



2005 Market Street, Suite 2800 215.575.9050 Phone  
Philadelphia, PA 19103-7077 215.575.4939 Fax

901 E Street NW, 10th Floor 202.552.2000 Phone  
Washington, DC 20004 202.552.2299 Fax  
[www.pewtrusts.org](http://www.pewtrusts.org)

December 13, 2018

Dear Secretary Barnes:

This letter and the attached documents provide final versions of the reports we submitted to your office on November 16<sup>th</sup>, and reflect the new requirement for pension stress testing as outlined in Connecticut Senate Bill 1502 and adopted in the 2018-2019 Budget and Appropriations Act.

Please find two documents attached:

- **Proposed Legislative Stress Test Report for Connecticut Public Pensions** – this document provides detailed specifications and supporting financial projections designed to meet the core reporting requirements of SB 1502. It is intended to provide a blueprint for compliance with SB 1502 and to inform analysis of the issues that are most critical to Connecticut.
- **Stress Test Analysis Tailored to Connecticut’s Retirement System** – an updated version of the policy analysis we shared at our September meeting, which builds on the technical report described above. This new version of the report incorporates recent actuarial updates as well as helpful feedback we received from you and your team in September.

The proposed legislative reporting requirements are based on the *Foundation for Pension Risk Reporting*, first discussed at the September 21<sup>st</sup> Harvard Kennedy School conference, and are modeled on the format used by the state of Hawaii in their inaugural stress test report. The stress test analysis is informed by the Actuarial Standards Board’s recently published guidance on risk reporting, and was created using Pew’s stress test methodology as described in our research paper, *Assessing the Risk of Fiscal Distress for Public Pension: State Stress Test Analysis*.<sup>1</sup>

As you know, stress testing is a simulation technique used to assess the potential impact of downside economic scenarios on financial balance sheets. Connecticut is one of five states to have adopted a formal requirement for stress testing since 2017, and we applaud Governor Malloy, your office, and other state officials for their early adoption of this important public finance policy. With the recent emergence of national actuarial standards on risk reporting, we expect many states will follow Connecticut’s leadership in the coming months and years.

This is a critical development given that pension debt and investment risk are at all-time highs across the 50 states, making retirement systems particularly vulnerable to the next recession – an eventuality many experts predict is likely within the next two to three years. We hope this draft standard report will be of use in your efforts to inform stakeholders on the impact such an event may have on the state’s public retirement systems, and develop policies to better address the associated risks.

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<sup>1</sup> Mennis, G., Banta, S., & Draine, D. (2018). *Assessing the Risk of Fiscal Distress for Public Pension: State Stress Test Analysis*. Harvard Kennedy School Mossavar-Rahmani Center Working Paper.

The key findings of our analysis include:

- **The Connecticut state budget is exposed to potentially unaffordable spikes in required pension contributions in scenarios where investment returns fall short of expectations.** In a 5 percent investment return scenario, for example, we estimate that total employer contributions required under state policy would increase from 13 percent of revenue currently to over 19 percent by 2028; and potentially crowd out a total of \$10 billion in other government spending by 2030. This issue is driven primarily by the funding requirements of TRS and is widely understood by policymakers in the state.
- **Connecticut SERS has minimal exposure to solvency risk or fiscal distress under an adverse recession scenario; however, TRS’s risk of insolvency is not insignificant if required contributions are not met, but instead are kept constant as a share of budget.** We assess the risk of insolvency or fiscal distress using a recession scenario under both current funding policy and assuming contributions are constrained as a share of revenue. The scenario includes an initial 25 percent decline, or asset shock, in pension fund assets followed by low returns after an initial recovery. Changes to SERS’ assumptions, contribution policy, and plan design protect the plan from insolvency despite a low funded rate of 36 percent. In contrast, TRS would face declining assets and potential insolvency in an asset shock scenario in which contributions only increased at the same rate as state revenue.
- **Recent reforms to SERS demonstrate positive results in managing financial market volatility and mitigating investment risk.** In contrast to TRS, the new funding policy for SERS translates into a relatively stable level of required contributions under a range of scenarios. In addition, placing new state employees in a hybrid plan is projected to significantly mitigate risk of higher costs, with estimated savings of \$1 billion to \$2.5 billion over 30 years depending on how investments perform.
- **Low funded levels may result in persistently high costs for decades if investments underperform.** While the state’s current level of contributions helps to diminish the likelihood of fiscal distress as described above, a realistic and achievable plan to reach full funding will still be needed to lower the impact of pension costs on the state budget over time. The issue of persistent high costs is discussed in greater detail in our research paper.<sup>2</sup>

