PENSION PLAN CHARACTERISTICS AND FRAMING EFFECTS IN EMPLOYEE SAVINGS BEHAVIOR

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Abstract—Defined contribution pensions in many postsecondary institutions are funded by a combination of an employer premium and a mandatory employee premium. Individuals can also contribute to a supplemental savings account. Holding constant total compensation, standard reasoning suggests that supplemental savings should depend negatively on the sum of the employer and employee pension contributions. Contrarily, we find that the supplementary savings of professors are significantly more sensitive to employee contributions than to employer contributions. This asymmetry is consistent with different marginal propensities to save out of the salary and pension components of compensation. Nevertheless, impacts on lifetime utility are relatively modest.

I. Introduction

SAVINGS rates vary widely across people, even among those with similar age, income, and family structure (Bernheim, Skinner, & Weinberg, 2001). As with other outcomes of individual choice, the interpretation of this heterogeneity remains controversial. A neoclassical reading is that individuals make different savings decisions depending on their preferences for current versus future consumption (Scholz, Seshadri, & Khitatrakun, 2006). Although this perspective provides the basis for most economic analyses, a growing body of research suggests that savings decisions are also affected by a wide range of influences that play no role in standard models, including framing effects (Shefrin & Thaler, 1992), default effects (Madrian & Shea, 2001; Choi, Laibson, & Madrian, 2004), and inattention (Reis, 2006; Lusardi, 2000).[1]

This paper contributes to the growing evidence of behavioral decision-making effects in savings outcomes using detailed microdata on the retirement savings behavior of college and university faculty. Many postsecondary institutions in the United States offer a defined contribution pension plan funded by the combination of an employer contribution and a mandatory employee contribution.[2] Employees can also make tax-deferred supplemental contributions to the same asset fund. Standard reasoning predicts that supplemental savings will depend negatively on the combined pension contributions made on behalf of an employee. If people compartmentalize their salaries and their employer's pension contributions into different "mental accounts," however, supplemental savings will tend to be more sensitive to employee contributions (which, like supplemental savings, appear as salary deductions) than to employer contributions (which do not). We test for differential responses using a unique data set combining ten years of salary and pension information for older faculty at a sample of colleges and universities with TIAA-CREF pensions.

Our findings confirm that supplemental savings rates depend on how compensation is labeled. In particular, supplemental savings are significantly lower when a larger fraction of the regular pension contribution appears as a salary deduction. The discrepancy is large: we estimate that supplementary savings are reduced by 60 to 80 cents per dollar of employee contributions to the regular pension, but only by one-half as much per dollar of employer contributions. Consequently, two faculty members with the same total compensation and the same total contribution rates to their regular pension will reach retirement age with substantially different amounts of supplemental saving depending on the share of regular pension premiums labeled as an employee contribution. We interpret these findings as further evidence that behavioral departures from a strict neoclassical choice framework can help to explain the observed variability in savings behavior and wealth outcomes, even among highly educated workers with predictable future income streams. Nevertheless, as Chetty, Looney, and Koft (2009) observe with respect to sales taxes, the welfare consequences of underresponding to employer pension contributions are "second order." An example calculation suggests that the welfare costs are equivalent to a reduction of lifetime wealth on the order of 2% to 3%, at most.

II. Previous Literature

Our work builds on a number of strands in the existing literature on savings behavior.[3] One well-known set of papers studies the effect of tax-deferred savings accounts on overall savings rates. Poterba, Venti, and Wise (1996, 1998) argue that tax-deferred savings mechanisms like

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[1] A related literature on procrastination (Akerlof, 1991; O'Donoghue & Rabin, 1999) and time inconsistency (Laibson, 1997; Laibson, Repetto, & Tobacman, 1998) asks why on average people appear to save "too little."

[2] For example, the employer may contribute 8% of salary, and the employee is required to contribute 8%. A similar distinction between payers arises in the Social Security payroll tax. A small fraction of retirement plans includes a matching formula. As discussed below, we exclude such plans from our analysis.

[3] Savings behavior is intimately connected to intertemporal consumption. See Deaton (1992) for an evaluation of the literature up to the early 1990s and Browning and Lusardi (1996) for a more recent survey.

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IRAs and 401(k) programs lead to an increase in savings, while Gale and Scholz (1994), Engen, Gale, and Scholz (1996), and Gale (1998) argue that the balances in these accounts are offset by reductions in other forms of household wealth. Our question is closely related, but we avoid some of the difficulties in this literature by focusing on the difference in the offsetting effect of two savings flows that are treated equally by the tax system and by using the same data source to measure pension contributions and supplemental savings.

A second body of research establishes that seemingly minor details about a defined contribution pension plan, such as the "default" arrangements for plan participation, can have relatively large effects on savings behavior (see Choi et al., 2004, for a recent survey). In an influential study, Madrian and Shea (2001) found that a change in the default option governing 401(k) enrollment (from "not enrolled" to "enrolled") led to a sharp increase in plan participation. Confirmatory evidence is presented by Choi, et al. (2004), Choi, Laibson, Madrian, and Metrick (2005), and Nesmith, Utkus, and Young (2007). Other studies have examined the effect of allowing employees freedom of choice in the allocation of pension contributions (Papke, 2004; Huberman, Iyengar, & Jiang, 2003) and the effect of default options in asset allocation choices (Beshears et al., 2007).

A third literature examines the quality or transparency of the information available to savers. Surveys suggest that many people lack basic information on their public and private retirement benefits (Bernheim, 1994; Gustman & Steinmeier, 2001). Morever, a number of recent studies have shown that people respond more strongly to transparent or easily accessible information than to "hidden" or inaccessible information.[4] Since employee pension contributions appear as deductions on monthly payroll statements whereas employer contributions do not, people may pay closer attention to their own pension contributions than to their employer's, leading to differential impacts on supplementary savings.[5] Unlike Social Security or defined benefit pension plans, however, TIAA/CREF sends regular quarterly statements to account holders showing total premium payments in the recent period. In view of this, we believe that differential accessibility of information is unlikely to fully account for our findings. As a check, however, we compare results among various groups of faculty, including those in different fields of study (for example, business and professional schools) and different age ranges (for example, those near retirement age). In all groups, we find a similar pattern of results.

Finally, our work builds directly on earlier studies of the influence of mental accounting on savings behavior. A basic premise of the mental accounting literature is that people assign different income sources to different "accounts" and treat the balances in different accounts as imperfect substitutes (Thaler, 1999). Shefrin and Thaler (1992) use this framework to explain the excess sensitivity of consumption to temporary income shocks, while Thaler (1990) posits that a mental accounting process can explain why people do not reduce their savings dollar-for-dollar by the amount of their pension wealth.

Field-based evidence on mental accounting and savings is limited.[6] Using data for older workers in the Retirement History Survey, Levin (1998) found that the marginal propensity to consume is substantially higher out of wage and salary income than wealth shocks, and they interpreted this as evidence of mental accounting. Davies, Easaw, and Ghoshray (2006) found that families in Malawi exhibited a higher savings propensity from remittances than other income sources. A difficulty in interpreting these findings is that the marginal propensity to save out of different income sources can vary, depending on the stochastic properties of the various sources (Carroll, 2001). In contrast, the offsetting effects of employer and employee pension premiums on supplementary savings should be equal regardless of the income process or potential credit constraints. Thus, we believe our empirical design provides a stronger test of mental accounting effects.

III. Some Features of Faculty Retirement Savings Programs

Before presenting a theoretical framework for modeling the effect of pension contributions on employee savings, it is useful to outline some of the main features of typical faculty retirement savings programs. As in other sectors, there are two basic types of pensions: defined benefit (DB) plans, which provide a pension benefit based on an employee's age, years of service, and average salary; and defined contribution (DC) plans, which create a retirement fund owned by the employee (Mitchell & Schieber, 1998). Typically DC pensions are funded by payments from the employer and the employee into an asset fund like TIAA-CREF or Vanguard. Employees usually have some choice in how funds are invested, but cannot freely access the money until they retire or reach a minimum age.

In a separate analysis, we matched pension characteristics to about 100 large U.S. universities that participated in

[4] See DellaVigna (2009) for a review of the growing literature on "limited attention" biases. For example, Chetty et al. (2009) show that consumers underrespond to changes in state sales taxes, relative to posted pretax prices, while Hossain and Morgan (2006) find that Ebay bidders underrespond to differences in shipping costs for similar items.

