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ABSTRACT

The extent, causes, and possible consequences of underfunded teacher pensions are examined. The analysis is divided into two separate studies. Essay I, "Appraising the Funding Status of Teacher Pensions: An Econometric Approach," examines the funding status of teacher pension plans for the 50 states and for selected localities for the decade 1971-1980. Based on a pension underfunding equation, the results reveal that the dollar value of plan underfundings have risen by over 50 percent in the average state from 1971 to 1980. Essay II, "Funding Teacher Pensions or Does Paul Rob Peter to Pay Mary?" seeks to answer the question of why some state plans are well funded and others are poorly funded. The analysis examines two central determinants of underfundings: pension benefits and pension contributions. Three models of state pension policymaking are discussed. Results indicate that there is a slow downward drift in the level of underfundings, and there seems to be no national teacher pension crisis on the fiscal horizon. However, the system does deserve continued scrutiny over the next two decades. (49 references) (SI)

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PROJECT REPORT

FOR

THE FINANCING OF PUBLIC TEACHERS PENSIONS: CAUSES, CONSEQUENCES AND PUBLIC POLICY

BY

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Executive Summary for "The Financing of Public Teacher Pensions: Causes, Consequences and Public Policy"

by

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In the last decade, the funding status of public employee pensions has become an issue of increasing public concern. A 1978 Congressional survey of public employee pension plans indicated that in 1976 approximately 90% of all state and local plans had some level of underfunding. Estimates of the level of underfunding for individual plans shows funding status to vary from almost fully-furded to underfundings of $2000 per resident or more in Alaska, Nevada, and South Carolina. Aggregate estimates show the state and local sector as a whole to have pension underfundings of approximately $500 per capita by the late 1970's. Underfunding occurs because promised pensions to current and future system retirees are not backed by an adequate volume of accumulated assets and planned contributions. When an underfunding occurs, either employee pensions benefits must be reduced, or public services must be curtailed, or taxpayer and current employee contributions must be increased.

This research examines the extent, causes, and possible consequences of underfunded teacher pensions. The analysis is divided into two separate studies. Essay I, "Appraising the Funding Status of Teacher Pensions: An Econometric Approach," examines the funding status of teacher pension plans for the fifty states and for selected localities for the decade, 1971-1980. A p on underfunding equation based upon actuarial principles is specified and estimated using a sample of pension plans for which actuarially sound measures of underfundings are available. The econometrically-estimated pension equation is then used to "predict" underfundings for each state and local pension plan for each year for which full pension plan data are available. The results reveal that the real dollar value of plan underfundings has risen by over 50 percent in the average state from 1971-1980. In 1971, the average level of pension underfunding for state pension plans involving teachers was \$190/taxpayer or \$7912/plan member (measured in 1967 dollars); by 1980 underfundings had risen to \$314/taxpayer and \$11324/plan member (again, in 1967 dollars). For local teacher plans the record is no better. Underfundings rose from \$117/taxpayer or \$10067/plan member in 1974 to \$155/taxpayer or \$11253/plan member by 1980 (again, in 1967 dollars). While the average level of underfunding has been growing, not all teacher plans are poorly funded. This analysis also provides state-by-state and city-by-city estimates of the plan underfundings. In 1980, the ten worst plans had an average level of underfundings of \$652 per resident (1967 dollars); the ten best funded plans had underfundings of only \$84 per resident. Alaska, Hawaii, Idaho, Maine, Massachusetts, Mississippi, West Virginia, and Wyoming were consistently among the worst funded state plans; Minnesota, Missouri, New Hampshire, Texas, and Wisconsin were always among the ten best funded plans. Among local teacher pension plans, the five worst funded plans had an average underfunding of \$428 per resident in 1980; the five best funded local plans actually had small surpluses (an average surplus of \$33/resident). The worst funded local plans were found in the older, more industrialized cities in our sample (New York City, Detroit, Chicago) and in Washington, D.C.

Essay II, "Funding Teacher Pensions <u>or</u> Does Paul Rob Peter to Pay Mary?," seeks to answer the question of why some state plans are well-funded and others are poorly funded. The analysis examines the determinants of the two central determinants of underfundings: pension benefits and pension contributions. Benefits are set by state pension policy and by the growth in teacher wages. Contributions are also determined by state pension policy and teacher wages (since teachers are often required to contribute a fixed percent of wages to their plans), but, importantly, contributions are also decided by state legislatures as part of the annual budget process. This study formally specifies and then econometrically estimates three interlocking models of state pension policy-making: (i) a model of state pension board policy which sets supplemental benefits, supplemental contributions, and plan investment policy; (ii) a model of state legislative decision-making which sets the states own level of contributions to the pension plan; and (iii) a model of local school district wage and employment policy for teachers, as the teacher wage bill will be an important determinant of teachers' pension benefits and teachers' pension contributions. The analysis reveals a fiscal system suffering from myopia. The empirical results show a clear bias in favor of current taxpayers and current teachers, to the potential detriment of future taxpayers and future retirees. Most states now legally guarantee their teachers' pensions, however. Thus it will be future taxpayers or their children who suffer. Of the various public policy measures considered--improved investment performance, more federal-to-state aid for education, a federal pension bail-out, or federal regulation of pension funding--only the federal regulation of increased contributions helps matters very much.

Are we on a collision course with bankruptcy? The answer is no--at least, for most state teacher pension plans. Based on the estimated structural model of state pension policy, simulations of the future path of plan underfundings to the year 2000 are developed for the 48 (mainland) state plans in the study. The general pattern is a slow downward drift in the level of underfundings. If the pension history of the 1970's seemed so bleak

(Essay I), why does the future look so promising? The answer lies in the unique expansion of pension benefits in the 1970's with the introduction of cost-of-living provisions (COLA's) and the liberalization of plan vesting (the number of years of service required before the pension is guaranteed). With those changes now behind us, benefit growth is modest and contributions begin to make a dent in the past levels of underfundings.

While there appears to be no national teacher pension crisis on our fiscal horizon, the system does deserve continued scrutiny over the next two decades. First, these unfunded liabilities do not fall to zero, and teacher pensions are only one form of public debt within our state and local system. Other public employee pensions are underfunded. Our major cities, at least, often run sizeable short-term deficits. And there is a growing concern over the status of state-local infra-structures. By themselves, teacher pensions will not cause a state-local fiscal crisis, but they may be part of one. Second, while the simulations reported in Essay II are based upon realistic income and demographic projections, a major new baby boom in the 1990's may place increasing strain on the current accounts budget of public education and force a significant postponement of pension funding. Simulations assuming a new baby boom beginning in 1990 show average underfundings begin to rise again. Finally, while the nation as a whole shows a favorable downward trend in underfundings, not all states perform well. South Carolina, Maine, Idaho, Virginia, Louisiana, and West Virginia are all projected to have underfunding levels which might be considered dangerously high (i.e., 10% of projected real income in the year 2000). Seven other states--Indiana, Iowa, Massachusetts, New Mexico, North Carolina, Pennsylvania, and South Dakota--are projected to have underfundings greater than $250/taxpayer in the year 2000. These thirteen states, at least, deserve close monitoring.

ESSAY I

"APPRAISING THE FUNDING STATUS OF TEACHER PENSIONS: AN ECONOMETRIC APPROACH"

Appraising the Funding Status of Teacher Pensions: An Econometric Approach

by

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November, 1985

Abstract: The financing of public employee pensions has become an issue of growing public concern. This paper examines the funding status of teacher pension plans for the fifty states and for selected localities for the decade, 1971-1980. A pension underfunding equation based upon actuarial principles is specified and estimated using a sample of pension plans for which actuarially sound measures of underfundings are available. The econometrically-estimated pension equation is then used to "predict" underfundings for each state and local pension plan for each year for which full pension plan data are available. The results reveal that the real dollar value of plan underfundings have risen by over 50% in the average state from 1971 - 1980.

Forthcoming

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Appraising the Funding Status of Teachers' Pensions:
An Econometric Approach

by

Robert P. Inman*

The financing of public employee pensions has become an issue of growing public concern. While the number of actual defaults are few, numerous recent estimates by actuaries and economists suggest that there may be significant funding deficits in our public employee retirement systems.[1] Underfunding occurs because promised pensions to current and future system retirees are not backed by an adequate volume of accumulated assets and planned contributions. When an underfunding occurs, either employee pensions benefits must be reduced, or public services must be curtailed, or taxpayer and current employee contributions must be increased.

When the level of underfunding is small and the pension system is young (a low current retiree/membership ratio) such adjustments in benefits, services, or contributions will be small and have few serious consequences. For mature systems with large underfundings, however, the consequences can be significant. As retirees claim their promised pensions and the unfunded liability falls due, either taxes and contributions must rise, or services decline, or pensions must go unpaid. If the liability is large enough, it may even precipitate a fiscal crisis in the public budget as a whole.[2] The one possible "winner" when public pensions go unfunded are earlier taxpayers who have left the jurisdiction and who did not contribute to the pension fund when the now retired public employees were providing services. Once we realize that public workers are paid a wage *and* a pension for their efforts, it is clear that these prior taxpayers have not paid the full cost of the labor services received. Unfunded pensions can act as a *de facto* subsidy from the current residents and/or retirees to the prior taxpayers who long ago may have left the state or locality. Like most unintended subsidies, it may lead to a serious misallocation of public resources (see Inman (1982)). This paper seeks to identify the extent of pension underfundings for a major class of public employees--teachers--as a first step to avoiding these unhappy consequences.

Section II outlines the methodology used to estimate teacher pension underfundings. The approach is econometric, rather than actuarial. The analysis seeks to detail recent trends in pension funding for the major state and local teacher and teacher-related pension plans; a detailed actuarial analysis of each plan for each year is not possible. I have adopted an alternative research strategy. I first specify--using the theoretical work of Ehrenberg (1980) and Winkelvoss (1977)--and then econometrically estimate--using the actuarially-based measures of underfunding in Arnold (1981)--a pension underfunding equation for state-local teacher and teacher-related pensions plans. This resulting equation correlates underfundings to commonly observed financial statistics and plan attributes. In Section III, the estimated underfunding model is used to predict underfundings for major state-local teacher plans for the period 1971-80, given the plans' actual financial data and plan attributes for those years. The concluding Section IV summarizes the results and comments briefly on their policy implications.

II. An Econometric Approach to Estimating Pension Underfundings

A public pension is considered underfunded when assets currently held by the pension plan plus the discounted present value of future employee and employer (i.e., taxpayer) contributions are less than the discounted present value of all promised annuity (i.e., annual pension benefits) payments. Public employee pensions are defined benefit pensions in which workers are promised a fixed fraction, called the replacement rate, of some (usually three to five year) average of their pre-retirement income. This fraction is calculated as the product of the annual benefit accrual rate (typically .02/year) times the number of years in service. For example, employees with 25 years of service will receive 50 percent (25 × .02) of their average pre-retirement income as their retirement annuity. To fund this annuity, the employer-taxpayers may either wait until the employee retires and then pay taxes at that time to cover each year's promised pension (the pay-as-you-go strategy), or the taxpayers can set aside a smaller nominal sum each year in a pension account to earn interest so that the accumulated principal and interest will be sufficient to cover the promised annuity stream when the workers retire (the full funding strategy).[3]

To employ the full funding strategy it is necessary to estimate the number of workers who will retire in each future year, how long they will live once retired, their average pre-retirement wage, and the length of job tenure before retirement. This information is sufficient to calculate the future stream of promised annuities. Given an estimate of market interest rates, the required annual contribution can be calculated which will be sufficient to fully fund these future pension obligations. These annual contributions are called the normal costs of the pension plan. Typically, both taxpayers and public employees will contribute to meet normal costs; contributions are generally calculated as a percent of the current public employee wagebill (e.g., 10 percent of wages). This percentage is called the contribution rate. If past contributions which are accumulating as plan assets fall short of the full-funding levels, an unfunded pension liability will arise. To cover these past shortfalls--often called the plan's supplemental liability--added contributions above normal costs are needed. These additional contributions are called the plan's supplemental costs and are usually calculated so as to cover the plan's unfunded liability gradually over a thirty to forty year period. It is our task here to approximate these funded pensions liabilities for the major pension plans which support retired teachers using a consistent methodology which will permit across state and across time comparisons.

Clearly it is not possible to do a detailed actuarial analysis of each state pension plan for each sample year. I have therefore developed an approximation which builds upon the conceptual work of Ehrenberg (1980) and Winklevoss (1977) and the careful acturial analysis of state plans for the fiscal year 1978-79 by Arnold (1981). First, a specification of pension underfundings is developed for a typical defined-benefit public employee pension plan. Second, the specification is generalized to allow for the unique features of individual pension plans. Third, the actuarial parameters of the underfunding model are estimated econ[illegible]ically; the data base employed is Arnold's estimates of pension underfundings supplemented by plan characteristics abstracted from state pension legislation. Fourth, using the statistically preferred underfunding model and available pension plan data, predicted levels of plan underfundings are calculated for each state and for selected local plans for each year for the decade, 1971-1980.

At any point in time, a typical public employee pension plan's liabilities (L) will equal the difference between the discounted present value of promised benefits (PVB) less the discounted present value of all anticipated future contributions from taxpayers and employees (PVC): L = PVB - PVC. The liability not offset by existing plan assets (A) is called the plan's unfunded liability (U): U = L - A. Our task is to approximate U. To do so for a typical pension plan, I shall assume: (i) a constant flow of (n) new employees each period who exhibit a constant quit rate (q) and a constant mortality rate (δ) over an employment period R years; (ii) a fixed contribution rate (c) of wages; (iii) an annual growth in employee wages of g + h, where g reflects growth due to worker experience and h reflects the inflation growth in wages; (iv) a constant and uniform replacement rate (b) which when multiplied by the worker's final wage (w^F) defines the worker's annual pension; and (v) a constant cost of living adjustment (COLA) to the annual pension of rate (θ) times the inflation rate (p). The analysis will discount all nominal benefits and contributions at a nominal interest rate (r). Under these assumptions:

$$(1) \qquad PVB = \int_0^\infty B(t)e^{-rt}dt \quad \text{and} \quad PVC = \int_0^\infty C(t)e^{-rt}dt ,$$

where B(t) equals aggregate pension benefits paid in year t and C(t) equals aggregate contributions received in year t. The current period date of evaluation is denoted by the index 0 and an infinite plan horizon is assumed.

The future wage of any worker at time v, who has been in the plan for s years, will be:

$$(2) \qquad w(s, v) = w_0 e^{hv} e^{gs} ,$$

where w_0 is the initial period wage. The final retirement wage of a worker who started in the system at time (v - s) and has been in the system for R years will be:

$$(3) \qquad w^F(s, v) = [w_0 e^{(v-s)h}] e^{hR} e^{gR} = w_0 e^{gR} e^{h(v-s+R)}$$

PVC is approximated in two steps. First, contributions into the system at any time v are estimated by:

(4) $$C(v) = \int_0^R cw(s, v)ne^{-(q+\delta)s}ds ,$$

where c is the fixed contribution rate from wages, w(s, v) is the wage of a worker with s years of experience in year v, and $ne^{-(q+\delta)s}$ is the number of workers of s years of experience who have survived (quits and mortality) to time v. Contributions are aggregate over all workers from those just starting (s = 0) to those just retiring (s = R). Second, the present value of these annual contributions are calculated by discounting by r summed over all time:

(5) $$PVC = \int_0^\infty C(v)e^{-rv}dv .$$

Solving equations (4) and (5) gives the following specifications for PVC:

(6) $$PVC = \frac{(cw_0n)(1 - e^{-(q+\delta-g)R})}{(r - h)(q + \delta - g)} .$$

PVB is also approximated in two steps. First, total retirement benefits paid in year v is estimated by:

(7) $$B(v) = \int_R^\infty bw^F(s, v)e^{\theta p(s-R)}ne^{-(q+\delta)R}e^{-\delta(s-R)}ds ,$$

where b is the replacement rate applied to the final wages of workers of age s in year v adjusted for inflation protection in the post-retirement years at the rate $\theta p(w^F(s, v)e^{\theta p(s-R)}$, s > R). Benefits paid in year v are the sum of benefits paid to all workers who have survived to retirement and are still alive ($ne^{-(q+\delta)R}e^{-\delta(s-R)}$). Second, the present value of these annual benefit payments are calculated by discounting at r over all time:

(8) $$PVB = \int_0^{\infty} B(v)e^{-rv}dv \ .$$

Solving equations (7) and (8) gives the following specifications for PVB:

(9) $$PVB = \frac{(bw_0n)e^{(g-(q+\delta))R}}{(h + \delta - \theta\rho)(r-h)} \ .$$

The unfunded liability of a pension plan is defined as U = L - A. Noting that L = PVB - PVC, U can now be specified as:

(10) $$U = \frac{(bw_0n)e^{(g-(q+\delta))R}}{(r - h)(h + \delta - \theta p)} - \frac{c(w_0n)(1 - e^{-(q+\delta)R})}{(r - h)(q + \delta - g)} - A$$

using the definitions of PVC and PVB in equations (6) and (9) respectively. Equation (10) can be simplified to:

(10') $$U = \left(\frac{1}{r - h}\right)B_0 - \left(\frac{\Delta}{r - h}\right)(c/b)B_0 - A \ ,$$

where,

$$B_0 = (bw_0n)e^{(g-(q+\delta))R}/(h + \delta - \theta p) \ ,$$

and measures benefits paid to today's retirees,[4] and where Δ defined as:

$$\Delta = \frac{(h + \delta - \theta p)}{(q + \delta - g)} \left(e^{(q+\delta-g)R} - 1\right) \ ,$$

and (r - h) are "actuarial constants" dependent upon actuarial assumptions. Equation (10') defines the level of today's (period 0) unfunded liability for a typical public employee pension plan.

To move from a typical to an actual pension plan requires a specification of plan-specific features. These include the level of benefits paid today (B_0), the plan's actual contribution rate (c) and replacement rate (b), the level of the plan's accumulated assets (A), the plan's rate of inflation protection (θ), and the plan's number of years of service before benefits are paid (R).[5] The other parameters of (10')--r, h, δ, q, g, and p--are actuarial parameters and, for the purposes of comparing plan underfundings, are assumed to be equal across pension plans.[6]

In fact, equation (10') may not capture all the plan-specific features which distinguish one teacher pension system from another. Assets, for example, may be held in different portfolios which earn different rates of return. Contributions may vary in some years from the anticipated rate c because of short-term political decisions or unexpected fluctuations in state revenues or non-pension expenditures. In addition, the relationship in (10') is based on the assumption that the plan is in a steady-state; in fact, the plan may be in an expansion or contraction phase. Finally, teacher-only pension plans may be differentially favored or disfavored in plan funding or portfolio performance compared to those pension plans which include teachers with all other public employees.

These observations suggest that the basic model in (10') should be extended to include a fixed component dependent upon plan type ($\phi = \phi_0 + \phi_1 T$, where T = 1 if teacher only plan, 0 otherwise), variations in the estimated actuarial constants because of variable plan growth,[7] and finally, a stochastic component related to the level of plan assets ($\epsilon = \gamma A$, where $E(\epsilon) = AE(\gamma) = 0$, and $\sigma_\epsilon^2 = A^2\sigma_\gamma^2$). Equation (11) allows for these extensions:

$$(11) \qquad U = \phi_0 + \phi_1 T + \phi_2 m + \left(\frac{\mu(m)}{r - h}\right)B_0 + \left(\frac{-\Delta\mu(m)}{r - h}\right)(c/b)(B_0) - A + \gamma A \,,$$

where m is the recent rate of growth in plan membership. Dividing by A and rearranging slightly gives the specification most suitable for estimation:

$$(11') \qquad (1 + U/A) = \phi_0(1/A) + \phi_1(T/A) + \phi_2(m/A) + (\mu(m)/r - h)(B_0/A) + (-\Delta\mu(m)/r - h)(c/b)(B_0/A) + \gamma \,.$$

To estimate the effects of plan growth on the actuarial parameters (r - h) and Δ, a simple interactive specification of the form $\mu(m) = 1 + \mu m$ will be tried; when $\mu = 0$ the actuarial parameters are not significantly affected by the observed variations in m. Finally, as Δ varies across pension plans as years to retirement (R) and COLA protection ($\theta\rho$) vary, I have approximated the steady-state specification of Δ (see above at equation 10') by the second-order Taylor series expansion about a fixed $\bar{\Delta}$:

$$\Delta = \bar{\Delta} + \Delta_1(\theta p - \bar{\theta}p) + \Delta_2(R - \bar{R}) + \Delta_3(\theta p - \bar{\theta}p)(R - \bar{R}) + \Delta_4(\theta p - \bar{\theta}p)^2 + \Delta_5(R - \bar{R})^2 \,.$$

Substituting this approximation for Δ into (11') gives the final specification used in the econometric analysis.[8]

Table 1 summarizes the econometric estimation of the underfunding model estimating from a sample of thirty-seven pension plans for the fiscal year 1978-79 for which full underfunding and plan attribute data were available.[9]

Pension underfundings (variable U) are from Arnold (1981) and measure plan continuation liability, the appropriate measure of U under the politically plausible assumption that existing pensions to current employees will not be terminated. (See Bulow (1982) for arguments which favor using plan termination liability; Bulow, however, is focusing on private pensions.) Data for plan assets (A), benefits (B), and membership (to calculate m) are from the Census of Government publication, Finances of State and Local Employee Retirement Systems (1978-79). Data for each plan's required contribution (c), rate, benefit replacement rate (b), years of service (R), and COLA (θ) were obtained from state pension laws. In calculating the benefit replacement rate, allowance was made for whether the plan was, or was not, integrated into social security. If full or partial integration is allowed, I assumed social security replaced 27 percent of employees' pre-retirement wages when calculating b.[10] In states which do not explicitly allow for COLA protection, but do grant periodic adjustments, I followed Arnold's (1981) assumption and set $\theta = .5$. In calculating years of service (R), I assumed the typical teacher begins service at age 30 and works without interruption to the state's legally set age of retirement.

Equation (1) in Table 1 corresponds to the basic underfunding model of (10') above, extended to permit a stochastic error structure of the form, $\epsilon = \gamma A$. The coefficient estimates for this simple model imply values for the actuarial parameters of $(r - h) = .022$ ($= 1/45.65$) and $\Delta = 2.69$ ($= -(-122.82/45.65)$). Both numbers are plausible.

Equation (2) in Table 1 extends the basic underfunding model by permitting a "fixed effect" to underfunding of $\phi_0 + \phi_1 T + \phi_2 m$, where T = 1 if the pension plan applies to teachers only, 0 otherwise, and m is the rate of growth of plan membership from 1971 to 1980. The results reveal no significant fixed effect differences on underfundings between teacher and general pension plans. This is not surprising as most states now jointly administer teacher and general employee plans However, the level of underfundings in teacher and general plans can still differ as plan attributes--B, A, c, b, θp, and R--differ; all we observe from the "fixed effect" in equation (2) is that there is no administrative bias in favor of, or against, teacher-only plans.

We do observe an almost significant effect of recent membership growth on underfundings, however. The fixed effect of m on underfundings is positive and becomes statistically significant in later specifications. The positive effect of m on underfundings is plausible; it implies new contributions in high growth plans have lagged the new increases in liabilities. In results not reported in Table 1, I also tested for the effect of m on the actuarial constants, $(r - h)$ and Δ, as defined by estimated "slope" coefficients. Multicollinearity prevented a precise identification of the effects of m on the relevant slope coefficients; a simpler test that low growth and high growth ($m \geq .03$ per annum) plans had equal actuarial coefficients could not be rejected in the full model.[11] Thus in the work which follows only the intercept, or fixed effect, of plan growth on underfunding is considered.

Equation (3) in Table 1 introduces the Taylor series approximation for the actuarial constant, Δ. The more elaborate specification for Δ has no significant consequences for our estimate of $(r - h)$, again it equals .022. The individual coefficients of the approximation ($\bar{\Delta}, \Delta_1, \ldots, \Delta_5$) generally have plausible signs (see fn. 8 above), though they are not always precisely estimated. The implied value of Δ is again about 3 for the average sample plan. Estimated equation (4) is a simple extension of equation (3) with the *a priori* constraint that $\Delta_4 = 0$ (again see fn. 8) imposed before estimation. Equations (3) and (4) are virtually identical.

Equations (5) and (6) in Table 1 impose additional structure on the estimation in hopes of improving the model's overall predictive performance. Variables whose estimated coefficients are less than their standard errors have their coefficients constrained to be 0, first for the slope coefficients which define Δ (equation 5) and then for the slope and intercept coefficients (equation 6). As expected the R^2 adjusted for degrees of freedom ($\bar{R}^2$ in Table 1) rises with each additional restriction.

Since our central concern is the level of underfundings, the preferred pension funding equation is that equation which minimizes the standard error of estimate of the aggregate level of pension underfunding, U (assuming quadratic loss). The standard error or U (SEE (U)) for each equation for our sample is reported in Table 1. Estimated equation (6) is the preferred pension underfunding equation by the criterion of minimizing SEE (U); it will be the basis for estimating the funding status of teachers' pension plans for the period 1971-1980.

III. The Estimated Funding Status of Teachers' Pensions

Tables 2 and 3 summarize the results for the predicted funding status of U.S. teacher pension plans for the decade 1971-1980.[12] Table 2 (state plans) and Table 3 (local plans) list the means for each year for four summary measures of underfunding: (i) estimated underfundings per (state or local) resident; (ii) the ratio of estimated underfundings to total plan liability; (iii) estimated underfundings per plan member; and (iv) the ratio of estimated underfundings per resident to income per resident.

The results show a general upward trend in estimated underfundings of teachers' pensions. Average underfundings per capita measured in constant

(1967) dollars have risen by 65% in all state plans from 1971-1980 and by approximately 33% for the full sample of local plans from 1974 to 1980. As a general rule-of-thumb public employee pensions are considered well funded when the underfunding to liability ratio (or alternatively, the asset to liability ratio) is less than .20 (greater than .8); see for example, Tilove (1976). Clearly, the majority of the plans considered here do not meet this standard; the underfunding/liability ratios in Tables 2 and 3 never fall below .5. Further, the trend has been upward for all plans, rising most sharply for the full sample of local plans (1974-1980). Underfundings have also worsened from the perspective of plan members. Underfundings per member in real (1967) dollars have risen for all plan types, with teachers significantly more at risk in teacher-only plans. As a measure of plan member risk, the ratio of underfundings to a teacher's promised benefits (U/PVB not reported in Tables 2 and 3) averaged about sixty percent in 1980 and was often as high as seventy percent in some plans.[13]

As taxpayers are ultimately responsible for unfunded pension liabilities, the ratio of underfundings to resident income is also of interest. Growing public debt need not be a serious long-run economic threat if taxpayer incomes grow faster than the public debt and the ratio of debt to income falls over time (Feldstein, 1976). As Tables 2 and 3 make clear, this has not been the case for teacher pension underfundings; the trend is steadily upward for the full sample of plans.

While the average level of underfunding of teacher pensions is significant and growing, not all plans are poorly funded. A comparison of individual state and local plan underfundings shows a wide variance across plans.[14] The ten worst state plans have an average level of underfunding generally eight times larger than the ten best funded plans. In 1980, the ten worst plans had an average level of underfundings of $652 per resident (1967 dollars); the ten best funded plans had underfundings of only $84 per resident. Alaska, Hawaii, Idaho, Maine, Massachusetts, Mississippi, West Virginia, and Wyoming were consistently among the worst funded state plans; Minnesota, Missouri, New Hampshire, Texas, and Wisconsin were always among the ten best funded plans. Among local teacher pension plans, the five worst funded plans had an average underfunding of $428 per resident in 1980; the five best funded local plans actually had small surpluses (an average surplus of $33/resident). The worst funded local plans were found in the older, more industrialized cities in our sample (New York City, Detroit, Chicago) and in Washington, D.C.

It is important to understand the reasons for such variance in plan underfundings. An examination of individual plans reveals that the major cause of the growth in underfundings is from a benefit expansion, not a cut-back in contributions. Real contributions have kept pace with real wage growth; that is, contribution rates, c, have remained stable. The benefit explosion has come from two sources: (1) a modest increase over the decade in the annual benefit accrual rate from an average of .015 per year of service in 1971 to .018 per year of service in 1980, and, more importantly, (2) the wide extension of COLA protection to retirees. The average annual rate of nominal benefit increases for retirees to protect against inflation rose from .021 (= θp) in 1971 to average annual rate of benefit increase of .048 (= θp) in 1980. For this sample those state and local plans which have been most generous in their expansion of benefits are generally the plans which face the highest levels of underfundings.

