State Pension Contributions and Fiscal Stress

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Abstract

States cut their pension contributions eight times more than other spending in response to fiscal stress. The cumulative impact of state undercontributions due to unexpected deficits over the last two decades explains about six percent of the total level of mid-2008 actuarial underfunding. States not paying their actuarially required contributions for reasons other than fiscal stress explains another third of mid-2008 underfunding. Investment returns do not explain this underfunding, as returns were above actuarial assumptions over the previous twenty years. This implies that most underfunding arose from insufficient employee and required government contributions to keep up with growing liabilities. Institutional differences affect state contributions, with states setting contributions by statute being less responsive to both fiscal stress and actuarial recommendations, but more responsive to union membership.

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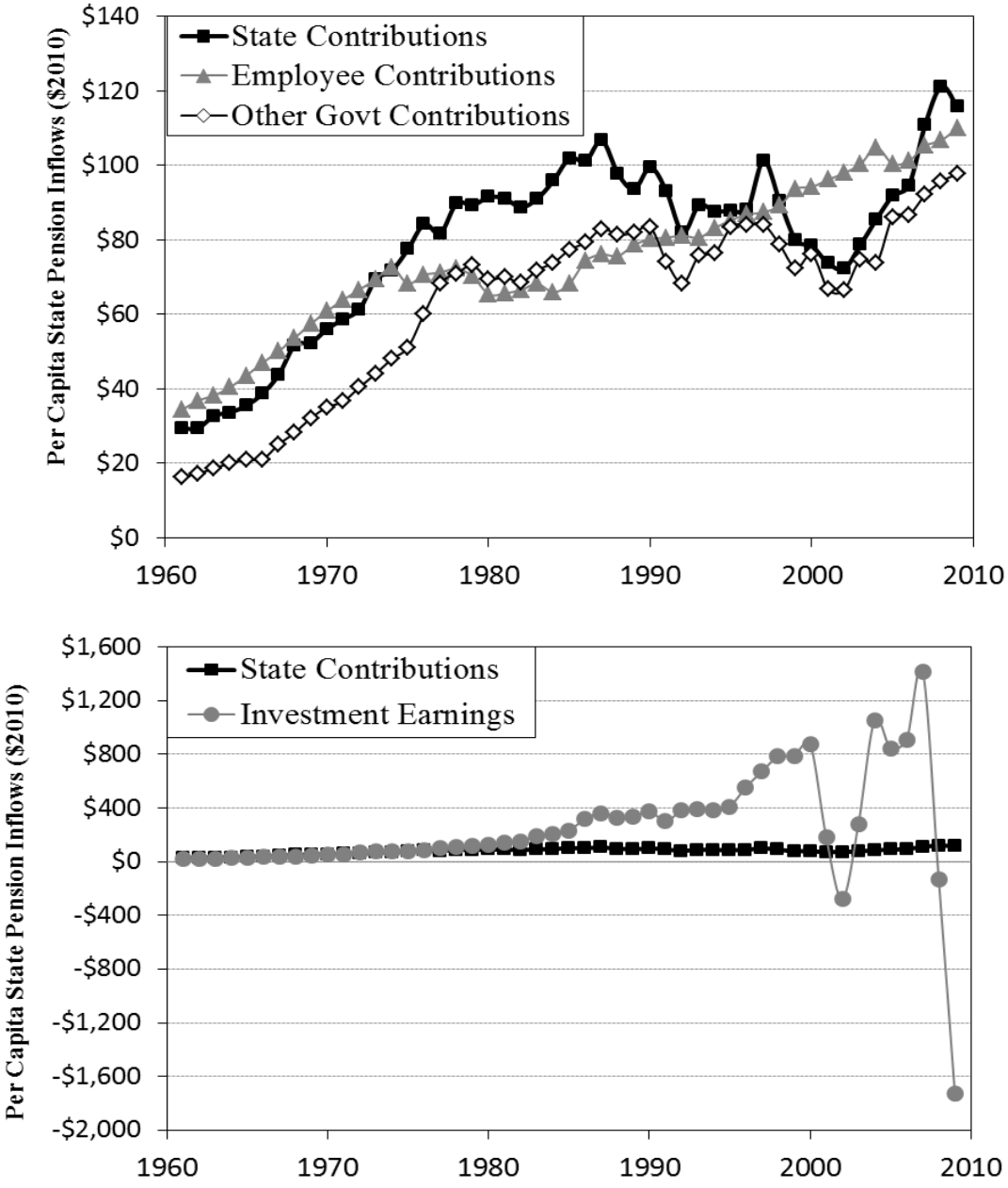
Introduction

Although federal laws regulate private pensions, imposing specific funding requirements to ensure eventual payment of promised benefits, state and local government pensions are not subject to these requirements. This lack of strict pension oversight means state legislatures can undercontribute to their pension plans. This may be of particular concern when state governments face fiscal stress, as undercontributing can help governments mitigate politically unpopular spending cuts or tax increases. Using the fraction of actuarially required contributions made by state governments, I show that fiscal stress caused states to cut their pension contributions eight times more than other spending.