[5] Employer pension contributions are counted as income for purposes of computing Medicare Hospital Insurance taxes, and thus appear (indirectly) on standard payroll forms.

[6] O'Curry (2000), Kooreman (2000), and Milkman et al. (2007) demonstrate a link between the source of an income gain and people's willingness to spend the gain on different things. Milkman et al., for example, show that grocery spending rises by about $1.60 in response to a $10 grocery coupon—far too large a response to be consistent with conventional demand models.

TABLE 1.—EXAMPLES OF CHARACTERISTICS OF DEFINED CONTRIBUTION PLANS AT U.S. UNIVERSITIES

Institution and State	Employer Contribution (Percent of Salary)	Required Employee Contribution (Percent of Salary)	Matching Provisions
Indiana University, IN	12.0	0	None
University of Michigan, MI	10.0	5.0	None
University of Miami, FL	11.0	0	None
Georgetown University, DC	10.0	3.0	None
Princeton University, NJ	9.3 up to SSMax	0	
	15.0 over SSMax	0	None
University of Pennsylvania, PA	Under age 30: 6.0	4.0	
	Ages 30–40: 8.0	8.0	
	Over age 40: 9.0	8.0	None
California Institute of Technology, CA	8.3 to age 55	5.7	
	12.3 after age 55	5.7	None
Harvard University, MA	Age<=40: 5.0 up to SSMax	0	
	10.0 over SSMax	0	
	Age>=41: 10.0 up to SSMax	0	
	15.0 over SSMax	0	None
Stanford University, CA	5.0 plus matching	0 to 5.0	Employer contributes 5% and will additionally match employee contribution of up to 5.0%.

SSMax refers to the earnings limit on Social Security contributions, which has varied over time. For 2006, the limit is $94,200. In 1990, the limit was $51,300.

the 1995–1996 Faculty Survey conducted by the Higher Education Research Institute at UCLA.[7] In this sample about 25% of faculty were employed at institutions that offered only a DB plan, about 37% worked at institutions with only a DC plan, and the remaining 38% worked for employers that offered both types of plans. DB plans are more common at public institutions, where faculty are often included in a broader pension program for state workers (see Berger et al., 2001, table 6.2). The most common DC pension fund is TIAA-CREF, which is available at about 72% of postsecondary institutions nationwide and an even higher fraction of four-year institutions (U.S. Department of Education, 1997, table 5.1).

Our empirical analysis is based on a sample of faculty employed at colleges and universities with DC plans who contributed to a pension fund managed by TIAA-CREF in the mid-1990s. Table 1 provides a few examples of the DC plans offered at U.S. universities, illustrating the range of variation in the contribution formulas.[8] The plans at the University of Michigan and Indiana University in the top rows of the table are typical of many plans throughout the country. At Michigan, the employer contributes 10% of salary, and the employee is required to make an additional contribution of 5%. We label this funding system, patterned after the original template recommended by TIAA-CREF in 1916, as a *contributory plan*.[9] At Indiana, the university makes an annual contribution of 12% of the employee's salary, with no employee contribution. We refer to this as a *noncontributory plan*. Note that in some plans, including Caltech and Harvard, employer or employee contribution rates can vary by age or salary.[10]

A third type of pension arrangement is illustrated by the plan at Stanford (bottom row of table 1). Here the employer offers a minimum contribution rate together with a matching formula based on the voluntary contributions of employees. Although such formulas are relatively common outside academia (see Choi, Laibson, & Madrian, 2005) they are less common in the postsecondary education sector. For example, among the 96 institutions in the Faculty Retirement Survey for which we are able to obtain pension plan characteristics, only 19 had some sort of matching formula for at least a fraction of employees. In our empirical analysis, we therefore focus on the savings behavior of faculty at the 80% of institutions with either no employee contribution to the regular pension (as at Indiana University) or a fixed employee contribution (as at the University of Michigan).

Because some share of the compensation of professors in most pension plans is actually deferred compensation, comparisons of nominal contribution rates, such as those listed in table 1, can be misleading. To address this issue, throughout this paper we express contribution rates as a fraction of total compensation (current salary plus the employer's contribution to the pension account). We call this the *effective contribution rate*. As an illustration, consider the pension plans of the University of Michigan and Indiana University, listed in table 1. At Indiana, the effective contribution rate is $0.12/1.12 = 10.7\%$. (That is, an individual with a nominal salary of $100,000 has total pre-

[7] Details of this analysis are available on request.

[8] The information in table 1 comes from Web sites of these institutions. We are unsure whether these institutions participated in the Faculty Retirement Survey that forms the basis for the following analysis, as we do not know the identities of survey participants.

[9] According to Greenough (1990), the historically recommended funding formula was for both the employer and employee to contribute 5% of salary.

[10] A 1968 survey of 1,170 four-year colleges and universities with TIAA-CREF pensions conducted by Greenough and King (1969) found that 84% of institutions had a contributory pension plan and 15% had a noncontributory plan. A survey from 10 years earlier (Greenough & King, 1959) found an even higher fraction of contributory plans (94%).

tax compensation of \$112,000, since the university also makes a \$12,000 contribution to his or her pension.) By comparison, the effective contribution rate at the University of Michigan is (0.10 + 0.05)/(1.1) =13.6%, which consists of two parts: the employer's effective contribution rate of 9.1% (0.10/1.1) and the employee's effective contribution rate of 4.5% (0.05/1.1).

In addition to a regular pension program, most colleges and universities offer a supplemental program for tax-deferred savings, known as a Section 403(b) elective deferral plan, or, in the case of TIAA-CREF, as a supplemental retirement annuity (SRA). These plans permit an individual to set aside part of his or her current earnings and avoid federal and (in most cases) state income taxes. Contributions to these plans are subject to a maximum annual contribution limit, which ranged from \$7,000 in 1987 to \$9,500 in 1996.

Elective deferral programs are intended to encourage saving for retirement, so there are penalties for early withdrawals (prior to age 59 1/2). Most plans, however, waive the penalty if the withdrawal is used for educational expenses or to purchase a house. Many plans also allow participants to borrow from their supplemental pension assets. (In contrast, it is illegal to borrow from regular retirement accounts or use these balances as collateral.) Because of their favorable tax treatment and ready accessibility, SRAs are a convenient instrument for supplemental retirement savings by college and university professors, and they arguably represent the preferred vehicle for the first dollar of supplemental savings by people who are allocating their regular pension contributions to TIAA/CREF.

IV. Supplemental Savings and Pensions

This section presents a simplified model of intertemporal savings and derives the relationship between supplemental savings and the regular pension contributions made on behalf of an employee. We initially present a model with perfect foresight and then discuss how the basic insights apply more generally. Assume that an individual's adult life is divided into T years of work and R years of retirement and that the individual has an additively separable utility function:

$$1/\beta \sum_0^{T+R} \beta^t u(c_t), \tag{1}$$

where c_t represents consumption in period t, $u(\ )$ is a concave within-period utility function, and β is a discount factor. During any period $t \leq T$, the individual earns a salary w_t (in inflation-adjusted dollars), while in retirement, the individual receives a Social Security benefit b_t. The individual also has a defined contribution pension, to which the employer makes a tax-deferred contribution p_t^1 and the individual makes a tax-deferred contribution of p_t^2.[11] The individual can save an additional amount s_t in a tax-sheltered supplemental (SRA) program. Pension and SRA contributions accumulate in a pooled fund with a fixed rate of return r. Letting A_t denote the value of combined assets at the beginning of any period t, assets in the next period are:

$$A_{t+1} = (1 + r)(A_t + p_t^1 + p_t^2 + s_t). \tag{2}$$

The individual faces a constant tax rate of τ. During any working period,

$$c_t = (1 - \tau)(w_t - p_t^2 - s_t),$$

while during retirement,

$$c_t = (1 - \tau)(b_t - s_t).$$

Solving for s_t and substituting into equation (2) yields the intertemporal budget constraint,

$$A_{t+1} = (1 + r)(A_t + y_t - c_t/(1 - \tau)), \tag{3}$$

where $y_t = w_t + p_t^1$ represents total compensation (salary plus the employer's pension contribution) in any working period, and $y_t = b_t$ in retirement. Note that this budget constraint is equivalent to 1 in which the individual has income y_t in each period and the price of consumption is \$1/(1-τ).

