

THE POLITICAL ECONOMY OF PUBLIC PENSIONS: PENSION FUNDING, GOVERNANCE, AND FISCAL STRESS*

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Abstract:

The purpose of this paper is to describe and evaluate how public sector defined benefit pension plans are managed, and to assess possible implications of different pension management styles for promised pension benefits. The authors explore the actuarial and economic assumptions employed by public pension managers when they set funding targets, using a new survey of state and local pension plans in the United States. The analysis shows that key assumptions under the control of public pension plan trustees are sensitive to factors in the pension environment. An implication of the paper is that public pension funding patterns may become more sensitive to strategic selection of interest rate and other key assumptions as public sector budgets are subjected to fiscal pressures, and when they are managed by participant-run boards.

As the world's population ages, many are calling on employer-sponsored pension plans to play a more substantial role in generating retirement income (c.f. James forthcoming). Yet there are many different ways to structure pension plans, and each approach has weaknesses as well as strengths. In this paper we examine one type of

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pension system prevalent in the United States as well as many other countries, namely defined benefit (DB) pensions. This form of pension is the dominant type of plan for approximately 13 million public sector and an additional 35 million private sector workers and retirees (Pascentini and Foley 1993; PWBA 1993). A unique aspect of DB pensions is that they specify annuity payments for retirees according to formulas that depend on retirement age, salary, and years of service. The DB plan differs from the defined contribution alternative (DC) by virtue of the fact that in the DB environment, explicit benefit promises are made; by contrast in the DC environment contributions to the pension are known *ex ante* but the final benefit amount is not. Therefore an employer who promises a defined benefit pension must rely on actuaries to estimate required periodic contributions which, along with investment earnings, should accumulate into a reserve large enough to meet eventual benefit payouts.

The fact that a DB plan specifies a benefit promise brings with it a potential risk, namely that the pension plan may have inadequate funds to meet benefit promises. Recognizing this risk, pension law in the United States requires *private sector* employers to pre-fund defined benefit plans – that is, to accumulate funding reserves adequate to pay retirees the promised benefits, in an orderly manner. This legislation was embodied in the 1974 Employee Retirement Income Security Act (ERISA), which has been quite effective in maintaining relatively well-funded private-sector plans¹. In contrast, *public sector* workers in the US are afforded no similar legal protection requiring prefunding of public defined benefit pensions. This lack of regulation yields the result that some public sector workers have fully funded pensions, while others do not. Recent studies show that on average funding ratios were about 85 percent for public plans, but there is a wide range with some plans having less than 20 percent of needed assets, and some plans more than fully funded (Mitchell and Smith forthcoming).

Public sector pension plan underfunding may have a variety of consequences which are only beginning to be recognized and understood. One concern is that public sector workers in the United States are a relatively mature population, nearing retirement age rapidly (Greenwich Associates 1993). This large group of workers nearing retirement fears possible benefit cuts should their pensions become massively underfunded. Nearer-term, the prospect of such cuts may in turn produce union demands for a risk premium (Smith 1981). Another concern is that underfunding public plans is equivalent to borrowing against the future, inasmuch as pension benefit obligations to covered employees represent claims on future tax revenues. There is a strong possibility that this can depress the ability of state and local governments to borrow money now and in the future (Bahl and Jump 1981; Bumgarner *et al.* 1991; Inman 1986). For all these reasons, public sector DB pension plan management is increasingly a matter of concern to public sector workers and retirees, to taxpayers, and to the politicians charged with keeping the pension plans afloat (Mitchell and Smith forthcoming).

The discussion that follows is divided into four sections. A first section summarizes previous studies on public sector pension funding and identifies key unanswered questions regarding the importance of actuarial assumptions in computing public pension obligations. The second section examines pension managers' choice of actuarial assumptions used in determining required pension contributions. With the help of a new 1992 survey on state and local pension plans in the U.S., we demonstrate that the key actuarial assumptions used in computing required pension contribution amounts are, in fact, not exogenous. The third section compares public sector pension plans' required versus actual contribution patterns, and we prove empirically that

pension funding patterns are substantially influenced by the manner in which the pension governing boards are constituted, as well as by fiscal stresses facing the states and localities. A discussion of possible interpretations of our findings appear in the final section of this paper.

1. Defined Benefit Pension Obligations and Actuarial Assumptions

Most pension experts but few other people are aware of the crucial role played by key demographic and economic assumptions when computing a pension plan's liabilities. In a defined benefit pension plan, for example, the promised benefit formula might be worth two percent of the retiree's final pay multiplied by his years of service. Prefunding this promise requires that well before employees retire, the plan sponsor must forecast those workers' likely future salaries, turnover patterns, and retirement ages, in order to project eventual benefits. Only in this way can the required contributions be computed, contributions which must be sufficient to generate enough reserves to fund the plan by the retirement date.