What can be done to ease the growing burden of teacher pension underfundings? While these estimated levels of underfundings are troubling, they are not unmanageable. Most states have now adopted COLA provisions and inflation is likely to be reasonably managed in the future. The benefit explosion is probably behind us. The task before us now is to cover these past pension debts gradually and, most importantly, to insure that future promised benefits are fully funded. Three groups may be asked to pay: current teachers via benefit reductions, current taxpayers via tax increases, or school-aged children via reduced school services. In 1980, the stock of underfundings per member in the average state-local teacher-related pension plan totaled $11324 per plan member (1967 dollars) or approximately 60 percent of each current teacher's anticipated stock of pension wealth (PVB). To ask current teachers to pay the entire burden would be a considerable hardship, particularly for teachers just now nearing retirement and unable to adjust their private savings. Were taxpayers alone to cover 1980's pension debts, a one-time tax of approximately 9.9% on average resident income would be sufficient to cover past underfundings in the average state-local plan (.099 = $314.54 of underfundings/resident divided by $3172 of income/resident both measured in 1967 dollars). Were school children alone to cover 1980's debts by sacrificing school expenditures, a one-time sacrifice of $560/public school enrollee (1967 dollars) or 60 percent of that year's average expenditure per enrollee would be sufficient. Of course, gradual repayment is possible. If we amortize the average state's 1980 pension debt over 30 years at an assumed 10 percent interest rate, a 3/10's of 1 percent annual increase in resident income taxes or a 5.5 percent fall in annual school expenditures devoted to education will be required. Such adjustments will probably not constitute significant hardship, particularly if they are shared. What will create significant hardship is if we ignore these early warnings signs of growing pension debt and continue to underfund our teachers' pensions.

IV. Conclusions

The funding status of public employee pensions has become an issue of increasing public policy concern, and for good reasons. Significantly underfunded public pensions are a possible source of economic inefficiency and may have unattractive implications of economic equity as well. This paper provides one estimate of the funding status of teacher pensions in the United States and finds a potentially significant level of underfunding in the average state and local plan. Lurking behind the average performance, however, is a dispersion in funding status which is perhaps even more disturbing. Many state and local plans--generally found in older, more industrialized cities or in poorer rural states--have underfundings which exceed $500/resident, measured in 1967 dollars. A concerted effort must be made to repay this debt before it reaches crisis proportions.

A balanced strategy of gradual debt reduction is still possible. Modest tax increases (perhaps 3/10's of 1% of resident income) will cover the interest costs of past pension debt and permit gradual repayment, without requiring benefit reductions to current teachers or service cutbacks for students. But such a policy must be considered in a wider context. Underfunded teacher pensions are only one source of our nation's growing public debt. Federal government budgets, social security, federal employees' pensions. and other state-local employee pensions are all underfunded. If considered together, as they should be, the tax increases or benefits and service reductions needed to service this debt may be sizable indeed. Principles of equity may require, therefore, that not all of the burden of past public debt fall on taxpayers; current public employees and service beneficiaries (e.g., school age children) should perhaps be asked to share in these costs as well.

We should note that in one happy [illegible] of circumstances these pension underfundings will not pose an economic problem. To the extent that taxpayers and/or teachers have correctly anticipated these underfundings they will have made fully compensating adjustments in their own savings behavior in expectation of larger future taxes or smaller pension annuities. Further, the increased savings would have been made possible by dollars given to current taxpayers by past taxpayers in the form of lower land prices (the "capitalization" of underfundings) or by dollars given to teachers as higher wage payments (the "compensating wage differential" for underfundings). In either case, the private market will have fully corrected for the failures of the public sector. The evidence for this hypothesis is mixed at best.[15]

Prudence, therefore, requires us to confront the observed underfundings directly through considered public policies to encourage the full funding of our public employees' pensions. The evidence presented here suggests now is time to start.

Footnotes

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[1]See for example, Aronson (1975), Munnell and Connolly (1976), House of Representatives (1978), Inman (1980), Pease (1980), Arnold (1981, 1982) and the Urban Institute (1981).

[2]It has been argued that the New York fiscal crisis was in part a fall-out of growing local pension costs; see Morris (1980) or the Urban Institute (1981).

[3]There are special circumstances when the "pay-as you-go" strategy may be preferred to the full-funding strategy; see Samuelson (1975), Arnott and Gersovitz (1980), or Merton (1983). Generally, however, full-funding insures a more efficient allocation of societal resources (Feldstein (1976) and Inman (1982)) as well as protects workers' pensions.

[4]This result follows from the solution to equation (7) for the period $v = 0$.

[5]The formal analysis ignores variation in vesting provisions across pension plans. Vesting defines the minimal number of years of service before

pension rights are secure. The greater the number of years to vesting, the lower should be the plan's unfunded liability since fewer workers are likely to qualify for pension benefits. Vesting differences will have to be substantial, however, before a sizable effect on underfundings will be observed; see, for example, Bulow (1982). In our sample, most plans vest their members within five to fifteen years and these differences have only small effects on underfunding estimates; see Arnold (1928) summarized in Kotlikoff and Smith (1983, section 7.7).

[6]This assumption is appropriate given by decision to use the Arnold data base. Arnold (1981) applies the same values for r, h, δ, q, g, and p to each plan when estimating that plan's unfunded liability. Thus in my econometric analysis these parameters are, by definition, constants. If estimates of U are based on different values of r, h, δ, q, g, or p, then the regression analysis used to describe differences in U must allow for variations in these parameters.

It should be noted that Arnold (1981) did test for differences in mortality rates (δ) across states and quit rates (q) across states and could not reject the null hypothesis of equality. The nominal interest rate r and the inflation rate p are national and thus should be uniform across all plans in any year. The assumption of similar wage structures (g) and nominal wage growth (h) across plans also seems reasonable as public employee bargaining is now commonplace.

[7]The formula outlined in equation (10) above is not precisely consistent with actuarial principles of pension accounting as used by Arnold (1981) and others. Specifically, as specified the calculation of PVB and PVC assume current taxpayers will be responsible for <u>all future</u> employees' benefits above all future planned contributions. The usual practice when calculating U is to

make current taxpayers responsible only for current employee benefits. It is possible to show that the algorithm in (10) will give a biased (likely upward) estimate of this "true" measure of underfunding. The bias is likely to be greatest for plans with high rates of membership growth. Permitting plan growth to influence both the intercept (a fixed effect) and the slope coefficients in an estimated underfunding equation should minimize the bias from employing the specification in (10); see Ehrenberg (1980, fn. 12).

[8]The coefficients $\Delta_1 \ldots \Delta_5$ have specific interpretations as first and second derivatives of the actuarial constant Δ with respect to the COLA rate, θp, and the years of service, R. For plausible values of the other actuarial parameters in Δ, we can predict the likely signs of $\Delta_1 \ldots \Delta_5$. For example, if $h + \delta > \theta p$ and $q + \delta > g$, then $\Delta_1 = \partial\Delta/\partial(\theta p) < 0$, $\Delta_2 = \partial\Delta/\partial R > 0$, $\Delta_3 = .5\partial\Delta/\partial(\theta p)\partial R < 0$, $\Delta_4 = .5\partial^2\Delta/\partial(\theta p)^2 = 0$, and $\Delta_5 = .5\partial^2\Delta/\partial^2 R > 0$.

[9]All local teacher plans and thirteen state plans had to be excluded from the regression analysis for reasons of incomplete estimates of U for the sample year, 1978-79. The excluded states were Alabama, Georgia, Indiana, Maryland, Massachusetts, Michigan, New Hampshire, Ohio, Oklahoma, Texas, Utah, Washington, and Wisconsin.

[10]See Boskin and Shoven (1984), Table 3. For the simulation of underfunding in years other than 1978-79, the social security replacement rate was adjusted to allow for the actual historical experience; see Boskin and Shoven (1984), Table 3.

[11]The sample was divided into low growth and high growth plans according to the criteria of whether plan membership from 1971-80 grew less than, or greater than, 3% per year. For estimated equations (1) the value of F for the null hypothesis of no difference was $F(2,33) = 6.32$; we can reject the null hypothesis of no difference at a 5% level of confidence. For the full model

specifications in equations (2) - (6), however, the F statistic for the null hypothesis of no difference did not reject the hypothesis; $F(5,27) = 1.831$ for equation (2), $F(10,17) = .706$ for equation (3), $F(9,19) = .672$ for equation (4), $F(7,23) = 1.049$ for equation (5), and $F(5,27) = 1.326$ for equation (6). Since m is included as a fixed effect in equations (2) - (6), the test applied to those equations is for slope effects only.

[12]There is always a danger in prediction of extrapolating to circumstances outside the original sample period. This is not a serious concern for our study for the simple reason that we are not estimating a behavioral relationship to predict behavior, but rather, an accounting rule to organize financial data. The accounting rule is valid across all periods of our sample, so our estimate of that rule is also valid across all sample periods.

[13]PVB can be approximated from equation (9) as $B_0/(r - h)$. B_0 is a plan's current payments to retirees and (r - h) is set equal to .022 from our regression estimates.

[14]A data appendix giving estimated underfundings for each plan for each year is available from the author upon request.

[15]See, for example, Epple and Schipper (1981), Inman (1982), and Smith (1981, 1983).

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Table 1
Correlates of Teacher Pension Underfundings
(Dependent Variable: 1 + U/A)

Estimated Actuarial Parameters	(1)	(2)	(3)	(4)	(5)	(6)
ϕ_0	= 0	64689 (302950)	-104220 (290600)	-204730 (270900)	-157990 (267210)	= 0
ϕ_1	= 0	16452 (257350)	162560 (269030)	185400 (255900)	117250 (231740)	= 0
ϕ_2	= 0	2.597×10^6 (2.113×10^6)	3.097×10^6 (1.962×10^6)	3.221×10^6 (1.093×10^6)	2.972×10^6* (1.016×10^6)	2.113×10^6* (1.043×10^6)
$(1/r-h)$	45.65* (8.14)	44.23* (9.09)	65.04* (8.81)	45.04* (9.31)	41.16* (6.00)	39.61* (6.03)
$(-\Delta/r-h)$	-122.02 (70.77)	-146.01* (84.57)	n.a.	n.a.	n.a.	n.a.
$(-\bar{\Delta}/r-h)$	n.a.	n.a.	-95.04 (121.27)	-109.44 (111.79)	= 0	= 0
$(-\Delta_1/r-h)$	n.a.	n.a.	521.90 (3079.00)	1576.70 (2022.10)	1402.00* (791.67)	1417.30* (770.70)
$(-\Delta_2/r-h)$	n.a.	n.a.	-46.62* (20.13)	-46.97* (27.65)	-63.97* (19.24)	-61.28* (17.57)
$(-\Delta_3/r-h)$	n.a.	n.a.	70.26 (303.93)	20.06 (333.00)	= 0	= 0
$(-\Delta_4/r-h)$	n.a.	n.a.	10559 (32932)	= 0	= 0	= 0
$(-\Delta_5/r-h)$	n.a.	n.a.	5.04* (1.90)	5.12* (1.93)	6.29* (1.56)	5.90* (1.42)
$\bar{R}^2$	.331	.391	.528	.543	.556	.579
SEE (U)	2.29×10^6	2.16×10^6	1.92×10^6	1.93×10^6	1.79×10^6	1.73×10^6

Notes to Table 1

n.a. = Not applicable to specification being estimated.

= 0 = Coefficient is constrained to equal zero, *a priori*.

* = Estimated coefficient is statistically different from zero at the 10% level or better; standard errors are in parentheses.

ϕ_0 = Estimated coefficient for the variable (1/A).

ϕ_1 = Estimated coefficient for the variable (T/A).

ϕ_2 = Estimated coefficient for the variable (m/A).

$(1/r-h)$ = Estimated coefficient for the variable (B_0/A).

$(-\Delta/r-h)$ = Estimated coefficient for the variable $(c/b)(B_0/A)$.

$(-\bar{\Delta}/r-h)$ = Estimated coefficient for the variable $(c/b)(B_0/A)$ when Taylor series approximation for Δ is employed.

$(-\Delta_1/r-h)$ = Estimated coefficient for the variable $(c/b)(B_0/A)(\theta p - \overline{\theta p})$; $\overline{\theta p} = 0$.

$(-\Delta_2/r-h)$ = Estimated coefficient for the variable $(c/b)(B_0/A)(R - \bar{R})$; $\bar{R} = 24$.

$(-\Delta_3/r-h)$ = Estimated coefficient for the variable $(c/b)(B_0/A)(\theta p - \overline{\theta p})(R - \bar{R})$; $\overline{\theta p} = 0$ and $\bar{R} = 24$.

$(-\Delta_4/r-h)$ = Estimated coefficient for the variable $(c/b)(B_0/A)(\theta p - \overline{\theta p})^2$; $\overline{\theta p} = 0$.

Table 2
Funding Status for Teachers' Pensions: State Plans

Year/Plan	Mean State Underfunding/Resident			Mean State Underfunding/Liability			Mean State Underfunding/Member			Mean State Underfunding/Income		
	All	General	Teacher	All	General	Teacher	All	General	Teacher	All	General	Teacher
1971*	$190.48	$300.69	$141.86	.567	.610	.549	$7912	$6875	$8370	.071	.113	.053
1972*	$211.82	$313.07	$158.04	.570	.614	.547	$8864	$9040	$8771	.073	.109	.055
1973	$239.47	$341.93	$181.84	.599	.645	.573	$9006	$7954	$9598	.081	.115	.061
1974	$256.72	$348.25	$200.63	.636	.657	.623	$9333	$7247	$10611	.088	.121	.068
1975	$264.38	$353.46	$209.78	.621	.641	.609	$9676	$7436	$11049	.089	.121	.069
1976	$287.62	$398.29	$213.12	.622	.648	.582	$10164	$7953	$11084	.094	.132	.068
1977	$295.99	$411.84	$217.53	.623	.642	.579	$10549	$8004	$11624	.094	.133	.067
1978	$300.61	$417.78	$228.78	.621	.647	.605	$10670	$7999	$12308	.093	.134	.069
1979	$315.33	$447.52	$234.31	.637	.679	.611	$11011	$8759	$12391	.098	.143	.070
1980	$314.54	$424.66	$247.04	.623	.654	.603	$11324	$8682	$12941	.099	.139	.075

*Results exclude Delaware for reasons of insufficient data. Underfunding per member and underfunding per resident are both measured in 1967 dollars.

Table 3
Funding Status of Teachers' Pensions: Local Plans

	Mean Local Underfunding/ Resident	Mean Local Underfunding/ Liability	Mean Local Underfunding/ Member	Mean Local Underfunding/ Income
1971*	$163.09	.658	$15736	.060
1972*	$186.50	.627	$16748	.064
1973*	$184.62	.628	$16216	.065
1974	$117.19	.516	$10067	.042
1975	$119.57	.641	$ 9794	.042
1976	$133.70	.654	$10705	.044
1977	$147.94	.655	$10694	.048
1978	$164.40	.667	$11948	.050
1979	$156.44	.657	$11273	.050
1980	$155.55	.657	$11253	.051

* 1971-1973 results are for a limited sample of local teacher plans. Only local teacher-only plans are included. Local teacher plans included in the analysis are Washington, D.C. (1971-1980), Chicago (1971-1980), Duluth (1971-1980), Minneapolis (1971-1980), Boston (1971-1980), New York City (1971-1980), Portland (1971-1980), Milwaukee (1971-1980), St. Louis (1972-1980), Fulton Co. Ga., (1973-1980), Des Moines (1973-1980), Wichita (1973-1980), Kansas City, Mo.(1973-1980), Denver (1973-1980), Omaha (1973-1980), Detroit (1974-1980), Arlington, Va. (1977-1980). Underfunding per member and underfunding per resident are both measured in 1967 dollars.

Appendix

to

"The Funding Status of Teacher Pensions: An Econometric Approach"

Estimated Unfunded Pension Liability

Per Capita (1967 dollars)*

UPCAP — STATES : 71-80

(…ATE)	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
…ama	245.18065	273.62631	305.52850	293.92380	380.17322	401.93164	373.20416	354.18387	399.48404	404.08353
…ska	449.97000	498.10916	569.83441	630.25226	574.34039	550.83154	599.27570	668.88312	726.88568	878.14613
…izona	27.34242	26.66026	26.62021	24.78692	46.14161	35.06588	67.27266	93.40778	136.83955	147.14473
…kansas	90.36765	89.70943	102.10904	100.44508	111.08688	125.23793	96.71656	83.96177	80.17717	59.40779
…lifornia	88.37122	112.44369	109.88351	106.49164	102.88456	110.35003	110.11404	112.06232	115.65655	112.65646
…rado	67.85126	85.71519	101.04060	87.93397	95.36686	113.09003	114.49796	89.41714	383.68372	384.19678
…necticut	126.23450	152.83197	167.99423	173.21461	136.03893	205.213	213.408	168.31322	172.31566	174.78833
…aware	n.c.	n.c.	431.27725	437.98961	407.31161	447.10397	409.45541	390.88956	413.76678	352.85165
…orida	215.92593	237.21379	231.78731	206.87651	244.74902	240.36913	238.12195	227.91977	220.34312	216.46890
…orgia	91.81351	90.06840	97.15791	94.68411	96.91673	100.94148	101.91445	119.21808	106.48553	107.00245
…waii	641.73102	722.58925	634.66066	737.11670	610.02393	793.55811	808.38525	782.23676	736.14630	678.70386
Idaho	430.02213	442.46893	437.65729	536.12579	566.69714	686.81592	692.67041	688.73102	658.28674	664.08502
Illinois	82.66743	108.43314	112.93575	116.53780	119.08912	134.05646	125.39262	122.02522	126.66432	113.17552
Indiana	243.30428	260.86429	263.00623	259.99747	294.66666	301.48441	368.14996	336.68405	323.52011	327.57153
Iowa	189.45174	218.23361	232.40012	230.40504	260.25967	314.46289	316.81281	340.56021	375.44196	369.96280
…nsas	115.83752	264.36557	445.67319	430.48369	413.69092	520.05330	407.69238	399.85880	421.00314	446.35126
…ntucky	46.55431	53.30917	66.53181	64.26314	191.69407	201.34888	248.17253	221.79672	195.94414	226.78638
…uisiana	117.89666	159.25604	186.77400	202.74133	251.96025	290.63934	308.63981	263.93488	229.40631	375.91788
…aine	409.70462	439.61685	519.92426	533.58362	538.48730	594.64941	828.19989	788.24554	792.09363	743.63057
…aryland	20.37603	41.24708	204.34233	212.33258	223.85187	223.49257	222.76633	224.92682	282.02631	228.36642
…ssachusetts	292.90286	311.66465	312.70404	317.20602	334.17883	364.92166	404.23013	415.40939	493.49597	454.25143
…ichigan	53.13114	56.68035	64.13980	68.82150	99.37199	131.39395	182.75252	179.29309	164.65294	148.11015
…innesota	34.05357	29.68800	61.65724	76.15952	78.83866	86.54340	94.74450	95.35715	103.99706	104.31956
…ississippi	276.08475	325.11011	434.25745	390.76340	417.40411	516.53864	497.63876	473.67987	171.39386	172.68663
…issouri	14.64866	3.06293	7.61515	7.25543	16.83035	52.47133	55.12331	31.28297	30.69907	18.44645
…ntana	45.68359	39.29489	203.65269	240.57065	254.14380	242.33261	242.48550	236.41045	262.01071	284.41840
…braska	86.80496	112.06007	98.54571	154.53467	125.68597	132.52423	115.98774	97.99837	92.32324	89.52602
…vada	432.94066	432.15631	404.73370	347.90494	186.10701	298.33167	314.98340	284.96231	303.73177	225.07339
…w Hampshire	12.18142	10.38870	-59.74792	-16.56799	-53.91971	-66.96230	-34.46518	-23.69462	-0.88625	-10.18398
…w Jersey	143.24518	159.95650	167.32980	271.24921	180.89766	217.44417	209.83798	228.88727	232.11223	229.71010
…w Mexico	373.61505	383.17444	396.78328	424.99435	390.31781	418.82184	416.62277	371.01224	364.76663	372.38852
…w York	144.42935	127.47275	147.41830	127.81664	126.20840	136.10020	141.83005	154.49538	155.43958	145.35016
…Carolina	202.39847	235.45016	274.67886	290.20886	290.38547	357.35129	409.27570	432.49664	490.82349	571.85089
…Dakota	109.58872	117.99738	207.67119	881.54117	173.08824	210.42000	189.63493	208.59363	290.00751	272.53439
…hio	261.48584	286.43033	306.72824	262.92102	372.46790	422.57132	446.70502	448.78030	146.35252	145.22116
…lahoma	183.64174	197.43066	219.74229	251.78293	286.90497	299.24402	296.47079	329.36746	298.06445	308.41949
…regon	141.34282	142.98030	162.44955	198.22084	205.01659	227.76083	252.43182	336.45010	339.07797	342.92917
…nsylvania	195.66562	226.65065	251.19028	263.61786	403.90442	323.84875	326.69144	345.93469	444.38391	433.84763
…ode Is.	257.35156	301.19955	304.76929	313.57578	340.60123	353.12985	363.06320	380.88214	331.30917	316.30884
…Carolina	188.13996	254.53003	298.30499	271.57562	310.41336	408.36957	498.32578	493.26059	1069.22925	1089.18164
…Dakota	319.79843	301.15201	288.82169	368.09891	401.27295	439.96021	454.63580	459.62161	453.01956	1399.49222
…nessee	89.64391	99.99223	117.92612	139.63449	144.68219	150.89375	144.13708	249.72812	227.67848	165.50990
…exas	49.69448	56.77419	65.53626	73.08933	82.12414	91.38554	95.58001	101.58208	190.50417	221.72763
…tah	150.11195	152.81035	158.37720	144.91226	183.11652	186.16435	159.33261	169.52840	162.60594	202.79279
…rmont	67.61077	153.72069	148.68201	138.81274	142.68570	155.63618	137.71687	134.76698	125.93861	106.43358
…rginia	202.27008	303.84192	344.08844	412.27148	365.47501	475.23962	466.50497	504.46759	565.20111	514.37970
…shington	11.55116	16.60036	30.82248	302.29428	169.41344	181.40446	177.47275	352.98651	343.00833	323.05518
…Virginia	387.13460	400.94675	465.25104	520.52814	519.24115	477.55618	466.04321	431.61127	452.65948	481.04663
…sconsin	78.86778	73.09890	89.94738	117.85954	114.63365	104.29185	104.23085	106.88548	152.77638	151.90658
…yoming	867.82214	790.05164	752.38000	659.16621	671.68243	594.66821	540.81628	521.02747	413.74924	434.73380

n.c.: not calculated because of missing data.

UPCAP-CITIES: 1971-1980

(Cities)	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Washington, D C	365.52075	433.77731	449.56595	484.55640	547.38190	583.90002	621.70453	760.69269	702.41479	706.26880
Chicago	179.11949	200.39258	206.74335	195.67380	194.03253	242.56382	230.68420	235.81473	249.27673	232.49786
Detroit	n.c.	n.c	n.c	n.c.	232.25452	327.76068	530.99811	525.13965	479.48044	481.35791
Duluth	58.94501	51.20826	70.29472	68.10141	59.32209	78.71604	97.99660	69.93123	43.72823	34.39861
Minneapolis	83.69796	72.63520	66.94167	61.27634	64.56720	107.14056	117.61477	123.67239	124.56859	154.44197
St. Paul	214.68056	207.53259	190.64021	176.81061	130.28157	212.51227	210.87320	203.38492	200.21263	173.95938
Boston	54.60559	53.32731	48.66296	43.63257	41.13105	39.16636	37.08533	37.43525	31.99199	31.68223
New York City	387.42957	668.28674	625.45569	537.95062	521.57678	497.58029	497.30331	585.48944	556.60052	534.52844
Portland	17.51734	51.10472	41.31677	36.80965	-152.04167	-150.28584	-145.07774	-132.76497	-123.54377	-114.72659
Milwaukee	106.28205	120.49046	141.29246	163.10898	192.61375	179.61041	168.29311	166.78069	169.46407	131.68406
Fulton County	n.c.	n.c.	n.c.	62.17451	62.77466	64.47770	66.63133	76.47590	74.49262	75.83904
Des Moines	n.c.	n.c.	n.c.	12.30402	21.79358	12.16179	24.96284	35.93311	49.14572	56.84267
Wichita	n.c.	n.c.	n.c.	-191.36775	-164.32339	-174.28995	-159.96509	-141.08467	-129.88548	-96.69540
Kansas City	n.c.	n.c.	n.c.	-23.99866	1.15672	13.81870	5.17456	9.47583	6.97742	9.28959
Saint Louis	n.c.	6.26674	5.25022	4.65787	29.55393	48.06946	22.99630	12.53603	8.16477	5.00650
Nashville	n.c.	n.c.	n.c.	180.09602	193.00360	195.06561	200.51862	199.92926	191.37573	164.94031
Arlington	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.	n.c.	217.91586	205.41229	187.75743
Denver	n.c.	n.c.	n.c.	8.23567	28.64067	9.80517	21.47829	29.43713	27.71820	30.76576
Omaha	n.c.	n.c.	n.c.	172.26259	168.30611	118.89049	113.64610	107.42299	104.70750	n.c.

n.c.: not calculated because of missing data

ESSAY II

"FUNDING TEACHER PENSIONS <u>OR</u> DOES PAUL ROB PETER TO PAY MARY?"

Funding Teacher Pensions

or

Does Paul Rob Peter to Pay Mary?

by

Robert P. Inman*

In the last decade, the funding status of public employee pensions has become an issue of increasing public concern. A Congressional survey (1978, Table 52) of public employee pension plans indicated that in 1976 approximately 90% of all state and local the plans had some level of underfunding. Estimates of the level of underfunding by Arnold (1982) for individual plans shows funding status to vary from almost fully-funded to underfundings of $2000 per resident or more in Alaska, Nevada, and South Carolina. Aggregate estimates by Arnold (1982) and by Inman (1980) show the state and local sector as a whole to have pension underfundings of approximately $500 per capita by the late 1970's. Further, the available evidence (Inman, 1980 and 1986) shows that real underfundings have been growing over the last fifteen years.

There is no need yet to announce a "crisis." Most all plans have accumulated sufficient assets and planned contributions to cover pension promises to current and near-future retirees. Real issues of national policy arise however, if current unfunded liabilities are not covered and overall underfunding continues to grow. As underfunding increases, workers' annuities are increasingly at risk. To the extent annuities are guaranteed, future public services or future taxpayers' incomes must decline. What workers and future residents lose, current taxpayers gain with underfunding. This intertemporal transfer may or may not be desirable. Large underfundings may have adverse effects on resource allocations as well, creating inefficiencies which cost current as well as future residents. In a manner fully analogous to social security, public employee pension underfunding may depress private savings (Feldstein, 1974). Further, as underfunding operates as an implicit subsidy to current taxpayers who employee pensioned workers, it creates incentives to over-provide state and local services (Inman, 1982). To avoid these possibly unwanted redistributions and misallocations, it is necessary to design a funding strategy for state and local pensions. To do so, we must understand the causes and consequences of current underfundings. That is my task here.

The focus of the analysis is on teachers, the single largest group of state and local employees, providing the single most important state and local service, education. Teacher pensions are now significantly underfunded and the real level of underfundings has been rising--see Table 1. The level of underfundings per capita and per plan member have grown from $190 and $7912 in 1971 to $314 and $11,324 respectively in 1980 (1967 dollars). While the average level of underfunding is large, so too is the variance. Some states (Minnesota, Missouri, New Hampshire, Wisconsin) have well-funded plans while other state plans (Idaho, Louisiana, Maine, Massachusetts, Mississippi, South Carolina, West Virginia, Wyoming) are consistently poorly funded. This paper seeks to explain this recent history and, on the basis of this history, to project the future trends in teacher pension benefits and funding. Simply put, can we expect a teacher pension crisis? If so, which states are the most vulnerable? Finally, what can be done today to stay the continued growth in underfundings?

To answer these questions, an econometric model of pension underfunding is specified and estimated for a sample of the forty-eight mainland state teacher pension plans for the decade 1971-1980.[1] The basic pension identities

Table 1: Underfunding of Teacher Pensions

	Average Underfundings per Resident	Average Underfundings per Plan Member	Average Underfundings per Resident (10 worst)[1]	Average Underfundings per Resident (10 best)[2]
1971	$190.48	$7919	$454.57	$31.52
1972	211.82	8864	474.61	33.57
1973	239.47	9006	509.59	45.03
1974	256.72	9333	532.25	59.91
1975	264.38	9676	532.28	69.56
1976	287.62	10164	565.70	62.54
1977	295.99	10549	585.25	65.09
1978	300.61	10670	582.89	78.80
1979	315.33	11011	643.79	91.87
1980	314.54	11324	652.18	84.60

Source: Inman (1986). All data are in 1967 dollars.

