

# PUBLIC SECTOR PENSIONS: FUNDING & PRACTICE 2001-2010

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## INTRODUCTION

THE PAST DECADE HAS CHALLENGED THE sustainability of public sector defined benefit (DB) pension funds. This paper addresses two related questions: how did the funds get to this point, and, looking forward, is the situation as bad as recent reports would suggest? It builds on the earlier work of Seligman (2013) which explored these topics with more limited data, a more limited set of dependent variables, and somewhat different methods. As such, a reader familiar with that work can reasonably skip the literature review and a good deal of the data description sections of this paper. A reader who wishes for more context and background is encouraged to consider these sections. The net contribution of this work is to consider the evolution of plan positions following a first year of recovery for both financial markets and state finances from the financial crisis and the recession of 2007-2009.

One does not observe general improvement in plans' average funding ratios following 2010; in fact, one observes further declines. Indeed, while fund assets grew by an average 10.7 percent in 2010, this was insufficient to reverse the decline in funded ratios. The pressing questions are whether the funds will recover sufficiently as part of any broad economic recovery and, if so, what we might expect the likely asset path to look like over the near- and middle-term. To address these questions, this paper documents changes in plans in the years leading up and following through the onset of the most recent recession, and then considers environmental and historical evolutions of asset paths over components of the business cycle.

The most general characterization of findings is that while public sector pensions have taken meaningful losses in recent years, they generally remain in a good position from which to recover. However, slightly over a third of the pension funds analyzed failed to recover from the 2001 recession, such

that in 2006 they were already in a compromised position from which to contend with the 2007-09 recession. These plans face greater challenges.

To place current concerns in perspective, this paper summarizes the literature and implications for the way in which public sector plans are evaluated. It then analyzes pertinent data. Given results, the paper highlights some relative strengths and weaknesses of arguments in the literature. Regarding post-recessionary prospects for the funds recovery, the paper offers evidence on historic asset pricing paths over economic recoveries to inform prospects for asset evolutions and plan reforms following the Great Recession. The paper ends with a few salient takeaways for a reader to consider when evaluating the finances of public pensions at current.

## LITERATURE REVIEW

As the baby boomers retire, the United States' demographics change. Average retirement durations are increasing, and this is a particular challenge in the public sector where workers tend to be eligible for retirement at earlier ages, due to both earlier workforce attachment and longer firm-tenure. Financing a traditional Defined Benefit Pension in this environment requires greater savings. Since Ando and Modigliani (1963), it has been generally acknowledged that the relative proportion of time spent in retirement is a main driver of savings motivations on the household and aggregate levels.

Financing longer benefit streams requires a higher savings rate over prime earnings years. How to manage these savings is being debated. Somewhat related to this is a debate about whether the pension obligations should be treated as "riskless."

Novy-Marx and Rauh (2009, 2011) have argued that due to the constitutional protections afforded in many states, the claims offered to individuals in these situations are "riskless" and should be discounted accordingly. The authors advocate applying rates from the U.S. Treasury yield curve.

Brown and Wilcox (2010) soften this point in two dimensions. These have to do with (1) peculiarities of the U.S. Treasury rate, and (2)

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differences in the estimation of future liabilities. First, estimating a riskless rate of return via U.S. Treasury instruments is problematic. Treasuries are tax-exempt and traditionally serve a store of value purpose in “flight to quality” episodes, both of which suppress their rate of return. Thus, riskless rates diverge from the return on a portfolio of U.S. Treasury bonds with similar maturity structure. The authors propose a synthetic taxable Treasury rate and swap rate be blended to estimate a riskless rate. Second, while a public sector pension fund’s Accumulated Benefit Obligation (ABO) is often legally protected, the ABO is limited to that earned by the current time period. Future expected obligations can be discounted in accordance with probabilities of vesting and accrual, a problem of hazard estimation.

Lucas and Zeldes (2009) differ somewhat. The choice of discount rate still depends on the certainty of the obligation being funded, but political risks are separately emphasized as well. Pension rules are not static. By this line of reasoning, again, the Pension Benefit Obligation (PBO) discount rate should be higher than the ABO rate. Lucas and Zeldes apply this logic to allocations such that the portfolio share of equities should be a function of the ratio of active workers to plan members.<sup>1</sup>

In line with the Lucas and Zeldes, Hess (2005) documents funding decisions, actuarial assumptions, and investment performance are influenced by political factors that may work counter to the plan’s long-term health. Mahoney (2002) notes that the Employer Retirement Income and Security Act (ERISA) does not apply to public plans. Thus there may be greater opportunity for unethical behavior.

Weller and Wenger (2008) investigate whether plans ‘chase returns’ loading up on risk to boost returns in response to underfunding. They find no evidence of imprudent allocation behaviors following the 2001 recession. Thus, it appears that policies regarding contributions rather than allocations may be the bigger risk to fund health.

In 2012, the Governmental Accounting Standards Board (GASB) issued statements 67 and 68 wherein pension liabilities and discount rates are addressed. Regarding liabilities, an approach more or less along the lines of Brown & Wilcox (2010) is adopted. Regarding discount rates, GASB approves the continued use of expected rates of return but only up to the proportion of assets represented in this fashion. Further, once a fund reports net liabilities greater than assets, funds are required

to discount using 20-year municipal bond rates for relatively high quality issuers.

Some authors have ignored the argument that discount rates on obligations and on fund asset rates of return should be held in equivalence. Peng (2004) considers funding strategies that highlight tradeoffs between: (i) changes in contributions, (ii) changes in investment allocation strategies, and (iii) changes in the funding ratio. Regarding the latter, it can be argued that allowing the funding ratio to vary somewhat over the business cycle is natural. Peng offers evidence in this line detailing average funding ratios in his sample of 80.2 percent in 1990, which increased to 103.8 percent in 2007. At play were both a strong economy helping contributions and increasing equities allocations—average equity portfolio shares are documented as having risen from 39.8 percent to 60.3 percent over this period.

Peng argues that chronic underfunding should be considered separately, citing Inman (1982). When chronic underfunding has been observed, public funds have generally dealt with it in one of two ways: either increasing contributions (including employee contributions), or issuing Pension Obligation Bonds (POBs). These bonds essentially decrease net fixed income holdings and increase remaining portfolio shares across the rest of the portfolio. Peng notes that whenever the assumed interest rate on Unfunded Accrued Actuarial Liabilities (UAAL) is greater than the terms investors offer to buy the POBs, the POB looks attractive. Wilcox (2006) further notes that high rate of return assumptions motivate POBs that are less likely to be prudent.

Summarizing the literature in terms of current concerns, the financial crisis that began in 2007, and the related recession, have together caused a good deal of stress for plan managers. Two basic arguments underlay their concerns. As a result of financial market losses, one argument is that these plans no longer hold adequate assets to fund their obligations, as in Rauh (2010). A second argument is that the plans should adopt low yield investment strategies commensurate with the low discount rate prescribed to the constitutional guarantees afforded them by the majority of sponsoring states (Novy-Marx & Rauh, 2009; to lesser extents Brown & Wilcox, 2010; Lucas & Zeldes, 2009). This second argument has the unfortunate effect of supporting the first, since any sequence of low returns on a reduced principal effectively reduces prospects for asset appreciation.

A third argument sometimes comes forward in discussions surrounding these papers as well – it conveys a sense of exasperation with plan managers and state leaders, as overfunded plans have motivated benefit increases and/or reductions in contributions. Components of this argument can be seen in Lucas & Zeldes (2009) and within the evidence offered for the case of New York City in Peng (2004). The sentiment is not out of line with Mahoney (2002) or Hess (2005), as well.

Finally, an extension of, or justification for, closing public employer pension funds and replacing them with Defined Contribution (DC) plans appears, generally, as the sentiment that DB plans are antiques, and it is time the public sector catch up to current standards. Liang (2010) put this argument as: taxpayers who do not hold pensions cannot be expected to support public sector pensions, as a matter of fairness.