Small changes in the key actuarial assumptions used to project benefits rate can clearly have a large impact on estimated future benefit payouts. For example, when workers remain with an employer 20 or 30 years as is common in the public sector, small deviations in wage growth projections can change benefit promises dramatically (Greenwich Associates 1993). Another highly critical economic assumption needed to value pension obligations is the pension plan's expected future investment return. This rate is used to discount future pension payout streams, and since benefits are typically paid over decades into the future, small changes in this discount rate have quite dramatic effects on required contributions. For instance, a recent study noted that "varying the interest rate assumption by 2 percentage points around a 7 percent baseline results in pension cost changes ranging from more than a 60 percent increase to nearly a 40 percent decrease" (Vanderhei 1994; p. 79). Along similar lines, the US General Accounting Office stated that a rise of one percentage point in the interest rate assumption used by pension sponsors cut plan liabilities between 10 and 20 percent (USGAO, 1993). Of most importance is the so-called "spread rate", or the difference between the assumed interest rate and the forecasted salary growth rate. This measure combines both the nominal wage growth forecast and the projected nominal investment return into what is in effect a real discount rate forecast used in calculating future pension liabilities.

In addition to these economic assumptions, pension contributions also depend on the actuarial period over which past service obligations may be amortized². In pension parlance, past service costs are benefits promised in years gone by which were not supported by contributions at the time the promises were made. Logically, a longer amortization period reduces the amount of money a public employer must pay to the plan in any given year, in order to stay on a required contribution schedule.

While each of these assumptions alters the pension contributions an employer is required to make in order to meet accumulating pension promises, very little is known about whether and when these assumptions are chosen "strategically" by public sector pension managers – that is, whether assumptions are chosen to minimize obligations under particular economic circumstances. There is reason to believe that there are grounds for concern, however, if we look to the private sector. A recent study of private pension plans concluded that underfunded pension plans did adopt higher-than-average

discount or spread rates to reduce or downplay funding obligations: in that analysis, private employers' pension liabilities rose by almost a third when a (lower and) economically more defensible rate was applied (GAO 1993). In recent months the U.S. Securities and Exchange Commission (SEC) has also suggested that some private plans are using excessively high spread rates in order to lower company pension contributions (and thereby spread more risk to the government insurance agency which guarantees DB plans in the event of underfunded termination)³.

If little is known regarding *private* pension plans' practices, even less is known about how *public* pension plans operate. A few available studies have found that government pension plan funding and investment performance appear sensitive to the institutional structure within which public pension managers operate, as well as the regulatory constraints imposed on the pension boards. For instance one project used information on state-administered public employee retirement systems in 1989 and concluded that pension promises were better funded when a state experienced above-average economic growth, and when employees were not unionized (Mitchell and Smith forthcoming). Also that study determined that funding practices were persistent, in that past funding practice tended to be perpetuated. What was unique about this research was that it recognized and tested for the endogeneity of *required* contribution levels, whereas previous analysis had assumed that actuarial calculations used to determine required targets could safely be assumed to be exogenous. A subsequent study used 1990 data on public pension systems to assess whether public pension outcomes were sensitive to the way in which the public pension boards were constituted and the regulations under which the boards operated (Mitchell and Hain 1994). This analysis found that pension systems appeared to be less well funded when the public board trustees were not required to carry liability insurance, when the state experienced fiscal stress, and when employees were represented on the pension board.

Past studies emphasize the importance of examining how the pension plans are governed in terms of influencing key pension outcomes, but none of them asks whether public pension managers select assumptions in order to strategically influence contributions owed to their public pension funds. The fact is that a "substantial minority" of pension plan sponsors are now using interest rate assumptions "well above average" (Greenwich Associates 1993) raising a concern that this pattern may exacerbate underfunding, and in the case of public plans, could even require that additional taxes be levied on the public in the future. Several news reports have spurred speculation of late: for instance the State of Louisiana in 1991 increased its projected return on pension assets from 7.5 to 8.25 percent, thereby reducing required pension contributions by \$11 million; in the same year, Missouri cut required pension contributions by almost double that amount by moving from an 8 to an 8.5 percent rate (Deuschman 1992; Hemmerick 1991). The New York State government raised the assumed return on pension assets from 8 to 8.75 percent in 1991, lowering required pension contributions by \$325 million per year (Price 1991). Pension amortization periods have also been subject to change of late: recently the governor of Maine proposed to extend the amortization period to 40 years from 25 years (Schwimmer 1993) which when combined with changes in other actuarial assumptions saved a projected \$200 million in pension contributions.

These patterns, while suggestive, do not prove that there is a problem. A 1989 survey revealed that public pension trustees' wage growth and return assumptions were reasonable at that time, and the assumptions seemed to be fairly independent of political and economic influences (Mitchell and Smith, forthcoming). Nevertheless, that

study used older data, which might be less relevant in the current, tighter, fiscal environment. In the next section we describe a new and larger public pension survey which allows a more systematic assessment of the responsiveness of public pension plans' actuarial assumptions to economic and political factors.

