Rating the State Government Public Pension Plans in the US

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Abstract

The government-sponsored pension plans in the US, mostly defined benefit (DB) pension plans, are severely underfunded. In this study we examine the current state of the public pension plans, and rate them based on their actuarial funding ratio, risky asset allocation, and other multiple variables using both a simple ranking and a principal component analysis method. We aim to help public employees/retirees understand the financial health of their pension plans, and to raise the public awareness of the pension *Tsunami*.

Keywords: Public pension, Funding ratio, Asset allocation risk

JEL Codes: G18, G11, G28

1. Introduction

The 50 states across the U.S. are currently facing a big issue with their government-sponsored pension plans. These plans, mostly defined benefit (DB) pension plans, are severely underfunded; that is, their assets are not sufficient to meet future liabilities (i.e., employees' retirement payment and benefit). The total funding gap, or the difference between pension assets and liabilities, is estimated to be $843 billion as of March 2013 for 99 pension systems. (Note 1) Using a more conservative method to estimate pension liabilities, some economists (i.e., Novy-Marx and Rauh, 2010, 2011; Rauh, 2011) estimate the funding gap to be $4.4 trillion. (Note 2) As a reference point, these unfunded pension liabilities of $4.4 trillion accounts for 33% of the 2011 U.S. real gross domestic product (GDP) of $13.3 trillion (Healey, Hess, and Nicholson, 2012).

Table 1. Five states in the U.S. with the largest pension funding shortfall

Panel A: If using actuarial rate to discount future pension liabilities

State	Pension funding shortfall ($ bil.)	Shortfall as a % of total pension liabilities
California	154.2	32%
Illinois	85.4	57%
Ohio	75.3	39%
New Jersey	62.9	51%
Texas	53.7	30%

Panel B: If using a conservative estimation method, as suggested by Novy-Marx and Rauh (2009)

State	Pension funding shortfall ($ bil.)	Shortfall as a % of total pension liabilities
California	475.7	59%
Illinois	219.1	77%
Ohio	216.9	65%
Texas	188.2	60%
New York	166.4	47%

Table 1 lists top (worst) five states with the largest pension funding shortfall as of fiscal year of 2009, based on a study conducted by Novy-Marx and Rauh (2009). When using actuarial rate to discount future pension liabilities, California suffers the largest pension funding gap of $154.2 billion, followed by Illinois ($85.4 billion), Ohio ($75.3 billion), New

Jersey ($62.9 billion), and Texas ($53.7 billion). However, when using Treasury yield as a beach market to discount future pension liabilities, the funding gap for California widens to $475.7 billion. When considering funding gap as a percentage of total pension liabilities, Illinois is the worst state with an underfunding ratio of 57% (when using actuarial rate as a discount rate) or 77% (when using Treasury yield as a bench mark).

The severe underfunding of public pension plans has threatened the retirement security of a large population, as public pension plans cover pension benefits for about 12.8 million active public employees and 5.9 million retirees and other annuitants. (Note 3) Rauh (2010) estimates that at an aggregate level, the pension payment would exhaust pension assets by 2028, and that several pension plans would run out much sooner – Illinois would run out of pension assets in 2018, and New Jersey, Connecticut and Indiana follow suit during the next year.

More severely, the 50 state governments continue to face major fiscal challenges and budget deficits. The combined budget gaps were $350 billion for 2010 and 2011, making most state governments unable to make pension contributions and to narrow funding gap. Facing various fiscal constraints and budget difficulties, some states have to cut spending, withdraw from reserves, or reduce investments in public services. In fact, according to the Center on Budget and Policy Priorities (2012), the budget difficulties have led at least 30 states to raise taxes, in some cases quite substantially. For example, lawmakers of Illinois, one of the states with the largest pension funding gap (as shown in Table 1), passed a big income-tax increase in January 2011, with the individual income-tax rate jumping to 5% from 3% and the corporate tax jumping to 7% from 4.8%. Illinois lawmakers hope that the tax increase will help to close the pension funding shortfall and reduce the budget deficit (Bellandi, 2011). (Note 4) According to Novy-Marx and Rauh's (2009) calculation, if the governments elect to raise the tax to close the funding gap between $1.27 to $3.26 trillion, each household would need to contribute an additional tax payment of $21,500. The effect of underfunded pension plans therefore touches a large percentage (if not all) of the population in the country, including those at risk and the taxpayers who may be ultimately called upon to close the funding gap (Mohan and Zhang, 2014).

The primary objective of this paper is to provide the first comprehensive study on the current state of public pension plans in the US. In particular, we rate each state pension plan based on a thorough evaluation of plan financial health (from A, A-,…, to D, F). Our rating framework will consider pension funding levels, investment risks, state fiscal constraints, and workforce/retirees demographics, as well as other important factors. We aim to help public employees/retirees understand the financial health of their pension plans, and to raise the public awareness of the pension *Tsunami*.

The remainder of this paper is organized as follows. Section 2 discusses the magnitude of pension funding gap. Section 3 describes the data, variables and methodology. Section 4 shows the empirical results. Section 5 concludes.

2. The Magnitude of Pension Funding Gap

Compared to the studies on the private pension plans, the studies concerning state government public pension plans have been sparse for a fairly long time. The lack of the related studies could be due to the different orientation of issues as well the data availability (Mohan and Zhang, 2012). In particular, firms or sponsors of private pension plans, including those firms listed on the stock exchanges, are required to file financial statements and other reports (i.e., Form 5500) to their shareholders and regulatory and government agencies (i.e., the Securities Exchange Commissions, Department of Labor, Pension Benefit Guaranty Corporation, and Internal Revenue Service). But the pertinent law and regulations on public pension plans are generally nonexistent. (Note 5) Although state governments are required to make their Comprehensive Annual Financial Report (CAFR) and budget report publicly available online, the information and discussions on the public pension plans in these reports is *very* limited. Indeed, the lack of information transparency for state and local governments has become a severe concern for the general public, municipal bond investors, and lawmakers. It has been reported that one third of the governments that issued debt to the public failed to disclose their financial information from 2005 to 2007. (Note 6)

This paper is mainly related with previous studies on public pension underfunding magnitude/scope. Novy-Marx and Rauh have been active researchers in public pension plans and they have conducted a series of the studies on the size and scope of public pension obligations. Using data of the 116 largest public pension plans in 2008, Novy-Marx and Rauh (2009) estimate the total pension liabilities to be $2.97 trillion for the 50 states in 2008. For the first time, this article has cautioned the general public of the staggering magnitude of public pension shortfall. In another article, Novy-Marx and Rauh (2010) conservatively estimate "already-promised" benefits between $3.21 and $5.2 trillion, depending on the discount assumption to be used. The latest estimation of total pension liabilities by Rauh (2011) is as high as $7.03 trillion. The growth of pension obligations is largely due to continuous decrease of Treasury yields, which is used to discount future pension payments. Regarding the effect of unfunded pension liabilities on the social welfare, Novy-Marx and Rauh (2009) report that in order to close funding gap, which is between $1.27 and $3.26

trillion, each household would need to make an additional tax payment of $21,500. Furthermore, assuming that newly created pension benefit debt is funded, Rauh (2010) estimates that the existing pension payment would exhaust pension assets, in aggregate, by 2028.