The actuarial shortfall for state sponsored pensions was about $400 billion at the end of fiscal year 2008, before the large drop in equity values. Accounting for risk by discounting future liabilities with Treasury securities interest rates, instead of assumed market returns, increases the underfunding to over $3 trillion. (Novy-Marx and Rauh, 2009) The U.S. Government Accountability Office (2008, 2009) estimates unfunded state and local government retiree benefits, such as healthcare, add liabilities of between $530 billion and $1.6 trillion. This brings the state pension and health care funding gap to nearly a quarter of U.S. GDP—close to Social Security's $5.4 trillion unfunded obligations reported in the *2009 OASDI Trustees Report*. By these calculations, unfunded state pension and benefit liabilities are many times the other forms of recognized state debt, and thus are likely drive up state borrowing costs (Novy-Marx and Rauh, 2009), especially since accrued pension benefits are likely protected by common law in a majority of states (Brown and Wilcox, 2009).

State-administered pensions receive funds from four sources. In fiscal year 2007, state governments, local governments, and employees each contributed about $30 billion, and while quite volatile, investment returns averaged about $100 billion annually over the last decade. Figure 1 shows historical trends of contributions from these sources. Despite these large inflows, state pension assets have not kept up with growing liabilities. Many states contribute the actuarially recommended amount to their pensions, but state governments tend to undercontribute to their pensions more when they face fiscal stress. For example, following the 1992 fiscal crisis, California delayed annual contributions of about $500 million to its Public Employees' Retirement System (CalPERS) for more than a year. A lawsuit was filed and a superior court judge ordered the state to make the delayed contribution with accrued interest. (U.S. General Accounting Office, 1996)

Figure 1: Per Capita State Pension Inflows by Source (2008 dollars)



Notes: All inflows for state-administered pension plans divided by U.S. population. Fiscal year data shown. Two outliers removed: 1973 CA employee contributions and 2004 IL state contributions. Fiscal year 2010 dollars (CPI-U).
Source: U.S. Census Survey of State and Local Public-Employee Retirement Systems

Paul Chaney et al. (2002) find that when fiscally stressed, states with balanced budget requirements both undercontribute to their pensions and choose discount rates that obscure actuarial underfunding. Their results also suggest that undercontributions due to fiscal stress are not fully restored in other years, a result confirmed in this study. Olivia Mitchell and Robert Smith (1994) estimate that fiscal stress in the late 1980s, proxied by above average

unemployment, led to lower state pension contributions. Fred Giertz and Leslie Papke (2007) find evidence that tax revenues influence funding status.

I estimate that between fiscal years 1989 and 2008 pension undercontributions due to unexpected deficits explain $25 billion of pension underfunding, or six percent of mid-2008 actuarial underfunding.[1] Unexpected deficits are estimated by the gap between forecasted and actual budgets. As legislators become of aware of this gap during the legislative session, they can adapt policy to undercontribute to pensions before the end of the fiscal year. State undercontributions for reasons other than fiscal stress explain about a third of underfunding.[2] If state undercontributions explain less than half of underfunding, then what caused the remaining unfunded liabilities?

Annual investment returns also do not seem to explain a significant amount of pension underfunding. Aggregate state pension investment returns were 9.1 percent between fiscal years 1989 and 2008 (Table A1), above the current average assumed return of 8 percent, while inflation was below the standard 3 percent assumption. Few states' pension returns were below the 8 percent threshold. The estimated cumulative excess of actual over assumed returns since 1989 was $1.3 trillion as of mid-2007; and even after the recent market downturn, there remained an excess of $300 billion in mid-2009 (both values in fiscal year 2010 dollars).[3]

The majority of local government employees also participate in state-run pensions (Clark, Craig, and Sabelhaus, 2011), but local contributions to these multiple-employer systems may be more restricted than state contributions.[4] State governments should incorporate underfunding for whatever cause into their actuarially required contributions, so state rather than local

[1] Data for state finances and pensions follow fiscal years. For most states, fiscal year 2009 runs from July 1, 2008 to June 30, 2009.

[2] Cumulative undercontributions in mid-2008 of $153 billion were estimated as in Table 3, where annual undercontributions were estimated with weighted ARCs and state contributions (U.S. Census). ARCs for 1993, 1995, 1997, and 1999 were interpolated, and ARCs for 1989-1991 were set to the 1992/94/96 average. These are likely overestimates, as a fraction of these undercontributions represent amortization of previous undercontributions, causing some double-counting.

[3] Instead of smoothing out returns over the long-run, temporary pension surpluses may be dispersed to public employees through reduced employee contributions or increased benefits (Peskin, 2001; Bader & Gold, 2007).

[4] Elizabeth Cove Delisle (2010, p. 5) writes that "many states cover some local employees under their pension plans and restrict the extent to which local governments can reduce their contributions to the plans when revenues fall." Chaney et al. (2002, p. 290) suggest that state governments' ability to ignore statutory constraints suggests that "statutorily determined contribution rates limit the discretion of local, but not state, governments."

undercontributions seem like the more appropriate focus for the state-sponsored plans considered in this study. In the short-run, however, some underfunding may be explained by local government contributions that do not cover increasing local pension liabilities.

Putting the pieces together, state undercontributions and lower than expected returns explain less than half of state pension unfunded liabilities.[5] This implies that most underfunding arose from insufficient employee and required government contributions to keep up with growing liabilities.