II. Are Public Sector Pension Plan Assumptions Exogenous?

Multivariate analysis of the determinants of pension plan assumptions is made possible by a recently released survey of public pension plans conducted by the Public Pension Coordinating Council. This dataset, known as the PENDAT file, includes extensive information on 325 state and local government retirement systems which covered 10.6 million active members or 83% of all public retirement system active participants and held \$791 billion or 86% of all public employee retirement system assets in 1992 (Zorn, 1993).

Information on three centrally important pension assumption variables was collected in this survey, which we use to determine whether public plan boards appear to be influencing reported pension obligations by strategic choice of assumptions. The first assumption is the public pension plans' *assumed interest rate*, which for public plans reporting in 1992 averaged 7.7 percent with a standard deviation of about 0.7 percent. These figures are virtually identical to the interest rate figures reported in an earlier study of a smaller set of pension plans (Zorn 1990). A second datum which concerns us is the *spread rate*, or the difference between a public plan's assumed interest rate and the salary growth rate projected for covered workers. The average reported in the newer survey was comparable to figures reported five years earlier, at 2.1 percent. However the newer data indicate that the range has widened considerably: in the 1992 survey the lowest spread rate was -2.5 percent and the maximum was 14.5 percent; five years before, the rate ranged only from -2.0 to 4 percent (Zorn 1990). A third critical pension assumption is the *amortization period* chosen by the public plans over which past obligations must be spread. In the PENDAT file this averaged 23 years with a large variance (12 years) and a range from 0 to 50 years (the earlier study did not report this variable). In all three cases, there is evidently substantial variation across pension plans, suggesting opportunities for fruitful analysis of these patterns.

What factors might determine how these actuarial assumptions are chosen by pension managers in the public sector? One important set of factors is likely to be economic in nature, reflecting budget stringencies in the state at large. We therefore hypothesize that fiscal stress may induce public pension managers to raise the assumed interest rate as well as the spread rate used to compute funding requirements, and perhaps it might also increase the amortization period over which pension liabilities are spread for funding purposes. The measure used to reflect fiscal stress in empirical analysis is one we have found useful in previous studies: namely, the deviation of recent unemployment from an area's long term unemployment rate. It is hypothesized that higher-than-average unemployment will increase the demand for public welfare payments and lower tax revenues, both of which reduce the funds available to contribute to public employees' pensions⁴.

Internal plan performance measures may also influence pension managers' choice of assumptions. Two proxies for internal stresses are available. One is the pension plan's reported return on assets averaged over the preceding five years, with the hypo-

thesis that better-performing pension funds will not need to select actuarial assumptions so as to reduce required contributions. A second measure of internal stress is the public sector plan's level of assets, expressed as a percentage of cumulative pension liabilities. We hypothesize that if a plan's promised benefits are well funded (that is, if pension assets are almost equal to benefit promises), a pension board will be less likely to employ high interest and spread rates, as well as long amortization periods, in order to curtail pension required contributions.

In addition to internal and external fiscal pressures affecting public pension plans' choice of assumptions, previous research suggests that additional institutional factors can be influential. For example, unionized plans tend to be less well funded in practice, partially because union employees receive higher pay which in turn raises benefit obligations (Mitchell and Smith 1992). A somewhat different explanation for why unionized plans might be less well funded is that public sector employers may intentionally underfund so as to increase their bargaining power and intentionally reduce the threat of a "holdup" from a unionized workforce (Ippolito 1985; Marks, Raman, and Wilson 1988). Under this hypothesis, public employers might selectively choose actuarial assumptions so as to reduce pension contributions when the workforce is unionized. Of course this effect will be moderated to the extent that union pension negotiators are alert to non-standard assumptions such as high spread/discount rates or long amortization periods. Conversely, more valuable and/or more educated public sector workers (e.g. police, fire fighters, teachers) might be more likely to impose conservative pension funding assumptions, as compared to their civil service counterparts.

In addition to these factors, it is possible that institutional features of a public pension board as well as the regulatory environment in which the board operates can affect important pension outcomes as well (Mitchell and Hsin 1994). For example, one reason a pension board would influence the choice of pension assumptions is that board members themselves are often plan participants. If this "watchdog function" serves a purpose, it could curtail opportunities for political appointees on public pension boards to chose actuarial assumptions reducing funding. On the other hand, elected pension plan board members chosen from the participant constituency may suffer the disadvantage of inexperience, making them less conservative in their actuarial assumptions (Mitchell and Hsin 1994). Finally, it is possible that including participant-trustees on a pension board could have a multiplicative effect on pension outcomes, depending on a state's fiscal situation. That is, participants who are also retirees may be more cautious than average in bad economic times since their own pension is subject to risk; hence they might impose more conservative actuarial assumptions in times of fiscal stress. It is clear that board composition can influence choice of pension assumptions via several pathways.