Because each of these four current critiques is fundamental to the current outlook for public sector pensions, they will be discussed again following data analysis. The next section details the data used in these analyses.

## DATA

Data for this paper are from the Center for State and Local Government Excellence (SLGE).<sup>2</sup> The Center has collaborated with the Center for Retirement Research at Boston College to build a database of public plans over the past several years - the Public Pension Database (2010). Current public-use data offer annual plan statistics each year over the 2001-2010 periods for a total universe of 126 defined benefit plans. Fifty-five of these plans cover police and fire personnel, 61 cover teachers, and 78 cover general employees. These data are the core data that inform tables on plan characteristics.

Two other data sources are engaged here. First, Robert Shiller's (2005) data consisting of stock market returns from 1871 to the present.<sup>3</sup> In addition, the National Bureau of Economic Research (NBER) Business Cycle Dating Committee data is used. Both of these sources provide statistics in monthly frequencies, and they are matched to discern prospects for asset accumulation over the recovery and subsequent expansion phase of the business cycle. These data are most useful for considering how funds did following the end of recessions this past decade.

Beginning with the SGLE data, the plans' workers characteristics are changing. Over the nine-year period of observation, the average age of employees increased by roughly two years, from 43.7 years old in 2001 to 45.5 years in 2009. This aging implies a two year reduction in contributing periods ahead of benefit realizations. Table 1 offers several other relevant summary statistics, annually.

Consider the evolution of funding ratios, a key health metric for any plan. At the beginning of the decade, plans were nearly fully funded (97.1 percent funded on average); however, following the 2001 recession, levels fell and stabilized in the mid-80's – notably above the level cited by Peng for the year 1990. In 2009, however, average funding levels fell below this level for the first time, to 78 percent. A year of recovery, 2010, did not evidence an improvement in the average funding ratio; in fact, it further declined to 75.6 percent. Throughout the period, the variance surrounding reported mean values was observed to be high.

The 1990 funding level of 80 percent (Peng, 2004) demarks not only a previous nadir, but also the rule of thumb that funding levels above 80 percent ahead of recession are more closely associated with funding level recoveries in the years following the recession. By this rule of thumb, funding ratios look okay on average. But averages fail to tell the whole story. The percent of plans funded at less than 80 percent increased gradually over this period from 11 percent in 2001 to 55 percent in 2009. Further, 35 percent of the 126 plans studied were below the 80 percent level in 2006, ahead of the latest economic and financial difficulties. Thus, more than half of the funds studied were below the 80 percent threshold by the end of the most recent recession.

Continuing down the table gives the reader a better sense of the evolving picture over several important dimensions. As one might expect, average public sector payroll expanded over the period through 2009, suggesting both a larger base for contributions and higher future benefit payments. Annual Required Contributions (ARC) as a percent of payroll roughly doubled over this period from 15 to 28 percent. Employers' portions on average grew by a much higher 153 percent to approach 21 percent of payroll.

Speaking to the debate on return assumptions, long-run investment return assumptions declined by about 13 basis points to 7.9 percent. Short-run investment returns have been quite volatile. This

*Table 1*  
**Summary of 126 State and Local Pension Plans from 2001-2009**

<i>Variable</i>	<i>2001</i>	<i>2002</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>	<i>2006</i>	<i>2007</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>
<b>Funded ratio (percent)</b>										
<b>mean</b>	<b>97.1%</b>	<b>91.6%</b>	<b>88.0%</b>	<b>85.5%</b>	<b>84.0%</b>	<b>83.5%</b>	<b>85.1%</b>	<b>82.0%</b>	<b>78.0%</b>	<b>75.6%</b>
variance	294.2%	281.1%	256.8%	226.7%	224.9%	220.4%	201.0%	209.8%	224.6%	240.2%
sample size	123	123	122	124	125	124	125	124	124	123
<b>Payroll (\$ millions)</b>										
<b>mean</b>	<b>\$3.68</b>	<b>\$3.67</b>	<b>\$4.01</b>	<b>\$4.02</b>	<b>\$4.12</b>	<b>\$4.31</b>	<b>\$4.54</b>	<b>\$4.78</b>	<b>\$4.92</b>	<b>\$4.96</b>
variance	2.E+07	2.E+07	3.E+07	3.E+07	3.E+07	3.E+07	4.E+07	4.E+07	5.E+07	5.E+07
sample size	123	123	122	124	125	124	125	124	124	124
<b>Annual Required Contribution (ARC) as a percent of Payroll</b>										
<b>mean</b>	<b>15.18%</b>	<b>17.13%</b>	<b>18.27%</b>	<b>20.81%</b>	<b>20.72%</b>	<b>21.01%</b>	<b>21.55%</b>	<b>24.64%</b>	<b>29.74%</b>	<b>27.92%</b>
variance	69.4%	89.4%	99.8%	178.0%	112.2%	139.0%	406.4%	1558.6%	7019.5%	2830.0%
sample size	72	75	74	79	80	81	83	84	95	97
<b>Annual Required Contribution (ARC) — Employer Portion as a percent of Payroll</b>										
<b>mean</b>	<b>8.19%</b>	<b>9.93%</b>	<b>12.35%</b>	<b>14.14%</b>	<b>14.01%</b>	<b>14.27%</b>	<b>14.66%</b>	<b>14.46%</b>	<b>22.05%</b>	<b>20.73%</b>
variance	161.8%	179.8%	63.4%	135.3%	80.2%	103.1%	326.8%	98.2%	5900.8%	2464.1%
sample size	80	84	82	91	92	93	96	99	112	110
<b>Percent of ARC paid</b>										
<b>mean</b>	<b>108.2%</b>	<b>114.9%</b>	<b>92.8%</b>	<b>90.5%</b>	<b>84.9%</b>	<b>88.8%</b>	<b>90.3%</b>	<b>99.8%</b>	<b>89.2%</b>	<b>84.7%</b>
variance	2414.5%	23899.3%	1267.9%	1377.5%	682.0%	1295.4%	1657.2%	5914.9%	446.1%	571.0%
sample size	126	126	126	126	126	126	126	126	126	124
<b>Long-run investment returns assumption</b>										
<b>mean</b>	<b>8.03%</b>	<b>8.04%</b>	<b>8.00%</b>	<b>7.99%</b>	<b>7.96%</b>	<b>7.96%</b>	<b>7.91%</b>	<b>7.94%</b>	<b>7.93%</b>	<b>7.90%</b>
variance	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
sample size	122	122	123	124	124	124	125	124	124	120
<b>Short-run (1 year) investment returns</b>										
<b>mean</b>	<b>-5.0%</b>	<b>-5.5%</b>	<b>7.1%</b>	<b>15.1%</b>	<b>10.5%</b>	<b>11.6%</b>	<b>16.5%</b>	<b>-7.4%</b>	<b>-12.9%</b>	<b>13.4%</b>
variance	18.2%	20.3%	54.9%	10.6%	4.2%	8.7%	13.3%	69.2%	205.2%	8.5%
sample size	118	120	124	125	125	125	125	125	125	124
<b>Rate of inflation assumption</b>										
<b>mean</b>	<b>3.87%</b>	<b>3.86%</b>	<b>3.70%</b>	<b>3.65%</b>	<b>3.59%</b>	<b>3.56%</b>	<b>3.50%</b>	<b>3.46%</b>	<b>3.47%</b>	<b>3.44%</b>
variance	0.00%	0.01%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
sample size	116	116	116	120	118	120	121	120	120	117
<b>Smoothing assumption for asset valuation (number of years included in moving average)</b>										
<b>mean</b>	<b>3.6</b>	<b>3.9</b>	<b>4.0</b>	<b>4.0</b>	<b>4.0</b>	<b>4.0</b>	<b>4.1</b>	<b>4.0</b>	<b>4.4</b>	<b>4.5</b>
variance	3.3	4.2	4.4	4.6	4.7	5.4	5.4	5.5	5.5	4.7
sample size	118	119	120	123	123	124	124	124	122	108
<b>Amortization assumption (number of years expected for accrued liabilities to be repaid)</b>										
<b>mean</b>	<b>23.6</b>	<b>26.8</b>	<b>27.8</b>	<b>29.4</b>	<b>27.2</b>	<b>26.8</b>	<b>24.7</b>	<b>25.4</b>	<b>27.9</b>	<b>26.3</b>
variance	100.7	172.4	202.6	252.2	161.5	151.9	42.7	40.0	134.9	41.2
sample size	105	109	108	111	110	111	112	113	111	104

has certainly contributed to uncertainty regarding the general outlook for public plans.

