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CENTRAL POLICIES FOR LOCAL DEBT: THE CASE OF TEACHER PENSIONS

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ABSTRACT

The recent debt crises in New York City and Cleveland, the deterioration of public infra-structures in certain of our states and larger cities, and the occasional bankruptcy of smaller pension plans suggest that not all of local finance stands on a sound fiscal base. This paper examines the trends in funding for one form of state and local government debt--teacher pensions underfundings--and asks what a central government might do to check any unwanted growth in these liabilities. The analysis concludes (i) that this form of state-local debt is sizeable and growing, (ii) that state and local governments have an implicit pay-as-you-go bias in pension financing which encourages the growth of debt, but (iii) central government benefit and funding regulations or debt relief policies can slow, or even reverse, that growth.

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Central Policies for Local Debt: The Case of Teacher Pensions

by

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The New York City and Cleveland bond defaults, the closing as unsafe of the bridges and roadways in New York, Boston, Philadelphia, and Cleveland, and the declared bankruptcy of local employee pension plans in Michigan and Pennsylvania are each a warning sign that the local fiscal sector may not, as is often assumed, be resting upon a bedrock of fiscal surpluses. Even the states of Texas and Alaska, once considered invulnerable to the threat of fiscal collapse, have recently been forced to enact emergency tax measures to insure their bills could be paid. While each of these instances has its own unique history and may appear by itself to be an isolated event, there is a common logic to the stories. The logic is one of fiscal competition between local and state jurisdictions, a competition which induces local politicians to maximize services for, and to minimize taxes upon, the current generation of taxpayers. Yet as services rise and taxes fall for current residents and firms, the local budget constraint requires someone to pay the shortfall. That someone is a future taxpayer. The increased use of short-term borrowing followed by debt roll-overs, a neglect of public infra-structures, and a failure to adequately fund public employee pensions are all mechanisms for shifting the current costs of public services onto future taxpayers. When future taxpayers are unable to cover these local debts, or if they refuse, we observe a default, a detour, or a bankruptcy.

While it is premature to announce today a state and local fiscal crisis, it does seem wise to begin exploring what we might propose as policies if local debt does prove to be a problem. Significant local debt unmatched by assets may have important long-run allocative and equity implications. To limit such adverse effects we must look for policies today to stem its growth. Two regulatory strategies are available to limit the growth in local debt: reduce spending but hold taxes fixed or increase taxes but hold spending fixed. If neither of these regulatory alternatives work--or if we now face the problem of what to do about past debt--we might wish to consider a debt "bail-out" strategy which more equitably distributes the burden of past underfundings. This paper examines all three policy options for local debt management--regulate spending, regulate taxes, or offer bail-outs--for one particular, but important, case: public debt from underfunded teacher pensions.

Section II presents estimates of the current stock of unfunded pension debt for teacher pensions and discusses the possible implications of this debt for the efficient and fair allocation of public resources. Section III specifies and estimates a model of debt creation via teacher pension underfundings and, given this model, predicts the likely trends in underfundings to the year 2000. Section IV outlines three policy strategies for the management of teacher underfundings--(i) a reduction in promised pension benefits (a "control spending" policy), (ii) an increase in required contributions (a "tax increase" policy), and (iii) a federal pension assistance program (a "debt bail-out" policy)--and then simulates the relative impact of each reform on the future trend in pension underfundings. Section V summarizes our results.

II. The Funding Status of Teacher Pensions

Teachers comprise the largest single group of state and local public employees. They are compensated, as are most public employees, through direct wage payments and through the promise of a pension upon retirement. Teacher pensions are defined benefit pensions which give each retiree an annuity upon retirement equal to a fixed fraction, called the replacement rate, of the teacher's pre-retirement salary. The replacement rate is defined as the product of the annual benefit accrual rate (typically .02 per year) times the number of years of teacher service. More recently, states have supplemented this fixed annuity with a cost-of-living adjustment (COLA) to protect the real value of the annuity in times of high inflation.

The accumulation of these pension obligations constitutes a fiscal liability for which the taxpayers of the state are responsible. To relieve this liability, taxpayers can adopt either of two funding strategies. First, taxpayers can save an amount each year such that those savings plus earned interest will be just sufficient to pay the promised pensions of the teachers when they retire. This strategy, called full-funding, insures that at the end of each fiscal year, existing pension fund assets plus expected future contributions are just equal to the expected pension obligations. The second strategy, called pay-as-you-go, makes no explicit contributions for future pensions but simply budgets for those expenditures when they fall due as part of a current accounts allocation. The funding status of a pension fund measures the gap between the present value of the promised pension obligations and the present value of future employee contributions plus current plan assets. Projections of pension benefits are based upon the growth in teacher wages, the growth in the number of teachers who reach retirement, the longevity of retired teachers, and the replacement rate (plus COLA protection, if any) of the pension plan. Projections of future contributions depend upon existing state laws for required employee contributions (usually as a fraction of teacher wages) and the expected growth in teacher wages and employment. This gap between the present value of promised obligations and the present value of expected contributions and existing assets is called the unfunded liability of the teacher pension and measures the implicit public debt created for taxpayers by the pension system.

What is the present funding status of teacher pensions? Inman (1986a) provides one set of estimates for the decade 1971-1980 for the forty-eight mainland state teacher plans. Table 1 summarizes the main results. Three conclusions emerge from the analysis. First, the trend in the average level of real underfundings has been steadily upward over the decade, measured either from the perspective of taxpayers (column 1) or teachers (column 3). Second, the real level of implicit public debt is significant, approaching 8% of taxpayer real income by 1980 (column 2) and 60% of the promised pension wealth to the average teacher (column 4). Third, there is great variation in the level of pension-created public debt; some plans are in real trouble with debt levels over $500/resident (column 6) while other plans are well funded with debt levels of only a $100/resident or less (column 5).

If allowed to grow, these underfundings of teacher pensions may have significant consequences for economic efficiency and fiscal equity. First, increases in the stock of public employee pension debt may have adverse effects on private savings in a manner fully analogous to increases in social security debt; see Feldstein (1974). If increases in public employee pension debt are viewed by current employees and taxpayers as a transfer of wealth from future taxpayers to themselves, the "created wealth" may induce a decline in today's rate of private savings; Inman and Seidman (1979) have found some tentative evidence for this hypothesis using aggregate time series data for the United States. Second, underfunded state and local pensions may create an incentive to over-provide state and local services or to adopt a less than efficient, more labor-intensive technology for service provision. Public employees are compensated for their effort with a wage and a pension. If the

Table 1: Teacher Pension Underfundings: 1971-1980

	Average Underfunding		Average Underfunding		Average Underfunding Per Resident*	
	Per Resident (1)	% of Income (2)	Per Member (3)	% of Benefit Wealth (4)	10 Best Plans (5)	10 Worst Plans (6)
1971	$142	.051	$7734	.538	$37	$346
1972	159	.054	8580	.535	41	352
1973	179	.060	8959	.564	59	421
1974	190	.066	9118	.584	72	444
1975	206	.069	9812	.584	85	431
1976	224	.072	10315	.594	94	473
1977	232	.072	10652	.589	95	485
1978	239	.073	10707	.587	96	480
1979	250	.076	10690	.593	106	539
1980	249	.077	11012	.582	106	539

Source: Inman (1986a). All data are in 1967 dollars for the forty-eight mainland states, except 1971 and 1972 which exclude Delaware for reasons of insufficient data. All summary statistics are population-weighted means of individual state values.

*Plans in Alaska, Hawaii, Idaho, Maine, Massachusetts, West Virginia and Wyoming were consistently among the ten worst funded plans; plans in Minnesota, Missouri, New Hampshire, Texas, and Wisconsin were always among the best funded plans.

pension is underfunded by current taxpayers, it is possible for some of the costs of current period labor to be shifted onto future taxpayers. If current taxpayers then escape this burden--for example, by re-locating before the pension debt falls due--then an implicit subsidy results in which future taxpayers support a fraction of the labor costs of public services received by current taxpayers. The resulting subsidy may stimulate a less than efficient provision of state and local services; Inman (1982, 1986b) provides some evidence that the purchase of public employee services is sensitive to the degree of pension underfunding. Third, if pension underfunding precipitates a fiscal crisis--as is may have in the case of New York City--cities or states may be forced into austerity budgeting with adverse consequences for the provision of services. Such crisis fiscal management discourages the location of economic activity to the possible detriment of long-run spatial efficiency.

The consequences of significant pension underfundings for fiscal equity may be no less important. Underfundings benefit current taxpayers at the possible expense of future taxpayers, future retirees, or future consumers of public services. While aggregate income will be rising over time and the average future taxpayer will be richer than the average current taxpayer, it is not clear that state-local pension underfundings will automatically involve a transfer from a rich future taxpayer to a poorer current taxpayer. If underfundings can be avoided by re-locating and if the wealthy are more likely to know the level of underfundings and have a wider set of possible re-location choices, then it may be that it is the richer current taxpayers who escape high underfundings and leave the burden for relatively poorer future taxpayers. This burden may be shared with future retirees if the promised pension is not fully paid or with future public service recipients (e.g., children) if services are curtailed. Balancing these resulting transfers of wealth will require an explicit welfare judgment, but the fact remains that sizeable underfundings create potentially significant, and possibly unwanted, redistributions of social resources.