[1]Plans in Alaska, Hawaii, Idaho, Maine, Massachusetts, Mississippi, West Virginia, and Wyoming were consistently among the ten worst funded plans.

[2]Plans in Minnesota, Missouri, New Hampshire, Texas, and Wisconsin were consistently among the ten best funded plans.

are first specified and the key fiscal variables which set the level of underfunding--government and employee contributions, investment earnings, and current and future benefits--are identified (Section II). A political-economic model of contributions, investment performance, and benefits is then specified (Section III) and estimated (Section IV). The estimated structural model can then be solved to predict the likely effects upon teachers and current and future taxpayers of economic or demographic changes and alternative pension reform policies (Section V). Further, the estimated model can be used to simulate the future path of pension underfundings (Section VI). A concluding Section (VII) summarizes the main results.

II. Accounting for Pension Underfundings

Teacher pension plans, like most public employee pension plans, are defined-benefit pensions. Such plans specify an annuity to be paid to a retiree at a fixed replacement rate (usually 2% for each year of service up to 50%) of the retiree's eligible pre-retirement salary (usually an average of the retiree's last three to five years of salary).[2] To cover these anticipated pension liabilities, teachers and their employers--i.e., local taxpayers through school districts--must make contributions to the plan, most often as a fixed percentage (contribution rate) of annual salary. At any point in time, the liabilities (L) of such a public employee pension plan will equal the difference between the discounted present value of promised benefits and the discounted present value of anticipated future contributions from taxpayers and employees. Under plausible assumptions about the pension plan's benefit and contribution structure and about the demographics of teacher longevity and turnover, plan liabilities per taxpayer can be specified as an actuarial constant (Ω) times the current wage bill for teachers: $L = \Omega w \ell$, where w is the average teacher wage and ℓ is the number of teachers per are first specified and the key fiscal variables which set the level of underfunding--government and employee contributions, investment earnings, and current and future benefits--are identified (Section II). A political-economic model of contributions, investment performance, and benefits is then specified (Section III) and estimated (Section IV). The estimated structural model can then be solved to predict the likely effects upon teachers and current and future taxpayers of economic or demographic changes and alternative pension reform policies (Section V). Further, the estimated model can be used to simulate the future path of pension underfundings (Section VI). A concluding Section (VII) summarizes the main results.

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$$U = \Omega w \ell - A \ . \tag{1}$$

The asset position of the pension plan is defined by the level of assets accumulated up to today, denoted A_{-1}, plus the net contributions made today to the pension plan, denoted n:

$$A = n + A_{-1} \ . \tag{2}$$

Net contributions to the plan equal the contributions made today by teachers (c_e) and school districts as employers (c_g), plus state government contributions (p), plus contributions from investment earnings on prior assets at rate r (rA_{-1}), less any benefits paid today to plan members (b). In all cases, state governments, through the executive branch, administer the pension plan, regulate investment policies, and collect employee and employer contributions. State legislatures set the level of state contributions to the plan (p).

Not all employee and employer contributions and not all of investment earnings need be allocated to increased pension funding, however. Indeed, there may be strong motivation on the part of current taxpayers and teachers to move some of these dollars out of pension contributions and into current period pension benefits or into the general state budget for current expenditures or tax relief. If this is so, then only a fraction of current employee and employer contributions and investment earnings will actually contribute to pension assets. If ϵ percent and ϕ percent of each locally contributed dollar spill over into current benefits or into the general budget, respectively, and υ percent and ψ percent of each dollar of investment earnings slips into benefits or the general budget, respectively, then only $(1 - \varepsilon - \phi)\{c_e + c_g\}$ and $(1 - \upsilon - \psi)\{rA_{-1}\}$ dollars actually remain as net contributions.[4] Allowing for the possibility of such leakages from pension funding means that net contributions (n) are specified as:

$$n = p + (1 - \varepsilon - \phi)\{c_e + c_g\} + (1 - \upsilon - \psi)\{rA_{-1}\} - b_0 , \qquad (3)$$

where p is state contributions and b_0 are basic benefits. Note that total benefits paid (b) will equal basic benefits b_0 plus supplemental benefits paid from contributions and investment earnings:

$$b = b_0 + \varepsilon(c_e + c_g) + \upsilon(rA_{-1}) .$$

The empirical analysis will estimate the spill-out parameters ε, υ, ϕ and ψ, as well as the basic benefit structure, b_0.

Equations (1) to (3) define the dynamic path of pension underfundings. For this analysis, the actuarial parameter Ω, and the spill-out parameters--ϕ, ε, υ and ψ--are treated as exogenous (though estimated in the analysis). Endogenous to the analysis are teacher wages (w) and employment (ℓ), assets (A), state contributions (p), employee (c_e) and employer (c_g) contributions, investment performance measured by the average rate of return on pension assets (r), and total benefits paid each year by the plan (b). Also endogenous to the analysis is state aid for local education (denoted as z); such aid is a key determinant of w and ℓ and is itself determined as part of the state budgetary process along with state pension contributions. The key determinants of each endogenous pension variable are specified in Section III; each emerges from a political bargaining game between teachers and taxpayers.

III. The Political Economy of Teacher Pensions

A. Process and Players

The process which determines the levels of contributions, investment performance, and pension benefits is a political process. Three groups, or coalitions of voters, have an interest in the outcome of the deliberations--current taxpayers, current plan members, and future taxpayers. Only two parties--current taxpayers and current members--have a direct voice in these political negotiations, however. Future taxpayers must stand in the wings; but they are not without potential influence. To the extent current negotiations affect the level of pension underfundings and to the extent future taxpayers are aware of these underfundings, these same future taxpayers may avoid these underfundings either by: (1) regulating pension contributions (most likely through the state pension board) to insure full funding, or 2) simply refusing to pay the underfunded pensions when they fall due, or 3) demanding compensation for the future burden of these underfundings, paid generally as reduced commercial or residential land prices when future taxpayers locate in the state. The first strategy is feasible to the extent future taxpayers have a proxy vote on the state pension board. Such support for the full-funding position is most likely to come from the pension's financial advisors and from absentee asset holders in the state such as banks and their shareholders. The second strategy has often been denied to future taxpayers as the courts have interpreted public employee pensions as a contractual obligations of the state.[5] The third strategy, called capitalization, is also feasible, but it requires future taxpayer to know the level of pension underfundings prior to moving into the state.

The active coalitions, current taxpayers and teachers, negotiate at three levels. The first level--called the regulation game--sets the level of employer (c_g) and employee (c_e) contributions, the level of pension benefits to be paid to current retirees and to eligible (e.g., disabled) non-retirees (b), and finally, determines investment performance of the pension portfolio (r). The regulation game is played between the governor and the pension regulation board, both of whom may be influenced by current taxpayers and plan members. The second game--called the legislation game--sets the level of gross state contributions to the pension (p) and the level of state assistance for local education (z); the legislation game is played knowing the outcome of the regulation game. The third game--called the local bargaining game--sets the level of teacher wages (w) and employment (ℓ). The bargaining game is played knowing the outcomes of the regulation and legislation games.[6] I will assume that taxpayers and teachers have rational expectations as to the consequences of their decisions in each game. Thus in reaching decisions in the regulation game, the parties anticipate the implications of their choices for the legislation and bargaining games, and when making choices in the legislation game the parties anticipate the consequences of their decisions for the bargaining game.

B. Coalition Preferences[7]

1. Taxpayers: I assume that the preferences of the taxpayer coalition can be represented by the preferences of an average coalition member. The well-being of the average current taxpayer is defined over two events: event 1 where the current taxpayer escapes payment for any unfunded pension liabilities which he may incur from this period's decisions, and event 2 where he must pay for those unfunded liabilities. The probability of paying for these unfunded liabilities is α; α is exogenous to the analysis. The taxpayer receives an after-tax income of $\bar{y}$ in event 1 and an after-tax income of $\underline{y}$ in event 2; $\bar{y} > \underline{y}$. The taxpayer also receives utility from the employment of

teachers in the current period, denoted ℓ. The taxpayer benefits from ℓ whether he pays for teacher pensions or not. Expected taxpayer utility is therefore:

$$V_T = (1 - \alpha)v_T(\bar{y}, \ell) + \alpha v_T(\underline{y}, \ell) ,$$

where $\partial V_T/\partial(\cdot) \geq 0$ and $\partial^2 V_T/\partial(\cdot)^2 \leq 0$, for $(\cdot) = \bar{y}, \underline{y}$, and ℓ .

To specify taxpayer after-tax income in the two events, I specify y generally as:

$$y = I - \lambda t_s - \lambda t_c - \delta\lambda(\Delta w\ell - n) ,$$

where I is the average taxpayer's (exogenous) before state and local tax income; λ is the rate of net burden of a dollar of state and local taxes on the average taxpayer after allowances for shifting to non-resident taxpayers ($0 \leq \lambda \leq 1$); t_s and t_c are state and local taxes per taxpayer respectively; $\Delta w\ell$ is the required level of annual contributions per taxpayer for the full-funding of current pension obligations often called the "normal costs" of the pension;[8] and n is the level of actual net contributions made in the given year. The difference between full funding and actual funding is the year's contribution to the stock of underfundings. This contribution to the pool of underfundings (which may be < 0, if $n > \Delta w\ell$) imposes a net tax burden on future taxpayers, the present value of which is $\lambda(\Delta w\ell - n)$. A fraction of these new underfundings δ ($0 \leq \delta \leq 1$) may be capitalized into the current taxpayer's property holdings. If capitalized, the current taxpayer will suffer decline in current income of $\delta\lambda(\Delta w\ell - n)$. It is here, through δ, that future taxpayers may come to influence current political deliberations over the pension budget.

State taxes equal the state's expenditures for teacher pensions (p) plus state-to-local education aid (z) plus other state expenditures (E) less federal-to-state aid (Z_s) and any spillovers (d) from the regulated pension accounts administered by the governor and the pension board:

$$t_s = p + z + E - Z_s - d .$$

The spillover from the regulated pension accounts (d) (see, p. 5 above) is specified formally as:

$$d = \phi\{c_e + c_g\} + \psi\{rA_{-1}\} .$$

When all employee and employer contributions stay within the pension account, ϕ equals 0; when all interest earnings stay within the pension account ψ equals 0. In such cases, d equals 0. It is possible for spillovers to occur, however. Interest earnings above some regulated target rate of return may be viewed as excess earnings available for general allocations; employee and employee contributions may exceed pension board expectations in which case the surplus might be retained in the general treasury (see fn. 4 above).

Local taxes equal school district expenditures on teacher wages, $w\ell$, plus other, exogenous school expenditures (S) plus employer contributions to the state for teacher pensions (c_g) less education aid received from the state ($\tilde{z}$) and from the federal government (Z_c). State aid received by local districts will be some (exogenous) fraction of the state aid actually allocated by the state--$\tilde{z} = \gamma z$, where $0 << \gamma < 1$--to allow for administrative expenses. Thus:

$$t_c = w\ell + S + c_g - \gamma z - Z_c .$$

Finally, the state's net contributions to the pension fund, n, equals the sum of the employee, employer, and state contributions plus earnings on past assets less any spillovers into the general budget from the pension accounts less benefits paid in the current period; see equation (3) above.

The average taxpayer's after-tax income can now be fully defined as a function of the relevant pension variables. Substituting t_s, t_c, d, b, and n into the original definition for y gives:

$$y=\{I + \lambda(Z_s + Z_c) - \lambda(E + S)\} + \lambda\{\phi + \delta(1 - \phi)\}c_e + \lambda\{\psi + \delta(1 - \psi)\}(rA_{-1})$$

$$-\lambda\{1 - [\phi + \delta(1-\phi)]\}c_g - \lambda\delta b - \lambda(1 - \delta)p - \lambda(1 - \gamma)z - \lambda(1+\delta\Delta)w\ell \ .$$

The first bracketed term represents the taxpayer's "full fiscal incom " and includes taxpayer earned income plus the value to the taxpayer of federal aid received by state and local governments (where λ is the after-tax value to the taxpayer of each dollar of government aid) less the net tax cost of exogenous state and local expenditures. The next two terms are the value to the taxpayer of teacher contributions and investment earnings, respectively, again allowing for the fact that a government dollar is worth (or costs) only λ to the taxpayer. With spillovers from the pension budget to the general budget, a dollar of contributions and earnings yields $\lambda\phi c_e$ and $\lambda\psi(rA_{-1})$ of direct spillover dollars to the taxpayer and promises, through the capitalization of retained contributions and interest earnings, a present value income of $\lambda\delta(1 - \phi)c_e$ and $\lambda\delta(1 - \psi)(rA_{-1})$. The taxpayer's own contributions as an employer (c_g) costs λc_g dollars but returns $\lambda[\phi + \delta(1 - \phi)]c_g$ dollars in spillover and capitalization benefits. The payment of current benefits (b), however, reduces the accumulation of pension assets and therefore costs the taxpayers $\lambda\delta b$ dollars. The taxpayer's pension contribution as a state taxpayer costs λp tax dollars and returns $\lambda\delta p$ dollars as capitalized benefits. State-to-local school aid (z) has a net cost of $\lambda(1 - \gamma)$ for each dollar transferred; the education bureaucracy which allocates the grant consumes $(1 - \gamma)$ of each dollar of aid. Finally, the taxpayer pays $\lambda(1 + \delta\Delta)$ for each dollar spent on teacher salaries ($w\ell$); λ dollars in direct costs and $\lambda\delta(\Delta w\ell)$ as subsequent pension obligations are capitalized into a present value loss in current income.

In the important special case of full capitalization ($\delta = 1$) the current taxpayer's income becomes:

$$y_{\delta=1} = \{I+\lambda(Z_s+Z_c)-\lambda(E+S)\}-\lambda(1-\gamma)z - \lambda w\ell - \lambda(b+\Delta w\ell - c_e - rA_{-1}),$$

where $(b + \Delta w\ell - c_e - rA_{-1})$ is the required annual contribution from taxpayers (after employee contributions and interest earnings) needed to cover current (b) and future $(\Delta w\ell)$ pension obligations. When $\delta = 1$, current taxpayers do fully fund their teacher's pensions either directly through contributions [illegible] and c_g or indirectly in lower property values. Future taxpayers are now unaffected by the pension budget. In this special case, the only fisca issues which remain to be decided are the levels of z, w, ℓ, b, c_e, and r, but each of these variables affects only current taxpayers and current teachers.

When $\delta < 1$, y as defined above is the general specification for taxpayer income. It is straightforward to show that taxpayer income with partial or no capitalization, $y_{\delta<1}$, is greater than taxpayer income with full capitalization. When full capitalization occurs, taxpayer income equals $y_{\delta=1}$, and when partial capitalization results income equals $y_{\delta<1}$; $\bar{y} = y_{\delta<1} > y_{\delta=1} = \underline{y}$.

2. Teachers: The well-being of a current teacher is also specified over two uncertain events: receiving or not receiving the full promised pension. The probability of receiving the full pension is μ, where μ is specified to depend upon the uncapitalized portion of the current stock of underfundings: $0 = \mu(\infty) \leq \mu[(1-\delta)U] \leq \mu(0) = 1$, where $d\mu/dU < 0$. If the teacher does receive the promised pension, then he or she receives a current level of compensation equal to $\bar{w} = w + \Delta w\ell/\ell - c_e/\ell = w(1+\Delta) - c_e/\ell$, where w is the

current wage per teacher, $\Delta w\ell/\ell$ is the present value of promised pensions per teacher, and c_e/ℓ is the current level of employee contributions per teacher. If the teacher does not receive any of the promised pension except his or her own contributions plus interest earnings (the most likely worst-case outcome), then he or she receives a total compensation in today's dollars of $\underline{w} = w + c_e/\ell - c_e/\ell = w$. In addition to total compensation, the average teacher is also assumed to value job tenure, represented here by the total number of teachers employed per taxpayer (ℓ). The expected utility to a current teacher of present state pension policy is therefore specified by:

$$V_e = \mu v_e(\bar{w}, \ell) + (1 - \mu)v_e(\underline{w}, \ell) ,$$

where $\partial V_e/(\cdot) \geq 0$ and $\partial^2 V_e/\partial(\cdot)^2 \leq 0$ for $(\cdot) = \bar{w}$, $\underline{w}$, and ℓ.

3. Preferences in the Pension Games: Given these specifications of teacher and current taxpayer utilities we can define each coalition's preferences over the variables of the pension budget. Three cases are relevant: partial capitalization ($0 \leq \delta < 1$) and teacher uncertainty as to the status of pension benefits ($0 \leq \mu < 1$); partial capitalization and teacher certainty on pension benefits ($\mu = 1$); and full capitalization ($\delta = 1$) and teacher certainty ($\mu = 1$). (The fourth possibility--full capitalization and teacher uncertainty--is irrelevant by our specification of μ as a function of the uncapitalized portion of unfunded liabilities.) Coalition preferences are conditional on the structure of the pension game. Preferences for allocations over c_e, c_g, r, and b from the regulation game are specified based upon the likely effects of those variables on the outcomes of the legislative and local bargaining games. Preferences for allocations of z and p in the legislative game are conditioned by the observed values of c_e, c_g, r, and b from the regulation game and by expectations as to the effects z and p may have on the

outcomes for w and ℓ from the bargaining game. Finally, preferences for w and ℓ are conditioned by the actual outcomes from legislative and regulation games. Table 2 summarizes the results; likely preferences of future taxpayers over outcomes are also presented.

In the case where teachers are certain to receive their pensions--perhaps because of judicial guarantees--teacher utility is described by $V_e=v_e(\bar{w}, \ell)$, where $\bar{w} = w(1 + \Delta) - c_e/\ell$. Here increases in c_e will only lower the income of teachers; teachers should therefore prefer to reduce own contributions. However, since pension policy emerges from a sequence of decisions (games), teachers must also consider the consequences of a lower c_e on taxpayers. As I show below, in the case of teacher pension certainty, a fall in c_e is likely to increase taxpayer income. Since higher taxpayer incomes are likely to mean increased expenditures for education aid and for teacher wages and employment, the indirect ("next games") effect of a fall in c_e are also favorable. Given these favorable direct and indirect effects on $\bar{w}$ and ℓ, teachers should prefer to reduce own contributions when pensions are guaranteed. This is indicated in Table 2 by a (<) for c_e under the column, $\mu = 1$. With pension certainty, teachers should also prefer to lower taxpayer contributions (c_g), for lower c_g means higher taxpayer incomes and possibly more state aid from the legislative game and more wages and job security from the local bargaining game. Thus Table 2 indicates a (<) for c_g under the column $\mu = 1$. Increases in the rate of return on the pension portfolio (r) are also favored for the same reason. There are no direct benefits for teachers with certain pensions from a rise in r, but taxpayer income may rise when r increases and the resulting increase in y will aid teachers in the legislative and bargaining stages of the pension game. Thus a (>) is indicated beside r in Table 2 for teachers with certain pensions. Teachers are also likely to prefer an increase in pension benefits

Table 2: Coalition Preferences for Pension Variables

Variables	Current Teachers		Current Taxpayers		Future Taxpayers	
	$\mu = 1$	$0 \leq \mu < 1$	$\mu = 1$	$0 \leq \mu < 1$	$0 \leq \delta < 1$	$\delta = 1$
Regulation						
c_e	(<)	(≤)	(<)*	(>)	(>)	(=)
c_g	(<)	(≥)	(<)*	(≤)	(>)	(=)
r	(>)	(>)	(>)	(>)	(>)	(=)
b	(≥)	(≥)	(≤)	(≤)	(<)	(=)
Legislative						
p	(<)	(≥)	(<)*	(≤)	(>)	(=)
z	(>)	(>)	(<)	(<)	(<)	(=)
Local Bargaining						
w	(≥)	(≥)	(≤)	(≤)	(<)	(=)
ℓ	(≥)	(≥)	(≤)	(≤)	(<)	(=)

(>) Increase Preferred

(<) Decrease Preferred

(=) Indifference

*If $\delta = 1$, current taxpayers are indifferent.

(b). An increase in b in the form of a higher guaranteed pension will increase $\bar{w}$ as Δ rises. An increase in b as disability benefits can be viewed in this model as increased job security, that is, as an increase in ℓ for teachers. Both $\bar{w}$ and ℓ increase teacher utility. The increase in b may have a countervailing cost, however. It lowers taxpayers' incomes which may mean lower state education aid or wages and employment in the legislative and bargaining games. Taxpayers (see below) prefer to reduce b. Teachers therefore will ask for increases in b only to that point (a point of indifference represented by (=) in Table 2) where the gains from b in higher $\bar{w}$ and ℓ just compensate for possible later losses in $\bar{w}$ and ℓ in the legislative and bargaining games. In Table 2 teacher preferences for b are represented by (≥).

In the legislative game--given the allocations from the regulation game--teachers with certain pensions prefer lower values of state pension contributions (p). Lower contributions impose no cost on the teachers but they do give taxpayers more income to allocate to state education aid or to wages and employment. Teachers will prefer more state education aid (z) provided the direct effects of aid on wages and jobs dominate the indirect effects of lost taxpayer incomes in the local bargaining game. This is likely if there is a significant expected "flypaper effect" to state aid (see Inman, 1979) and if the administrative costs of state education aid (measured by $1 - \gamma$) are not large. Table 2 assumes this to be the case and specifies a (>) for z, when $\mu = 1$. Finally, given the outcomes of the regulation and legislative games, increases in wages (w) and employment (ℓ) in the local bargaining game are favored, up to satiation, by teachers with certain pensions. A (≥) for w and ℓ are reported in Table 2 for teachers.

When faced with teachers who view their pensions as guaranteed ($\mu = 1$),[9] taxpayers will prefer to reduce c_e and c_g when underfundings are partially capitalized ($\delta < 1$) and are indifferent to the levels of c_e and c_g when underfundings are fully capitalized ($\delta = 1$). For c_g, this result follows directly from the definition of taxpayer income. The argument is more subtle for levels of c_e. An increase in teacher contributions (c_e) will have a direct positive effect on taxpayer incomes, but when pensions are guaranteed to teachers there may be a subsequent negative effect as teachers demand a compensating increase in wages in the local bargaining model. The initial gains in income from the increase in c_e in the regulation game must be balanced against the subsequent losses in income in the bargaining game. From an initial equilibrium in the local bargaining game, an increase in c_e will lower $\bar{w}$ and therefore command an equal compensating increase in w. The net effect on the taxpayer's income of an increase in c_e (denoted c_e^+) will therefore be to first increase income by $\lambda\{\phi + \delta(1 - \phi)\}c_e^+$ (from the definition of y) but then to lower taxpayer income by λc_e^+ because of equal compensation paid to teachers in the bargaining model: the net change in income equals $\lambda\{\phi + \delta(1 - \phi) - 1\}c_e^+$.[10] In the case of partial capitalization ($\delta < 1$; and $\phi < 1$) taxpayer income declines as employee contributions rise; thus taxpayers prefer to reduce employee contributions with partial capitalization and certain teacher pensions. When there is full capitalization ($\delta = 1$), the change in income is zero and taxpayers are indifferent. Taxpayers unambiguously prefer increases in the rate of return of the pension portfolio (r) as it increases their incomes. However, taxpayers are indifferent to, or prefer to decrease, pension benefits (b). An increase in b reduces taxpayer income from the regulation game, but as b is valued by teachers it may mean compensating reductions in z, w, or ℓ in the legislative and bargaining games. If the fall in aid or the labor budget just compensates for the income lost from the increase in b then taxpayers will be indifferent to changes in pension benefits; otherwise, a reduction is preferred.

In the legislative game, when taxpayers confront teachers who are certain of their pensions ($\mu = 1$), taxpayers will prefer lower levels of state pension contributions (p) when there is partial capitalization ($\delta < 1$) and will be indifferent to levels of pension funding when there is full capitalization. This result follows from the definition of y and the fact that with secure pensions teachers will not demand compensating changes in wages or employment for reductions in p. Current taxpayers also prefer lower levels of state aid for education (z). From y, increases in z reduce taxpayer income--because of the administrative expense of $1 - \gamma$--without offering taxpayers any gains in w or ℓ in the local bargaining game which they could not have achieved on their own without aid.[11]

Finally, in the local bargaining game, taxpayers prefer lower levels of wages (w) but may prefer to increase or decrease teacher employment (ℓ). If the expected benefits of an additional teacher exceed the expected costs of that teacher (at a given wage), then taxpayers will prefer to increase ℓ; if expected benefits fall short of expected costs then taxpayers will wish to decrease ℓ.[12] However, since teachers always prefer to increase ℓ, the relevant range of ℓ for bargaining will be when taxpayers are indifferent to, or prefer to reduce ℓ. This is indicated in Table 2 as ($\leq$).

Teacher and taxpayer preferences over key pension variables are also defined when there is partial capitalization of underfundings and teachers are not certain of receiving benefits; see Table 2 under the columns $0 \leq \mu < 1$. The analysis is identical to that in the case of certain pensions for both taxpayers and teachers for r, b, z, w, and ℓ. Where matters may differ is over the pension funding variables: c_e, c_g, and p. Here teachers enjoy a direct benefit from any increase in c_e, c_g, and p as increased funding lowers U and increases the probability that teachers will receive their uncertain pensions. There are costs, however, which the teachers must consider. For example, an increase in c_e imposes a possible burden on teachers for c_e lowers $\bar{w}$. There is therefore a preferred level of c_e beyond which teachers may not wish to go; beyond this point teachers prefer to reduce c_e.[13] Since taxpayers (see below) also prefer to increase c_e as long as teachers prefer to increase c_e, the only relevant range for bargaining is where teachers are indifferent to or wish to reduce c_e. Table 2 therefore represents teacher observed preferences for c_e as (≤). Similar arguments apply to teacher preferences for increases in c_g and p. Here increases in c_g and p lower taxpayer incomes which are likely to make subsequent negotiations over z, w, and ℓ more difficult. Teachers will prefer increases in c_g and p only to that point where the expected gains from reduced underfundings just equal the expected costs in lower wages and employment.[14] But as taxpayers (see below) prefer to reduce c_g and p, teachers who view their pensions as insecure will always be in that range of c_g and p where they are indifferent to (=) or prefer to increase (>) c_g and p. Thus relevant teacher preferences for c_g and p are denoted as (≥) for $\mu < 1$.

Taxpayers must also balance the gains and costs of pension funding when bargaining with teachers who see their pensions as uncertain. In contrast to the case of certain teacher pensions, here taxpayers gain with any offer on the part of teachers to contribute to their pensions. Since teachers prefer to increase c_e (at least to their point of indifference), taxpayers do not have to compensate teachers for the increase. Thus any offered increase in c_e

is a clear benefit to taxpayers. As in the case of certain teacher pensions, however, taxpayers continue to prefer to reduce c_g and p. Reductions in c_g and p add to taxpayer incomes, though now there are potential costs as teachers demand compensating increases in wages for the added pension risk they bear. Taxpayers will continue to seek to lower c_g and p as long as the direct gains in y dominate any compensation which must be paid to teachers through higher wages. When the income gains from the regulation and legislative games just equal the expected income losses from the bargaining game, then taxpayers will be indifferent to further reductions. Table ? represents taxpayer preferences for c_g and p as ($\leq$).

The last two columns of Table 2 summarize the preferences of future taxpayers for pension allocations made by current taxpayers and teachers. Future taxpayers are assumed to prefer all allocations which minimize their tax obligations for past underfundings when there is pension shifting due to partial capitalization and to be indifferent to all allocations when there is full capitalization. With partial capitalization (the column, $0 \leq \delta < 1$), underfundings are minimized when current teacher and taxpayer contributions are maximized (c_e, c_g, p), when the return to the pension portfolio is maximized (r), and when pension benefits and its determinants are minimized (b, z, w, and ℓ).

C. The Structure of Pension Politics

Having specified coalition preferences over outcomes, the next task is to define the structure of the regulation, legislative, and bargaining games.

1. <u>The Regulation Game</u>: The regulation game controls c_e, c_g, r, and b and involves a conflict between current taxpayers, current teachers, and, possibly, future taxpayers. Institutionally, the regulation game is played between tne governor as an elected representative of current taxpayers, and

possibly teachers, and a pension regulation board. Typically, the pension board is composed of two groups: appointed members (often bankers or those with financial backgrounds) responsible for the "soundness" of the plan and members elected from the plan membership. Each coalition--current and future taxpayers and teachers--is represented in the regulation game. The relative influence of teachers in this game is represented by two variables: the percent of the pension board which is elected (%ELC) and a (0, 1) dummy variable to indicate whether the pension plan is a teacher only (TEACH = 1) or a general (TEACH = 0) pension plan. The relative influence of future taxpayers comes from appointed members to the board; their influence will therefore be inversely related to the variable %ELC. The influence of current taxpayers is measured by the party affiliation of the governor, where Republican governors (REP = 1, if Republican, 0 otherwise) are expected to be relatively more supportive of taxpayers' interest over those of the teachers.[15] I also examine the possible influence of an alliance of current and future taxpayers against teachers. If a significant portion of current taxpayers remain within the state until present teachers retire, then the interests of current and future taxpayers may well coincide; see fn. 7 above. A variable which measures the percent of the state population which has not migrated from the state in the past year (STAY) is used to approximate the coincidence of current and future taxpayer interests. If STAY is high, teachers may be less influential. To test for this possibility, the interaction variable STAY · %ELC is included along with %ELC, TEACH, and REP to specify the relative influence of each coalition in the regulation game.