Several large consulting firms and research institutions have recently focused on public pension issues as well. Using data in fiscal year 2009, the Pew Center on the States (2011) estimates the total pension liabilities to be $2.94 trillion. The Pew Center uses the actuarial assumption, rather than Treasury yields as a discount rate to estimate pension liabilities, so its estimation of pension liabilities is smaller than that made by Novy-Marx and Rauh. The total pension liabilities would jump to $4.6 trillion if the Treasury rate is used to discount the same liabilities by the Pew Center. The total size of pension liabilities for the 126 largest public plans in 2010 estimated by Wilshire (2012) is $3.23 trillion. According to Public Fund Survey (2013), the aggregate pension liabilities are $3.49 trillion and pension assets exceed $2.65 trillion, with a funding deficit of $843 billion. The severe underfunding of public pension plans has threatened the retirement security of a large population. Moreover, taxpayers may be ultimately called upon to close the funding gap, as the state governments continue to face major fiscal challenges and budget deficits.

3. Data, Variables, and Methodology

The data on public pension funds are obtained from the Public Plans Database (PPD), maintained by the Center for Retirement Research at Boston College. The sample period extends from fiscal years 2001 through 2011, covering 126 pension systems for 50 states and the District of Columbia. These pension systems together held $2.28 trillion pension assets at the end of fiscal year 2011. In addition, the public employee union membership and coverage data are obtained from the Union Membership and Coverage Database. (Note 7)

The key variables in this study are pension funding ratio and risky asset allocation. Pension funding ratio (*FUNDING_RATIO*) is defined as the ratio of pension actuarial assets over pension actuarial liabilities.

$$FUNDING\_RATIO = \frac{PENSION\ \ ACTUARIAL\ \ ASSETS}{PENSION\ \ ACTUARIAL\ \ LIABILITIES} \tag{1}$$

Risky asset allocation is the percentage of a pension plan assets invested in equity market and alternatives (i.e., private equity and venture capital). Other variables including (1) % of annual required contribution paid, (2) 1-year actual return of pension assets, (3) actuarial discount rate, (4) projected total annual required Contribution as a % of payroll, (5) total normal cost as a % of payroll, (6) inflation rate assumption, (7) active to retired employee ratio, and (8) % of unionized employees.

Table 2. Anticipated rating structure of public pension plans

Rating Classification	Cardinal Value	Letter Grade
Safe pension plans		
Highest Grade	1	A
High Grade	2, 3	A-, B+
Medium Grade	4, 5	B, B-
At-risk pension plans		
Low Grade	6, 7, 8	C+, C, C-
Poor Standing	9, 10	D, F

This table is created based on Jorion, Liu and Shi (2005). We rate all pension plans from fiscal year 2001 to 2011 using (1) actuarial funding ratio, (2) risky asset allocation, and (3) a combination of 10 variables as ranking variables. When ranking pension plans based on multivariate variables, we use a simple ranking and a principal component analysis (PCA) method. The pension plan rating structure is similar to bond credit ratings performed by S&P. The rating structure is shown inTable2. We classify all pension plans into two categories: safe pension plans and at-risk pension plans. Safe pension plans refer to those with a rating between B- to A and at-risk plans refer to those with a rating between F to C+.

4. Empirical Results

In this section we first describe summary statistics for all pension plans during the fiscal years of 2001 to 2011. We then proceed to rate all pension funds based on various criteria.

4.1 Summary Statistics

Table 3. Summary Statistics

Variable Name	Mean	MIN	Q1	Median	Q3	MAX	STD
Actuarial Funding Ratio	83.3386	19.0786	72.6153	84.2485	96.3889	147.7331	17.2269
Risky Asset Allocation %	58.9846	0.0000	54.0000	60.5000	66.0000	88.0000	11.0079
% of Annual Required Contribution Paid	92.3146	0.0000	79.5900	100.0000	100.0000	1727.7000	59.0401
1-Year Actual Return of Pension Assets	5.6359	-29.6300	-4.4750	9.3000	15.0100	36.2400	12.3640
Actuarial Rate (Pension Liab. Discount Rate)	0.0798	0.0450	0.0775	0.0800	0.0825	0.0900	0.0039
Projected Total Annual Required Contribution as a % of Payroll	19.3656	0.0000	13.5900	17.7500	24.3600	100.1100	9.0284
Total Normal Cost as a % of Payroll	12.4826	-19.2700	9.8500	11.5435	14.6400	49.7600	4.7384
Inflation Rate Assumption	0.0358	0.0050	0.0300	0.0350	0.0400	0.3000	0.0103
Active to Retired Employee Ratio	3.3255	0.0376	1.8689	2.2712	2.8239	179.7286	7.7921
% of Employees w/Collective Bargaining Contract	0.3962	0.1038	0.2297	0.3679	0.5587	0.7533	0.1766

Table 3 shows that public pension plans, on average, are underfunded during our sample period. A historical evolution of pension funding status is illustrated in Figure 1. The mean (median) actuarial funding ratio is 83.34% (84.25%), and half of the pension plans have a funding ratio is between 72.62% and 96.39%. The minimum and maximum funding ratios are 19.08% and 147.73%, with a standard deviation of 17.23%, indicating a high variability of pension funding status. Pension funds tend to invest a majority of their assets in risky assets, including equity and alternatives. Table 3 shows that 75% of the plans in the sample have allocated more than 54% of their pension funds into risky assets. The average (median) risky asset allocation is 58.98% (60.5%), with a range of 0 to 88% and a standard deviation of 11.01%. Note that about half of the pension plans did not report their actuarial assets and liabilities in 2011 when we obtain the data. In Figure 2, we provide average and median risky asset allocation for the pension funds from 2001 to 2011. The average risky asset allocation peaked in 2004 – 2006 at about 62% and then declined to 56% in 2009. Risky asset allocation is about 57% at the end of fiscal year 2011. Note that about half of the pension plans did not report their asset allocation in 2011 when we obtain the data.

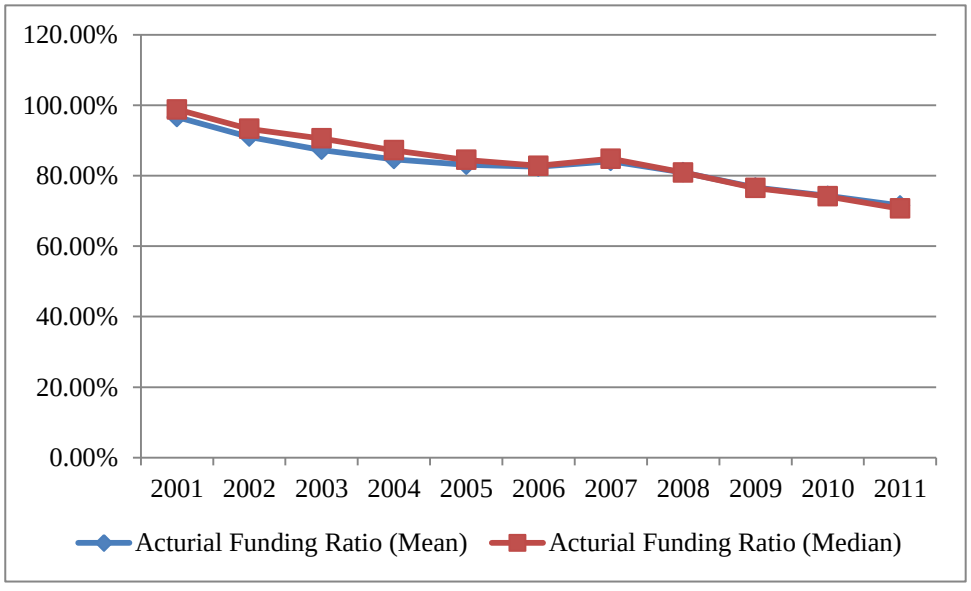

Figure 1. Average and Median Pension Actuarial Funding Ratios for US Public Funds from 2001 to 2011