There is one important check to all of these adverse consequences of public pension debt, however. There is for public pension debt--and for state-local debt generally--a Ricardian neutrality result which insures that current taxpayers will bear the burdens of any state and local underfundings. If future taxpayers recognize the burden of the underfundings, they will demand a fully compensating reduction in the price they pay for land when they move into the state or local jurisdiction. This reduction in land price insures that the current, not future, taxpayers bear the full burden of the created public debt. Not only are any adverse redistributive effects avoided by this capitalization process, but so too are the efficiency effects of underfunding. Current taxpayer wealth, once increased by underfunding, is returned to its original levels through capitalization; the disincentive to private savings is thereby removed. Further, current taxpayers now bear the full responsibility for the costs of hiring public employees; thus, efficient labor hiring will result. Finally, while public employee pension debt still exists on the books of the state or local government, the asset position of future taxpayers has been increased by an equal amount thereby mitigating the risks of a fiscal crisis. Through the capitalization of underfunded pension debt, the private sector can neutralize the excesses of the public sector. The important question is: Does it? Here the evidence is meager. Epple and Schipper (1981) find evidence of full capitalization, but Inman (1982, 1986b) finds that employees and taxpayers budget as if only partial or no capitalization occurs. The definitive resolution of this issue remains a central research question.

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In the meantime, it seems prudent to address the question of what can be done to control the future growth of state-local debt generally, and teacher pension debt in particular. That is our task here. When the economic interests of future taxpayers go unrepresented in the political arena, or stand unprotected in the market place, then central government intervention may be desirable. To examine the relative effectiveness of a central government policy towards local debt, we must first determine the causes of that debt. Section III provides the needed analysis for teacher pension underfundings.

III. Teacher Pension Underfundings: Causes and Trends

A. Pension Accounting

The unfunded liability of a public employee pension system, of which teacher pensions are typical, is defined as expected plan liabilities less expected plan contributions and existing plan assets. Under plausible specifications for the structure of plan benefits and plan required contributions, the present value of expected liabilities less expected employee contributions can be defined as an actuarial constant, Ω, times the current wage bill, $w\ell$, paid to today's employees, ℓ, receiving a wage of w; see Inman (1986a). Subtracting the level of assets accumulated to today will define the remaining unfunded liability, U, due to be paid by taxpayers:[1]

$$U = \Omega w \ell - A \quad (1)$$

From the perspective of taxpayers, the actuarial constant Ω can be defined as a positive function of the plan's benefit replacement rate (β) and the plan's degree of COLA protection against inflation (specified as the rate of protection, ρ, times the rate of inflation, π) and a negative function of the plan's required rate of contribution from employees (η_e). Ω will also depend upon the years of employee service before retirement (R) and the expected rate of growth in employee wages (ω). No clear a priori predictions for the effects of R and ω on Ω are possible, however. Both variables increase the level of benefits and the level of employee contributions; if the benefit effect dominates (is dominated by) the contribution effect then Ω will rise (fall) as R or ω increases. Formally, we specify Ω as:

$$\Omega = \Omega(\beta, \rho\pi, \eta_e, R, \omega) . \tag{2}$$

The asset position of the pension plan is given by the level of assets accumulated prior to today, A_{-1}, plus net contributions made today (n):

$$A = n + A_{-1} . \tag{3}$$

Net contributions in turn equals taxpayer contributions, plus interest earnings, plus additional employee contributions above their required contributions, less benefits paid from the plan to current plan members. In the case of teacher pensions, taxpayer contributions come from two sources. The first is the contribution that taxpayers make as local taxpayers responsible for teacher salaries. Local contributions are often legally required at a rate η_g of teacher wages; supplemental contributions above η_g are also possible. These payments are made by the local school district to the state teacher pension plan. The second contribution is made by taxpayers through the state legislature's decision to supplement the local contributions. We shall denote the total of local school district contributions as c_g and the state legislative contribution as p. In addition to their required contributions (at rate η_e of wages), employees may be asked to make supplemental contributions to the plan; these supplemental contributions from employees we denote as s_e. Interest earnings equal the plan's rate of return (r) times the level of last period's assets--that is, rA_{-1}. Finally, benefits paid to plan members (denoted b) go to current retirees and to other members for disability or as lump-sum payments upon withdrawal from plan. Formally, n can be specified as:

$$n = p + c_g + s_e + rA_{-1} - b \ .$$

In fact, the net contribution relationship may be more than a mere budget identity. The institutions which administer the pension system may allow for the possibility of a less than dollar for dollar relationship between gross and net contributions. A dollar that flows into the pension system from c_g and s_e may not be fully allocated to the accumulation of pension assets via an increase in n. Taxpayers may instruct their elected representatives administering the pension to circumvent plan regulations and syphon off a portion, ϕ, of $(c_g + s_e)$ for use elsewhere in the state budget.[2] If so, only $(1 - \phi)(c_g + s_e)$ will be finally allocated to assets via n. It is also possible for current taxpayers to tap into interest earnings. Most state laws only require that interest earnings up to a pre-assigned interest rate to remain within the pension fund; "excess" earnings, denoted as $\psi(rA_{-1})$, may be allocated to other state activities.[3] If so, then only $(1 - \psi)(rA_{-1})$ remains within the pension accounts for accumulation via n. If in fact state-administered pension plans can be so manipulated for the benefit of the general state budget, then the net contribution equation becomes a behavioral relationship of the general form:

$$(4) \qquad n = \{p - b\} + (1 - \phi)(c_g + s_e) + (1 - \psi)(rA_{-1}) \ .$$

Equation (4) will be estimated as part of our behavioral model of pension underfundings.

Equations (1)-(4) define the dynamic path of pension underfundings. For this analysis the pension plan's replacement rate (β), the rate of COLA protection (ρ), the required rates of employee and local taxpayer contributions (η_e and η_g), and the typical number of years of service (R) are taken as given. The rate of inflation (π) is also exogenous. Endogenous to the analysis and specified as part of a behavioral model of pension underfundings are teacher wages (w), teacher employment (ℓ), state government contributions (p), total local government contributions (c_g), supplemental employee contributions (s_e), the average rate of return on pension assets (r), and total benefits paid (b).

B. A Behavioral Model of Underfundings[4]

Three groups have a vested interest in the outcomes of the pension benefit and funding decisions: current teachers (and retirees), current taxpayers (and their children), and future taxpayers. However, only two of these groups have a direct say in the final allocations. Benefits and fundings are decided by current teachers and current taxpayers within the state and local fiscal process. Yet future taxpayers are not without influence. To the extent current taxpayers become future taxpayers by remaining within the state, the voices of future taxpayers will be heard by proxy. Further, future taxpayers may simply refuse to pay for pensions over which they had no direct say. Finally, future taxpayers can demand a compensating reduction in land prices equal to any unfunded pension liabilities created by the decisions of current taxpayers and teachers. The first strategy--proxy voting--requires a low rate of resident turnover in the state. If a majority of current taxpayers move before the pensions fall due then the voice of future taxpayers, even if heard, will most likely go unheeded. The second strategy--refusal to pay--has been effectively removed by the courts in most states; the pension agreement is now viewed as a contractual obligation.[5] It is the third strategy--capitalization of underfundings--which offers future taxpayers their best hope of influencing the current pension decisions of present taxpayers and teachers.

Against the backdrop of voter turnover, court enforcement, and potential capitalization, current taxpayers and teachers negotiate the level of pension benefits and pension funding. Negotiations take place within three distinct institutional settings. The first--pension fund regulation and administration--enforces existing rules as established by the fund's enabling legislation. A pension board, composed of current taxpayers (generally appointed by the governor or state legislature) and current teachers (generally elected by plan members), sets benefit levels (b), determines contributions from teachers (s_e) and local taxpayers (c_g), and defines the plan's investment policy and hence the rate of return on assets (r). The second institutional level--the state legislature--defines a supplemental contribution (p) for the funding of the pensions. The allocation p from the state legislature is set as part of the general state budgetary process and is meant to meet any special financial needs of the fund, defined in most cases by a recent actuarial evaluation of the plan's funding status. At the third level of decision-making, the local school district level, current taxpayers and current teachers bargain over the level of teachers' salaries (w) and employment (ℓ). Decisions by taxpayers and teachers within these regulatory, legislative, and local bargaining institutions define the seven endogenous variables (b, c_g, s_e, r, p, w, and ℓ) needed to predict--along with the four funding equations in (1) to (4) above--the future path of pension debt.[6]

Tables 2 and 3 summarize the specification and estimation of a pension benefit and funding model for a sample of the 48 mainland states for the

Table 2: Regulated Benefits and Funding

	Dependent Variables (Mean)	Independent Variables	$\bar{R}^{2}$**
$(\hat{5})$	b ($10.01)	$= \hat{\theta}_0^s (w\ell)_{-1} + \underset{(.003)^*}{.016} \cdot (CPI) + \underset{(.028)^*}{.262} \cdot (c_g + s_e) + \underset{(.025)^*}{.165} \cdot (rA_{-1})$	.988
$(\hat{6})$	c_g ($4.15)	$= (w\ell)_{-1}(1+\omega) \{ \hat{\eta}_g^s + \underset{(.146)^*}{.779} + \underset{(.006)^*}{.021} \cdot (CPI) + \underset{(.000017)}{.000003} \cdot (U_{-1}) - \underset{(.144)^*}{.686}(1+\omega) - \underset{(.006)^*}{.024} \cdot (SS) - \underset{(.006)^*}{.053} \cdot (TEACH) - \underset{(.011)^*}{.045} \cdot (\%ELC) - \underset{(.076)^*}{.153} \cdot (\%STAY) - \underset{(.005)^*}{.014} \cdot REP \}$	.392
$(\hat{7})$	s_e ($3.69)	$= (w\ell)_{-1}(1+\omega) \{ \underset{(.114)^*}{.505} - \underset{(.004)}{.004} \cdot (CPI) + \underset{(.00002)}{.00002} \cdot (U_{-1}) - \underset{(.114)^*}{.332}(1+\omega) - \underset{(.005)}{.002} \cdot (SS) - \underset{(.004)^*}{.071} \cdot (TEACH) + \underset{(.256)}{.007} \cdot (\%ELC) - \underset{(.060)}{.085} \cdot (\%STAY) - \underset{(.004)^*}{.008} \cdot REP \}$	.533
$(\hat{8})$	$(r - r_f)$ (.0015)	$= \hat{r}_a^s + \underset{(.006)^*}{.038}(r_m - r_f)$	.401

†Each equation was estimated by three stage least squares as part of a full model system involving eqs. $(\hat{4})$ to $(\hat{11})$.

