets in non-rural settings. Finally, the rate for teachers with a graduate degree is 1.2 percentage points higher than teachers with Bachelor's degrees. This difference seems counterintuitive and contradicts findings in the literature, which finds discount rates decreasing in educational attainment. These statistics are merely descriptive, however, and likely do not capture other potentially important factors that might explain

[66] Figure A.1 and Figure A.2 in Appendix A produce fitted scatterplots for PWCOR and IROR on YOS.

differences across subgroups. For instance, individuals from high-income households may have a stronger tendency to obtain graduate degrees than individuals from lower-income households. Moreover, pension benefits are a function of salary and tenure, which are usually affected by teachers with graduate degrees.

Summary

About 36 percent of teachers opt to cash out their refundable contributions while 64 percent defer an annuity. Descriptive statistics suggest lower annuity rates among male teachers, African American and Hispanic teachers, teachers with less post-secondary education, and teachers in rural settings. Thus, these teachers, on average, have higher internal discount rates. Overall, these observations parallel findings in other studies in the annuitization literature, though they are merely descriptive. The next chapter presents results of the main behavioral analysis.

Chapter 4: Results and Discussion

This chapter begins by reporting and discussing results from the main behavioral models, which consist of logit regressions on teachers who separated before age 50. Because teachers who separate closer to retirement eligibility and choose to cash out are arguably unusual, I focus on the restricted sample. I also estimate models on the unrestricted sample for comparison. The key analytic controls include the pension-wealth-to-cash-out-ratio (*PWCOR*), net pension wealth (*NetPW*), and the internal rate of return (*IROR*) variables. By including them in the behavioral models, I am able to account for the complex interplay between tenure, age, and salary that occurs in determining financial incentives in the pension plan. This chapter then supplements these results with model estimations based on samples not restricted by age and under different discount rates. It finishes by estimating the amount of money that members of the Illinois Teachers' Retirement System (TRS) "leave on the table." The choice variable in the behavioral models is the decision to cash out or leave one's refundable contributions in the pension fund and is observed for each TRS member. Results for logit and probit regressions report marginal effects at the mean. Where appropriate, tables include a column for covariates' means, where marginal effects are evaluated.

Table 11: Results for logistic regressions, separations under age 50 (dependent variable = decision to claim refundable contributions)

	mean	(1)	(2)	(3)	(4)
Age At Separation	34.24	0.001			
		(0.001)			
Total Service	8.08	-0.021***			
		(0.003)			
Salary, in ten thousands	2.92	-0.015			
		(0.011)			
PWCOR	0.75		-0.095***		
			(0.018)		
Net PW, in ten thousands	-0.48			-0.023***	
				(0.005)	
IROR	0.03				-2.955***
					(0.536)
after_2008	0.35	-0.018	-0.026**	-0.026**	-0.024*
		(0.014)	(0.013)	(0.013)	(0.013)
Female	0.82	-0.162***	-0.148***	-0.148***	-0.144***
		(0.018)	(0.018)	(0.018)	(0.018)
Black	0.02	0.267***	0.271***	0.271***	0.269***
		(0.048)	(0.048)	(0.048)	(0.048)
Hispanic	0.03	0.066*	0.098**	0.089**	0.098**
		(0.039)	(0.041)	(0.041)	(0.041)
Asian	0.01	-0.069	-0.066	-0.067	-0.067
		(0.045)	(0.046)	(0.045)	(0.046)
High school teacher	0.23	0.011	0.005	0.003	0.005
		(0.016)	(0.015)	(0.015)	(0.015)
Special education teacher	0.14	0.000	-0.002	-0.003	-0.001
		(0.018)	(0.018)	(0.018)	(0.018)
Suburb	0.59	0.003	0.005	0.006	0.006
		(0.019)	(0.019)	(0.019)	(0.019)
Rural or town	0.27	0.059**	0.066***	0.067***	0.066***
		(0.024)	(0.023)	(0.023)	(0.023)
Graduate Degree	0.12	0.006	0.023	0.019	0.023
		(0.020)	(0.020)	(0.020)	(0.020)
Degree from elite IL college	0.09	-0.075***	-0.080***	-0.080***	-0.080***
		(0.019)	(0.019)	(0.019)	(0.019)
Degree from in-state	0.72	0.022	0.015	0.017	0.015
		(0.013)	(0.013)	(0.013)	(0.013)
Art	0.07	-0.000	-0.003	-0.002	-0.003
		(0.023)	(0.023)	(0.023)	(0.023)

Table 11: Results for logistic regressions, separations under age 50 (dependent variable = decision to claim refundable contributions) (Cont.)

	mean	(1)	(2)	(3)	(4)
ELA	0.23	-0.016	-0.016	-0.016	-0.015
		(0.016)	(0.016)	(0.016)	(0.016)
Foreign language	0.06	-0.001	-0.005	-0.005	-0.005
		(0.024)	(0.024)	(0.024)	(0.024)
Math or Science	0.13	-0.015	-0.015	-0.014	-0.015
		(0.018)	(0.018)	(0.018)	(0.018)
Social Science	0.22	0.001	0.001	0.001	0.001
		(0.016)	(0.016)	(0.016)	(0.016)
Vocational	0.02	-0.036	-0.036	-0.035	-0.036
		(0.038)	(0.038)	(0.038)	(0.038)
Dist enrollment, in thousands	6.63	0.002***	0.003***	0.003***	0.003***
		(0.001)	(0.001)	(0.001)	(0.001)
Dist pupil-teacher ratio	16.22	-0.002	-0.002	-0.002	-0.002
		(0.003)	(0.003)	(0.003)	(0.003)
Dist IEP percent	0.16	0.014	0.023	0.018	0.032
		(0.191)	(0.191)	(0.191)	(0.191)
Dist FRL percent	0.32	0.039	0.046	0.044	0.048
		(0.049)	(0.049)	(0.049)	(0.049)
Dist minority percent	0.29	-0.011	-0.011	-0.010	-0.012
		(0.041)	(0.041)	(0.041)	(0.041)
Assumed real interest rate		--	0.04	0.04	--
Observations		5,622	5,622	5,622	5,622
Pseudo R-squared		0.0419	0.0350	0.0342	0.0355
Log Lik		-3112	-3134	-3137	-3132

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Sample comprises TRS members hired in or after 1980 who quit in or after 2002 as a full-time teacher, and separations up to age 50; sample excludes teachers with a Single Sum Retirement benefit, individuals observed teaching in the City of Chicago PSD, and Inactive teachers who moved into a reciprocal Illinois pension system. Pension wealth is computed in 2011 dollars and based on 4 percent real interest and 2.5 percent inflation. Survival probabilities are based on gender and race/ethnicity.

Table 11 displays marginal effects of logit model estimations for the main sample, which includes teachers who separated up to age 50.[67] Means for each variable are reported in the left-hand side. All columns include individual, professional, school, and district factors. Column (1) includes controls for basic conditions that potentially affect retirement decisions, namely age, tenure, and salary and serves as the baseline model. The other columns correspond to models that control for *PWCOR*, *NetPW,* and *IROR*. These variables are discussed in detail in Chapter 3. Note that columns (1) and (4) do not include any measures of PW and, therefore, do not rely on an assumption about the interest rate. Results for models that control for *PWCOR* and *NetPW* are based on a 4 percent interest rate and 2.5 percent inflation.[68]

Briefly reviewing *a priori* expectations, I anticipate that *PWCOR*, *NetPW*, and *IROR* will exhibit an inverse relationship with the propensity to cash out. An increase in benefits, and therefore increase in pension wealth, make cashing out less desirable than deferring. Higher values of *PWCOR*, *NetPW*, and *IROR* are indicative of higher benefits. Based on research about intertemporal time preferences, I expect teachers who are male, minority, have less education, and work in challenging districts and rural areas to exhibit higher rates of cashing out because these background characteristics are associated with higher discount rates. There are additional possible explanations for these expectations as well. Differences in risk preferences would make females less likely to cash out than males due to greater risk aversion. Given that lower-income individuals and minorities face less favorable terms in credit markets (Apgar & Calder, 2005), I expect that minority teachers will cash out at a higher rate than white teachers. In addition, I

[67] I also estimate probit and linear probability models. Results are very close to logit results and are included in Appendix C.

[68] Wald test statistics fail to reject the null hypothesis that the estimated coefficients on endorsement variables are jointly equal to zero at the α=0.01 significance level. Their exclusion from models has little effect on the estimates (not shown).

hypothesize that teaching in suburban districts is associated with a lower propensity to cash out than teaching in non-suburban districts because suburban households likely enjoy more favorable credit terms. Hard-to-staff districts, such as those with high proportions of ELL and FRL students, may also reflect areas with weak credit markets and subsequently work to increase the likelihood of teachers cashing out. Finally, teachers with more education (or higher quality education) will likely annuitize at higher rates than teachers who invest less in their education because of expected differences in levels of financial literacy.

The sign on quit age in column (1) suggests a positive relationship with cashing out. The probability of cashing out increases by 0.1 percentage points if a teacher delays separation by one year, *ceteris paribus*. While the sign on this coefficient opposes expectations, it is not statistically significant at any conventional level. The coefficient on tenure, negative and statistically significant at the α=0.01 level, is consistent with expectations and implies that an additional year of work reduces the propensity to cash out by 2.1 percentage points. While an additional service credit implies increases for both pension wealth and refunds, the back-loading nature of defined benefit plans implies that the marginal increase in PW will be larger over later points in a teacher's career. The coefficient on salary implies that increasing a teacher's salary by $10,000 lowers the probability of cashing out by 1.5 percentage points, though it is not statistically significant. The expected direction for salary is ambiguous. On one hand, an increase in an individual's salary will lower her propensity to cash out because it raises the value of her pension and, therefore, makes deferring more valuable. On the other hand, a positive coefficient on salary might suggest the presence of wealth effects. Wealthier individuals may be more willing to take on more risk and, therefore, more likely to cash out.