The employee and employer contribution equations have the same basic structure: contributions are composed of a legally mandated level of contributions and a negotiated level of supplemental contributions. Mandated contributions equal a state required contribution rate--η_e and η_g, both generally set in the original legislation which established the pension plan--times the expected wage bill: $\eta_e(1 + \omega)(w\ell)_{-1}$ for employees and $\eta_g(1 + \omega)(w\ell)_{-1}$ for employers, where ω is the expected rate of growth in the wage bill from last year's level, $(w\ell)_{-1}$. The mandated rates, η_e and η_g, are taken as exogenous. Supplemental contributions are made at variable supplemental rates, σ_e and σ_g for employees and employers respectively, times the expected wage bill; σ_e and σ_g are endogenous. The rates σ_e and σ_g may depend upon the stock of past underfundings (U_{-1}), the expected growth in wages $(1 + \omega)$ to measure future liabilities and employee contributions, the presence of required social security contributions (SS = 1 if required, 0 if not), and the four variables which measure the relative influence of current and future taxpayers and teachers in the regulation game. Formally:

$$c_e = \{\eta_e + \sigma_{e0} + \sigma_{e1}U_{-1} + \sigma_{e2}(1+\omega) + \sigma_{e3}SS + \sigma_{e4}TEACH + \sigma_{e5}\%ELC + \sigma_{e6}STAY \cdot \%ELS + \sigma_{e7}REP\}(1 + \omega)(w\ell)_{-1}\text{, and} \qquad (4)$$

$$c_g = \{\eta_g + \sigma_{g0} + \sigma_{g1}U_{-1} + \sigma_{g2}(1 + \omega) + \sigma_{g3}SS + \sigma_{g4}TEACH + \sigma_{g5}\%ELC + \sigma_{g6}STAY \cdot \%ELC + \sigma_{g7}REP\}(1 + \omega)(w\ell)_{-1}\ . \qquad (5)$$

The average rate of return earned on current pension assets (r) is specified as the sum of three separate components: the current risk-free rate of return (r_f, measured by the annual rate of return on U.S. Treasury Bills), plus a risk premium equal to the price of risk (measured as the difference between a rate of return for a "market" portfolio (r_m),[16] and the risk free rate, $r_m - r_f$) times the amount of risk in the state's portfolio (measured by the state portfolio's investment "beta," β), plus an average return unique to each state which measures the state's relative investment performance (r_a, which may be positive or negative). Formally, $r = r_f + \beta(r_m - r_f) + r_a$, or alternatively:

$$(r - r_f) = r_a + \beta(r_m - r_f) , \qquad (6)$$

where the coefficients r_a and β are possibly unique to each state.[17]

Total benefits paid to plan members (b) is the sum of retirement (b_r) plus disability (b_a) plus plan withdrawal (b_w) benefits. Retirement benefits consist of the legally required contributions to retirees--denoted b_{r0} and defined as $b_{r0} = \theta_{r0}(w\ell)_{-1}$, where the lagged wage bill $(w\ell)_{-1}$ is approximately proportional to the retirees' benefit wage base--plus supplemental benefits paid to retirees from employee and employer contributions at rate ε_r and from investment earnings at rate ν_r. Withdrawal benefits are a fixed, and state-specific, obligation imposed by teachers who leave the pension system before retirement. Disability benefits are made at a rate θ_a, also against the lagged wage bill $(w\ell)_{-1}$, where θ_a is specified to depend upon the level of economic activity in state (measured by the state unemployment rate, UE),[18] the percent of teachers who are male (MALE), the availability of social security to plan members (measured by the variable SS=1 if members are in social security, and 0 otherwise), the relative power of teachers versus current and future taxpayers--as measured by the variables, TEACH, %ELC, %ELC·STAY, and REP--and employee plus employer contributions and investment earnings. Formally, the benefit structure can be specified as:

$$b = b_r + b_w + b_a \qquad (7)$$

where,

$$b_r = \theta_{r0}(w\ell)_{-1} + \varepsilon_r(c_e + c_g) + \nu_r(rA_{-1}) \qquad (7a)$$

and,

$$(b - b_r) = b_w + \{\theta_{a1}UE + \theta_{a2}MALE + \theta_{a3}SS + \theta_{a4}TEACH + \theta_{a5}\%ELC \tag{7b}$$

$$+ \theta_{a6}\%ELC \cdot STAY + \theta_{a7}REP + \theta_{a8}(c_e + c_g) + \theta_{a9}(rA_{-1})\}(w\ell)_{-1} .$$

By substituting (7a) and (7b) into (7), the behavioral specification for total system benefits (on p.5 above) can be defined:

$$b = b_0 + \varepsilon\{c_e + c_g\} + \nu(rA_{-1}) , \tag{7'}$$

where b_0 is basic system benefits paid each year, ε $\left(= \varepsilon_r + \theta_{a8}(w\ell)_{-1}\right)$ is the system-wide rate of spillover from contributions into benefits, and ν $\left(= \nu_r + \theta_{a9}(w\ell)_{-1}\right)$ is the system-wide rate of spillover from investment earnings into benefits.

2. The Legislative Game: The results of the regulation game are assumed to be known prior to the start of the legislative game; thus c_e, c_g, rA_{-1}, and b are exogenous when current teachers and taxpayers negotiate over levels of state aid for education (z) and state contributions to the pension fund (p). Also assumed to be exogenous to legislative negotiations are federal aid to state and local governments (Z_s and Z_c) and state and local spending for services other than education (E and S). The legislative game is viewed as a two party cooperative game in which teachers and taxpayers negotiate to a contract line involving alternative levels of state aid and pension contributions. In effect, we are modelling the allocations of a state legislature's "education committee," taking as given the level of other state expenditures (E). When teachers and taxpayers preferences differ for both z and p ($0 \leq \mu < 1$), teachers are assumed to want more of both expenditures. In the case where teachers and current taxpayers agree that pension funding should be minimized ($\mu = 1$), the legislative game reduces to negotiations over only z and again teachers are assumed to want more z than taxpayers. Outcomes

in the legislative game will be some compromise between that which each party would prefer if they could dictate the final allocations--that is, some weighted average of their "ideal" or "bliss" points in tne (z, p) bargaining space. Specifications for each party's "bliss" points are derived in Appendix A.[19] The position of that compromise is assumed to depend upon the relative bargaining strengths of the two parties.[20] Formally,

$$z = \{1 - \pi_z(Q_s)\}z_T^*(\tilde{\tau}, Y_s, T_s, \alpha, (1 - \delta)\hat{U}) + \pi_z(Q_s)z_e^*(\cdot) , \qquad (8)$$

and

$$p = \{1 - \pi_p(Q_s)\}p_T^*(\tilde{\tau}, Y_s, T_s, \alpha, (1 - \delta)\hat{U}) + \pi_p(Q_s)p_e^*((1 - \delta)\hat{U}) , \qquad (9)$$

where $z_T^*(\tilde{\tau}, Y_s, T_s, \alpha, (1 - \delta)\hat{U})$ and $p_T^*(\tilde{\tau}, Y_s, T_s, \alpha, (1 - \delta)\hat{U})$ are the preferred allocations of z and p for current taxpayers (their bliss points), where $z_e^*(\cdot)$ and $p_e^*[(1 - \delta)\hat{U}]$ are the teachers' preferred allocations for z and p, and where $\pi_i(Q_s)$ $(i = z, p)$, $0 \le \pi_i(Q_s) \le 1$, is the relative weighting on teacher preferences in the legislative bargaining game as a function of a vector Q_s representing relative teacher power. Determinants of taxpayer ideal points include the tax prices for p and z $(\tilde{\tau} = [\lambda(1 - \delta), \lambda(1 - \gamma)])$, taxpayer's exogenous income to the legislative game given allocations from the regulation game $(Y_s = \{I + \lambda(Z_s + Z_c) - \lambda(E + S)\} + \lambda\{\phi + \delta(1 - \phi)\}c_e + \lambda\{\psi + \delta(1 - \psi)\}(rA_{-1}) - \lambda\{1 - [\phi + \delta(1 - \phi)]\}c_g - \lambda\delta b)$, taxpayer tastes for z and p (T_s, measured by the percent of taxpayers over 65 (OLD) and the number of school age children per family (KIDS)), a proxy variable for the probability (α) that current taxpayers will fully pay for teacher pensions (measured by the percent of taxpayers who did not leave the state in the previous year, STAY), and the uncapitalized portion of pension underfundings following the regulation game $((1-\delta)\hat{U} = (1-\delta)\{U_{-1} - [(1-\varepsilon-\phi)(c_e+c_g) + (1-\nu-\psi)(rA_{-1}) - b]\})$. Teachers' ideal allocations for z and p are given by their levels of satiation in w and ℓ and by that level of p which insures pension benefits. Assuming identical teacher preferences, $z_e^*(\cdot)$ will be constant across all teachers and $p_e^*(\cdot)$ will depend only upon each state's level of uncapitalized underfundings following the regulation game, (i.e., $(1 - \delta)\hat{U}$). The vector (Q_s) of variables to measure the relative influence of teachers in legislative bargaining include: the percent of teachers in the state covered by collective bargaining agreements (%CB),[21] the number of teachers per taxpayer (ℓ), the percent of those teachers who belong to the two professional organizations (NEA and the AFT), the dues collected by the NEA measured in dollars per taxpayer (DUES), whether the NEA has an established legislative liaison for lobbying (LIAS = 1 if so, 0 if not), and the percent of all (non-education) public employees in the state who belong to the ally public union, AFSCME (denoted AFSCME).

3. The Local Bargaining Game: Given the outcomes of the regulation and legislative games, current taxpayers and teachers finally negotiate wages and employment in the local labor bargaining game. Like the legislative game, the local bargaining game is viewed as a cooperative game with a final allocation located on the contract line between taxpayer and teacher bliss points, now in the w and ℓ bargaining space. Inman (1982) outlines the details of such a bargaining process when pension funding influences negotiations. The formal specification of such a game is represented here by:

$$w = \{1 - \pi_w(Q_c)\}w_T^*(w_{pr}) + \pi_w(Q_c)w_e^*\{\Delta, (1 - \delta)\hat{U}, c_e/\ell\} , \qquad (10)$$

and

$$\ell = \{1 - \pi_\ell(Q_c)\}\ell_T^*(\tilde{w}_{pr}, Y_c, T_c, \alpha) + \pi_\ell(Q_c)\ell_e^*\{\Delta, (1 - \delta)\hat{U}, c_e/\ell\} . \qquad (11)$$

The wage w_T^* is the taxpayer's most preferred wage and equals the teacher's alternative wage in private sector ($w_T^* = w_{pr}$), while ℓ_T^* is the taxpayer's most preferred level of teacher employment defined by the cost per teacher at the preferred wage inclusive of pension payments ($\tilde{w}_{pr} = \lambda(1 + \delta\Delta)w_{pr}$), taxpayer income before the local bargain ($Y_c = Y_s - \lambda(1 - \delta)p - \lambda(1 - \gamma)z$), taxpayer tastes for education (measured by KIDS) and the probability (α) that the taxpayer will fully pay for teacher pensions (measured by STAY). The teacher's preferred levels of wage and job security, w_e^* and ℓ_e^*, respectively, depend upon the rate of full-funding needed to cover the "normal costs" of the pension (Δ, alternatively, the rate of private savings needed by the worker to match the promised public pension), the likelihood that the promised pension will be paid (μ, measured here by the uncapitalized share of underfundings after the regulation and legislative games, $(1 - \delta)\tilde{U}$, where $\tilde{U} = \hat{U} - p$) and by the teachers' own contributions to pensions (c_e/ℓ). Finally, the relative influence of teachers in contract negotiations is measured by $\pi_i(Q_c)$, ($i = w$ or ℓ), $0 \leq \pi_i(Q_c) \leq 1$, where $\pi_i(Q_c)$ is specified as a function of the percent of teachers covered by collective bargaining (%CB). The formal derivation of taxpayer and teacher ideal points is given in Appendix A.

Equations (1) through (11) above fully specify a dynamic political economy model of teacher pension funding. Equations (1) - (3) are the key funding identities which define the level of underfunding in each period; equations (4) - (11) are the behavioral equations of the model which specify the determinants of each fiscal variable used in the funding identities. Together these equations allow us to predict the future trends in the funding status of teacher pensions and, to the extent underfundings appear excessive, to evaluate alternative federal policies to encourage a sounder state and local pension policy.

IV. The Funding of Teacher Pensions

The pension model specified in equations (1)-(11) is estimated as three connected subsystems of equations for a sample of the 48 mainland states for the ten year period, 1971-1980. Equation (1) is a reduced form specification for the stock of pension underfundings and is estimated separately for each state. Equations (2)-(7) specify the regulation game and the administrative decision to contribute to the pension funding; these six equations are estimated as a system allowing for cross-equation correlations of the equation-specific error terms. Equations (8)-(11) specify the state legislative game and the local bargaining game and these four equations are estimated as a third subsystem, again allowing from cross-equation correlations of equation-specific error terms. All fiscal and income variables are measured in 1967 dollars and are deflated by the number of taxpayers, defined here as the state's population minus the number of public school teachers. Finally, for the estimated specification of each equation, error terms are assumed to be additive, normally distributed, and uncorrelated through time and across states. Results are summarized in equation (1) and Tables 3 to 5 below.

A. Pension Accounting

Equation (1) is the reduced form specification for a state's level of unfunded pension liabilities. The equation has been estimated state by state to allow for across state variation in the key pension plan parameters which relate current wages to current levels of underfunding. Data for plan underfundings are from Inman (1986) and are based upon the original actuarial estimates in Arnold (1982). A pooled, across state and time, estimation of (1) summarizes the basic underfunding relationship for the sample as a whole:

(1) $$\hat{U} = \underset{(.127)}{5.171}(w\ell) - A, \quad R^2 = .78$$

The actuarial constant, Ω, has an average value for our sample of 5.171, implying the average plan's gross liabilities will be approximately five times the current wage bill. There is great variation in Ω across states, however. While most states cluster between values of 4 to 7, some states have values as high as 10 (Idaho and Maine) or as low as 2 (Minnesota and Missouri). Variation in Ω is due to differences in benefit replacement rates, retirement ages, and, most importantly, COLA protection (see Inman (1986)).

Of central interest here, however, are the determinants of U, given Ω. The stock of underfunding in a given state, U, increases as w and ℓ increase and is reduced as assets (A) accumulate. Assets grow as net contributions (n) to the pension system increase. These key variables--w, ℓ, and n--are set within the regulation, legislative, and local bargaining games summarized below.

B. The Regulation Game

Table 3 summarizes the structure of the pension regulation game. Equations (2)-(7b) were estimated as a system of interdependent equations allowing for possible correlation of the error terms across the six behavioral equations of the regulatory model. Because of this possible error term interdependence, the variables (p - b), ($c_e + c_g$), and (rA_{-1}) in equation (3) are treated as endogenous; estimation was by three stage least squares (3SLS). The results strongly suggest a pension system susceptible to fiscal manipulation, particularly in contribution, benefit, and savings behavior.

Equation (3) describes the net savings behavior of the pension system as a whole, given outlays from the system because of current benefit payments (b) and contributions to the system from the state legislature (p), from employees (c_e), from local governments (c_g), and from the investment returns on prior assets (rA_{-1}). Equation ($\hat{3}$) is the econometric specification of equation (3),

Table 3: The Regulation Game

Dependent Variables			Independent Variables**
$(\hat{3})$	n	=	$\underset{(.122)^*}{.928}(p - b) + \underset{(.100)^*}{.679}(c_e + c_g) + \underset{(.120)}{.044}(rA_{-1})$
$(\hat{4})$	c_e	=	$\{\hat{n}_e^s + \underset{(.112)^*}{.464} + \underset{(.00002)}{.00002}\, U_{-1} - \underset{(.114)^*}{.366}(1 + \omega) - \underset{(.005)}{.005}SS - \underset{(.004)^*}{.073}TEACH$ $+ \underset{(.181)}{.158}\%ELC - \underset{(.201)}{.174}\%ELC \cdot STAY - \underset{(.006)^*}{.021}REP\}(1 + \omega)(w\ell)_{-1}$
$(\hat{5})$	c_g	=	$\{\hat{n}_g^s + \underset{(.143)^*}{.828} + \underset{(.00002)}{.00002}U_{-1} - \underset{(.145)^*}{.724}(1 + \omega) - \underset{(.006)^*}{.031}SS - \underset{(.006)^*}{.057}TEACH$ $- \underset{(.231)^*}{.533}\%ELC + \underset{(.256)^*}{.526}\%ELC \cdot STAY - \underset{(.007)^*}{.028}REP\}(1 + \omega)(w\ell)_{-1}$
$(\hat{6})$	$(r - r_f)$	=	$\hat{r}_a^s + \underset{(.006)^*}{.039}\,(r_m - r_f)$
$(\hat{7}a)$	b_r	=	$\hat{\theta}_0^s(w\ell)_{-1} + \underset{(.049)^*}{.271}\,(c_e + c_g) + \underset{(.026)^*}{.195}(rA_{-1})$
$(\hat{7}b)$	$(b - b_r)$	=	$\hat{b}_w^s + \{\underset{(.075)}{.016}UE - \underset{(.155)}{.044}MALE - \underset{(.067)}{.007}SS - \underset{(.009)}{.003}TEACH - \underset{(1.319)}{.629}\%ELC$ $+ \underset{(1.404)}{.665}\%ELC \cdot STAY - \underset{(.009)^*}{.019}REP + \underset{(.0008)^*}{.0018}\,(c_e + c_g) + \underset{(.005)^*}{.0015}(rA_{-1})\}(w\ell)_{-1}$

*All coefficients marked by an (*) exceed their standard errors (reported within parentheses) by at least 1.65.

**All coefficients denoted by (^s) are estimated unique to each state; full results are available from the author upon request.

noting that $b = b_0 + \varepsilon(c_e + c_g) + \upsilon(rA_{-1})$. Thus the coefficients on $(c_e + c_g)$ and on (rA_{-1}) are estimates of $(1 - \phi)$ and $(1 - \psi)$, respectively. (Estimates of the parameters ε and υ are obtained from the benefit equations (7a) and (7b) below.) Were equation (3) simply an identity--that is, were the pension regulators just to pass dollars into and out of the system--all estimated coefficients in equation $(\hat{3})$ would be 1. This is in fact the case for state contributions less total benefits paid, $(p - b)$, whose coefficient is not significantly different from 1. The coefficients on employee and employer contributions and on interest earnings, however, are both significantly less than 1. The coefficient on $(c_e + c_g)$ is .679 (the t statistic of $3.21 = (1.0 - .679)/.100$ rejects the null hypothesis that the coefficient equals 1.0) and implies that \$.321 of every contributed dollar leaks from the pension accounts into the general state budget--that is, $\phi = .321$. The coefficient on (rA_{-1}) is only .044 (again, the t statistic of $7.97 = (1.0 - .044)/.120$ rejects the null hypothesis that the coefficient equals 1.0) and suggests that on average \$.956 of every dollar of interest earnings spills out of the pension budget and into the general budget--that is, $\psi = .956$. These released pension dollars are then allocated within the general state budget to one or more of four alternatives: 1) state government funding of pensions (p, where now the legislature can take the credit), or 2) state-to-local school aid, or 3) other state expenditures, or 4) general state tax relief. Estimation of the legislative model shows us where the dollars go, but suffice to say for now, it is not back into state pension funding.

The levels of local taxpayer (c_e) and teacher (c_g) contributions are also open to political manipulation. Estimated equations $(\hat{4})$ and $(\hat{5})$ specify econometrically the two contribution equations (4) and (5). The fixed, <u>legal rates</u> of contribution-- $\hat{n}_e^s$ and $\hat{n}_g^s$ --are unique to each state and datum, known from state laws.[22] The estimated coefficients define the supplemental rates of contributions for teachers (eq. $(\hat{4})$) and taxpayers (eq. $(\hat{5})$).

The results are most consistent with a specification in which teachers assume they will receive their pension ($\mu = 1$). Thus supplemental contributions are minimized (see Table 2; columns, $\mu = 1$). First, while past underfundings (U_{-1}) do show a positive effect on the rate of supplemental contributions, the effects are neither statistically nor quantitatively significant. A doubling of the level of lagged underfundings per taxpayer (from a mean of $246/taxpayer to $492/taxpayer) will increase each supplemental rate of contribution by only .005, or about 10% from their respective means (= .05 for employee contributions and .04 for employer contributions). Second, teacher-only pension plans, in contrast to those plans where teachers are part of a general public employee system, show significantly lower supplemental rates of contributions. For this sample, teacher-only plans have supplemental rates of contributions which average only .012 of wages for employers and .023 of wages for employees, in contrast to supplemental contribution rates for general plans which average .073 for employers and .099 for employees. Third, as teachers gain more political control over pension board policies through increased elected representation (%ELC), teachers' own pension contributions remain largely unchanged but taxpayer contributions are significantly reduced. The variable %ELC is statistically and quantitatively insignificant in the c_e equation but it has an important negative effect on c_g: $\partial c_g / \partial \%ELC = -.533 + .526 * STAY = -.065$, for STAY equal to its mean of .89. Increasing elected representation from 0 to 50% will reduce the mean rate of supplemental contributions from taxpayers from .04 to .008. These strong results for the effects of the variables TEACH and %ELC on supplemental contributions are only consistent with the specification in which retiring teachers are confident they will receive their pensions; see Table 2, column $\mu = 1$ vs. column $\mu < 1$.[23] Fourth, there is a strong "pay-as-you-go" bias in supplemental contributions. In those states with high rates of growth in teacher wages, supplemental contributions from teachers and taxpayers are significantly lower than in states with low wage growth. The expectation is that contributions from future teacher wages will help fund pension obligations incurred today; thus current contributions from wages can be reduced. Fifth, participation in social security has a negative effect on both rates of contribution and (as with %ELC) is particularly significant for the supplemental rate of employer contributions. Since the level of unfunded liabilities is included in the estimated equation, the negative effect of the separate social security variable does not represent the influence of plan integration. Rather, the negative effect is a pure rate offset and suggests that were the Federal government to impose an additional tax on employees and employers to help fund state or local pensions, own contributions to the state plan might well decline. Finally, states with Republican governors have lower rates of employee and employer contributions to pension funding, reflecting a desire to keep current taxes low.

In contrast to savings and contribution behavior, investment performance seems largely immune to politics. Estimates in equation $(\hat{6})$ of the rate of return equation provide a measure of the teachers' pension funds' systematic investment risk, β, as well as each state's relative investment performance, $\hat{r}_a^s$. When interpreted as a measure of portfolio risk, the coefficient β on the variable $(r_m - r_f)$ will be 0 when the pension's portfolio is uncorrelated with the market portfolio (essentially, risk-free) and will equal 1 when the portfolio is perfectly correlated with the market portfolio. Our results ($\beta = .039$) suggest that state pension investment portfolios in the 1970's were largely risk free.[24] The state specific constant terms ($\hat{r}_a^s$) show the portfolios in Arkansas, Delaware, Florida, Indiana, Nebraska, Nevada, New Mexico, and South Dakota to be better than average performers, generally 1% per annum, while the portfolios in Kansas, Maryland, and Utah are revealed to be poorer than average performers, also by about 1% per annum. Efforts to attribute these performance differences to systematic differences in the governing structure of pension plans were generally inconclusive; politics does not seem to influence investment policy.[25] Such results are not surprising, however, given the fact that all parties in the model have an interest in maximizing current period returns.

The estimated benefit structure in equations ($\hat{7}$a) and ($\hat{7}$b) also reveals a flexible pattern of allocations, generally aimed at increasing payments to current period teachers and taxpayers. The retirement benefit equation, ($\hat{7}$a), shows that \$.271 of every dollar of employee-employer contributions ($c_e + c_g$) and \$.195 of every dollar of investment earnings (rA_{-1}) are allocated to current retirees. Further, payments to disabled teachers are also increased as contributions and investment earnings are increased; see equation ($\hat{7}$b). Evaluated at the mean level of the lagged wage bill per taxpayer (≈ \$71), a dollar of increased contributions adds approximately \$.13 to disability payments (= .0018 × \$71) while a dollar of increased investment earnings adds \$.11 (= .0015 × \$71) to disability payments. Together, one dollar of ($c_e + c_g$) adds \$.40 (= \$.27 + \$.13) to total benefits paid while one dollar of investment earnings adds \$.30 (= \$.195 + \$.11). These marginal effects are estimates of the spill-out parameters from contributions and investment earnings into current benefits: $\epsilon = .40$ and $\upsilon = .30$.

By themselves, these marginal effects may not seem too troubling, for it appears that about \$.60 to \$.70 of every contributed or investment dollar remains as a net contribution for future investment. Unfortunately, this is not the case, as our estimates of the net contribution equation ($\hat{3}$) have shown. Those new pension dollars which are not allocated to current benefits are largely syphoned off for expenditure by the general state budget! From ($\hat{3}$) we estimated that \$.32 (= ϕ) of every contributed dollar and \$.96 (= ψ) of every dollar of investment earnings are transferred to the general budget for allocation to state education aid, to other state expenditures, or to tax relief. In summary, only \$.28 (= $1 - \varepsilon - \phi = 1 - .40 - .32$) of each dollar of employer plus employee contributions is actually allocated to future asset growth. And even then, these remaining pennies are not allowed to accumulate, for all of interest earnings are re-allocated to current benefits (υ = \$.30) or to the general state budget (ψ = \$.96).[26]

The overall impression from these results is one of a pension regulation system run largely for the benefit of current teachers, retirees, and taxpayers despite nominal state requirements to fully fund state pensions. While portfolio decisions seem immune to overt political manipulation--except to adopt a safe, risk-free investment strategy--benefit payments and net contributions seem strongly biased towards serving current retirees, current teachers, and current taxpayers. Future taxpayers and/or future retirees are the potential losers, but teachers, at least, behave as if they will get their pensions ($\mu \equiv 1$). There appears to be an implicit, yet clear, pay-as-you-go bias to the present regulation of teacher pensions.

C. The Legislative Game

The regulatory bias towards serving current residents will not be troubling if the legislative and bargaining processes show restraint by funding pensions (via p) and by controlling wage (w) and employment (ℓ)

growth. However, the economic, demographic, and political pressures again move allocations to favor the current period's residents and teachers.

Table 4 summarizes the estimates of the state legislative model. Estimation was by 3SLS with the pension funding (p) and state aid (z) equations as part of a general system of state (eqs. 8 and 9) and local (eqs. 10 and 11) educational finance. The specification allows for the possible correlation of errors across the four equations due to common omitted factors. The model as estimated introduces one important extension to the original specifications of the p and z equations. Taxpayers exogenous income to the state legislative game, Y_s, is broken down into its four main components: private before-state-tax income ($I_s = I - \lambda S - \lambda c_g$), exogenous fiscal income ($FY_s = \lambda\{Z_s + Z_c + \hat{\phi}(c_e + c_g) + \hat{\psi}(rA_{-1})\}$), the capitalized flow of contributions to fiscal wealth ($FW_s = \delta\lambda\{(1 - \hat{\phi})(c_e + c_g) + (1 - \hat{\psi})(rA_{-1}) - b\}$), and state non-education expenditures (E). The effects of each component are estimated separately. The advantage of this procedure is that it allows us to focus more directly on the effects of possible policy variables which work through Y_s.