*All coefficients marked by an * exceed their standard errors (reported within parentheses) by at least 1.65. The coefficients $\hat{\theta}_0^s$, $\hat{\eta}_g^s$, and $\hat{r}_a^s$ are unique to each state and are not reported here. They are available upon request.

**The value of $\bar{R}^2$ is from the first stage estimates of each equation.

period 1971-1980.[7] Benefits (b) and contributions (c_g, s_e, p) are defined in real (1967) dollars per taxpayer. The fund's rate of return (r) is defined as the plan's current investment earnings divided by last year's level of assets, both measured in 1967 dollars. Teacher wages (w) are measured in real (1967) dollars per teacher while teacher employment (ℓ) is specified as the number of public school teachers per 1000 taxpayers. Equations ($\hat{5}$)-($\hat{8}$) of Table 2 and equations ($\hat{9}$)-($\hat{11}$) of Table 3 were estimated jointly by three-stage least squares because of possible correlation of error terms across the seven behavioral equations; the variables b, c_g, s_e, r, p, w, and ℓ are endogenous.

Benefits are paid to current retirees and to disabled teachers or to teachers who withdraw from the plan during the year. The pension regulation board is responsible for setting benefits according to a previously legislated benefit structure for retirees and disabled workers--defined here by a state specific constant term times the lagged wage bill, $\hat{\theta}_0^s(w\ell)_{-1}$--but the board may offer supplemental benefits to eligible members if it wishes. These supplemental benefits are hypothesized to depend upon the level of private good prices in the state (CPI) and the availability of income to the fund from contributions ($c_g + s_e$) and investment earnings (rA_{-1}). Estimated eq. ($\hat{5}$) does show state pension boards will supplement statutory benefits in times of rising prices and as contributions and investment earnings increase. The significant positive effect of ($c_g + s_e$) and (rA_{-1}) on benefits is important for it shows a willingness on the part of the pension board to channel current income into current benefits.

The contribution equations specify employer (c_g) and supplemental employee (s_e) contributions to be a fixed rate times the expected wage bill. The expected wage bill is specified as last period's wage bill per taxpayer plus the expected growth in the wage bill: $(1 + \omega)(w\ell)_{-1}$, where ω is the annual rate of growth in the wage bill over the decade 1971-1980. For employers (i.e., school districts), the rate of contribution consists of the statutory rate of contribution ($\hat{\eta}_g^s$) plus a supplemental rate of contribution set by the pension board. This supplemental rate is assumed to depend upon the level of state prices (CPI), the level of lagged underfunding per taxpayer (U_{-1}), the expected growth in the wage bill ($1 + \omega$), whether the plan is integrated with social security (if so, SS = 1, 0 otherwise), whether the plan is a teacher-only plan (if so, TEACH = 1, 0 otherwise), the percent of the pension board which is elected by the members (%ELC), the percent of last year's taxpayers who remain within the state (STAY), and whether the governor (to whom the board generally reports) is a Republican (if so, REP = 1, 0 otherwise). For employees, the supplemental rate of contribution is also specified to depend upon the CPI, U_{-1}, ($1 + \omega$), SS, TEACH, %ELC, STAY and REP, though we may see different effects of these variables on c_g and s_e because of the desire of the pension board to shift the funding burdens between teachers and current taxpayers. Note that the statutory contributions by employees at rate η_e are not included here for they have already been specified within the model as part of the actuarial constant Ω; see equation (2).

Four general points emerge from the estimated contribution equations ($\hat{6}$) and ($\hat{7}$). Rising private good prices elicit a higher rate of taxpayer contributions but leave teacher contributions (given real wages) unaffected. When seen in conjunction with the benefit equation, it appears teachers are able to extract real transfers from current taxpayers in an inflationary environment. Second, the insignificant effect of U_{-1} and the significant negative effect of real wage growth and STAY on contributions implies a strong pay-as-you-go bias to contribution behavior. Third, participation in social security and the fact that a plan may be for teachers only both reduce the rates of employer and employee contributions. We interpret both effects as an indication that perceived future plan security by employees will encourage less funding. Finally, politics matter. Increased representation by teachers on the pension board and the political inclination of the administering agent--the governor--both have important effects on contributions. The effects, both negative, may seem counter-intuitive, but there are good reasons for believing the results. If teachers are confident that they will receive their pensions, then it is in their interest to minimize current taxpayer funding of pensions. The released dollars can then be allocated to current period wage and employment growth. This is exactly the behavior we observe here. The negative effect of Republican governors on funding, all else equal, reflects the general tendency of Republicans to be the party of tax control in the 1970's.[8]

In contrast to contribution behavior, investment performance seems largely immune to overt political manipulation. Equation ($\hat{8}$) estimates the determinants of portfolio performance measured against the risk-free rate of return on Treasury Bills (r_f) for the year, ($r - r_f$). The pension's performance is compared to the return on a "market portfolio" of stocks, bonds, time deposits, and mortgages, similarly measured against the risk-free rate, ($r_m - r_f$).[9] If the return on the pension portfolio is perfectly correlated with movements in the market portfolio, then the coefficient on ($r_m - r_f$)--called the beta coefficient--will be 1; if the two portfolios are uncorrelated then the coefficient on ($r_m - r_f$) will be zero. In fact, for the decade 1971-80, teacher pension portfolios appear immuned from movements in the returns of a general market portfolio. Rather, teacher pension portfolios largely tracked the risk-free Treasury rate. Furthermore, a specification which allowed the beta coefficient to vary across states could be rejected in favor of a common coefficient.[10] All states seem to play a conservative investment strategy.

Table 3 details the influence of the determinants of state pension funding via legislative allocation (p) and teacher wages (w) and employment (ℓ) via local school district labor bargaining. The model specified here is a linear, reduced form model of legislative bargaining and local labor negotiations; Inman (1986b) presents the underlying structural model. Supplemental pension funding by the state legislature--p in eq. ($\hat{9}$)--is seen to depend upon exogenous fiscal resources available to the state budget (income, non-matching federal aid, and any spill-overs to the general budget from contributions to the pension budget from s_e, c_g, or rA_{-1}); the net-of-federal-deduction tax price for state spending ($1 - t_f$, where t_f is the marginal tax rate for the state's median income); the relative bargaining position of teachers versus taxpayers in the legislature, measured by the political resources of the National Education Association lobby (NEA dues per teacher, the presence of an NEA legislative liaison, and the power of the ally public union AFSCME); the potential voice of future taxpayers in the state legislature, measured by the percent of taxpayers who stay within the state from one year to the next (STAY); and the stock of pension underfunding per taxpayer in the previous year (U_{-1}) whose influence on p may vary if there exists a court-enforced pension guarantee. State legislative decisions on p may also be influenced by the expected levels of teacher wages and employment. If so, the exogenous determinants of w and ℓ should also be included in the pension funding equation as well as in the wage and employment equations. Those variables include the likely determinants of the demand for education such as state income and the net-of-federal-deduction tax price as well as such tastes-for-education variables as the percent of local taxable

Table 3: Legislated Funding, Teacher Wages, and Employment

Independent Variables†	Dependent Variables (Mean) $\hat{(9)}$ State Funding ($6.96/taxpayer) (p)	$\hat{(10)}$ Teacher Wages ($6020/teacher) (w)	$\hat{(11)}$ Employment (11.81/1000 taxpayers) (ℓ)
Fiscal Resources			
Income	-.001 (.001)	.506* (.108)	-.0003* (.0001)
Federal Aid	-.011 (.015)	9.534* (2.126)	.016* (.004)
s_e	.045 (.065)	32.512* (8.723)	.036* (.013)
c_g	-.519* (.053)	3.738 (7.029)	-.003 (.012)
(rA_{-1})	.380* (.043)	-8.033 (5.702)	-.033* (.009)
Tax Price			
$(1 - t_f)$	-4.821 (12.479)	3893.39* (1672.03)	2.325 (2.333)
Legislative Bargaining			
NEA Dues	.035 (.026)	11.657* (3.493)	.009* (.005)
NEA Liaison	.507 (.743)	157.08 (89.78)	.167 (.135)
% of State Employees AFSCME	11.796* (5.871)	668.54 (786.67)	-1.730 (1.113)
Residency			
% Who Stay	203.16* (44.71)	-504.26 (5950.44)	2.082 (3.745)
Lagged Underfunding			
U_{-1}	-.000 (.002)	.176 (.253)	.000 (.000)
U_{-1}·(Pension Guaranteed=1,0)	.005* (.002)	.146 (.267)	-.001 (.001)
Tastes-for-Education			
% Property Commercial	20.967 (26.870)	611.902 (3587.204)	-.357 (3.855)
% Pop. > 65 years	-95.475 (120.703)	51738* (16051)	-33.854* (12.296)
School-Age Kids per Family	-22.174* (6.167)	-1159.71* (826.84)	-2.407* (1.054)
% Enrolled in Public Schools	-15.570 (11.666)	-2360.10 (1559.95)	-1.529 (1.834)
Local Labor Bargaining			
% Districts > 2500 Teachers	-7.170 (6.575)	1372.42 (876.66)	1.155 (.916)
% Collective Bargaining	1.141 (4.349)	-3563.67* (583.27)	.304 (.801)
Private Wage	.001 (.001)	.106* (.072)	.0002* (.0001)
Private Wage · % Collective Bargaining	-.001 (.001)	.354* (.012)	-.0003* (.0001)
Δ	-2.339 (13.163)	-1831.35 (1762.04)	-4.905* (2.169)
Inflation			
CPI	.309 (2.958)	711.37 (396.44)*	-1.007* (.303)
$\bar{R}^{2}$**	.866	.893	.838

Notes for Table 3

†Each equation also includes state specific constant terms. For each equation, income and fiscal variables are measured in real 1967 dollars and all other independent variables have been deflated by the state price index (CPI); see fn. 11.

