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# PENSION FUNDING IN THE PUBLIC SECTOR

**ABSTRACT**

This paper explores the determinants of pension funding in the public sector. We formulate and test several hypotheses about the determinants of public employer pension funding practices, using a new data set describing financial and other characteristics of state, local, and teacher plans.

The data show that, on average, public sector pension plans were relatively well-funded during the late 1980s. There were, however, wide variations in funding practices in our sample. Our analysis of these variations suggests that past funding practice tends to be perpetuated, that unionized employers are less likely to fully fund future pension obligations, and that funding is sensitive to fiscal pressure.

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## Introduction

After a decade of neglect by researchers, public employee retirement plans are again coming into the public eye. This new concern is partly due to public sector of revenue shortfalls that public pension funds have been asked to help meet in some states.[1] In other cases, required contributions for public pensions simply have not been forthcoming: contributions for school employee pensions have recently been deferred or cancelled in a dozen states and cities.[2]

The purpose of this paper is to explore the determinants of public employee retirement system (PERS) funding, so as to better understand what drives the the political economy of these ever-more important institutions. State and local pension plans now cover 10 million employees and command a substantial fraction of the nation's capital stock, with assets of more than $720 billion.[3] State-sponsored pension plans paid benefits to over 3.5 million retirees and their survivors, and many more expect future benefits: some 9 million full-time state and local workers anticipate receiving pensions at retirement.[4] As Leonard put it succinctly, "public pensions are big business" (1986, p. 26).

To an active worker, a pension promise represents a claim to a future income stream payable after leaving his or her employer. The covered worker receives wage and salary compensation in each year of active employment, and in addition accrues a claim to a retirement benefit annuity which will be paid out after retirement. Thus, labor economists are in agreement that pension promises, like wages, represent employee compensation.[5] Nevertheless, employers do not always recognize in their annual budgets the full liability created by pension promises

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[1]In the last five years, almost two-thirds of all states have reportedly reduced budget deficits (at least in the short run) by altering the actuarial assumptions used to compute their public employee pension obligations. For example, New York State pension officials recently agreed to raise the assumed rate of return on pension fund assets from 8 to 8.75 percent, which lowered pension contributions by $325 million annually and helped balance a state budget deficit (see Verhovek, 1990, and Price, 1991). Similar approaches are being used to cover state deficits in California, Connecticut, Maine, Pennsylvania, and Texas; see Durgin (1991) and Hemmerick (1991).

[2]See the articles in Employee Benefit Plan Review (1991) and Durgin (1991).

[3]Descriptive data on pension assets and coverage are provided by Phillips (1991 forthcoming); see also Turner and Beller (1989).

[4]Turner and Beller (1989).

[5]For a review of the recent literature on pensions' role in labor compensation see Gustman and Mitchell (1991).

accrued each year. This is particularly common in the public sector. No federal regulation requires state and local governments to value pension promises made in one year if they are not to be paid until some future year.[6] Not only are these liabilities not recognized, but frequently they are not advance-funded; that is, as noted above, some localities do not currently accrue adequate monies to meet their eventual pension promises. This process produces an underfunded pension plan wherein assets (and anticipated earnings on them) are insufficient to meet promised benefit obligations.

Taxpayers, employees, and government agencies should be concerned about underfunded public employee retirement systems for several reasons. Underfunded systems represents a major form of public borrowing against the future, yet the practice receives little public scrutiny. Though public employee pension system borrowing is kept "off the books," it may nevertheless powerfully affect future tax and revenue-raising potentials of the government agencies in question. In addition, the security of public sector retirees is critically affected by state and local governments' ability to met promised pension benefit payments, which may be threatened in times of fiscal crisis. Finally, compensation packages offered to public sector workers may be influenced by the size and riskiness of the pension promise. For all these reasons, and because the public sector workforce is maturing along with the rest of the population, PERS funding practices will become increasingly important in coming years.

Much of the previous literature on this topic is primarily descriptive rather than analytical,[7] in part because of the fact that good data on public plans' financial status have been extraordinarily difficult to obtain. One contribution of this paper is an investigation of new data on public sector pensions containing better and more comparable information on assets and liabilities than heretofore available. A second contribution is that we devise and estimate a structural model of public employers' pension funding behavior, exploring the links between three interrelated

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[6]In contrast, pension obligations must be recognized on an annual basis and specified in private corporations' annual reports under the Employee Retirement Income Security Act of 1974 (ERISA); see Ippolito (1986).

[7]Descriptive studies of public pension plan characteristics include Bahl and Jump (1974), Testin (1984, 1986), Taylor (1986) and most recently Testin and Snell (1989) and Turner and Beller (1989).

outcomes: required annual pension contributions, actual annual pension contributions, and public employee earnings.[8] Our most important conclusion is that there are wide variations in funding practices across governmental units, some due to habit persistence, some to the collective bargaining process, and some to fiscal pressures.

In Section I we discuss public sector pension plan funding and present descriptive evidence on funding patterns using a variety of different funding measures. Section II outlines a theoretical model of the determinants of public employee pension plan funding and presents hypotheses. The empirical model is described in Section III, along with our estimates. The paper concludes with a discussion of policy applications.

## I. Funding State and Local Pension Plans

In order to fully develop the economic content of public sector pension funding practices, it is necessary to first clarify the nature of the pension promise. In a defined contribution plan, one of two pension types, the employer specifies an annual pension contribution made on behalf of each participating worker. Pension contributions are invested in the capital market, and at retirement the pensioner receives benefits that depend on the outcome of this contribution and investment process. There is no particular funding problem for this type of plan; instead, pension assets are by definition equal to pension obligations.

While defined contribution plans have become increasingly popular in the private sector over the last decade, a second plan type -- the defined benefit plan -- is much more prevalent in the public sector, with more than 95 percent of all covered public employees having pensions of this latter type (Turner and Beller 1989). In this type of plan, the employer specifies a retirement benefit formula typically varying with the worker's retirement age, final average salary, and years of service. For instance, a common defined benefit annuity promise from retirement until death

[8]Relevant previous studies are discussed in more detail in Section II below.

might equal two percent of final pay per year of service. In many cases, too, these plans index benefits after retirement so the benefit promise is effectively a real, rather than a nominal, one.