The results of Table 4 reflect two compromises necessitated by the difficulty of estimating eqs. 8 and 9 as originally specified. First, the number of economic and political variables of interest requires the estimation of an extensive number of interaction effects. The full model was estimated, but the correlation among the many interactions precluded any firm conclusions from being drawn about the effects of individual variables. The model was therefore re-estimated with state specific constant terms and a time trend as proxies for all political-economic interactions, thereby allowing a clearer view of the direct effects on p and z of the economic and political variables of interest. Second, efforts to estimate the rate of capitalization (δ)

Table 4: The State Legislative Game: The Education Budget

Independent Variables**	State Pension Funding ($\hat{p}$) (Eq. (8))		State Education Aid ($\hat{z}$) (Eq. 9)	
	$\delta = 0.0$	$\delta = 1.0$	$\delta = 0.0$	$\delta = 1.0$
Tax Price				
τ	-1.683 (7.966)	-2.877 (7.529)	-39.324 (29.154)	-38.244 (28.821)
Taxpayer Income				
I_s	-.001 (.001)	-.001 (.001)	.020* (.004)	.021* (.004)
Fiscal Income				
FY_s	-.016 (.022)	-.002 (.021)	.371* (.077)	.368* (.077)
FZ_s	-.029 (.025)	-.036 (.023)	.498* (.089)	.498* (.088)
or FP_s	.027 (.055)	.128* (.054)	-.158 (.204)	-.206 (.208)
FW_s	—	-.572* (.083)	—	.143 (.319)
Taxpayer Preferences				
KIDS	-12.006* (3.166)	-9.695* (2.959)	22.438* (11.552)	22.596* (11.317)
OLD	-87.349 (63.764)	-114.167 (59.266)	-658.33* (233.48)	-659.05* (227.04)
Taxpayer Mobility				
STAY	74.486* (21.854)	71.133* (20.361)	357.79* (78.86)	359.61* (77.48)
Teacher Preferences				
$(1-\delta)\hat{U}$	.003 (.002)	—	-.004 (.007)	—
$(1-\delta)\hat{U} \cdot GR$	-.001 (.003)	—	.001 (.010)	—
Committee Bargaining				
%CB	-2.067* (1.084)	-1.583 (1.027)	21.316* (3.964)	21.159* (3.957)
ℓ	-.951* (.269)	-.422 (.258)	3.691* (.986)	3.752* (.991)
NEA-AFT	.877 (1.059)	1.386 (1.009)	-3.611 (3.879)	-3.893 (3.867)
DUES	-2.715 (3.231)	-4.096 (3.079)	39.007* (11.807)	39.714* (11.772)
LIAS	.847* (.408)	.853* (.389)	5.332* (1.497)	5.128* (1.491)
AFSCME	5.257* (2.972)	5.327* (2.838)	31.562* (10.886)	30.939* (10.863)
Legislature				
E	.017* (.009)	.012 (.008)	-.381* (.025)	-.379* (.026)

*All coefficients marked by an (*) exceed their standard errors (reported within parentheses) by at least 1.65.

**Other independent variables included in each equation but not reported in Table 4 include state specific constant terms and a time trend. There is no significant trend in pension funding, but real education aid per taxpayer has been rising at a rate of about $1.50 per year, *ceteris paribus*. To control for state legislators' expectations as to the effects of p and z decisions on w and ℓ, I have also included in each equation the rate of income growth, the percent of school-aged children who attend public school, and the percent of school districts with more than 1000 teachers. None of these additional variables were significant in the p and z equations as specified above.

implicit in state and local education budgeting proved inconclusive. A maximum likelihood search over alternative values of δ between 0 (no capitalization) and 1 (full capitalization) revealed a preferred value of $\hat{\delta} = 0$ but with a standard error which includes $\delta = 1.0$ well within its 90% confidence interval.[27] Table 4 therefore reports results for both the specifications $\hat{\delta} = 0$ and $\hat{\delta} = 1.0$.

1. State Pension Funding: The average level of state contributions to teacher pensions for the decade 1971-80 was \$6.75 per taxpayer (standard deviation = \$4.93) measured in 1967 dollars. The resulting pattern of spending on p is the outcome of conflicting demographic, political, and economic trends, the most important of which appear to be demographic and political. The demographic variables create, or relax, short-term fiscal pressures to which the political system responds.

The demographic variables--KIDS, STAY, and OLD--have a particularly important effect on the decision to fund teacher pensions. States with a higher rate of resident turnover (lower STAY) make significantly lower pension contributions. For example, the high turnover states where STAY equals .80 (20% of the residents move in a given year) will spend \$6.70 ($\hat{\delta} = 0$) to \$6.40 ($\hat{\delta} = 1.0$) less per year than the average state where STAY equals .89 (10% of the residents move). Swings in the number of school-age children per family (KIDS) also has a significant effect on the level of funding. States with a large number of children per fami'" spend less on pensions (but more on state aid for education, see below). The low KIDS state (KIDS = 1.0) spend from \$1.94 ($\hat{\delta} = 1.0$) to \$2.40 ($\hat{\delta} = 0$) more on pensions than does the mean KIDS state (KIDS = 1.2) which in turn spend from \$3.88 ($\hat{\delta} = 1.0$) to \$4.80 ($\hat{\delta} = 0$) more than the highest KIDS state (KIDS = 1.6). These are significant swings in funding for our sample states. Importantly, the decline in children per family over the last two decades has helped pension funding. The variable OLD (percent of population over 65) is not quite significant statistically, but its effects are important quantitatively. A modest two percentage point increase in the percent OLD (mean = .10, s.e. = .02) means a drop in pension funding of \$1.75 ($\hat{\delta} = 0$) to \$2.28 ($\hat{\delta} = 1.0$) per taxpayer.

While the historic importance of these demographic variables is clear, what is particularly crucial is what they portend for the future. The current baby boom generation will eventually reach age 65, increasing OLD. Taxpayer mobility is likely to remain high or increase, reducing STAY. If there is then a new baby boom acting to increase KIDS, the combined effect of the three demographic trends may well push state funding per taxpayer to new lows as we near the year 2000; see Section VI. Whether the levels of underfundings reach new highs remain to be seen, but what does seem clear now is that we cannot count on future demographic trends for a solution to today's unfunded pension liabilities.

Will, then, the current political system meet the funding challenge? Particularly important in explaining p, both statistically and quantitatively, are the number of teachers per taxpayer (ℓ) and the percent of the teaching force covered by collective bargaining (%CB). Both variables indicate the potential influence of teachers in state politics,[28] and both have a negative effect on p. Increasing the percent of teachers covered by collective bargaining by 47% (from the mean level of .53 to full coverage) reduces funding by \$.74 ($\hat{\delta} = 1.0$) to \$.97 ($\hat{\delta} = 0$) per taxpayer. Increasing the number of teachers per taxpayer by 10% will reduce pension funding by 7% or \$.47 ($\hat{\delta} = 1.0$) to 17% or \$1.15 ($\hat{\delta} = 0$) for the average state. The financial strength of the teacher coalition (measured by professional association dues collected per taxpayer, DUES) also has a negative effect on p, but it is not statistically significant. Whether teachers have a legislative liaison (LIAS) has a positive effect on funding, adding about \$.85 to the mean level of funding of \$6.75, and, interestingly, so too does the extent to which other public employees are unionized. AFSCME increases p, though the elasticity of state funding with respect to AFSCME coverage is only .07. It does not appear from these results that the teacher coalition is keenly interested in, nor allocates much political capital to, increased funding for their pensions.

Nor will future economic growth do much to stimulate state pension contributions. Funding is not significantly affected by the level of state private income (I). Factors which lower the tax price (λ) of state expenditures such as matching aid or federal tax deductibility will similarly have no important effect on p.[29]

Fiscal income (FY_s), defined as the sum of exogenous federal aid ($FZ_s = \lambda'Z_s + Z_c$)) and the net flow from the pension accounts into the general budget [$FP_s = \hat{\phi}(c_e + c_g) + \hat{\psi}(rA_{-1})$] has a small and insignificant negative effect on p. It is more instructive, however, to disaggregate fiscal income into its two components, FZ_s and FP_s, and examine their separate effects on p. (The results reported in Table 4 are from a regression with FY_s omitted and FZ_s and FP_s included along with all other variables; estimation was by 3SLS as before. Only the FZ_s and FP_s coefficients from those regressions are reported here; the other coefficients changed only marginally.) FZ_s is federal to state aid and it continues to have a small negative (yet insignificant) effect; increased general aid will do little to stimulate pension funding. FP_s plays the role of pension-specific grants-in-aid and in this study it has almost no net effect on the level of pension funding. Inman (1982) obtained a similar result in his study of local government pension funding. Together, these results imply that any federal bail-out strategy which gives pension aid to the general budget will probably prove ineffective without careful monitoring of state contributions (see Section V).

Perhaps most importantly, past level of pension underfundings ($\hat{U}$, when $\hat{\delta} = 0$) have no significant effect on the current decision to contribute to the pension accounts. When $\hat{\delta} = 0$ teachers may well lobby for increased funding as the stock of unfunded liabilities ($\hat{U}$) increases, though perhaps less so when pensions are judicially guaranteed (GR = 1). There is no evidence here that they do; doubling underfundings from the mean of \$246/taxpayer to \$492/taxpayer adds on \$.74 to p when pensions are not guaranteed and only \$.50 when they are. Again teachers seem confident that they will receive their future, though currently underfunded, pensions.

Finally, if we adopt the alternative specification and assume full capitalization ($\hat{\delta} = 1.0$), underfundings are no longer relevant for teachers, but the annual net flow of contributions to the stock of fiscal wealth, measured by FW_s, will be important to taxpayers. The results here show that any increases in net wealth will be offset by a reduction in state funding at a rate of \$.57 on the dollar. This reduction in p will then be allocated to other state expenditures or tax relief. Again, fiscal allocations within the pension budget favor current residents.

The general impression left by these results is of a funding strategy driven largely by taxpayer preferences to cutback contributions as other budgetary demands increase (KIDS) and as the opportunity to escape the consequences of underfunding grow (STAY and OLD). Teachers, on the other hand, seem confident of their pensions, even if $\delta = 0$. Rather than lobby for increased pension funding, they choose to allocate their political influence to other ends. Their favoured alternative, it appears, is state-to-local education aid.

2. State Education Aid: The average level of state support for local public education over our sample period, 1971-80, is $72.99 per taxpayer or approximately $310 per public school child (measured in 1967 dollars). Levels of support range from a low of $15/taxpayer to a high of $140/taxpayer. Taxpayer preferences, the relative bargaining position of teachers, and state economic resources each has an important influence on the political process which sets state-to-local education aid.

The incomes and preferences of the taxpayer coalition affect the allocation to state education aid much as one would expect. Higher resident private income increases z; $.02 of each dollar of private income is allocated to school aid and the implied income elasticity for the average state is .87. The tax price (λ) has the expected negative effect and an average tax price elasticity of -.35, though the coefficient estimates are not quite statistically significant (also see fn. 29 above). States with more school-age children per family (KIDS) and less population turnover (STAY) spend significantly more on school aid; states with more elderly (OLD) spend less.

Teachers will always prefer to increase state aid. The results here strongly support the hypothesis that increased political activity by teachers has been effective to this end. Increased coverage of teachers through collective bargaining (%CB), more teachers per taxpayers (ℓ), more professional dues per taxpayer (DUES), and the use of legislative lobbying via a liaison (LIAS) have all increased state school aid. Interestingly, so does AFSCME membership, suggesting a public employee union coalition to increase dollars generally to the local public sector. More dollars to local schools will mean less local tax pressure, and therefore more dollars for other local public services

Among the state fiscal variables, neither of the two pension wealth variables ($\hat{U}$ or FW_s) are significant in the state school aid equation: However, the flow of current fiscal resources (FY_s) to the state has a positive effect on state school aid. A dollar of aggregate fiscal income (FY_s) to the general budget increases state school aid by $.37, the remaining $.63 leaking out into general tax relief (see also Craig and Inman, 1982). The estimated effect of FY_s, however, is an average of the quite different effects of its two components, FZ_s and FP_s. A dollar of federal to state aid FZ_s, increases z by $.50; a major fraction of FZ_s is federal to state education aid. A dollar of spillover "aid" from the pension budget, FP_s, has no significant effect on z, however. Spillover "aid" from the regulatory pension budget is allocated entirely to other state expenditures or to general tax relief.

The final fiscal variable of interest in the z equation is non-education state expenditures (E). The model of state education budgeting proposed here is a model of constrained bargaining between teachers and taxpayers, given the level of spending on other state services. Institutionally, one might imagine p and z being set within the education subcommittee of the state legislature. Formally, the budget emerges from a Cournot game between this committee and all other budget committees.[30] The negative overall effect of E on (p + z) equal to -.37 (= -.381 + .017 or -.379 + .012) implies a downward sloping "reaction curve" of the education budget to increase in other state spending. As E is increased by $1, $.63 is financed by state revenues and $.37 is financed by a cutback in education spending. All of the cutback comes from school aid. Pension funding, it appears, is protected from the swings of fortune in the Grosspolitik.[31]

D. The Local Bargaining Game

Tables 5a and 5b summarize estimates of the bargaining game between teachers and local taxpayers over the levels of wages (w) and employment (ℓ), given state pension regulations and legislative allocations. Wages are defined as the real wage (1967 dollars) per teacher while employment is specified as teachers per (1000) taxpayers. The w and ℓ equations were estimated by 3SLS as part of a state and local fiscal system including the p and z equations from the state model; this specification allows for the influence of common omitted variables through error terms which may be correlated across the four equations. As with the state legislative model, results for both the no capitalization ($\delta = 0$) and full capitalization ($\delta = 1$) specifications are presented. And again, local resident income (Y_c) is decomposed into its four separate components, specified here as: private-before-local-tax income ($I_c = I - \lambda t_s - \lambda c_g$), exogenous fiscal income to the local community ($FY_c = \lambda Z_c + \lambda\gamma z$), the capitalized flow of contributions to fiscal wealth ($FW_c = FW_s + \delta\lambda p$), and local education expenditures other than for teacher salaries (S). The separate influence of each component is estimated.

1. <u>Teacher Wages</u>: The wage equation is specified as a weighted average of the teachers' preferred wage (w_e^*) and the preferred wage of local taxpayers $w_T^* = w_{pr}$, where w_{pr} is defined as the state's average private sector wage earned in retail and wholesale trade and selective services. The teachers' preferred wage (w_e^*) is that wage which achieves some (utility-specified) satiation level of compensation given teachers' expected levels of pension benefits and own pension contributions.[32] Expected pension benefits will depend upon the present value of pension compensation per dollar of wages (Δ, also called the pension's normal cost), the level of uncapitalized

Table 5a: Local Bargaining Game--Wages per Teacher

Independent Variables	(Eq. 10) $\delta = 0.0$	$\delta = 1.0$
Intercept	3555* (604)	3492* (622)
Taxpayer		
w_{pr}	.341* (.148)	.357* (.151)
$w_{pr} \cdot$ %CB	.615* (.212)	.648* (.212)
Teacher		
(c_e/ℓ)	1.102* (.207)	.961* (.206)
$(c_e/\ell) \cdot$ %CB	-1.498* (.280)	-1.406* (.276)
Δ	1717 (1402)	937 (1316)
$\Delta \cdot$ %CB	2773 (2160)	1935 (1936)
$\Delta \cdot (1 - \delta)\hat{U}$	-6.715* (1.729)	--
$\Delta \cdot (1 - \delta)\hat{U} \cdot$ %CB	6.317* (3.480)	--
$\Delta \cdot (1 - \delta)\hat{U} \cdot$ GR	2.385 (2.093)	--
$\Delta \cdot (1 - \delta)\hat{U} \cdot$ GR $\cdot$ %CB	-6.003* (3.517)	--
Bargaining		
%CB	-1222 (866)	-1182 (888)

All coefficients marked by an (*) exceed their standard errors (reported within parentheses) by at least 1.65.

Table [illegible]: Local Bargaining Game: Teachers per (1000) Taxpayer

Independent Variables	(Eq. 11) $\delta = 0.0$	$\delta = 1.0$
Tax Price		
$\tau \cdot w_{pr}$	−.000 (.000)	−.0003 (.0002)
$\tau \cdot w_{pr} \cdot \$CB$	.0005 (.0004)	.001* (.0004)
$(1-\delta) \cdot \tau \cdot (p/w_{pr}\ell)$	−1.559* (.897)	—
$(1-\delta) \cdot \tau \cdot (p/w_{pr}\ell) \cdot \$CB$	−2.692* (1.225)	—
Taxpayer Income		
I_c	.000 (.000)	.000 (.000)
$I_c \cdot \$CB$	−.001 (.001)	−.001 (.001)
Fiscal Income		
FY_c	.028* (.007)	.028* (.007)
$FY_c \cdot \$CB$	−.022* (.008)	−.022* (.009)
FW_c	—	.053* (.025)
$FW_c \cdot \$CB$	—	−.107* (.034)
Taxpayer Preferences		
KIDS	−1.042 (.721)	−.731 (.646)
KIDS · $CB	.179 (1.066)	.581 (.948)
Taxpayer Mobility		
STAY	2.652 (5.200)	−1.853 (4.876)
STAY · $CB	−5.740 (5.081)	−7.666 (4.819)
Teacher Preference		
(c_e/ℓ)	.000 (.000)	−.000 (.000)
$(c_e/\ell) \cdot \$CB$	−.000 (.000)	.000 (.000)
$(1-\delta)\bar{U}$	−.000 (.000)	—
$(1-\delta)\bar{U} \cdot \$CB$	.000 (.001)	—
$(1-\delta)\bar{U} \cdot GR$	.001 (.001)	—
$(1-\delta)\bar{U} \cdot GR \cdot \$CB$	−.000 (.001)	—
Bargaining		
$CB	6.256 (4.936)	6.128 (4.411)

*All coefficients marked by an (*) exceed their standard errors (reported within parentheses) by at least 1.65.

**Also included in the teacher per taxpayer equation are state specific constant terms and the variables S (= other local education expenditures, non-capital) and S · $CB. The constant terms are always positive and significant; S and S · $CB are never significant.

underfundings after the regulation and legislative games $((1 - \delta)\bar{U})$, and the presence, or not, of pension guarantees (GR = 1, if pensions are legislatively or judicially guaranteed, 0 otherwise). Each teacher's own contributions to pensions is defined as (c_e/ℓ). The teachers' preferred wage is expected to increase as the expected level of pension benefits declines--or as the actuarial rate Δ declines, as $(1 - \delta)\bar{U}$ rises, or if GR = 0--and as the level of own contributions (c_e/ℓ) increases. The relative bargaining strength of teachers in the local negotiations--specified to depend on the percent of teachers covered by collective bargaining, %CB--defines how far teachers can move the taxpayers from their preferred w_T^* to the teachers' preferred w_e^*. The higher is %CB, the higher will be average teacher wage in the state. In this specification, %CB interacts with $w_T^* = w_{pr}$ and the determinants of w_e^*.

The results show an important role for teacher collective bargaining within local labor negotiations. For a state with mean values of the independent variables and where $\delta = 0$, teacher wages will equal $5359 per teacher (1967 dollars) if %CB = 0 and rise to $5989 per teacher if %CB = 1.0. For the average state, but if $\delta = 1$, teacher wages will equal $5543 without collective bargaining and rise to $6253 with full coverage. The move to full collective bargaining for all teachers in a state adds from 11% (δ = 0) to 13% (δ = 1) to real wages earned by teachers. Quantitatively and statistically, the most important influence of unionization has been in allowing teacher wages to keep pace with the upward trend in real private sector wages; without collective bargaining teacher wages would have risen at only about 1/3 the rate of increase in the alternative private sector wage.

Wage levels seem largely immune to the swings in the pension system, however. The effects of increases in the promised rate of benefits as a fraction of current wages (Δ) are statistically insignificant and of the wrong sign. Increases in the levels of uncapitalized underfundings also have an unexpected (negative) effect on wages. The effect is small, however; the elasticities of wages with respect to $(1 - \delta)\tilde{U}$ range from 0 to -.03 (for $\Delta = .15$ and for alternative values of %CB and GR). Teachers are compensated for changes in their own contributions to pensions, however. In non-unionized states (%CB = 0), the marginal rate of compensation is approximately $1 for $1. In the more heavily unionized states (%CB > .70), however, wages actually fall slightly as c_e/ℓ increases, but the elasticities are small ($\approx -.04$).

In the end, it appears that the alternative private sector wage and the degree of collective bargaining have been the two main determinants of teacher wages over the past decade; pension funding or pension taxes have had only small effects on teacher wages.

2. <u>Teachers per Taxpayer</u>: The expansion of collective bargaining has also played an important role in setting teachers per taxpayer (ℓ). The variable %CB has a positive and quantitatively important own effect on ℓ. Perhaps more importantly, the growth in %CB appears to have reduced the responsiveness of teacher employment to swings in the major economic and demographic variables. While the coefficients on the interaction variables with %CB are not always statistically significant, the direction of influence is always (with one exception) to push the estimated effects of a given variable towards zero. The growth in collective bargaining appears to have led to increased rigidity in teacher employment.

The exception to this general pattern involves the one pension variable which is statistically significant in the employment model: $(1 - \delta)\lambda(p/w_{pr}\ell)$, a measure of the implicit subsidy to current taxpayers in the purchase of teachers because of pension underfunding. By underfunding pensions, current taxpayers are able to shift a portion of the full labor costs of teachers onto future taxpayers; the after-tax, uncapitalized portion of the ratio of pension funding to the current taxpayer's (preferred) wage bill measures this subsidy.[33] As this ratio falls, the implicit subsidy to hiring teachers increases and ℓ should rise. In fact it does (for $\delta = 0$), and the influence of the subsidy is significantly larger the more extensive is collective bargaining within the state. It appears that pension underfunding is being used to reduce labor costs to current taxpayers and to thereby provide job protection for current teachers. That this result follows from a conscious union strategy seems further supported by the fact that in the more unionized states the levels of state pension funding are themselves significantly lower; see Table 4 and the discussion of the state funding equation. Quantitatively, however, the effects of the subsidy are small, primarily because the level of pension funding is already low relative to the potential wage bill. Thus (for this sample) there is not much money saved per teacher by reducing p. The elasticity of ℓ with respect to rate of subsidy is only -.02 when %CB = 0, and -.06 when %CB = 1.[34]

The overall impression left by the results of the local model is one of increasing wage and employment rigidity, motivated largely by the growth of collective bargaining. Teacher wages rise lock-step with the growth in private service wages and employment per taxpayer has become generally immuned to the swings in a state's economic or demographic fortunes. With the exception of the implicit subsidy effect of underfunding on teachers per taxpayer, the pension system has had little effect on the current period labor contract. Specifically there is no evidence of positive wage compensation for underfundings.

VI. Who Pays for Teacher Pensions?

Table 6 summarizes the general equilibrium effects on current teachers and retirees, current taxpayers. and future taxpayers of changes in the key determinants of teacher wages and pensions. This incidence analysis is based on solving the estimated structural model of equations (1) - (11) for the change in the net income to current teachers ($(1 + \Delta)w\ell + b_w + b_a - c_e$), net income to retirees (b_r), net income to taxpayers received as private income (y) and non-educational public services (E), and the liability imposed on future taxpayers measured both as the change in the stock of underfundings (U) and as the approximate annual flow (u) needed to generate the change in that stock. All estimates are for an average state--i.e., exogenous variables are given mean sample values--under the assumption that there is no capitalization of pension underfundings ($\delta = 0$).[35]

Table 6 seeks to answer two questions. First, who pays for teacher pensions or, more pointedly, do current taxpayers "rob" future taxpayers to pay for current teachers? The answer appears to be yes. Second, what public policies might be introduced to reduce this unfunded liability now imposed upon future taxpayers? The most efficacious strategy--indeed, the only one which seems to have much impact at all--is a regulated increase in contributions from current teachers and current taxpayers.

Column (1) of Table 6 outlines the effects on each player of an exogenous increase in the relative bargaining power of teachers, measured by an increase in the percent of teachers covered by collective bargaining. The average degree of coverage for our sample states in 1980 was .629; Table 6 shows the effects of moving from this average to full coverage (%CB = 1.0). Teachers' net income rises by 3% or \$2.20/taxpayer (= \$183 per teacher, estimated as \$2.20 divided by .012 teachers per taxpayer), while current retirees' benefits

Table 6: The Equilibrium Incidence of Wage Determinants and Pension Policy

Variable	%CB	W_{pr}	$Z_s + Z_c$	rA_{-1}	$C_e + C_g$	Pension Aid (=FP)
Change in:	+.371	+ $350	+ $8.47	+ $1.20	+ $1.12	+ $8.85
Effect upon:	(1)	(2)	(3)	(4)	(5)	(6)
Current Teachers*						
$(1+\Delta)w\ell+b_w + b_a - c_e$ ($74.22)	$2.20**	$3.25	$.13	$.01	-$.13	-$.07
b_r ($8.47)	$.21	$.29	$.01	~0	$.31	-$.01
Current Taxpayers*						
y ($2954)	$.69	-$3.06	-$2.36	$.21	-$.45	$2.14
g ($261)	-$2.57	~0	$11.27	$.85	$.07	$6.06
Future Taxpayers*						
U ($ 295)	$35.05	$16.09	-$.17	-$2.43	-$10.19	-$5.91
$u=(-.03 \cdot U)$ (-$8.85)	-$1.05	-$.48	$.01	$.08	$.31	$.18

*The 1980 values for each dependent variable are given in parentheses and reported as real (1967) dollars per taxpayer.

**All changes are reported in real (1967) dollars per taxpayer.

rise by 2.4% or \$.21/taxpayer (= \$42 per retiree, estimated as \$.21 divided by .005 retirees per taxpayer). An important consequence of increased teacher bargaining power is its effect on the state budget; increasing %CB increases state to local school aid (z) and reduces state spending on non-education public services (E), here by -\$2.57/taxpayer. Interestingly, some of the increased state aid for education is allocated to local tax relief. Thus while the local school wage bill increases as %CB rises, state to local school aid covers the increase and even allows for a small amount of local tax relief. On balance, current taxpayers' private incomes rise slightly, by \$.69/taxpayer. Overall, of course, current taxpayers lose, as E is reduced by more than y rises. Current teachers and current retirees benefit with increased bargaining coverage.

The big losers here--as they have been with the historical increase in union coverage--are future taxpayers. Unfunded liabilities increase by 12% or \$35.05/(current) taxpayer. The major sources of the increased underfundings are, first, the rise in liabilities as the wage bill increases, and second, the fall in net contributions per taxpayer because of %CB's negative effect on state contribution to pension funding (p). The approximate annual loss imposed on future taxpayers (u = -.03 × dU, assuming a .03 real interest rate) is \$1.05/(current) taxpayer.

Overall, as %CB rises to 1.0, current teachers and current retirees gain \$2.41/taxpayer (= \$2.20 to current teacners and \$.21 to current retirees), current taxpayers lose \$1.36/taxpayer in equivalent annual income (= \$.69 in income less \$2.05 as the income value of -\$2.57 in E if paid as taxes at the tax price λ = .80), and future taxpayers lose \$1.05/taxpayer. Who, then, pays for the \$2.41/taxpayer increase in compensation to current teachers and retirees? Current taxpayers contribute \$1.36/taxpayer, or 56% of the total increase. Future taxpayers pay $1.05/taxpayer, or 44% of the total. As current teachers gain added influence over state and local fiscal bargains, it appears that current teachers collude with current taxpayers to shift a significant portion of the increase in the current compensation package onto future taxpayers. Paul robs Peter to pay Mary.

A similar tale can be told for an exogenous increase in the private sector alternative wage, the results for which are reported in Table 6, column 2. With a 10% increase in w_{pr} from its 1980 value of $3500 (1967 dollars) net teacher compensation rises by $3.25/taxpayer (= $271/teacher). Current retirees also gain as their benefits are indirectly linked to current teacher wages (see equations ($\hat{4}$), ($\hat{5}$), ($\hat{7a}$)). Current taxpayers lose $3.06/taxpayer to pay for the increase in wages to teachers. But future taxpayers also lose as the stock of underfundings rise by $16.09/(current) taxpayer. On an annual basis, future taxpayers are indirectly contributing $.48/(current) taxpayer (u = -.03 × $16.09), $.29 of which goes to current retirees and $.19 of which goes to current teachers. These indirect annual contributions are paid via inadequate funding of the new pension obligations associated with the increase in teacher wages. Again future taxpayers pay for increases in current compensation. In this case, they cover 14% of the total increase paid to current teachers and retirees (= $.48/($3.25 + $.29)).

The increase in collective bargaining and the rise in the alternative private service sector wage over the decade of the 1970's provide major explanations for the recent increase in teacher pension underfundings.[36] These trends are likely to remain in force in the 1980's. Against these trends, what can be done to improve the funding position of teacher pensions? Columns (3) - (6) examine the effects of four alternative policy reforms: increased general aid to the state and local sector (column 3), improved pension fund performance (column 4), increased required contributions to pension funding by teachers and current taxpayers (column 5), and pension fund aid (column 6).

General government aid, not surprisingly, has very little effect on pension underfundings and the position of future taxpayers. A 10% increase in aid from its 1980 level (= \$84.70/taxpayer) is allocated almost entirely to current taxpayers in the form of increased outlays for non-education state services (see also Craig and Inman (1986)). Of the \$8.47/taxpayer increase in aid, current teachers capture only \$.13/taxpayer while current retirees garner \$.01/taxpayer. Less than one penny annually finds it way into the pension fund (u = \$.005/taxpayer) which reduces the stock of underfundings by \$.17/(current) taxpayer. The rest of the aid--\$8.32/taxpayer--goes to increased spending on non-education services (E). Further, since such aid has implicit federal matching requirements (or there is program "lumpiness") taxpayers add some private income to the state treasury to support an additional increase in expenditures on E of \$2.95/taxpayer; E rises by \$11.27/taxpayer (= \$8.32 + \$2.95). The \$2.95 increase in taxes reduces private income by \$2.36/taxpayer (= $\lambda \times$ \$2.95, where $\lambda = .8$).