An optimal consumption path is characterized by the first-order condition:

$$u'(c_t) = \lambda_0 \beta(1 + r)/(1 - \tau), \tag{4}$$

where $\lambda_0 > 0$ is a multiplier. If the rate of time preference equals the interest rate, then the individual obeys the permanent income hypothesis (PIH), setting $c_t = c^* = y^P\ (1 - \tau)$, where y^P is the annuity value of lifetime wealth ("permanent income"). Supplemental savings are then given by

$$s_t = S_t^* - p_t^1 - p_t^2, \tag{5}$$

where $S_t^* \equiv y_t - c_t^* /(1\text{-}\tau) = y_t - y^P$ represents total desired saving in period t. Under the PIH, desired saving is simply the difference between current income and the annuity equivalent of life cycle wealth (Campbell, 1987). More generally, c_t^* can rise or fall if $\beta \neq 1/(1 + r)$, or if the marginal utility of consumption varies with age, and S_t^* will vary accordingly. In any case, holding constant preferences and the life cycle profile for y_t, supplemental savings are reduced dollar for dollar by the sum of total pension contributions made by the employer and the individual in period t.

If earnings early in life are relatively low or pension contribution rates are relatively high, equation (5) will require negative supplemental savings (that is, borrowing). Provided that interest on debt is tax deductible, this does not complicate the model, but it does introduce a distinction between supplemental savings (which can be negative) and supplemental pension contributions (which cannot). Specifically, if one assumes that an individual uses SRA contribu-

[11] Technically, the employee's contribution is subject to Social Security taxes, whereas the employer contribution is exempt. Both contributions are subject to the Medicare tax. We ignore these tax differences.

tions to save whenever supplemental savings are strictly positive, then

$$SRA_t = \max[0, S_t^* - p_t^1 - p_t^2]. \quad (6)$$

Dividing both sides of this equation by total compensation in period t leads to an expression for the supplemental savings rate:

$$SRA_t/y_t = \max[0, \psi_t - \pi_t^1 - \pi_t^2], \quad (7)$$

where $\psi_t \equiv S_t^*/y_t$ is the optimal savings rate in period t, and $\pi_t^1 \equiv p_t^1/y_t$ and $\pi_t^2 \equiv p_t^2/y_t$ are the effective pension contribution rates for the employer and employee, respectively.

Although we derived equation (7) under perfect foresight, the same relationship holds under uncertainty with a suitable definition of optimal savings S_t^*.[12] This reflects the fact that the objective function (2) and the budget constraint (3) depend only on c_t and y_t, regardless of whether y_t is certain or uncertain.

A. *Framing Effects, Mental Accounting, and Imperfect Information*

Although a conventional savings model assumes that wages and employer pension contributions are fully fungible, a behavioral perspective suggests that people may treat them differently. In particular, suppose that people assign their employer's pension contributions to one mental account and wages to another. Since employee pension contributions and supplemental savings are both withdrawn from the "wages" account, supplemental savings will be offset dollar-for-dollar by the value of employee pension contributions. With imperfect fungibility across accounts, however, supplemental savings will be less sensitive to employer contributions. Rewriting equation (7) as

$$SRA_t/y_t = \max[0, \psi_t + \gamma_1\pi_t^1 + \gamma_2\pi_t^2], \quad (8)$$

a conventional model suggests $\gamma_1 = \gamma_2 = -1$ while a mental accounting model suggests $\gamma_2 = -1$ and $\gamma_1 > -1$.

Another explanation for a smaller offsetting effect of employer pension contributions is that people pay less attention to these contributions because they are harder to monitor.[13] While we cannot decisively rule out a differential observability hypothesis, we note that people with a TIAA-CREF pension account receive regular quarterly statements that summarize total contributions to their pension over the period. Moreover, in many colleges, the employer and employee contributions are fixed proportions of baseline salary, so there is no new information about contribution rates that has to be monitored. To provide some evidence on the "inattention" explanation, we estimate models for the subsample of employees at colleges and universities with simple fixed contribution pension schemes (such as Michigan and Indiana). We also examine the savings behavior of people relatively close to retirement (ages 55–61), who are arguably most focused on savings and retirement income.

V. Econometric Implementation

In this section we discuss some important issues in the econometric estimation of our key behavioral equation (8). The primary difficulty is that there may be a correlation between the unobserved determinants of desired savings and the pension contribution rates π_t^1 and π_t^2. This can lead to biases in the estimation of the offset parameters γ_1 and γ_2. Most of the sources of bias will affect the estimates of γ_1 and γ_2 equally. Thus, we can still test for equality of γ_1 and γ_2, though we cannot offer an unambiguous interpretation of the differential between -1 and the estimates of γ_1 and γ_2.

We have access to data on pension contributions and supplemental savings in TIAA-CREF accounts for faculty over the age of 45 who are employed at a set of institutions in the Faculty Retirement Survey (Ashenfelter & Card, 2002) and observed in the years between 1986 and 1996. We observe individual i's salary in year t and the pension plan parameters at his or her institution (j), enabling us to construct total compensation y_{ijt} and the effective pension contribution rates for person i in year t, π_{ijt}^1 and π_{ijt}^2. In addition, we observe any SRA contributions, SRA_{ijt}, and a set of individual characteristics (including age, gender, and academic department). Given this information and a stochastic specification for the determinants of the desired savings rate ψ_{ijt}, equation (7) can be estimated as a censored regression (a tobit-style) model.

As a benchmark specification, consider the case of an agent who follows the PIH, so $\psi_{ijt} = \log y_{ijt} - \log y_{ij}^P$ (where y_{ij}^P represents individual i's permanent income). Suppose that annual compensation is determined by a process of the form

$$\log y_{ijt} = \alpha_i + h(t) + \xi_{ijt}, \quad (9)$$

where α_i is a person-specific constant, $h(t)$ is a polynomial in age, and ξ_{ijt} is a (fully anticipated) deviation with the property that $\sum_{t=1}^{T} \exp(h(t) + \xi_{ijt} - rt) = k_1$, a constant that depends on the duration of working life and the interest rate.[14] Assuming that the present value of Social Security income is proportional to total lifetime earnings, equation

[12] For example, Flavin (1981) discusses a simple model with uncertainty in which $S_t^* = y_t - y_t^P$, where y_t^P is the annuity equivalent of current wealth plus discounted expected future labor income.

[13] In cognitive psychology, the processes of categorization, memory, and decisionmaking are seen as closely interrelated (Nosofsky, 1986), so we believe that mental accounting (a form of categorization) and inattention or imperfect information explanations for different values of γ_1 and γ_2 are complementary rather than direct competitors.

[14] This assumption will be satisfied if the deviations are uncorrelated with age and average to a constant. In our sample of older faculty, a model for log total compensation with a fixed effect and a cubic in age has an R^2 of 0.90. Thus, the deviations are relatively small, reflecting the stability of income for older (mainly tenured) faculty.

(9) implies that $y^P_{ij} = k_2 \exp(\alpha_i)$ for a constant k_2. Consequently,

$$\psi_{ijt} = -\log k_2 + h(t) + \xi_{ijt}.$$

Ignoring variation in k_2, the optimal savings rate depends on age and the deviation of i's compensation in period t from the smooth life cycle profile.

More generally, if optimal consumption differs from the PIH benchmark by some function of age and a transitory deviation

$$\log c^*_{ijt}/(1-\tau) - \log y^P_{ij} = f(t) + \upsilon_{ijt},$$

then

$$\psi_{ijt} = -\log k_2 + h(t) - f(t) + \xi_{ijt} - \upsilon_{ijt} = X_{ijt}\delta + \epsilon_{ijt}, \tag{10}$$

where X is a vector of individual characteristics (including age and other factors that influence the duration of work life, the desire for bequests, and so on), and $\epsilon_{ijt} = \xi_{ijt} - \upsilon_{ijt}$ is a composite error that reflects the difference between the period-specific compensation shock and the period-specific consumption demand shock. Assuming that ϵ_{ijt} is normally distributed, equations (7) and (10) specify a simple tobit model for the observed SRA contribution rate:

$$SRA_{ijt}/y_{ijt} = \max[0, X_{ijt}\delta + \gamma_1\pi^1_{ijt} + \gamma_2\pi^2_{ijt} + \epsilon_{ijt}].^{15} \tag{11a}$$

A key assumption for consistent estimation of the coefficients γ_1 and γ_2 in equation (11a) is that premium contribution rates π^1_{ijt} and π^2_{ijt} are uncorrelated with ϵ_{ijt}, the unobserved component of desired savings. One potential source of correlation is sorting: people with a higher desired savings rates may be attracted to jobs with a higher pension contribution rate.[16] This will lead to a positive correlation between ϵ_{ijt} and $\pi^1 + \pi^2$ and a positive bias in the offset coefficients γ_1 and γ_2. Importantly, any such bias should affect γ_1 and γ_2 equally, attenuating the negative impacts of both the employer and employee pension contribution rates on the supplemental savings rate.