PWCOR in column (2) is negative and statistically significant. Increasing this ratio by one (which implies doubling pension wealth) reduces the propensity to cash out by 9.5 percentage points. The coefficient on *NetPW* in column (3) implies that a unit ($10,000) increase in *NetPW* lowers the probability of cashing out by 2.3 percentage points. This result supports expectations that increasing PW, holding refundable contributions constant, makes an annuity more desirable for teachers and reduces the propensity to cash out. Alternatively, increasing refundable contributions will lower *PWCOR*, thereby raising the likelihood of cashing out. Finally, the coefficient on *IROR* is negative and significant. An increase in the break-even discount rate (the rate that equalizes the lump-sum refund with the present discounted value of the stream of lifetime annuity payments) by 1 percentage point lowers the propensity to cash out by 2.8 percentage points.

Because total service largely determines the value of pension benefits, its coefficient in column (1) appears to provide the same explanation as *PWCOR, NetPW*, and *IROR*, and its model fits the data a bit better than models in columns (2) through (4). When total service is included in the models with the key control variables, it remains statistically significant while *PWCOR, NetPW*, and *IROR* each become statistically insignificant. Controlling for *PWCOR, NetPW*, and *IROR*, however, affords an economic interpretation about the tradeoffs related to distribution choices whereas total service does not.

The sizes of coefficients on demographic characteristics across columns are remarkably consistent. Female teachers are 14.4 to 16.2 percent less likely to cash out than male teachers, holding other covariates constant. This is likely due to men having higher discount rates and falls in line with previous studies finding lower cashout rates among female workers in other

settings.[69] Men tend to be dominant earners in two-income households (Winkler & Rose, 2001) and therefore may seek greater control over retirement savings by cashing out. Alternatively, gender differences may reflect variation in risk preferences. Given that women reveal more risk aversion than men with their investment choices (Bajtelsmit, Bernasek, & Jianakoplos, 1999; Gerrans & Clark-Murphy, 2004), female teachers may view an annuity as the safer choice.

Black teachers are about 27 percentage points more likely to cash out than white teachers. The higher probability to cash out may reflect differential credit access and possibly discrimination against minorities (Duca & Rosenthal, 1993). Teachers without access to credit and teachers who face less favorable credit terms will seek capital elsewhere, possibly in retirement savings. Positive coefficients on Hispanic ethnicity comport with the explanation of credit constraint and suggest that Hispanic teachers are 6.6 to 9.8 percentage points more likely than white teachers to cash out.

The coefficients for graduate degree are statistically insignificant, implying that the data are insufficient to detect any difference. The estimates for elite IL college, however, are significant and in the expected direction. Teachers who graduated from a top-50 nationally ranked university in Illinois are 7.5 to 8.0 percentage points less likely to cash out than teachers who did not graduate from an elite IL school.[70] Admittedly, this measure is noisy because the data do not include information about attendance at specific out-of-state institutions (28 percent of the sample). Nonetheless, it conveys information that supports previous research which

[69] Clark, Morrill, and Vanderweide (2013), for instance, find that male public employees in North Carolina are about 10 to 12 percent more likely to cash out their contributions.
[70] Illinois universities listed in the Top 50 "National University Rankings" are the University of Chicago, Northwestern University, and the University of Illinois–Urbana-Champaign. Illinois universities with Graduate Education Schools listed in the Top 50 are Northwestern University, the University of Illinois–Urbana-Champaign, and the University of Illinois–Chicago.

largely finds a negative relationship between the likelihood of cashing out and an individual's investment in education. Education, in turn, may correlate with financial literacy, which plays an important role in retirement planning and behavior (e.g. Lusardi & Mitchell, 2006; Lusardi & Mitchell, 2007). Students at elite colleges in Illinois may be more likely to take classes that boost financial literacy, though this notion is only speculative. If individuals do not understand the tradeoffs they face with certain decisions, then their choice may reflect a misconception rather than their true preferences. Teachers receive annual benefit statements that report information about their accounts, including cumulative refundable contributions and estimated retirement benefits they would receive if they separate that year. Appendix B displays a redacted copy of a full report sent annually to TRS members and shows that estimated benefits are given in monthly annuity amounts. These reported pension benefits are not directly comparable to the value of teachers' refundable contributions, which are reported as a lump sum. Teachers, however, may make different decisions about cashing out if they have information on both benefits that are directly comparable.[71]

The likelihood of cashing out by teachers who work in rural or town districts is between 5.9 and 6.7 percentage points higher than teachers working in a city district. Teachers in rural settings may, on average, have higher discount rates. This finding may also reflect individuals in rural areas having less access to favorable loan terms. The coefficients on district enrollment are positive across specifications and statistically significant. The expected increase in the propensity to cash out from increasing district enrollment by one thousand students is 0.3 percentage point.

[71] Teachers, for example, may make different retirement decisions about cashing out if TRS reported the present discounted value of members' pension payments, which can be compared to the lump sum value of members' refunds.

Though statistically significant, the magnitude of this estimate is quite small. The estimates on other district-level variables are statistically insignificant.

I finally account for the recession in 2008 by including a variable that controls for separation from service that occurs during FY 2009 onward. The financial crisis changed financial circumstances for many people and households. It also arguably altered people's attitudes about the financial markets. Thus, the recession likely changed people's preferences for certain benefit distributions. There may be at least two effects from the recession. On one hand, the recession dampened people's financial standings, increasing the pool of financially constrained individuals or households and thereby increasing the demand for liquidity. This effect would increase the propensity for cashing out because more teachers would require financial resources in the near term. On the other hand, the recession may have altered people's perceptions about the financial markets and dampened tolerance for risk. In this sense, teachers may view a deferred lifetime annuity in a more favorable light than cashing out. In other words, teachers post-recession likely view rolling over their refunds into retirement savings as a riskier prospect than if they made the decision before the recession. This effect would subsequently lower the probability of cashing out. The sign on the coefficient is negative and significant, suggesting that the latter effect is stronger. Teachers who separated after 2008 were about 2.6 percentage points less likely to cash out than teachers who quit leading up to the time of the recession.

Supplemental analyses

Teachers who separate at or a few years away from retirement eligibility and choose to take a refund disbursement instead of annuitizing likely make these choices based on highly unusual circumstances. Therefore, I originally exclude teachers who quit from age 50 from the sample. Below, I report results for samples that do not restrict separation ages. I then estimate models under different discount rate assumptions of 2 percent and 6 percent.

Sample with all separation ages

Table 12 provides estimates from logit regressions based on a sample not restricted by quit age. The estimates on age, service, and salary barely change while the slopes for *PWCOR*, *NetPW*, and *IROR* decline significantly. The estimate on *IROR* becomes statistically insignificant. These differences are not surprising given that logit models are highly nonlinear. Because slope estimates depend on the sample means of the covariates, changing the sample may change the means and, subsequently, change the slope estimates. Estimates on demographic-specific covariates, on the other hand, remain largely unchanged. This is not surprising given that covariate means for the two samples are very similar. Including teachers of all separation ages in the sample appears to affect only pension wealth, largely by virtue of age's correlation with service.

Table 12: Results for logistic regressions, all separation ages (dependent variable = decision to claim refundable contributions)

	mean	(1)	(2)	(3)	(4)
Age At Separation	35.62	0.002**			
		(0.001)			
Total Service	8.14	-0.022***			
		(0.002)			
Salary, in ten thousands	2.93	-0.009			
		(0.011)			
PWCOR	0.88		-0.018*		
			(0.010)		
Net PW, in ten thousands	-0.08			-0.008***	
				(0.003)	
IROR	0.04				-0.158
					(0.232)
after_2008	0.36	-0.028**	-0.036***	-0.034***	-0.037***
		(0.013)	(0.012)	(0.012)	(0.012)
Female	0.82	-0.159***	-0.150***	-0.151***	-0.151***
		(0.017)	(0.017)	(0.017)	(0.017)
Black	0.02	0.256***	0.272***	0.272***	0.270***
		(0.044)	(0.044)	(0.044)	(0.044)
Hispanic	0.03	0.060*	0.077**	0.080**	0.072**
		(0.036)	(0.037)	(0.037)	(0.036)
Asian	0.01	-0.052	-0.050	-0.050	-0.050
		(0.046)	(0.047)	(0.047)	(0.047)
High school teacher	0.23	0.010	0.004	0.004	0.004
		(0.015)	(0.015)	(0.015)	(0.015)
Special education teacher	0.14	0.004	0.005	0.005	0.004
		(0.017)	(0.017)	(0.017)	(0.017)
Suburb	0.58	0.001	0.003	0.003	0.003
		(0.019)	(0.019)	(0.019)	(0.019)
Rural or town	0.27	0.063***	0.069***	0.069***	0.068***
		(0.023)	(0.022)	(0.022)	(0.022)
Graduate Degree	0.13	-0.011	0.005	0.008	0.002
		(0.019)	(0.018)	(0.018)	(0.018)
Degree from elite IL college	0.09	-0.075***	-0.079***	-0.080***	-0.078***
		(0.019)	(0.019)	(0.019)	(0.019)
Degree from in-state	0.71	0.022*	0.015	0.015	0.016
		(0.013)	(0.013)	(0.013)	(0.013)
Art	0.07	-0.001	-0.003	-0.003	-0.003
		(0.023)	(0.023)	(0.023)	(0.023)

Table 12: Results for logistic regressions, all separation ages (dependent variable = decision to claim refundable contributions) (Cont.)