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

**The value of $\bar{R}^2$ is from the first stage estimates of each equation.

property which is commercial-industrial, the percent of the population over the age 65, the number of school age children per family, and the percent of school age children in public schools. Also important to the local determination of wages and employment is the local labor bargaining environment, specified here by the percent of school districts with more than 2500 teachers, the percent of teachers covered by collective bargaining agreements, the alternative private sector wage (measured by the state's average wage earned in retail and wholesale trade and selective services) and its interaction with the percent of teachers covered by bargaining, and an actuarial constant (denoted Δ) which measures the current period cash value of future retirement benefits specified as the ratio of required full-funding contributions to current wages (the mean Δ equals .17 for our sample). Finally, local school wages and employment will also be strongly influenced by state-to-local school aid, a variable determined as part of the legislative deliberations which set state pension funding. Thus all the exogenous determinants of p--which also define state school aid--will have a role to play in setting w and ℓ.

The model's specification also allows for a direct influence of the state's private good price level (denoted CPI) on the nominal levels of state pension contributions (p) and on teacher wages (w). While an effort is often made in bargaining and budget negotiations to track a state's cost-of-living with nominal adjustments in fiscal variables such as p and w, there is no reason to think the process does so perfectly. To capture this direct effect of price adjustments on the real values of p and w, we first specify these equations in nominal terms. <u>All</u> variables are then deflated by the state price index (CPI). While CPI does not appear directly in the real p and real w equations, the intercept term in those equations will measure the direct effect of price changes on p and w. These results are reported in Table 3 as the direct CPI effect. For the teacher equation (ℓ), all exogenous variables are measured in real terms and the state CPI is entered directly into the ℓ equation.[11] Table 3 reports the influence of all exogenous variables on p (eq. $\hat{9}$), w (eq. $\hat{10}$), and ℓ (eq. $\hat{11}$).

State income, federal aid, and the net-of-deduction tax price have no significant effect on legislated pension funding. What does influence legislated funding are the dollar flows into the regulated pension accounts via s_e, c_g, and rA_{-1}. Additional payments by local taxpayers through c_g are offset by a \$.52 per dollar reduction in spending on p. Increases in teacher contributions to funding through s_e lead to an insignificant increase in p of \$.05 per dollar. Finally, a one dollar increase in interest earnings increases p by \$.38. Together, however, there is a small net decline in legislative contributions (p) of \$.03 as total regulated contributions rise by one dollar (\$.33 from c_g, s_e and rA_{-1}, respectively). This tiny cutback in legislative spending on p is allocated to increased expenditures on other state activities or to state tax relief; not shown here, but see Inman (1986b).

Just as with administratively set pension contributions (c_g and s_e), the lagged stock of pension underfundings (U_{-1}) has only a small effect on the legislated contributions (p) and the subsequent accumulation of pension assets. For example, from Table 3 a \$100 increase in the stock of pension underfundings per taxpayer has no effect on legislated contributions in states without a pension guarantee (Pension Guaranteed $\equiv$ 0) and only a \$.50/taxpayer effect on p ($\$.50 = (-.000 + .005) \times \$100$) in states where pensions are guaranteed (Pension Guaranteed $\equiv$ 1). If continued for 30 years (a typical repayment period for new pension debt), this \$.50/taxpayer flow will accumulate (assuming a real rate of return of .03) to about $25/taxpayer in pension assets by year 30, the present value of which (discounting at .03) is $10.30. Thus an exogenous increase of $100 in pension debt stimulates at most a $10.30 increase in pension assets from legislative contributions. Again, we observe a preference for pay-as-you-go financing for teacher pensions, now on the part of elected legislators.

The teacher coalition does not seem to be a strong counterforce to the apparent pressure from taxpayers to ignore underfundings. Teachers do not allocate their state political influence--measured here by the variables NEA Dues and NEA Liaison--to pension funding; both variables are statistically and quantitatively insignificant. What does seem to help pension funding is pressure from current taxpayers who stay within the state. An increase of .03 in the percent of state residents who do not move in a given year (a one standard deviation increase from a mean of .89) will increase funding by about $3.22 per taxpayer adjusted for the level of state prices. Interestingly, AFSCME membership also matters. A doubling of the percent of state employees in AFSCME (from a mean of .10 to .20) increases pension funding for teachers by about $.62 adjusted for state prices.[12] Finally, the demographic downturn in the number of school age children and an increase in private education have also helped state funding. As the number of children in public schools decline, there is less pressure on the current education budget and hence less need for state school aid. This frees a few dollars for pension funding. A 10% decline in the number of children in public schools increases real spending on p by $1.13/taxpayer through the variable School-Age Kids and by $.83/taxpayer through the variable % Enrolled in Public Schools.[13]

In contrast to pension funding, teacher wages (w) and employment (ℓ) do seem to attract economic resources and political capital. Residential income and federal aid both have positive effects on wages (the income elasticity equals .25 while the aid elasticity is .08). Federal aid also stimulates local teacher employment (the elasticity is .10). Income has a statistical significant, but quantitatively unimportant, negative effect on employment (the elasticity equals -.05). Measures of the net tax costs of the teacher budget--$(1 - t_f)$ and % Commercial Property--are generally insignificant. Inflation, however, significantly increases real wages, an increase which is offset in part by a significant decline in teacher employment; on balance, the teacher wage bill ($w\ell$) rises with inflation. States with more large school districts (% Districts > 2500 teachers) also have higher wages and employment. Increases in the number of teachers covered by collective bargaining (% Collective Bargaining) is a two-edged sword for teachers. The results show teachers wages are initially lower in unionized as opposed to non-unionized states. That is, non-unionized states offer a wage premium for teachers not to organize. But once organized, unionized states do better in protecting the teachers' relative wage position vis a vis the private sector. In more unionized states wages rise with the private wages; in non-unionized states they do not. These results also show a weak positive effect of unionization on employment. The strongest influence of teacher organizations appears to be at the state level, however. Teacher organizations active in state politics--in this case the NEA--can have a significant positive effect on teacher wages and employment through the organization's ability to increase state-to-local school aid. Those effects are seen in this reduced form model as the positive effects of NEA Dues and the NEA Liaison on w and ℓ.[14] Finally, while the demographic downturn in school age children in the last decade helped to stimulate increased state pension funding (p), equations $(\hat{10})$ and $(\hat{11})$ reveal that it has also prompted an increase in pension liabilities via an increase in teacher wages and employment.

The structure of the pension system is also a potential influence on teacher wages and employment. But perhaps the most important result is the non-effect of lagged pension underfundings (U_{-1}) on w and ℓ. Even when pensions are not legally guaranteed, teachers do not receive a significant increase in wages as U_{-1} increases; underfundings are not capitalized into higher wages. Similarly, underfundings do not affect employment. What does seem to influence w and ℓ are the level of promised pension benefits, measured here by ratio of required full-funding contributions to wages (Δ). As Δ rises, there is a compensating decline in teacher wages, but the amount of the decline is less than dollar for dollar of benefit increase and is not statistically significant. Benefit increases therefore mean an increase in the total wage plus benefit cost ($= (1 + \Delta)w$) of hiring a teacher. This increase in labor costs via the increase in Δ induces a small, and statistically significant, decline in employment; the elasticity of ℓ with respect to Δ is -.07. However, the combined effect of an increase in Δ on the total compensation paid to teacher ($(1 + \Delta)w\ell$) is slightly positive.[15] Finally, the regulated pension accounts can feed back to influence teacher wages and employment. Increases in pension contributions from teachers (via s_e), taxpayers (via c_g), and assets (via rA_{-1}) do not--as we show below in equation ($\hat{4}$)--remain fully within the pension accounts. These dollars leak out for expenditures elsewhere in the fiscal system. One outlet is increased state-to-local school aid which in turn can be spent on increasing teacher wages and employment. This appears to be what happens. Teacher contributions (s_e) increase w and and ℓ, taxpayer contributions (c_g) have no effect, while asset earnings (rA_{-1}) have a negative effect on ℓ and an insignificant effect on w. Their joint effect is to increase teacher wages and to leave teacher employment largely unchanged. For each dollar increase in exogenously regulated pension funding (\$.33 from s_e plus \$.33 from c_g plus \$.33 from rA_{-1}), there is a final \$.10 increase in the teacher wage bill.[16]

The future consequences of these changes in funding, benefits, teacher wages, and employment are realized through the process of asset accumulation and liability creation for the pension fund. Equation $(\hat{4})$ describes net savings behavior for the fund:[17]

$$(\hat{4}) \quad n = \underset{(.109)^*}{.946}\ \{p - b\} + \underset{(.086)^*}{.627}\ \{c_g + s_e\} + \underset{(.115)}{.089}(rA_{-1})\ , \quad \bar{R}^2 = .410$$

If the fund administrators simply pass dollars into the fund from contributions and withdraw dollars to pay benefits, then all the estimated coefficients in eq. $(\hat{4})$ 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 unity. The coefficients on required contributions and on interest earnings, however, are both significantly less than 1, and indicate that only \$.627 of every regulated dollar of contributions $(s_e + c_g)$ and only \$.089 of every dollar of investment income (rA_{-1}) are retained within the fund for future asset accumulation. Where do the remaining \$.373 of contributions and \$.911 of investment earnings go? The answer is into the general state budget for expenditure on state-to-local school aid (and ultimately on w and ℓ), for other state expenditures, or for general tax relief. As we saw above, state legislated pension funding (p) does not increase as $(s_e + c_g + rA_{-1})$ rises.