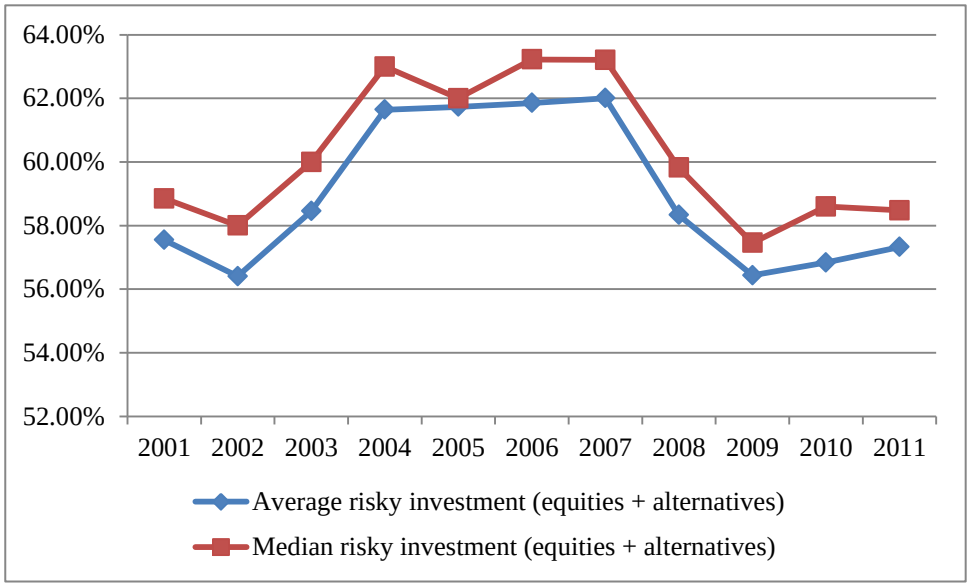

Figure 2. Average and Median Risky Asset Allocation for US Public Funds from 2001 to 2011

These two figures are created based on the authors' own calculations. And they are consistent with the figures reported by Mohan and Zhang (2012, 2014). As shown in Table 3, the mean actuarial rate is 7.98%, with a standard deviation of 0.39%. Actuarial rate is based on pension fund long-term expected investment returns. Such a relatively low variation probably indicates that plans do not often change their pension discount rate. In contrast to the actuarial rate, the actual investment returns are lower. The average 1-year investment return is 5.64%, employing that pension plans generally underperform their expectations by 2.34%. Table 3 shows there are relatively few working employees (3.33) for each retiree, an indication of an aging workforce. Finally, on average 39.62% of all public employees are unionized.

4.2 Rating Pension Plans

We use (1) actuarial funding ratio, (2) risky asset allocation percentage, and (3) a combination of 10 variables as ranking variables to rate all pension plans.

4.2.1 Ranking Pension Plans by Actuarial Funding Ratios

Table 4. Ranking Pension Plans by Actuarial Ratio

(1)	(2)	(3)	(4)	(5)
Fiscal Year	Pension Name	Actuarial Funding Ratio (%)	Ranking	Letter Rating
2010	Washington LEOFF P	126.5768	1	A
2010	New York State Tea	100	2	A
2010	NY State & Local E	100	2	A
2010	NY State & Local P	100	2	A
2010	Washington LEOFF P	100	2	A
2010	Washington PERS 2/	100	2	A
2010	Washington School	100	2	A
2010	Washington Teacher	100	2	A
2010	Wisconsin Retireme	99.83667	9	A
2010	North Carolina Loc	99.59287	10	A
2010	Maine Local	96.34939	11	A-
2010	South Dakota PERS	96.30235	12	A-
2010	Delaware State Emp	95.95045	13	A-
2010	North Carolina Tea	95.36732	14	A-
2010	Texas County & Dis	89.35037	15	A-
2010	Minnesota State Em	87.29861	16	A-
2010	Oregon PERS	86.94427	17	A-

2010	University of Cali	86.71912	18	A-
2010	Florida RS	86.59335	19	A-
2010	Texas LECOS	86.26372	20	A-
2010	Georgia Teachers	85.74881	21	A-
2010	Texas ERS	85.39764	22	B+
2010	Indiana PERF	85.18651	23	B+
2010	Washington Teacher	84.67608	24	B+
2010	Wyoming Public Emp	84.595	25	B+
2010	California PERF	83.37144	26	B+
2010	Illinois Municipal	83.25362	27	B+
2010	Texas Teachers	82.93626	28	B+
2010	Texas Municipal	82.93338	29	B+
2010	Nebraska Schools	82.42578	30	B+
2010	Utah Noncontributo	82.235	31	B+
2010	Iowa PERS	81.3704	32	B
2010	Vermont State Empl	81.15081	33	B
2010	Missouri Local	81.04596	34	B
2010	Massachusetts SERS	80.95523	35	B
2010	Missouri State Emp	80.41462	36	B
2010	Georgia ERS	80.06082	37	B
2010	Missouri PEERS	79.05542	38	B
2010	Idaho PERS	79.03002	39	B
2010	New Mexico PERF	78.47799	40	B
2010	Minnesota Teachers	78.45047	41	B
2010	Missouri Teachers	77.70221	42	B
2010	New Jersey Police	77.05897	43	B-
2010	Arizona SRS	76.4339	44	B-
2010	Minnesota PERF	76.40432	45	B-
2010	Ohio PERS	76.10072	46	B-
2010	Pennsylvania State	75.15123	47	B-
2010	Pennsylvania Schoo	75.0668	48	B-
2010	West Virginia PERS	74.62891	49	B-
2010	Michigan Municipal	74.54393	50	B-
2010	South Carolina Pol	74.48164	51	B-
2010	Montana PERS	74.20878	52	B-
2010	Washington PERS 1	74.11809	53	B-
2010	Arkansas PERS	74.05531	54	C+
2010	Arkansas Teachers	73.76547	55	C+
2010	Rhode Island Munic	73.55031	56	C+
2010	North Dakota PERS	73.43476	57	C+
2010	Colorado Municipal	73.04948	58	C+
2010	Ohio School Employ	72.61528	59	C+
2010	Michigan SERS	72.5573	60	C+
2010	Virginia Retiremen	72.42895	61	C+
2010	California Teacher	71.46219	62	C+
2010	Nevada Regular Emp	71.21079	63	C+
2010	Alabama Teachers	71.14176	64	C
2010	Michigan Public Sc	71.05881	65	C
2010	North Dakota Teach	69.84622	66	C