Mismeasurement of income may also bias our estimates. In fact, it is quite common for college and university professors to have income from outside sources. The 1989 Survey Among College and University Faculty, conducted by the Carnegie Foundation for the Advancement of Teaching in spring 1989, provides information about sources and amount of noninstitutional income from the time period that we examine. The survey asks, "In 1988, roughly how much did you earn over and above your institutional salary? (Please estimate as a percentage of your basic salary.)" About 31% of faculty reported no outside income, and another 31% reported outside income of less than 10% of institutional income. Yet a full 8% reported outside income of more than 50% of their base salary. The amount of outside income varies across fields, with professional and business faculty typically earning somewhat more and social science and humanities faculty earning less. Again, we expect some attenuation bias due to measurement errors in income; however, we expect this bias to affect γ_1 and γ_2 equally, as discussed in the previous paragraph.

Another source of bias may arise if some people use a vehicle other than a SRA issued by TIAA-CREF for their supplemental savings—for example, IRAs or contributions to some other pension fund.[17] Let $z_{ijt} = 1$ if individual i is using an SRA for supplemental savings in year t, and 0 otherwise. Assuming that equation (11a) is correct for SRA contributors, the observed data-generating process is a tobit model with misclassification error:

$$\begin{aligned} SRA_{ijt}/y_{ijt} &= \max[0, X_{ijt}\delta + \gamma_1\pi^1_{ijt} + \gamma_2\pi^2_{ijt} + \epsilon_{ijt}] \ \ if \ \ z_{ijt} = 1, \\ &= 0 \quad if \ \ z_{ijt} = 0. \end{aligned} \tag{11b}$$

If z_{ijt} is independent of (X_{ijt}, y_{ijt}, π^1_{ijt}, π^2_{ijt}, ϵ_{ijt}), maximum likelihood applied to equation (11b) will yield coefficient estimates that are attenuated toward 0 (Hausman, 2001). As with sorting bias, however, the presence of misclassified 0's will affect the estimates of γ_1 and γ_2 equally. An observationally equivalent source of bias arises if some people fail to make supplemental savings deductions at all—perhaps because of procrastination (O'Donoghue & Rabin, 1999) or inattention (Lusardi, 2000). If people further from retirement are more likely to procrastinate (or ignore the need to save), the attenuation in γ_1 and γ_2 should vary systematically with the age range of the sample, an issue we explore below.

While sorting, unobserved income, and unobserved supplemental savings are expected to cause equal biases in the estimates of γ_1 and γ_2, a differential bias can arise if the employer's pension contribution rate varies with age (or salary), and the specification of $X_{ijt}\delta$ is not sufficiently rich to capture the corresponding shift in desired savings. Consider, for example, an employee at Caltech (see table 1). At age 55 there is a rise in the employer pension contribution

[15] Since contributions were also subject to a legal maximum, our actual estimating equation is a two-limit tobit model with lower and upper bounds on observed contributions.

[16] People who want to save more may find it convenient to have their savings automatically deposited in their regular pension account or may be concerned about hitting the maximum contribution ceiling for their SRA. Alternatively they may want to "commit" to a high level of savings by choosing a job with a high pension contribution rate. See DellaVigna and Malmendier (2006) for an interesting analysis of the demand for commitment.

[17] We suspect that faculty who are using TIAA-CREF for their regular pension accounts are most likely to use an SRA at TIAA-CREF for their supplemental savings. Consequently, we limit our empirical analysis to person/year observations with a regular pension contribution to TIAA-CREF in the same year. Even in this case, some people may prefer to place their elective deferral contributions with another carrier. As a crude adjustment, we amend the vector X to include a dummy for whether other pension carriers are available at the institution.

TABLE 2.—SAMPLE CHARACTERISTICS

	All Faculty at All Schools	Faculty at Schools with Usable Plans	Faculty at Schools with Usable Plans Age 45 or Older in Sample Period	
			All	All - Weighted
Mean age in 1986	43.3	42.8	49.1	48.9
Percent female	24.0	24.3	19.8	17.2
Percent nonwhite	12.7	12.2	8.9	8.2
Percent with Ph.D.	83.4	83.6	83.3	85.2
Field (%)				
Arts and Sciences	51.0	51.0	52.1	55.3
Engineering	10.9	10.9	9.6	10.2
Business	7.2	7.4	6.4	5.8
Professional schools	25.6	25.3	26.3	23.4
Salary in 1992	56,668	55,553	59,017	60,901
Total compensation in 1992	62,269	61,319	65,151	67,439
Regular pension premium in 1992	5,131	5,027	5,796	8,419
Supplemental premium in 1992	775	790	1,025	1,420
School characteristics				
Research university (%)	69.2	69.6	67.8	67.0
Privately controlled (%)	40.1	37.6	37.1	41.1
Alternative to TIAA/CREF (%)	66.7	71.3	71.0	65.3
Matching formula (%)	16.6	0.0	0.0	0.0
Contribution rates in 1992				
Institutional contribution (%)	9.1	9.1	9.2	9.5
Individual contribution (%)	3.7	3.3	3.3	2.8
Number of individual faculty	48,000	38,342	25,451	25,451
Number of institutions	100	77	77	77

Sample derived from Faculty Retirement Survey, which includes faculty at a stratified sample of 100 four-year colleges and universities with significant participation in TIAA/CREF as of 1996. Usable pension plans are those with no matching formula for which retrospective data were available in 2001/2002. Entries in fourth column are weighted averages, with data for each individual weighted by the number of years he or she is included in estimation sample. Annual observations for 1986–1996 are included if the person is between 45 and 65 years of age (as of September 1 of the year), has total annual compensation of $10,000 or more (in 1996 dollars), and had a regular pension premium contribution of at least $250 in that year.

rate that induces an equal shift in the desired saving rate.[18] If $X_{ijt}\delta$ does not incorporate a discontinuous jump at age 55, there will be positive covariation between ϵ_{ijt} (the error in desired savings) and π^1_{ijt}, inducing an upward bias (toward 0) in the estimate of γ_1. Interestingly, similar variation in the required employee contribution rate will not lead to such problems, since changes in the employee contribution rate have no effect on the desired saving rate.

To address potential attenuation biases in γ_1 caused by variation in the employer contribution rate, we adopt two approaches. First, we replace the contribution rate for person i at employer j and age t with the average employer contribution rate for all employees. The average contribution rate π^1_j should be highly correlated with π^1_{ijt} but will be uncorrelated with age-specific shifts in the desired savings rate. As a simple alternative, we restrict the analysis to the subset of institutions in the FRS that have constant employer (and employee) contribution rates for all faculty.

VI. Sample Description

Our sample is drawn from the Faculty Retirement Survey (FRS), a stratified random sample of four-year colleges and universities with a significant fraction of faculty participation in TIAA-CREF. Ashenfelter and Card (2001) provide a detailed description of how the sample was designed and collected. The FRS design was a stratified quota sample, with sixteen strata based on four regions of the country and four Carnegie classifications (research universities, doctoral granting institutions, comprehensive institutions, and liberal arts colleges). In the sample are 100 institutions: 31 research universities (about 30% of all such institutions in the country), 17 doctorate-granting institutions (about 15% of the corresponding universe), 23 comprehensive institutions (about 5% of the universe), and 29 liberal arts colleges (about 5% of the universe).[19]

The FRS gathered administrative data on annual salaries and other information for tenured and tenure-track faculty at each institution over the age of 45 for the period from 1986 to 1997. In addition, pension account information for the same period was obtained from TIAA-CREF, including annual contributions and balances, and SRA contributions and balances. For this paper, we merged information about the pension plans at each institution, including the contribution formulas governing employer and employee contributions in each year.[20]

Table 2 provides an overview of the FRS sample and the subsample of faculty included in our main analysis sample. The first column of the table presents data on all 48,000 faculty members included in the 100 institutions in the

[18] Recall that desired saving is equal to the deviation of current income from desired consumption. A shift in the pension contribution rate at some age (or salary threshold) causes a jump in total compensation that should be fully absorbed by a rise in savings.