The final link in the behavioral model is the specification of the actuarial constant Ω which connects current wages and employment to the expected liability of the fund. A linear specification for Ω gives:[18]

$$(\hat{2}) \quad \Omega = \underset{(.87)^*}{5.41\beta} + \underset{(2.61)^*}{9.96(\rho\pi)} - \underset{(5.50)^*}{10.51n_e} + \underset{(.007)^*}{.079R} + \underset{(6.30)^*}{12.62\omega} - \underset{(.22)^*}{3.10(\text{TEACH})}, \quad \bar{R}^2 = .875$$

As expected, pension liabilities increase as the benefit replacement rate (β) increases, as COLA protection ($\rho\pi$) improves, and as the required rate of employee contributions (n_e) declines. Liabilities are also shown to rise, on balance, as years to retirement (R) increase and the rate of wage growth (ω) rises; for both variables their positive influence on benefits dominates their effects on added required contributions. Finally, a constant term for teacher-only plans (TEACH) is included to capture the systematic differences between the actuarial experiences of teachers and the general state employee (e.g., longevity, work histories) or any systematic differences in plan benefits not measured by β and $\rho\pi$; see, for example, the results in Quinn (1982).

The pension underfunding identity in equation (1), the estimated Ω specification in ($\hat{2}$), the asset accumulation identity in (3), the net savings equation in ($\hat{4}$), the regulated benefit and funding equations in ($\hat{5}$)-($\hat{8}$), and the legislative and local bargaining equations in ($\hat{9}$)-($\hat{11}$) together define a reduced form model of teacher underfundings. Given starting values for the stock of underfundings (U_{-1}) and pension assets (A_{-1}), the model is capable of predicting the future path of teacher pension debt for alternative paths of the model's exogenous variables. Section C maps the pattern of underfunding to the year 2000 for five such future regimes.

C. Trends in Underfunding

Table 4 summarizes the path of underfundings to the year 2000 for five different paths of the key exogenous variables of the model. In the "base

Table 4: The Future Path of Underfundings: 1980 to 2000

Simulation Regimes*	All States			Well-Funded States†			Near-Risk States†			At-Risk States†		
	U(1980)	U(2000)	$\dot{u}$	U(1980)	U(2000)	$\dot{u}$	U(1980)	U(2000)	$\dot{u}$	U(1980)	U(2000)	$\dot{u}$
1. Base Case	$249	$337	1.53%	$161	$245	2.15%	$399	$520	1.34%	$648	$683	.26%
2. Baby Boom	$249	$332	1.46%	$161	$243	2.09%	$399	$514	1.28%	$648	$668	.15%
3. 6% Inflation	$249	$328	1.40%	$161	$241	2.05%	$399	$509	1.23%	$648	$649	.01%
4. Full Unionization	$249	$359	1.86%	$161	$261	2.47%	$399	$538	1.51%	$648	$774	.89%
5. Increased Aid	$249	$396	2.35%	$161	$291	3.01%	$399	$598	2.05%	$648	$810	1.12%

Simulation Regimes:

1. Base Case: Demographic trends in Kids per family and the % > 65 years of age are based on U.S. Bureau of Census projections to 2000. Real income per taxpayer is projected from the state's 1980 value using the actual rate of growth in state income to 1984, an assumed rate of .02 thereafter. Real private sector wage is projected from the state's 1980 value using the actual rate of growth in the private sector wage to 1984, an assumed rate of .0141 thereafter. Rate of returns on pension fund assets assumed to equal the real rate of return on Corporate Aaa bonds until 1985, and then set equal to .05 in 1986 and then .04 thereafter. Real federal aid per resident is projected from the state's 1980 value using the actual rate of growth in federal aid to 1984, assumed to equal 0% thereafter. Price levels grow at the actual national inflation rate to 1985, assumed to grow at .03 per annum thereafter. Republican governorship are equal to actual governorships to the end of terms based upon the 1986 elections, thereafter, assumed to remain in Republican control until 2000. All other exogenous variables of the model are set to equal their 1980 state values for each year to 2000.

2. Baby Boom: The Census demographic trend in school-age Kids per family is replaced by a "baby-boom" growth in Kids per family beginning in 1990. The "baby-boom" growth rate is the historical growth rate in school-age Kids per family from 1950 to 1960.

3. 6% Inflation: Price level growth equals the historical rate to 1985 and is then increased to .03 in 1986, .045 in 1987, and set equal to .06 from 1988 to 2000.

4. Full Unionization: The percent of teachers covered by collective bargaining is increased for each state from the state's 1980 rate of coverage by a linear trend until 100% coverage is achieved by 1990.

5. Increased Aid: Real Federal aid is assumed to grow at actual rates until 1986, at which time the high historical growth rate in aid from 1970 to 1980 applies.

†"At-risk" states include Idaho, Maine, North Carolina, South Carolina, Virginia and West Virginia. "Near-risk" states include Alabama, Colorado, Indiana, Iowa, Kansas, Louisiana, Massachusetts, New Mexico, Oregon, Pennsylvania, Rhode Island, South Dakota, and Wyoming. All other states qualify as "well-funded" plans.

case," Bureau of Census projections (1984) for future population growth are used to define the growth in school age children per family (Kids per Family) and the percent of the population over 65 (% > 65 years). The recent historical record is the basis for projecting future incomes (Income), private sector wages (Private Wage), interest rates (r = the Treasury Bill rate), inflation rates (π and the level of the state CPI), federal aid (Federal Aid), and Republican control of governorships (REP); see Table 4 for details. All other exogenous variables of the model are fixed at their 1980 values for the duration of the simulations. We then examine the effects of four potentially important deviations from the base case trends: a new baby boom, a high inflation rate, a move to full coverage of all teachers under collective bargaining agreements, and a return to the 1970's levels of federal aid for state-local government. For each simulation we report the average 1980 level of underfundings for our sample of the 48 mainland states (U(1980)), the average level of underfundings in the year 2000 (U(2000)), and the annual rate of growth in underfundings from 1980 to 2000 ($\dot{u}$). The simulation results are also reported for three subsamples of states. The first group consists of all states whose ratio of underfunding to income in 1980 was .10 or less; this group is called the "well-funded" subsample. The next subsample consists of all states with 1980 underfunding to income ratios between .1 and .15; these states are called the "near-risk" states. The final group, called the "at-risk" group, is the small subset of poorly funded plans with 1980 underfunding to income ratios greater than .15.[19]

Perhaps the single most important conclusion from the results in Table 4 is the fact that teacher pension underfundings will not go away by themselves. If the funding and benefit behavior exhibited during the 1970's continues for the next twenty years, the average level of underfundings in our sample states for the base case simulation will grow at a rate of 1.53% per year, from $249 per taxpayer to $337 per taxpayer. The upward trend is observed for all three state subsamples as well. Simulations 2-5 in Table 4 show how sensitive the future path of underfundings is to four, possibly damaging, structural changes. Neither a new baby boom in 1990 nor a moderate increase in the rate of inflation is likely to affect the pattern of underfundings very much. In fact, both tend to lower the growth rate slightly from that seen in the base case. What does matter are structural changes that drive up the overall wage bill for education. Increased unionization and increased federal aid do just that. By the year 2000, underfundings per taxpayer have increased over their 1980 values by 44% with full unionization and by 59% with a return to the 1970's levels of federal-to-state aid.

We conclude that a hands-off approach to the issue pension underfundings--barring the saving grace of capitalization--may only lead to larger problems in the future. The revealed inclinations of the present benefit and funding process is to channel resources to current teachers and taxpayers. Existing state government regulations for employer, employee, and legislative contributions are, it seems, easily and willingly circumvented. It is important therefore to consider the effectiveness of alternative, central government regulations of these pension systems.

IV. Central Policies for Local Debt

The central government can adopt one, or more, of three policies towards the control of local debt, each of which has a specific formulation for the management of pension underfundings. The first strategy--control local spending--appears here as a control of pension benefits. The second strategy--require added local taxation--becomes a central government requirement for increased pension funding. The final strategy--the central assumption of excessive local debt--can be specified as a central government program to "bail-out" those pension plans on the verge of bankruptcy.

A. Central Policies for Underfundings[20]

1. Control of Pension Benefits: Available evidence suggests state and local government employees receive significantly better pensions than their colleagues in the private sector. Recent research by Quinn (1982) estimates that a typical member of a state pension plan has a promised pension wealth (even after adjustments for employee contributions) which is as much as 80% larger than the wealth available to an identical worker in the private sector. Members of local government plans have pensions which are on average 30% more valuable than those available to a comparable private worker. Given these facts, it is useful to consider central government regulations which reduce pension benefits paid to public workers. Two reforms are considered here. The first policy reduces the promised rate of benefit accruals to new employees by 50% from their current levels, the net effect of which is to reduce the replacement rate for benefits paid upon retirement. Since this benefit reduction policy will be limited to new employees only, for a time the state will be required to administer two pension plans. We assume that funding for the new pension plan will be under the funding rules now in force for the original state plan. To the extent those rules are followed as before (a favorable assumption), aggregate pension underfundings should decline. The second policy to reduce pension benefits is to cut the COLA protection for all employees through a reduction in the rate of inflation coverage, ρ. For these simulations here, a 50% cut in rate of inflation protection is considered.