A different hypothesis regarding the determinants of pension assumptions pertains to the autonomy that a public pension board has. Some public pension plans require that trustees carry liability insurance, an institutional structure which can impose market limits on the range of assumptions that can be chosen by board members. Pension plan reporting requirements can also play a role: if a plan lacks accurate and frequent reports regarding plan performance, board members (and taxpayers) will have difficulty monitoring the reasonableness of public plan needs and payments. In this event requiring reporting could make board-selected actuarial assumptions more conservative, since a plan's funding status would be more transparent to the participants and the public.

A final factor we examine, drawing from prior studies, is the extent to which public pension plans are used as an off-budget "safety valve" when states are legally required to balance their state budgets annually (Mitchell and Hsin 1994). This hypothesis is tested by examining whether states permitting deficit carryovers also defer funding by using longer amortization periods and higher discount rates (and spread rates) in their pension plans, as compared to states which do not permit this budget flexibility.

Based on these hypotheses, we posit that each of the three key pension actuarial assumptions of central interest to this study may be modelled in the following format (detailed variable definitions appear in the appendix):

$$Y_i = a_0 + a_1 X_1 + a_2 X_2 + e_{1i} \quad (1)$$

where Y_i is the plan's assumed interest rate (or assumed spread rate, or assumed amortization period: $i = 1, 2, 3$); and e_{1i} is a normally distributed iid error term. In this equation, X_1 is a vector of economic factors including the degree of local fiscal stress, proxied by the deviation of the state's unemployment rate from the previous five year mean (UNEMPD); the plan's average rate of return on assets over the past five years (Y5ROR); an indicator for union status (ISUNION); two indicators for teacher (TCHRPPLAN) and police/firefighter plans (POFPLAN); and a measure of the pension plan's stock funding ratio, computed according to a common interest rate and other assumptions (ADJSTOCK)⁵. The second set of explanatory variables, X_2 , includes a set of structural/governance controls including the fraction of pension participants elected to the board of trustees (BDELMEM); an interaction term between the fraction elected and fiscal stress (BDELMEM*UNEMPD); an indicator for whether trustees carry liability insurance (LIABINS); an indicator of whether the state is permitted to carry deficits from one year to the next (DEFPoS); and two variables indicating whether a plan issues its own annual report (REPSOLO) and the frequency of independent pension plan valuation (FREQVAL).

Collecting hypotheses thus far, our framework posits that the coefficients of UNEMPD, REPSOLO, and FREQVAL will be positive; the coefficients of Y5ROR, ADJSTOCK, TCHRPPLAN, POFPLAN, BDELMEM*UNEMPD, LIABINS and DEFPoS will be negative; and the coefficients of ISUNION and BDELMEM are ambiguous. These expectations are evaluated using the PENDAT data set with multivariate regression analysis of equation system (1); estimated coefficient results appear in Table 1.

One conclusion evident in the top row of Table 1 is that fiscal problems have a significantly positive effect on assumed interest and spread rates adopted by the public plans in the sample, but do not appear to affect amortization periods. In other words, when unemployment rises above the long-term average, some of the key pension assumptions become less conservative. Since computed "required" pension contributions fall when these actuarial assumptions rise, there is the suggestion that the economic environment does indeed influence pension contributions, and in the direction some have expressed concern over during the last few years.

The next several rows of Table 1 confirm some additional consistent effects across the three outcome variables of key interest. Public plans which met funding obligations in the past are less likely to use high interest and spread rates for computing current pension obligations, and also employ lower amortization periods. Similarly, public

TABLE 1
MULTIVARIATE ANALYSIS OF ACTUARIAL ASSUMPTIONS
(estimated s.e. in paren.)

Explanatory Variables	Assumed	Assumed	Amortization Period (3)
	Interest Rate (1)	Spread Rate (2)	
<i>Economic Incentives</i>			
UNEMPPD	0.10 ** (0.04)	0.11 ** (0.05)	0.43 (0.89)
YSROR	0.01 (0.02)	-0.001 (0.02)	-1.14 ** (0.40)
ISUNTON	0.18 ** (0.08)	-0.05 (0.09)	1.79 (1.61)
TCHRPLAN	-0.07 (0.12)	-0.15 (0.17)	1.79 (2.39)
POPIPLAN	-0.28 ** (0.07)	-0.22 ** (0.08)	3.45 ** (1.47)
ADISTOCK	-0.005 ** (0.001)	-0.004 ** (0.001)	-0.07 ** (0.01)
<i>Governance Structure</i>			
<i>Pension Board Composition</i>			
BDELMEM	-0.003 ** (0.001)	-0.002 ** (0.001)	-0.03 (0.03)
BDELMEM*UNEMID	-0.001 (0.001)	-0.003 ** (0.001)	-0.04 * (0.02)
<i>Pension Management Practice</i>			
LIABINS	0.08 (0.07)	0.07 (0.08)	-0.18 (1.41)
DEPOS	-0.24 ** (0.07)	-0.05 (0.08)	1.24 (1.46)
<i>Pension Reporting Practice</i>			
REPSOLO	0.07 (0.07)	-0.02 (0.08)	3.21 ** (1.46)
FREQVAL	0.05 (0.07)	-0.03 (0.08)	0.77 (1.56)
R-square	24.8	14.0	17.3
N	418	309	316