Properly funding the defined benefit promise requires setting aside enough money to ensure that the the promised benefit stream can be paid after the worker retires. In the private sector, reserve funding is now legally required. Thus, actuaries must forecast future benefits, and then work backward to determine the time path of contributions required to meet future benefit needs.[9] In PERS, however, reserve (or advance) funding is not currently required. As a result, some government sector employers pursue a reserve funding process while others do not. In the latter case, when contributions are below the level required to meet accruing benefit obligations, the pension plan becomes underfunded.

Valuation of Pension Liabilities

To further clarify the calculation of pension liabilities, it is useful to begin with the information that most public sector pension systems provide in their periodic audit reports -- a figure called the plan's actuarial accrued liability (AAL). This figure is whatever the sponsoring plan chooses to report as its future pension obligations to both current retirees and active workers. AAL figures cannot be taken literally, however, because plan obligations differ from one to the other, depending on actuarial method chosen and the assumptions used to calculate future obligations. Thus, the variety of actuarial practices employed makes reported AALs non-comparable across plans.

Recognizing the need for more similar figures across plans, the Government Accounting Standards Board (GASB) in 1987 required public pension plans to begin reporting liability figures using a standardized actuarial computation called the "projected benefit cost method."[10] This approach produces the "pension benefit obligation" (PBO) for each defined benefit plan by grouping prospective pension liabilities into five logical categories:

(1) benefits pledged to currently retired employees,

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[9]For a discussion of pension funding requirements in the private sector, see McGill and Grubbs (1989).
[10]This nomenclature is used by Zorn (1990) and Allen et al. (1988).

(2) benefits to vested terminated employees, based on past service,

(3) benefits to vested active employees, based on currently accumulated service,

(4) prospective benefits payable to non-vested active employees who may vest in the future, and

(5) benefit increases that will be earned by current workers resulting from future salary increases.

Projected pension obligations thus derived represent the projected benefits accruing in each year of plan operation; these yearly accruals are termed the plan's "normal cost."

To be actuarially sound, an employer's annual contributions must amortize past unfunded pension liabilities. If the current stock of pension fund assets should be smaller than projected liabilities, actuarial practice requires employers to make up this difference over time by making yearly contributions in excess of normal cost. This is usually termed the "amortized past service cost," which arises from obligations due to workers for service rendered prior to the current year.[11]

Most public sector plans now report the GASB-required PBO liability measure, as we shall see, but some plans employ a different measure to calculate actual pension contributions. Specifically, in some states an accrued benefit cost method rather than the projected benefit cost method is used, where the accrued method indicates smaller liabilities primarily by omitting funding for category 5 listed above. For our purposes, where we wish to compare funding positions across public sector plans, it is necessary to focus on the standardized actuarial PBO computation.

Having a PBO reported in all public sector plans greatly facilitates comparisons of plan liabilities. Nevertheless, even with this projection method in common, liability computations are very sensitive to several assumptions employed in assessing future pension benefit streams, including salary growth rates, investment rates of return, turnover and mortality patterns, and

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[11]Past service obligations may also include benefit improvements negotiated over the years but not explicitly embodied in the initial benefit promise. In any event, obligations based on future service are not taken into account.

retirement ages. PERS administrators have wide leeway in the choice of assumptions, and they can therefore dramatically alter the size of anticipated liabilities if they so choose. For instance, a defined benefit pension plan paying retirees a given fraction of their final pay would show a smaller estimated liability if a lower (real) rate of future salary increase is assumed. Similarly, a computation of future liabilities would also be reduced if an assumption of higher real rates of return on pension fund investments is made.

In general, then, GASB's requirement that public systems use a common valuation method in computing liabilities is an essential first step in producing comparable measures across pension plans. Nevertheless, different underlying assumptions used in projecting benefit amounts can still produce liability estimates that may make cross-plan comparisons invalid; we investigate this issue in some detail later in the paper.

Computing Pension Underfunding

Two perspectives can be taken in investigating how well the pension promise is funded: a "flow" and a "stock" perspective. The "flow" perspective asks whether an employer is setting aside enough money each year to meet that year's requirements -- where required contributions are determined by adding together accruals earned by active employees in that year (normal cost), and the amount required to amortize past unfunded liabilities. This required level is not always achieved by actual annual contributions for a variety of reasons, and flow underfunding develops when actual.contributions fall short of required. A "stock" perspective, in contrast, reveals the cumulation of both funding practices and investment performance over the plan's history to date. This stock notion is summarized in the ratio of the pension plan's total assets to its total promised obligations.[12]

Descriptive Findings on Stock Funding

[12]Both stock and flow funding calculations require accurate valuation of plan assets to arrive at a meaningful number. However, assets in public sector pension plans were traditionally carried at book value, making it difficult to compare funding ratios across plans. This was remedied in the late 1980's by GASB, which urged public sector plans to begin reporting assets at market value for the first time. Calculations reported below generally report assets at market value, unless otherwise reported.

The information on public sector pension plans used in this study is derived from several different sources, primarily a 1989 compilation of pension data published by the National Association of State Retirement Administrators (NASRA) and the National Council on Teacher Retirement (NCTR).[13] The NASRA/NCTR survey consists of a nine-part questionnaire completed by pension plan administrators containing descriptive data on plan types as well as active and retired membership, auditors' reports on plan assets and liabilities, flow and stock funding patterns, assumptions used to derive PBO's, benefit formulas and payroll amounts, and other investment data. Pension sponsors from 60 plans responded to the basic survey; however, in this study we use 42 plans which reported a complete set of financial data. The public sector pension plans examined here covered a total of 4.7 million employees in 31 states, and were of three types: teacher-only pension systems (33 percent), hybrid plans combining state, local and teachers (38 percent); and plans with only state and local workers (29 percent).

Plan sponsor information is then augmented by merging additional state-specific data by plan. Variables taken from several sources (described in Appendix 1) include measures of fiscal pressures affecting each state, indicators of each state's political environment, and a measure of alternative pay levels for public sector workers. Also data were obtained on the fraction of the active pension-covered employees who were unionized in each plan by contacting each of the pension plan sponsors in the survey.