2. Increased Contributions: The analysis above, and in Inman (1982, 1986b), show a strong bias in state and local funding practices towards pay-as-you-go behavior. While state pension enabling legislations do contain

minimal required rates of contributions by employees and taxpayers as well as explicit provision for actuarial evaluations and subsequent full-funding, most states have devised fiscal strategies to escape these regulations. In the face of such behavior, the central government can adopt one or both of two contribution regulations. First, the central government can simply require more money be collected from employees and taxpayers, but leave to the state all responsibility for allocating those dollars into pension funding. We should expect--from eq. ($\hat{4}$)--that a fraction of the required increased contributions will be "lost" before they become pension assets. Alternatively, the central government could adopt national standards for pension funding and then monitor state contributions to insure that these required dollars are in fact allocated to pension assets. We shall simulate the effects of both strategies. The first policy will simply require states to increase contributions to a level which in theory would remove the existing level of pension underfunding and any new accruing underfundings within forty years. The second policy supplements these required contributions with a central government enforcement effort to insure that all new contributions are in fact allocated to pension savings.

3. Debt Relief: Funding relief for obviously troubled pension plans is a final policy alternative. Such a program would provide central government assistance in the form of federal contributions to the troubled state plan, contributions which could then be given immediately to retirees (if plan assets are not sufficient to cover even current benefit obligations) or saved to lower underfundings. Such a policy will require an explicit definition of what constitutes a state plan "in trouble." Without such a standard, all states would have strong incentives to simply let the central government fund their pensions. For the debt relief simulations presented here, we define a

state plan as "troubled"--and thus eligible for federal pension aid--if the yearly level of steady-state contributions required to fully-fund the pension plan over a forty-year horizon exceed 30% of the current year's wage bill for plan employees. The choice of .30 as an upper limit to a state's full-funding rate of contribution--beyond which federal aid is possible--is, of course, a policy decision. A higher limit will mean that fewer states will qualify as "troubled." Once a state plan qualifies, the central government is assumed to cover all of the needed contributions above the .30 limit through federal pension aid--that is, Pension Aid $= C - .3w\ell$, where C is the required full-funding contribution and Aid ≥ 0. There will, of course, be a moral hazard problem with such a policy; offering federal aid to pension plans in serious trouble may only further discourage own contributions. To offset this difficulty, the central government can offer bail-out aid which is directly related to the state's own level of contributions. To illustrate the point, we therefore consider a second pension aid program which not only covers the gap of full-funding contributions above 30% of the wage bill but also matches each state's own contributions dollar for dollar--that is, Pension Aid Match $= C - .3w\ell + (n_e w\ell + s_e + c_g + p) \geq 0$.

There is, unfortunately, no exogenous variable called federal pension aid in our model of state funding behavior. To simulate the effects of pension aid we therefore assume that federal pension aid influences pension funding decisions like an extra dollar of pension fund investment income--that is, like (rA_{-1}) in Table 3 and equation $(\hat{4})$.[21] If that observed behavior is in fact how federal pension aid performs, then only \$.469 of each aid dollar will actually be allocated to net asset creation; \$.089 of each dollar goes directly into assets (eq. $(\hat{4})$) while an additional \$.380 of each dollar arrives via legislatively set contributions (p). The remaining \$.531 is allocated to other state activities. To prevent such re-allocations, the central government can attempt to regulate the allocation of pension aid relief to insure that each dollar of pension aid is in fact saved. To simulate the effects of such a pension aid plus enforcement policy, we exogenously impose the constraint that all aid be saved. We report the results as a pension aid with match plus enforcement policy.

4. A "PERISA" Program: Reform to effectively control the funding status of public employee pension plans has been a Congressional concern since 1976. Legislation entitled the Public Employee Retirement and Income Security Act (PERISA) has since been introduced to insure a stronger funding basis for state and local pension plans. While these bills have emphasized centrally enforced reporting and monitoring of funding status (an obvious first step), we could well imagine a more extensive PERISA policy. Following the lead of its private pension counterpart (ERISA), such a PERISA program might well include benefit regulations, contribution regulations, and pension debt relief. To test for the effects of such a PERISA program, we will simulate the path of underfundings for two combined policy packages. Under PERISA-1 we combine contribution regulations with the pension aid plus match program for any states which fall within the previously-specified "troubled" category. PERISA-2 adds a 50% reduction in the pension benefit replacement rate for new employees only to the PERISA-1 package. For both the PERISA-1 and PERISA-2 reforms, we assume the federal government adopts the strong enforcement structure needed to insure contributed dollars and pension aid are allocated to pension savings.

B. The Effects of Pension Reform Policies

Table 5 summarizes the effects of central government pension policies on the future path of state underfundings. All policy simulations use the

Table 5: Central Policies to Control Underfundings

Pension Reforms*	All States			Well-Funded States			Near-Risk States			At-Risk States†		
	U(1980)	U(2000)	$\dot{u}$	U(1980)	U(2000)	$\dot{u}$	U(1980)	U(2000)	$\dot{u}$	U(1980)	U(2000)	$\dot{u}$
0. Base Case	$249	$337	1.53%	$161	$245	2.15%	$399	$520	1.34%	$648	$683	.26%
1. Benefit Reductions												
a) COLA	$249	$279	.58%	$161	$189	.81%	$399	$459	.70%	$648	$624	-.19%
b) Replacement Rate	$249	$229	-.40%	$161	$142	-.60%	$399	$394	-.06%	$648	$583	-.53%
2. Full-Funding Contributions												
a) Contribution Only	$249	$238	-.23%	$161	$175	.44%	$399	$360	-.51%	$648	$478	-1.51%
b) Contribution plus Enforcement	$249	$178	-1.64%	$161	$132	-.95%	$399	$265	-2.01%	$648	$350	-3.03%
3. Debt Relief												
a) Pension Aid	$249	$334	1.48%	$161	$245	2.15%	$399	$519	1.33%	$648	$642	-.04%
b) Pension Aid-Match	$249	$305	1.03%	$161	$236	1.94%	$399	$460	.72%	$648	$528	-1.02%
c) Pension Aid-Match plus Enforcement	$249	$287	.72%	$161	$229	1.76%	$399	$438	.47%	$648	$431	-2.01%
4. PERISA												
a) PERISA-1 plus Enforcement	$249	$179	-1.63%	$161	$139	-.69%	$399	$241	-2.48%	$648	$368	-2.79%
b) PERISA-2 plus Enforcement	$249	$93	-4.78%	$161	$61	-4.69%	$399	$156	-4.57%	$648	$216	-5.34%

Notes for Table 5

*Specification of Reform Simulations:

1. Benefit Reduction: COLA reductions reduce the rate of COLA protection, ρ, by 50% for each year beginning in 1981. The simulation model adjusts Ω in each year for the decline in ρ to $.5\rho$. Replacement rate reforms involve a 50% reduction in β for new employees. Beginning in 1981, new employees are assumed to replace existing employees at the rate of 5% per year. By the year 2000 all employees are covered by the new lower benefit plan. The simulation model adjusts Ω in each year for the decline in the system-wide, weighted average replacement rate across the two plans.

2. Full-Funding: A full-funding level of contributions was estimated for each state sufficient to amortize the existing pension debt plus new debt over a forty year period. It was assumed new debt would occur at the state's growth rate in U from the "base case" simulations. The contribution-only simulation allocates the responsibility for the full-funding contributions as one-quarter from employees (i.e., via an increase s_e), one quarter from employers (i.e., via an increase in c_g) and one half from state taxpayers (via an increase in p). The contribution plus enforcement simulations assume all of the full-funding contributions are allocated as state contributions p, which enters directly into pension savings (see equation (4)).

3. Debt Relief: Federal pension aid is calculated as the difference between the full-funding level of contributions (as estimated in policy regime 2 above) and $.30 \times (w\ell)$, where $w\ell$ is the year's predicted wage bill, before aid. Federal pension aid plus match calculates aid as the difference between full funding contributions and $.30 \times (w\ell)$ plus an additional dollar of aid for each dollar of contributions raised from employees ($n_e w\ell + s_e$), employers (c_g) or state taxpayers (p). The pension aid simulations allocate these aid dollars as an increase (rA_{-1}). For the pension aid plus enforcement simulations, all federal pension aid is allocated as p which enters directly into pension savings (see equation (4)).

4. PERISA: The PERISA-1 simulation combines the specifications for contributions plus enforcement (reform 2b) with the specification for pension aid plus match plus enforcement (reform 3c).

The PERISA-2 simulation combines the specifications for the 50% cut in replacement rates (reform 1b) with contributions plus enforcement (reform 2b) with pensions aid plus match plus enforcement (reform 3c).

underlying economic and political structure of the "base case" simulation presented in Table 4, the results of which are repeated in Table 5. Table 5 also details exactly how each policy reform is implemented within the structure of the simulation model. For each policy simulation, Table 5 reports the initial 1980 level of underfundings U(1980), the post-policy level of underfundings by the year 2000 U(2000), and the annual rate of growth in U from 1980 to 2000 ($\dot{u}$). Results are for the full sample of mainland states and for each of the three pension risk subsamples.

The results in Table 5 are instructive. Central government policies which regulate benefits or contributions or which offer pension aid to reduce excessive underfundings do reduce the level of locally created pension debt. In all cases considered here, the central government reform reduced underfundings in the year 2000 below what they would have been in the base case without reform. It is also important to note that among the three risk-group subsamples of states, each reform has its strongest effect for those six states whose 1980 levels of underfundings place the state pension most "at-risk."