Improved investment performance--measured here by an exogenous 10% increase in average investment earnings from the 1980 level of \$12.00/taxpayer--is a bit more helpful to future taxpayers, but the real winners again are current taxpayers who siphon off most of the increased earnings for expenditures on non-education public services or tax relief. From equation ($\hat{3}$) we saw only .044 of every dollar of investment earnings went directly into the pension account. The rest went to the general state budget and to increased benefits to current retirees and teachers. What enters the state budget is allocated marginally to state contributions to pensions (see equation ($\hat{8}$), where p rises through the increase in FP) but most of these dollars go to tax relief or increased spending on E. There are trivial second-order effects (via taxpayer income and underfunding) on teacher wages; current teachers do gain a small amount from the spill-out of investment earnings into disability benefits (see equation ($\hat{7}$b)). The equilibrium net effects of $1.20 increase in investment earnings is to increase current teachers' real net incomes by $.01/taxpayer, to increase future taxpayers' real incomes by about $.08/taxpayer through increased pension funding, and to increase current taxpayers' incomes by $.85/taxpayer in more state services and by $.26/taxpayer in tax relief. The $.26/taxpayer in tax relief implies a $.21/taxpayer increase in real after-tax incomes (given the tax price λ = .8).

Column 5 of Table 6 shows the equilibrium effects of a 10% increase in required teacher and taxpayer contributions from the 1980 (combined level) of $11.20/taxpayer. In calculating the equilibrium adjustments I assumed one-half of the $1.12/taxpayer increase would be paid by taxpayers through an increase in c_g and one-half by teachers through an increase in c_e. Current teachers are able to avoid $.43 of their initial $.56 increase in required contributions, primarily through a compensating increase in teacher wages (see equation ($\hat{10}$)) and through an increase in disability benefits (see equation ($\hat{7}$b)). They lose only -$.13/taxpayer (= $10.83 per teacher vs. an initial increase via c_e of $46.67 per teacher). Current taxpayers lose $.56/taxpayer in increased contributions which reduces private after-tax income by $.45/taxpayer (= $\lambda \times .56$, where λ = .8). The net $.13/taxpayer from teachers plus the $.56/taxpayer from current taxpayers is then allocated as $.31/taxpayer to current retirees (see equation ($\hat{7}$a)), $.07/taxpayer in increased expenditures on E (via slippage from the pension budget), leaving $.31/(current) taxpayer for allocation to future taxpayers as increased pension funding. The stock of underfundings (U) is thereby reduced by \$10.19/(current) taxpayer. While increased required contributions do have a significant beneficial effect on the level of underfundings, the fact remains that only 28% of each newly contributed dollar actually helps future taxpayers. The remaining 72% remains in the pockets of current teachers, retirees, or taxpayers.

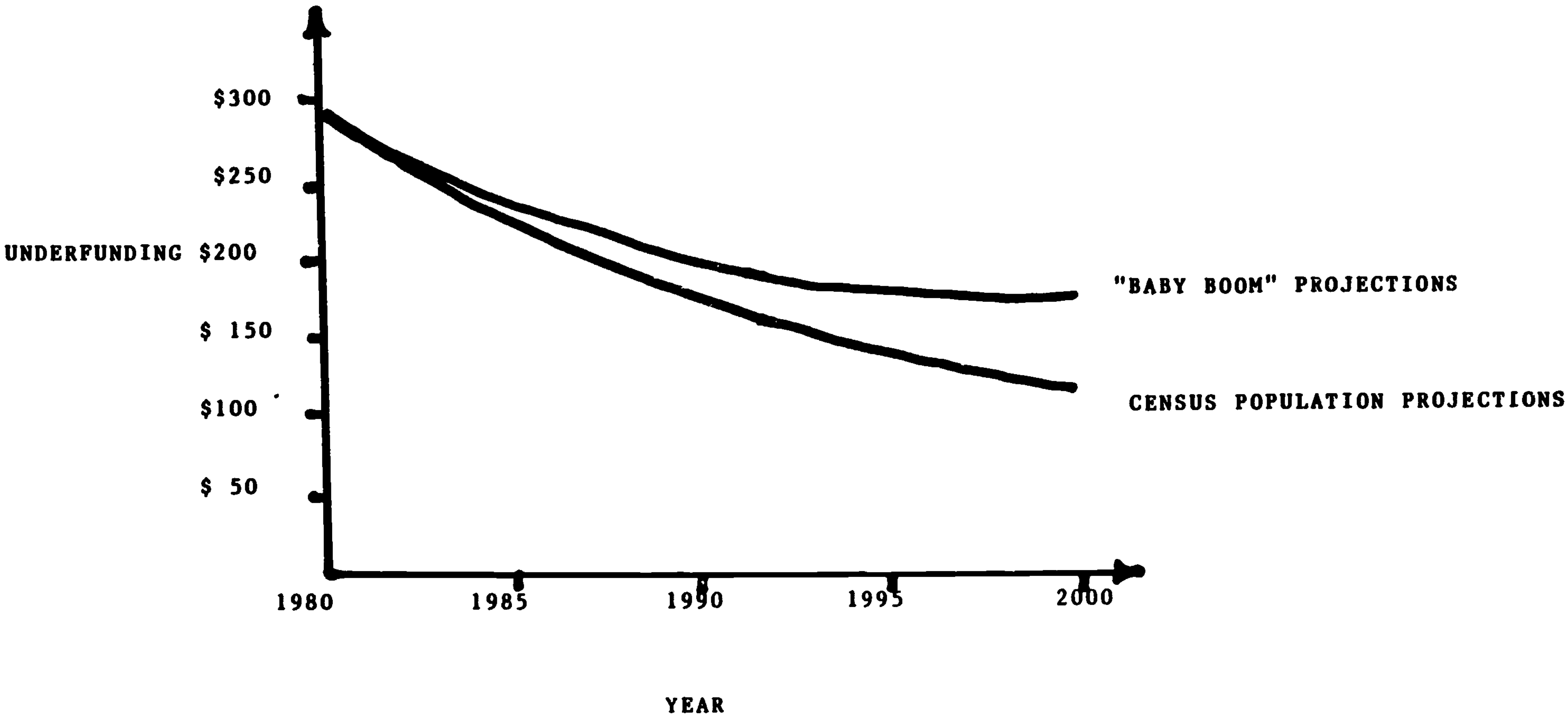
What then of a pension bail-out strategy? Column (6) examines the equilibrium distribution of federal pension aid sufficient to liquidate (or at least pay interest on) the existing stock of pension underfundings. An annual payment of \$8.85/taxpayer to state governments would be sufficient to cover interest payments on the 1980 stock of underfundings for the sample of 48 mainland states, assuming a .03 real interest rate. What happens to the aid? Modelled as a change in pension spillovers from the pension accounts (variable FP),[37] the \$8.85/taxpayer received by the state is spent almost entirely for the benefit of current taxpayers. A small amount is allocated to increased state pension funding--\$.19/taxpayer, estimated as the general equilibrium effect of FP on p, .021 × \$8.85/taxpayer[38]--but the remaining \$8.66/taxpayer is spent on increased non-education expenditures (\$6.06/taxpayer for E) and state tax relief (\$2.60/taxpayer in lower taxes or \$2.08/taxpayer in increased after-tax income assuming $\lambda = .8$). Teachers actually suffer a small decline in real incomes of about \$.08/taxpayer as the increased level of state funding via p raises the net price of hiring a new teacher which prompts local taxpayers to hire fewer teacher.[39] The fall in the teacher wage bill ($w\ell$) lowers teacher pension contributions (c_e) which reduce benefits paid to retirees by \$.01. The small decline in the teacher wage bill also means further tax relief for taxpayers of about \$.06/taxpayer ($= \lambda \times -\$.08$/taxpayer, $\lambda = .8$); overall current taxpayers gain \$2.14 in after-tax income (= \$2.08 + \$.06). The fall in the teacher wage bill also lowers net contributions to the pension account by about \$.01/taxpayer (see equations ($\hat{4}$) and ($\hat{5}$)) which thereby lowers the net flow to future taxpayers from \$.19/taxpayer to \$.18/taxpayer. The stock of underfundings ultimately falls by \$5.91/taxpayer. Pension aid will lower the unfunded liability born by future taxpayers, but not by very much. Only 2% (= \$.18/\$8.85) of such bail-out aid is finally allocated to future taxpayers; current taxpayers keep most of it. Giving such assistance to current taxpayers is a bit like asking a fox to care for a new brood of baby chicks; one should not expect to see too many chickens.

VI. The Future Status of Teacher Pensions

The impression left by the econometric analysis of sections IV and V is of a fiscal system suffering from myopia. The empirical results show a clear bias in favor of current taxpayers and current teachers, to the potential detriment of future taxpayers. Most states now legally guarantee their teachers' pensions. To the extent those pensions are underfunded and not capitalized into the value of properties now owned by current taxpayers, it will be future taxpayers who pay the bill. Outside of regulations to increase contributions by current teachers and taxpayers, public policies are not likely to help matters very much. It would appear that the system is on a collision course with bankruptcy, with future taxpayers paying the bills.

In fact, however, the future may not be so bleak, at least for the majority of teacher pension plans. Based upon the structural model developed here, I have simulated the path of teacher pension underfundings for the period 1981-2000. Figure 1 summarizes the path of the national average level of underfunding; the overall trend is downward.[40]

FIGURE 1: TRENDS IN UNDERFUNDING



If the 1970's seemed so bleak, why does the future look so promising? The answer lies in the fact that the 1970's was a period of significant structural reform in the basic benefit package offered by teacher pensions. Two changes were particularly important. Cost-of-living protection was introduced into most plans during this period, and plan vesting (the number of years of service required before the pension is guaranteed) was liberalized insuring the pensions of more teachers. The net effect was a significant upward drift in the actuarial constant, Ω, which translates the current wage bill into a future pension liability; see footnote 36 above. Those reforms are now behind us. For any fixed actuarial constant Ω, if net contributions (n) are greater than the added liabilities imposed by future increases in the teacher wage bill then underfundings will decline: $U_{t+1} - U_t = \Omega\{(w\ell)_{t+1} - (w\ell)_t\} - n_t < 0$ as $n_t > \Omega\{(w\ell)_{t+1} - (w\ell)_t\}$. That is exactly what is happening in most states over the simulation period. The average teacher wage bill grows only modestly, at about 0.005 per annum. As long as net contributions exceed $2 to $3 per taxpayer--the approximate annual increase in the liability from wage growth--underfundings will decline.[41] For most states, future net contributions average about $10 per taxpayer, primarily from state contributions (p) and from increased taxpayer and teacher contributions as the wage bill rises. The net effect is an annual downward drift in underfundings per taxpayer of about $8 per year, from a national average of $295/taxpayer in 1980 to $130/taxpayer by the year 2000.

While there appears to be no national teacher pension crisis on our fiscal horizon, the sytem does deserve continued scrutiny over the next two decades. First, these unfunded liabilities do not fall to zero, and teacher pensions are only one form of public debt within our state and local system. Other public employee pensions are underfunded (see Arnold, 1982). Our major cities, at least, often run sizeable short-term deficits (see Inman, 1986). And there is a growing concern over the status of state-local infrastructures. By themselves, teacher pensions will not cause a state-local fiscal crisis, but they may be part of one. Second, while the simulations reported in Figure 1 are based upon realistic income and demographic projections, a major new baby boom in the 1990's will place increasing strain on the current accounts budget of public education and force a significant postponement of pension funding (see Section IV above). Simulations assuming a new baby boom beginning in 1990 show average underfundings only fall to \$160/taxpayer by the year 2000, not to the originally projected level of \$125/taxpayer. Finally, while the nation as a whole shows a favorable downward trend in underfundings, not all states perform so well. South Carolina (U_{2000} = \$815/taxpayer in 1967 dollars), Maine (\$768/taxpayer), Idaho (\$500/taxpayer), Virginia (\$450/taxpayer), Louisiana (\$447/taxpayer), and West Virginia (\$445/taxpayer) are all projected to have underfunding levels which might be considered dangerously high (i.e., ≈ 10% of projected real income in the year 2000).[42] Seven other states--Indiana, Iowa, Massachusetts, New Mexico, North Carolina, Pennsylvania, and South Dakota--are projected to have underfundings greater than \$250/taxpayer in the year 2000. (For state by state projections, see Appendix B.) These thirteen states, at least, deserve close monitoring.

VII. Conclusions

This paper has sought to explain the recent funding history for teacher pensions and on the basis of that history to answer three questions of public policy. First, the level of underfundings has been rising over the past decade; will it continue to levels of crisis proportions? The answer, at least for the system as a whole, is no, but a few of the currently troubled state will continue to have high unfunded pension liabilities. Second, which states are the most vulnerable in the future? The answer is those states which have historically accumulated large levels of underfundings because of generous benefit structures and/or poor funding practices and those states which in the future may experience rising service sector (teacher alternative) wages, increased teacher collective bargaining, or a renewed baby boom. Third, what public policies are likely to be most effective in reducing high levels of teacher pension underfundings? The answer is not increased grants-in-aid to the state and local sectors or a new pension "bail-out" aid policy. Both programs assist current teachers and taxpayers far more than they they help reduce the levels of pension underfundings. Improved (i.e. less conservative) investment portfolio management will help matters somewhat. The one policy which will make a dent in the level of underfundings is a regulated increase in contributions from current teachers and taxpayers. Yet even with regulation, the current generation has ways of returning most (72%!) of their regulated contributions back to their own pockets.

For all that we have discovered about teacher pension funding, there are two more general lessons of political economy to be learned from these results. The conjecture of Freeman (1986) in his recent survey of economic effects of public unionization--that to understand the full influence of public unions we must look beyond the labor bargaining table--is well supported here. Teacher unions have important effects not only upon negotiations over wages and employment levels, but also upon the fiscal environment in which those negotiations take place. That fiscal environment is decided by state politics, and teacher unions are an important interest group in those deliberations. Second, on the important issue of a national policy towards public debt, we have here another confirmation that our political process which sets debt levels is biased to favor the current generation of taxpayers and program recipients.[43] One can do no better than to quote Pogo on such matters: "We have seen the enemy, and they are us."

FOOTNOTES

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[1]Excluded from this analysis are the state teacher pensions in Hawaii and Alaska whose unique fiscal institutions do not permit an easy comparison to the mainland states. The few local teacher pension plans in large cities are also excluded. The analysis covers approximately 95% percent of all teachers in pension plans in 1980.

[2]The alternative is a defined contribution pension in which the retiree's pension is simply an annuity or fixed payment based upon the actual contributions made to the plan by the worker and his or her employer in pre-retirement years. By definition, a defined contribution pension cannot be underfunded.

[3]For details of the specification of Ω, see Inman (1986) at equation (10). The value of Ω will depend upon the plan's replacement rate, the expected rate of employer and/or employee contributions, the rate of growth in wages per employee, the rate of growth in the number of employees, the extent of inflation protection for members' annuities and the expected rate of inflation, and the expected rate of interest for discounting future benefits paid and future contributions received. The actuarial constant Ω varies across state pension plans as these determinants vary.

[4]Generally, the payments for employer (c_g) and employee (c_e) contributions are made to the state treasury and then transferred by the governor to the pension account, often as a single check inclusive of c_e, c_g, and the state's own supplemental contribution, Within this system, it is easy to see how c_e and c_g dollars might be "lost" in the process. It is also possible for the governor or legislature to "tap off" interest earnings; see Note, Harvard Law Review (1977) and a recent article in the Wall Street Journal entitled "Novel California Pension Plan Provides an Inflation Antidote" (October 22, 1985, p. 33). (I wish to thank Richard Aronsen of Lehigh University for sharing this article with me.)

[5]See Note, Harvard Law Review (1977). By 1980, 32 of the sample 48 states had such explicit guarantees.

[6]This sequence for the three pension games is dictated by a typical state's budgetary cycle. Administrative decisions are generally negotiated prior to legislative budget setting, while local government budgets are set knowing (with reasonable certainty) their allocations from the state budget. For example, for a July 1 fiscal year, the regulation game would be played in December or January as the governor's budget request is set, which is prior to setting the legislative budget in April or May, which is in turn decided before local government budgets are finalized in June.

[7]The analysis assumes that the preferences of each coalition are well represented by the preferences of an average coalition member. It therefore ignores possible conflicts within each coalition which can influence pension policy.

Within the taxpayer coalition the most likely conflict is between those taxpayers who are planning to move from the state before pension obligations fall due ("movers") and those taxpayers who are committed to remaining within the state ("stayers"). Given the typical length of time (ten to twenty years) between current pension decisions and future pension consequences, "movers" are likely to be majority groups within the taxpayer coalition. "Stayers," however, can insure themselves against the consequences of underfunding by the majority of "movers" by savings for their future tax obligations from underfundings at a tax-free rate (e.g., in housing appreciation). If such tax-free savings are not available, then conflicts between stayers and movers may arise. Stayers may act like future taxpayers, a possibility I consider below (p. 19).

The likely conflict within the teacher coalition is between current teachers and current retirees. Current teachers, however, are the overwhelming majority in all states and it is their preferences which I model here.

[8]The rate Δ is the full-funding rate required of taxpayers to meet current period pension obligations. In this model, contributions are paid by the taxpayer both in his capacity as a local school employer (via c_g) and as a state taxpayer (via p). Values of Δ range from .1 to .3 for most plans, but a value of .15 is typical. For this analysis, I assume Δ is exogenous and given by the parameters of the state's pension plan; for the actuarial definition of the rate Δ, see Winklevoss (1976).

[9]It is assumed that whether teachers view pensions as guaranteed or risky is common knowledge, perhaps because judicial decisions to guarantee those pension are common knowledge.

[10]Compensation can either be paid as a fixed sum per teacher of (c_e^+/ℓ) or as an increase in wages of $w^+ = \{c_e^+/\ell(1 + \Delta)\}$. In either case, the taxpayer loses λc_e^+ in income.

[11]It is important to ask why state aid for education exists at all in this model. Teachers and taxpayers should be able to strike a bargain which sets $z \equiv 0$ and then allocates all saved tax dollars to the local bargain. If taxpayers could be trusted, this is indeed the efficient allocation. Unfortunately, taxpayers cannot be trusted to allocate private income in the local bargain in a way similar to lump-sum state-to-local education aid. Money given to taxpayers stays in the taxpayer's pocket, while money given directly as aid to the local school district remains under the control of the teachers. See, for example, Fillimon, Romer, and Rosenthal (1982). This argument only pushes matters back one step, however. We still need to know why teachers have such control over the local budget--an important question, but one I do not puruse here.

[12]See Appendix A.

[13]The conclusion follows from the first-order conditions for the maximization of teacher's expected utility, V_e, with respect to c_e. Teachers will prefer to increase, leave unchanged, or reduce c_e as long as the expected marginal benefits are ($\gtrless$) the expected marginal costs:

expected marginal benefits $= (\partial\mu/\partial U)(dU/dc_e)\{v_e(\bar{w}, \ell) - v_e(\underline{w}, \ell)\} + \{\mu \cdot (\partial v_e(\bar{w}, \ell)/\partial\bar{w})(1+\Delta)+(1-\mu)(\partial v_e(\underline{w}, \ell)/\partial\underline{w})\}(\partial w/\partial c_e)+\{\mu(\partial v_e(\bar{w},\ell)/\partial\ell + (1-\mu)(\partial v_e(\underline{w}, \ell)/\partial\ell)\}(\partial\ell/\partial c_e) \gtrless \mu(\partial v_e(\bar{w},\ell)/\partial\bar{w})(1/\ell) =$ expected marginal costs.

The term dU/dc_e embodies both the direct effect of c_e on U (via n) and the indirect effects of c_e on U (via anticipated changes in w and ℓ).

[14]The result follows from the first-order condition for the maximization of teacher's expected utility, V_e, with respect to c_g (or p). Teachers prefer to increase, leave unchanged, or reduce c_g (or p) as long as the expected marginal benefits are ($\gtrless$) the expected marginal costs. For c_g:

expected marginal benefits $= (\partial\mu/\partial U)(dU/dc_g)\{v_e(\bar{w}, \ell) - (v_e(\underline{w}, \ell)\} \gtrless$

$$-\{\mu \partial v_e(\bar{w}, \ell)/\partial \ell + (1 - \mu)(\partial v_e(\underline{w}, \ell)/\partial \ell)\}(\partial \ell/\partial c_g) - \{\mu(\partial v_e(\bar{w}, \ell)/\partial \bar{w})(1 + \Delta) + (1 - \mu)(\partial v_e(\underline{w}, \ell)/\partial \underline{w})\}(\partial w/\partial c_g) = \text{expected marginal costs.}$$

The term dU/dc_g embodies both the direct effect of c_g on U (via n) and the indirect effects of c_g on U (via anticipated changes in w and ℓ). A similar expression holds for changes in p.

[15]The use of political party affiliation to represent the majority preferences of a large constituency is at best a proxy for those preferences, but perhaps not a bad one; see Romer and Rosenthal (1985).

[16]The rate of return on a given state's "market" portfolio (r_m) is defined by the weighted average return of those investments legally available to the state, where the individual returns for each investment are national returns for that investment. The weights are the state's permitted share of investments in each of five broad categories: (i) demand deposits (the annual rate of return is the maximum payable rate on savings deposits); (ii) federal securities (the annual rate of return is the annual return on long-term government bonds from Ibbotson and Sinquefield (19xx, I-S, Exhibit B-6); (iii) investment grade corporate bonds (the annual rate of return on long-term corporate bonds from I-S, Exhibit B-5); (iv) stocks (the annual rate of return on the I-S market portfolio, from I-S, Exhibit B-1); and (v) mortgages (the annual rate of return on conventional home mortgage loans). The rate r_m measures how well the state would have done had it invested in a (legally-specified) portfolio of nationally available investment instruments; actual state returns may be better or worse than r_m.

[17]This expression for portfolio performance follows from the capital asset pricing model (CAPM) and was first derived by Jensen (1968).

[18]Previous research on disability insurance has found that increases in the state's rate of unemployment will induce increased demand for disability payments; see for example Parsons (1980).

[19]Taxpayer and teacher bliss points in the (z, p) space are defined by the maximization of V_T and V_e, respectively, with respect to z and p, given c_e, c_g, r, and b from the regulation game. Solving each pair of first-order conditions for z and p gives each coalition's ideal points. See Appendix A.

[20]Teachers and current taxpayers are assumed to play a cooperative game which sets z and p. The game will define a contract line connecting each player's bliss points. The final outcome along that contract line will depend upon the relative bargaining power of the two players and is assumed to be a compromise (i.e., between) each player's preferred allocation along each dimension, z and p. Thus final allocations will be weighted averages of each player's preferred allocations, where the weights depend on the relative bargaining power of the players. The weights need not be the same along each policy dimension. Teacher may have to give up more p to protect z, or conversely.

[21]For an excellent study of the potential influence of collective bargaining on state labor laws for teachers; see Saltzman (1985).

[22]The mean rate of required local employer contributions is $\hat{\eta}_g^s$ = .025 (s.e. = .036) and the mean rate of required local employee contributions is $\hat{\eta}_e^s$ = .049 (s.e. = .021). These rates are set by state pension law, usually passed as part of the enabling pension legislation. Since $\hat{\eta}_g^s$ and $\hat{\eta}_e^s$ are known _a priori_, equations ($\hat{4}$) and ($\hat{5}$) were estimated with the rates of supplemental contribution as the dependent variables, defined as $\{c_g - \hat{\eta}_e^s(1 + \omega)(w\ell)_{-1}\}/(1 + \omega)(w\ell)_{-1}$ for ($\hat{4}$) and $\{c_g - \hat{\eta}_g^s(1 + \omega)(w\ell)_{-1}\}/(1 + \omega)(w\ell)_{-1}$ for ($\hat{5}$).

[23]The insignificant effect of %ELC on c_e need not be inconsistent with this conclusion. While those teachers who are sure to retire as members of the state's pension system do want to reduce c_e, teachers who leave the system before retirement--and most teachers face this possibility--may prefer to invest in c_e as a tax-favored means of private savings. Own contributions plus interest are generally available to all teachers upon withdrawal from the pensions system.

[24]It is not hard to imagine why state pension boards might favor a risk-free portfolio when teachers see their pensions as secure and current taxpayers plan to exit the state. Riskier investments offer little gain to current teachers or taxpayers if they pay-off, yet they may prove embarrassing to the current pension board if they fail. The politically prudent strategy is to be a conservative investor. For additional evidence on the conservative nature of state-local pension fund investments, see Kotlikoff and Smith (1983, p. 434).

It should be noted, however, that this econometric estimate of β is likely to be biased towards zero, though it is difficult to know by how much. The rate of return for state portfolios (r) is approximated by ratio of investment earnings to the reported value of all assets in the portfolio. The reported asset value will include an unknown fraction of assets valued at book, not market value, and investment earnings will not include appreciation or depreciation of assets unless those assets are actually sold. We therefore have measurement error in our dependent variable which is likely to be positively correlated with the independent variable (r_m - r_f). The effect is to bias the slope coefficient downward. In addition to this error in variable problem, these estimates of β for teacher pension funds, as for any managed portfolio, will be biased towards zero because of selectivity bias; see Frankfurter, Phillips, and Seagle (1974).

[25]Specifically, I specified $\hat{r}_a$ to be a function of TEACH, %ELC, %ELC · STAY, and REP, and the ratio of the state's unemployment rate to the national unemployment rate ($UE_s/\overline{UE}$). This specification examined whether high UE states may have invested in local (possibly lower return) companies to soften the effects of the business cycle on the state economy. In fact, the results show a small positive, but insignificant, effect of ($UE_s/\overline{UE}$) on $\hat{r}_a$. %ELC had a small negative effect on $\hat{r}_a$; REP was insignificant. TEACH was negative and significant, but small in effect. The state constant terms, $\hat{r}_a^s$, performed as well as this more elaborate political model.

Further, the rate of return equation was also estimated allowing the slope coefficient, β, to vary across states. I could not reject the null hypothesis that β was equal across the states in this sample.

[26]The total effect of investment earnings on the pension and state budgets is $\nu + \psi = \$1.26$; the approximate standard error of the estimate of $\nu + \psi = .13$. A $1 increase in real investment earnings therefore stimulates a more than $1 increase in real expenditures elsewhere in the budget. This tendency to over-spend investment earnings is possible if real assets are depleted. As assets are sold at nominal values, nominal investment proceeds are allocated to benefits and to the state budget so that fewer real assets can be re-purchased. In an inflationary economy, there need be no obvious selling of real assets, even though those assets depreciate in value.

[27]Estimation was by three-staged least squares which is asymptotically equivalent to full information maximum likelihood estimation. The log likelihood function could then be specified for alternative values of δ and the 90% confidence interval specified for $\hat{\delta}$.

[28]See Saltzman (1985).

[29]The individual coefficients on the tax price λ will be weighted averages of separate own- and cross-price effects as λ enters each expenditure equation in the system. While own effects may be negative, cross effects can be positive, zero, or negative. Thus the effect of λ in any individual equation is not a clear estimate of an own price effect. From the definition of y, the taxpayer pays $\lambda(1 - \delta)$ for p, $\lambda(1 - \gamma)$ for z, and expects to pay $\lambda(1 + \delta\Delta)$ for increases in w and ℓ.

[30]Such a model is presented in Shepsle (1979) and developed for state budgets in Craig and Inman (1986).

[31]Within the structure of the legislative bargaining model, these exogenous changes in other spending (E) imply a nearly horizontal ($dp/dz \approx 0$) contract line in the (p, z) bargaining space. In this model, changes in E do not alter the contract line between p and z, but they do alter where on that contract line the final (p, z) allocation will be. A dollar increase in E lowers total spending on p and z by \$.37. This inward shift in the budget to education is allocated entirely as a cutback in state-to-local school aid: $dz/dE = -.381$ while $dp/dE = .017$. Thus $dp/dz \approx -.045$ ($= -.017/.381 = (dp/dE)/(dz/dE)$). Such a contract line is consistent with teacher indifference curves which are perpendicular to a horizontal line at a required level of pension funding, but where increases above the required level are not valued by teachers. Teachers seem to demand a token amount of state funding ($\approx$ \$7/taxpayer on average), nothing more or nothing less.