Table 1 depicts pension plan assets and liabilities reported by NASRA/NCTR survey plans for which complete financial data are available. One measure of plan obligation is the reported "actuarial accrued liability" figure (AAL), which averaged $5.5 billion per plan (line 1). The pension benefit obligation (PBO), computed as required by GASB, averaged $5.9 billion per plan (line 2). As argued above, the latter measure employs a common method of projecting benefit costs and thus is more comparable across plans. The most economically relevant asset measure in

[13]For a full discussion of these data see National Association of State Retirement Administrators and National Council on Teacher Retirement (1990) and Zorn (1990).

our dataset appears in line 3, indicating assets valued at market.[14] Across the plans in the sample, the average plan asset amount reported is $4.9 billion. There are two ways we measure the average stock funding ratio. One, given on line 4, is the median of the ratios across plans; the typical plan in our sample has a stock funding ratio of 91 percent. The other measure, presented on line 5, is the ratio of the average assets (line 3) to the average PBO (line 2). The fact that this latter ratio is only 84 percent is indicative that funding is poorer among the larger funds. Under either measure, assets typically fall short of liabilities by 9 to 16 percent.

We conclude that some degree of stock underfunding was common among PERS plans during the late 1980's. However it remains to describe current practice -- that is, the extent to which employer contributions fall short of required contributions on an annual basis. We next turn to an extensive analysis of flow funding.

## II. Flow Funding Patterns in Public Sector Plans

The current underfunding of pension promises generally takes two forms. One method of underfunding is to adopt unrealistic assumptions that reduce legally required pension contributions. For example, the spread between the assumed rate of return on pension investments and the rate of assumed wage growth determines, in effect, the real discount rate applied to future pension liabilities. The larger the spread between these two, the lower the present value of calculated pension obligations. The other form of underfunding involves failure of the public sector employer to actually contribute its calculated pension obligation. Put differently, state governments may view the adequate funding of pension promises each year as optional, with current funding inadequacies posing no immediate threat to the integrity of the pension plan vis-a-vis current employees.

### Determinants of Required Pension Funding

[14] In the past most plans reported fund assets valued at book; see Kotlikoff and Smith (1984) and Arnold (1983) for a discussion of public plan funding practices in the 1970's.

In the public sector, retirement benefits are almost always calculated by applying a replacement rate, which depends on the worker's years of service, to the employee's final average salary (often the average of the highest three consecutive years of earnings). Thus, given the pension benefit formula and current salary levels, calculating the actuarially-needed yearly pension contribution requires projecting future retirees' years of service at retirement (a function of turnover rates and retirement age) as well as anticipated salary growth rates. In addition, contributions needed to fund yearly normal costs are affected by the expected rate of return on pension fund investments (that is, when rates of return are expected to be relatively higher, current contributions can be correspondingly lower). Algebraically, the required per worker annual pension contribution (Req) by employer i must depend on current salary levels (Avepay), pension benefit parameters (Ben%), current levels of stock funding (Stock), and assumptions about salary growth expectations (Wdot) and investment return projections (ROR):

$$Req_i = f( Avepay_i, Ben\%_i, Stock_i, Wdot_i, ROR_i ). \quad (1)$$

The Choice of Underlying Assumptions

Our dataset contains information on two critical assumptions underlying the calculations of required flow funding for employers sponsoring pension plans. These are (1) the expected future rate of wage growth, and (2) the rate of return anticipated on pension fund investments. Table 2 indicates that the mean rate of wage growth assumed by the plans in our sample is 5.6 percent per year, while the investment returns assumption averaged 7.6 percent. The difference between these two rates, commonly called the "spread," effectively serves as a real discount rate in present value calculations of pension liabilities, and the mean difference of 2 percent is comfortably close to both historic and recent real interest rates in the United States.[15] Further, the standard deviations of these two rates presented in Table 2 are relatively small.

[15]Simon (1990) summarizes several historic studies and concluded that a 3 percent rate is a reasonable estimate of the real rate of return in the long run. Over the last 25 years, however, the real rate of return on 6-month Treasury bills has averaged 1.5% (derived from US President 1991, Tables B-58 and B-71.)

Taken together, the mean spread and the small variances suggest that in our late-1980's dataset there were few, if any, instances of egregious misuse of assumptions for the purpose of reducing employers' pension fund contributions. To corroborate this implication, we conducted extensive empirical analysis of the data, seeking to relate the spread used by each plan to a variety of regional, political, and economic variables. None of these factors proved statistically significant at conventional levels in explaining the spread, and in no equation could our composite of variables account for more than 15 percent of the variance.[16] We must therefore conclude that, in this sample and for this time period at least, the assumed rates of wage growth and investment returns were not manipulated for the purpose of making public pension plans appear better-funded than they actually were.

The fact that wage growth and investment returns assumptions seem reasonable does not necessarily imply that other critical assumptions, such as those regarding expected future years of service by active employees, were prudent. We have no data on these less visible assumptions, but are able to determine the sensitivity of each plan's reported pension benefit obligation (PBO) to changes in four assumed parameters, including the average age of active and retired employees, the average number of years of service accumulated by active employees, and the number of years before active workers begin to receive pension benefits. As detailed in Appendix 2, three of the four alternative PBO estimates we calculated varied from those reported by less than 4%. Because imposing uniform assumptions on all plans virtually guarantees that deviations from reported figures will occur, the fact that reported and "adjusted" PBOs were so close provides further evidence that, at least in these plans during this time, actuarial assumptions do not appear to have been manipulated for purposes of reducing employers' pension contributions.

Determinants of Actual Pension Underfunding

Another way in which pensions can become financially troubled is for employers to fail to contribute the funds actuarially determined to be needed by the pension plan each year. At first

[16]Results of these analyses may be obtained from the authors on request.

glance, the data seem to suggest this is not a problem in our data set either. Table 3 (line 3) indicates that the median employer's "flow funding" ratio in this dataset is 100 percent, implying that the typical employer made contributions each year equal to those required. However, when one compares average contributions and average requirements (lines 2 and 1, respectively), the ratio of the former to the latter is only 89 percent, suggesting that funding is poorest among plans with the most generous pension benefits. In an effort to better understand the determinants of these patterns, in this section we develop and estimate a behavioral model of public plan flow underfunding.[17]

We anticipate that the most important determinant of public employers' actual pension contributions is likely to be the required obligation, as determined by actuaries. However, deviations from the ideal are common, and this difference might be related to several factors. One factor that might affect actual PERS contributions is be the local political "climate." We hypothesize that, for a variety of reasons, some states will have a greater propensity to fund required obligations than do other states. To the extent that these are embedded in a state's political fabric and do not change from year to year, they can be proxied in our estimating equations by including a measure of "stock" funding levels.[18] Stock funding measures capture the cumulative effect of past flow funding decisions, and therefore embody the influences of the long-term plan-specific political environment. If stock funding measures reflect political climate, we would expect PERS that have been funded poorly in the past to be more poorly funded currently; that is, we would expect to see habit persistence in funding patterns.