Notes:

- **1 ≥ 1.96; *1 ≥ 1.65.
- Additional controls include a constant term and variables indicating the pension return and stock funding figures were missing.

pension plans which experienced higher 5-year returns on assets report statistically significantly lower amortization periods (though the effect on the assumed interest and spread rate is not significant). These findings suggest that well-performing plans select assumptions which are more conservative, while poorly performing plans tend to use assumptions which reduce required pension contributions.

More complex patterns are detected for the three plan-type variables. Focusing first on pension plans covering union employees, we find the countervailing theoretical effects yield mixed results empirically. There is evidently a strong positive effect of unionization on assumed interest rates, but this is offset by correspondingly high wage growth assumptions, producing no strong overall net influence of unionization on the spread rate which subsumes both effects. Pension assumptions do not appear to be strategically chosen in teacher plans; however a more mixed picture emerges for plans covering uniformed officers where interest and spread rate assumptions appear lower and amortization periods much longer. In-depth and case-study analysis of these officer plans would probably yield additional insights.

Table 1 also proves that pension assumptions are sensitive to the way in which the public pension board is structured and regulated. For instance when participants are elected to a pension board, the plan uses significantly lower interest and spread rates than when a plan is managed by political appointees. Furthermore, this tendency is somewhat stronger when the state's fiscal situation is worse. This finding may be encouraging to those who desire increased involvement by pension participants in plan governance, since participant-trustees appear to be less malleable than government appointees when it comes to choosing actuarial assumptions. The beneficial effect of participant-trustees should be balanced against findings implied by our earlier study in which it appeared that public plans were less well-funded when boards had higher participant representation (Mitchell and Hsin, 1994).

Relatively few factors are consistently significant among the remaining pension management and reporting practice variables included in Table 1. In particular, none of the outcomes are systematically and statistically related to whether the board trustees have liability insurance, whether they are valued frequently, whether deficits can be carried over from one year to the next, and whether the reports are jointly or separately issued.

Looking at Table 1 as a whole, then, we conclude that the factors which are most consistently associated with public boards' choice of pension assumptions are fiscal stress, the plan's historic funding pattern, and the ratio of participants elected to the pension board. These findings do not prove that all public pension boards make actuarial assumptions which minimize contributions. However, a state's and a plan's economic environment and political governance structure does matter to boards selecting actuarial assumptions. Since these assumptions directly influence a plan's required pension contributions, this finding implies that required contributions are endogenously determined by the same set of environmental factors. This issue is taken up in the next section.

III. Determinants of Required Public Pension Contributions

Many analysts agree that a useful metric for capturing pension funding practice is the plan's flow funding rate, or the ratio of pension contributions actually deposited with the pension plan in a given year, divided by that plan's required annual

contribution target. In light of our discussion thus far, however, the denominator of this measure is likely to be endogenous because the plan's required annual contributions are sum of the plan's annual *normal cost*, equal to the increase in the employer's PBO from one year to the next, plus the plan's *annual amortization payment* for unfunded past service costs. Both factors depend crucially on the assumed spread rate as well as the amortization period assumed in making the calculations, which are endogenous as we have shown in the last section. Consequently it is quite likely that strategically chosen assumptions will translate into endogenous funding requirements.

To test this hypothesis we examine an equation which links required pension contributions by public sector employers with a set of funding determinants (as before, variable definitions appear in the appendix):

$$\text{Reqcont} = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + e_2 \quad (2)$$

where Reqcont is the plan's required level of pension contributions per year (as a fraction of payroll), and e_2 is a normally distributed iid error term. The X_1 and X_2 terms are as defined for equation (1); the new vector, X_3 , includes the plan's assumed spread rate and amortization period for past service costs.

Two models of required pension contributions are examined. First we estimate a "reduced form" equation where b_3 , which is the coefficient vector on the actuarial effect of economic and governance variables on required pension plan contribution amounts. Next we permit b_3 to be nonzero, in which case we expect that the b_1 and b_2 vectors will be attenuated. This is because the economic and other explanatory variables directly affect the plan's actuarial assumptions, as demonstrated above. In other words, by comparing these two models we can examine the extent to which the X_1 and X_2 variables influence Reqcont directly, versus through the chosen actuarial assumptions. We hypothesize that variables which have positive (negative) effects on the spread rate and the amortization period will grow (decrease) in the second model.