The first page of the attached report includes a brief overview with key findings as well as a table of contents to guide you through the results. All projections and calculations by The Pew Charitable Trusts and The Terry Group are based on assumptions and other data available in public documents. Baseline projections are designed to match as closely as possible, but not replicate, official projections developed by plan actuaries.

Sincerely,

Greg Mennis, Director  
Susan Banta, Director of Research  
David Draine, Senior Officer

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<sup>2</sup> Mennis, et al. (2018).

# Proposed Legislative Stress Test Report for Connecticut Public Pensions

## The Pew Charitable Trusts

The purpose of this letter is to describe in greater detail the elements of a sensitivity and stress test analysis for the joint standing committee of the General Assembly that would meet the requirements of provisions enacted and codified in Connecticut Code Title 4, Chapter 50m, sec. 4-68ee entitled “Report of sensitivity and stress test analyses for teachers’ retirement system and state employees’ retirement system”.

**Sec. 4-68ee.** Report of sensitivity and stress test analyses for teachers' retirement system and state employees' retirement system. The Secretary of the Office of Policy and Management shall develop and annually report to the joint standing committee of the General Assembly having cognizance of matters relating to appropriations sensitivity and stress test analyses for the teachers' retirement system and the state employees' retirement system. Such reporting shall include projections of benefit levels, pension costs, liabilities, and debt reduction under various economic and investment scenarios. The secretary shall submit the report in accordance with section 11-4a of the general statutes and shall post and update the report on the Office of Policy and Management Internet web site at least annually.

### Requirements of Annual Stress Test Report

The attached legislative stress test report contains the following exhibits and projections:

1. A “**baseline**” projection of assets, liabilities, unfunded liabilities, service cost, employee contributions, employer contributions, benefit payments, payroll, funded ratio, and change in the unfunded liability, for the Teacher’s Retirement System (TRS) and the State Employees’ Retirement System (SERS) for each of the next thirty years based on current plan assumptions and existing policies for actuarial required contributions (“**state contribution policy**”).
2. Two projections of the same items for TRS and SERS using the following investment scenarios:
  - a. A “**low return**” scenario assuming a fixed 5% annual return.
  - b. An “**asset shock**” scenario, based on the financial market and economic assumptions used in the Dodd-Frank Adverse Stress Test scenario published by the Federal Reserve, including a significant one-time loss in asset values followed by a period of economic and financial market recovery, and 5% returns on equity after that period.
3. To assess contribution risk, projections for the low return and asset shock scenario with employer contributions growing at the same rate as projected own source revenue (“**revenue constrained contributions**”) instead of following the current actuarial funding policy.
4. A simulation analysis showing the range of employer contribution rates and funded ratios over 10- and 20-year intervals, assuming that annual returns fluctuate with the market, but the 20-year return matches the plans’ assumed rates of return.
5. Sensitivity analysis of total normal cost and employer normal cost for new employees using investment return assumptions of +/- 1% of the discount rate and 5% fixed rate of return. This analysis will incorporate any variation in employee contributions from investment performance under current plan provisions.
6. Sensitivity analysis of liabilities and unfunded liabilities based the existing disclosures required by the Governmental Accounting Standards Board (GASB) of pension liability at +/- 1% of the discount rate and the investment risk defeasement measure as outlined in proposed draft changes to Actuarial Standard of Practice (ASOP) No. 4.