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[17]There are few previous studies of flow funding; for example, Inman (1980) devised and estimated a model of pension funding per capita on a flow basis for police and firefighters, and Inman and Albright (1987) did so for teacher plans. However no previous study examined separately the plan's actual versus required contribution patterns as we do here, and none had data on pension assets assessed at market value and PBO data comparable to that which we have here.

[18]For instance, Mumy (1978) hypothesizes that some states are more likely to borrow against the future on a long-term basis than are other states. Inman (1985) suggests that states where residents are homeowners in large numbers will seek to fund pensions more fully since they will be at risk to cover future pension obligations via property taxes. These and other characteristics of the local political economy are captured in the stock funding measure we discuss in the text.

Stock funding measures, however, are only an imperfect measure of past practice, because unanticipated returns on investments are common, and these unanticipated returns will also affect stock funding ratios. Therefore we look beyond these ratios for further explanatory variables.

One major influence on pension funding may derive from the public sector collective bargaining process. A variety of influences can be reasonably hypothesized, some of which work in opposing directions. On the one hand, unions may function primarily as the informed agents of their members, who may be unaware of the complex issues surrounding actual and required pension funding. In some cases union leaders and their staffs may make it their business to be informed about pension funding and to apply pressure on government agencies to improve funding where it is inadequate. Thus, one possible influence is that union strength may help to rectify past practice of underfunding pension obligations.[19]

Alternatively, unions might themselves be under pressure to produce "results" in the areas about which workers are most informed and most likely to care: namely, pay levels. If union leaders believe that workers care only (or primarily) about wages, and much less about the complexities of funding a rather distant pension obligation, then unions may exert efforts to secure a high wage, while tacitly allowing public employers to partially "pay for" that high wage through inadequate pension contributions. Under this view, one could hypothesize that funding would be less adequate in more heavily-unionized environments.[20]

In addition to long-term factors in the local political economy that might influence flow underfunding, it is necessary to investigate whether funding is affected by worsening fiscal pressures, such as unexpected changes in a state's economic circumstances. For example, imagine a PERS plan that intends to customarily fund X percent of its actual pension obligation, where X is equal to or less than 100 percent. If the state suddenly faces an unexpected increase in unemployment (and as a consequence an unanticipated reduction in tax revenues), it may fund less than X percent in the current period. Likewise, if a state experiences unexpected revenue

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[19]For a discussion of this "face" of unionism in the public sector, see Freeman (1981 and 1986).
[20]Opposing views of union effects on pension funding are discussed in Mitchell and Smith (1990).

increases, it might fund more than required while times are good, in anticipation of leaner periods in the future.

Algebraically, the model outlined above can be summarized as follows:

$$Act_i = f(Req_i, Stock_i, Unempd_i, Union_i) \quad (2)$$

For each employer i, actual pension contributions per public employee (Act) are a function of actuarially required pension contributions per public employee (Req), the plan's stock funding ratio (Stock), a measure of fiscal pressure which here we proxy by recent deviations in the state's unemployment rate from its long run level (Unempd), and the percentage of workers in the employing unit who are covered by collective bargaining contracts (Union).

One problem in estimating any given functional form of the behavioral funding equations (1 and 2) is that Act and Req are, in theory, simultaneously determined. To elaborate, public sector pension promises are put at risk when actual pension funding falls short of required funding, because an underfunded pension fund may run short of money with which to pay promised benefits.[21] If workers or unions perceive underfunding as a threat to the pension promise, then underfunding should lead to a compensating wage differential driving salaries in the jurisdiction higher than they would otherwise be.[22] This compensating increase in salary will, by itself, tend to increase required pension contributions, because pension benefits in the public sector are a direct function of final average salary. Thus, any estimate of (1) and (2) requires a simultaneously estimated system that includes an additional equation explaining salary levels as they vary across observations.

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[21]Private sector defined benefit plans do not face this same risk because there is a federal insurance agency which guarantees most of the retiree benefit. Nevertheless Ippolito (1989) argues that the private pension insurance system is in financial jeopardy, a view that is held by many other analysts as well. To date, pension plan bankruptcy has not been a serious threat for most public employees, but Inman and Albright (1987) note that local employee plans in Michigan and Pennsylvania did declare bankruptcy, and the near-failure of the Cleveland and New York City pension plans have also engendered new worries about the security of underfunded plans. Other plans have also been found close to crisis: the police pension fund in the District of Columbia alone was recently reported to be suffering a $5 billion underfunding problem, with pension contributions required to cover this shortfall almost equalling police payroll (Shine, 1991).

[22]For a full discussion of the theory and some empirical work with public sector employees in Pennsylvania see Smith (1981); also Inman (1980) examined teacher salaries for risk premiums for underfunded teacher plans.

Of course, several factors other than pension risk influence the salary that a public sector employer must pay to attract and keep employees.[23] One, which should have a positive effect on PERS workers' wages, is the level of nongovernment salaries in the state (the opportunity wage). A second factor widely thought to influence public sector pay is the degree of unionization among public sector employees. We hypothesize that in jurisdictions in which workers are more heavily unionized, wages will tend to be higher, other things equal. Finally, it must be recalled that wages and employee benefits are substitutes in the compensation package, ceteris paribus.[24] To the extent that other differences can be held constant across workers and jobs, we posit that the data will show jurisdictions offering (and funding) more generous promised pension benefits to have lower cash salaries.

Combining these factors in equation form, we have the following generalized salary model:

$$Avepay_i = f(W_a, Union_i, Req_i, Act_i) \qquad (3)$$

where $W_a$ equals public sector workers' alternative wage in state i, and other variables are as defined above. It will be noted from the discussion that Avepay , Req , and Act are simultaneously determined.