Among the separate reform options, the most effective policy is regulation of contributions (reforms 2a and 2b). The least effective policies are cuts in the rate of COLA protection (reform 1a) (primarily because we assume only modest levels of inflation in the future) and pension debt relief. Pension aid with a matching provision to minimize moral hazard (reform 3b) performs better than simple pension aid (reform 3a). Pension aid with a match and with federal enforcement to insure aid dollars are actually saved (reform 3c) is the most effective of the debt relief policies considered here.

Of the PERISA-type reforms, the PERISA-1 policy (reform 4a)--fully regulated contributions (reform 2b) combined with enforced pension aid plus match (reform 3c)--performs about as well as the fully regulated contribution policy (reform 2b) alone. This is not surprising as contribution regulations move most states below the underfunding cut-off needed for the receipt of aid. Adding benefit regulations (reform 1b) to the PERISA package to create PERISA-2 (reform 4b), reduces underfundings still further. The two regulatory policies--reforms 1b and 2b--are roughly additive in their effects on the levels of underfundings. Pension aid adds little to the effectiveness of these reforms in reducing U, except in the few "at-risk" states. In the end, PERISA-1 and PERISA-2 make significant in-roads toward reducing the stock of state-local government pension debt.

Table 6 summarizes the incidence effects of the major, alternative reform strategies. The impact of benefit reductions (reform 1b), contribution regulations (reform 2a), pension debt relief (reform 3a), and a strong PERISA policy (reform 4b) are reported for teachers and retirees, current and future taxpayers, and public school-age children. The position of current teachers is defined by teacher wages (in 1967 dollars) less supplemental contributions to the pension plan ($\tilde{\omega} = w - s_e$) and by their net pension wealth per teacher ($W = \Omega w$). The position of present retirees is defined by benefits paid per retiree (B, in 1967 dollars). The position of current taxpayers is specified by each taxpayer's after-tax income (y = Income - $(1 - t_f)$ {all state taxes - c_g - $w\ell$}, in 1967 dollars), while the position of future taxpayers' is given by the value of pension underfunding per taxpayer (U, in 1967 dollars). We also report the student-teacher ratio for public school-age children (t) to examine the effect of pension reform on the provision of services to children. Results are based upon the simulations reported for the

Table 6: The Incidence of Pension Reform*

	Current Teachers				Retirees		Current Taxpayers		Future Taxpayers		Public School Children	
	$\tilde{\omega}$(1980)	$\tilde{\omega}$(2000)	W(1980)	W(2000)	B(1980)	B(2000)	y(1980)	y(2000)	U(1980)	U(2000)	t(1980)	t(2000)
0. Base Case	$6243	$7026	$28,101	$42,300	$2546	$3651	$3199	$5121	$249	$337	16.6	13.8
1. Benefit Reduction via Replacement Rate (Reform 1b)	$6243	$7016	$28,101	$31,754	$2546	$3614	$3199	$5120	$249	$229	16.6	13.9
2. Full-Funding Contributions Only (Reform 2a)	$6243	$7097	$28,101	$41,650	$2546	$4166	$3199	$5118	$249	$238	16.6	14.2
3. Debt Relief via Lump-sum Pension Aid (Reform 3a)	$6243	$7026	$28,101	$42,169	$2546	$3657	$3199	$5120	$249	$334	16.6	13.9
4. PERISA-2 plus Enforcement (Reform 4b)	$6243	$7004	$28,101	$30,570	$2546	$3690	$3199	$5118	$249	$93	16.6	14.3

*Notation for Table 6:

$\tilde{\omega}(\cdot)$: Net wages per teacher in year $(\cdot)$ defined as $\tilde{\omega} = w - s_e$.

$W(\cdot)$: Net pension wealth per teacher in year $(\cdot)$ defined as Ωw.

$B(\cdot)$: Benefits paid per retiree in year $(\cdot)$, $B = b/(\text{retirees}/\text{taxpayer})$.

$y(\cdot)$: Taxpayer after state-and-local tax income in year $(\cdot)$ defined as $y = \text{Income} - (1 - t_f)[(\text{all state revenues}) - w\ell - c_g]$.

$U(\cdot)$: Stock of teacher pension underfundings per current taxpayer in year $(\cdot)$.

$t(\cdot)$: Public school enrollees per public school teacher in year $(\cdot)$.

All dollar figures are measured in real (1967) dollars. The numbers reported are averages across the 48 mainland states.

base case and for each policy reform in Table 5; we compare the position of each group in 1980 before reform to their position in the year 2000 after reform.

Comparing the base case and reform outcomes reveals that the annual income position of teachers is not much affected by reform. The only modest change is the increase over the base case in teacher income in the year 2000 with full-funding contributions. This occurs because the spill-over of pension funding into state school aid and finally into wages is larger than the teachers' specified share of increased contributions. As expected, teachers' pension wealth is most significantly affected in the year 2000 by the 50% cut in the replacement rate (reforms 1b and 4b), while an increase in contributions or in pension aid leaves teachers' pension wealth largely unchanged. Retirees lose most under the benefit reduction reform (reform 1b) and gain most under a full contribution reform (reform 2a), where some of those contributions spill-out into retiree benefits. On balance, and not surprisingly, teachers and retirees benefit most with full contribution reforms, are not much affected by pension aid bail-outs, and lose the most with those reforms which lower pension benefits.

Taxpayers looking ahead to the year 2000 see their current income position virtually unaffected by pension reform. First, pension aid policies are limited to a few crisis situations; thus federal taxes to run the aid program are trivial. Second, benefit reductions cost taxpayers nothing directly and have only a very small (in fact slightly negative) compensation effect on $w\ell$ through the variable Δ; see the discussion of Δ in III.B above. Third, contribution reforms will lower the average taxpayer's income as c_g and p are increased, but some of these monies are returned as state tax relief (see III.B above); the net effect is a small reduction in y. Taxpayers today do benefit from reform, however, in that unfunded pension debt (U) is reduced by the year 2000. As we saw from Table 5, regulated contributions (reform 2a), reduced benefits (reform 1b), and the two reforms together (reform 4b) have significant effects in reducing U.

Finally, public school children are hurt by each reform strategy as the student to teacher ratio rises over what it would have been (the base case) without reform. The effect is most significant for the reform requiring full-funding of existing pensions; here increased contributions make teachers more expensive on the current accounts and thereby discourage the hiring of new teachers. Note, however, that the continued demographic downturn in the number of school-age children over the next twenty years more than offsets the effects of any pension reform.

Two primary conclusions emerge from these simulations of pension reform. First, central government benefit regulations and regulations to insure full-funding contributions can significantly reduce the stock of outstanding state teacher pension debt. Pension "bail-out" aid relief can slow the growth of debt but will not reduce the stock of existing underfundings. Second, of all the reform strategies, a central government policy to regulate contributions (reforms 2a and 2b) may be the most acceptable to all parties involved. Current teachers and retirees are not much harmed, in fact they are slightly better off under reform 2a. Current taxpayers lose a small amount of real income but gain in that they avoid a growing pension debt to be paid as future taxpayers. The only constituency who loses are school-age children as fewer new teachers are hired under reform. But the general decline in public enrollments for demographic reasons softens this consequence.

If this full-funding policy is so attractive, then, why hasn't it already been adopted as a reform strategy for growing pension debt? To answer this question is to return to our opening theme: The incentives in a decentralized fiscal system are against it. In an economy with less-than-fully informed yet mobile taxpayers, the incentives at the state and local levels are to underfund and run. Why pay for your current public employees' pensions when you may have to pay again when you relocate in another state? While we may all be better off with full-funding, the micro-motives in our decentralized fiscal system are to underfund. Like any prisoner's dilemma situation, only an imposed (i.e., regulated) strategy can insure a favored outcome. In this case, the regulator is the central government, and the imposed strategy is full-funding.

V. Summary and Conclusions

Without proclaiming a state and local fiscal crisis, this paper has sought to raise the issue of growing local government debt and to ask what a central government might do, if anything, to check that growth. The analysis has focused on one form of state and local debt: underfunded teacher pensions. We have presented evidence that this form of debt is sizeable and growing and have argued that such debt may have significant adverse consequences for economic efficiency and equity. While the private market may be able to neutralize the consequences of excessive borrowing through land value capitalization, there is as yet no clear evidence for, or against, this hypothesis. Nor is there any reason to believe the problem of growing state-local debt will correct itself. As we have seen here, the motivations of the major players in a decentralized political economy are to create not reduce such debt. It seems prudent, therefore, to examine the possible effectiveness of alternative central government reforms for the control of local debt unmatched by assets. Of the three pension reform strategies considered here--reduce spending through benefit reductions, increase revenues through regulated contributions, or grant debt relief via pension aid--each can ease the growth in pension debt and one approach--regulating contributions--does so with only modest burdens on employees and taxpayers. Of course, the fact that our analysis was limited to only one form of local debt qualifies these conclusions. Whether these results generalize to other forms of excessive state-local borrowing and to the aggregate level of such debt remains to be seen.

Footnotes

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[1]This specification of U is based upon the "plan continuation liability" of the pension, under the assumption that the plan will be offered into the foreseeable future. In contrast, the unfunded liability of a private pension may more appropriately be measured by what is called the plan termination liability, under the assumption that the firm has the right to pay off all future pension obigations to existing employees at any time; see Bulow (1982).

[2]The reason for this fiscal sleight-of-hand is that pension administrators face de jure regulations for pension fundings which on the surface, at least, must appear to be met. The plan's pension enabling act often contains explicit contribution rules which require employees to contribute η_e of their salaries and employers to contribute an additional η_g of salary. Further, the enabling laws may also require a periodic actuarial evaluation; if the required contributions above are not sufficient to fully fund the pensions then supplemental contributions from employees, employers, and state taxpayers will be required. Administrators can legally meet these formal requirements by insuring that sufficient dollars are paid

into the system. But there are no requirements that these dollars actually be saved as net addition to assets. That is what we are testing here.