Table 2 reports the results of estimating these two models in the PENDAT file; the first column represents the reduced form model, while the second column includes actuarial assumptions. The evidence in Column 1 clearly reveals that several of the economic and governance conditions influence what the public pension boards report as their required contribution amount. States experiencing higher fiscal stress report that required contributions are significantly lower as a fraction of payroll, even after controlling on unfunded past service liabilities (adjusted to a common set of actuarial assumptions). Returns on assets do not seem to play a significant role, but each of the plan type factors is extremely important in shaping pension contribution targets: thus plans covering union employees tend to report lower contribution rates as a fraction of payroll, *ceteris paribus*, while unformed office plans seem to require higher rates. Column 1 also shows that some of these factors affect required public plan contribution levels directly. Most importantly, boards with numerous elected members tend to select higher targets, and the effect is increased in times of fiscal stress. Few statistically significant effects are detected for the reporting variables.

Comparing the two models in Table 2 shows that economic factors have a much smaller effect on required contributions in the extended model versus the reduced form. For instance, fiscal stress has no significant partial effect on required contribution

TABLE 2
MULTIVARIATE ANALYSIS OF REQUIRED PENSION CONTRIBUTION
(estimated s.e. in paren.)

Explanatory Variables	Required Contributions (% of payroll) (1)	Required Contributions (% of payroll) (2)
INTEREST		-4.86 **
AMORTPER		(1.09)
		0.005
		(0.06)
<i>Economic Incentives</i>		
UNEMPP	-1.72 *	-1.02
	(0.99)	(0.98)
YSROR	-0.37	-0.25
	(0.51)	(0.50)
ISUNION	-3.82 **	-3.29 *
	(1.94)	(1.89)
TCHRPLAN	-0.81	-1.70
	(2.76)	(2.69)
POFFPLAN	11.68 **	9.97 **
	(1.80)	(1.80)
ADISTOCK	-0.07 **	-0.10 **
	(0.02)	(0.02)
<i>Governance Structure</i>		
<i>Pension Board Composition</i>		
BDELMEM	0.11 **	0.09 **
	(0.03)	(0.03)
BDELMEM*UNEMPP	0.05 **	0.04 *
	(0.02)	(0.02)
<i>Pension Management Practice</i>		
LIABINS	-0.87	-0.56
	(1.64)	(1.59)
DEPPOS	2.17	1.32
	(1.68)	(1.64)
<i>Pension Reporting Practice</i>		
REPSOLO	-0.88	-0.65
	(1.69)	(1.64)
FREQVAL	2.82	2.40
	(1.96)	(1.91)
R-square	30.3	34.8
N	312	312

Notes:

1. ** $t \geq 1.96$; * $t \geq 1.65$.

2. Additional controls include a constant term and variables indicating the pension return and stock funding figures were missing.

levels once interest and amortization assumptions are held constant (column 2). Some of the other plan type variables are also attenuated, as are the factors reflecting governance structure. Thus the observed effect of having elected plan participants sit on the board of trustees seems to work both through the choice of assumptions, and also through the setting of requirements directly.

Overall, what the data show is that required contributions reported by public sector pension plans are endogenously determined. In other words, estimating the full effect of changes in the economic and governance environment on pension funding patterns must recognize that these environmental factors have both a direct effect on the level of reported required contributions, and also an indirect effect on the actuarial assumptions selected.

IV. Determinants of Actual Pension Contributions

Earlier sections established that actuarial assumptions and required pension contributions appear to be a function of both fiscal and governance factors shaping the environment in which public pension boards operate. In this section we demonstrate the impact that these findings have on models of actual pension contributions. Specifically, we posit that analyses which fail to consider the endogeneity of required contributions may yield biased coefficients to the extent that the aforementioned endogeneity is substantial.

This can be clearly established in a model of public sector employers' actual contribution patterns. As a general rule, actual contributions usually rise when required contributions increase. Not all public sector employers achieve full funding, however, and it is of interest to ask what explains the funding gap when it arises. This can be addressed by controlling on required contributions, and asking whether other factors also affect employers' willingness to fund. Based on our earlier research, we posit that actual pension payments are likely to be lower in times of fiscal stress, when a plan has experienced better investment performance; and when the employees are unionized (Mitchell and Smith forthcoming). Earlier work has also suggested that contributions are higher when board trustees are covered by liability insurance; when states are allowed to carry over their deficits from one year to the next; and when a pension plan is subject to more accurate and frequent reporting requirements (Mitchell and Hsin, 1994). Past research also reported evidence of habit persistence, such that higher past funding increased the probability of higher current funding (Mitchell and Smith forthcoming). The effect of having participant-trustees is ambiguous, depending on whether participants are expert enough to require high rates of pension funding.