2010	New Jersey PERS	69.49479	67	C
2010	Ohio Police & Fire	69.42738	68	C
2010	Alabama ERS	68.18293	69	C
2010	Nevada Police Offi	67.81105	70	C
2010	Arizona Public Saf	67.73081	71	C
2010	New Jersey Teacher	67.14388	72	C
2010	Vermont Teachers	66.45811	73	C
2010	Massachusetts Teac	66.25765	74	C
2010	Maine State and Te	66.02651	75	C-
2010	Oklahoma PERS	65.97383	76	C-
2010	New Mexico Teacher	65.70732	77	C-
2010	Kentucky County	65.54854	78	C-
2010	South Carolina RS	65.50862	79	C-
2010	Montana Teachers	65.43765	80	C-
2010	Maryland Teachers	65.41274	81	C-
2010	Colorado School	64.84332	82	C-
2010	Mississippi PERS	64.15106	83	C-
2010	Colorado State	62.84061	84	C-
2010	Maryland PERS	62.79893	85	D
2010	Alaska PERS	62.37984	86	D
2010	Kansas PERS	62.18446	87	D
2010	Connecticut Teache	61.41582	88	D
2010	Hawaii ERS	61.38165	89	D
2010	Kentucky Teachers	61.00533	90	D
2010	Ohio Teachers	59.06447	91	D
2010	New Hampshire Reti	58.45296	92	D
2010	Louisiana SERS	57.65642	93	D
2010	Louisiana Teachers	54.3551	94	D
2010	Alaska Teachers	54.26799	95	D
2010	Illinois Teachers	48.43776	96	F
2010	Rhode Island ERS	48.3819	97	F
2010	Oklahoma Teachers	47.87994	98	F
2010	West Virginia Teac	46.53408	99	F
2010	Illinois Universit	46.36934	100	F
2010	Connecticut SERS	44.40732	101	F
2010	Indiana Teachers	44.25355	102	F
2010	Missouri DOT and H	42.2185	103	F
2010	Kentucky ERS	40.30588	104	F
2010	Illinois SERS	37.39932	105	F
2011	NY State & Local E	100	1	A
2011	NY State & Local P	100	1	A
2011	South Dakota PERS	96.38537	3	A
2011	Delaware State Emp	93.95691	4	A
2011	Maine Local	93.46841	5	A
2011	TN State and Teach	92.08305	6	A
2011	Idaho PERS	90.24934	7	A-
2011	TN Political Subdi	89.14514	8	A-
2011	Florida RS	86.92971	9	A-
2011	Texas LECOS	86.42691	10	A-

2011	Minnesota State Em	86.39723	11	A-
2011	Missouri Teachers	85.46991	12	A-
2011	Missouri PEERS	85.33277	13	A-
2011	Texas ERS	84.50336	14	B+
2011	Texas Teachers	82.72835	15	B+
2011	University of Cali	82.49314	16	B+
2011	Wyoming Public Emp	81.86826	17	B+
2011	Missouri Local	81.55346	18	B+
2011	Oklahoma PERS	80.67011	19	B+
2011	Indiana PERF	80.46984	20	B+
2011	Nebraska Schools	80.39494	21	B
2011	Maine State and Te	80.23863	22	B
2011	Iowa PERS	79.89258	23	B
2011	Vermont State Empl	79.55891	24	B
2011	Missouri State Emp	79.24578	25	B
2011	West Virginia PERS	78.37662	26	B
2011	Minnesota Teachers	77.27212	27	B-
2011	Georgia ERS	76.04988	28	B-
2011	Arizona SRS	75.52833	29	B-
2011	Minnesota PERF	75.17664	30	B-
2011	New Jersey Police	74.88585	31	B-
2011	Arkansas Teachers	71.81238	32	B-
2011	Arkansas PERS	70.68787	33	B-
2011	Nevada Regular Emp	70.62969	34	C+
2011	North Dakota PERS	70.53766	35	C+
2011	New Mexico PERF	70.45609	36	C+
2011	Montana PERS	70.24728	37	C+
2011	Virginia Retiremen	69.90645	38	C+
2011	Pennsylvania Schoo	69.05753	39	C+
2011	Nevada Police Offi	68.41859	40	C+
2011	New Jersey PERS	66.77933	41	C
2011	Maryland Teachers	66.29916	42	C
2011	North Dakota Teach	66.28237	43	C
2011	Ohio School Employ	65.21357	44	C
2011	Vermont Teachers	63.75736	45	C
2011	Arizona Public Saf	63.73059	46	C
2011	New Jersey Teacher	63.17063	47	C-
2011	New Mexico Teacher	63.04935	48	C-
2011	Kentucky County	62.91141	49	C-
2011	Maryland PERS	62.8113	50	C-
2011	Mississippi PERS	62.21252	51	C-
2011	Montana Teachers	61.53136	52	C-
2011	Hawaii ERS	59.42608	53	C-
2011	Ohio Teachers	58.83642	54	D
2011	Louisiana SERS	57.57223	55	D
2011	New Hampshire Reti	57.4152	56	D
2011	Kentucky Teachers	57.40812	57	D
2011	Oklahoma Teachers	56.72065	58	D
2011	Louisiana Teachers	55.13728	59	D

2011	West Virginia Teac	53.72774	60	D
2011	Illinois Teachers	46.45741	61	F
2011	Illinois Universit	44.25186	62	F
2011	Indiana Teachers	43.77038	63	F
2011	Missouri DOT and H	43.28285	64	F
2011	Kentucky ERS	35.60094	65	F
2011	Illinois SERS	35.54653	66	F

A snap shot of the complete rank of all pension plans from fiscal year 2001 to 2011, Table 4 shows the ranking and rating for pension plans in 2010 and 2011 only. Actuarial funding ratio in column (3) is calculated as in Eq. (1). "Ranking" in column (4) is a simple rank (descending) of actuarial funding ratio. In column (5) We assign each pension plan a letter rating based on rating structure denoted in Table 2, with A denoting the healthiest pension plans and F the worst plans.

Six pension plans have the highest A ratings in fiscal year 2011: (1) NY State & Local Employee, (2) NY State & Local Police and Firefighters, (3) South Dakota PERS, (4) Delaware State Employees, (5) Maine Local Employees, and (6) TN State and Teachers. Six pension plans have the lowest F ratings in fiscal year 2011: (1) Illinois Teachers, (2) Illinois Universities, (3) Indiana Teachers, (4) Missouri DOT and Highway, (5) Kentucky ERS, and (6) Illinois SERS.