Assumptions regarding rates of inflation are in line with private forecasts and decline modestly over the period. Asset value smoothing assumptions have increased on average from 3.6 to 4.4 years.<sup>4</sup> Longer smoothing periods desensitize plan statistics from any current environment, such that declines or advances in financial markets take longer to impact fund-asset measures. A concurrent trend in table 1 evidences increased amortization: funds appear to be moving toward a norm of 30 years, which has implications for the evolution of ARC. Extensions of the amortization period tend to reduce volatility in yearly changes to required contributions, effectively reducing payments in the near term, but keeping them elevated for a longer time period following negative shocks.

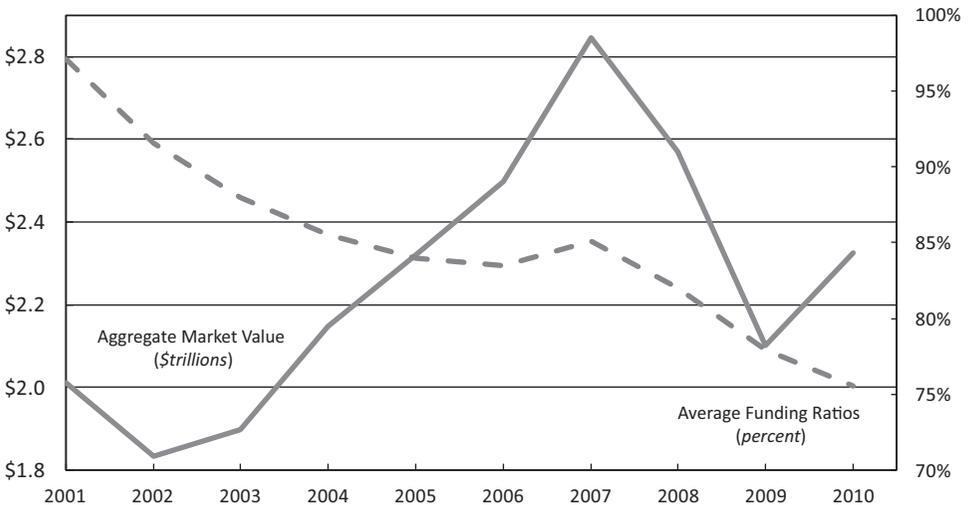
Placed in context, table 1 helps the reader understand the evolving challenges and the actions taken by plans over the period of two recessions. Figure 1 offers a visual look at the evolution in average returns and aggregate plan assets over the 2001-2010 periods.

Over the full period of study, recessions have diminished assets backing these funds, and though their plan values have consistently recovered in non-recession years, they have generally failed to keep pace with growing burdens. Average funding ratios improve in only one year (2007).

It is natural to immediately wonder what these plans invested in and how that changed over the course of recessions and intermediary period. Table 2 highlights allocations between equities and other financial instrument classes.

Generally equities holdings move between 50 and 60 percent of portfolio holdings, increasing through the middle of the decade before declining to their minimum portfolio weight in 2010. Fixed income (bond) investments range from 26-33 percent; initially declining from their peak in 2001 to a nadir in 2007, before edging back up a few percentage points to rest at an average 27 percent share. Real estate investments increase over much of the period from a roughly 5 percent share in 2001 to a peak proportion of just above 7 percent in 2008. In 2010 they accounted for 6.2 percent of the average fund portfolio. Holdings of cash and short maturity bills are somewhat low and move in a narrow range between 2-3 percent of assets, suggesting a predominance of transactional motives by the funds. Alternate investments appear to gain in popularity over the period, beginning in 2001 at under a 2 percent share and ending at over four times that initial allocation. Miscellaneous, so-called ‘other,’ holdings account for a rising share of portfolios as well – more than doubling from a 3.5 to 8.2 percent share over the period. Overall, equities and fixed income shares together declined from roughly 88 percent to 76 percent, while the

**Figure 1: Aggregate Market Value of Plans’ Assets & Average Funding Ratios**  
 2001-2010 Data Source: CRR SGLE data on 126 major public sector pension plans



*Table 2*  
**Investment Allocations**

<i>Variable</i>	<i>2001</i>	<i>2002</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>	<i>2006</i>	<i>2007</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>
Proportion invested in equities										
<b>mean</b>	<b>55.8%</b>	<b>54.6%</b>	<b>56.8%</b>	<b>59.6%</b>	<b>59.4%</b>	<b>59.1%</b>	<b>58.4%</b>	<b>52.8%</b>	<b>50.7%</b>	<b>49.5%</b>
variance	117.4%	105.0%	99.2%	90.3%	91.3%	93.2%	96.0%	98.5%	110.4%	127.6%
sample size	125	126	126	126	126	126	126	126	126	124
Proportion invested in fixed income										
<b>mean</b>	<b>32.0%</b>	<b>32.9%</b>	<b>29.7%</b>	<b>28.0%</b>	<b>28.0%</b>	<b>26.9%</b>	<b>25.9%</b>	<b>27.5%</b>	<b>27.7%</b>	<b>26.8%</b>
variance	129.0%	125.0%	85.8%	92.6%	96.2%	91.2%	89.2%	83.8%	62.0%	57.2%
sample size	125	126	126	126	126	126	126	126	126	124
Proportion invested in real estate										
<b>mean</b>	<b>4.7%</b>	<b>5.1%</b>	<b>4.8%</b>	<b>4.5%</b>	<b>4.8%</b>	<b>5.5%</b>	<b>5.9%</b>	<b>7.1%</b>	<b>6.6%</b>	<b>6.2%</b>
variance	25.0%	28.1%	19.2%	15.9%	17.4%	19.4%	20.1%	29.3%	30.5%	20.4%
sample size	123	124	122	122	126	124	124	124	124	123
Proportion in cash or invested in short term liquid obligations (bills)										
<b>mean</b>	<b>2.6%</b>	<b>2.2%</b>	<b>2.7%</b>	<b>2.4%</b>	<b>2.1%</b>	<b>2.0%</b>	<b>2.2%</b>	<b>2.0%</b>	<b>2.4%</b>	<b>2.5%</b>
variance	10.9%	7.6%	10.3%	8.0%	6.3%	4.9%	10.8%	4.1%	7.3%	9.9%
sample size	123	125	123	123	125	124	124	124	124	123
Proportion invested in alternative investment vehicles										
<b>mean</b>	<b>1.7%</b>	<b>1.7%</b>	<b>1.8%</b>	<b>2.1%</b>	<b>2.3%</b>	<b>2.5%</b>	<b>3.3%</b>	<b>5.2%</b>	<b>5.8%</b>	<b>7.4%</b>
variance	14.0%	13.1%	13.5%	13.6%	15.0%	15.3%	21.1%	49.7%	74.2%	88.0%
sample size	123	125	122	122	124	123	123	123	124	121
Proportion invested in 'other'										
<b>mean</b>	<b>3.5%</b>	<b>3.6%</b>	<b>3.8%</b>	<b>3.7%</b>	<b>3.6%</b>	<b>4.2%</b>	<b>4.5%</b>	<b>5.7%</b>	<b>7.0%</b>	<b>8.2%</b>
variance	22.8%	22.7%	25.5%	25.8%	22.5%	27.1%	31.5%	45.1%	52.1%	88.0%
sample size	123	124	122	123	125	123	123	125	125	118
> <i>Sum non equities, non fixed income</i>										
	<b>12.5%</b>	<b>12.6%</b>	<b>13.1%</b>	<b>12.7%</b>	<b>12.7%</b>	<b>14.2%</b>	<b>16.0%</b>	<b>20.0%</b>	<b>21.8%</b>	<b>24.3%</b>
> <i>Sum equities and fixed income</i>										
	<b>87.8%</b>	<b>87.5%</b>	<b>86.5%</b>	<b>87.6%</b>	<b>87.4%</b>	<b>86.0%</b>	<b>84.3%</b>	<b>80.3%</b>	<b>78.4%</b>	<b>76.3%</b>

remaining four categories increased their average share. The change in allotments appears to accelerate from 2006 on.