Liabilities have grown in part because of increasingly generous benefits. New promises slowly accrue as actuarial liabilities over many years. If these liabilities are in excess of pension assets then this underfunding is amortized over a number of years, usually over 30 years. This means increases in pension benefits can appear and persist as underfunding long after new promises are made. Richard Johnson (1997) finds that state and local pensions take advantage of this temptation, as pensions more able to shift costs to future taxpayers through underfunding are more likely to increase the relative generosity of promised benefits.

Pension liabilities have also increased with changing actuarial assumptions. For example, Rhode Island recently changed its actuarial assumptions to reflect workers retiring earlier and living longer, resulting in an increase of $50 million in liabilities. But Rhode Island is one of many states trying to limit the growth of liabilities with a number of reforms: making workers wait until age 62 to collect benefits, reducing the maximum pension to 75 percent of average pay near retirement, and limiting annual COLAs for new retirees (Gregg, 2011). Snell (2010) gives many examples of recent reforms tightening eligibility conditions and reducing benefits. However, Novy-Marx and Rauh (2010) estimate that even implementing extreme versions of some of these policy changes, such as the complete elimination of COLAs, would only eliminate half of underfunding with Treasury discounting.[6]

Underfunding can also be addressed by raising employee or required government contributions. States recently increasing employee contributions include Colorado, Iowa, Minnesota,

[5] Underfunding at the beginning of this analysis in 1989 may also explain some the mid-2008 underfunding, but the amortization portion of the actuarially required contributions should account for most of this initial period underfunding.

[6] Perhaps an even more striking proposal to reduce liabilities by Maria Fitzpatrick (2010) is that governments offer to buy back promised pension benefits for less than their expected present cost. As "the majority of Illinois public school teachers are willing to pay just 17 cents for a dollar increase in the present value of expected retirement benefits" (p. 2), this proposal could be Pareto-improving in some cases.

Mississippi, Vermont, and Wyoming (Poulson, 2011). States would increase their actuarially required contributions if the amortization period for unfunded liabilities is decreased. For example, amortizing over the average remaining years of employee service, as required by the corporate accounting board, could cut the amortization period in half and double this part of states' required contributions (Miller, 2010). In multiple-employer systems, states may also require local governments to increase their contributions.

Required state contributions could also rise dramatically if pensions lower their discount rates. Munnell et al. (2010a) show that lowering the discount rate from 8 to 5 percent would more than double the average required contributions of state-administered pensions—from 5 to 9 percent of state and local budgets. In a statement of preliminary views, the Governmental Accounting Standards Board (GASB) discusses a partial decrease of discount rates: "Benefit payments that are expected to occur beyond the point at which expected plan assets are projected to be exhausted would be discounted…using a high-quality municipal bond index rate." (2010, p. 5) As many states have not paid their full required contributions, discount rate reform could be reinforced by binding state governments to a minimum contribution ratio. Although it did not address discount rates or get placed on the ballot, the 2010 New Jersey Pension Fund Amendment would have constitutionally mandated the state government to pay the entire actuarially required contribution after a seven year phase-in.

Pension Funding and Contribution Ratios

In a defined benefit plan, actuaries calculate the assets needed to pay for promised benefits based on assumptions of fund investment returns, benefit levels, and employee characteristics. The state government's annual *actuarially required contribution* (ARC) includes new liabilities and an installment to amortize any underfunding, usually over 30 years. The *contribution ratio* divides actual contributions by the ARC.[7] Undercontributions occur when pension contributions are less than the ARC, that is, the contribution ratio is less than 100 percent.

All 50 states have laws regarding fiduciary standards for state pensions and these provisions are similar to the requirements of private sector pensions in about half of states. According to the United States General Accounting Office (1996, pp. 3-4):

[7] A possible issue with using ARCs is that they can be adjusted by manipulating assumptions (Chaney et al., 2002; and Giertz and Papke, 2007).

> "…annual contributions to 56 percent of state and local pension plans are required to be actuarially based; for 40 percent of these plans, statutes set a specific contribution level, which in most cases is periodically adjusted to achieve actuarial balance, according to a state pension official."

States with contributions constrained by statute, e.g., a fixed percent of tax receipts, may undercontribute both because of a persistently low statutory rate or declines in tax revenue. While some unconstrained states consistently pay their full required contributions,[8] other unconstrained states use this flexibility to undercontribute in years of fiscal stress.

Considering these unconstrained plans, Alicia Munnell et al. (2008) find that pension sponsors are more likely to undercontribute if a pension has more assets and if states have poor fiscal health, as measured by debt-to-GSP. Sponsors are also more likely to undercontribute if they use the projected unit credit actuarial method instead of the more widely used entry-age method. The projected unit credit method has growing contributions over time, allowing some postponement of contributions relative to the entry-age actuarial method, which requires constant contributions.