## Exhibits

Exhibit	Plans Included	Description
1	SERS and TRS Combined	30-year Projection: State Contribution Policy; 7.43% Deterministic Return
2	SERS and TRS Combined	30-year Projection: Revenue Constrained Contribution Policy; 7.43% Deterministic Return
3	SERS and TRS Combined	30-year Projection: State Contribution Policy; 5% Deterministic Return
4	SERS and TRS Combined	30-year Projection: Revenue Constrained Contribution Policy; 5% Deterministic Return
5	SERS and TRS Combined	30-year Projection: State Contribution Policy; Asset Shock Scenario
6	SERS and TRS Combined	30-year Projection: Revenue Constrained Contribution Policy; Asset Shock Scenario
7	SERS	30-year Projections: State Contribution Policy, Revenue Constrained Contribution Policy; 5% and Asset Shock Scenario
8	TRS	30-year Projections: State Contribution Policy, Revenue Constrained Contribution Policy; 5% and Asset Shock Scenario
9	SERS	Stochastic Analysis of Employer Contributions and Funded Ratio
10	TRS	Stochastic Analysis of Employer Contributions and Funded Ratio
11	SERS	Sensitivity of Liability and Normal Costs
12	TRS	Sensitivity of Liability and Normal Costs

## Notes and Disclosures

The information contained in this report is based on the valuation results of the State Employees' Retirement System (SERS) and the Teachers' Retirement System (TRS) as of June 30, 2016. The return of 7.43% is based on the average return between the SERS (6.9%) and TRS (8.0%) plans weighted by 2017 liabilities. Projections are based on a roll-forward model using publicly available actuarial data and assumptions.

The **asset shock scenario** applied to the SERS and TRS investment portfolios results in a one-time loss of approximately 25%, followed by three years of recovery with average annual investment returns of 12%. Subsequent years have equity returns of 5%. These parameters were informed by the Federal Reserve's "2017 Supervisory Scenarios for Annual Stress Tests Required under the Dodd-Frank Act Stress Testing Rules."

The **revenue constrained contribution policy** scenario projects employer contributions growing at the same rate as own source revenue instead of following the current contribution policy. Own source revenue is projected based on long-term forecasts of state GSP growth, as estimated by Moody's Analytics, and the historical relationship in each state between GSP growth and growth in own source revenue. The **revenue constrained contribution policy** scenario serves to assess contribution risk, one of the five risk factors specifically listed in Actuarial Standard of Practice (ASOP) 51.

# Exhibit 1

## Connecticut Retirement System 30 Year Projections

Plans included: State Employees' Retirement System, Teachers' Retirement System  
 State contribution policy under assumed rate of return (7.43%)