Given these data, whether the funds are being proactive, reactive, or passive regarding these changes in portfolio allocation is unclear. Consider three paths by which one might observe a reduction in equity share: one that is passive, one that is reactive, and one in which managers are proactive.

A passive reduction is one in which losses will reduce an allocation proportion, while selling low and chasing returns represents a reactive reduction. Lastly, selling ahead of declines in prices and purchasing an alternate category that does relatively better represents a proactive reduction. Of these, only the latter speaks to good management of allocations, but in all three allocations decline. What is clear is that the investment allocation strategies

playing out within public sector pensions are evolving relatively slowly over a period of unusually high financial sector volatility.

Regression analyses are engaged next. Since not all plans report data on all included variables in all years, the regression sample covers 95 plans, whereas the full data described to this point cover up to 126 plans. Table 3 documents both the full sample and the panel sample employed in regressions.

Within the top panel, the left side of table 3 offers statistics on the full sample, while the right side focuses on the sample employed in regressions. While the regression sample is smaller, the two samples are very comparable. The regression sample represented in table 3 is designed to capture the minimum sample utilized: a 10-year panel of 95 public sector plans in the SGLE data. Across the table, the reader can observe that there is a great deal of heterogeneity across plans, as suggested by the variance terms in tables 1 and 2. The top rows of this table describe variables employed as dependents in table 4. The second panel of rows describes plan features and controls. The final panel of rows concerns the characteristics of investments. Among asset classes, three are signaled out: equities, fixed income, and the increasingly popular alternative investment category.

**METHODS**

Seligman (2013) details work with a series of panel regressions where Maximum Likelihood Estimation (MLE), a non-clustered Tobit, a Tobit with fixed bounds (0,1), and a random effects Tobit estimator clustered at the state level are each employed and compared. To test for robustness, an alternate clustering model and an alternate fixed effects model were employed and presented to reviewers, as well. Together those findings suggest that model selection does not drive reported results in Seligman (2013). Clustering at the state level – the level at which many practices are standardized – is best. As a result, a random effects Tobit model that allows for clustering the variance-covariance matrix is employed here. Neither the upper or lower limits are specified. The model is generic in so much as its routine first identifies evidence of censoring and thereafter selects censoring parameters as part of the procedure. As with the earlier data, a reasonable conclusion is that these data are not censored.

The dependent variables investigated here are: (1) the funded ratio of the plans, (2) log value of plan assets, (3) percentage change in plan assets, (4) benefits as a percent of plan asset values, and (5) short run (year to year) asset returns. It is with respect to short run asset returns that the sensitivity of method to new data is greatest.

Regardless of the estimating procedure, the general model for each of the routines is:

$$(1) \quad y_D = \hat{\beta}_0 + \hat{\beta}X_{-D} + \varepsilon$$

Where ‘dependent’ variables are described by  $D = \{(1), (2), (3), (4), (5)\}$ ,  $\hat{\beta}_0$  estimates a constant value the dependent takes on at the average values for all included ‘independent’ variables.  $\hat{\beta}$  estimates the correlation coefficient between each of the included ‘independent’ variables within the vector  $X$ , and  $\varepsilon$  denotes an error between the predicted and actual values of the ‘dependent’ variable.

The baseline vector,  $X$ , is composed of: (1), (2) and (5) from above. As well, (6) the percent of annual required contribution (ARC) paid, (7) whether teachers are covered by the plan, (8) whether police and fire workers are covered by the plan, (9) whether plan workers participate in Social Security, (10) whether the plan has been frozen, (11) whether the plan has been closed, (12) whether the plan offers a lump-sum payout option, (13) the average benefit level of the plan, (14) the plan’s inception date, (15) the natural log of the plan’s associated worker payroll, (16) the plan’s employed smoothing assumption for asset valuation, (17) the amortization assumption, (18) the employee contribution rate, (19) long-run investment returns assumptions, (20) allocations across the proportions invested in equities (stocks) fixed income (bonds) and alternative investment vehicles, (21) investment-related expenses, (22) administrative expenses, and (23) the size of the plan’s membership.

**RESULTS**

Table 4 offers results from panel regressions. Ten regressions cover five dependent variables. Two variables are sequentially discarded to test for robustness to the omission of seemingly irrelevant independent variables: (8) coverage of police and fire in specifications where that variable is statis-

*Table 3*  
**Summary Statistics for Variables Included in Panel Regressions**

	<i>Observations: full sample (Tables 1, 2)</i>					<i>Observations: regression panel (Table 4)</i>				
	<i>N</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>	<i>N</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
<i>Dependent Variables:</i>										
Funded ratio of plan	1,312	84.3%	16.6%	19.1%	147.7%	732	84.3%	15.5%	19.2%	141.0%
Market value of assets (in thousands of dollars)	1,357	\$15,959	\$1,264	\$12,100	\$19,341	732	\$15,949	\$1,231	\$12,100	\$19,341
<i>ln</i> (Market value of assets) (in dollars)	1,357	9.7	7.1	9.4	9.9	732	9.7	7.1	9.4	9.9
Percent change in market value of assets <sup>2</sup>	1,132	1.0	14.5	-127.6	40.7	665	-0.6	15.2	-127.6	26.7
Benefits as a percent of market value of assets	1,255	5.9	2.9	0.0	25.2	732	6.0	2.4	0.2	25.2
Short-run (1 year) investment returns	1,361	5.6%	12.4%	-29.6%	36.2%	732	3.5%	12.5%	-29.6%	26.0%
<i>Plan Features and Characteristics:</i>										
Teachers are covered by plan	1,385	31.8%	46.6%	0	1	732	34.2%	47.5%	0	1
Police and Fire are covered by plan	1,385	9.5%	29.4%	0	1	732	8.9%	28.5%	0	1
Workers participate in Social Security	1,385	75.4%	43.1%	0	1	732	72.7%	44.6%	0	1
Plan has been frozen	1,385	5.0%	21.8%	0	1	732	4.5%	20.8%	0	1
Plan has been closed	1,385	5.6%	22.9%	0	1	732	5.7%	23.3%	0	1
Plan offers a lumpsum payout option	1,216	30.5%	46.1%	0	1	732	33.2%	47.1%	0	1
Plan offers a deferred retirement option	1,248	13.9%	34.7%	0	1	732	19.0%	39.2%	0	1
Average benefit level of plan (in dollars)	1,266	\$22,682	\$17,189	\$740	\$394,772	732	\$22,405	\$12,583	\$740	\$90,877
Plan's inception date (year)	1,385	1947	20	1889	2000	732	1945	17	1889	1979
Payroll (in thousands of dollars)	1,314	\$14,574	\$1,309	\$8,971	\$17,624	732	\$14,565	\$1,300	\$9,544	\$17,624
<i>ln</i> (Payroll) (in dollars)	1,314	4.05	2.19	0.00	10.00	732	3.80	2.05	0.00	10.00
Smoothing assumption for asset valuation (in yrs)	1,266	4.05	2.19	0.00	10.00	732	3.80	2.05	0.00	10.00
Amortization assumption (in years)	1,160	26.65	11.28	0.00	100.00	732	27.54	12.34	0.00	100.00
Employee contribution rate	1,102	5.7%	3.1%	0.0%	48.0%	732	5.7%	2.7%	0.0%	13.0%
Number of members	1,300	178,372	230,557	0	1,631,769	732	187,719	242,593	3,246	1,619,352
Percent of required contributions (ARC) paid	1,342	94.0%	61.7%	0.0%	1727.7%	732	91.7%	43.7%	0.0%	830.7%
Long-run investment returns assumption	1,302	8.0%	0.4%	4.5%	9.0%	732	8.0%	0.5%	4.5%	9.0%
<i>Investment Considerations</i>										
Proportion invested in equities	1,352	55.2%	10.9%	0.0%	82.0%	732	57.5%	9.4%	10.7%	82.0%
Proportion invested in fixed income	1,352	28.3%	9.7%	0.0%	100.0%	732	27.9%	8.4%	10.0%	57.4%
Proportion invested in alternative investment vehi	1,324	28.3%	9.7%	0.0%	100.0%	732	27.9%	8.4%	10.0%	57.4%
Investment related expenses (in dollars)	1,107	\$9,792	\$1,480	\$5,696	\$15,082	1107	\$9,682	\$1,391	\$5,861	\$15,082
<i>ln</i> (Investment related expenses) (in dollars)	1,092	9.19	7.30	8.65	9.62	1092	9.18	7.24	8.68	9.62
Administrative expense	1,305	\$13,702	\$28,941	\$0	\$427,809	732	\$13,208	\$30,771	\$272	\$427,809
Plan employs a separate investment council	1,128	35.7%	57.2%	0	1	732	32.2%	46.8%	0	1