[32]If $\tilde{w}_e$ is the satiation level of compensation preferred by teachers and $w_e\{1 + \mu((1 - \delta)\bar{U})\Delta\} - (c_e/\ell)$ is the teachers' expected level of compensation, then $w_e^* = \{\tilde{w}_e + (c_e/\ell)\}/\{1 + \mu((1 - \delta)\bar{U})\Delta\}$ specifies the teachers preferred wage.

[33] For the specification of this subsidy rate, see Inman (1982).

[34] Inman (1982) finds somewhat higher subsidy effects in his study of local government purchases of police and fire personnel.

[35] The full general equilibrium model used to estimate the effects of changes in the exogenous variables in Table 6 on the economic positions of teachers, retirees, and current and future taxpayers follows the structural model (1) - (11) with the addition of a state revenue equation (t_s) and the removal of E from the pension (p) and school aid (z) equations. E is now endogenous and is estimated from the state budget identity, given the econometrically estimated state revenue equation. Equilibrium values for all endogenous variables were solved iteratively, given the dynamic structure of the model.

[36] In addition to these variables, the other, and most important, cause of increased pension underfundings was the liberalization of the pension's benefit structure. The relaxation of vesting requirements and the introduction of COLA provisions had important positive effects on the actuarial constant, Ω, which translates the current wage bill into future pension liabilities. For our sample period, the average $\Omega = 5.171$; see equation ($\hat{1}$) above. But in 1971, the average value of Ω for our sample states was 3.723. By 1980, Ω had risen to 6.590.

[37] There is currently no direct federal to state aid program for pension fundings, and therefore these results based upon the FP variable should be used with care. Nonetheless, FP seems a reasonable proxy for such aid. First, FP dollars are "pension" dollars given to the state budget. Second, the effects of FP on state allocations parallel closely the results in Inman (1982) for the effects of "true" state pension aid on local allocations. Finally, Craig and Inman (1982, 1986) find that most targeted Federal aid

programs are "fungible" dollars within the state budget; there is no reason to think pension aid will not be similarly manipulated.

[38]The coefficient .021 is the estimated marginal effect of FP on p from the general equilibrium budget model with endogenous E. The partial equilibrium budget model with exogenous and fixed E gave a marginal effect of FP on p of .027 (for $\delta = 0$); see Table 4.

[39]There is a potential fiscal illusion here which suggests we may want to ignore this negative effect of pensions aid on $w\ell$. While it is true that p rises and would (generally) imply a higher cost to hiring a new teacher, in this case the increase in p is paid for through increased federal aid. On the other hand, the federal aid might well be allocated elsewhere and thus the increase in p does reflect a true (opportunity) cost. Whether ℓ declines depends upon whether taxpayers see pensions aid as fully fungible (hence an increase in p is costly) or not fungible (hence p is "free"). The calculations in Table 6 assume pensions aid is fungible.

[40]Albright and Inman (1986) summarize the details of the simulation model. The key economic and demographic assumptions which lay behind the projections in Figure 1 are: (i) a 2% annual growth in real private service sector wages (w_{pr}) and taxpayer incomes (I); (ii) a zero rate of growth in real federal to state and local aid ($Z_s + Z_c$); (iii) a 2.5% real interest rate earned by all teacher pension plans based upon the starting 1980 asset level; and (iv) a demographic age distribution for school-age children and for taxpayers over 65 which follows the Bureau of Census national projections for the years 1980 to 2000 (from U.S. Department of Commerce, Bureau of Census (1984)). All other exogenous variables and actuarial parameters of the model are fixed at their 1980 values for each state.

[41]If $n > \Omega\{d(w\ell)\}$, underfundings will decline. If wages grow at .005 per year, then as long as $n_t > \Omega(.005)(w\ell)_{t-1}$ in any year, underfundings will decline. The wage bill varies from \$60 to \$80/taxpayer and Ω averaged 6.59 in 1980. Thus if n exceeds \$2 to \$3/taxpayer, U will decline.

[42]One might want to add Alaska and Hawaii to this list as both states had very large 1980 underfundings, though they have not been included in my empirical and simulation analysis because of their unique fiscal situations. Hawaii has a state school system. Alaska is simply rich; in 1980 the state's one year fiscal surplus was larger than its accumulated stock of pension underfundings.

[43]On the federal budget see Fair (1978); on state budgets see Baber and Sen (1986); on local budgets see Inman (1982).

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Appendix A: Specification of Coalition Ideal Points

A. The Legislative Game

The specification of coalition ideal points in the legislative game follows from the maximization of each coalition's typical member's expected utility with respect to the policies at issue--the levels of pension funding (p) and state-to-local aid (z)--and then solving the resulting first-order conditions for z and p as functions of the relevant exogenous variables which define expected utility. Second-order conditions necessary to insure that the resulting values of z and p are unique maxima are assumed to hold.

(1) Specification of Ideal Points for the Taxpayer Coalition: The maximization of expected taxpayer utility, V_T (see p. 7 above), with respect to z and p yields as first-order conditions:

$$(A.1)\quad \frac{\partial V_T}{\partial z} = (1-\alpha)\left\{\frac{\partial v_T(\bar{\ })}{\partial \bar{y}}\frac{d\bar{y}}{dz} + \frac{\partial v_T(\bar{\ })}{\partial \ell}\frac{d\ell}{dz}\right\} + \alpha\left\{\frac{\partial v_T(\underline{\ })}{\partial \underline{y}}\frac{d\underline{y}}{dz} + \frac{\partial v_T(\underline{\ })}{\partial \ell}\frac{d\ell}{dz}\right\} = 0$$

and

$$(A.2)\quad \frac{\partial V_T}{\partial p} = (1-\alpha)\left\{\frac{\partial v_T(\bar{\ })}{\partial \bar{y}}\frac{d\bar{y}}{dp} + \frac{\partial v_T(\bar{\ })}{\partial \ell}\frac{d\ell}{dp}\right\} + \alpha\left\{\frac{\partial v_T(\underline{\ })}{\partial \underline{y}}\frac{d\underline{y}}{dp} + \frac{\partial v_T(\underline{\ })}{\partial \ell}\frac{d\ell}{dp}\right\} = 0$$

The notations $\partial v_T(\bar{\ })/\partial(\cdot)$ for $(\cdot) = \bar{y}$ and ℓ and $\partial v_T(\underline{\ })/\partial(\cdot)$ for $(\cdot) = \underline{y}$ and ℓ represent the marginal utility of income and teachers to taxpayers evaluated at $y = \bar{y}$ for $v_T(\bar{\ })$ and at $y = \underline{y}$ for $v_T(\underline{\ })$.

To evaluate (A.1) and (A.2), I assume $\partial v_T(\bar{\ })/\partial(\cdot)$ for $\bar{y}$ and ℓ and $\partial v_T/\partial(\cdot)$ for $\underline{y}$ and ℓ are all non-negative throughout; taxpayers prefer more income and more teachers whether they do, or do not, fully fund teacher pensions. Further, I assume taxpayers expect z to have non-negative effects on ℓ in the local bargain and for at least the first dollars of aid, $d\ell/dz$ >

0. I also assume taxpayers expect an increase in p to have non-positive effects on ℓ in the local bargain and clearly negative effects ($d\ell/dp < 0$) for high values of p because of consequent income costs to taxpayers entering the local bargain and because teachers are confident of receiving their pensions. From the definition of $\bar{y}$ (p. 10 above) and $\underline{y}$ (p. 11 above), we can also sign the effects of z and p on income in the two states:

$$d\bar{y}/dz = -\lambda(1 - \gamma) - \lambda(1 + \Delta\delta)d(w\ell)/dz < 0 ;$$

$$d\underline{y}/dz = -\lambda(1 - \gamma) - \lambda(1 + \Delta)d(w\ell)/dz < 0 ;$$

$$d\bar{y}/dp = -\lambda(1 - \delta) - \lambda(1 + \Delta\delta)d(w\ell/dp) \gtrless 0 \text{ ; and}$$

$$d\underline{y}/dp = 0 ,$$

assuming $d(w\ell)/dz \geq 0$ and $d(w\ell)/dp \leq 0$ (for $\delta < 1$) or $d(w\ell)/dp = 0$ (for $\delta = 1$). Craig and Inman (1982) and Tables 5a and 5b above provide evidence that $d(w\ell)/dz \geq 0$. When $\delta = 1$, changes in p have no effect on taxpayer income (see p. 11 above) and when $\delta = 1$, $\mu = 1$ (teachers view pensions as certain) so no compensation need be paid to teachers as p is changed; thus $d(w\ell)/dp \equiv 0$. When $\delta < 1$, the local wage bill may rise or fall depending upon teacher aversion to underfundings. When $\delta < 1$ and values of $\mu < 1$ (teacher uncertainty regarding pension wealth), an increase (decrease) in p may lower (increase) teacher demands for compensating wages or job security; thus $d(w\ell)/dp < 0$ is possible. When $\delta < 1$, but $\mu = 1$, then $d(w\ell)/dp = 0$; that is, when teachers are certain of a pension bail-out no compensation need be paid.

If we assume that compensation paid is largest when p is small and $\mu = 0$, we can sign $d\bar{y}/dp$ more precisely. Specifically when $\mu = 0$, teachers expect no public pension. A small increase in p = dp gives each teacher a benefit of (dp/ℓ) in pension savings. This savings allows the teacher to reduce her private pension savings by an equivalent amount which can be given back to taxpayers as lower wages. Each teacher can lower her wage by $dw = -(dp/\ell)(1/\lambda)$.[1] Thus $dw/dp = -(1/\lambda\ell)$. If, around $\mu = 0$, full compensation is paid in wages (so $d\ell/dp = 0$), then $d(w\ell)/dp = (dw/dp)\ell + w(d\ell/dp) = -(1/\lambda)$. Substituting this specification for $d(w\ell)/dp$ into $d\bar{y}/dp$ gives:

$$d\bar{y}/dp = -\lambda(1 - \delta) + (1 + \Delta\delta) = (1 - \lambda) + \delta(\lambda + \Delta) > 0 \text{ , } \quad \text{as } 1 > \lambda \text{ .}$$

Thus for small values of p and $\mu = 0$, $d\bar{y}/dp > 0$ is likely. Further, for $\mu = 1$, $d(w\ell)/dp = 0$ (see above), and $d\bar{y}/dp = -\lambda(1 - \delta) < 0$. For some values of μ between 0 and 1, $d\bar{y}/dp = 0$.

Conditions (A.1) and (A.2) can be re-arranged with the marginal benefits of a small change in z or p on the L.H.S. and the marginal costs on the R.H.S.:

$$\text{(A.1')} \quad \underset{(+)\ \cdot\ (+)}{(1-\alpha)\{\frac{\partial v_T(\bar{\ })}{\partial \ell}\frac{d\ell}{dz}\}} + \underset{(+)\ \cdot\ (+)}{\alpha\{\frac{\partial v_T(\_)}{\partial \ell}\frac{d\ell}{dz}\}} = -[\underset{(+)\ \cdot\ (-)}{(1-\alpha)\{\frac{\partial v_T(\bar{\ })}{\partial \bar{y}}\frac{d\bar{y}}{dz}\}} + \underset{(+)\ \cdot\ (-)}{\alpha\{\frac{\partial v_T(\_)}{\partial \underline{y}}\frac{d\underline{y}}{dz}\}}]$$

and,

$$\text{(A.2')} \quad \underset{(+)\ \cdot\ (+)}{(1-\alpha)\{\frac{\partial v_T(\bar{\ })}{\partial \bar{y}}\frac{d\bar{y}}{dp}\}} + \underset{(+)\ \cdot\ (0)}{\alpha\{\frac{\partial v_T(\_)}{\partial \underline{y}}\frac{d\underline{y}}{dp}\}} = -[\underset{(+)\ \cdot\ (-)}{(1-\alpha)\{\frac{\partial v_T(\bar{\ })}{\partial \ell}\frac{d\ell}{dp}\}} + \underset{(+)\ \cdot\ (-)}{\alpha\{\frac{\partial v_T(\_)}{\partial \ell}\frac{d\ell}{dp}\}}]$$

where signs of all marginal effects are indicated.[2]

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[1] Teachers are assumed to pay taxes on their wages at the same marginal rate as taxpayers. Thus $-\lambda dw$ equals the change in after-tax teacher income from a small change in wages which equals dp/ℓ (fringe benefits are not taxed), or $-\lambda dw = (dp/\ell)$, or $dw = -(dp/\ell)(1/\lambda)$.

[2] Second-order conditions for a maximum require that the marginal benefits of additional z and p expenditures decline as z and p increase and that marginal costs rise or decline less steeply than marginal benefits. Reasonable arguments can be advanced to support both conditions. Diminishing (continued)

(A.1') balances the benefits to taxpayers of an increase in z (from $z = 0$) against its cost. Solving (A.1') for z; conditional on values of p, will give:

(A.3) $$z_T = f_T(\bar{\tau}, Y_s, T_s, \alpha; p) ,$$

where the vectors of tax prices ($\bar{\tau}$), income (Y_s), taxpayer tastes (T_s) and the probability of full pension payment (α) are as defined in pp. 23 in the text above. The vector T_s embodies the likely determinants of w and ℓ in the local bargain which define $d(w\ell)/dz$ and $d(w\ell)/dp$.

(A.2') balances the benefits to taxpayers of an increase in p (from $p = 0$) against its costs. Only when teachers fully discount their pensions ($\mu = 0$) are there any benefits to taxpayers from funding the pension; in this case, small increase in p may save taxpayers some income in their high income state, $d\bar{y}/dp > 0$. As p and μ rise in value, however, $d\bar{y}/dp = 0$ and eventually $d\bar{y}/dp < 0$. When $d\bar{y}/dp \le 0$, (A.2') shows there are no benefits to funding pensions. In this case, $p \equiv 0$ is the preferred allocation. Note, however, μ is a function of $(1 - \delta)U$ (see p. 11 above) and therefore will depend on p (from equations (1) - (3) in the text). In specifying the demand curve for p, conditional on z, I include only those exogenous determinants of μ which do not depend on p, specifically the level of uncapitalized underfundings inherited from the previous period less net pension wealth created from the regulation budget--$(1-\delta)\hat{U} = (1-\delta)\{U_{-1} - [(1-\phi)(c_e + c_g) + (1 - \psi)(rA_{-1})-b]\}$:

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marginal utility in ℓ and y plus constant or declining effects of z and p on the local labor budget (ℓ and $w\ell$) are sufficient to insure falling marginal benefits. The marginal costs of increases in z and p will rise if the changes in the marginal utility of y and ℓ dominate any declining effects z and p may have on ℓ and $w\ell$. If the marginal effects z and p on the local budget are constant, then diminishing marginal utility in ℓ and y will be sufficient to establish that (A.1') and (A.2') define a utility-maximizing allocation.

(A.4) $$p_T = h_T(\tilde{\tau},\ Y_s,\ T_s,\ \alpha,\ (1-\delta)\hat{U};\ z)\ .$$

Solving the conditional demand curves (A.3) and (A.4) for z and p yields the specification for the taxpayer cc lition's ideal, or preferred, levels of z and p:

(A.3') $$z_T^* = z_T^*(\tilde{\tau},\ Y_s,\ T_s,\ \alpha,\ (1-\delta)\hat{U})\ ,\quad \text{and}$$

(A.4') $$p_T^* = p_T^*(\tilde{\tau},\ Y_s,\ T_s,\ \alpha,\ (1-\delta)\hat{U})\ .$$

2. Specification of Ideal Points for the Teacher Coalition: The maximization of teacher's expected utility (V_e; see p. 12 above) with respect to z and p gives as first-order conditions:

(A.5) $$\frac{\partial V_e}{\partial z} = \frac{\partial \mu}{\partial z}\{v_e(\bar{\ }) - v_e(\underline{\ })\} + \mu\{\frac{\partial v_e(\bar{\ })}{\partial \bar{w}}\frac{d\bar{w}}{dz} + \frac{\partial v_e(\bar{\ })}{\partial \ell}\frac{d\ell}{dz}\}$$

$$+ (1-\mu)\{\frac{\partial v_e(\underline{\ })}{\partial \underline{w}}\frac{d\underline{w}}{dz} + \frac{\partial v_e(\underline{\ })}{\partial \ell}\frac{d\ell}{dz}\} = 0\ ,\quad \text{and}$$

(A.6) $$\frac{\partial V_e}{\partial p} = \frac{\partial \mu}{\partial p}\{v_e(\bar{\ }) - v_e(\underline{\ })\} + \mu\{\frac{\partial v_e(\bar{\ })}{\partial \bar{w}}\frac{d\bar{w}}{dp} + \frac{\partial v_e(\bar{\ })}{\partial \ell}\frac{d\ell}{dp}\}$$

$$+ (1-\mu)\{\frac{\partial v_e(\underline{\ })}{d\underline{w}}\frac{d\underline{w}}{dp} + \frac{\partial v_e(\underline{\ })}{\partial \ell}\frac{d\ell}{dp}\} = 0\ .$$

The notations $\partial v_e(\bar{\ })/\partial(\cdot)$ for $(\cdot) = \bar{w}$ and ℓ and $\partial v_e(\underline{\ })/\partial(\cdot)$ for $(\cdot) = \underline{w}$ and ℓ represent the marginal utility of teacher incomes and job security measured at $w = \bar{w}$ or $w = \underline{w}$ respectively.

To evaluate (A.5) and (A.6), I assume $\partial v_e(\bar{\ })/\partial(\cdot)$ for $\bar{w}$ and ℓ and $\partial v_e(\underline{\ })/\partial(\cdot)$ for $\underline{w}$ and ℓ are all non-negative throughout; teachers prefer more current income or job security whether they receive their promised pension or not. As $\mu = \mu\{(1 - \delta)U\}$, $\partial\mu/\partial z = 0$ and $\partial\mu/\partial p \geq 0$, from the definition of U given by eqs. (1) - (3) in the text. Teachers share taxpayers' expectations that increases in z will increase wages and/or employment in the local bargain; thus $d\bar{w}/dz > 0$ and $d\underline{w}/dz > 0$ or $d\ell/dz > 0$ or both (see Tables 5a and 5b and Craig and Inman (1982)). Like taxpayers, teachers also expect an increase in p to have non-positive effects on ℓ in the local bargain, and for high values of p, $d\ell/dp < 0$. Finally, an increase in p is also assumed to have a non-positive effect on wages; teachers either do, or do not, demand and receive a compensating wage differential for underfunding; thus $d\bar{w}/dp \leq 0$ and $d\underline{w}/dp \leq 0$.

Conditions (A.5) and (A.6) can be re-arranged with the marginal benefits of change in p or z on the L.H.S. and the marginal costs on the R.H.S.:

$$(A.5') \quad \underset{(0)\,\cdot\,\{+\text{ or }0\}}{\frac{\partial\mu}{\partial z}\{v_e(\bar{\ })-v_e(\_)\}}+\mu\{\underset{(0)\,\cdot\,(+)}{\frac{\partial v_e(\bar{\ })}{\partial\bar{w}}\frac{d\bar{w}}{dz}}+\underset{(0)\,\cdot\,(+)}{\frac{\partial v_e(\bar{\ })}{\partial\ell}\frac{d\ell}{dz}}\}+(1-\mu)\{\underset{(0)\,\cdot\,(+)}{\frac{\partial v_e(\_)}{d\underline{w}}\frac{d\underline{w}}{dz}}+\underset{(0)\,\cdot\,(+)}{\frac{\partial v_e(\_)}{\partial\ell}\frac{d\ell}{dz}}\} = 0$$

and,

$$(A.6') \quad \underset{(0)\,\cdot\,\{+\text{ or }0\}}{\frac{\partial\mu}{\partial p}\{v_e(\bar{\ })-v_e(\_)\}} = -[\mu\{\underset{(0)\cdot(-)}{\frac{\partial v_e}{\partial\bar{w}}\frac{d\bar{w}}{dp}}+\underset{(0)\,\cdot\,(-)}{\frac{\partial v_e(\bar{\ })}{\partial\ell}\frac{d\ell}{dp}}\}+(1-\mu)\{\underset{(0)\,\cdot\,(-)}{\frac{\partial v_e(\_)}{\partial\underline{w}}\frac{d\underline{w}}{dp}}+\underset{(0)\,\cdot\,(-)}{\frac{\partial v_e(\_)}{\partial\ell}\frac{d\ell}{dp}}\}],$$

where the equilibrium signs of all marginal effects are indicated. Since, for teachers, an increase in z imposes 0 marginal costs, we see from (A.5') that teachers will prefer to increase z until satiation in income and job security--that is, until $\partial v_e(\bar{\ })/\partial\bar{w} = \partial v_e(\_)/\partial\underline{w} = \partial v_e(\bar{\ })/\partial\ell = \partial v_e(\cdot)/d\ell = 0$. The teacher's ideal point for z is therefore defined by the point of satiation in w and ℓ which I take as exogenous to the analysis and equal across all teachers. Thus

$$(A.7) \qquad z_e^* = z_e^*(\cdot) \ .$$

(A.6') balances the benefits and costs for teachers of increases in p, conditional on preferred levels of z. Given that the preferred level of z is for satiation in w and ℓ, $\partial v_e(\bar{\ })/\partial \bar{w} = \partial v_e/\partial_{\underline{w}} = \partial v_e(\_)/\partial \ell = \partial v_e(\_)/\partial \ell = 0$ in (A.6') as well. Thus the R.H.S. of (A.6') is zero. The L.H.S. of (A.6') also becomes zero at $\partial \mu/\partial p = 0$. Teachers' preferred (ideal) p is that level where $\partial \mu/\partial p$ is just zero--that is, where the pension is just guaranteed. This level of p depends on the stock of past underfundings less net pension wealth created from the regulation budget, or $(1 - \delta)\hat{U}$ as defined above for (A.4). Thus:

$$(A.8) \qquad p_e^* = p_e^*\{(1 - \delta)\hat{U}\} \ .$$

(A.7) and (A.8) define the teacher coalition's ideal points in the (p, z) legislative game.[3]

B. The Local Bargaining Game

Ideal points in the local bargaining game are specified first by the maximization of each coalition's typical member's expected utility with respect to w and ℓ, and then by solving the resulting first-order conditions for w and ℓ as functions of the relevant exogenous variables which define

[3]Diminishing marginal utility for teachers in w and ℓ is sufficient for satiation at z_e^* to be utility maximizing. The assumption that $\mu\{(1 - \delta)U\}$ is bounded from above by 1 is sufficient for p_e^* to be utility maximizing.

expected utility. Again, second-order conditions necessary to insure that the resulting values of w and ℓ are unique maxima are assumed to hold.

1. Specification of Ideal Points for the Taxpayer Coalition: To define taxpayer ideal points for w and ℓ in the local bargaining game we assume taxpayers take the outcomes from the regulation and legislative games as given. The maximization of V_T with respect to w and ℓ therefore gives:

$$\text{(B.1)} \qquad \frac{\partial V_T}{\partial w} = (1-\alpha)\{\frac{\partial v_T(\bar{\ })}{\partial \bar{y}} \frac{d\bar{y}}{dw}\} + \alpha\{\frac{\partial v_T(\_)}{\partial \underline{y}} \frac{d\underline{y}}{dw}\} = 0 ,$$

and,

$$\text{(B.2)} \qquad \frac{\partial V_T}{\partial \ell} = (1-\alpha)\{\frac{\partial v_T(\bar{\ })}{\partial \bar{y}} \frac{d\bar{y}}{d\ell} + \frac{\partial v_T(\bar{\ })}{\partial \ell}\} + \alpha\{\frac{\partial v_T(\_)}{d\underline{y}} \frac{d\underline{y}}{d\ell} + \frac{\partial v_T(\_)}{d\ell}\} = 0 .$$

From the definitions of $\bar{y}$ and $\underline{y}$ (see pp. 10-11 above), $d\bar{y}/dw = -\lambda(1+\delta\Delta)\ell$, $d\underline{y}/dw = -\lambda(1+\Delta)\ell$, $d\bar{y}/d\ell = -\lambda(1+\delta\Delta)w$ and $d\underline{y}/d\ell = -\lambda(1+\Delta)w$. Since increases in teacher wages only reduce the taxpayer's income, the taxpayer wishes to minimize w, subject, of course, to the constraint that w exceed the teachers' opportunity wage, denoted w_{pr}. The ideal wage is therefore:

$$\text{(B.3)} \qquad w_T^* \equiv w_{pr} .$$

The ideal level of employment is defined by (B.2), where w is set equal to w_{pr}. (B.2) can be re-arranged in a more familiar form where expected marginal benefits (L.H.S.) are set equal to expected marginal costs (R.H.S.):

$$\text{(B.2')} \quad (1-\alpha)\{\frac{\partial v_T(\bar{\ })/\partial \ell}{\partial v_T(\bar{\ })/\partial \bar{y}}\} + \alpha\{\frac{\partial v_T(\_)\partial \ell}{\partial v_T(\_)/\partial \underline{y}}\}\nu = (1-\alpha)\lambda(1+\delta\Delta)w_{pr} + \alpha\lambda(1+\Delta)w_{pr}\nu ,$$

where ν is the value of income in the low income event ($\underline{y}$) relative to the value of income in the high income state ($\bar{y}$).[4] Solving for ℓ as a function of the exogenous variables in (B.2') gives:

$$(B.4) \qquad \ell_T^* = \ell_T^*(\tilde{w}_{pr}, Y_c, T_c, \alpha)$$

where $\tilde{w}_{pr} = \lambda(1 + \delta\Delta)w_{pr}$, Y_c is the taxpayer's local income (see the text at p. 24), T_c is a vector of exogenous determinants of taxpayer tastes for local education (see text at p. 24), and α is the exogenous probability of full-funding.

2. Specification of Ideal Points for the Teacher Coalition: To define the teacher coalition's preferred allocation in the local bargaining game we assume teachers take the allocations from the regulation and legislative games as given. The maximization of V_e with respect to w and ℓ defines the relevant first-order conditions:

$$(B.5) \quad \frac{\partial V_e}{\partial w} = \frac{\partial \mu}{\partial w}\{v_e(\bar{\ }) - v_e(\underline{\ })\} + \mu\{\frac{\partial v_e(\bar{\ })}{\partial \bar{w}} \frac{d\bar{w}}{dw}\} + (1 - \mu)\{\frac{\partial v_e(\underline{\ })}{\partial \underline{w}} \frac{d\underline{w}}{dw}\} = 0 ,$$

and,

$$(B.6) \quad \frac{\partial V_e}{\partial \ell} = \frac{\partial \mu}{\partial \ell}\{v_e(\bar{\ }) - v_e(\underline{\ })\} + \mu\{\frac{\partial v_e(\bar{\ })}{\partial \bar{w}} \frac{d\bar{w}}{d\ell} + \frac{\partial v_e(\bar{\ })}{\partial \ell}\} + (1-\mu)\{\frac{\partial v_e(\underline{\ })}{\partial \underline{w}} \frac{d\underline{w}}{d\ell} + \frac{\partial v_e(\underline{\ })}{\partial \ell}\} = 0.$$

[4](B.2') defines the utility maximizing value of ℓ if marginal benefits decline as ℓ increases and marginal cost rise, or fall less steeply than marginal benefits. A diminishing marginal rate of substitution between income and teachers (so the terms within { } decline as ℓ rises) plus a constant marginal utility of income (so ν is constant) will be sufficient to insure that (B.2') gives a maximum. A constant ν implies risk neutral taxpayers over income. Alternatively, if taxpayers can self-insure against losses in the bad state (underfunding plus full capitalization) by investing at the before-tax-rate of return, then α effectively equals 0. In this case, ν disappears from (B.2') and a diminishing marginal rate of substitution between income and teachers is sufficient for a maximum.

As before, I assume all derivatives of $v_e(^-)$ and $v_e(_-)$ are non-negative. As increases in w and ℓ increase pension underfunding, <u>ceteris paribus</u>, $\partial\mu/\partial w < 0$ and $\partial\mu/\partial \ell < 0$. Finally, given the definitions of $\bar{w}$ and $\underline{w}$, $d\bar{w}/dw = (1 + \Delta)$, $d\underline{w}/dw = 1$, $d\bar{w}/d\ell = -c_e/\ell^2$, and $d\underline{w}/d\ell = 0$.