[19] Four nonrandomly selected schools were originally part of a pilot study for the FRS and are excluded here.

[20] The identity of the schools included in the FRS is confidential and is unknown to us. Details of pension plans were collected by the same group that collected the original FRS data. Plan data were unavailable for four schools.

FRS. Fifty-six schools provided information for all their faculty to the FRS, while 44 schools provided only data for people age 45 or older. Thus, the age distribution of the overall sample is somewhat skewed toward older faculty, with an average age of 43.3 in 1986. The sample is about one-quarter female and 12% nonwhite, reflecting the demographic composition of the professoriate at that time.[21] Just over one-half of the sample are faculty members in arts and sciences departments, with another 10% in engineering, 7% in business, and 25% in various professional schools (for example, law). The average annual salary for the sample in 1992 was $56,700; average pension contributions to TIAA-CREF (including zeros for faculty with other pension carriers) were about $5,100; and average SRA contributions (including zeros) were $775.[22]

As shown in the lower panels of the table, nearly 70% of the faculty members in the FRS are at research universities, reflecting the relatively high sampling rate for these schools and their relatively large size. Roughly two-thirds of the sample worked at institutions with at least one alternative pension carrier besides TIAA-CREF (for example, Fidelity or Vanguard). Seventeen percent worked at one of the 19 institutions with a matching component in the pension contribution formula. The average employer's pension contribution rate across all individuals in 1992 was 9.1%, while the average employee's contribution rate was 3.7%.

Column 2 presents descriptive statistics for faculty at the subsample of 77 institutions for which we were able to obtain pension plan information and that had no matching component in their contribution formula. These are very similar to the characteristics of the overall sample. Finally, columns 3 and 4 show corresponding data for the subset of 25,451 faculty in our final analysis sample. A person is included in this sample if, in at least one year during the sample period, he or she was between the ages of 45 and 64, had total annual compensation of $10,000 or more, and made a regular pension contribution to TIAA-CREF of at least $250. The entries in column 3 are simple averages across everyone who appears in the analysis sample, whereas the entries in column 4 are weighted averages, weighted by the number of years a person met the sample inclusion criteria. (The average number of years included is 4.5.) Members of the analysis sample are slightly older and have slightly higher salaries, regular pension contributions, and SRA contributions, but otherwise they are fairly similar to the overall sample.

We estimate versions of equation (11) using annual observations on compensation and SRA contributions for the individuals described in columns 3 and 4 of table 2. An issue in our data is that we only see the net SRA contribution made by an individual in a given year. In the vast majority of cases the net contribution represents new savings, but in a few cases, it includes roll-overs (transfers) from or to other tax-sheltered supplemental savings vehicles. These roll-overs appear as large, positive (or negative) premium payments. We exclude from our analysis any person-year in which the SRA premium is negative or exceeds 25% of salary (a total of only 78 person-years). However, even after excluding these cases, we observe a number of individuals in each year whose SRA contribution exceeds the legal limit. This represents a small fraction of the sample, typically between 1.5% and 2.5% percent. In our censored regression models, we treat anyone whose contribution is at or above the legal maximum for the year as right-censored at the legal maximum amount.

The variation in pension contribution rates across institutions in our analysis sample is illustrated in figure 1, which shows the mean employee and employer pension contribution rates at each of the 77 colleges and universities in the sample.[23] For reference we also show a point that represents the mean for the institutional and individual contribution rates and a line through this point with slope -1. Schools with noncontributory plans (a required individual contribution rate of 0) appear along the x-axis of the figure and comprise 22% of all institutions. A glance at the figure suggests wide variation in both the overall pension contribution rate and in share of the total contribution rate that is attributable to the employer versus the employee.

VII. Estimation Results

Table 3 reports estimates from a simplified specification of our SRA contribution model, in which the desired savings rate is assumed to depend on only a cubic in age and a dummy for the presence of alternative pension carriers. To address the potential biases introduced when the employer contribution rate varies by age or salary, we present three complementary specifications. The first column of the table shows estimates using person- and period-specific contribution rates. Column 2 shows estimates when we assign each faculty member the mean contribution rates for all sample members at the corresponding institution. Finally, column 3 presents estimates derived from a subsample of faculty at institutions with constant contribution rates. The standard errors reported in the table (and all subsequent tables) are clustered by school, allowing for an arbitrary correlation structure across the observations for faculty at the same school.

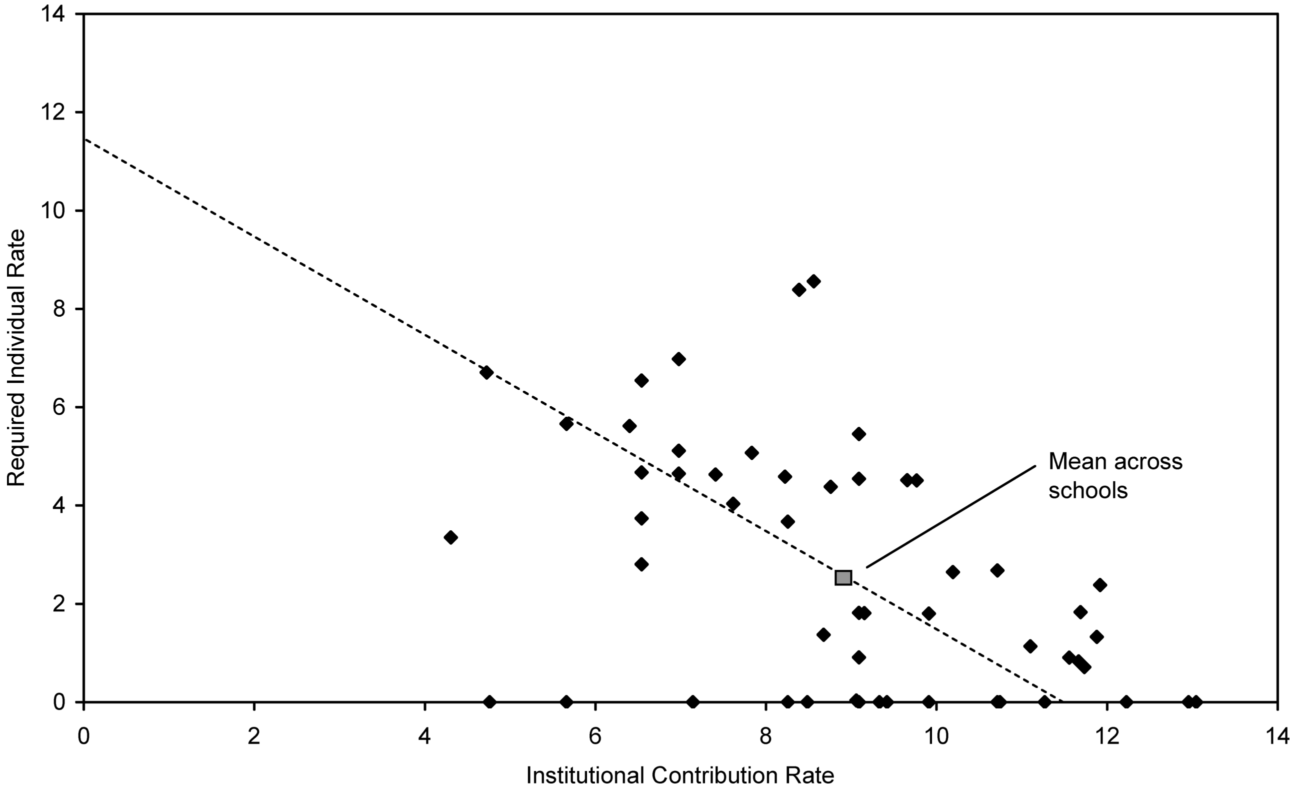
As a point of departure, the top row of the table presents estimates from a restricted specification in which we

[21] Comparisons between the FRS sample and the sample in the National Survey of Post-Secondary Faculty suggest that the FRS is representative of the four Carnegie groups (see Ashenfelter & Card, 2001; table A2).