<sup>1</sup> log values of (0) set to missing.

<sup>2</sup> loss of one years data (2001)

Table 4  
Panel Regressions Funding Ratios

independent:	dependent:	1	2	3	4	5	6	7	8	9	10
		Funded Ratio	Market Value of Plan	Change in Market Value	Benefits : Market Value	Market Value	Annual Returns	Market Value	Annual Returns	Market Value	Annual Returns
		percent	ln(\$ thousands)	percent	ratio	percent	ratio	percent	ratio	percent	percent
Funded ratio		-	0.00717***	0.0166	0.0170	-0.108***	-0.109***	-0.104***	-0.102***	-0.104***	-0.102***
percent			(0.000530)	(0.0202)	(0.0202)	(0.00429)	(0.00429)	(0.0333)	(0.0333)	(0.0333)	(0.0333)
Market value of plan assets		24.17***	24.18***	-	-	-	-	7.491***	7.497***	7.491***	7.497***
ln(\$ thousands)		(1.684)	(1.686)					(1.279)	(1.281)	(1.279)	(1.281)
Annual returns		-0.123***	-0.123***	1.062***	1.064***	-0.0335***	-0.0335***	-	-	-	-
(percent)		(0.0219)	(0.0219)	(0.0206)	(0.0205)	(0.00296)	(0.00296)				
Percent of ARC Paid		0.0277***	0.0277***	-0.000192*	-0.000192**	0.000230	0.000225	0.000230	0.000225	0.000230	0.000225
(percent)		(0.00665)	(0.00664)	(0.000105)	(0.000105)	(0.00655)	(0.00656)	(0.000960)	(0.000960)	(0.0103)	(0.0103)
Teachers are covered by plan		-6.618**	-7.159**	0.0270	0.0449	-0.155	-0.344	0.388	0.388	-0.244	-0.244
(binary: 1="yes")		(2.929)	(2.853)	(0.108)	(0.105)	(0.651)	(0.626)	(0.313)	(0.313)	(0.973)	(0.973)
Police and Fire are covered by plan		3.875	-0.132	-0.132	1.279	1.279	-1.392**	-1.216**	-1.392**	2.942*	3.060*
(binary: 1="yes")		(5.156)	(0.184)	(0.184)	(1.192)	(1.192)	(0.558)	(0.558)	(0.545)	(1.772)	(1.71)
Workers participate in Social Security		-3.685	-3.751	-0.107	-0.103	0.169	0.221	1.267***	1.206***	-2.376*	-2.276*
(binary: 1="yes")		(3.317)	(3.331)	(0.116)	(0.116)	(0.835)	(0.835)	(0.363)	(0.362)	(1.262)	(1.263)
Plan has been frozen		8.047***	7.994***	-0.168***	-0.168***	-1.523	-1.700	-0.0318	-0.0151	3.315	2.867
(binary: 1="yes")		(2.784)	(2.785)	(0.0466)	(0.0466)	(1.476)	(1.468)	(0.378)	(0.379)	(2.200)	(2.187)
Plan has been closed		-3.373	-3.399	-0.0885**	-0.0883**	-1.365	-1.530	2.261***	2.246***	-7.234***	-7.668***
(binary: 1="yes")		(2.578)	(2.581)	(0.0422)	(0.0422)	(1.320)	(1.312)	(0.337)	(0.338)	(2.349)	(2.339)
Plan offers a lumpsum payout option		0.195	0.213	-0.0595**	-0.0594**	0.420	0.470	0.670***	0.657***	1.063	1.172
(binary: 1="yes")		(1.512)	(1.513)	(0.0262)	(0.0262)	(0.621)	(0.620)	(0.197)	(0.197)	(0.945)	(0.944)
Average benefit level of plan		-0.806***	-0.795***	0.0125***	0.0124***	-0.0448*	-0.0340	0.0571***	0.0579***	-0.170***	-0.146***
(thousands of dollars)		(0.0680)	(0.0667)	(0.00120)	(0.00119)	(0.0270)	(0.0250)	(0.000879)	(0.00881)	(0.0474)	(0.0451)
Payroll		-17.67***	-17.84***	0.512***	0.515***	1.138***	1.110***	-0.503***	-0.516***	-7.443***	-7.512***
ln (thousands of dollars)		(1.613)	(1.601)	(0.0314)	(0.0312)	(0.376)	(0.375)	(0.153)	(0.153)	(1.114)	(1.115)

Smoothing assumption for valuations <i>(number of years)</i>	-0.984*** (0.331)	-0.990*** (0.331)	-0.0135** (0.00597)	-0.0135** (0.00598)	-0.160 (0.141)	-0.161 (0.141)	0.0302 (0.0440)	0.0301 (0.0441)	-0.0470 (0.218)	-0.0540 (0.218)
Amortization assumption <i>(number of years)</i>	-0.0672*** (0.0255)	-0.0674*** (0.0255)	-0.000413 (0.000403)	-0.000411 (0.000403)	0.0228 (0.0227)	0.0239 (0.0227)	-0.00523 (0.00366)	-0.00508 (0.00365)	-0.0164 (0.0370)	-0.0145 (0.0371)
Employee contribution rate <i>(percent)</i>	-1.187*** (0.314)	-1.194*** (0.314)	-0.000834 (0.00579)	-0.000872 (0.00579)	0.0700 (0.128)	0.0551 (0.128)	-0.0987** (0.0409)	-0.0937** (0.0409)	-0.404** (0.200)	-0.437** (0.199)
Long-run returns assumption <i>(percent)</i>	7.579*** (1.146)	7.642*** (1.143)	-0.0265 (0.0192)	-0.0269 (0.0192)	-0.339 (0.700)	-0.261 (0.696)	0.133 (0.162)	0.147 (0.162)	-2.472** (1.095)	-2.306** (1.092)
Proportion invested in equities <i>(percent)</i>	-0.0817 (0.0571)	-0.0843 (0.0570)	0.00406*** (0.000907)	0.00408*** (0.000907)	0.0230 (0.0397)	0.0137 (0.0388)	-0.0343*** (0.00788)	-0.0347*** (0.00788)	0.374*** (0.0606)	0.352*** (0.0592)
" fixed income <i>(percent)</i>	0.132** (0.0653)	0.129** (0.0652)	-0.00181* (0.00105)	-0.00178* (0.00105)	0.0866* (0.0457)	0.0802* (0.0453)	-0.0230** (0.00912)	-0.0236*** (0.00912)	0.0535 (0.0721)	0.0371 (0.0715)
" alternative investment vehicles <i>(percent)</i>	-0.250*** (0.0740)	-0.250*** (0.0740)	0.000696 (0.00119)	0.000691 (0.00119)	-0.0299 (0.0566)	-0.0348 (0.0564)	-0.000481 (0.0105)	-0.00133 (0.0105)	0.222** (0.0910)	0.211** (0.0910)
Investment related expenses <i>In (thousands of dollars)</i>	-4.469*** (0.585)	-4.525*** (0.580)	0.0912*** (0.00958)	0.0916*** (0.00957)	-0.356 (0.305)	-0.450 (0.293)	-0.162** (0.0780)	-0.168** (0.0780)	-0.504 (0.505)	-0.730 (0.488)
Administrative expense <i>In (thousands of dollars)</i>	1.26e-05 (2.68e-05)	1.25e-05 (2.68e-05)	-2.57e-07 (4.56e-07)	-2.58e-07 (4.56e-07)	9.56e-06 (1.30e-05)	1.02e-05 (1.30e-05)	-7.48e-06** (3.61e-06)	-7.52e-06** (3.62e-06)	-1.90e-05 (2.06e-05)	-1.76e-05 (2.06e-05)
Plan Membership <i>(number of members)</i>	-1.07e-05 (7.91e-06)	-1.06e-05 (7.94e-06)	1.18e-06*** (1.88e-07)	1.18e-06*** (1.88e-07)	-2.81e-06 (2.20e-06)	-2.72e-06 (2.21e-06)	2.92e-06*** (8.81e-07)	2.95e-06*** (8.86e-07)	2.80e-07 (3.47e-06)	4.74e-07 (3.47e-06)
Constant	-25.76 (23.89)	-22.70 (23.60)	6.726*** (0.505)	6.665*** (0.498)	-21.67** (9.031)	-20.36** (8.954)	23.34*** (2.666)	23.72*** (2.666)	14.62 (14.44)	17.95 (14.33)
Observations	809	809	809	809	742	742	809	809	809	809
Number of Plans	95	95	95	95	95	95	95	95	95	95

Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

tically unimportant and (7) coverage of teachers otherwise.<sup>5</sup>

### Funding Ratios

Beginning with the funding ratio (columns 1 and 2), the market value of assets appears strongly correlated with a plan's funded ratio after accounting for plan size and features. Interpreting the log transform, each 1 percent increase in plan assets is associated with a 0.24 percentage point increase in the funded ratio of a plan. Annual returns are inversely associated with plans funding (-12 percent), suggesting that better funded plans are more conservative in terms of allocations. The payment of annual required contributions is also associated with improved funding ratios (+3 percent). Each of these three results is statistically significant at or above the 1 percent level of confidence. This result helps the reader to price the value of immediate action for long-term solvency criteria. Investment strategies can help a plan, but contributions are more fundamental.

Binary variables are offered for two employee categories: teachers and police/fire; the third (omitted) general employee type plan serves as a baseline. Teachers' plans appear less well funded on average, by roughly 7 percentage points, statistically significant at the 5 percent level. Frozen plans are estimated to hold higher funded ratios, by roughly 8 percentage points. This result is statistically significant at the 1 percent level. Higher benefits are associated with lower funding ratios. Each thousand dollars of increased benefit is associated with a decline in funding of 0.8 percentage points, statistically valid at the 1 percent level. Plans with larger payrolls also appear to have lower funding ratios. In this case, since the payroll numbers are log-transformed, the interpretation is that a 1 percent increase in payroll appears correlated with a 0.18 percentage point decline in funding ratio. This result is statistically sound at or above the 1 percent confidence level.

Increases in the number of years employed in smoothing and amortization procedures are strongly statistically correlated with reduced funded ratios. Each year, increase is associated with about a 1 percent drop in the funding ratio, implying that increases in smoothing periods may be reactive, motivated in part by declining fund ratios. Amortization period increases are generally associated with a smaller and statistically weaker negative correlation to funding ratio on an annual basis.

Employee contribution rates are strongly associated with lower funding ratios. Each percentage

point an employee contributes is associated with a slightly larger than 1 percentage decline in the ratio. This association may reflect a dynamic whereby funds with low ratios introduce employee contributions to partially offset declines – again reactive.

Higher long-run return assumptions appear to be strongly positively associated with plan's funded ratios. An interpretation of this result is that investment return decisions react to reductions in returns that are associated with lower funding ratios for the plans. In this downward direction, each percentage point decrease in assumption is associated with an 8 percent decrease in the funded ratio.

Regarding investment allocations, fixed income allocations are associated with higher funded ratios (each 1 percent increase in share is associated with a 0.13 percent increase in the funded ratio), whereas increased alternate investment allocations are strongly associated with lower funded ratios (an equal increase in share being associated with a negative 0.25 percent in the funded ratio). Investment-related expenses appear negatively correlated with funding ratios, in line with concerns regarding the impact of fees in the personal finance literature.

### Market Value of Plan Assets

Moving next to columns 3 and 4, the strong association with funded ratios is again observed. One year returns are also positively associated with improvements, though their impact is relatively small – each 1 percent improvement in returns being associated with a roughly 0.05 percent improvement in assets. By contrast, payment of ARC is not associated with improvements in market value. Statistically weak evidence suggests a 1 percent increase in the paid contributions may be related to a -0.002 percent decline in market value.

Frozen or closed funds are associated with lower asset values. Lump-sum payment options are similarly associated with lower funding levels. Average benefit levels are strongly correlated with higher balances: a \$1,000 dollar increase in annual benefits is associated with about a 0.01 percent increase in market value, all else equal. Every 1 percent increase in payroll is very strongly associated with a 0.5 percent increase in market assets. Smoothing is negatively correlated with market value, with each one year increase in the applied period associated with a 1.4 percent decline in market value. Employee contributions are consistently positively but never strongly correlated with plan asset values.

Long-run investment assumptions are consistently negatively associated with market value. This result is only weakly statistically significant, however. Short-run returns do matter for market values: a 1 percentage point increase in returns is robustly associated with roughly a 0.6 increase in market values. Allocations appear meaningful seeing that as much as each percentage point increase in the proportion of fund invested in equities is correlated with a 0.2 percent increase in the size of fund. This result is statistically robust in a few specifications, but otherwise only weakly so.

Incremental increases in equity investments are positively related to market value; there is weak evidence that similar incremental emphasis on fixed income is negatively associated with performance.

Investment-related expenses are positively related to fund size, suggesting proportional compensation. The estimated elasticity suggests a 1 percent increase in expenses, which is correlated with a 0.9 percent increase in asset values. The number of members in a plan is strongly correlated with size of plan. This variable is employed mainly as a control.

#### **Change in Market Value of Plan Assets**

Only one variable is meaningfully associated with changes in market value. The constant here documents that over the period of study changes in assets were, on average, quite negative, as illustrated in figure 1 earlier.

#### **The Ratio of Benefits to Market Value**

The ratio of benefits to market value serves to measure the amount of stress on a plan; the higher this ratio, the more likely the fund is or will face problems in the future. Funded ratios move counter to the dependent variable; a 1 percent improvement in funded ratios is associated with a 0.1 percent reduction in benefit stress. Annual returns are also found to be helpful, though magnitudes are about one-third as big.

Generally, police and fire plans show less stress as do those where employers' pensions act as a substitute for social security as well (Illinois notwithstanding). These categorical findings are relatively minor in terms of impacts, however, being between 1.2 and 1.4 percentage points. Closed plans are similarly associated with a 2.3 percentage point improvement in benefit stress. Lump-sum payout options are correlated with

higher benefit stress. When coupled with the earlier result for market value (see "Market Value of Plan Assets" above) and controlling for other factors, this suggests that lump-sum options may be offered in plans with lower market values and act to relieve benefit stress. Plans offering larger benefits tend to be in better shape by this measure as well, whereas those requiring higher levels of employee contribution appear to endure higher benefit stress levels – each percentage point increase in the contribution requirement being associated with a roughly 0.1 percent reduction in benefit stress. Incremental increases in equities and fixed income are correlated with lower benefit stress, on average, by 0.03 and 0.02 percentage points respectively. Expenses do not appear to be a concern in these specifications and are associated with lower stress. Larger plans are associated with greater levels of stress, with each 1,000-unit increment in the number of employees associated with about a 0.001 percentage point increase in benefit stress.