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Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2018	7,821	63,734	826	4,618	(3,990)	65,188	28,947	3,321	2,154	(3,990)	30,432	34,756	(31)	0%	47%	-2%	2,907	N/A	37%
2019	7,904	65,188	830	4,721	(4,160)	66,579	30,432	3,366	2,261	(4,160)	31,900	34,680	(76)	-1%	48%	-3%	2,904	0%	37%
2020	8,169	66,579	835	4,819	(4,330)	67,903	31,900	3,660	2,376	(4,330)	33,605	34,298	(382)	-5%	49%	-2%	3,178	9%	39%
2021	8,444	67,903	857	4,913	(4,503)	69,169	33,605	3,702	2,499	(4,503)	35,304	33,866	(432)	-5%	51%	-2%	3,197	1%	38%
<b>2022</b>	<b>8,728</b>	<b>69,169</b>	<b>879</b>	<b>5,002</b>	<b>(4,675)</b>	<b>70,375</b>	<b>35,304</b>	<b>4,050</b>	<b>2,633</b>	<b>(4,675)</b>	<b>37,311</b>	<b>33,064</b>	<b>(802)</b>	<b>-9%</b>	<b>53%</b>	<b>-2%</b>	<b>3,527</b>	<b>10%</b>	<b>40%</b>
2023	9,021	70,375	902	5,088	(4,849)	71,516	37,311	4,191	2,782	(4,849)	39,436	32,081	(983)	-11%	55%	-2%	3,647	3%	40%
2024	9,325	71,516	926	5,168	(5,022)	72,589	39,436	4,576	2,949	(5,022)	41,938	30,651	(1,430)	-15%	58%	-1%	4,010	10%	43%
2025	9,638	72,589	951	5,244	(5,194)	73,591	41,938	4,734	3,136	(5,194)	44,615	28,976	(1,675)	-17%	61%	-1%	4,146	3%	43%
2026	9,963	73,591	977	5,315	(5,366)	74,517	44,615	4,801	3,334	(5,366)	47,384	27,134	(1,842)	-18%	64%	-1%	4,188	1%	42%
<b>2027</b>	<b>10,298</b>	<b>74,517</b>	<b>1,004</b>	<b>5,380</b>	<b>(5,535)</b>	<b>75,367</b>	<b>47,384</b>	<b>4,967</b>	<b>3,543</b>	<b>(5,535)</b>	<b>50,358</b>	<b>25,009</b>	<b>(2,125)</b>	<b>-21%</b>	<b>67%</b>	<b>-1%</b>	<b>4,330</b>	<b>3%</b>	<b>42%</b>
2028	10,644	75,367	1,032	5,441	(5,703)	76,136	50,358	5,010	3,764	(5,703)	53,429	22,707	(2,302)	-22%	70%	-1%	4,348	0%	41%
2029	11,002	76,136	1,061	5,495	(5,869)	76,824	53,429	5,183	3,999	(5,869)	56,743	20,081	(2,625)	-24%	74%	-1%	4,495	3%	41%
2030	11,372	76,824	1,091	5,544	(6,035)	77,424	56,743	5,262	4,249	(6,035)	60,218	17,206	(2,876)	-25%	78%	-1%	4,547	1%	40%
2031	11,755	77,424	1,122	5,587	(6,203)	77,929	60,218	5,443	4,516	(6,203)	63,974	13,956	(3,250)	-28%	82%	-1%	4,700	3%	40%
<b>2032</b>	<b>12,150</b>	<b>77,929</b>	<b>1,154</b>	<b>5,623</b>	<b>(6,365)</b>	<b>78,342</b>	<b>63,974</b>	<b>5,735</b>	<b>4,810</b>	<b>(6,365)</b>	<b>68,154</b>	<b>10,188</b>	<b>(3,767)</b>	<b>-31%</b>	<b>87%</b>	<b>-1%</b>	<b>4,963</b>	<b>6%</b>	<b>41%</b>
2033	12,559	78,342	1,188	5,653	(6,519)	78,664	68,154	5,931	5,135	(6,519)	72,701	5,963	(4,225)	-34%	92%	-1%	5,130	3%	41%
2034	12,982	78,664	1,222	5,677	(6,665)	78,897	72,701	2,666	5,356	(6,665)	74,058	4,839	(1,124)	-9%	94%	-6%	1,835	-64%	14%
2035	13,418	78,897	1,258	5,694	(6,803)	79,047	74,058	2,761	5,458	(6,803)	75,474	3,573	(1,266)	-9%	95%	-5%	1,898	3%	14%
2036	13,870	79,047	1,296	5,706	(6,932)	79,116	75,474	2,677	5,557	(6,932)	76,777	2,340	(1,233)	-9%	97%	-6%	1,782	-6%	13%
<b>2037</b>	<b>14,337</b>	<b>79,116</b>	<b>1,334</b>	<b>5,712</b>	<b>(7,051)</b>	<b>79,112</b>	<b>76,777</b>	<b>2,772</b>	<b>5,656</b>	<b>(7,051)</b>	<b>78,154</b>	<b>958</b>	<b>(1,381)</b>	<b>-10%</b>	<b>99%</b>	<b>-6%</b>	<b>1,844</b>	<b>3%</b>	<b>13%</b>
2038	14,819	79,112	1,374	5,713	(7,161)	79,039	78,154	2,740	5,755	(7,161)	79,489	(450)	(1,408)	-10%	101%	-6%	1,778	-4%	12%
2039	15,318	79,039	1,416	5,710	(7,261)	78,904	79,489	2,837	5,857	(7,261)	80,922	(2,018)	(1,568)	-10%	103%	-6%	1,839	3%	12%
2040	15,833	78,904	1,459	5,702	(7,351)	78,714	80,922	2,814	5,961	(7,351)	82,347	(3,632)	(1,614)	-10%	105%	-6%	1,780	-3%	11%
2041	16,366	78,714	1,504	5,689	(7,431)	78,477	82,347	2,913	6,069	(7,431)	83,898	(5,421)	(1,789)	-11%	107%	-5%	1,842	3%	11%
<b>2042</b>	<b>16,917</b>	<b>78,477</b>	<b>1,551</b>	<b>5,674</b>	<b>(7,502)</b>	<b>78,200</b>	<b>83,898</b>	<b>2,895</b>	<b>6,182</b>	<b>(7,502)</b>	<b>85,473</b>	<b>(7,273)</b>	<b>(1,852)</b>	<b>-11%</b>	<b>109%</b>	<b>-5%</b>	<b>1,784</b>	<b>-3%</b>	<b>11%</b>
2043	17,487	78,200	1,599	5,655	(7,564)	77,890	85,473	2,996	6,302	(7,564)	87,206	(9,316)	(2,043)	-12%	112%	-5%	1,846	3%	11%
2044	18,075	77,890	1,650	5,634	(7,618)	77,556	87,206	2,703	6,417	(7,618)	88,709	(11,153)	(1,837)	-10%	114%	-6%	1,513	-18%	8%
2045	18,684	77,556	1,702	5,610	(7,663)	77,204	88,709	2,798	6,527	(7,663)	90,371	(13,166)	(2,014)	-11%	117%	-5%	1,566	4%	8%
2046	19,313	77,204	1,756	5,584	(7,702)	76,842	90,371	2,673	6,640	(7,702)	91,982	(15,140)	(1,974)	-10%	120%	-6%	1,476	-6%	8%
<b>2047</b>	<b>19,963</b>	<b>76,842</b>	<b>1,812</b>	<b>5,557</b>	<b>(7,734)</b>	<b>76,477</b>	<b>91,982</b>	<b>2,766</b>	<b>6,757</b>	<b>(7,734)</b>	<b>93,771</b>	<b>(17,294)</b>	<b>(2,154)</b>	<b>-11%</b>	<b>123%</b>	<b>-5%</b>	<b>1,527</b>	<b>3%</b>	<b>8%</b>