[22] The administrative data from TIAA/CREF do not allow us to distinguish between annual contributions to an SRA and "rollover" transfers into or out of the SRA. We set the SRA contribution to missing for cases where the SRA inflow exceeds 25% of total salary in that year or is negative.

[23] Although the formulas at some institutions changed over our sample period, in most cases they were constant. For some institutions, we do not have a complete history of the contribution formulas. For these cases, we use whatever data are available.

FIGURE 1.—DISTRIBUTION OF INSTITUTIONAL AND INDIVIDUAL CONTRIBUTION RATES



There were 77 institutions in FRS.

TABLE 3.—TOBIT MODELS FOR SUPPLEMENTAL PENSION CONTRIBUTION RATE

	Person-Specific Contribution Rates	Averaged Contribution Rates	Subsample of Schools with Constant Contribution Rates
	(1)	(2)	(3)
Restricted model:			
Total contribution rate	−0.48	−0.58	−0.57
	(0.16)	(0.16)	(0.16)
Unrestricted model			
Individual contribution rate	−0.53	−0.61	−0.71
	(0.18)	(0.17)	(0.15)
Institutional contribution rate	−0.18	−0.23	−0.23
	(0.16)	(0.18)	(0.17)
Difference: Institutional minus individual effects	0.34	0.37	0.39
	(0.13)	(0.15)	(0.12)
T-test for equality	2.61	2.45	3.29
Controls for age and presence of alternative pension carrier(s)	Yes	Yes	Yes
Number individual observations	114,211	114,211	79,044
Number of institutions	77	77	53

Standard errors clustered by institution are in parentheses. Estimates are derived from tobit models fit to person-year observations for faculty at schools with nonmatching pension formulas. An annual observation is included if the faculty member is between 45 and 65 years of age, has total compensation of $10,000 or more (in 1996 dollars), and had a regular pension premium contribution of at least $250 in that year. Sample for models in column 3 includes only faculty at schools with contribution rates that are the same for all faculty. Two separate models are fit for specification in each column: one that restricts the effects of the individual and institutional contribution rates to be the same and a second that allows the effects to be different.

assume that the employer and employee contribution rates have the same effect on the supplementary savings rate. The estimates of the combined offset coefficient range from −0.48 to −0.57 and are significantly different from either 0 or −1. Rows 2 to 4 show estimates from a specification that allows separate offset effects for the employer and employee contributions, as in equation (11). Across all three columns, the estimated effect of the employee contribution rate is larger (in absolute value) than the effect of the employer contribution rate. *T*-statistics for equality of γ_1 and γ_2, presented in the fifth row, range from 2.40 to 3.18. As expected, the estimated offset effect of the employer contribution rate is smaller in absolute value in column 1 than in the alternative specifications that abstract from within-school changes in the employer contribution rate. Even in columns 2 and 3, however, the offset effects of the employer contribution rate are insignificantly different from 0.

The simple specifications in table 3 suggest that supplemental savings are significantly more responsive to employee pension contributions than to employer contributions. To probe the robustness of this conclusion, we fit a series of expanded models that include additional controls in the vector of determinants of desired savings. The results are summarized in table 4. The first three columns present models that expand on the simple specifications in table 3 by including controls for log of individual compensation in year *t*, an interaction of this variable with age, and dummies for the year of the sample, the Carnegie classification of the institution, and private (versus public) control of the institution. Columns 4 to 6 include these variables plus a further set of controls for gender, race, Ph.D. degree, academic department (classified into eight groups), and years of seniority. The latter variables are available only for a subset of faculty at 71 schools, leading to some reduction in the sample size.

Inspection of the estimates in table 4 suggests that the addition of the extra control variables leads to a modest narrowing of the gap between the estimated effects of the employee and employer contribution rates, although the estimated differences between the estimates of γ_1 and γ_2 remain significant or marginally significant and are particularly large for the subsample drawn from institutions with constant contribution rates (columns 3 and 6). Arguably, this subsample provides the "cleanest" test of the substitutability between supplemental savings and the regular pension contributions of employers and employees. Despite the smaller number of institutions in this subsample, the estimates are generally similar to those obtained on the full sample using averaged contribution rates, and about as precise.

We also conducted two other robustness checks. First, we fit the simpler specifications in table 3 to subsamples from each year of the overall sample. This check is potentially useful because in a single-year cross-section, each faculty member contributes one observation to the data set, whereas in our overall samples, an individual faculty member can appear up to eleven times. One might be concerned that this multiple sampling somehow leads to biased estimates (or overstated precision), despite our use of clustered standard errors. The results from this exercise are summarized in table A1. (To save space, we show the results only for the first and third specifications in table 3.) Reassuringly, we find that the estimates of γ_1 and γ_2 are very similar for each year of the sample and are typically only slightly less precise than in the pooled sample.

As a second check, we averaged the SRA contribution rates of individual faculty at each institution and ran a series of linear regression models relating the average SRA contribution rate (or the average contribution rate for a particular age range of faculty) to the average pension contribution rates at each institution. The results from these models, fit to 77 institutional observations (with controls for Carnegie code, private or public status, and the presence of an alternative pension carrier) are presented in table A2. Fitting a linear regression model to a censored outcome will lead to attenuated coefficient estimates, with an attenuation factor that depends on the fraction of censored observations (Greene, 1981). Similar reasoning applies to a linear model fit to the average of a censored outcome: thus, we expect the coefficient estimates from this procedure to be significantly attenuated toward 0. Nevertheless, it is interesting to compare the relative size of the effects of the averaged employer and employee contribution rates on the average SRA contribution rate. As shown in table A2, the estimated effects of the employer contribution rate are typically about one-half as big as the effects of the employee contribution rate, and the two effects are significantly different ($t = 2.45$). Overall, we interpret the results from this simple analysis as strongly supportive of the patterns shown in tables 3 and 4.

As a final check, table 5 presents some evidence on the heterogeneity in estimates of γ_1 and γ_2 and in the gap between them. For this analysis, we focus on the subset of institutions with fixed employer and employee contribution rates, and present specifications that control for the full set of available covariates. Column 1 of table 5 presents a baseline model fit to all available observations—this specification is identical to the model presented in column 6 of table 4. Columns 2 and 3 explore heterogeneity by gender. Not surprisingly, perhaps, the estimates for men (who make up 83% of the sample) are similar to the pooled estimates. In particular the gap between γ_1 and γ_2 is similar in magnitude and significance, although the offset effects of both the employer and employee pension contributions are somewhat larger in absolute value for men than for the overall sample. For women, the point estimate of γ_2 is actually positive (though quite imprecise); again the gap between γ_1 and γ_2 is positive and statistically significant.

Columns 4 to 6 examine heterogeneity by field. We separate three broad groups: social sciences and humanities (column 4), professional schools and business faculty (column 5), and faculty in life and physical sciences and engineering (column 6). For all three groups we find a positive and at least marginally significant gap between γ_1 and γ_2. The point estimates of γ_1 and γ_2 vary somewhat across the fields, with the smallest estimates for faculty in humanities and social sciences and the largest for faculty in business and professional schools. Interestingly, for the latter subgroup, the point estimate of the offset effect of individual pension contributions is -1.00. Even for this subgroup, however, the offset effect of the employer's pension contribution is significantly smaller.