	mean	(1)	(2)	(3)	(4)
ELA	0.23	-0.018	-0.018	-0.017	-0.018
		(0.015)	(0.015)	(0.015)	(0.015)
Foreign language	0.07	0.002	0.000	-0.000	0.000
		(0.023)	(0.023)	(0.023)	(0.023)
Math or Science	0.13	-0.013	-0.011	-0.011	-0.010
		(0.017)	(0.017)	(0.017)	(0.017)
Social Science	0.22	0.003	0.002	0.002	0.002
		(0.016)	(0.016)	(0.016)	(0.016)
Vocational	0.02	-0.027	-0.025	-0.025	-0.026
		(0.036)	(0.037)	(0.037)	(0.037)
Dist enrollment, in thousands	6.68	0.002**	0.002***	0.002***	0.002***
		(0.001)	(0.001)	(0.001)	(0.001)
Dist pupil-teacher ratio	16.25	0.001	0.000	0.000	0.000
		(0.002)	(0.002)	(0.002)	(0.002)
Dist IEP percent	0.16	-0.016	-0.011	-0.011	-0.014
		(0.183)	(0.184)	(0.184)	(0.184)
Dist FRL percent	0.32	0.053	0.044	0.048	0.040
		(0.047)	(0.047)	(0.047)	(0.047)
Dist minority percent	0.29	-0.012	0.002	-0.001	0.004
		(0.039)	(0.039)	(0.039)	(0.039)
Assumed real interest rate		--	0.04	0.04	--
Observations		6,058	6,058	6,058	6,058
Pseudo R-squared		0.0450	0.0328	0.0336	0.0324
Log Lik		-3363	-3406	-3403	-3408

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Sample comprises TRS members hired in or after 1980 who quit in or after 2002 as a full-time teacher, and all quit ages; sample excludes teachers with a Single Sum Retirement benefit, individuals observed teaching in the City of Chicago PSD, and Inactive teachers who moved into a reciprocal Illinois pension system. Pension wealth is computed in 2011 dollars and based on 4 percent real interest and 2.5 percent inflation. Survival probabilities are based on gender and race/ethnicity.

Results under different discount rates

I also estimate behavioral models under different discount rate assumptions. Table 13 reports results for models under 2 percent and 6 percent discount rates. These models control for *PWCOR* and *NetPW* and correspond to columns (2) and (3) in Table 11. Changing the discount rate will change pension wealth, which in turn impacts the *PWCOR* and *NetPW* variables. Specifically, a lower discount rate implies higher *PWCOR* and *NetPW* and would act to lower the propensity to cash out, and *vice versa*. This pattern is evident in Table 13. Under a risk-free discount rate of 2 percent, a unit increase in *PWCOR* lowers the likelihood to cash out by 7.4 percentage points. Under a 6 percent real interest rate assumption, the probability of cashing out decreases by 12.6 percentage points. The propensity to cash out under a 4 percent discount rate falls in between these two estimates, though *NetPW* does not. Under a 2 percent discount rate, a unit increase in *NetPW* lowers the probability to cash out by 1.9 percent. The estimate becomes statistically insignificant with a 6 percent assumption.

The predictive probabilities for teachers' background and district factors vary little under different discount rates. For example, female teachers are between 14.0 and 15.1 percent less likely to cash out than male teachers under different assumed interest rates. Black teachers are 26.3 to 27.5 percentage points more likely to cash out. The predictive probability for teachers with a degree from an elite Illinois institution is about 8 percentage points less than their counterparts. Similarly, coefficients for urbanicity categories and district enrollments change

only slightly under different discount rate assumptions. Overall, behavioral results are consistent under different assumptions for the discount rate.[72]

Table 13: Results for logistic regressions under different interest rates, separations under age 50 (dependent variable = decision to claim refundable contributions)

Assumed real interest rate	2% mean	2% (1)	2% (2)	6% mean	6% (3)	6% (4)
PWCOR	1.49	-0.074***		0.40	-0.126***	
		(0.013)			(0.026)	
Net PW, in ten thousands	1.83		-0.019***	-1.61		-0.001
			(0.003)			(0.006)
after_2008	0.35	-0.024*	-0.020	0.35	-0.026**	-0.031**
		(0.013)	(0.013)		(0.013)	(0.013)
Female	0.82	-0.140***	-0.148***	0.82	-0.151***	-0.150***
		(0.018)	(0.018)		(0.018)	(0.018)
Black	0.02	0.263***	0.265***	0.02	0.275***	0.275***
		(0.048)	(0.048)		(0.048)	(0.048)
Hispanic	0.03	0.106**	0.096**	0.03	0.093**	0.065*
		(0.042)	(0.041)		(0.041)	(0.039)
Asian	0.01	-0.066	-0.067	0.01	-0.066	-0.065
		(0.046)	(0.045)		(0.046)	(0.046)
High school teacher	0.23	0.005	0.009	0.23	0.004	0.002
		(0.015)	(0.015)		(0.015)	(0.015)
Special education teacher	0.14	-0.002	-0.001	0.14	-0.002	-0.003
		(0.018)	(0.018)		(0.018)	(0.018)
Suburb	0.59	0.005	0.005	0.59	0.005	0.005
		(0.019)	(0.019)		(0.019)	(0.019)
Rural or town	0.27	0.066***	0.061***	0.27	0.066***	0.064***
		(0.023)	(0.023)		(0.023)	(0.023)
Graduate Degree	0.12	0.023	0.021	0.12	0.022	0.008
		(0.020)	(0.020)		(0.020)	(0.019)
Degree from elite IL college	0.09	-0.080***	-0.079***	0.09	-0.080***	-0.076***
		(0.019)	(0.019)		(0.019)	(0.019)
Degree from in-state	0.72	0.014	0.016	0.72	0.015	0.019
		(0.013)	(0.013)		(0.013)	(0.013)

[72] Results are similar under 2 and 6 percent discount rates for the sample not restricted by separation age. I report estimates of logit models for this group in Appendix C (Table C.3).

Table 13: Results for logistic regressions under different interest rates, separations under age 50 (dependent variable = decision to claim refundable contributions) (Cont.)

Assumed real interest rate	2% mean	2% (1)	2% (2)	6% mean	6% (3)	6% (4)
Art	0.07	-0.003	-0.000	0.07	-0.003	-0.002
		(0.023)	(0.023)		(0.023)	(0.023)
ELA	0.23	-0.015	-0.015	0.23	-0.016	-0.016
		(0.016)	(0.016)		(0.016)	(0.016)
Foreign language	0.06	-0.005	-0.004	0.06	-0.005	-0.003
		(0.024)	(0.024)		(0.024)	(0.024)
Math or Science	0.13	-0.015	-0.015	0.13	-0.015	-0.013
		(0.018)	(0.018)		(0.018)	(0.018)
Social Science	0.22	0.001	0.001	0.22	0.001	0.001
		(0.016)	(0.016)		(0.016)	(0.016)
Vocational	0.02	-0.036	-0.036	0.02	-0.035	-0.033
		(0.038)	(0.038)		(0.038)	(0.038)
Dist enrollment, in thousands	6.63	0.003***	0.003***	6.63	0.003***	0.002***
		(0.001)	(0.001)		(0.001)	(0.001)
Dist pupil-teacher ratio	16.22	-0.002	-0.002	16.22	-0.002	-0.002
		(0.003)	(0.003)		(0.003)	(0.003)
Dist IEP percent	0.16	0.024	0.013	0.16	0.022	0.006
		(0.191)	(0.190)		(0.191)	(0.191)
Dist FRL percent	0.32	0.047	0.042	0.32	0.044	0.024
		(0.049)	(0.049)		(0.049)	(0.049)
Dist minority percent	0.29	-0.012	-0.011	0.29	-0.010	0.002
		(0.041)	(0.041)		(0.041)	(0.041)
Observations		5,622	5,622		5,622	5,622
Pseudo R-squared		0.0360	0.0388		0.0344	0.0306
Log Lik		-3131	-3122		-3136	-3148

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Sample comprises TRS members hired in or after 1980 who quit in or after 2002 as a full-time teacher, and separations up to age 50; sample excludes teachers with a Single Sum Retirement benefit, individuals observed teaching in the City of Chicago PSD, and Inactive teachers who moved into a reciprocal Illinois pension system. Pension wealth is computed in 2011 dollars and based on 4 percent real interest and 2.5 percent inflation. Survival probabilities are based on gender and race/ethnicity.

Leakage in TRS

Lastly, I estimate the amount of leakage that both refund claimants and the group of inactive members who leave their contribution in the fund incur in TRS. I define leakage for refund claimants as simply *NetPW* when separation occurs at a point in their career when the value of their pension wealth accrued outweighs their refundable contributions. It occurs among annuitants when the value of one's refundable contributions outweighs the present discounted value of the pension they choose to receive, both evaluated at the point of separation. To obtain estimates, I first compute *NetPW* for all refund claimants and annuitants in TRS, including non-teachers, hired since 1980. Then I sum *NetPW* for all vested refund claimants (annuitants) who separate at a point such that $NetPW>0$ ($NetPW<0$). Table 14 and Table 15 report leakage that refund claimants and annuitants incur, respectively, for all members and for classroom teachers only. Estimates rely on assumptions where the real discount rate is 4 percent and inflation is 2.5 percent. The table for refund claimants also reports values that adjust for taxes and penalties associated with not rolling over refunds and withdrawing before age 59.5 without a roll over. The unadjusted amount reflects leakage that implicitly stays in the state's TRS pension fund while the adjusted amount reflects total leakage actually experienced by refund claimants. Because I do not know if an annuitant would roll over a refund if she cashes out instead, I do not make any assumptions about rollovers for this group and, therefore, do not make any adjustments.

Since 1980, 1,913 refund claimants quit after vesting in the plan and separated with positive *NetPW*. The aggregate value of leakage for these members is $55.2 million ($69.1 million in adjusted terms). Members who quit since 2000 experienced the largest share of this leakage, or 84 percent. Since 1980, teachers incurred roughly 65 percent of leakage occurring in

the system, or $35.4 million ($44.6 million in adjusted terms). Again, teachers incur most of this leakage since 2000, worth $38.1 million after adjusting for withholdings (or 85 percent of leakage since 1980).

Expressing leakage in amounts per refund claimant add perspective. In unadjusted terms, leakage equals $28,865 per member since 1980 and over $34,000 per member since 2000. After adjusting for tax withholdings and early distribution penalties, TRS members experienced $36,000 in leakage since 1980 and over $42,800 since 2000. The corresponding amounts for classroom teachers are similar.