4.2.2 Ranking Pension Plans by Risky Asset Allocation (Equities + Alternatives)

Table 5. Ranking Pension Plans by Risky Asset Allocation

Fiscal Year	Pension Name	Risky Asset Allocation (%)	Ranking	Letter Rating
2010	Nebraska Schools	26.3814	1	A
2010	Texas Municipal	33.1	2	A
2010	Washington LEOFF P	34.71	6	A
2010	Washington Teacher	34.71	6	A
2010	Washington LEOFF P	34.71	6	A
2010	Washington PERS 2/	34.71	6	A
2010	Washington School	34.71	6	A
2010	Washington Teacher	34.71	6	A
2010	Washington PERS 1	34.71	6	A
2010	Vermont State Empl	37	10.5	A
2010	Vermont Teachers	37	10.5	A
2010	Oregon PERS	37.4	12	A-
2010	Iowa PERS	38.67	13	A-
2010	Arizona Public Saf	40.95	14	A-
2010	Missouri DOT and H	41.6	15	A-
2010	Utah Noncontributo	44.6	16	A-
2010	TN Political Subdi	46	17.5	A-
2010	TN State and Teach	46	17.5	A-
2010	Indiana Teachers	47.6	19	A-
2010	Virginia Retiremen	48	20	A-
2010	Pennsylvania Schoo	48.8	21	A-
2010	North Dakota PERS	49.8	22	B+
2010	Montana Teachers	51	23	B+
2010	Illinois Teachers	51.8	24	B+
2010	South Dakota PERS	52.2	25	B+
2010	Wisconsin Retireme	52.23692	26	B+
2010	Kansas PERS	52.38	27	B+
2010	Massachusetts SERS	52.51	28.5	B+
2010	Massachusetts Teac	52.51	28.5	B+
2010	South Carolina RS	53.05	30	B+
2010	South Carolina Pol	53.22	31	B+

2010	Nevada Regular Emp	53.8	32.5	B
2010	Nevada Police Offi	53.8	32.5	B
2010	University of Cali	54.5	34	B
2010	Connecticut Teache	54.6	35	B
2010	Ohio School Employ	55	36	B
2010	Alaska PERS	55.03	37	B
2010	Alaska Teachers	55.13	38	B
2010	North Carolina Tea	55.4	39.5	B
2010	North Carolina Loc	55.4	39.5	B
2010	Idaho PERS	55.9	42	B
2010	Missouri PEERS	55.9	42	B
2010	Missouri Teachers	55.9	42	B
2010	Texas Teachers	55.9	44	B-
2010	Hawaii ERS	56.2	45.5	B-
2010	New York State Tea	56.2	45.5	B-
2010	Florida RS	56.6	47	B-
2010	Missouri State Emp	56.7	48	B-
2010	Ohio PERS	56.95	49	B-
2010	NY State & Local E	57.8	50.5	B-
2010	NY State & Local P	57.8	50.5	B-
2010	New Jersey PERS	58.4	52	B-
2010	Maine State and Te	58.6	53.5	C+
2010	Maine Local	58.6	53.5	C+
2010	Alabama ERS	58.64	55	C+
2010	New Mexico Teacher	59	56	C+
2010	California PERF	59.21	57	C+
2010	Ohio Teachers	59.47	58	C+
2010	Alabama Teachers	59.7	59.5	C+
2010	Kentucky Teachers	59.7	59.5	C+
2010	Illinois SERS	59.72	61	C+
2010	New Jersey Teacher	60.2	62	C+
2010	Arkansas Teachers	60.3	63	C+
2010	Rhode Island Munic	60.6	64.5	C
2010	Rhode Island ERS	60.6	64.5	C
2010	Oklahoma Teachers	60.75	66	C
2010	North Dakota Teach	61	67	C
2010	Oklahoma PERS	61.1	68	C
2010	New Jersey Police	61.5	69	C
2010	Georgia Teachers	61.9	70	C
2010	Texas LECOS	63.19	71.5	C
2010	Texas ERS	63.19	71.5	C
2010	Montana PERS	63.49	73	C
2010	Ohio Police & Fire	63.88	74	C
2010	New Hampshire Reti	64.1	75	C-
2010	Georgia ERS	64.2	76.5	C-
2010	Indiana PERF	64.2	76.5	C-
2010	Arkansas PERS	64.8	78	C-
2010	Arizona SRS	65.29	79	C-
2010	Kentucky ERS	65.4	80.5	C-
2010	Kentucky County	65.4	80.5	C-

2010	Illinois Municipal	65.7	82	C-
2010	Maryland PERS	65.9	83.5	C-
2010	Maryland Teachers	65.9	83.5	C-
2010	Illinois Universit	66.3	85	D
2010	California Teacher	66.34	86	D
2010	Texas County & Dis	66.8	87	D
2010	Colorado State	67	89	D
2010	Colorado School	67	89	D
2010	Colorado Municipal	67	89	D
2010	Missouri Local	67.61171	91	D
2010	Wyoming Public Emp	67.62	92	D
2010	West Virginia Teac	68.02591	93	D
2010	Pennsylvania State	68.8	94	D
2010	West Virginia PERS	68.95282	95	D
2010	Mississippi PERS	69.3	96	F
2010	Delaware State Emp	70.2	97	F
2010	Louisiana Teachers	72.898	98	F
2010	Michigan SERS	72.9	99	F
2010	Minnesota PERF	73.1	100	F
2010	Minnesota Teachers	73.15422	101	F
2010	Minnesota State Em	73.24363	102	F
2010	Louisiana SERS	73.4	103	F
2010	Michigan Public Sc	73.9	104	F
2010	New Mexico PERF	79.6	105	F
2011	Nebraska Schools	21.7827	1	A
2011	Missouri DOT and H	31.5	2	A
2011	Arizona Public Saf	35.9	3	A
2011	Washington LEOFF 1	36.83	7	A
2011	Washington LEOFF 2	36.83	7	A
2011	Washington PERS 1	36.83	7	A
2011	Washington PERS 2	36.83	7	A
2011	Washington School	36.83	7	A
2011	Washington Teacher 1	36.83	7	A
2011	Washington Teacher 2	36.83	7	A
2011	Vermont Teachers	37	11.5	A-
2011	Vermont State Empl	37	11.5	A-
2011	Iowa PERS	42.48	13	A-
2011	Pennsylvania Schoo	47.4	14	A-
2011	Virginia Retiremen	48	15	A-
2011	Ohio School Employ	50.9	16	A-
2011	South Dakota PERS	51.1	17	B+
2011	Illinois Teachers	51.2	18	B+
2011	TN Political Subdi	52	19.5	B+
2011	TN State and Teach	52	19.5	B+
2011	Indiana Teachers	53.3	21	B+
2011	University of Cali	53.97	22	B+
2011	Texas Teachers	54.7	23	B+
2011	Montana Teachers	55	24.5	B+
2011	New Mexico PERF	55	24.5	B+
2011	Wisconsin Retireme	55.03444	26	B