Finally, columns 7 to 9 present models fit to person-year observations from three age ranges: ages 45 to 54 (column 9), ages 55 to 61 (column 10), and ages 62 to 65 (column 3). For all three age groups, we estimate a significant gap between γ_1 and γ_2, with the smallest gap for the youngest group. In particular, even for the older age groups, who are at or near conventional retirement age and have relatively high rates of participation in SRAs, we find a larger offset

TABLE 4.—EXTENDED TOBIT MODELS FOR SUPPLEMENTAL PENSION CONTRIBUTION RATE

	Subsample and Choice of Contribution Rate Measure								
	Overall Sample					Subsample with Individual Controls			
	Person-Specific Contribution Rates	Averaged Contribution Rates	Subsample with Constant Contribution Rates	Person-Specific Contribution Rates	Averaged Contribution Rates	Subsample with Constant Contribution Rates	Person-Specific Contribution Rates	Averaged Contribution Rates	Subsample with Constant Contribution Rates
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Individual contribution rate	−0.53	−0.61	−0.62	−0.49	−0.59	−0.62	−0.49	−0.61	−0.70
	(0.18)	(0.17)	(0.15)	(0.19)	(0.18)	(0.17)	(0.18)	(0.17)	(0.15)
Institutional contribution rate	−0.18	−0.23	−0.23	−0.22	−0.30	−0.25	−0.25	−0.37	−0.38
	(0.16)	(0.18)	(0.17)	(0.16)	(0.18)	(0.20)	(0.16)	(0.17)	(0.18)
Difference: Institutional minus	0.34	0.37	0.39	0.27	0.29	0.37	0.24	0.23	0.33
Individual	(0.13)	(0.15)	(0.12)	(0.12)	(0.15)	(0.10)	(0.12)	(0.14)	(0.10)
T-test for equality	2.16	2.45	3.29	2.32	1.93	3.62	2.05	1.64	3.38
Additional controls									
Cubic in age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alternative pension carrier(s)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log total compensation and interaction with age	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Dummies for Carnegie code and private institution	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Controls for gender, race, Ph.D., field, and years of seniority	No	No	No	No	No	No	Yes	Yes	Yes
Standard deviation of	10.72	10.72	10.92	10.70	10.70	10.91	10.69	10.69	10.81
residual	(0.37)	(0.37)	(0.39)	(0.37)	(0.37)	(0.39)	(0.38)	(0.38)	(0.40)
Number of individual observations	114,211	114,211	79,044	114,211	114,211	79,044	108,553	108,553	76,677
Number of institutions	77	77	53	77	77	53	71	71	49

Standard errors clustered by institution are in parentheses. See notes to table 3 for sample. Samples for columns 7–9 are restricted to schools that provided individual characteristic data to FRS. Samples in columns 3, 6, and 9 are limited to institutions where contribution rates are the same for all faculty.

TABLE 5.—TOBIT MODELS FOR SUPPLEMENTAL PENSION CONTRIBUTION RATE, AGES 55–61 ONLY

	Subsample and Choice of Contribution Rate Measure:								
	Overall Sample					Subsample with Individual Controls			
	Person-Specific Contribution Rates	Averaged Contribution Rates	Subsample with Constant Contribution Rates	Person-Specific Contribution Rates	Averaged Contribution Rates	Subsample with Constant Contribution Rates	Person-Specific Contribution Rates	Averaged Contribution Rates	Subsample with Constant Contribution Rates
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Individual contribution rate	−0.64	−0.76	−0.76	−0.63	−0.80	−0.80	−0.62	−0.81	−0.89
	(0.18)	(0.17)	(0.17)	(0.21)	(0.18)	(0.19)	(0.19)	(0.17)	(0.18)
Institutional contribution rate	−0.25	−0.31	−0.35	−0.29	−0.47	−0.43	−0.32	−0.53	−0.55
	(0.16)	(0.16)	(0.13)	(0.18)	(0.20)	(0.20)	(0.20)	(0.19)	(0.20)
Difference: Institutional minus Individual	0.40	0.46	0.42	0.33	0.33	0.37	0.30	0.27	0.34
	(0.13)	(0.15)	(0.14)	(0.13)	(0.15)	(0.13)	(0.13)	(0.15)	(0.13)
T-test for equality	3.09	2.96	2.94	2.78	2.20	2.99	2.41	1.85	2.63
Additional controls:									
Cubic in age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alternative pension carrier(s)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log total compensation and interaction with age	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Dummies for Carnegie code and private institution	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Controls for gender, race, Ph.D., field, and years of seniority	No	No	No	No	No	No	Yes	Yes	Yes
Standard deviation of residual	10.54	10.54	10.62	10.50	10.50	10.58	10.51	10.51	10.51
	(0.34)	(0.34)	(0.35)	(0.34)	(0.34)	(0.34)	(0.36)	(0.36)	(0.35)
Number of individual observations	37,932	37,932	26,044	37,932	37,932	26,044	35,892	35,892	25,223
Number of institutions	77	77	53	77	77	53	71	71	49

Standard errors clustered by institution are in parentheses. Sample includes people age 55–61 with compensation over $35,000 in 1996 dollars and a regular pension contribution of $1,500 or more. See notes to table 4 for additional information on subsamples.

effect of employee pension contributions than employer contributions.

Overall, there appears to be some heterogeneity in the responsiveness of supplementary savings to employer and employee pension contributions. Across all subgroups, however, the offset effect of individual contributions is consistently larger (in absolute value) than the effect of employer contributions. Although not shown in the table, a similar conclusion holds when we compare person-year observations with total compensation above or below the median value for the entire sample. The gap between the estimates of γ_1 and γ_2 is larger for lower-income observation but also positive and marginally significant ($t = 1.3$) for higher-income observations.

VIII. Discussion

It is important to emphasize that the estimates presented in this paper are based on purely observational comparisons across a limited number of institutions. Although we have tried to control for a variety of institutional and personal characteristics, it is possible that unobserved institution-specific factors (such as the financial education programs described in Clark & d'Ambrosio, 2002) confound the relationship between key pension features and supplemental retirement contribution rates. That said, the pattern of results is consistent across samples and estimation methods and suggests that supplemental saving are substantially less sensitive to employer pension contributions than to employee contributions. In particular, supplemental savings are reduced by 60 to 80 cents per dollar of employee pension contributions, but only by about one-half as much per dollar of employer contributions.

The difference in these responses suggests that mental accounting or differential inattention leads to substantial differences in realized supplementary savings amounts across people with similar compensation streams but different pension formulas. To get a sense of the magnitudes involved and the potential misallocation costs that arise when a larger fraction of pension contributions is made by the employer, we conducted a simple simulation, calibrated to reflect the characteristics of a typical member of our sample. Specifically, we consider an individual with perfect foresight who is employed between the ages of 30 and 65 and then retires and lives to 90. We assume that the individual's total annual compensation follows a traditional Mincerian profile, peaking at age 58, with an average value of \$73,000 between the ages of 45 and 65 (a little above the average for our estimation sample). We also assume the individual is entitled to Social Security benefits of \$16,800 per year (roughly the maximum level for new retirees in the early 1990s), and ignore taxes.

With respect to preferences, we assume the individual has a rate of time preference equal to the real interest rate (on all debts and assets) of 5%. We assume that the within-period utility function in period t is

$$u_t(c_t) = (1-\rho)^{-1} F_t^{\rho} c_t^{1-\rho},$$

where $\rho > 0$ is the elasticity of the marginal utility of consumption and F_t is a shifter in the marginal utility of consumption that follows a quadratic profile with a jump at retirement (starting with a value of 0.65 at age 30, peaking at a value of 1.15 at age 55, falling to 1 at age 65, and then dropping to a constant value of 0.8 after-retirement).[24] The assumed compensation profile and the associated optimal life cycle consumption profile are plotted in figure 2.

To evaluate the misallocation costs of underresponding to the employer pension contribution, we compared two scenarios. In the first, an individual's pension plan has no employer contribution and a 12% employee contribution rate. We assume the individual fully recognizes his or her contribution (sets $\gamma_2 = -1$) in determining supplemental savings, leading to a fully optimal lifetime allocation of consumption. In the alternative scenario, we assume that the pension plan has a 12% employer contribution and no employee contribution and that the individual ignores one-half of the employer contribution in determining both the path of total saving until retirement and the offset effect of pension contributions on supplemental savings.[25] Under this scenario, the individual oversaves early in life and then is surprised by the pension wealth he or she has accumulated at retirement. The implied path of consumption under this mental accounting scenario is also shown in figure 2.