The aggregate value of leakage for all annuitants is $89.8 million since 1980 and $71.0 million since 2000. Among annuitants, the level of per capita leakage is substantially lower, primarily due to about 65 percent of this group separating with less than 10 years of service (and therefore low levels of benefits in terms of pension wealth). The average amount of leakage for all groups in Table 15 is about $9,000. Because of the backloading nature of the FAS DB plan, refund claimants experience substantially greater amounts of leakage.[73]

The overall savings by the state from this leakage is miniscule relative to its total unfunded liabilities. By its own estimates, TRS's unfunded liabilities as of June 30, 2013 are $55.7 billion. Total leakage by members since 1980 as a percentage of this debt, however, is only 0.2 percent. Thus, although the savings realized from leakage by its members are very small, leakage among some members are substantial, particularly among refund claimants.

[73] Please note that these estimates of leakage reflect the value of pension only and do not include the value of retiree health insurance (RHI), which is accessible to annuitants and relinquished by refund claimants. Incorporating RHI into the calculus will have the effect of enlarging the group of refund claimants and shrinking the group of annuitants who experience leakage.

Table 14: Aggregate NetPW by refund claimants with positive NetPW

		Unadjusted		Adjusted for tax, penalties	
	Number	total	per member	total	per member
All members					
1980 to 2013	1,913	$55,217,808	$28,865	$69,096,880	$36,120
2000 to 2013	1,349	$46,664,952	$34,592	$57,773,704	$42,827
Teachers only					
1980 to 2013	1,266	$35,386,172	$27,951	$44,599,448	$35,229
2000 to 2013	927	$30,472,650	$32,872	$38,101,556	$41,102

NOTE: samples exclude refund claimants hired before 1980 and non-vested members; PW is computed assuming a 4 percent real interest rate, 2.5 percent inflation, and is expressed in 2011 dollars; adjusted estimates reflect a 20 percent withholding on members who do not roll over their refunds and 10 percent federal penalty levied on members who take a refund disbursement prior to age 59.5 without rolling them over

Table 15: Aggregate NetPW by annuitants with negative NetPW

	Number	total	per member
All members			
1980 to 2013	9,864	$89,771,536	$9,100
2000 to 2013	7,742	$70,986,272	$9,168
Teachers only			
1980 to 2013	7,036	$65,323,496	$9,284
2000 to 2013	5,598	$52,340,428	$9,349

NOTE: samples exclude annuitants hired before 1980; PW is computed assuming a 4 percent real interest rate and expressed in 2011 dollars; adjusted estimates reflect a 20 percent withholding on members who do not roll over their refunds and 10 percent federal penalty levied on members who take a refund disbursement prior to age 59.5 without rolling them over

Summary

This chapter presents results for behavioral models that estimate the propensity of teachers to cash out along observable characteristics. Results parallel findings in the general retirement literature that examines retirement behavior in different public sector settings. Overall, teachers that are male, Black, Hispanic, have a degree from a non-elite school in IL or out of state institution, and who teach in rural areas exhibit higher predictive probabilities for cashing out than their counterparts. Additionally, teachers who quit after the 2008 recession exhibit a lower probability to cash out than teachers who quit before the recession. I find no relationship between subject endorsements and cashout decisions. These findings are consistent across models based on different discount rate assumptions.

The chapter concludes with an estimate of the aggregate leakage that occurs among TRS members who take a refund claim and members who choose instead to leave their funds in the stewardship of the system. I define leakage as *NetPW* for refund claimants who quit when the value of their pension wealth outweighs their refundable contributions, and vice versa for annuitants. Leakage that refund claimants experienced since 1980, adjusted for taxes and penalties, amounted to $36,120 per refund claimant among all members. Over four-fifths of this leakage, however, occurred since 2000. Each annuitant, on the other hand, incurred about $9,000.

Relative to the overall fiscal health of TRS, total leakage by members since 1980 as a percentage of pension debt is 0.2 percent. Thus, while the mean leakage per member among refund claimants with positive *NetPW* and annuitants with negative *NetPW* is substantial, the

savings to the pension fund realized from leakage are very small. The next and final chapter turns to a discussion about policy implications and reform options.

Chapter 5: Conclusion

To my knowledge, this dissertation is the first analysis that documents pension benefit choices made by public school teachers as a standalone group. While the literature on teacher pensions has ventured into numerous areas of policy import, it has yet to examine teachers' choices that pertain to benefit distributions. A body of research on distribution choice exists in the general retirement literature, however, and point to an "annuity puzzle." Although theory predicts high rates of annuitization, substantial variation occurs in actual take-up. This puzzle is borne out in the Illinois retirement data, where 36 percent of classroom teachers in TRS choose to withdraw their refundable contributions. This paper analyzes benefit distribution choices by public school teachers enrolled in the Illinois Teachers' Retirement System (TRS), where they make decisions between taking a lump-sum withdrawal of their refundable contributions and deferring a pension benefit until reaching retirement eligibility, thereby leaving their contributions in the pension fund.

Illinois provides an interesting case because, like most states, teachers enroll in a "final salary" defined benefit (FAS DB) plan, and those who opt to receive a refund do not collect the employer's portion of contributions to the pension fund. Unlike most states, however, teachers collect less than their cumulative contributions (TRS withholds one percent of earnings for survivor benefits, which refund claimants are ineligible for). Moreover, Illinois does not credit interest on teachers' refundable contributions. Thus, refund claimants receive less money than if they initially did not contribute anything to TRS and instead deposited their money in a savings account. Finally, while the provisions that govern public FAS DB plans like Illinois's vary across states, the general structure and behavior of these plans are strikingly similar. Thus, results from

this analysis arguably generalize to a wider set of public retirement systems. Because refund rules in Illinois are less favorable for teachers than any other state, the 36 percent refund withdrawal rate in Illinois arguably sets a lower bound estimate for potential cashout rates in other states. This analysis aims to answer two research questions:

1. To what extent do vested teachers enrolled in TRS separate from service with positive pension wealth, and how much money is "left on the table" at a conventional discount rate?
2. As indicated by cashout patterns, what types of teachers display higher or lower discount rates?

The idiosyncratic, highly nonlinear financial incentives common in FAS DB plans play an important role in benefit decisions and provide a key component in the analysis. To control for the relative attractiveness between choices, this analysis employs three central measures: the pension-wealth-to-cash-out-ratio (*PWCOR*), net pension wealth (*NetPW*), and the internal rate of return (*IROR*) variables. I include these controls in a series of behavioral models that estimate the propensity of teachers to cash out along observable characteristics.

Behavioral results parallel findings in the general retirement literature that examines retirement behavior in different public sector settings. Overall, this analysis finds higher cashout rates among male, African American, and Hispanic teachers; teachers who work in rural districts; and teachers who did not receive a degree from an elite institution in Illinois. These results are indicative of higher discount rates among these groups and comport with the literature. I find no evidence in the data of a relationship between subject endorsements and

cashout decisions. These findings are consistent across models that assume different discount rates.

The analysis concludes with an estimate of the aggregate leakage that occurs among TRS members who take a refund claim. Leakage is defined as *NetPW* for refund claimants who quit when the value of their pension wealth outweighs their refundable contributions. Leakage that refund claimants experience since 1980, adjusted for taxes and penalties, amounted to $36,120 per refund claimant among all members and $35,229 per refund claimant among classroom teachers. Over four-fifths of this leakage, however, occurred since 2000. Each annuitant, on the other hand, incurs about $9,000. Relative to the overall fiscal health of TRS, total leakage by members since 1980 as a percentage of pension debt is 0.2 percent. Thus, while the mean leakage per member among refund claimants with positive *NetPW* and annuitants with negative *NetPW* are substantial, the savings to the pension fund realized from leakage are very small. The findings in this analysis suggest a set of policy implications, both for retirement security and for how some teachers value their retirement benefits.

Policy Implications

Retirement security poses a major concern not only for individuals and households, but for societies at large which may face concerns about poverty among the elderly (Smeeding & Sandstrom, 2004). Leakage of funds from retirement savings for other uses such as hardship, paying off debt, or consumption poses a potential threat to retirement security. This analysis finds large potential for leakage among classroom teachers in TRS. Teachers who leave prior to reaching retirement eligibility and opt for receiving a lump sum distribution upon separation

rather than collecting a deferred annuity face potentially large capital losses. First, taking a refund means that the teacher will receive less than her cumulative contributions. Second, by taking a lower distribution, teachers will forgo possibly large amounts of accrued interest that could have accumulated in an investment or retirement account. To exacerbate matters, 80 percent of all refund claimants in TRS hired since 1980 did not elect to arrange a rollover of any portion of their refunds with TRS. Thus, arguably most of these members collect an even much lower refund benefit because public retirement systems by law withhold 20 percent of the claim amount for taxes, and refund claimants also face a 10 percent early distribution penalty if their withdrawal occurs before age 59½ without a roll over. Consequently, it is likely that refund rules, coupled with early distribution penalties, increases the prospect for drawing down retirement funds too fast (and possibly outliving one's retirement savings).

Mobile and young public employees in FAS DB plans who do not stay in a system for an entire career are particularly disadvantaged by these plans (Costrell & Podgursky, 2010). First, FAS DB plans lack portability, meaning that teachers who leave one system cannot take their retirement accounts with them. Second, FAS DB plans are "backloaded," meaning that pension wealth accrues non-linearly and increasingly rapidly from about mid-career. Thus, a teacher who leaves before reaching retirement eligibility stands to lose out on a substantial amount of pension wealth (potentially more than half of one's accrued pension wealth worth tens of thousands or even hundreds of thousands of dollars). Refund claimants stand to lose even more. Third, most public plans do not include employer's contributions in refunds. This is far different from the private sector, where law requires that refund distributions equal or exceed the present discounted value of the annuity benefit. Fourth, many states that have public FAS DB plans face large unfunded liabilities for numerous reasons. As public pension funds run out of options for

reducing pension debt, they are less likely to make changes favorable for short-termers. Benefit enhancements for this group without commensurate decreases in benefits for full-term employees are difficult, especially when some states consider benefit reductions unconstitutional. Rather, recent pension reforms have trended towards increasing retirement ages and vesting requirements that apply to new hires only. Such reforms make matters worse for mobile employees in particular.