2011	North Dakota PERS	55.2	27	B
2011	Massachusetts SERS	55.4	28.5	B
2011	Massachusetts Teac	55.4	28.5	B
2011	Missouri State Emp	55.7	30	B
2011	Alabama ERS	56	31	B
2011	North Carolina Loc	56.6	32.5	B
2011	North Carolina Tea	56.6	32.5	B
2011	Kentucky ERS	57	34.5	B-
2011	Kentucky County	57	34.5	B-
2011	NY State & Local E	57.3	36.5	B-
2011	NY State & Local P	57.3	36.5	B-
2011	Alabama Teachers	57.42	38	B-
2011	New Mexico Teacher	58	39	B-
2011	Alaska PERS	58.25	40	B-
2011	Alaska Teachers	58.46	41	B-
2011	New York State Tea	58.5	42	C+
2011	Nevada Police Offi	59	43.5	C+
2011	Nevada Regular Emp	59	43.5	C+
2011	Idaho PERS	59.4	45	C+
2011	Oklahoma Teachers	60	46	C+
2011	Kansas PERS	60.65	47	C+
2011	Maryland Teachers	61.8	48.5	C+
2011	Maryland PERS	61.8	48.5	C+
2011	Maine Local	62.3	50.5	C
2011	Maine State and Te	62.3	50.5	C
2011	Missouri Teachers	62.5	52.5	C
2011	Missouri PEERS	62.5	52.5	C
2011	South Carolina Pol	62.69	54	C
2011	South Carolina RS	62.83	55	C
2011	California PERF	63.13	56	C
2011	Arizona SRS	63.29	57	C
2011	Florida RS	63.4	58	C
2011	Kentucky Teachers	63.5	59	C-
2011	Ohio Teachers	63.66	60	C-
2011	Hawaii ERS	64.4	61	C-
2011	Texas ERS	64.63	62.5	C-
2011	Texas LECOS	64.63	62.5	C-
2011	North Dakota Teach	65	64	C-
2011	New Hampshire Reti	66.6	65	C-
2011	Oklahoma PERS	67	66	C-
2011	West Virginia Teac	67.10659	67	D
2011	Montana PERS	67.33	68	D
2011	California Teacher	67.8	69	D
2011	Indiana PERF	68.5	70	D
2011	Michigan SERS	69.2	71	D
2011	West Virginia PERS	69.2606	72	D
2011	Michigan Public Sc	69.9	73	D
2011	Louisiana SERS	70	74	D
2011	Mississippi PERS	71	75	F
2011	Georgia Teachers	72.3	76	F

2011	Delaware State Emp	72.6	77	F
2011	Georgia ERS	73.8	78	F
2011	Louisiana Teachers	74.343	79	F
2011	Minnesota Teachers	75.19407	80	F
2011	Minnesota PERF	75.4	81	F
2011	Missouri Local	77.58282	82	F

Table 5 shows the ranking and rating for pension plans in fiscal year 2010 and 2011 based on the risky asset allocation percentage. "Ranking" in column (4) is a simple rank (ascending) of risky asset allocation. In column (5) we assign each pension plan a letter rating based on rating structure denoted in Table 2, with A denoting the safest pension plans and F the riskiest plans.

Pension plans have the highest A ratings (or safest pension plans) in fiscal year 2011 are as follows: (1) Nebraska Schools, (2) Missouri DOT and Highway, (3) Arizona Public Safety, and (4) several Washington state pension plans. The following pension plans are rated as "riskiest": (1) Mississippi PERS, (2) Georgia Teachers, (3) Delaware State Employees, (4) Georgia ERS, (5) Louisiana Teachers, (6) Minnesota Teachers, (7) Minnesota PERF, and (8) Missouri Local Employees.

4.2.3 Ranking Pension Plans by a Combination of Variables

We now use a combination of 10 variables to rate pension plans, including (1) Actuarial Funding Ratio, (2) Risky Asset Allocation %, (3) % of Annual Required Contribution Paid, (4) 1-Year Actual Return of Pension Assets, (5) Actuarial rate (Pension Liab. Discount Rate), (6) Projected Total Annual Required Contribution as a % of Payroll, (7) Total Normal Cost as a % of Payroll, (8) Inflation Rate Assumption, (9) Active to Retired Employee Ratio, and (10) % of Unionized Employees. We here use both a simple ranking and a PCA method.

A. A Simple Ranking Method

With a simple ranking method, We rank each of the 10 variables (mentioned in the above section) into 10 groups from the best to the worst, and then We sum all the ranks for these 10 variables –this is called "Aggregate Rank", which ranges from 1 to 100 (10 variables × 10 ranks = 100). We sort this "Aggregate Rank" into 10 groups and assign the letter rating (as shown in the rating structure of Table 2), with A denoting the best pension plans and F the worst plans.

Table 6. Ranking Pension Plans based on Multivariable Variables: A Simple Ranking Method

Fiscal Year	Pension Name	Aggregate Rank	Letter Rating
2010	Georgia Teachers	70	A
2010	Indiana Teachers	70	A
2010	Iowa PERS	70	A
2010	North Carolina Tea	74	A
2010	Oregon PERS	74	A
2010	Virginia Retiremen	74	A
2010	Texas Teachers	75	A
2010	Missouri PEERS	66	A-
2010	Missouri State Emp	66	A-
2010	Texas LECOS	66	A-
2010	Nebraska Schools	67	A-
2010	Washington PERS 2/	67	A-
2010	Washington School	67	A-
2010	South Carolina Pol	68	A-
2010	South Carolina RS	68	A-
2010	Alabama ERS	55	B
2010	Arizona SRS	57	B
2010	New Mexico Teacher	57	B
2010	Wyoming Public Emp	57	B
2010	Minnesota PERF	59	B
2010	Arkansas Teachers	60	B

2010	Mississippi PERS	60	B
2010	North Dakota PERS	60	B
2010	Arizona Public Saf	52	B-
2010	Arkansas PERS	52	B-
2010	Ohio School Employ	52	B-
2010	Oklahoma PERS	52	B-
2010	Montana Teachers	53	B-
2010	West Virginia Teac	53	B-
2010	Illinois Municipal	54	B-
2010	North Dakota Teach	54	B-
2010	Oklahoma Teachers	54	B-
2010	Rhode Island Munic	54	B-
2010	Delaware State Emp	62	B+
2010	Kansas PERS	62	B+
2010	Kentucky County	62	B+
2010	West Virginia PERS	62	B+
2010	Colorado Municipal	63	B+
2010	Idaho PERS	63	B+
2010	Washington LEOFF P	65	B+
2010	Washington Teacher	65	B+
2010	Louisiana SERS	47	C
2010	New Mexico PERF	47	C
2010	Rhode Island ERS	47	C
2010	Colorado School	48	C
2010	Pennsylvania Schoo	48	C
2010	Texas ERS	48	C
2010	Missouri Teachers	49	C
2010	Nevada Regular Emp	49	C
2010	Washington PERS 1	49	C
2010	Washington Teacher	49	C
2010	Colorado State	44	C-
2010	Kentucky Teachers	44	C-
2010	Maryland PERS	44	C-
2010	Minnesota Teachers	44	C-
2010	Illinois Universit	45	C-
2010	Kentucky ERS	45	C-
2010	New Hampshire Reti	46	C-
2010	Alabama Teachers	50	C+
2010	New Jersey PERS	50	C+
2010	Hawaii ERS	51	C+
2010	Maryland Teachers	51	C+
2010	Montana PERS	51	C+
2010	Ohio PERS	51	C+
2010	California Teacher	40	D
2010	Connecticut Teache	40	D
2010	Alaska PERS	41	D
2010	Ohio Teachers	42	D
2010	Pennsylvania State	42	D
2010	Nevada Police Offi	43	D