#### **Annual Returns**

Finally, regarding annual returns, results here are consistent with those in the "Funding Ratios" section: better funded plans systematically are invested in fixed income to higher degrees consistent with lower risk – lower return strategies. Plans with higher market values tend to enjoy higher returns, consistent with evidence in the "Market Value of Plan Assets" section. Plans paying higher shares of their ARC tend to receive lower annual returns, again suggesting a tradeoff between conservative funding strategies that emphasize contributions and those that emphasize market performance.

There is weak statistical evidence that police and fire plans perform about 3 percent better than others, whereas those plans that substitute for social security perform about 2.3 percent worse. Closed plans consistently perform about 8 percent worse, in line with a conservative investment strategy.

Plans offering higher benefit levels also perform worse, each \$1,000 dollar increase in the average benefit level is associated with a 0.15-0.17 percent decline in returns. The result of payrolls is consistent with this finding as well. Increases in employee contributions also are associated with lower returns, again in line with the notion that some plans substitute between contributions and higher returns. Alternatively, however, employee contributions could be reacting to poor performance, in line with the increasing emphasis on

this source of funds over the decade. (By table 1 subtracting employer ARC funding burdens from total burden documents an increase in the employee's share.) Some states have taken on this strategy explicitly. For example, in Ohio, as a result of declines in funded ratios employees contributions to retirement savings and pension plans, will increase by 4 percentage points (from 10 percent to 14 percent of pay).

By far the most concerning result herein is for long-run investment returns. Each percentage point increase in long-term returns assumptions is associated with a 2.3-2.5 percentage point decline in realized annual returns. This suggests a lack of feedback, however, mitigating concerns somewhat. Over the period of observation, long-run investment returns have been declining.

Next, focusing on allocations, equities and alternative investments are both associated with higher returns. No other regressors appear to be significantly related to returns.

## DISCUSSION OF RESULTS

Earlier in the paper, current funding concerns were laid out. By the evidence provided in tables 1-4, it appears that some of these are well founded, but that conclusions regarding public sector pensions are not likely to be as calamitous as some have made out. Four general arguments were introduced in earlier in this paper. First, losses over the past decade were so bad that the funds have no chance to recover. Second, pensions should invest in low-risk instruments set to the discount rates of their promises that would demonstrably impact their ability to recover. Third, defined benefit pension plans constitute an inappropriate form of deferred compensation, because plan managers are not consistently ethical and workers outside of the public sector have moved away from them. Fourth, private sector taxpayers have a limited tolerance for tax increases linked to benefits with which they do not personally identify.

Beginning with the first argument regarding prospects for recovery, as for all investors the 2001-2009 period was not kind to public sector pension funds. Gains by and large failed to keep pace with the increases in obligations. Rauh (2010) employs data on 115 plans across all 50 states, a comparable sample to that employed here, and makes the argument that even if pensions could expect to earn a consistent 6 percent return each year,

many of them would fail going forward, perhaps beginning as early as 2018. Munnell et al (2011) estimate dates of 2023 for a linear 6 percent return, and 2033 at a linear 8 percent rate – the modal plan rate – though plans do appear to be reducing this assumption somewhat over time. While offering linear rates of 6, 8, or 10 percent may appear to give plan performance the benefit of the doubt, it is likely to understate near-term prospects as the recession and financial market challenges of the last two recessions lift. Figure 2 employs the Shiller and NBER data sets to offer the reader a look at historic equity market returns following recessions over the 1871-2011 periods.

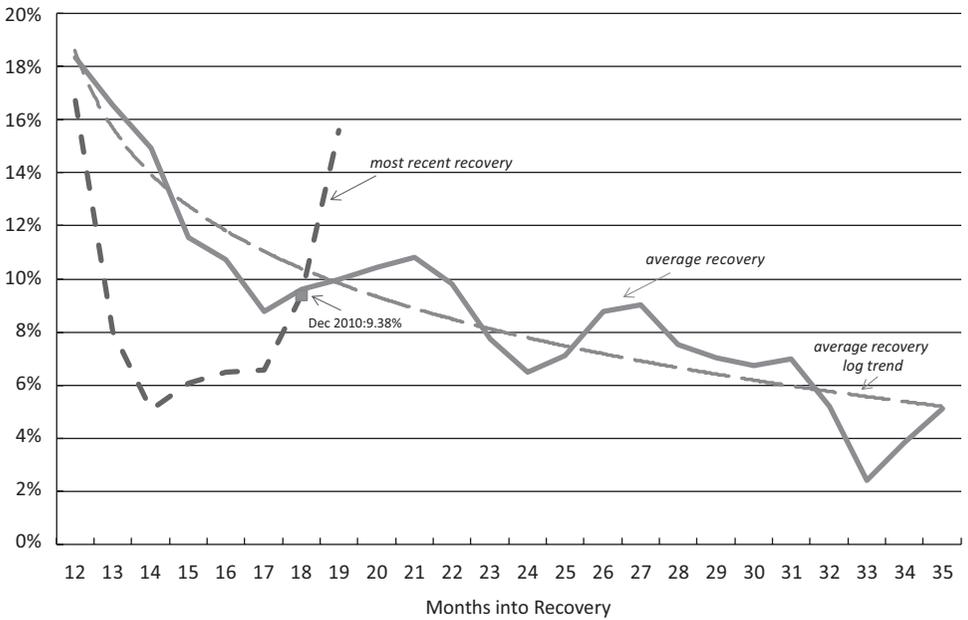
As the figure depicts, observed average annual returns for the first year following a recession are greater than 18 percent. Annual returns decline from there, but do not settle below 8 percent, on average, until close to the second year following a recession, and only dip below 6 percent just ahead of year three. Thereafter, they follow a more normal walk, bouncing about their long-term average.

Comparing this general post-recession performance to estimated returns in equities since the end of the 2007-09 recession yields a few notable differences. First, over the July 2009-December 2010 period, monthly measures of annualized returns averaged 15.4 percent. Thus, comparing the evolution of equity markets during the most recent recovery to others documents that it started slower. By the end of 2010 it appeared fairly typical, albeit with greater volatility from month to month.

Placing these impacts in dollar terms, for each \$100 dollars employing a Rauh-styled straight linear rate of 6, 8, or 10 percent yields compounded returns of roughly \$109, \$112, or \$115 dollars for the first 18 months following a recession. By comparison, employing the average return series in figure 2 yields roughly \$125 dollars, and employing data from the most recent period – July 2009-December 2010 – yields \$121 dollars. Thus, while the current equities recovery has been softer than average, returns are still a good deal greater than any of the three linear rates would generate.

Of note, however, public sector plans are not fully invested in equities. The average plan was about half invested in equities in 2009 and slightly less so in 2010, a year in which assets rebounded. Assets improved by 10.7 percent in 2010 – a very positive sign.<sup>6</sup> Figure 1 highlights that even in this case there can be a large lag between when assets begin growing and when the funded ratios of plans

**Figure 2: Average Annual U.S. Equity Market Returns Following Recessions**  
 1871-2010 Data Sources: Robert Shiller & NBER Business Cycle Dating Committee, Monthly Series.



improve. Whereas plans aggregate market values recovered between 2003 and 2007 following the decades first recession, average funding ratios improved in only one year, 2007, before continuing to decline. Much of this has to do with growth in benefit payments over this same period.

The question here is what should plans do going forward. While some of the most vulnerable plans have issued bonds that leverage fund assets in hopes of amplifying upside gains across the plans selected investment portfolio (for example Illinois, New Jersey), this tactic brings new and large risks as well as potential benefits. Clearly there is a balance between being too timid or too aggressive in smoothing contributions and allocations in any period.