Measuring Fiscal Stress with Unexpected Deficits

To measure the impact of fiscal stress on pension contribution ratios, I calculate unexpected deficit shocks following James Poterba (1994). Unexpected deficit shocks measure the estimated gap between forecasted and actual budgets when adjusting for within-fiscal-year tax and spending changes. Let $DeficitShock_{it}$ be the per capita unexpected deficit (surplus) for state i in year t, where positive deficit shocks are deficits and negative shocks are surpluses. *DeficitShock* is calculated by subtracting *RevenueShock* from *ExpenditureShock*. In years of fiscal stress, positive expenditure shocks and negative revenue shocks both contribute to positive deficit shocks.

$$ExpenditureShock_{it} = ActualExpenditure_{it} - ExpectedExpenditure_{it} + BudgetCut_{it} \quad (1)$$

$$RevenueShock_{it} = ActualRevenue_{it} - ForecastRevenue_{it} - TaxChange_{it} \quad (2)$$

$$DeficitShock_{it} = ExpenditureShock_{it} - RevenueShock_{it} \quad (3)$$

[8] All of the states consistently making their full required contribution in this study have contributions unconstrained by statutes.

To determine the effect of unexpected deficits on pension funding, deficit shocks are separated into positive (*UnexpDeficit*) and negative values (*UnexpSurplus*) in linear models of the following form:

$$ContributionRatio_{it} = a_0 + a_1 UnexpDeficit_{it} + a_2 UnexpSurplus_{it} + \Sigma_k a_k Controls_{k,it} + e_{it} \quad (4)$$

The coefficient of interest, a_1, is negative if unexpected deficits cause undercontributions, and a_2 is close to zero if unexpected surpluses do not cause extra contributions. *Controls* includes average state pension funding ratios, lagged end-of-year balances, lagged pension investment returns, lagged employee pension contributions, public employees and public union members as a percent of state population, and whether or not a state has limitations on raising taxes.

To estimate the expected undercontribution assuming state pension contributions were cut proportionally with other spending in response to unexpected deficits, I first calculate the expected contribution cut by multiplying a state's spending cuts by its contribution as a percent of expenditures.

$$ExpContributionCut_{it} = OutlayRevisionPerCapita_{it} * StateContrib\%Expenditures_{it} \quad (5)$$

Unexpected deficits are then regressed on expected contribution cuts.

$$ExpContributionCut_{it} = b_0 + b_1 UnexpDeficit_{it} + b_2 UnexpSurplus_{it} \quad (6)$$

If states cut pension contributions more than other spending in response to unexpected deficits then the ratio of a_1 to b_1 will be greater than one.

Data

State-sponsored pension data comes from the Public Pension Coordinating Council's PENDAT database for even-numbered fiscal years from 1992 to 2000 and from the Public Fund Survey annually from 2001 to 2009. The Public Fund Survey includes more than 85 percent of state and local government pension assets and members in the U.S.[9] Funds exclusively for local

[9] The plans in this study had $2.4 trillion in actuarial assets in 2008, as compared to $2.7 trillion in total cash and investment holdings for state plans reported by the U.S. Census' Annual Survey of State and Local Public Employee Retirement Systems. So relative to the holdings reported by the Census, which surveys about 220 state plans, 87 percent of assets were included in 2008, while 104, 105, 96, and 96 percent of assets were in the sample for even

government, county, or city level employees were removed. As most states have at least two large pensions, one for teachers and another for state employees, state level actuarial funding ratios and contribution ratios were created by weighting plan values by their actuarial liabilities. There were 38 of these weighted contribution ratios missing, 31 of these were in the PENDAT covered years.

U.S. Census data are used for state contributions, employee contributions, and investment earnings by pensions sponsored by state governments. Public employee and union statistics come from the Union Membership and Coverage Database (Hirsch and Macpherson, 2010). Tax limitations are present when raising state taxes requires a legislative supermajority or popular vote (Advisory Commission on Intergovernmental Relations, 1987). State fiscal data comes from various issues of the National Association of State Budget Officers' (NASBO) *Fiscal Survey of the States*. NASBO does not report data on the District of Columbia, so it is excluded from this study. Unexpected deficit observations are missing for three observations (TX 2001, MT 2003, and PA 2004).

Pension funding status can be calculated by the *funding ratio,* calculated by dividing the actuarial assets by liabilities, or the *unfunded actuarial accrued liability* (UAAL), calculated by subtracting actuarial liabilities from assets. Note that actuarial assets are smoothed, often over five years. Table 1 shows that the average funding ratio in the sample increased from 81 percent to 102 percent between 1992 and 2000, only to fall back to 81 percent in 2009. Although the funding ratio was the same in 1992 and 2009, the unfunded liability grew from $900 to $1,900 per capita as assets did not keep up with a doubling of pension liabilities. For comparison, Novy-Marx and Rauh (2011) estimate an average unfunded liability using risk-free Treasury rates of $27,000 per household or about $10,000 per capita—five times the actuarial unfunded liability shown here. Table 1 also shows large unexpected deficits in the fiscal years immediately following the 1991, 2001, and 2008 recessions and surpluses in the expansionary years of the late 1990s and 2000s.

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numbered years between 1994 and 1998. The large fractions in the early 1990s are because smoothed assets values may not show recent losses and low fractions in the mid-1990s and in 2008 may not show gains. The small sample in 2000 has only 83 percent of assets relative to Census values. Before 2001, between 132 and 157 plans are included in this study. As many smaller plans for judges, legislators, police and firefighters are not included in the Public Fund Survey, since 2001 the same 93 large plans are used. Dropping the additional plans before 2001 gives similar results throughout the paper.