Results: The Basic Model

In analyzing the causes and effects of pension underfunding, we first estimate a "basic" model which represents a simple linearization of the 3-equation simultaneous system (1-3).[25] Specifically we assume all disturbances are normally distributed and apply a two-stage least squares procedure to estimate the following model (variables are described in Table 4):

$$Act_i = a_0 + a_1 Req_i + a_2 Stock_i + a_3 Unempd_i + a_4 Union_i + e \qquad (4)$$

$$Req_i = b_0 + b_1 Avepay_i + b_2 Ben\%_i + b_3 Stock_i + b_4 Wdot_i + b_5 ROR_i + e' \qquad (5)$$

$$Avepay_i = c_0 + c_1 W_{ai} + c_2 Union_i + c_3 Req_i + c_4 Act_i + e'' \qquad (6)$$

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[23] For a review of public sector pay determination see Ehrenberg and Schwarz (1986)

[24] For a survey of the wage-pension tradeoff literature see Mitchell and Pozzebon (1987); recent work in the area includes Montgomery et al (1990).

[25] As indicated in Appendix 1, the estimating sample consists of 41 plans for which complete data are available on all variables; means for this subsample appear in Appendix Table 1.

In evaluating the results from estimating equations (4-6) we have the following expectations regarding the signs of coefficients:

Equation 5: $b_1, b_2, b_4 > 0$; $b_3$ and $b_5 < 0$.

Equation 6: $c_1, c_2, c_3 > 0$; $c_4 < 0$.

Coefficients $c_3$ and $c_4$ in equation (6) represent compensating wage differentials, as argued above.

In equation (4), the behavioral equation of primary interest, we expect $a_1$ and $a_2$ to be positive -- the latter due to habit persistence. The coefficient of Unempd, $a_3$, is expected to be negative because as unemployment rises above its long term level, the accompanying fiscal pressure may cause states to underfund their plans. The coefficient of the unionization term, $a_4$, has an ambiguous sign prediction, as argued above. Therefore, in assessing the results presented in Table 5, all significance tests are one-tailed except for those on the unionization coefficient in the Act equation.[26]

Of most interest in Table 5 are the results for the equation explaining actual funding patterns, Act. The findings indicate that an additional dollar of required pension contributions (Req) is met by only 94 cents of actual additional funding, *ceteris paribus*. While this point estimate suggests that, on average, public sector employers do not fully fund increases in pension obligations, it should be noted that the coefficient on Req is not significantly different from unity. Therefore we cannot reject the hypothesis that marginal increases in Req are fully funded, all else constant.

A second conclusion regarding actual funding patterns is that the coefficient on stock funding is positive, suggesting that current and past funding practices are positively correlated. Put differently, pension funding "habits" seem to persist among public sector employers.

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[26]For identification purposes, this model assumes that stock funding is exogenously determined. To test this assumption we also examined a variety of models exploring the effects of making stock funding practices a function of geographic, political environment, and plan-type variables; results for the dependent variables of interest are virtually identical to those presented here and do not change conclusions. Previous empirical models of public sector stock funding practices include those by Arnold (1983); Epple and Schipper (1981); Grosskopf et al. (1983); and Inman (1985).

There is also evidence in Table 5 that economic distress -- in the form of unusually high unemployment rates in the state -- causes public employers to underfund. The effect of Unempd is negative, and while it is statistically significant at only the .10 level, the point estimate suggests that a positive 1 percentage point deviation in a state's unemployment rate will lead public employers to reduce Act by about $120 (roughly a 6 percent reduction in annual per worker contributions).[27]

Finally, the results suggest that, other things equal, greater unionization is associated with lower levels of actual pension funding. Thus, while unions may in some cases exert pressure to improve public plan funding, the net negative effect is probably due to the upward pressure on salaries associated with collective bargaining, to which employers respond by lowering pension contributions. Interestingly, our estimates imply that if a public sector employment unit went from being completely nonunion to 100 percent union, actual employer pension contributions would fall by approximately 50 percent.

How credible are these results? We first evaluate them by looking at the signs, significance levels, and magnitudes of coefficients estimated in the other two equations in the system, focusing on Avepay and Req. Next, as described in the following section, we assess the robustness of our estimates to plausible changes in specification.

In looking at the results in Table 5 for the Req and Avepay equations, all coefficients have their expected signs and are different from zero at the .10 statistical significance level or better. In equation (5), which describes the determinants of required funding patterns, the coefficients of Wdot and ROR are opposite in sign and equal in magnitude, thus conforming to expectations (their difference is effectively the real discount rate, so a one unit change in each should not change the present value of obligations). Furthermore, a one dollar increase in salary translates into higher required pension obligations of 24 cents. This finding implies a marginal "replacement value" of plausible size.

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[27]Our results thus extend the conclusion of Bumgarner et al (1991) who find that fiscal distress reduces expenditures for public sector capital and capital-maintenance funds.

The results from the pay equation (6) are, for the most part, of credible sign and magnitude. Public sector salaries are positively correlated with workers' opportunity wage, proxied here by their private sector salaries. Moreover, the hypothesis that private sector pay increases are reflected dollar-for-dollar in public sector pay cannot be rejected. The measured union effect on public sector pay levels, while significant only at the .10 level, implies that going from a nonunion environment to a completely unionized one will increase salaries by about $4900 per year, a 22 percent increase from the sample mean of $22,000. This estimated union differential is within the range of differentials found in studies of the federal government and private sector.[28]

The only result that causes concern pertains to the estimated coefficients on Act and Req in the salary equation. As expected, the coefficient on Act is negative and significantly different from zero, suggesting the presence of a compensating wage differential. Moreover, the difference between the two coefficients is negative; thus, if promised pension obligations were to increase by one dollar per year, and this increase were fully funded, we estimate that salaries would decrease by about 50 cents per year.[29] However, the estimated coefficients seem implausibly large if taken one at a time. The results in Table 5 suggest that if required pension contributions per worker were held constant while actual yearly contributions per worker were improved by one dollar, the average worker's salary would fall by almost $5 per year.

Alternative Specifications

Several other model specifications were examined to determine the robustness of the basic results appearing in Table 5. We explored variants of the actual funding equation (5) that included additional control variables for the type of employee covered by the plan and several variables reflecting the state's political climate. Plan-type controls involved creating an indicator for teacher-only pension plans (Tchrplan), and hybrid plans combining state, local and teachers (SLTplan); the reference category was plans with only state and local workers. Political variables included the

[28]See Ehrenberg and Schwarz (1986) for a survey of union effects on public sector pay. Because our model controls for both public pension levels and pension funding adequacy, these results are not strictly comparable to those estimated previously (pension variables were not typically included in previous analyses).