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports

# Exhibit 2

## Connecticut Retirement System 30 Year Projections

Plans included: State Employees' Retirement System, Teachers' Retirement System  
 Revenue constrained contribution policy under assumed rate of return (7.43%)

\$MMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2018	7,821	63,734	826	4,618	(3,990)	65,188	28,947	3,054	2,144	(3,990)	30,155	35,033	247	3%	46%	-3%	2,640	N/A	34%
2019	7,904	65,188	830	4,721	(4,160)	66,579	30,155	3,211	2,233	(4,160)	31,438	35,141	108	1%	47%	-3%	2,749	4%	35%
2020	8,169	66,579	835	4,819	(4,330)	67,903	31,438	3,292	2,324	(4,330)	32,725	35,178	37	0%	48%	-3%	2,809	2%	34%
2021	8,444	67,903	857	4,913	(4,503)	69,169	32,725	3,439	2,418	(4,503)	34,080	35,089	(89)	-1%	49%	-3%	2,935	4%	35%
<b>2022</b>	<b>8,728</b>	<b>69,169</b>	<b>879</b>	<b>5,002</b>	<b>(4,675)</b>	<b>70,375</b>	<b>34,080</b>	<b>3,585</b>	<b>2,517</b>	<b>(4,675)</b>	<b>35,507</b>	<b>34,868</b>	<b>(221)</b>	<b>-3%</b>	<b>50%</b>	<b>-3%</b>	<b>3,062</b>	<b>4%</b>	<b>35%</b>
2023	9,021	70,375	902	5,088	(4,849)	71,516	35,507	3,728	2,621	(4,849)	37,007	34,509	(359)	-4%	52%	-3%	3,184	4%	35%
2024	9,325	71,516	926	5,168	(5,022)	72,589	37,007	3,870	2,730	(5,022)	38,586	34,003	(506)	-5%	53%	-3%	3,304	4%	35%
2025	9,638	72,589	951	5,244	(5,194)	73,591	38,586	4,010	2,845	(5,194)	40,248	33,343	(660)	-7%	55%	-3%	3,422	4%	35%
2026	9,963	73,591	977	5,315	(5,366)	74,517	40,248	4,151	2,966	(5,366)	42,000	32,518	(825)	-8%	56%	-3%	3,538	3%	36%
<b>2027</b>	<b>10,298</b>	<b>74,517</b>	<b>1,004</b>	<b>5,380</b>	<b>(5,535)</b>	<b>75,367</b>	<b>42,000</b>	<b>4,292</b>	<b>3,094</b>	<b>(5,535)</b>	<b>43,850</b>	<b>31,517</b>	<b>(1,001)</b>	<b>-10%</b>	<b>58%</b>	<b>-3%</b>	<b>3,655</b>	<b>3%</b>	<b>35%</b>
2028	10,644	75,367	1,032	5,441	(5,703)	76,136	43,850	4,449	3,229	(5,703)	45,825	30,311	(1,205)	-11%	60%	-3%	3,787	4%	36%
2029	11,002	76,136	1,061	5,495	(5,869)	76,824	45,825	4,610	3,374	(5,869)	47,941	28,883	(1,428)	-13%	62%	-3%	3,922	4%	36%
2030	11,372	76,824	1,091	5,544	(6,035)	77,424	47,941	4,771	3,529	(6,035)	50,205	27,218	(1,665)	-15%	65%	-3%	4,056	3%	36%
2031	11,755	77,424	1,122	5,587	(6,203)	77,929	50,205	4,938	3,695	(6,203)	52,636	25,293	(1,925)	-16%	68%	-3%	4,196	3%	36%
<b>2032</b>	<b>12,150</b>	<b>77,929</b>	<b>1,154</b>	<b>5,623</b>	<b>(6,365)</b>	<b>78,342</b>	<b>52,636</b>	<b>5,112</b>	<b>3,874</b>	<b>(6,365)</b>	<b>55,257</b>	<b>23,085</b>	<b>(2,209)</b>	<b>-18%</b>	<b>71%</b>	<b>-2%</b>	<b>4,341</b>	<b>3%</b>	<b>36%</b>