2010	New Jersey Teacher	43	D
2010	Ohio Police & Fire	43	D
2010	Illinois SERS	31	F
2010	Illinois Teachers	35	F
2010	Alaska Teachers	36	F
2010	New Jersey Police	36	F
2010	Louisiana Teachers	38	F
2010	Michigan Public Sc	39	F
2010	Michigan SERS	39	F
2011	Texas Teachers	69	A
2011	Virginia Retiremen	70	A
2011	Missouri PEERS	74	A
2011	New Mexico PERF	66	A-
2011	Delaware State Emp	68	A-
2011	Arizona SRS	61	B
2011	Indiana Teachers	61	B
2011	Iowa PERS	62	B
2011	Missouri State Emp	62	B
2011	Montana Teachers	58	B-
2011	Nebraska Schools	58	B-
2011	Ohio School Employ	59	B-
2011	Idaho PERS	63	B+
2011	Kentucky County	63	B+
2011	Minnesota PERF	63	B+
2011	North Dakota PERS	63	B+
2011	Texas LECOS	63	B+
2011	Arizona Public Saf	52	C
2011	Oklahoma Teachers	52	C
2011	New Mexico Teacher	53	C
2011	Louisiana SERS	47	C-
2011	Maryland Teachers	47	C-
2011	Kentucky Teachers	50	C-
2011	Montana PERS	51	C-
2011	Missouri Teachers	54	C+
2011	North Dakota Teach	54	C+
2011	Mississippi PERS	55	C+
2011	Oklahoma PERS	56	C+
2011	Pennsylvania Schoo	45	D
2011	Louisiana Teachers	46	D
2011	Texas ERS	46	D
2011	Kentucky ERS	39	F
2011	Illinois Teachers	41	F
2011	Minnesota Teachers	44	F

Table 6 shows the "Aggregate Rank" and rating for pension plans in fiscal year 2010 and 2011 based on these 10 variables. Five pension plans have the highest A or A- ratings in fiscal year 2011: (1) Texas Teachers, (2) Virginia Retirement, (3) Missouri PEERS, (4) New Mexico PERF, and (5) Delaware State Employees. Five pension plans have the lowest F or D ratings in fiscal year 2011: (1) Pennsylvania School, (2) Louisiana Teachers, (3) Texas ERS, (4) Kentucky ERS, and (5) Illinois Teachers.This rating framework is more comprehensive and accurate than previous method which only uses one single rating variable. It paints a colorful picture of the US public pension funds status.

The rationale is that pension plans have a number of important dimensions while only using pension actuarial ratio or risky asset allocation to rank them might not be an optimal way.

B. PCA Method

Table 7. The Result of PCA Method

Panel A: Eigenvalues of the Covariance Matrix

	Eigenvalue	Difference	Proportion	Cumulative
1	1038.5950	734.3147	0.6260	0.6260
2	304.2803	135.3629	0.1834	0.8094
3	168.9174	86.6442	0.1018	0.9113
4	82.2732	27.6112	0.0496	0.9608
5	54.6620	46.1511	0.0329	0.9938
6	8.5110	6.7456	0.0051	0.9989
7	1.7653	1.7397	0.0011	1.0000
8	0.0256	0.0256	0.0000	1.0000
9	0.0000	0.0000	0.0000	1.0000
10	0.0000		0.0000	1.0000

Panel B: Eigenvectors

	Prin1	Prin2	Prin3	Prin4	Prin5
fundingratio	0.1393	0.9012	0.1470	0.0371	0.3646
bargain_cov_pct	-0.0009	0.0000	-0.0007	0.0031	0.0033
percentarc	0.9866	-0.1586	0.0390	-0.0016	0.0008
inflationassump	0.0000	0.0001	0.0000	0.0001	-0.0001
invreturnassump	0.0000	0.0000	0.0000	0.0001	0.0001
totarc	-0.0555	-0.3663	-0.0604	0.0553	0.8147
totnc	-0.0138	-0.0684	-0.0173	0.0159	0.4460
riskyinv	-0.0195	-0.0574	0.2989	0.9499	-0.0616
ret_1yr	-0.0602	-0.1407	0.9400	-0.3041	0.0231
actives_retirees	0.0039	0.0287	-0.0066	-0.0218	0.0069

Panel C: Eigenvectors

	Prin6	Prin7	Prin8	Prin9	Prin10
fundingratio	-0.1077	-0.0317	-0.0015	0.0000	0.0000
bargain_cov_pct	0.0008	-0.0145	0.9999	0.0010	-0.0069
percentarc	0.0035	0.0011	0.0009	0.0000	0.0000
inflationassump	0.0003	0.0005	-0.0017	0.9943	-0.1070
invreturnassump	0.0001	0.0003	0.0068	0.1070	0.9942
totarc	-0.4383	-0.0124	-0.0028	0.0002	0.0000
totnc	0.8912	0.0365	-0.0018	-0.0003	-0.0001
riskyinv	0.0140	0.0255	-0.0021	-0.0001	-0.0001
ret_1yr	0.0002	0.0036	0.0015	0.0000	0.0000
actives_retirees	-0.0418	0.9983	0.0145	-0.0005	-0.0003

Table 7 shows the result of PCA method. It shows the first principal component explains 62.60% of total variance and the first 7 principal components (each with an Eigenvalue > 1) explain all variance. As the first principal component explains a fairly large proportion of total variance, we use the first principal component in my analysis.

Table 8. Ranking Pension Plans based on Multivariable Variables: PCA Method

Fiscal Year	Pension Name	Letter Rating
2010	Arizona Public Saf	A
2010	Arkansas Teachers	A
2010	Delaware State Emp	A
2010	Idaho PERS	A
2010	Kentucky County	A
2010	North Carolina Tea	A
2010	Oregon PERS	A
2010	Washington LEOFF P	A
2010	Arizona SRS	A-
2010	Arkansas PERS	A-
2010	Colorado Municipal	A-
2010	Georgia Teachers	A-
2010	Hawaii ERS	A-
2010	Missouri State Emp	A-
2010	Nebraska Schools	A-
2010	South Carolina Pol	A-
2010	Illinois Municipal	B
2010	Iowa PERS	B
2010	Maryland Teachers	B
2010	Missouri PEERS	B
2010	Montana Teachers	B
2010	Nevada Regular Emp	B
2010	New Hampshire Reti	B
2010	Rhode Island ERS	B
2010	Illinois SERS	B-
2010	Indiana Teachers	B-
2010	Michigan SERS	B-
2010	Nevada Police Offi	B-
2010	New Mexico PERF	B-
2010	Texas Teachers	B-
2010	Washington PERS 2/	B-
2010	West Virginia PERS	B-
2010	Alabama ERS	B+
2010	Alabama Teachers	B+
2010	Connecticut Teache	B+
2010	Mississippi PERS	B+
2010	Ohio PERS	B+
2010	Ohio School Employ	B+
2010	Rhode Island Munic	B+
2010	South Carolina RS	B+
2010	Alaska Teachers	C
2010	Louisiana Teachers	C
2010	Minnesota PERF	C
2010	North Dakota Teach	C
2010	Oklahoma Teachers	C
2010	Washington School	C
2010	Washington Teacher	C
2010	Wyoming Public Emp	C