Options for policy reform

Findings in this analysis point to the lack of fairness towards all teachers who enroll in FAS DB plans. The exclusion of employer contributions from refund withdrawals, plus withholding of interest and the one percent survivor benefit contribution, levies a substantial cost on most teachers who choose this benefit. Moreover, leakage in retirement funds raises concerns about retirement security. At a basic level, policy changes could address a few shortcomings inherent in FAS DB plans that systematically disadvantage mobile teachers. Pension policy can implement at least three reforms to increase the fairness of pension plans for all teachers.

1. To encourage more refund claimants to roll over their distributions, pension funds can take advantage of the power of defaults. Policy could require workers to designate or establish a retirement account for automatic roll over of refunds when they start working. Of course, individuals can choose to withdraw these funds according to their own circumstances (e.g. financial hardship), but the consequences associated with withdrawing can be severe. Policy should also ensure that these individuals are clearly informed of the penalties associated with withdrawing funds and the value of the costs in

the future. In Illinois, public employees must designate beneficiaries on day one – a box could be added that requires designation of a retirement account where disbursements are automatically rolled over in the case a teacher separates and files a refund claim.

2. Policy can increase transparency by requiring pension funds to report information on benefit statements that allows teachers to compare the value of a refund distribution with the present value of the annuity they would collect conditional on various separation points.
3. Policy could come in line with regulations in the private sector by requiring lump sum refunds to equal or exceed the present value of the present discounted value of their annuity.

While these policy changes might address the inherent unfairness in FAS DB plans, they amount merely to tinkering around the edges and will not address other pressing issues such as underfunding that face public plans all over the nation. It is well known, for instance, that peculiar political incentives led to the mismanagement and underfunding of these plans (McGee, no date). In addition, these reforms will likely increase the system's liabilities by virtue of increasing the number of members who leave with positive NetPW and choose to annuitize. Moreover, this analysis, combined with growing evidence from other research (e.g. Fitzpatrick, 2012; Aldeman & Rotherham, 2014; Goldhaber & Grout, 2014b), implies that some teachers may not value FAS DB benefits as much as their counterparts who opt to leave their contributions in the pension fund. To address these issues, large-scale systemic change is indicated.

Alternative plans such as cash balance (CB) plans and defined contribution (DC) plans offer favorable alternatives for a more diverse and mobile workforce. The neutral accrual of

pension wealth, portability, and spreading financial risk across both employers and employees arguably make CB plans particularly appealing to today's workforce. Figure D.1 in Appendix D illustrates a hypothetical CB plan (dotted line) and replicates the tradeoffs between benefit choices for a stylistic Tier 1 teacher illustrated in Figure 2 (Chapter 1). The solid line represents pension wealth accrual and the dashed line represents refundable contributions. Under the CB plan, this teacher is allowed to collect her contributions, including the one percent survivor contribution and interest, along with an employer match (5 percent) and an annual interest credit set at 5 percent applied to her notional CB account. The benefit under the CB plan accrues in a smooth manner and exceeds the FAS DB benefit until about mid-career. Unlike the FAS DB plan, under which pension wealth accrual spikes at arbitrary points in a career and eventually declines, benefits under CB plans accrue smoothly and continuously. For refund claimants in particular, the CB plan can offer more favorable benefits at all separation points. Importantly, portability allows the CB plan to offer a reasonable level of benefits that teachers who leave the system before retirement eligibility can take with them. Clearly, this alternative is more favorable for mobile teachers and career-switchers (e.g. the engineer with a desire to switch over and teach high school math).

This analysis focuses on decisions made by teachers under Tier 1 because all teachers enrolled in the current Tier 2 plan have not vested yet. Because TRS discontinued Tier 1 after 2010, I briefly extend the above discussion to Tier 2. Figure D.2 replicates Figure D.1 for Tier 2. This teacher's refundable contributions exceed her pension wealth until age 58. Thus, up to this point under the current plan, she is better off taking a refund than deferring. Again, because the refund she receives does not include interest and excludes one percent of her earnings, she is left worse off than if she originally put her contributions into a normal savings account. Under the

CB plan, her notional account would include both her contributions and the employer contributions, plus interest. This plan offers a promising alternative that is more fair and palatable for today's teaching workforce, especially young and mobile teachers.

Summary

Despite the heavy backloading in FAS DB plans arguably intended to recruit and retain workers until arbitrary ages set for early and normal retirement, a healthy portion of teachers in Illinois elect to leave the system prior to reaching these ages. Three-quarters of teachers in TRS leave before accumulating five years of service. Of vested teachers who separate from TRS before reaching retirement eligibility, 36 percent opt to take a refund of their contributions despite collecting less than the amount they originally contributed to the pension fund. Male teachers, minority teachers, teachers in rural districts, and teachers without a degree from an elite Illinois institution are more likely to cash out than their respective counterparts and indicate higher discount rates among these groups than their counterparts. While policy changes to the DB system itself may address some of the issues associated with disadvantaging young and mobile teachers, such changes do not address other pressing issues that face public retirement systems. Large-scale reforms, such as offering optional CB or DC plans, may address these issues, including the problems highlighted by this dissertation.

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Appendix A: Supplemental Table and Figures

Table A.1: Distribution of NetPW for TRS classroom teacher refund claimants under different discount rates

	Unadjusted for tax			Adjusted for tax		
Net pension wealth	2 percent	4 percent	6 percent	2 percent	4 percent	6 percent
Less than $0	22.1%	76.0%	89.8%	7.1%	65.0%	84.2%
$0 to $10,000	38.1%	9.9%	4.3%	41.0%	15.4%	7.3%
$10,000 to $20,000	13.2%	4.8%	1.8%	19.2%	7.0%	3.2%
$20,000 to $30,000	6.8%	2.8%	1.6%	9.1%	3.8%	1.9%
$30,000 to $40,000	5.1%	1.9%	0.6%	5.7%	2.8%	1.0%
$40,000 to $50,000	3.0%	1.3%	0.5%	3.9%	1.7%	0.5%
More than $50,000	11.6%	3.3%	1.6%	13.9%	4.2%	1.9%

Notes: NetPW values are reported in 2011 dollars and based on gender- and race-specific survival probabilities from the CDC's 2007 Life Tables; statistics are based on a sample that includes all classroom teachers hired in or after 1980, all separation ages, and individuals who vested in the system; it excludes teachers who left TRS and continued work in another Illinois reciprocal retirement system.

Figure A.1: Fitted scatterplot of PWCOR on YOS

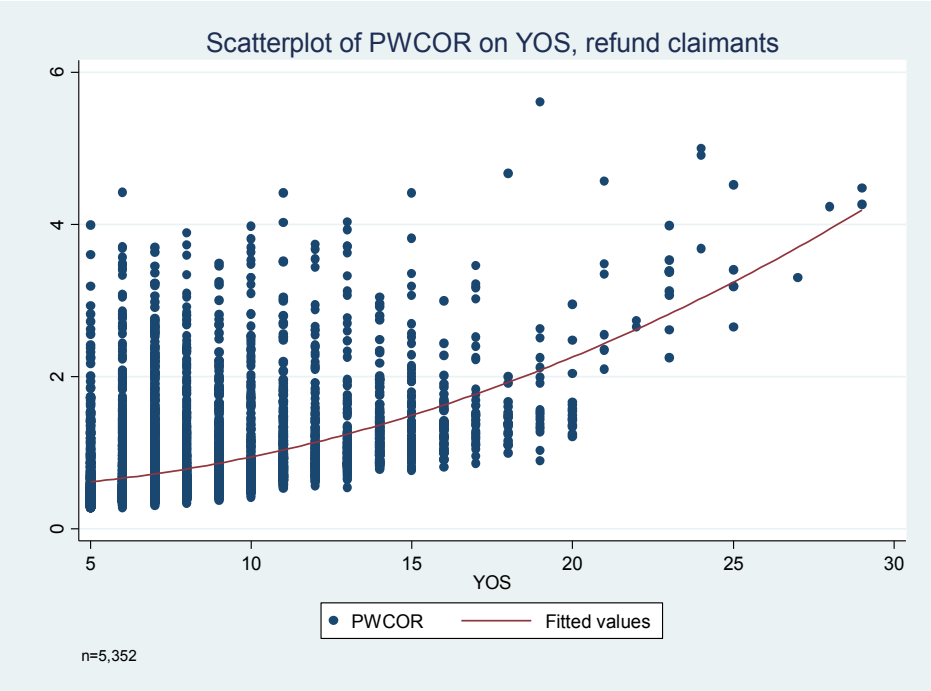
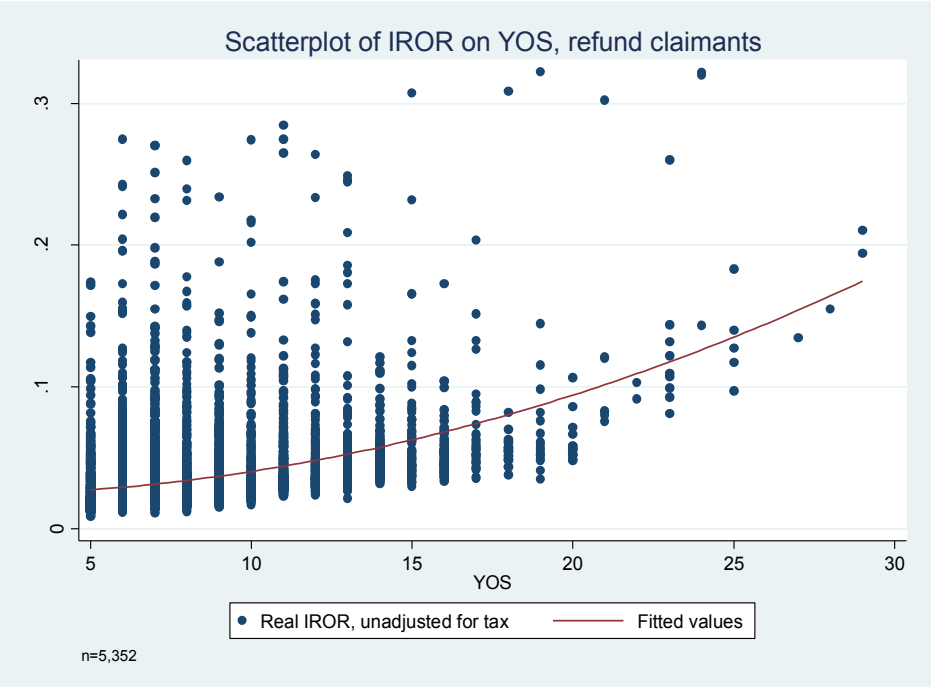