Table 1: Summary Statistics for Included State-Administered Pension Funds

Year	Funding Ratio (%)	Actuarial Assets	Actuarial Liabilities	Deficit (Excess)	Contrib. Ratio (%)	State Contrib.	Unexpected Deficit (Surplus)
1992	82	4,363	5,261	899	94	83	53
1993						88	(7)
1994	85	4,730	5,541	811	95	87	(29)
1995						88	5
1996	86	5,181	5,966	785	95	89	(49)
1997						103	19
1998	95	6,639	6,919	280	100	92	(67)
1999						82	(254)
2000	103				98	78	(61)
2001	100	7,747	7,682	(65)	90	74	14
2002	96	7,779	8,051	271	74	72	125
2003	90	7,548	8,349	801	82	79	54
2004	87	7,424	8,512	1,088	80	88	(17)
2005	86	7,411	8,601	1,191	79	92	(85)
2006	85	7,413	8,704	1,291	82	95	(121)
2007	87	7,747	8,983	1,237	83	111	(32)
2008	85	7,790	9,130	1,341	87	121	7
2009	80	7,875	9,846	1,972	88	116	139

Notes: Values in per capita 2008 dollars (CPI-U-RS) for all 50 states and calculated by summing all values and dividing by U.S. population. State contributions excludes IL in 2004 and unexpected deficits excludes AK and MA. Assets and liabilities not shown for 2000 because of missing plans.
Sources: PENDAT, Public Fund Survey, U.S. Census, NASBO, and author's calculations.

Estimating Undercontributions Caused By Unexpected Deficits

Unexpected deficits cause states to undercontribute and unexpected surpluses do not seem to affect state pension contributions. Regressing state contribution ratios on unexpected deficits between 1992 and 2007 results in a coefficient on unexpected deficit that is negative and significant while the coefficient on unexpected surplus is close to zero. Results are shown in Table 2, where Alaska and Massachusetts are dropped because of outlier unexpected deficits. A number of controls are used. Lagged end-of-year balance controls for higher contributions due to leftover funds from the previous fiscal year, and the fraction of workers in a state that are public employees controls for possible pressure to fund pensions with state tax dollars.

We can interpret the regression coefficients by converting them into dollars of undercontributions per $100 of per capita unexpected deficit. Given a U.S. average contribution ratio of 89 percent and state contribution of $87 per capita across all years of this sample, a one percentage point decrease in the contribution ratio implies undercontributions of about $1 per

capita. So the coefficient of -0.060 for all states implies pension undercontributions of $6 per $100 of per capita unexpected deficit. This is eight times the expected contribution cut of $0.73 per $100 of unexpected deficit.[10] Also, the coefficients for unexpected surplus are near zero and insignificant, suggesting that unexpected surpluses do not lead to overcontributions to pensions.

Expected revenues and expenditures may be distorted by state budget officers. For example, Richard Boylan (2008) shows that budget forecasts are biased upward near elections. I estimate the model with instrumental variables to address this concern. Instrumental variables for deficit shocks are estimated with time-series models for state spending and revenues using lagged spending and lagged expenditures, similar to Poterba (1994). Table 2 shows that the instrumental variable model gives similar results.

Table 2: Unexpected Deficits and State Pension Contribution Ratios
All States (1992-2007)

	OLS	FE	IV	OLS	FE	IV
Unexpected Deficit ($pc)	-0.057**	-0.054**	-0.042	-0.060**	-0.054**	-0.072
Unexpected Surplus ($pc)	-0.006	0.004	0.029	0.002	-0.001	0.045
Lagged End-of-Year Balance ($pc)				0.011[1]	0.006	0.016**
Public Employees (%population)				0.55	2.5	0.5
Constant	91.1***	91.1***	92.5***	86.0***	72.2***	88.0***
State Fixed Effects	NO	YES	YES	NO	YES	NO
R-squared	0.019	0.019	0.012	0.025	0.019	0.014
Observations	535	535	535	535	535	535

Notes: The dependent variable is the average state contribution ratio, weighted by each pension's liabilities. Years missing are 1993, 1995, 1997, and 1999. AK and MA dropped. Linear model. Significant at 10%(*), 5%(**) and 1%(***) levels; errors clustered by state. Values in 2008 dollars per capita ($pc).
Sources: PENDAT, Public Fund Survey, U.S. Census, NASBO, and Union Membership and Coverage Database.

How much pension underfunding has actually occurred due to unexpected deficits? The cumulative unexpected deficit for all states except AK and MA was about $170 billion between 1989 and 2008 (in 2008 dollars), meaning $6 of undercontributions per $100 of per capita unexpected deficits implies cumulative underfunding of $10 billion. But if the investments had

[10] This result holds with state annual contributions ($0.73) or an average of contributions from years before and after ($0.74) in a state fixed effects models, both significant at a five percent level. Unexpected surplus coefficients are near zero and not significant. Congruent with this estimate, Poterba (1994) finds that after the 1991 downturn $100 of per capita unexpected deficit lead to within-fiscal-year spending cuts of about $40. Pension contributions averaged 2.5 percent of state general fund expenditures over the last two decades. So if pension contributions were cut proportionally with other spending then they should decrease $1 per $100 of per capita unexpected deficit (40*0.025=1).