[3]Legally, interest earnings may be allocated back into the pension system as a contribution to net savings (n) or may be allocated to pay for current benefits or be spent in the general state budget. See Note, Harvard Law Review (1977) and the recent Wall Street Journal article (October 22, 1985, p. 33) entitled, "Novel California Pension Plan Provides an Inflation Antidote."

[4]The analysis developed here is presented in more detail in Inman (1986b). This model stands as the reduced-form equivalent of Inman's structural model.

[5]See Note, Harvard Law Review (1977).

[6]The three institutional settings function sequentially. Generally, the pension board will reach its decisions on employee (s_e) and employer (c_g) contributions, on benefits (b), and on portfolio investments (r) near the end of the calendar year as part of administrative decisions-making. Given s_e, c_g, b, and r, the state legislature meets in January to March to decide p. Then in May and June, before the start of the new fiscal year, local school districts decide w, ℓ. The structural model in Inman (1986b) makes use of the sequential nature of this budgeting process.

[7]Excluded from this sample of pension plans are the plans in Hawaii and Alaska whose unique fiscal institutions do not allow an easy comparison to the 48 mainland states. Also excluded are the few large city teacher pension plans. The analysis covers 95% of all teachers in pension plans in 1980.

[8]See, for example, Taylor (1986, p. 71) who quotes from an interview with a Democratic state legislator on pension contributions and benefits: "there are just a few who care about (pension costs) and they are mostly Republicans who look for ways to cut costs."

[9]The market rate of returns is unique to each state and is defined by the state-specific weighted average of national returns of those investments which are legally available to the state pension board for investment.

[10]An F-test for the equality of the state β coefficients could not reject the null hypothesis of equal coefficients. It should be noted that this common β coefficient is likely to be biased towards zero because of measurement error in the specification of r. The rate of return for state portfolios is calculated from reported plan asset values which include an (unknown) fraction of assets valued at book, not market, value. The measurement errors in r will likely be correlated with the independent variable $(r_m - r)$. Despite this bias, there are good political reasons to believe our result that β is near zero and that states adopt conservative investment strategies for pension assets. Risky investments offer little gain to current teachers and taxpayers if they pay-off, yet expose the pension board to public embarrassment if they fail. For additional evidence on the conservative bias in pension investment, see Kotlikoff and Smith (1983, p. 434).

[11]Formally, the nominal wage and pension contribution equations are specified as:

$$(w \cdot CPI) \text{ or } (p \cdot CPI) = \alpha_s + \beta CPI + \delta X + (\varepsilon \cdot CPI) ,$$

and estimated as:

$$w \text{ or } p = (\alpha_s/CPI) + \beta + \delta(X/CPI) + \varepsilon ,$$

where α_s are state-specific constant terms, X is the vector of all exogenous variables (with fiscal variables measured in nominal terms), and ε is the equation's normally distributed error term. The teacher equation is specified to include CPI directly in the equation with all other exogenous variables again deflated by the CPI:

$$\ell = \alpha_s + \beta CPI + \delta(X/CPI) + \varepsilon \ .$$

[12]All exogenous variables have been deflated by the state's cost-of-living price level, the mean value of which is \$1.89 over the sample period. Thus the marginal effect of a .03 increase in the "% Who Stay" on funding (p) will equal, on average, dp = 203.16 × (.03/1.89) = \$3.22. A similar calculation applies for the marginal effect of changes in AFSCME membership: dp = 11.79 × (.10/1.89) = \$.62.

[13]Again, adjusted for the level of the state's cost-of-living (\$1.89 at the mean), the marginal effect on p of a 10% decline in school age kids per family will equal, on average, dp = -22.174 × (1.13 × -.10)/1.89 = \$1.33, where 1.13 is the mean number of school-age kids per family. The marginal effect on p of a 10% decline in the percent of kids enrolled public schools will equal, on average, dp = -15.570 × (-.10/1.89) = \$.83.

[14]The effect on real wages of a \$9 (one standard deviation) increase in real DUES from its mean value of \$17/teacher is dw = 11.86 × \$9 = \$105. The effect on real wages of introducing an NEA liaison will be dw = 157.08 × (1/1.89) = \$83, adjusted for price deflation. The joint effect of these two changes will be to increase real wages by \$188 per teacher, or by 3.1% from the mean real wage of \$6020/teacher over the 1971-1980 period. Employment also rises, but marginally, for a \$9 increase in DUES; employment increases by 1% (= $d\ell/\ell$ = (.009 × \$9) teachers/11.81 teachers). With the introduction of a legislative liaison, employment rises by 1.4% ($d\ell/\ell$ = .167 teachers/11.81 teachers). The joint effect of all these changes is to increase the real teacher wage bill by a bit more than 5% (=3.1% + 1% + 1.4%).

[15]The average value of Δ for our sample is .17. Thus, the fully-funded level of pension contributions for a teacher with an average wage of \$6020 is \$1023. A 10% increase in Δ implies a \$102.3 increase in fully-funded contributions. A 10% increase in Δ decreases teacher wages by -\$31.13 (= (.10 × .17)(-1831)). Thus a \$102.3 increase in the present value of pension benefits only reduces wages by \$31.13, or about \$.30 on the dollar.

Further, as \$102.30 increase in benefits is only offset by \$31.13 decline in wages, the full cost per teacher rises by \$71.17 for each 10% increase in Δ. This increase in full labor costs reduces employment by 7/10's of 1% or -.083 teachers/1000 taxpayers (=(.10 × .17)(-4.905)). The small effect on ℓ is likely due to the fact that current taxpayers do not anticipate paying the full increase in labor costs due to the increase in pension benefits.

Overall, the present value of total compensation to be paid to teachers by taxpayers (= $(1 + \Delta)w\ell$) rises from \$83.18/taxpayer (= (1 + .17)(6020)(11.81/1000)) to \$83.51/taxpayer {= (1+.187)(6020-31)(11.83-.083)/1000} for a 10% increase in Δ from its mean value of .17.

[16]A \$.33 increase in s_e increases the mean $w\ell$ by \$.20 {= .33 × $(dw/ds_e)\ell + .33(d\ell/ds_e)w = .33 \times 32.51 \times (11.81/1000) + .33 \times (.036) \times (6020)$}; a \$.33 increase in c_g increases the mean $w\ell$ by \$.01 (calculated as above using dw/dc_g and $d\ell/dc_g$); and a \$.33 increase in rA_{-1} decreases the mean $w\ell$ by \$.11 (calculated as above using dw/drA_{-1} and $d\ell/drA_{-1}$). The combined effect is a \$.10 increase in the mean teacher wage bill per taxpayer.

[17]The net savings equation ($\hat{4}$) has been estimated by three-staged least squares as part of the full fiscal system involving equations ($\hat{4}$)-($\hat{11}$); see above. The reported $\bar{R}^2$ is from the first-stage estimate of the net savings equation. Standard errors of coefficient estimates are within

parentheses; an * indicates the coefficient estimate exceeds the standard error by at least 1.65.

[18]Estimation was by ordinary least squares. Standard errors of coefficient estimates are within parentheses; an * indicates the coefficient estimate exceeds the standard error by at least 1.65. Data for Ω are from Inman (1986a).

[19]The choice of .15 as the "critical" pension debt/income ratio to indicate "at-risk" states follows the convention in the bond industry to "red-flag" governments whose ratio of <u>all</u> debt to market value approaches 10 percent. Since market value is usually 2.0 times income, the implied critical or "red-flag" ratio of <u>total</u> debt to income would be around .20. Since non-pension debt will usually be .05 to .10 of income, a pension debt to income ratio $\geq$ .15 will be "critical" and a ratio $\geq$ .10 will be "worrisome." See Lamb and Rappaport (1980), pp. 112-115.

[20]A policy which we could not examine in this model--but which should be seriously considered in any reform debate--is to move all teacher pensions from their current status as defined benefit plans to a new status as defined contribution plans. In defined benefit plans annuities are based upon worker's pre-retirement salary. In a defined contribution plan annuities are based upon workers' and employers' contributions only. By definition, defined contribution plans cannot be underfunded, and thus we avoid all of the allocative and equity disadvantages of underfunded pensions. We do so at a cost, however. Defined contribution plans do not offer the worker a stable retirement income relative to his or her pre-retirement salary; workers are exposed to the risk of a sharp fall in their real living standard at retirement if inadequate contributions had been made or if returns on the invested portfolio have not kept pace with income growth; both are possible

problems in inflationary economies. Indexed bonds, if they are available, could solve the problem, however. For general discussion of the relative advantages and disadvantages of defined benefit and defined contribution pension plans, see Bodie, Marcus, and Merton (1985).

[21]Since there is no currently existing Federal-to-state pension aid program, we must assign one of the model's available independent variables to stand as a "proxy" measure for the effects of this program. Four variables are possible candidates: Federal Aid, s_e, c_g, or (rA_{-1}). The variable (rA_{-1}) seems to us to be the preferred choice. The variables s_e and c_g which measure teacher contributions and local taxpayer contributions compound the effect of new pension dollars and the taxation of teachers and taxpayers. Both s_e and c_g involve "compensation effects" at the state and local level which may not be observed with pension aid. The Federal Aid variable is the sum of all lump-sum grants to the state. These are not pension dollars and thus Federal Aid will not capture any pension specific effect of such aid. On the other hand, investment earnings (rA_{-1}) are pension fund dollars and do not involve any present period taxation. Thus $r(A_{-1})$ seems the best variable to proxy for the effects of true federal-to-state pension aid.

For comparison purposes, simulations based upon an increase in Federal Aid are given in Table 4. As we see there, an increase in such assistance will clearly do little to ease the pension debt problem.

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