Figure A.2: Fitted scatterplot of IROR on YOS



Appendix B: TRS Sample Benefits Report

Your TRS Benefits Report

Teachers' Retirement System of the State of Illinois
2815 West Washington, P.O. Box 19253
Springfield, Illinois 62794-9253
(800) 877-7896 or TDD (217) 753-0329
members@trs.illinois.gov
http://trs.illinois.gov

Name
&
Address

Member ID: [redacted]

Unless otherwise stated, data is as of:
11/26/2013
Date of birth: [redacted]

Tier I and Tier II Definitions

Tier I members: First contributed to TRS before Jan. 1, 2011 or have pre-existing creditable service with a reciprocal pension system prior to Jan. 1, 2011.

Tier II members: First contributed to TRS on or after Jan. 1, 2011 and do not have any previous service credit with a pension system that has reciprocal rights with TRS.

Your TRS Service Record
As of June 30, 2013

You are a Tier I member.

Active service and purchased optional service - page 4	9.114 year(s)
Sick leave reported from former employers - page 2	0.000 year(s)
Total	**9.114 year(s)**
Optional service that you may purchase - page 3	0.000 year(s)
Refunded service that you may reinstate - page 3	3.762 year(s)

Retirement Contributions

In most cases, your retirement contributions are returned to you in the form of benefits.

Refundable contributions. If you cease TRS-covered employment, you may choose a refund that will terminate all TRS benefits. We urge caution in seeking a refund because repayment with interest can be costly if you resume a career in a TRS-covered position.

Beneficiary refund. If you die before you retire, your beneficiaries will receive your unrecovered pension contributions. The beneficiary refund is in addition to any survivor benefits shown on page 2.

Your Refundable Contributions	$11,147.87
Your Beneficiary Refund	$18,263.26

Beneficiary Information

Your designated beneficiaries are listed in this section. You may name or change beneficiaries at any time by filing a new Membership Information and Beneficiary Designation (MIBD) form with TRS. A fillable MIBD is available from the TRS Web site at http://trs.illinois.gov. MIBD forms are also available by calling (800) 877-7896; press 2 for the Forms Order Line when prompted.

Your Beneficiaries

Benefits will be paid to dependent beneficiaries, if there are none, to your estate.

Estimated Benefits

Retirement Benefits. Your retirement benefits are generally based on your age, service credit, and your final average salary. This estimate uses today's dollars. For active members, we added service credit through the year you are eligible to receive a nondiscounted annuity. We used your latest average salary in the calculation.

Most likely, inflation will cause salaries to increase, but using today's dollars is an easy way to compare pension benefits to your current standard of living. An estimate is printed to the right if you are at least age 50 with five years of service credit.

You may also create a benefit estimate in the secure Member Account Access area of our Web site. A user ID and password are required.

Disability Benefits. When eligible, nonoccupational and occupational benefits are available to you.

Survivor Benefits. If you leave behind a surviving spouse or other dependent beneficiary, TRS offers monthly survivor benefits. Lump-sum benefits are provided for non-dependent survivors.

Your Estimated Retirement, Disability, and Survivor Benefits

Member ID: [redacted]

Retirement

At age 60 with 10.138 service credit — $300.07 per month

Your service credit has been increased using your most recent service credit through the year you are eligible for a nondiscounted annuity. Your estimate has been calculated using the 2.2 formula. The 2.2 formula requires an upgrade payment for any service prior to July 1, 1998.

This is an estimate based on a June 30, 2015 retirement date. If you would like a more detailed estimate, please contact Member Services, (800) 877-7896. Be prepared to supply your retirement date, your unused sick leave with your current employer, and your estimated salaries for future years.

The following amounts are based on service and earnings currently on file

Disability

Nonoccupational disability	$256.81 per month
Occupational disability	$385.21 per month

Survivor

Survivor benefits (paid to eligible dependent)	$400.00 per month

Sick Leave Days Reported from Former Employers

Service credit is calculated by dividing the number of reported sick leave days by 170 to a maximum of two years of credit. **The amount does not include sick leave with your current employer.** This is not reported to TRS until you resign or retire.

Your Sick Leave Service

Your record does not show sick leave service credit.

About 2.2 Upgrades

You may upgrade your pre-July 1998 service credit to the 2.2 formula by making an additional contribution.

Your 2.2 Upgrade Information

You have not upgraded your pre-July 1998 service credit. If you wish to upgrade your service credit, please call Member Services, (800) 877-7896.

Member ID: [redacted]

Reciprocal Service

Your recorded service with another system is listed. Request an estimate at least five years before retirement or before reinstating reciprocal service. Concurrent service may be reduced.

Your Reciprocal Service

Your record does not show reciprocal service.

Refunded Service

Service canceled by your withdrawal of contributions may be repaid if you return to service. If you have returned to contributing service and wish to reinstate this service credit, you must repay the contributions plus interest from the date of the refund.

Please contact Member Services if you are interested in purchasing this service.

Your Refunded Service That May Be Reinstated

School Year	Employer	Service Credit
1976-77	[redacted]	0.762
1977-78		1.000
1978-79		1.000
1979-80		1.000
Total		3.762

Optional Service

You may purchase TRS credit for many types of optional service, including:

- out-of-system teaching,
- leaves of absence (which could include involuntary layoff or periods away from teaching due to pregnancy or adoption),
- military service,
- substitute and part-time teaching prior to July 1, 1990, or
- reinstated refunds.

Teachers' Health Insurance Security Fund (THIS Fund). TRS members make contributions to the THIS Fund to help finance the Teachers' Retirement Insurance Program.

This contribution, which must be paid with a separate check to the THIS Fund, is required when purchasing credit for optional service earned on or after July 1, 1995. If this applies to you, your payments to date and balance are shown.

Your Optional Service Details

Your record does not show any optional service that is available for purchase.

Active Service

Your total active service credit is shown. Currently, you earn one year of credit for 170 or more paid days in a school year. If you work less than 170 paid days, you will earn a partial year of service credit. If you work 170 or more days, you receive the maximum annual credit of one year. The total amount includes all fully-paid optional service credit.

Important Reminder

In preparing this Benefits Report, every effort has been made to provide accurate information. However, any projected information is approximate. All information is subject to revision due to errors, omissions, or future changes in the rules and laws governing the Teachers' Retirement System. In addition, salaries reported to TRS are subject to audit to determine compliance with reporting rules and procedures.

For More Information

See your *Member Guide* for complete information on your TRS benefits. This publication and others are available on our Web site, http://trs.illinois.gov or through our Forms Order Line, (800) 877-7896, press "2" when prompted.

Benefit Reports Online

Members may view and print their TRS Benefit Reports from 2004 to the present within the secure Member Account Access area. After signing in, members may print the reports as a PDF from the Web site.

Your Active Service

As of June 30, 2013

Member ID: [redacted]

School Year	Employer	Service Credit	Earnings
2012-13	[redacted]	0.512	$7,704.25
2011-12		0.412	$6,727.50
2010-11		0.312	$4,887.50
2009-10		0.400	$6,267.50
2008-09		0.547	$7,755.00
2007-08		0.612	$13,739.00
2006-07		0.441	$6,510.00
2005-06		0.571	$8,295.00
2004-05		0.541	$7,550.00
2003-04		0.594	$8,350.00
2002-03		0.606	$9,400.00
2001-02		0.559	$8,450.00
2000-01		0.494	$7,110.00
1999-00		0.471	$5,947.50
1998-99		0.541	$6,400.00
1997-98		0.553	$9,410.00
1996-97		0.571	$9,465.14
1995-96	Multiple	0.377	$5,308.09
Total		9.114	

Teachers' Retirement System of Illinois (2013d). *Your TRS Benefits Report* [financial statement], obtained 1/23/2014 by request.