been made in the past then they would have grown with investments. Using each state's average nominal pension returns on investment over time, Table 3 shows that unexpected deficits explain $25 billion of underfunding. This is equal to six percent of mid-2008 actuarial underfunding.[11]

Table 3: Estimated Cumulative State Pension Underfunding from Positive Unexpected Deficit Undercontributions (millions dollars)

Year	Unexpected Deficits (nominal)	Undercontributions due to Unexpected Deficits (nominal)	Avg. Nominal Investment Returns (%)	Cumulative Underfunding (nominal)
1989	5,352	321	--	321
1990	3,359	202	10	554
1991	12,827	770	8	1,370
1992	9,467	568	10	2,068
1993	3,197	192	15	2,569
1994	2,357	141	16	3,091
1995	5,483	329	16	3,902
1996	677	41	18	4,579
1997	10,606	636	13	5,835
1998	290	17	18	6,808
1999	1,349	81	15	7,951
2000	933	56	16	9,214
2001	7,640	458	5	10,109
2002	29,091	1,745	-4	11,517
2003	16,037	962	7	13,431
2004	7,398	444	19	16,225
2005	923	55	14	18,556
2006	1,334	80	14	21,343
2007	3,824	229	16	24,997
2008	8,392	503	-2	24,532

Notes: Annual compounding. Assumed $6 of undercontributions per $100 of unexpected deficit. U.S. aggregate returns shown but state specific returns based on U.S. Census data were used in the calculation of cumulative underfunding, where 12 observations had rates of returns top-coded at 30 percent and 2 replaced with average returns. AK and MA excluded.
Sources: PENDAT, Public Fund Survey, U.S. Census, and NASBO.

States with annual legislatures may undercontribute more in reaction to unexpected deficits because they have more frequent opportunities to respond. Meanwhile, statutory constraints may not allow states to contribute the amount recommended by their plans' actuaries, at least until the statute is changed. Munnell et al. (2008) show that two-thirds of pension plans not making their ARC in 2006 were statutorily constrained—but as 2006 was a year of large unexpected surpluses, these states seem to have persistent undercontributions. While unconstrained states may make their ARC

[11] Instead of using the average state contributions and ARC, an alternative estimation of undercontributions by state and year of 0.06*defshockpos*state contribution/ARC yields only $12 billion of cumulative underfunding due to unexpected deficits.

in expansionary years, they may use their flexibility to undercontribute more in recessionary years. To test this, I divide annual states into those statutorily constrained and unconstrained.[12]

Compared with the entire sample, Table 4 shows that annual states should not be analyzed as one group, but that statutorily constrained and unconstrained states behave differently. States with annual legislatures and statutorily unconstrained contributions tend to undercontribute more in response to unexpected deficits, suggesting that some state legislatures take advantage of their greater flexibility. Contribution ratios for constrained states seem driven by other factors. The coefficient for the lagged funding ratio of 0.70 means that states with well-funded pensions tend to meet their ARC better than states with less well-funded pensions, suggesting a persistence of contributing behavior. It also appears that tax limits decrease state governments' ability to pay required pension contributions when they are statutorily constrained.

Table 4: Unexpected Deficits and State Pension Contribution Ratios

	1992-2007			1992-2009		
	All States	Annual & Unconstrained	Annual & Constrained	All States	Annual & Unconstrained	Annual & Constrained
Unexpected Deficit ($pc)	-0.064**	-0.082*	-0.005	-0.049**	-0.059*	0.003
Unexpected Surplus ($pc)	0.008	0.011	0.011	0.003	0.016	0.008
Lagged End-of-Year Balance ($pc)	0.010	0.009	0.001	0.007	0.012	0.001
Public Employees (%population)	0.4	0.8	-0.4	0.0	2.0	0.0
Public Union Members (%pop)	-1.6	-4.4	-0.5	-1.8	-4.0	-0.2
Lagged Funding Ratio (%)	7.7	12.7	0.73***	0.10	0.12	0.70***
Tax Limit	0.9	3.8	-6.3[1]	1.3	5.9	-6.5**
Constant	85.1***	86.9*	31.6**	85.4***	77.2*	30.4**
State Fixed Effects	NO	NO	NO	NO	NO	NO
R-squared	0.033	0.085	0.424	0.032	0.092	0.430
Observations	507	202	97	601	238	115

Notes: The dependent variable is the annual state contribution ratio, weighted by each pension's liabilities. Years missing are 1993, 1995, 1997, 1999. AK and MA dropped. Linear model. Significant at 10%(*), 5%(**) and 1%(***) levels; errors clustered by state. Values in 2008 dollars per capita ($pc). Extreme deficit shock observations (>$300 pc) dropped for Annual & Constrained.

Sources: PENDAT, Public Fund Survey, U.S. Census, NASBO, and Union Membership and Coverage Database.