[29]Other studies examining compensating wage differentials for public sector employees include those by Ehrenberg (1979), Smith (1981), and Smith and Ehrenberg (1983).

fraction of the state's population voting Democratic in the last presidential election (Dembyvt), the political rating given to a state's senators by the AFL-CIO (AFLCIO), and an indicator of whether a state had a right-to-work law (Rtowk).[30] Political and employee-type variables were included to control for the possibility that the level of unionization is affected by factors that themselves might affect flow funding adequacy. Put differently, this approach allows us to see whether omitted variables bias affects our estimate of union effects on actual contributions.

The results from simultaneously estimating the three-equation model with this augmented equation for Act appear in Table 6, and we find that the basic results are qualitatively unchanged. Except for the coefficient on Unempd, coefficients on all economic variables examined previously remain significant at the .10 level or better, though the difference between the Act and Req coefficients is now slightly positive instead of negative as before. Most importantly, the estimated union coefficient in the actual funding equation is of similar magnitude, and the inclusion of the additional variables (while not themselves statistically significant) enhances the significance of the union term. Finally, the fact that the plan-type and political/environment controls are not statistically significant at conventional levels suggests that the most important determinants of pension plan funding behavior are well-captured by the economic variables previously described.

The union effect was further explored by adding a union-fiscal pressure interaction term (Union*Unempd) to the basic equation for Act. This specification posits that responses to fiscal pressures are different in union and nonunion states; estimates of this model appear in Table 7. We find that the coefficient on the interaction term implies poorer funding in union environments when fiscal pressures mount. Even though the estimated coefficient is larger than its standard error, it is not statistically significant at the .10 level, however. The remainder of the results suggests that other conclusions are fundamentally the same as those described in Table 5. This finding, as well as those in the previous table, imply that the basic results are robust to changes in specification.

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[30]A complete discussion of data definitions and sources appears in Appendix 1.

## IV. Discussion

This paper has explored the determinants of public sector pension funding. Using a new survey on public employee pension plans, we investigated several hypotheses about the determinants of flow funding behavior, focusing on a model that permits the simultaneous determination of three interrelated outcomes: required annual pension contributions, actual annual pension contributions, and public employee earnings.

Implications of our work for public pension plan funding practices can be highlighted. Regarding stock funding, the findings are both comforting and worrisome. On the one hand, data from the late 1980's indicated no instances of egregious misuse of actuarial and economic assumptions for the purpose of reducing employers' pension fund contributions. On the other hand, public plan funding ratios were only 90 percent of required on average, which is not particularly high in light of strong capital markets during the decade of the 1980's. In addition, new challenges face public pension plans in the 1990's with the advent of unprecedented state budget deficits. *Business Week* recently reported that "governors and legislators are scrambling to tap employee pension funds or cut back on contributions to avoid more painful budget cuts or tax increases," citing as examples West Virginia's use of pension fund loans to finance teacher pay hikes, and Philadelphia's borrowing of $75 million funds to pay city workers (Schine 1991). The funding status of public sector pension plans will deteriorate quickly if new political and economic pressures influence stock funding outcomes in the 1990's, in ways which differed from those of the 1980's.

Our analysis also focused on flow funding patterns, or the rate at which public sector employers actually contribute what they are required to each year. While flow funding practices during the late 1980's seemed adequate on average, there were still wide variations in behavior. The good news is that we cannot reject the hypothesis that marginal increases in required contributions were usually fully funded. On the other hand, pension funding "habits" seemed to persist among public sector employers, and not all public employers fully funded their current

obligations. Further, we found that fiscal pressure caused some public employers to reduce their annual contributions below required levels, and the recent economic decline could subject public pensions to increased pressures. We also found that growth in employee unionization reduced flow funding, ceteris paribus.

Finally, there was some evidence of compensating wage differentials; that is, if the promised pension benefit rose by a dollar per year, and this increase were fully funded, salaries would probably fall by about 50 cents per year. This effect confirms that an important response to funding public pension promises is reflected in lower public sector employee wages, a result not surprising in light of other studies finding partial capitalization of local fiscal conditions.[31] Research to further disentangle these and other state-specific effects must await the development of panel data on public sector pension plans.

[31]Capitalization patterns in the non-pension case are discussed by Gyourko and Tracy (1989).

**Table 1.**
**Public Sector Pension Plan Financial Data:**
**Assets, Obligations and Stock Funding**

| | Mean | St. Dev. |
|---|---|---|
| OBLIGATIONS (million $): | | |
| 1. Actuarial accrued liablility (AAL) | 5519.99 | 6723.39 |
| 2. Reported pension benefit obligation (PBO) | 5884.93 | 5760.21 |
| ASSETS (million $): | | |
| 3. Market asset value | 4940.11 | 4814.08 |
| STOCK FUNDING RATIO MEASURES (%): | | |
| 4. Median stock funding ratio across plans (Using assets at market value and PBO) | 0.91 | |
| 5. Ratio of Line 3 to Line 2 | 0.84 | |

Source: Computed by authors from NASRA/NCTR data

**Table 2.**
**Earnings Growth and Investment Return Assumptions Used in Computing Public Pension Plan Liabilities**

| | Mean | St. Dev. |
|---|---|---|
| 1. Wage growth assumption (WDOT) | 5.63% | 1.44 |
| 2. Investment returns assumption (ROR) | 7.61% | 0.64 |
| 3. Implicit real discount rate (Spread) | 1.98% | 1.44 |

Source: Computed by authors from NASRA/NCTR data

**Table 3.**
**Public Pension Plan Flow Funding Patterns**

| | Mean | St. Dev. |
|---|---|---|
| 1. Required annual pension contribution per worker [Req] | $2316 | 1754 |
| 2. Actual annual contribution per worker [Act] | $2069 | 1450 |
| 3. Median flow funding ratio across plans | 1.00 | |
| 4. Ratio of line 2 to line 1 | 0.89 | |