Appendix C: Ancillary behavioral model results

Table C.1: Results for probit regressions, separations under age 50 (dependent variable = decision to claim refundable contributions)

	mean	(1)	(2)	(3)	(4)
Age At Separation	34.24	0.001			
		(0.001)			
Total Service	8.08	-0.020***			
		(0.003)			
Salary, in ten thousands	2.92	-0.016			
		(0.011)			
PWCOR	0.75		-0.093***		
			(0.018)		
Net PW, in ten thousands	-0.48			-0.022***	
				(0.005)	
IROR	0.03				-2.891***
					(0.523)
after_2008	0.35	-0.017	-0.025*	-0.026**	-0.024*
		(0.014)	(0.013)	(0.013)	(0.013)
Female	0.82	-0.161***	-0.148***	-0.148***	-0.144***
		(0.018)	(0.018)	(0.018)	(0.018)
Black	0.02	0.266***	0.270***	0.270***	0.268***
		(0.048)	(0.047)	(0.047)	(0.047)
Hispanic	0.03	0.067*	0.097**	0.088**	0.097**
		(0.039)	(0.041)	(0.040)	(0.041)
Asian	0.01	-0.071	-0.069	-0.070	-0.070
		(0.045)	(0.045)	(0.045)	(0.045)
High school teacher	0.23	0.012	0.005	0.004	0.006
		(0.016)	(0.015)	(0.015)	(0.015)
Special education teacher	0.14	0.001	-0.002	-0.003	-0.001
		(0.018)	(0.018)	(0.018)	(0.018)
Suburb	0.59	0.002	0.005	0.005	0.005
		(0.019)	(0.019)	(0.019)	(0.019)
Rural or town	0.27	0.058**	0.066***	0.067***	0.066***
		(0.023)	(0.023)	(0.023)	(0.023)
Graduate Degree	0.12	0.006	0.022	0.019	0.023
		(0.020)	(0.019)	(0.019)	(0.019)
Degree from elite IL college	0.09	-0.075***	-0.080***	-0.080***	-0.081***
		(0.020)	(0.019)	(0.019)	(0.019)
Degree from in-state	0.72	0.021	0.015	0.017	0.015
		(0.014)	(0.014)	(0.013)	(0.014)

Table C.1: Results for probit regressions, separations under age 50 (dependent variable = decision to claim refundable contributions) (Cont.)

	mean	(1)	(2)	(3)	(4)
Art	0.07	-0.002	-0.004	-0.002	-0.004
		(0.023)	(0.023)	(0.023)	(0.023)
ELA	0.23	-0.017	-0.016	-0.016	-0.016
		(0.016)	(0.016)	(0.016)	(0.016)
Foreign language	0.06	-0.002	-0.006	-0.005	-0.006
		(0.024)	(0.024)	(0.024)	(0.024)
Math or Science	0.13	-0.016	-0.016	-0.015	-0.017
		(0.018)	(0.018)	(0.018)	(0.018)
Social Science	0.22	0.001	0.001	0.001	0.001
		(0.016)	(0.016)	(0.016)	(0.016)
Vocational	0.02	-0.033	-0.036	-0.035	-0.036
		(0.038)	(0.038)	(0.038)	(0.038)
Dist enrollment, in thousands	6.63	0.002***	0.003***	0.002***	0.003***
		(0.001)	(0.001)	(0.001)	(0.001)
Dist pupil-teacher ratio	16.22	-0.002	-0.002	-0.002	-0.002
		(0.003)	(0.003)	(0.003)	(0.003)
Dist IEP percent	0.16	0.010	0.017	0.010	0.027
		(0.191)	(0.191)	(0.191)	(0.191)
Dist FRL percent	0.32	0.036	0.046	0.044	0.048
		(0.049)	(0.049)	(0.049)	(0.049)
Dist minority percent	0.29	-0.009	-0.011	-0.011	-0.012
		(0.041)	(0.041)	(0.041)	(0.041)
Assumed real interest rate		--	0.04	0.04	--
Observations		5,622	5,622	5,622	5,622
Pseudo R-squared		0.0418	0.0350	0.0342	0.0355
Log Lik		-3112	-3134	-3137	-3133

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Sample comprises TRS members hired in or after 1980 who quit in or after 2002 as a full-time teacher, and separations up to age 50; sample excludes teachers with a Single Sum Retirement benefit, individuals observed teaching in the City of Chicago PSD, and Inactive teachers who moved into a reciprocal Illinois pension system. Pension wealth is computed in 2011 dollars and based on 4 percent real interest and 2.5 percent inflation. Survival probabilities are based on gender and race/ethnicity.

Table C.2: Results for linear probability model regressions, separations under age 50 (dependent variable = decision to claim refundable contributions)

	mean	(1)	(2)	(3)	(4)
Age At Separation	34.24	0.001			
		(0.001)			
Total Service	8.08	-0.019***			
		(0.003)			
Salary, in ten thousands	2.92	-0.015			
		(0.011)			
PWCOR	0.75		-0.087***		
			(0.016)		
Net PW, in ten thousands	-0.48			-0.017***	
				(0.004)	
IROR	0.03				-2.759***
					(0.491)
after_2008	0.35	-0.017	-0.025**	-0.026**	-0.023*
		(0.014)	(0.013)	(0.013)	(0.013)
Female	0.82	-0.159***	-0.148***	-0.150***	-0.145***
		(0.016)	(0.016)	(0.016)	(0.016)
Black	0.02	0.261***	0.266***	0.266***	0.264***
		(0.040)	(0.040)	(0.040)	(0.040)
Hispanic	0.03	0.067*	0.092**	0.081**	0.092**
		(0.036)	(0.036)	(0.036)	(0.036)
Asian	0.01	-0.066	-0.062	-0.063	-0.063
		(0.048)	(0.048)	(0.048)	(0.048)
High school teacher	0.23	0.011	0.004	0.003	0.005
		(0.015)	(0.015)	(0.015)	(0.015)
Special education teacher	0.14	-0.000	-0.002	-0.002	-0.002
		(0.017)	(0.017)	(0.017)	(0.017)
Suburb	0.59	0.004	0.007	0.007	0.007
		(0.019)	(0.019)	(0.019)	(0.019)
Rural or town	0.27	0.058***	0.065***	0.066***	0.066***
		(0.022)	(0.022)	(0.022)	(0.022)
Graduate Degree	0.12	0.006	0.021	0.017	0.022
		(0.020)	(0.018)	(0.018)	(0.018)
Degree from elite IL college	0.09	-0.074***	-0.079***	-0.079***	-0.080***
		(0.021)	(0.021)	(0.021)	(0.021)
Degree from in-state	0.72	0.022	0.015	0.018	0.015
		(0.013)	(0.013)	(0.013)	(0.013)
Art	0.07	-0.001	-0.004	-0.002	-0.004
		(0.023)	(0.023)	(0.023)	(0.023)

Table C.2: Results for linear probability model regressions, separations under age 50 (dependent variable = decision to claim refundable contributions) (Cont.)

	mean	(1)	(2)	(3)	(4)
ELA	0.23	-0.016	-0.015	-0.015	-0.015
		(0.015)	(0.015)	(0.015)	(0.015)
Foreign language	0.06	-0.001	-0.005	-0.004	-0.005
		(0.023)	(0.024)	(0.024)	(0.024)
Math or Science	0.13	-0.014	-0.015	-0.014	-0.015
		(0.018)	(0.018)	(0.018)	(0.018)
Social Science	0.22	0.001	0.001	0.001	0.001
		(0.016)	(0.016)	(0.016)	(0.016)
Vocational	0.02	-0.035	-0.035	-0.034	-0.036
		(0.039)	(0.040)	(0.040)	(0.040)
Dist enrollment, in thousands	6.63	0.002***	0.003***	0.003***	0.003***
		(0.001)	(0.001)	(0.001)	(0.001)
Dist pupil-teacher ratio	16.22	-0.002	-0.002	-0.002	-0.002
		(0.003)	(0.003)	(0.003)	(0.003)
Dist IEP percent	0.16	0.020	0.030	0.022	0.039
		(0.188)	(0.189)	(0.189)	(0.189)
Dist FRL percent	0.32	0.038	0.045	0.039	0.047
		(0.049)	(0.048)	(0.048)	(0.048)
Dist minority percent	0.29	-0.012	-0.012	-0.010	-0.014
		(0.040)	(0.040)	(0.040)	(0.040)
Constant		0.542***	0.431***	0.361***	0.446***
		(0.079)	(0.057)	(0.056)	(0.057)
Assumed real interest rate		--	0.04	0.04	--
Observations		5,622	5,622	5,622	5,622
R-squared		0.049	0.042	0.041	0.043

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Sample comprises TRS members hired in or after 1980 who quit in or after 2002 as a full-time teacher, and separations up to age 50; sample excludes teachers with a Single Sum Retirement benefit, individuals observed teaching in the City of Chicago PSD, and Inactive teachers who moved into a reciprocal Illinois pension system. Pension wealth is computed in 2011 dollars and based on 4 percent real interest and 2.5 percent inflation. Survival probabilities are based on gender and race/ethnicity.

Table C.3: Results for logistic regressions under different interest rates, all separation ages (dependent variable = decision to claim refundable contributions)

Assumed real interest rate	2% mean	2% (1)	2% (2)	6% mean	6% (3)	6% (4)
PWCOR	4.04	-0.022***		1.04	-0.013	
		(0.008)			(0.013)	
Net PW, in ten thousands	9.59		-0.011***	0.44		0.001
			(0.002)			(0.003)
after_2008	0.36	-0.034***	-0.027**	0.36	-0.037***	-0.038***
		(0.012)	(0.012)		(0.012)	(0.012)
Female	0.82	-0.148***	-0.150***	0.82	-0.151***	-0.151***
		(0.017)	(0.017)		(0.017)	(0.017)
Black	0.02	0.270***	0.270***	0.02	0.271***	0.269***
		(0.044)	(0.044)		(0.044)	(0.044)
Hispanic	0.03	0.084**	0.090**	0.03	0.073**	0.069*
		(0.037)	(0.037)		(0.037)	(0.036)
Asian	0.01	-0.050	-0.050	0.01	-0.050	-0.050
		(0.047)	(0.046)		(0.047)	(0.047)
High school teacher	0.23	0.005	0.008	0.23	0.004	0.004
		(0.015)	(0.015)		(0.015)	(0.015)
Special education teacher	0.14	0.005	0.006	0.14	0.004	0.004
		(0.017)	(0.017)		(0.017)	(0.017)
Suburb	0.58	0.003	0.002	0.58	0.003	0.003
		(0.019)	(0.019)		(0.019)	(0.019)
Rural or town	0.27	0.069***	0.066***	0.27	0.068***	0.068***
		(0.022)	(0.022)		(0.022)	(0.022)
Graduate Degree	0.13	0.008	0.014	0.13	0.003	-0.001
		(0.018)	(0.018)		(0.018)	(0.018)
Degree from elite IL college	0.09	-0.080***	-0.081***	0.09	-0.078***	-0.077***
		(0.019)	(0.019)		(0.019)	(0.019)
Degree from in-state	0.71	0.014	0.013	0.71	0.016	0.017
		(0.013)	(0.013)		(0.013)	(0.013)
Art	0.07	-0.003	-0.002	0.07	-0.003	-0.003
		(0.023)	(0.023)		(0.023)	(0.023)
ELA	0.23	-0.017	-0.016	0.23	-0.018	-0.018
		(0.015)	(0.015)		(0.015)	(0.015)
Foreign language	0.07	-0.000	0.000	0.07	0.000	0.000
		(0.023)	(0.023)		(0.023)	(0.023)
Math or Science	0.13	-0.011	-0.012	0.13	-0.010	-0.010
		(0.017)	(0.017)		(0.017)	(0.017)