[12] The following list from Munnell et al. (2008) for 2006 is applied to all years of the sample.
State with annual legislatures and pension contributions constrained by statute: CA, CO, IA, IL, KS, MD, MO, NM, OK
Annual and not constrained by statute: AK, AL, AZ, CT, DE, GA, ID, LA, MA, MI, MS, NJ, NY, PA, RI, SC, SD, TN, UT, WV
Biennial and constrained by statute: KY, MN, MT, NV, ND, OH, OR, TX, VA, VT
Biennial and not constrained by statute: AR, FL, HI, IN, ME, NE, NC, NH, WA, WI, WY

Extending the estimation of state responses to unexpected deficits through 2009 shows a decrease in the effect of unexpected deficits, with the undercontributions going from an estimated six to five dollars per hundred dollars of unexpected deficits. This recent change in contributing behavior corresponded with many pensions falling below the benchmark 80 percent funding ratio as asset values fell and liabilities continued to increase. From 2007 to 2009, the number of states with weighted funding ratios below this benchmark increased from 20 to 29. These worsening funding ratios may have increased the priority of state legislatures to make pension contributions. Also, the 2009 Recovery Act (ARRA) significantly boosted state government inflows, perhaps breaking the link between estimated unexpected deficits and pension contributions. Referring to the second quarter of 2009, the end of fiscal year 2008, Cauchon (2009) writes that the "flood of federal money lifted total revenues by 7.5%, overcoming an 8% drop in tax collections."

Estimating Undercontributions with an Alternative Measure of Fiscal Stress

Unexpected deficits depend on state budget forecasts, which as mentioned previously may be biased. Alternatively, Russell Sobel and Randall Holcombe (1996) and Dean Stansel and David Mitchell (2008) define fiscal stress as the sum of below trend general fund spending and discretionary tax increases during downturns. I focus on how dampened tax revenues affect pension contributions by estimating *trend tax shocks* as in equation 2, but with quadratic-year actual revenue trend residuals minus within-fiscal-year tax changes. Downturn years are dropped from the revenue trend regressions, i.e., 1991, 1992, 2002, 2003, and 2009.

The results of regressions using this alternative measure of fiscal stress suggest similar effects on pension contributions. Positive trend tax shocks cause undercontributions ten times other spending cuts. Following the same procedure shown in Table 3, over the preceding two decades positive trend tax shocks caused $22 billion of underfunding, similar to the underfunding estimated due to unexpected deficits.

What Determines State Pension Contribution Levels?

An alternative model of pension contributions considers per capita state contributions as a function of actuarial funding ratios, as follows:

$$PerCapitaContribution_{it} = a_0 + a_1 ARC_{it} + \Sigma_k \, a_k Controls_{k,it} + e_{it} \quad (5)$$

Mitchell and Smith (1994) did a similar study of state contributions in the late 1980s and found a persistence of funding behavior and that higher unionization of covered employees led to less state contributions. They suggest that the negative effect of unions may be "due to the upward pressure on salaries associated with collective bargaining, to which employers respond by reducing pension contributions." (p. 286)

To estimate this model, Actuarially Required Contributions (ARCs) are calculated by dividing state contributions (U.S. Census) by state contribution ratios. ARCs are more stable from year to year than contribution ratios, so to maximize the number of observations I interpolate missing ARCs. Unexpected deficits and surpluses have an insignificant effect in this model and do not affect the results, so they are left out so that AK can remain in the sample.

The results in Table 5 show that state pension contributions can be predominantly explained by actuarial requirements. The ARC explains 74 percent of state per capita contributions for all states and 70 percent for states with annual legislatures, but only 48 percent for states with annual legislatures and constrained contributions. This fits the expectation that states with annual legislatures will deviate more from actuarial recommendations because of more responsiveness than biennial legislatures to changing fiscal situations. These results also support the previous finding that constrained states deviate more from actuarial recommendations because of the need to pass statutory changes to adhere to actuarial recommendations.

While public employees and union membership may have a negative effect in some states—perhaps to offset higher salaries as suggested by Mitchell and Smith (1994)—in states with annual legislatures and statutorily constrained contributions they are correlated with higher state contributions. The last column of Table 5 shows that a one percentage point increase in the fraction of public employees (federal, state, and local) increases per capita state contributions by $10. A one percentage point increase in public union members increases contributions by $6.

However, in these states increased state contributions are also correlated with higher employee contributions. The negotiations involved in setting state contributions through statute may explain these observations.

Table 5: Determinants of Per Capita State Contributions (1992-2009)

	All States	Annual States	Annual & Unconstrained	Annual & Constrained
Actuarially Req. Contributions ($pc)	0.74***	0.70***	0.71***	0.48***
Lagged End-of-Year Balance ($pc)	0.011***	0.013***	0.013**	-0.001
Public Employees (%population)	-0.3	1.8	-1.2	10.2***
Public Union Members (%population)	0.4	0.5	-0.4	6.1***
Tax Limit	-1.5	0.8	5.6	-21.2***
Employee Contributions ($pc)	0.0	-0.1	-0.2	0.2***
Constant	15.1	8.3	29.3	-64.2***
State Fixed Effects	NO	NO	NO	NO
Overall R-squared	0.784	0.783	0.785	0.885
Observations	810	472	319	153

Notes: Dependent variable is per capita state contributions ($2010). Linear model with coefficients significant at 10%(*), 5%(**) and 1%(***) levels; errors clustered by state. Interpolated ARCs for missing years. Missing ARCs for ME before 2001 and IA, NM, and RI before 1996 and VT before 2004, and AK 1998 lagged balance and NH 2003 employee contributions. Dropped MA, NC, and NJ because of missing contribution ratios and IL 2004 because of outlier state contributions.
Sources: PENDAT, Public Fund Survey, U.S. Census, NASBO, and U.S. Census.