2010	Colorado School	C-
2010	Kansas PERS	C-
2010	Kentucky Teachers	C-
2010	Maryland PERS	C-
2010	New Jersey Police	C-
2010	Oklahoma PERS	C-
2010	Texas ERS	C-
2010	Virginia Retiremen	C-
2010	Alaska PERS	C+
2010	Illinois Teachers	C+
2010	Louisiana SERS	C+
2010	Michigan Public Sc	C+
2010	Missouri Teachers	C+
2010	New Mexico Teacher	C+
2010	Texas LECOS	C+
2010	West Virginia Teac	C+
2010	California Teacher	D
2010	Colorado State	D
2010	Illinois Universit	D
2010	Minnesota Teachers	D
2010	Montana PERS	D
2010	North Dakota PERS	D
2010	Ohio Teachers	D
2010	Ohio Police & Fire	D
2010	Kentucky ERS	F
2010	New Jersey PERS	F
2010	New Jersey Teacher	F
2010	Pennsylvania State	F
2010	Pennsylvania Schoo	F
2010	Washington Teacher	F
2010	Washington PERS 1	F
2011	Kentucky Teachers	A
2011	Kentucky County	A
2011	Minnesota PERF	A
2011	Arizona Public Saf	A-
2011	Delaware State Emp	A-
2011	Missouri PEERS	A-
2011	Missouri State Emp	A-
2011	Missouri Teachers	B
2011	Montana Teachers	B
2011	Nebraska Schools	B
2011	New Mexico PERF	B
2011	Idaho PERS	B-
2011	Louisiana Teachers	B-
2011	Texas Teachers	B-
2011	Arizona SRS	B+
2011	Mississippi PERS	B+
2011	Ohio School Employ	B+
2011	Illinois Teachers	C
2011	Maryland Teachers	C

2011	Oklahoma Teachers	C
2011	Minnesota Teachers	C-
2011	North Dakota Teach	C-
2011	Oklahoma PERS	C-
2011	Texas LECOS	C-
2011	Indiana Teachers	C+
2011	Iowa PERS	C+
2011	Louisiana SERS	C+
2011	New Mexico Teacher	C+
2011	Kentucky ERS	D
2011	Montana PERS	D
2011	Texas ERS	D
2011	North Dakota PERS	F
2011	Pennsylvania Schoo	F
2011	Virginia Retiremen	F

Table8 shows the letter ranking of all pension plans (during 2010 and 2011) using PCA method. Seven pension plans have the highest A or A- ratings in fiscal year 2011: (1) Kentucky Teachers, (2) Kentucky County, (3) Minnesota PERF, (4) Arizona Public Safety, (5) Delaware State Employee, (6) Missouri PEERS, and (7) Missouri State Employee. Six pension plans have the lowest F or D ratings in fiscal year 2011: (1) Kentucky ERS, (2) Montana PERS, (3) Texas ERS, (4) North Dakota PERS, (5) Pennsylvania School, and (6) Virginia Retirement. The rating results are consistent with previous results.

5. Conclusions

The 50 states across the US are currently facing a big issue with their government-sponsored pension plans. As the first comprehensive study on the current state of public pension plans, this study has important impact on the American people's retirement security. It provides the first rating of all the government pension plans after incorporating a number of important dimensions, including pension funding levels, financial heath, investment risk, state fiscal constraints, and workforce/retirees demographics. We use (1) actuarial funding ratio, (2) risky asset allocation percentage, and (3) a combination of 10 variables as ranking variables to rate all pension plans. These variables include funding ratio, risky asset allocation, % of annual required contribution paid, 1-year actual return of pension assets, actuarial discount rate, projected total annual required Contribution as a % of payroll, total normal cost as a % of payroll, inflation rate assumption, active to retired employee ratio, and % of unionized employees. When considering a combination of 10 variables, we use both a simple "aggregate" ranking method and a principal component analysis method.

Our study complements previous studies on the significant issue of the US public pension funds. It has been estimated that the total pension liabilities for the 50 states to be $2.97 trillion in 2008 (Novy-Marx and Rauh, 2009) and the "already-promised" benefits between $3.21 and $5.2 trillion (Novy-Marx and Rauh, 2010). Rauh (2011) estimates that the latest total pension liabilities to be $7.03 trillion, mainly due to the decreased Treasury yields, which is used to discount future pension payments. The pension funding gap has been estimated to be between $1.27 and $3.26 trillion (Novy-Marx and Rauh, 2009). Similar findings have been reported by several large consulting firms and research institutions that have focus on public pension issues for a long time. Our studyhelps public employees/retirees to understand their pension plans, and to raise the public awareness of the pension issues.

One limitation of this study is that when we use risky asset allocation to rate pension funds, risky asset allocation is the percentage of a pension plan assets invested in equity market and alternatives (i.e., private equity and venture capital). Jin et al. (2006) propose an innovative measure of pension risk, pension asset beta, which is estimated as the weighted average beta of all asset classes in a pensionfund. Future research can use this alternative measure of pension investment risk. In addition, the effects of pension underfunding and investment risk on a state government fiscal policy, tax rate, or municipal bond yield can be other interesting research questions.

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Notes

Note 1. See the Public Fund Survey (http://www.publicfundsurvey.org/publicfundsurvey/scorecard.asp), jointly sponsored by the National Association of State Retirement Administrators and the National Council on Teacher Retirement.

Note 2. The difference of estimated pension shortfall between different methods is mainly due to the discount rate (or the denominator) used to calculate the present value of projected total future pension benefits. State governments and the Public Fund Survey use actuarial rate (based on pension asset long-term expected investment return), which is generally 8%, as a discount rate, while economists prefer to use Treasury yield, which is much less than the actuarial rate, as a discount rate. High (low) discount rate translates to low (high) pension liabilities. Also see Congressional Testimony by Joshua Rauh, Feb. 24, 2011 for the hearing on "The Role of Public Employee Pensions in Contributing to State Insolvency and the Possibility of a State Bankruptcy Chapter" (http://judiciary.house.gov/hearings/pdf/Rauh02142011.pdf).

Note 3. Source: The National Association of State Retirement Administration's Web site, http://www.nasra.org.

Note 4. As another example, a $650 million shortfall of Pittsburg's pension system dried up "funds for the sustained investments that remade Pittsburgh after the 1980s collapse of the steel industry" (Green, 2011, p1). In order to deal with this situation, Mayor Luke Ravenstahl created a 1% fair-share tax for the privilege of attending colleges in the city of Pittsburgh (Maher, 2009).

Note 5. Note that although there are no formal laws regulating state government financial information disclosure, both Securities Exchange Commissions and Government Accounting Standard Board have specific requirements on filing state government financial report.

Note 6. See "Recent trends in municipal continuing disclosure activities" (DPCDTATA, 2011) (http://www.dpcdata.com). The rate of failure to file current fiscal disclosure further rose to 40% in 2009.

Note 7. The data are available at http://www.unionstats.com and are constructed by Barry Hirsch and David Macpherson based on the Current Population Survey (CPS), a monthly household survey (Hirsch and Macpherson 2003).