We evaluate whether bias can arise in this setting, consider the two alternative formulations:

$$\begin{aligned} \text{Actcont} &= c_0 + c_{1a} X_1 + c_{2a} X_2 + c_3 \text{Reqcont} + e_{3a} & (3a) \\ \text{Actcont} &= c_0 + c_{1b} X_1 + c_{2b} X_2 + e_{3b} & (3b) \end{aligned}$$

where Actcont = Actual pension contributions per year (as a fraction of payroll); Reqcont, X_1 and X_2 are as defined above; and e_{3a} , e_{3b} = normally distributed iid error terms. If, as we argued above, required contributions are endogenously determined, including Reqcont in the equation as in (3a) may yield biased c_1 and c_2 coefficient

estimates. In particular, $c_{1a} \neq c_{1b}$ and $c_{2a} \neq c_{2b}$ will hold if Reqcont is correlated with the other economic and governance structure (X_1 , X_2) variables.

Evaluating whether this is a matter of serious concern is facilitated using the results in Table 3. When Reqcont is controlled, actual contributions are higher for police/firefighter pension plans and when actuarial valuation are infrequent. When Reqcont is excluded, additional coefficients become significant (e.g. those for ADJUSTOCK, BDELMEM, and BDELMEM * UNEMPD). In general, however, though some coefficients do appear to be underestimated when required contribution levels excluded, the entire vector of coefficient estimates is not statistically different at conventional levels across the two equations.

IV. Discussion

Public pension systems are of considerable interest both in the US and abroad because they have promised millions of workers a retirement benefit payout which many will soon begin receiving. The security of this pension promise has been challenged in recent years by some who contend that public defined benefit plans have been subjected to political pressures and fiscal stress, which in some cases may threaten retirees' eventual pension payouts.

Our analysis of a new dataset on public pensions suggests that environmental factors have begun to play a role in influencing plan actuarial assumptions. Fiscal stresses provoked by deviations in the local unemployment rate and pension board composition are linked statistically significantly to plan outcomes of concern. Focusing first on the actuarial assumptions, our results imply that if an increase in local unemployment of one percentage point above the long-run level (a change of about one standard deviation) would increase a public pension plan's assumed interest rate and spread rate by 0.1 percentage point. Though this appears to be a small response elasticity, it must be recalled that pension costs are quite sensitive to even tiny interest rate changes. Indeed, our evidence suggests that an increase in the unemployment deviation of one percentage point curtails required contributions by almost two percent of payroll. Pension governance structure also makes a difference: in these data, adding a participant-trustee on the pension board (an increase of about 12.5 percentage points in participant representation) is associated with a decline in the assumed interest rate of 0.04 percentage point, and a smaller negative 0.02 percentage point decline in the spread rate. The same increase in elected Board members is predicted to increase required pension contributions by 1.3 percent of payroll. Amortization periods do not appear to be as responsive to these factors.

This paper differs from other work in exploring the determinants of public pension actuarial assumptions, and in finding that these patterns are influenced by fiscal stress and governance structures through changes in actuarial assumptions. These influences are not readily revealed when required pension plan contributions are assumed to be exogenous, despite the fact that many prior studies have assumed they can be treated as independent of other environmental influences.

One general conclusion from this study as well as prior research on public pension funding is that fiscal and governance factors have probably affected public pension funding patterns for many years. Nevertheless the ways in which public sector employers have responded to these influences appears to have changed over time. Data from the late 1980's indicated that employers adjusted their actual contributions as the

TABLE 3
MULTIVARIATE ANALYSIS OF ACTUAL PENSION CONTRIBUTIONS
(estimated s.e. in paren.)

Explanatory Variables	Actual Contributions (% of payroll)	
	(1)	(2)
REOCONT	0.70 ** (0.04)	
<i>Economic Incentives</i>		
UNEMPD	-0.20 (0.54)	-0.94 (0.74)
YSROR	-0.21 (0.26)	-0.15 (0.36)
ISUNION	0.96 (1.04)	-0.94 (1.43)
TCHRPLAN	-1.92 (1.44)	-1.93 (2.00)
POFIPLAN	2.24 ** (1.07)	8.05 ** (1.40)
ADJSTOCK	-0.002 (0.002)	-0.008 ** (0.004)
<i>Governance Structure</i>		
<i>Pension Board Composition</i>		
BDELMEM	0.005 (0.02)	0.06 ** (0.02)
BDELMEM•UNEMPD	0.005 (0.01)	0.03 * (0.02)
<i>Pension Management Practice</i>		
LIABINS	0.93 (0.88)	1.00 (1.22)
DEFPPOS	1.46 (0.95)	1.72 (1.31)
<i>Pension Reporting Practice</i>		
REPSOLO	0.54 (0.96)	0.21 (1.32)
FREOVAL	3.40 ** (1.04)	5.77 ** (1.43)
R-square	59.0	20.7
N	298	298

Notes:

1. ** $t \geq 1.96$; * $t \geq 1.65$.
2. Additional controls include a constant term and variables indicating the required contribution, pension return and stock funding figures were missing.

pension environment changed, while in the 1990's they appear to have taken a different tack, altering actuarial assumptions and required contribution targets to meet changing situations. As government officials confront increasingly tight budgets and pension participants seek to become more involved in managing their pension plans, it will become increasingly important to be aware to strategic selection of interest rate and other key pension funding assumptions.