Among annual and constrained states, tax limitations are correlated with lower state contributions. Tax limitations may cause states to postpone contribution increases or seek innovative funding strategies. For example, the statutorily constrained Oklahoma state teachers' pension had a contribution ratio of only 56 percent in 2005. The contribution ratio increased to 86 percent the next year as dedicated sources increased from 4.0 to 4.5 percent of state tax revenues and 5 percent of lottery proceeds began going to the pension. (Oklahoma Office of State Finance, 2010; for a discussion of Oklahoma PERS see Munnell et al. 2010b, p. 9).

There is a positive correlation between state contributions and lagged end-of-year balances for annual and unconstrained states, but it only suggests a cumulative positive effect of $4 billion, a sixth of the negative effect of unexpected deficits. As expected, contributions from constrained states are not correlated with balances.

Conclusion

Fiscal stress pressures legislators to either raise taxes or cut spending, but state pensions provide a vehicle to postpone tax increases and maintain current spending. This process works like a rainy day fund in reverse—instead of first accumulating reserves to deal with fiscal stress, state governments "go in the red" by undercontributing to pensions and presumably make up the difference in the future.

Public pension underfunding results from many factors. This study shows that over the past two decades state undercontributions due to unexpected deficits explain only six percent of unfunded liabilities as of mid-2008, and state undercontributions for other reasons explain another third. Meanwhile, investment returns have actually been in excess of assumed returns. Thus the primary source of pension underfunding was an increase in liabilities—which roughly doubled over this period—that was not matched by sufficient employee or required government contributions.

The fraction of state spending going to underfunded pensions and unfunded health care promises will grow in the future. Addressing underfunding today could help reduce pressure on tomorrow's state budgets. Munnell et al. (2010b, p. 1) argue that "each generation of taxpayers should pay the full cost of the public services it receives. If a worker's compensation includes a defined benefit pension, the cost of the benefit earned in that year should be recognized, and funded, at the time the worker performs that service, not when the pension is paid in retirement." They believe that disciplining governments to pay required contributions could discourage them from promising excessive pension benefits in place of current wages—limiting the transfer of fiscal burdens to future taxpayers.

Ensuring that states meet their required contributions can help, but as pension underfunding seems largely due to increasing benefits, effective contribution reform could also force governments to more quickly fund new promises. For example, states could require increased pension benefits to be fully funded with a combination of employee and government contributions over a period of only a few years. This would compel current taxpayers to fund new pension promises rather than shifting the burden to future taxpayers.

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Appendix

Table A1: Average State Pension Investment Returns

Fiscal Year	Total State Pension Assets	Total State Investment Returns	Average Nominal Return (%)	Inflation (%)	Average Real Return (%)
1988	447	43			
1989	503	46	10.3	4.1	6.2
1990	575	52	10.3	4.3	6.0
1991	631	47	8.2	5.0	3.2
1992	704	62	9.8	2.6	7.2
1993	731	62	8.8	2.6	6.2
1994	812	66	9.0	2.2	6.9
1995	914	76	9.4	2.4	7.0
1996	1,045	107	11.7	2.4	9.3
1997	1,221	134	12.8	2.6	10.2
1998	1,426	159	13.0	1.6	11.4
1999	1,582	166	11.6	1.6	10.1
2000	1,798	193	12.2	2.9	9.3
2001	1,782	40	2.2	3.4	-1.2
2002	1,774	-66	-3.7	1.8	-5.5
2003	1,802	68	3.8	2.2	1.6
2004	2,079	264	14.7	2.2	12.5
2005	2,226	221	10.6	3.0	7.6
2006	2,424	249	11.2	3.8	7.4
2007	2,819	401	16.5	2.6	13.9
2008	2,664	-39	-1.4	3.7	-5.1
Average			9.1%	2.8%	6.2%

Notes: Assets and returns in nominal billion dollars are for U.S. aggregate of all state sponsored pensions. Fiscal year 2008 ended in June 30, 2008, before the large fall and recovery in equity values. Inflation rates from June CPI-U-RS. Returns calculated by dividing state investment earnings by previous year assets.
Sources: U.S. Census and Bureau of Labor Statistics

Table A2: Data Summary: 1992-2009

Variable	Mean	Min	Max	Standard Deviation
Actuarially Req. Contributions ($pc)	116	1	1,034	104
Employee Contributions ($/pc)	87	1	249	49
Lagged End-of-Year Balance ($pc)	17	-73	168	21
Lagged Investment Returns ($pc)	0.078	-0.31	0.28	0.10
Public Employees (%)	7.3	4.9	12.8	1.3
Public Union Members (%)	2.3	0.4	5.7	1.2
State Contributions ($pc)	96	0	949	80
Unexpected Deficit ($pc)	14	0	1,714	59
Unexpected Surplus ($pc)	-18	-1,452	0	63
Weighted Contribution Ratios (%)	89	0	207	27

Notes: Excluded years are 1993, 1995, 1997, 1999. AK and MA dropped. All values in 2010 dollars (CPI-U-RS), dollars per capita ($pc), and percent of workers in a state.