This brings us to the second argument: pensions should invest in low-risk instruments set to the discount rates of their constitution promises. The evidence in this paper suggests that investing at the risk-free rate will not provide returns needed to afford future benefits. Said another way, it is not credible that the funds can honor their commitments via this strategy, whether it be based on the Novy-Marx and Rauh (2009), Brown and Wilcox (2010), or Lucas and Zeldes (2009) approaches without large increases in contributions. Evidence here sup-

ports the notion that as state finances improve states are likely to increase their contributions to plans, as a proportion of ARC. Better financed plans appear to prefer to invest more conservatively along the lines suggested by the authors just cited.

That noted, the evidence here, when coupled with portfolio theory, suggests that GASB statements 67 and 68 are well designed. Asset management should be based on relative risk and return across an estimated efficiency frontier as described by Sharpe (1964). Risk-free portfolios by and large do not lie on the efficiency frontier, and so they arguably represent a breach of fiduciary responsibility. That said, movements along the efficiency frontier are bounded to a conservative range by appealing to the same arguments of fiduciary responsibility. Once funds get into trouble their discounting reverts to the more conservative approach detailed earlier.

This brings us to the third argument regarding the idea that defined benefit pension plans are relics and/or are fundamentally flawed by design given a natural tendency towards underfunding. Private sector pensions have largely been replaced by a retirement savings plan. This is a matter of public record as described in Solis and Hall (2010). But

the main reason for its demise arguably had to do with reductions in employee tenure that made vesting less likely and the back loading of accruals less attractive, while more portable and linear vesting schedules embedded in the retirement savings plans became more attractive. The public sector and a few other employers by and large still experience longer employee tenure, and for them pensions arguably make sense. However, data analysis above does not argue against the idea that political and appointed managers of public funds are failing to fund adequately, allocate efficiently, or report negative results in a consistent way. This raises concerns regarding patterns of moral hazard in governance.

Finally this brings us to the last associated argument that taxpayers have a limited tolerance paying for benefits they themselves do not have. This is a salient point and one to bear in mind regarding the administration of pension rules and asset allocations. The fact that private workers do not hold these benefits is not merely a matter of choice. In some cases, private firms have broken promises, bankrupted pensions, and betrayed their commitment to deferred compensation contracts. Public sector pensions are by and large protected by many states' constitutions, but the value of that protection is fundamentally contingent on plan management and the willingness of leaders, employees, and taxpayers to make contributions as and when needed. In lieu of contributions or a willingness to contribute on the part of leaders and taxpayers, the discount rate on these promises is unfortunately higher than otherwise, however it may be debated.

### SUMMARY AND CONCLUSION

Public sector pensions find themselves in relatively much worse shape today than they did a decade ago. Neither the recovery of the mid-decade, nor the improvements in 2010 have been sufficient to mitigate the slide in their funded ratios. Whether the pensions can and will recover over the 2011-2020 period in ways similar to the 1991-2000 period cannot be known, but it is arguably not reasonable to expect equities portfolio share to increase by an additional 20.5 percentage points as was then the case (Peng, 2004). Indeed equities portfolio share has fallen by roughly 6.3 percentage points since 2001 (table 2). Further, the work of Novy-Marx and Rauh (2011), Brown and Wilcox (2010), and Lucas and Zeldes (2009) all suggest

that fund proportions invested in equities are not likely to rise – in at least the majority of cases.

Some pensions are increasing employee contributions as a way to bolster fund assets at current, and this may become more of a norm. Policy changes in Ohio and debates elsewhere this past year suggest as much. Allowing for deferred retirement options at less actuarially attractive rates is another policy that would improve financial prospects. While none of the specifications run with these data yielded compelling evidence of this nature to date, these sorts of changes have not been as generally implemented. Again, the most recent policy debates suggest a shift to consider delayed retirement, vesting, and general benefit calculations. Inflation protections are being limited as well. Eliminating actuarially attractive early retirement benefits, where they exist, would also be beneficial, as would moderating certain lump-sum pay out options in time-consistent ways. (In Ohio all of these strategies for change were debated and most were implemented to some extent.) Fund asset balances are likely to see improved yields in the days ahead, and so this option would appear more attractive now than otherwise. Given the aging of the workforce, there is no reasonable justification for failing to pay ARC, while compounding can do the most good for fund health. Regarding the dynamics surrounding assessment of funding, while on average the smoothing of asset balances occurs over shorter periods of time than is popularly reported in a number of places, smoothing periods have nonetheless been increasing. Longer moving averages on asset balances have dulled sensitivity to fund conditions. Use of annual returns data is therefore more important – offering a bifocal approach to measuring pension funds performance.

Similarly, increases in observed amortization periods damp annual required contributions at present, but will require a longer series of contributions moving forward. Both because current savings are the best remedy for future challenges and because a number of other fiscal and personal financial challenges face taxpayers at present, it makes sense to standardize and reverse trends in amortization policies over the past decade. Again, recent GASB policy appears headed in the right direction.

More reassuringly, plans have shown a tendency to reduce investment return assumptions, and this is prudent. In particular, this understates likely benefits of economic and financial market recovery. Further, regarding contributions there is

evidence over the past two decades that public sector plan managers use ARC as a guideline, not as a minimum or maximum. If history serves as guide, managers are likely to make greater than the annual required contribution as the economy improves.

Considering frozen and closed funds, neither of these actions offers an obvious opportunity to improve the public sector's balance sheet, largely writ. There is little evidence that these funds have fared appreciably better over the recent past. While there is some evidence that frozen plans tend to hold somewhat better funded ratios, there is no strong evidence that either frozen or closed plans hold better asset balances – in fact, the “Market Value of Plan Assets” section details lower market values for the frozen and closed plans in this sample. Finally, there is strong evidence that closed plans have substantially underperformed other plans returns. Thus, it is possible that their funding ratios will soon fall below that of open plans over the next few years. Because these funds do not gain participant contributions, the risks to taxpayers increase in this case. In short, should distressed pensions be frozen or closed it is not at all clear that their ability to pay current commitments will improve.

Following a discouraging decade, funding ratios in 2010 are not dissimilar to those of 1990, ahead of a broad and profound recovery in the decade that followed. However, some plans are at greater risk, and the environments in which the plans exist have changed in ways that should prompt caution going forward.

While the future is by no means clear, it appears that there are a number of meaningful policy reforms that, together with prudent asset management, can readily improve the ability of active public sector pension funds to honor current and future commitments. However, with equity proportions at or near top-end allocations, aging workforces, generally increasing longevity among retirees, changing private sector retirement norms, and increased fiscal pressures forecast for state and local governments over the coming years, forestalling action at this time is likely to jeopardize plans' prospects going forward.

## Notes

<sup>1</sup> In some states there has been pressure for consolidation of several small plans. This may make sense from an efficiency standpoint. Of note, however, is that

public pension plan life-cycles can differ from those of private plans. Public sector pension plans further display a great deal of segmentation by worker type, e.g. teachers vs. public safety vs. general state worker pension plans. Over time, each of these plan types may generally fare better or worse as a matter of the relative evolution of career timing, health, and safety in these professions. Thus, by the Lucas-Zeldes criteria, each plan may have somewhat different discount rates and asset allocation strategies.

<sup>2</sup> Many of the primary data were initially collected by the National Association of State Retirement Administrators (NASRA) and the National Council on Teacher Retirement (NCTR).

<sup>3</sup> Shiller's stock market data was updated January 2011.

<sup>4</sup> In many places elsewhere in the literature, the reader will find reference to 5-year smoothing, (Munnell et al., 2008b, for example), but that appears to be an evolving norm rather than a current fact.

<sup>5</sup> In results not reported here, additional regressors were employed, including the age of plan, and features related to governance. None of these are statistically relevant and none change the coefficients or statistical relevance of any results reported here. They are omitted for the sake of brevity.

<sup>6</sup> Had the funds been 100 percent invested in the S&P 500 over 2010, they would have seen returns of roughly 18.5 percent; however, their exposure to risk in this and earlier periods would have been more significant as well.

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