Source: Computed by authors from NASRA/NCTR data

**Table 4.**
**Variable Definitions**

| | | Variable Mean |
|---|---|---|
| Endogenous Variables: | | |
| Act | Required employer pension fund contribution per worker ($/year) | 2069 |
| Req | Actual employer pension fund contribution per worker ($/year) | 2316 |
| Avepay | Annual average salary of public sector workers in state ($/year) | 22049 |
| Exogenous Variables: | | |
| Stock | Ratio of pension fund assets (valued at market) to pension benefit obligation (%) | 90.02 |
| Union | Fraction of public sector workers covered by a collective bargaining agreement (%) | 33.80 |
| Unempd | Average unemployment rate in last two years minus the average unemployment rate over previous five years (%) | -1.92 |
| ROR | Assumed rate of return on pension fund assets (%) | 7.61 |
| Wdot | Salary growth rate assumed in calculating $R_i$ (%) | 5.63 |
| Ben% | Benefit credit percent per year of service (%) | 1.75 |
| $W_a$ | Opportunity wage: average salary of private service-sector workers ($/year) | 18187 |
| SLTplan | Indicator of plan covering state, local and teacher employees | 0.38 |
| Tchrplan | Indicator of plan covering teachers only | 0.33 |
| Rtowk | Indicator of state right to work law | 0.36 |
| Dembyvt | Fraction of voters voting Democratic in 1984 election | 43.47 |
| AFLCIO | AFLCIO voting record rating of state senators | 58.52 |

Note: For a full discussion of variable sources and descriptive statistics see Appendix 1.

**Table 5.**
**Determinants of Actual and Required Public Pension Contributions, and Pay**
(2SLS, s.e. in parens)

| | Act (1) | Req (2) | Avepay (3) |
|---|---|---|---|
| Act | | | -4.99** (2.53) |
| Req | 0.94*** (0.13) | | 4.50*** (1.93) |
| Avepay | | 0.24*** (0.04) | |
| Stock | 12.99** (6.05) | -13.20** (7.13) | |
| Union | -11.06** (5.00) | | 49.32* (33.55) |
| Unempd | -119.84* (83.67) | | |
| ROR | | -423.19* (281.90) | |
| Wdot | | 427.02*** (104.83) | |
| Ben% | | 710.49* (442.06) | |
| $W_a$ | | | 0.85** (0.40) |
| N | 42 | 42 | 42 |
| $R^2$ | 0.68 | 0.72 | 0.48 |

Notes: *** = Significant at .01 level, one-tailed test
** = Significant at .05 level, one-tailed test on all coefficients except on Union in eq. (1)
* = Significant at .10 level, one-tailed test

**Table 6.**
**Augmented Model of Contributions and Pay**
(2SLS, s.e. in parens)

| | Act (1) | Req (2) | Ave (3) |
|---|---|---|---|
| Act | | | -2.31** (1.34) |
| Req | 0.94*** (0.15) | | 3.06*** (1.15) |
| Avepay | | 0.23*** (0.04) | |
| Stock | 8.50* (6.28) | -14.34** (6.86) | |
| Union | -14.29*** (5.08) | | 54.36** (24.93) |
| Unempd | -28.37 (104.46) | | |
| ROR | | -374.17* (269.98) | |
| Wdot | | 420.34*** (103.05) | |
| Ben% | | 735.88** (434.89) | |
| $W_a$ | | | 0.59** (0.30) |
| SLTPlan | 220.73 (380.40) | | |
| Tchrplan | -280.33 (379.19) | | |
| Rtowk | 35.37 (375.75) | | |
| Dembyvt | 32.23 (27.86) | | |
| AFLCIO | 7.70 (5.35) | | |
| N | 42 | 42 | 42 |
| $R^2$ | 0.75 | 0.73 | 0.60 |

Notes: *** = Significant at .01 level, one-tailed test
** = Significant at .05 level, one-tailed test on all coefficients except on Union in eq. (1)
* = Significant at .10 level, one-tailed test

**Table 7.**
**Model of Actual and Required Public Pension Contributions, and Pay, with Union Interaction Term**
(2SLS, s.e. in parens)

| | Act (1) | Req (2) | Avepay (3) |
|---|---|---|---|
| Act | | | -5.47** (2.50) |
| Req | 0.90** (0.12) | | 5.03** (1.81) |
| Avepay | | 0.25** (0.04) | |
| Stock | 13.34** (6.17) | -12.53* (7.05) | |
| Union | -16.63** (7.84) | | 42.07 (32.63) |
| Unempd | 2.48 (124.75) | | |
| Union*Unempd | -3.44 (2.81) | | |
| ROR | | -452.40 (277.60) | |
| Wdot | | 431.00** (105.58) | |
| Ben% | | 695.37 (445.52) | |
| $W_a$ | | | 0.83** (0.41) |
| N | 42 | 42 | 42 |
| $R^2$ | 0.70 | 0.73 | 0.49 |

Notes: *** = Significant at .01 level, one-tailed test
** = Significant at .05 level, one-tailed test on all coefficients except on Union in eq. (1)
* = Significant at .10 level, one-tailed test

Appendix 1: Data Appendix

The primary data source for public sector pension plans used in this paper is a compilation of pension data collected by the National Association of State Retirement Administrators (NASRA) and National Council on Teacher Retirement (NCTR) entitled "Survey of Systems 1989". This NASRA/NCTR survey consists of a nine-part questionnaire completed by pension plan administrators containing descriptive data on plan administration, active and retired member information, evidence on actuarial and investment performance, and data on assets, liabilities, actual and required flow funding, and the wage growth and investment performance assumptions for each plan. Financial data were provided in the NASRA/NCTR survey for a total of 60 public sector pension plans; complete information on all variables needed for empirical analysis was available for 42 of these plans, which together covered a total of 4.7 million employees in 31 states. These plans were of three types, teacher-only pension systems (33 percent), plans with only state and local workers (29 percent), and hybrid plans combining state and local workers with teachers (38 percent).

The NASRA/NCTR survey contained most, but not all, the information needed to conduct our analysis, and various other sources were consulted for additional data (which were then merged by plan to the basic survey responses). Political variables included the fraction of the state's population voting Democratic in the last presidential election (Dembyvt), taken from US Bureau of the Census (1989). The AFL-CIO political rating awarded to a state's U.S. Senators (AFLCIO) was drawn from Congressional Quarterly Almanac (1988). An indicator of whether a state had a right-to-work law (Rtowk) was taken from Ehrenberg and Smith (1988). State-specific data also included measures of deviations in state unemployment levels. These were derived by differencing the average unemployment rates in 1987-88 from the average unemployment rate during the period 1980-85 (US Bureau of the Census, 1989). Pay levels for private service-sector workers, used as a measure of the opportunity wage, appear in US Department of Labor (1989).