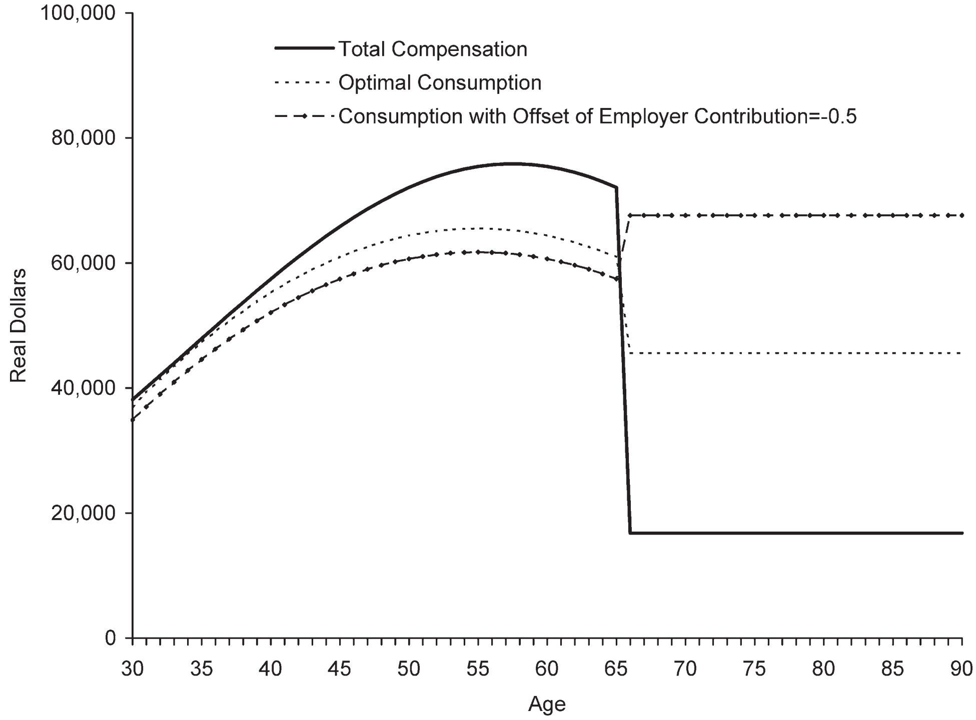
To calculate the welfare loss arising from the misallocation of consumption under the mental accounting scenario, we set ρ equal to 2 or 3 and then found the reduction in total lifetime wealth that would make an optimized consumption plan equivalent to the mental accounting plan (in discounted utility units, as of age 30). For a value of $\rho = 2$, the suboptimal allocation is utility equivalent to a 2% loss in lifetime wealth, while for $\rho = 3$, it is equivalent to a 2.6% reduction in lifetime wealth. Although the mental accounting profile leads to oversaving and a superoptimal level of retirement income, the welfare loss from following this profile relative to a fully optimal profile is small. As noted by Chetty et al. (2009) this reflects the fact that around an optimized profile, the cost of misallocating spending from one period to another is second order.[26]

[24] The concave shape of F_t is meant to reflect variation in family size and composition that typically lead to higher spending in mid to late career (see Attanasio et al., 1999). The drop in F_t at retirement is motivated by evidence (Aguiar & Hurst, 2005) that people substitute time for expenditures after retirement. Adding this drop increases the misallocation cost of underresponding to the employer pension contribution because people tend to oversave, and with the assumed drop in F_t extra consumption after retirement is marginally less valuable.

[25] An alternative assumption is that the individual calculates the "right" level of total savings, but then underaccounts for the employer's pension contribution. This has a slightly smaller welfare cost than the alternative we use.

[26] This insight was also pointed out by Akerlof and Yellen (1985), who note that the aggregate effects may be first order.

FIGURE 2.—LIFE CYCLE COMPENSATION AND CONSUMPTION PROFILES



In summary, we find that the supplementary savings decisions of older college and university faculty, a group with ready access to tax-advantaged savings plans, are affected by seemingly minor differences in how their regular pension plans are set up. We interpret these findings as further evidence that behavioral departures from a strict neoclassical choice framework can help to explain the observed variability in savings behavior and wealth outcomes. Despite the distortionary effects on supplementary savings, the impacts on lifetime utility are modest—equivalent to 2% to 3% of life cycle wealth. The small cost of nonoptimizing behavior may help explain why it appears to persist even among a highly educated group like college professors.

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APPENDIX

Additional Analyses

TABLE A1.—TOBIT MODELS FIT BY YEAR

	Sample of All Available Schools				Sample with Fixed Contribution Rates			
	Individual Contribution Rate	Institutional Contribution Rate	Difference	Number of Institutions	Individual Contribution Rate	Institutional Contribution Rate	Difference	Number of Institutions
All years	−0.53 (0.18)	−0.18 (0.16)	0.34 (0.13)	77	−0.62 (0.15)	−0.23 (0.17)	0.39 (0.12)	53
1986	−0.73 (0.18)	−0.30 (0.23)	0.43 (0.20)	56	−0.59 (0.22)	−0.01 (0.38)	0.58 (0.40)	39
1987	−0.63 (0.15)	0.00 (0.18)	0.63 (0.15)	59	−0.53 (0.18)	0.21 (0.18)	0.74 (0.16)	41
1988	−0.39 (0.22)	0.05 (0.18)	0.44 (0.15)	66	−0.59 (0.17)	0.01 (0.15)	0.60 (0.16)	47
1989	−0.46 (0.22)	−0.18 (0.19)	0.28 (0.15)	69	−0.61 (0.17)	−0.10 (0.17)	0.51 (0.15)	48
1990	−0.52 (0.24)	−0.17 (0.22)	0.35 (0.20)	52	−0.78 (0.19)	−0.17 (0.22)	0.61 (0.18)	34
1991	−0.60 (0.23)	−0.22 (0.21)	0.38 (0.18)	76	−0.72 (0.18)	−0.30 (0.19)	0.43 (0.14)	52
1992	−0.52 (0.18)	−0.23 (0.20)	0.29 (0.17)	76	−0.58 (0.17)	−0.29 (0.18)	0.29 (0.13)	52
1993	−0.50 (0.18)	−0.20 (0.19)	0.30 (0.16)	77	−0.54 (0.16)	−0.27 (0.17)	0.27 (0.12)	53
1994	−0.55 (0.15)	−0.27 (0.19)	0.29 (0.17)	77	−0.64 (0.17)	−0.42 (0.18)	0.22 (0.12)	53
1995	−0.56 (0.16)	−0.24 (0.20)	0.32 (0.18)	77	−0.63 (0.18)	−0.41 (0.20)	0.22 (0.12)	53
1996	−0.46 (0.16)	−0.27 (0.21)	0.19 (0.19)	46	−0.57 (0.21)	−0.48 (0.23)	0.09 (0.15)	29

Standard errors, clustered by institution, are in parentheses. Specifications are the same as in columns 1 and 3 of table 4. Each row presents two separate models, one fit to data on all available observations in the year indicated by the row heading (with key coefficients in columns 1–2) and a second fit to data for faculty at schools with constant contribution rates (with key coefficients in columns 5–6). Note that because of missing pension data for a subset of schools in 1990, the sample size in this year is substantially reduced.

TABLE A2.—OLS MODELS FIT TO INSTITUTIONAL-AVERAGE DATA

	All Ages (45–64)	Ages 45–49 Only	Ages 50–54 Only	Ages 55–59 Only	Ages 60–64 Only
	(1)	(2)	(3)	(4)	(5)
Percent with positive supplemental contributions	27.80	22.30	26.20	30.60	34.10
Mean contribution rate (% of compensation)	2.04	1.53	1.85	2.34	2.71
Estimation results (weighted OLS fit to institutional average data)					
Individual contribution rate	−0.22	−0.15	−0.19	−0.26	−0.27
	(0.04)	(0.04)	(0.04)	(0.04)	(0.06)
Institutional contribution rate	−0.10	−0.08	−0.08	−0.12	−0.12
	(0.07)	(0.07)	(0.06)	(0.07)	(0.09)
Difference: Institutional minus individual effects	0.13	0.06	0.11	0.15	0.16
	(0.05)	(0.05)	(0.05)	(0.06)	(0.07)
T-test for equality	2.45	1.30	2.16	2.61	2.13
Controls for Carnegie code, private, and presence of alternative pension carrier(s)	Yes	Yes	Yes	Yes	Yes
R^2	0.39	0.19	0.35	0.43	0.32

Standard errors in parentheses. Upper rows show average fraction of people in indicated age range with positive supplemental savings and mean supplemental savings rate (as percent of total compensation). Lower rows show weighted OLS estimation results from a model fit to 77 institutional observations. Dependent variable is average supplemental contribution rate for age range indicated. Explanatory variables are average individual and institutional contribution rates at the institution, plus controls for Carnegie classification, private status, and presence of alternative pension carrier(s).