2033	12,559	78,342	1,188	5,653	(6,519)	78,664	55,257	5,291	4,067	(6,519)	58,096	20,567	(2,518)	-20%	74%	-2%	4,490	3%	36%
2034	12,982	78,664	1,222	5,677	(6,665)	78,897	58,096	5,473	4,276	(6,665)	61,180	17,717	(2,850)	-22%	78%	-2%	4,642	3%	36%
2035	13,418	78,897	1,258	5,694	(6,803)	79,047	61,180	5,661	4,503	(6,803)	64,541	14,506	(3,211)	-24%	82%	-2%	4,798	3%	36%
2036	13,870	79,047	1,296	5,706	(6,932)	79,116	64,541	5,851	4,751	(6,932)	68,211	10,905	(3,601)	-26%	86%	-2%	4,956	3%	36%
<b>2037</b>	<b>14,337</b>	<b>79,116</b>	<b>1,334</b>	<b>5,712</b>	<b>(7,051)</b>	<b>79,112</b>	<b>68,211</b>	<b>6,051</b>	<b>5,022</b>	<b>(7,051)</b>	<b>72,233</b>	<b>6,879</b>	<b>(4,026)</b>	<b>-28%</b>	<b>91%</b>	<b>-1%</b>	<b>5,123</b>	<b>3%</b>	<b>36%</b>
2038	14,819	79,112	1,374	5,713	(7,161)	79,039	72,233	6,211	5,317	(7,161)	76,599	2,439	(4,440)	-30%	97%	-1%	5,299	3%	36%
2039	15,318	79,039	1,416	5,710	(7,261)	78,904	76,599	6,426	5,639	(7,261)	81,404	(2,500)	(4,939)	-32%	103%	-1%	5,483	3%	36%
2040	15,833	78,904	1,459	5,702	(7,351)	78,714	81,404	6,649	5,993	(7,351)	86,695	(7,980)	(5,480)	-35%	110%	-1%	5,672	3%	36%
2041	16,366	78,714	1,504	5,689	(7,431)	78,477	86,695	6,866	6,382	(7,431)	92,512	(14,035)	(6,055)	-37%	118%	-1%	5,856	3%	36%
<b>2042</b>	<b>16,917</b>	<b>78,477</b>	<b>1,551</b>	<b>5,674</b>	<b>(7,502)</b>	<b>78,200</b>	<b>92,512</b>	<b>7,085</b>	<b>6,810</b>	<b>(7,502)</b>	<b>98,904</b>	<b>(20,705)</b>	<b>(6,669)</b>	<b>-39%</b>	<b>126%</b>	<b>0%</b>	<b>6,039</b>	<b>3%</b>	<b>36%</b>
2043	17,487	78,200	1,599	5,655	(7,564)	77,890	98,904	7,311	7,279	(7,564)	105,930	(28,040)	(7,335)	-42%	136%	0%	6,229	3%	36%
2044	18,075	77,890	1,650	5,634	(7,618)	77,556	105,930	7,539	7,794	(7,618)	113,645	(36,089)	(8,050)	-45%	147%	0%	6,420	3%	36%
2045	18,684	77,556	1,702	5,610	(7,663)	77,204	113,645	7,771	8,358	(7,663)	122,111	(44,907)	(8,817)	-47%	158%	0%	6,613	3%	35%
2046	19,313	77,204	1,756	5,584	(7,702)	76,842	122,111	8,007	8,977	(7,702)	131,393	(54,550)	(9,643)	-50%	171%	0%	6,809	3%	35%
<b>2047</b>	<b>19,963</b>	<b>76,842</b>	<b>1,812</b>	<b>5,557</b>	<b>(7,734)</b>	<b>76,477</b>	<b>131,393</b>	<b>8,244</b>	<b>9,654</b>	<b>(7,734)</b>	<b>141,556</b>	<b>(65,079)</b>	<b>(10,529)</b>	<b>-53%</b>	<b>185%</b>	<b>0%</b>	<b>7,005</b>	<b>3%</b>	<b>35%</b>