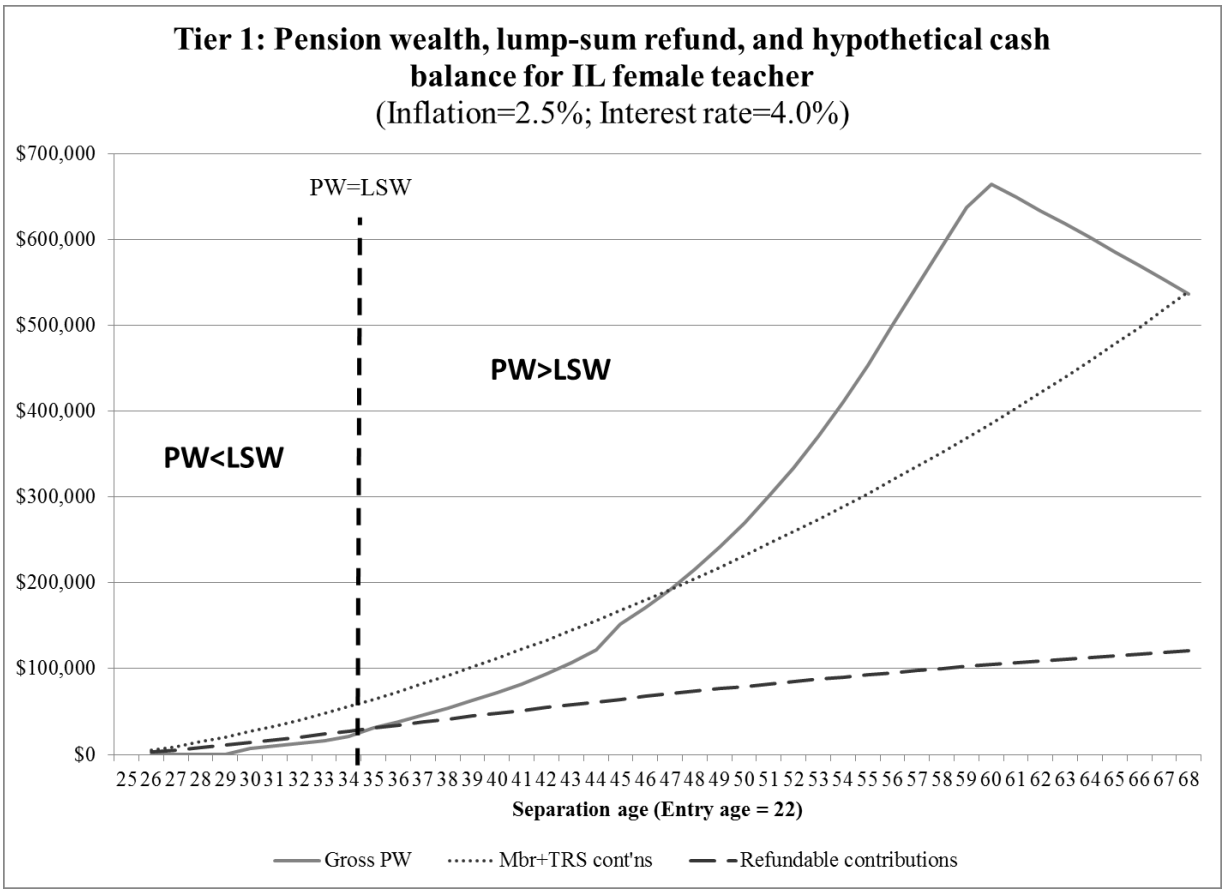
Table C.3: Results for logistic regressions under different interest rates, all separation ages (dependent variable = decision to claim refundable contributions) (Cont.)

Assumed real interest rate	2% mean	2% (1)	2% (2)	6% mean	6% (3)	6% (4)
Social Science	0.22	0.002	0.002	0.22	0.002	0.002
		(0.016)	(0.016)		(0.016)	(0.016)
Vocational	0.02	-0.025	-0.025	0.02	-0.025	-0.026
		(0.037)	(0.037)		(0.037)	(0.037)
Dist enrollment, in thousands	6.68	0.002***	0.002***	6.68	0.002***	0.002***
		(0.001)	(0.001)		(0.001)	(0.001)
Dist pupil-teacher ratio	16.25	0.000	0.001	16.25	0.000	0.000
		(0.002)	(0.002)		(0.002)	(0.002)
Dist IEP percent	0.16	-0.008	-0.012	0.16	-0.013	-0.016
		(0.184)	(0.183)		(0.184)	(0.184)
Dist FRL percent	0.32	0.048	0.053	0.32	0.041	0.037
		(0.047)	(0.046)		(0.047)	(0.047)
Dist minority percent	0.29	0.000	-0.004	0.29	0.004	0.006
		(0.039)	(0.039)		(0.039)	(0.039)
Observations		6,058	6,058		6,058	6,058
Pseudo R-squared		0.0334	0.0372		0.0325	0.0323
Log Lik		-3404	-3391		-3407	-3408

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Sample comprises TRS members hired in or after 1980 who quit in or after 2002 as a full-time teacher, and all quit ages; sample excludes teachers with a Single Sum Retirement benefit, individuals observed teaching in the City of Chicago PSD, and Inactive teachers who moved into a reciprocal Illinois pension system. Pension wealth is computed in 2011 dollars and based on 4 percent real interest and 2.5 percent inflation. Survival probabilities are based on gender and race/ethnicity.

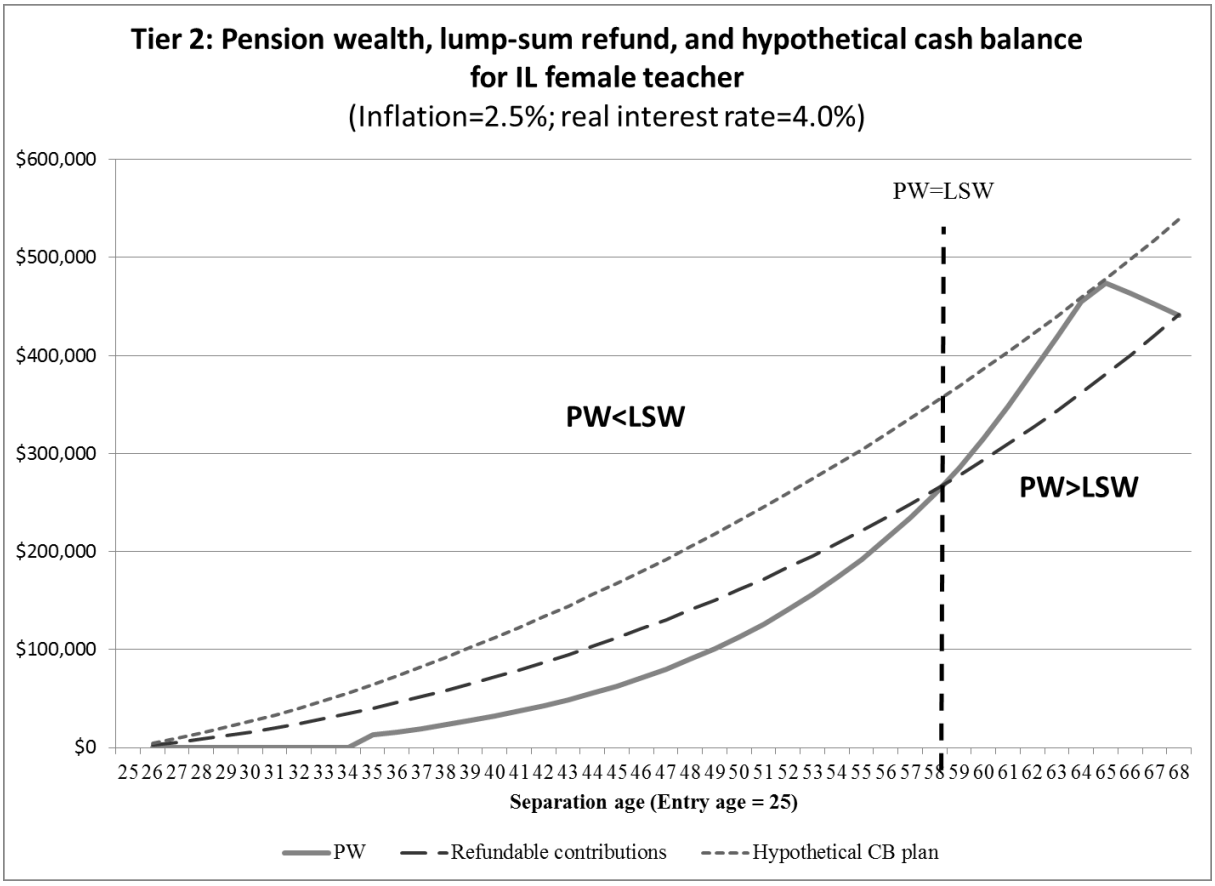
Appendix D: Cash balance simulations compared with TRS benefits

Figure D.1: Pension wealth, lump sum refund, and hypothetical CB benefit for Tier 1 female teacher in Illinois TRS



Note: based on author's calculations

Figure D.2: Pension wealth, lump sum refund, and hypothetical CB benefit for Tier 2 female teacher in Illinois TRS



Note: based on author's calculations