The NASRA/NCTR survey does not contain one additional piece of information needed to conduct our analysis: the fraction of the active pension-covered employees unionized. Telephone calls were made to each of the pension plan sponsors in the survey (and other relevant parties as necessary) to ascertain the fraction of members covered by collective bargaining. Since some states legislatively prohibit collective bargaining among public sector employees, the percent covered by collectively-bargained contracts ranges in our data set from 0 to 100%, with the average being 40 percent.

Appendix 2: Alternative Valuation Methods for Pension Liabilities

In this appendix we investigate the effects of changing key assumptions underlying estimates of each plan's PBO. These adjustments are helpful both in making plan liability figures more comparable and in shedding light on whether assumptions were manipulated to make pension underfunding more difficult to detect.

In particular, we evaluate the effects of changing discount rates, salary growth projections, and assumptions regarding worker service and longevity, to show the sensitivity of PBO estimates to varying assumptions. Two valuation methodologies were employed by us to correct for different underlying assumptions: one was proposed by Ippolito (1986) in a study of private sector plan liabilities, and a second relied on our own calculations of benefit present values. In both cases, a crucial role was played by the reported interest rate in adjusting the future value of the benefits stream, and both methods converted each plan's reported liabilities to adjusted by employing a common discount rate.

Ippolito's adjustment method, termed PBO-1 in Table A1, posits a separate conversion factor for active and retired workers and then combines the two with weights representing the fraction of each type of participant in the plan (Ippolito 1988, p. 65). This adjustment method assumes that the typical retiree has 12.49 years remaining in which to collect the pension annuity, and that the typical active worker has completed 60 percent of his potential service. On the assumption that $i^r$ is the reported discount rate which varies from one plan to the next, and $i^e$ is the common economic discount rate, the two formulas are as follows:

for retirees: (Economic liability/Reported liability) $= \exp [-.057 (i^e - i^r)]$; and (A1)

for actives: (Economic liability/Reported liability) $= \exp [-.077 (i^e - i^r)]$. (A2)

Thus, for example, liabilities calculated for actives at a 6 percent discount rate will be 73 percent as large as they would have been at a 2 percent rate. Of course the conversion formula is only an approximation to the precise actuarial calculation required to re-value each plan's liability figures, but as Ippolito says, "as a first order of magnitude it will reveal true economic pension liabilities"(p. 65).

The second method of adjusting reported liabilities allows us to vary both the discount rate assumption and, for active workers, the assumptions about salary growth and the number of years remaining until retirement. The employer's total pension liabilities (TPL) can be shown to equal the number of employees (J) times the present value of the annuity needed as of retirement age ($A_j$) to finance retirement benefits over the remaining lifetime (T), given the number of years until active members separate (n) and their years of service at retirement age (m). This is expressed as:

$$TPL = J * A_j / (1+i^e)^n = J * ß * [ (1 + g)^n / (1+ i^e )^n ] * \alpha_j \qquad (A3)$$

where $i^e$ is the common economic discount rate; $\alpha_j = 1/i^e * \{ 1- [ 1 / (1+i^e)^{T-m} ] \}$; ß is the pension benefit a retiree would received based on current salary levels, and g is the projected future salary growth rate. The NASRA/NCTR data set reports each public plan's interest rate and projected salary growth rate, which we then vary using equation (A3) along with different assumptions for T, m, and n. Three calculations that adjust reported PBO figures in this manner are:

PBO-2: assumes g=5%, $i^e$=7%, m=n=23, T=37.

PBO-3: assumes g=5%, $i^e$=7%, m=23, n=18, T=37.

PBO-4: assumes g=5%, $i^e$=8%, m=n=23, T=37.

In other words, the PBO-2 measure assumes that the "spread" (or the real discount rate) is 2%, the average public sector worker is around 40 years old, has 23 years of work remaining before retirement, and has a life expectancy of 37 years. Low public sector quit rates are reflected in the assumption that m=n, but this assumption is altered in PBO-3, where n is set to m-5 = 18. The final measure, PBO-4, tests the sensitivity of the liability measure to an assumed spread of 3% rather than 2%.

Table A1 reports these five measures of public employee pension plan obligations, using adjusted wage growth, investment return, and turnover assumptions. Line 1 recapitulates the reported PBO described in the text, while the next four lines present alternative obligation measures PBO-1 though PBO-4. These five PBO measures are used to compute alternative stock funding ratios, which were then used in alternative versions of the basic three-equation model

presented in the text. In no case was the pattern of coefficient estimates very different (results available from the authors on request). The similarity in results probably results from the fact that all of the generated PBO measures have a relatively similar distribution to the one reported by the pension systems in our sample.

**Appendix Table A1.**
**Reported versus Adjusted Stock Funding Patterns**

| | Mean | St. Dev. |
|---|---|---|
| Measures of Pension Obligations | | |
| 1. Reported PBO | 5884.93 | 5760.21 |
| 2. PBO-1 | 5867.38 | 5691.84 |
| 3. PBO-2 | 5911.08 | 5731.53 |
| 4. PBO-3 | 5276.35 | 5108.83 |
| 5. PBO-4 | 6090.84 | 5965.05 |
| Alternative Stock Funding Ratios (Using market asset values) | | |
| 6. Using reported PBO | 90.02 | 23.90 |
| 7. Using PBO-1 | 86.31 | 22.66 |
| 8. Using PBO-2 | 91.82 | 28.70 |
| 9. Using PBO-3 | 90.11 | 26.47 |
| 10. Using PBO-4 | 101.79 | 31.51 |

NOTE:
PBO-1: Ippolito correction factor
PBO-2: Wage growth=5%, invst. return=7%, m=n=23, T=37
PBO-3: Wage growth=5%, invst. return=7%, n=18, m=23, T=37
PBO-4: Wage growth=5%, invst. return=8%, m=n=23, T=37

Source: Computed by authors using NASRA/NCTR data (see Appendix 2)

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