Numerous research questions remain. One puzzle that certainly deserves additional exploration is that uniformed officers' pension boards seem to behave quite differently from boards of pension plans covering other groups of public sector workers, in that pension managers for these plans select conservative actuarial assumptions and are able to garner more contributions even after controlling for required contributions. Another as-yet unsettled question is whether investors, public employees, and taxpayers can see through the veil of pension actuarial assumptions. Efforts to strategically select actuarial assumptions will not alter economic realities if borrowing costs, labor costs, and property values are influenced by "true" rather than "reported" public unfunded pension liabilities.

Appendix Table

DESCRIPTIVE STATISTICS AND VARIABLE DEFINITIONS

	Mean	St. Dev.
<i>Dependent Variables</i>		
INTEREST	7.74	0.71
SPREAD	1.94	0.55
AMORT	23.21	12.22
REOCONT	14.83	10.98
ACTCONT	14.21	11.41
<i>Explanatory Variables</i>		
<i>Economic Incentives:</i>		
UNEMPD	-0.20	1.17
YSROR	7.13	5.56
ISUNION	0.75	0.44
TCHRPLAN	0.09	0.28
POFIPLAN	0.36	0.48
ADJSTOCK	95.78	43.23
<i>Governance Structure:</i>		
<i>Pension Board Composition</i>		
BDELMEM	32.85	27.87
BDELMEM•UNEMPD	-10.17	56.64

	Mean	St. Dev.
<i>Pension Management Practice</i>		
LIABINS	0.40	0.49
DEFPOS	0.46	0.50
<i>Pension Reporting Practice</i>		
REPSOLO	0.68	0.47
FREQVAL	1.21	0.47

Variables Definitions

Note: All variables are qualitative (0,1) unless specified. All variables are taken from PENDAT unless noted.

Dependent Variables

INTEREST: Interest rate assumption (%)
SPREAD: Spread rate assumption (interest rate - salary growth rate) (%).
AMORT: Amortization period for past service liabilities (years).
REQCONT: Employer's annual actuarially required pension contribution as a percentage of payroll (%).
ACTCONT: Employer's annual actual pension contributions as a percentage of payroll (%).

Explanatory Variables

Economic Incentives

UNEMPD: Recent (1990 and 1991) level of unemployment minus previous 5 years average level of unemployment in the state (Sources: US Bureau of the Census 1992).
YSROR: At least some of the employees covered by the pension plan are unionized.
ISUNION: Plan participants are largely teachers and school employees.
THRPLAN: Plan participants are largely police and firefighters.
POFIPLAN: Ratio of reported pension plan assets to adjusted PBO measure of cumulative plan liability (%).
ADJSTOCK:

Governance Structure

Pension Board Composition

BDELMEM Fraction of pension Board elected by pension participants (%).

Pension Management Practice

LIABINS Board is covered by liability insurance.
DEFPOS State law does not prohibit carryover of state budget deficit from one year to the next (National Association of State Budget Officers 1992).

Pension Reporting Practice

REPSOLO Plan issues own financial report (not integrated with other budgets).
FREQVAL Frequency of independent performance evaluations (years).

Notes

- 1 The U.S. government also requires private sector DB plans to participate in a government-run pension insurance plan covering a major portion of promised benefits (Ippolito 1986; Vanderhei 1993).
- 2 Demographic assumptions also are important but play a less central role than economic ones. Thus Vanderhei (1994) notes that changes in turnover, mortality and disability rates have relatively modest effects on defined benefit pension obligations as compared to the economic factors emphasized above.
- 3 A recent discussion of the SEC's stance appears in Joreski (1993). These concerns (expressed in McGinn 1993 for instance) renew questions raised more than a decade ago by Feldstein and Morek (1983) who argued that underfunded private pension plans selected high discount rates to reduce required contributions. There is no evidence that ERISA restrictions on private pension amortization periods have affected private pension contribution patterns.
- 4 Other proxies for fiscal stress are discussed in Mitchell and Smith (forthcoming). We avoid using the region's budget deficit because this measure could be endogenously influenced by the public plan's funding activity. Another fiscal stress proxy might be government revenues, but these too may be endogenous if tax collections are raised to cover pension obligations.
- 5 A pension plan's reported stock funding ratio is the ratio of assets at market value divided by projected benefit obligations (PBO). Since plans compute PBO's based on their (endogenously chosen) actuarial assumptions, it is inappropriate to use reported stock funding figures in the proposed model. Mitchell and Smith (forthcoming) show how to adjust reported PBO stock funding ratios to a common set of actuarial assumptions, and it is this adjustment which is applied to variable used in the Table. Zorn (1991) and Vanderhei (1993) discuss various liability measures and how they depend on actuarial assumptions.
- 6 See for example Imman (1986), Marks *et al.* (1988), and Mitchell and Smith (forthcoming).

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