The first-order condition can be re-written with marginal benefits of an increase in w and ℓ on the L.H.S. and marginal costs on the R.H.S.:

$$\text{(B.5')} \quad \underset{(+)}{\mu\{\frac{\partial v_e(^-)}{\partial \bar{w}}(1 + \Delta)\}} + (1 - \mu)\underset{(+)}{\{\frac{\partial v_e(_-)}{\partial \underline{w}}\}} = -\underset{(-)}{\frac{\partial\mu}{\partial w}}\underset{(+)}{\{v_e(^-) - v_e(_-)\}} ,$$

and,

$$\text{(B.6')} \quad \underset{(+)}{\mu\{\frac{\partial v_e(^-)}{\partial \ell}\}} + (1 - \mu)\underset{(+)}{\{\frac{\partial v_e(_-)}{\partial \ell}\}} = -\underset{(-)}{\frac{\partial\mu}{\partial \ell}}\underset{(+)}{\{v_e(^-) - v_e(_-)\}} + \mu\underset{(+)}{\{\frac{\partial v_e(^-)}{\partial \bar{w}}\}}\underset{(+)}{(\frac{c_e}{\ell^2})} ,$$

where the equilibrium signs of all marginal effects are indicated. If we assume all teachers' preferences for w and ℓ are identical, then (B.5') and (B.6') can be solved for w and ℓ as functions of μ, Δ, and c_e/ℓ alone. However, since μ depends on (1 - δ)U which in turn is defined in part by w and ℓ, the final reduced form specification of teacher ideal points specifies w and ℓ as functions of Δ, c_e/ℓ and only the exogenous components to the local bargain of underfundings or $(1 - \delta)(\hat{U} - p) = (1 - \delta)\bar{U}$:

$$\text{(B.7)} \qquad w_e^* = w_e^*\{\Delta,\ (1 - \delta)\bar{U},\ c_e/\ell\}$$

and,

$$\text{(B.8)} \qquad \ell_e^* = \ell_e^*\{\Delta,\ (1 - \delta)\bar{U},\ c_e/\ell\} .$$

Equations (B.7) and (B.8) define teacher ideal points for the local bargains.[5]

[5]The specifications define utility maximizing values of w and ℓ if the marginal benefits of w and ℓ decline and marginal costs increase (or fall less steeply than marginal benefits) as w and ℓ are increased. In the special case where $\mu \equiv 1$, ideal points are defined by satiation, and diminishing marginal utility to w and ℓ is sufficient for maxima. When $\mu < 1$, matters are more complicated, and necessitate a not very intuitive balancing of changes in μ and the marginal utilities in the two states.

APPENDIX B

Predicted Teacher Pension Underfundings: 1981-2000*

Column 1: Predicted Teacher Pension Underfunding Assuming Population Projections for School Age Children as Developed by Bureau of Census (Projections of the Population of the United States, By Age, Sex, and Race: 1983 to 2080, Series P-25, No. 952, U.S. Department of Commerce, Bureau of Census.)

Column 2: Predicted Teacher Pension Underfunding Assuming Another "Baby-Boom" Beginning in the year 1990. (The "Baby-Boom" projections assume the historical growth rate in school-age children per family for the decade 1950 to 1960 re-occurs in the decade 1990 to 2000.)

* All underfundings are measured in 1967 dollars per capita.

	ALABAMA		ARIZONA	
	(1)	(2)	(1)	(2)
1981	397.24479	396.29779	162.66974	161.95613
	374.02605	376.60871	143.48494	143.44778
	353.82498	357.19912	120.27150	124.07312
	334.07836	336.23650	100.13020	104.59236
	322.04794	325.07637	84.18183	90.05574
	311.00150	316.50462	63.79947	76.14521
	303.33183	310.05209	53.64642	62.44567
	289.84759	301.31356	38.54121	48.64376
	279.36774	291.87072	23.64847	35.37574
	268.21913	284.04003	5.61915	21.33573
	258.27321	278.25774	0.00000	8.95100
	248.13875	268.75749	0.00000	0.00000
	238.20707	261.47096	0.00000	0.00000
	228.46654	254.18276	0.00000	0.00000
	218.67923	247.08953	0.00000	0.00000
	208.91090	240.47952	0.00000	0.00000
	198.95656	233.59591	0.00000	0.00000
	188.92051	227.77731	0.00000	0.00000
	173.62547	221.54951	0.00000	0.00000
2000	167.97455	215.53579	0.00000	0.00000

ARKANSAS		CALIFORNIA	
(1)	(2)	(1)	(2)
47.84191	48.79023	134.71293	135.60566
37.69797	35.92105	125.65917	127.81064
23.23849	21.16010	117.29159	120.15550
13.91072	22.42651	103.35800	112.42127
11.04501	15.73701	103.12115	107.70795
3.44483	9.39052	97.51657	103.23480
0.00000	3.11308	91.93390	99.82243
0.00000	0.00000	86.32289	94.41140
0.00000	0.00000	80.53439	89.99712
0.00000	0.00000	74.84085	85.54652
0.00000	0.00000	68.95691	81.33359
0.00000	0.00000	63.10394	77.20120
0.00000	0.00000	57.22583	73.08907
0.00000	0.00000	51.32930	69.00891
0.00000	0.00000	45.34485	64.93250
0.00000	0.00000	39.27345	60.97296
0.00000	0.00000	33.04231	57.05164
0.00000	0.00000	26.66709	53.15507
0.00000	0.00000	20.09423	49.25997
0.00000	0.00000	13.28344	45.40811

	COLORADO (1)	COLORADO (2)	CONNECTICUT (1)	CONNECTICUT (2)
1981	343.53127	365.03946	187.57990	[illegible]
	325.04759	329.05234	179.04150	190.22459
	302.53903	314.53947	172.57790	174.03372
	282.58306	289.67811	165.94737	167.90317
	264.37797	273.22051	161.31947	164.95620
	247.18677	257.94770	158.00153	162.04931
	230.42978	243.02233	154.30349	159.07310
	213.37213	228.19370	150.65949	157.42947
	197.33455	213.44193	144.74545	[illegible]
	181.73283	198.67836	143.12971	151.57596
	164.14057	184.72056	139.24203	14?.59236
	147.94450	171.05537	135.50149	146.74377
	131.95079	157.47111	131.?1436	144.94151
	115.14375	143.49655	130.16597	145.15778
	100.25413	130.60457	124.42912	143.53925
	84.47134	117.61854	120.61933	142.12754
	68.40632	104.80242	115.01511	14?.75777
	52.27861	92.19031	112.45172	139.?4?4?
	35.91252	79.49162	108.03812	136.1?94?
	19.22155	66.97631	103.30617	[illegible]
2000				

DELAWARE (1)	DELAWARE (2)	FLORIDA (1)	FLORIDA (2)
444.25479	440.64032	257.92791	259.72277
417.28297	420.24877	241.51999	245.71479
397.22120	395.75600	223.93390	229.14073
356.69083	360.95875	206.36751	212.34766
333.52985	339.58983	192.45799	199.75566
311.46259	315.35639	179.02997	187.65437
289.87722	299.54140	165.95746	175.55678
268.57750	279.93334	152.82917	164.15290
247.37241	260.50976	139.36597	152.56923
226.19315	241.18391	125.92688	141.05740
205.12678	222.76515	114.02721	130.01413
184.52220	204.73571	101.33849	119.17264
164.22075	186.91096	88.75839	108.42030
144.19919	169.32722	76.28371	97.77175
124.23027	151.94703	63.79532	87.23645
104.36312	135.07927	51.29991	76.85216
84.42031	118.50773	38.67788	66.60219
64.43430	102.17396	25.96756	56.40629
44.38982	86.05340	13.09417	46.25163
24.74014	70.15609	1.59375E-03	36.14613

	GEORGIA (1)	GEORGIA (2)	IDAHO (1)	IDAHO (2)
1981	[illegible]	94.52229	604.55048	[illegible]
	[illegible]	86.33375	[illegible]	[illegible]
	77.9[illegible]	76.[illegible]	[illegible]	[illegible]
	[illegible]	65.94309	[illegible]	627.77[illegible]
	[illegible]	61.93233	614.76333	619.[illegible]
	[illegible]	54.00395	605.48[illegible]	613.[illegible]
	43.[illegible]9547	46.26073	596.0037[illegible]	607.[illegible]
	[illegible]	41.[illegible]	595.0[illegible]	[illegible]
	[illegible]	[illegible]93	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]2.41776	591.73[illegible]
	[illegible]	26.21197	56[illegible].47951	[illegible]
	[illegible]	21.91015	557.70648	[illegible]
	[illegible]	15.77359	[illegible].145[illegible]	57[illegible]
	[illegible]	9.10915	[illegible]	576.[illegible]
	[illegible]	3.71[illegible]	53[illegible].0000[illegible]	573.[illegible]
	0.0000	[illegible]	53[illegible].27176	57[illegible]
	[illegible]	[illegible]	523.33706	[illegible]
	0.0000[illegible]	0.00000	51[illegible].24077	[illegible]
	0.0000[illegible]	0.00000	50[illegible].72401	56[illegible]
2000	0.0000[illegible]	0.00000	500.5[illegible]	563.3[illegible]77[illegible]

	ILLINOIS (1)	ILLINOIS (2)	INDIANA (1)	INDIANA (2)
1981	143.12458	140.54721	337.[illegible]9600	[illegible]
	135.55950	137.14039	333.31447	[illegible]
	130.47454	132.21513	32[illegible].67376	331.14047
	124.71887	127.05928	323.86963	327.13051
	120.52335	123.21729	320.79717	325.35643
	116.42741	120.77934	317.91664	323.82125
	112.35433	117.82241	315.14597	322.39736
	108.28335	114.80900	312.41216	321.00499
	104.12901	111.97203	309.62656	319.64745
	99.57427	109.04123	306.74317	318.27227
	95.53525	106.39190	303.80484	317.31333
	91.24359	103.66267	301.04184	316.65832
	86.95712	101.38767	298.34571	315.99269
	82.67316	98.97624	295.71649	315.42823
	78.31620	96.60573	293.01290	314.88874
	73.88991	94.39633	290.26791	314.62370
	69.21129	92.27062	287.35757	314.44968
	64.59934	90.20690	284.33716	314.40357
	59.69137	88.20073	281.18260	314.40995
2000	54.57876	86.25691	277.55269	314.45734

	IOWA (1)	IOWA (2)	KANSAS (1)	KANSAS (2)
1981	[illegible]	335.43937	[illegible]	[illegible]
	[illegible]	345.54942	391.79770	390.15593
	335.22949	341.01169	359.77277	370.73617
	325.45807	331.01209	339.45474	351.47773
	319.34239	326.05479	323.91700	[illegible]
	313.79407	324.74545	309.38143	325.54047
	307.30327	319.03257	295.19644	313.01061
	303.03179	315.31553	281.19177	301.77009
	297.71731	311.07851	267.20590	290.07319
	292.39547	308.03099	253.18154	[illegible]
	286.93209	305.11350	239.12390	267.11554
	281.83675	302.43177	225.44770	256.17033
	275.70987	299.71513	212.09.6	[illegible]
	272.06237	297.12324	[illegible]	[illegible]
	267.14930	294.50574	185.3347	224.64355
	262.20770	292.42307	171.94946	[illegible]
	257.25074	290.17677	158.35200	204.67872
	251.76375	288.39254	144.51984	[illegible]
	246.20241	285.46432	[illegible]	[illegible]
2000	240.28709	284.07444	115.21555	[illegible]

KENTUCKY (1)	KENTUCKY (2)	LOUISIANA (1)	LOUISIANA (2)
193.56674	[illegible]	443.24200	[illegible]
187.29761	190.00534	[illegible]	[illegible]
177.50371	181.10720	[illegible]	[illegible]
168.01691	172.35678	[illegible]	[illegible]
161.74377	167.59035	437.79083	[illegible]
155.34124	163.21944	434.10597	446.72750
150.09174	159.01103	433.71125	449.28477
144.40926	154.86676	439.42421	451.63590
138.68697	150.77385	440.07530	454.52435
132.38405	146.09664	440.55317	457.11113
127.04367	143.15630	441.02791	460.47631
121.40504	139.81091	441.79529	464.10308
115.96079	136.56154	442.71309	467.30526
110.40633	133.42131	443.77091	471.61297
104.39644	130.37923	444.72715	475.49377
99.36611	127.63700	445.54497	479.77154
93.69779	125.04376	445.33547	484.22519
87.89457	122.57138	446.77079	488.33097
81.89935	120.20790	447.10652	493.47340
75.42470	117.96159	446.37765	[illegible]

	MAINE (1)	MAINE (2)	MARYLAND (1)	MARYLAND (2)
1981	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
2000	[illegible]	[illegible]	[illegible]	[illegible]

MASSACHUSETTS (1)	MASSACHUSETTS (2)	MICHIGAN (1)	MICHIGAN (2)
[illegible]	[illegible]	186.07447	[illegible]
[illegible]	325.11379	[illegible]	[illegible]
311.59715	[illegible]	161.27715	[illegible]
[illegible]	305.63517	143.22323	[illegible]
299.30171	306.93020	137.81501	141.53761
295.29667	304.50093	127.24694	132.94347
291.46741	302.35647	117.07354	[illegible]
287.71329	300.25243	106.93052	114.77377
283.92995	298.26380	96.74970	105.96879
280.07222	296.35195	86.49251	97.17561
276.17595	294.75934	76.18507	[illegible]
272.46513	293.45928	65.90572	[illegible]
268.84645	292.27105	55.87097	72.37962
265.30570	291.17099	45.79970	[illegible]
261.71610	290.15932	35.68349	[illegible]
258.08891	289.42709	25.54794	[illegible]
254.37444	288.83352	15.28384	[illegible]
250.39767	288.34514	4.92764	33.55575
246.27674	287.94636	0.00000	25.17086
241.27915	287.54794	0.00000	[illegible]

	MINNESOTA (1)	MINNESOTA (2)	MISSISSIPPI (1)	MISSISSIPPI (2)
1981	134.29797	134.81292	172.66415	174.21581
	124.47938	122.92242	151.13464	155.28011
	114.71854	115.88605	143.39427	143.34397
	105.34172	107.64022	139.77519	131.77575
	97.88495	101.42075	120.30491	121.46477
	90.03211	95.14559	112.21449	114.73493
	83.38377	89.17122	104.38319	105.19879
	75.19546	83.13958	95.57394	100.71719
	68.94657	77.12832	93.35547	96.21588
	61.81737	71.13771	81.30257	88.77414
	54.27444	65.59430	73.13147	83.01744
	45.93395	60.32943	65.61485	77.67912
	37.09129	54.59073	57.35727	71.77385
	32.47441	49.32356	51.15162	67.38914
	25.19594	43.98521	43.77247	62.33147
	17.36632	36.84771	35.57056	57.59277
	10.38721	32.65772	29.37741	52.29679
	7.79969	25.94858	21.83149	46.77215
	0.00000	24.17332	13.74163	44.08975
2000	0.00000	19.34655	5.81153	40.50775

	MISSOURI (1)	MISSOURI (2)	MONTANA (1)	MONTANA (2)
	24.30996	29.21834	305.77976	287.20[illegible]
	18.69230	24.73079	287.71794	280.44377
	12.25500	18.58577	273.61491	278.21213
	5.95102	13.55490	269.34410	274.87348
	2.34852	8.77898	264.62190	271.79123
	0.00000	5.36930	260.50457	269.35452
	0.00000	3.51861D-02	256.61181	267.11945
	0.00000	0.00000	252.81910	264.94981
	0.00000	0.00000	248.99243	262.62555
	0.00000	0.00000	245.35152	260.69682
	0.00000	0.00000	241.14183	259.18643
	0.00000	0.00000	237.44693	257.82716
	0.00000	0.00000	233.37945	256.07320
	0.00000	0.00000	230.41784	255.55472
	0.00000	0.00000	226.80705	254.52273
	0.00000	0.00000	223.34967	253.81954
	0.00000	0.00000	219.67761	253.26651
	0.00000	0.00000	215.80977	252.82311
	0.00000	0.00000	211.75900	252.47742
	0.00000	0.00000	207.34641	252.23674

	NEBRASKA (1)	NEBRASKA (2)	NEVADA (1)	NEVADA (2)
1981	91.41435	81.10136	[illegible]	[illegible]
	85.34966	87.82871	223.17734	233.00731
	81.56707	83.59401	203.00739	217.52254
	75.73161	79.30638	175.86439	171.53939
	74.00983	76.57145	155.83107	163.07972
	69.47361	73.94579	131.90005	145.95221
	67.84174	71.45645	113.73507	131.37541
	62.29446	69.07642	97.84631	110.16501
	59.60979	64.53904	78.01772	90.70103
	55.71100	60.17171	[illegible]	79.12971
	51.23191	62.05216	41.15000	59.43104
	47.03995	55.07533	27.47371	42.07112
	43.35139	57.08110	[illegible].1671	20.17370
	42.70701	56.13305	0.00000	11.45072
	36.53147	54.34463	0.00000	0.00000
	32.23567	51.59971	0.00000	0.00000
	28.77113	51.33543	0.00000	0.00000
	24.30100	47.54311	0.00000	0.00000
	20.69911	46.05137	0.00000	0.00000
	17.26637	46.01979	0.00000	0.00000
2000				

NEW HAMPSHIRE (1)	NEW HAMPSHIRE (2)	NEW JERSEY (1)	NEW JERSEY (2)
1.27344	1.72727	213.34907	217.17577
0.00000	0.00000	207.41491	209.38114
0.00000	0.00000	199.43717	199.17364
0.00000	0.00000	195.48473	186.82961
0.00000	0.00000	177.34903	191.91372
0.00000	0.00000	159.37957	175.27264
0.00000	0.00000	161.46961	166.81923
0.00000	0.00000	153.65277	162.39215
0.00000	0.00000	145.78321	156.00355
0.00000	0.00000	137.91720	149.63225
0.00000	0.00000	129.79241	143.69547
0.00000	0.00000	121.94139	137.97077
0.00000	0.00000	114.16365	132.31569
0.00000	0.00000	106.45904	126.74147
0.00000	0.00000	98.66261	121.23658
0.00000	0.00000	90.92449	115.99577
0.00000	0.00000	82.80734	110.56145
0.00000	0.00000	74.65640	105.32132
0.00000	0.00000	65.27247	100.17362
0.00000	0.00000	57.58259	95.06492

NEW MEXICO

	(1)	(2)
1981	375.06772	375.[illegible]
	363.25558	364.22216
	359.11047	351.37135
	3[illegible]6.03709	339.01851
	33[illegible].[illegible]55[illegible]	334.45273
	3[illegible]4.[illegible]55[illegible]	330.47355
	319.50099	326.39946
	314.17467	322.81612
	308.00347	319.03845
	30[illegible].3[illegible]12	315.335[illegible]
	297.73414	312.41470
	292.71509	309.73482
	287.77564	307.14351
	283.07454	304.67517
	277.15591	302.32985
	273.11154	300.38702
	268.27443	298.06184
	263.12722	297.04582
	257.77346	295.57[illegible]
2000	251.95759	294.24935

NEW YORK

	(1)	(2)
1981	173.91[illegible]	171.[illegible]
	167.51[illegible]	[illegible]
	157.[illegible]	[illegible]
	147.[illegible]	[illegible]
	142.29172	[illegible]
	135.55[illegible]	[illegible]
	130.98347	[illegible]
	125.21079	[illegible]
	117.40757	[illegible]
	112.45157	[illegible]
	107.73341	[illegible]
	101.[illegible]	[illegible]
	[illegible]	[illegible]
	[illegible].[illegible]6577	101.72[illegible]
	[illegible].[illegible]7564	[illegible]
	77.40[illegible]	[illegible]
	72.26177	[illegible]
	65.[illegible]	[illegible]
	57.44[illegible]	[illegible]
2000	52.[illegible]	[illegible]

NORTH CAROLINA

	(1)	(2)
1981	583.26341	58[illegible].[illegible]4974
	553.74744	557.29354
	533.38759	535.21345
	508.79491	513.94924
	495.44412	502.73793
	482.76495	492.11273
	470.42896	481.63494
	458.27277	471.30258
	446.10298	460.92510
	433.32924	450.62210
	421.56437	441.25218
	409.77037	432.13947
	395.20441	423.07007
	386.83213	414.10495
	375.35144	405.27325
	363.86463	396.75622
	352.13905	388.43131
	340.29772	380.29383
	329.12207	372.17642
2000	313.53987	364.13800

NORTH DAKOTA

	(1)	(2)
1981	263.[illegible]	263.[illegible]
	257.75[illegible]	258.33203
	251.08341	253.19877
	246.20073	248.02199
	244.40212	247.49037
	243.00097	247.49311
	241.35571	247.66345
	240.09787	247.88073
	239.73093	248.12975
	238.52649	248.35208
	237.37657	249.14724
	236.15603	250.11216
	235.16256	251.14274
	234.34540	252.35031
	233.24137	253.42303
	232.18791	254.89215
	230.93460	256.45769
	229.56492	258.11683
	227.79646	259.84474
2000	225.01234	261.65951

	OHIO (1)	OHIO (2)	OKLAHOMA (1)	OKLAHOMA (2)
1981	151.1421[illegible]	[illegible]	[illegible]	[illegible]
	1[illegible]7.52141	153.2975[illegible]	[illegible]	[illegible]
	143.15[illegible]	145.391[illegible]	271.[illegible]	[illegible]
	13[illegible].69[illegible]	13[illegible].4[illegible]	26[illegible].[illegible]	[illegible]
	13[illegible].[illegible]44[illegible]	134.[illegible]	262.3[illegible]	[illegible]
	126.230[illegible]	131.5379[illegible]	[illegible]	[illegible]
	121.716[illegible]	12[illegible].30[illegible]5	247.9[illegible]	[illegible]
	117.23[illegible]	[illegible]	243.[illegible]	[illegible]
	112.[illegible]	[illegible].937[illegible]	[illegible]	[illegible]
	[illegible]	[illegible].740[illegible]	[illegible]	[illegible]
	1[illegible]3.[illegible]167	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]3.44956	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	2[illegible]	[illegible]7.127[illegible]
	[illegible]	[illegible]03.[illegible]	[illegible]	[illegible]
	[illegible]	101.[illegible]	191.57[illegible]	[illegible]
	[illegible]	99.97[illegible]	[illegible]	[illegible]
	[illegible]	9[illegible].077[illegible]	[illegible]	[illegible]
2000	6[illegible].6477[illegible]	95.25[illegible]	173.[illegible]	[illegible]

	OREGON (1)	OREGON (2)	PENNSYLVANIA (1)	PENNSYLVANIA (2)
	[illegible]	[illegible]	45[illegible]	[illegible]
	[illegible]	[illegible]	44[illegible].[illegible]	[illegible]
	272.44[illegible]	[illegible]	437.12[illegible]	[illegible]
	2[illegible].26[illegible]	256.73644	42[illegible].[illegible]	436.[illegible]
	[illegible]13[illegible]	243.25[illegible]	423.79[illegible]	433.[illegible]
	227.6[illegible]143	230.649[illegible]7	419.977[illegible]	431.[illegible]
	[illegible]	218.30[illegible]	416.212[illegible]	43[illegible].22475
	19[illegible].348[illegible]	20[illegible].[illegible]459[illegible]	412.[illegible]49[illegible]	426.5755[illegible]
	173.90[illegible]	193.8[illegible]	40[illegible].[illegible]495[illegible]	426.5[illegible]
	165.091[illegible]7	181.62857	405.343[illegible]	425.328[illegible]
	151.1612[illegible]	170.11174	401.5892[illegible]	424.329[illegible]7
	137.546[illegible]	158.21142	39[illegible].[illegible]	423.559[illegible]
	124.[illegible]	147.57719	394.60747	422.85049
	11[illegible].7444[illegible]	136.4293[illegible]	[illegible]1.3942[illegible]	42[illegible]
	97.34362	125.34604	38[illegible]	421.[illegible]
	83.[illegible]17[illegible]	114.[illegible]	38[illegible]	421.[illegible]
	[illegible]0716	103.9[illegible]120	3[illegible].[illegible]476	421.[illegible]
	[illegible]6.5[illegible]	93.44[illegible]5	[illegible]77.[illegible]94	[illegible]
	43.610[illegible]3	[illegible]	372.3[illegible]	[illegible]
	2[illegible]	72.[illegible]	3[illegible].39166	[illegible]

Year	RHODE ISLAND (1)	RHODE ISLAND (2)	SOUTH CAROLINA (1)	SOUTH CAROLINA (2)
1981	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
2000	[illegible]	[illegible]	[illegible]	[illegible]

Year	SOUTH DAKOTA (1)	SOUTH DAKOTA (2)	TENNESSEE (1)	TENNESSEE (2)
1981	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	154.0[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	117.39[illegible]	122.75039
	[illegible]	[illegible]	104.66[illegible]	111.53719
	387.98234	401.23506	92.39344	[illegible]
	378.32177	393.89563	80.31025	90.31950
	369.36586	286.71915	68.32474	79.89756
	359.37043	379.66837	56.33[illegible]	69.55[illegible]
	350.64410	372.64237	44.29536	55.24430
	341.49073	360.69549	32.24976	49.475[illegible]
	332.94538	361.115[illegible]	20.42374	39.921[illegible]
	324.51304	355.67665	8.71104	30.47545
	315.45749	350.43095	0.00000	21.15287
	303.35773	345.35808	0.00000	11.94014
	300.30941	340.66265	0.00000	3.03065
	292.06733	336.31064	0.00000	0.00000
	283.72675	332.12145	0.00000	0.00000
	275.11470	328.07382	0.00000	0.00000
2000	266.09467	324.17083	0.00000	0.00000

	TEXAS (1)	TEXAS (2)	UTAH (1)	UTAH (2)
1981	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	240.30282	[illegible]	[illegible]
	[illegible]	231.34759	[illegible]	[illegible]
	[illegible]	221.91072	[illegible]	[illegible]
	[illegible]	215.43216	157.91111	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	147.[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	144.[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
2000	113.36[illegible]	[illegible]	[illegible]	[illegible]

VERMONT (1)	VERMONT (2)	VIRGINIA (1)	VIRGINIA (2)
[illegible]	[illegible]	[illegible]	569.[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
72.[illegible]	79.56432	[illegible]	[illegible]
[illegible]	77.36233	522.7356[illegible]	534.017[illegible]
[illegible]	75.22435	517.1951[illegible]	531.4661[illegible]
61.2[illegible]	73.22259	512.09[illegible]	528.62075
57.64647	71.23654	[illegible]	525.86363
[illegible]	69.43022	[illegible]	523.14234
50.233[illegible]	67.52875	497.148[illegible]	520.36475
46.[illegible]	65.12352	492.06278	518.54067
42.96740	64.37432	[illegible]	517.0129[illegible]
[illegible]	63.74417	[illegible]	515.[illegible]
35.[illegible]	62.70137	[illegible]	514.19709
32.26769	61.75639	474.34462	512.905[illegible]
[illegible]	61.03766	469.96907	[illegible]
[illegible]	60.35359	465.35994	511.42063
21.47777	60.13476	[illegible]	510.[illegible]
17.577[illegible]	59.62410	455.49[illegible]90	[illegible]
13.44[illegible]	59.63283	[illegible]	510.07715

	WASHINGTON (1)	WASHINGTON (2)	WEST VIRGINIA (1)	WEST VIRGINIA (2)
1981	227.43093	[illegible]	478.21773	[illegible]
	212.51347	[illegible]	471.26171	[illegible]
	207.95155	[illegible]	475.90327	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	278.14757	[illegible]	421.23594	[illegible]
	273.97699	[illegible]	432.44793	[illegible]
	263.67086	[illegible]	473.72705	[illegible]
	256.54786	[illegible]	475.15697	[illegible]
	249.39197	271.22591	426.71215	[illegible]
	242.15975	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	227.71941	[illegible]	431.17724	[illegible]
	[illegible]	[illegible]	477.99717	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	476.9576	[illegible]
	199.25222	[illegible]	478.94448	[illegible]
	[illegible]	[illegible]	449.72177	[illegible]
	184.44443	[illegible]	442.41445	[illegible]
	175.77527	[illegible]	443.95413	[illegible]
	[illegible]	[illegible]	444.94997	[illegible]
2000				

WISCONSIN (1)	WISCONSIN (2)	WYOMING (1)	WYOMING (2)
191.79347	192.34593	433.2699[illegible]	[illegible]
190.75557	187.89071	404.15447	[illegible]
175.29127	176.14029	374.92566	378.07873
165.56277	166.05255	346.17847	352.23070
153.01574	161.59620	331.07476	[illegible]
150.71946	155.56129	316.77494	324.65078
143.57195	149.63146	303.29705	312.97410
136.48396	143.25633	287.31609	301.15527
129.35421	138.07699	276.31390	289.37045
122.13910	132.29519	262.71417	277.57434
114.87562	126.99346	249.13199	265.70232
107.79629	121.87432	236.02197	253.10241
100.77474	116.83154	223.14486	245.09134
93.83696	111.87338	213.47745	235.29325
86.83470	106.99045	197.71213	224.97621
79.79057	102.36010	184.96292	213.13944
72.59077	97.84959	172.00572	205.49435
65.24505	93.43013	158.93797	195.04513
57.69075	89.03465	145.55302	185.52357
49.84302	84.33579	131.72647	177.19[illegible]