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports

# Exhibit 3

## Connecticut Retirement System 30 Year Projections

Plans included: State Employees' Retirement System, Teachers' Retirement System  
 State contribution policy under low rate of return (5%)

\$MMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2018	7,821	63,734	826	4,618	(3,990)	65,188	28,947	3,321	1,426	(3,990)	29,704	35,484	697	9%	46%	-2%	2,907	N/A	37%
2019	7,904	65,188	830	4,721	(4,160)	66,579	29,704	3,366	1,461	(4,160)	30,371	36,208	724	9%	46%	-3%	2,904	0%	37%
2020	8,169	66,579	835	4,819	(4,330)	67,903	30,371	3,676	1,497	(4,330)	31,214	36,689	481	6%	46%	-2%	3,194	10%	39%
2021	8,444	67,903	857	4,913	(4,503)	69,169	31,214	3,718	1,536	(4,503)	31,965	37,204	515	6%	46%	-3%	3,213	1%	38%
<b>2022</b>	<b>8,728</b>	<b>69,169</b>	<b>879</b>	<b>5,002</b>	<b>(4,675)</b>	<b>70,375</b>	<b>31,965</b>	<b>4,171</b>	<b>1,580</b>	<b>(4,675)</b>	<b>33,041</b>	<b>37,334</b>	<b>130</b>	<b>1%</b>	<b>47%</b>	<b>-2%</b>	<b>3,645</b>	<b>13%</b>	<b>42%</b>
2023	9,021	70,375	902	5,088	(4,849)	71,516	33,041	4,322	1,634	(4,849)	34,148	37,368	34	0%	48%	-2%	3,768	3%	42%
2024	9,325	71,516	926	5,168	(5,022)	72,589	34,148	4,926	1,699	(5,022)	35,752	36,837	(531)	-6%	49%	0%	4,348	15%	47%
2025	9,638	72,589	951	5,244	(5,194)	73,591	35,752	5,098	1,779	(5,194)	37,436	36,155	(682)	-7%	51%	0%	4,495	3%	47%
2026	9,963	73,591	977	5,315	(5,366)	74,517	37,436	5,471	1,868	(5,366)	39,410	35,107	(1,048)	-11%	53%	0%	4,842	8%	49%
<b>2027</b>	<b>10,298</b>	<b>74,517</b>	<b>1,004</b>	<b>5,380</b>	<b>(5,535)</b>	<b>75,367</b>	<b>39,410</b>	<b>5,661</b>	<b>1,967</b>	<b>(5,535)</b>	<b>41,503</b>	<b>33,863</b>	<b>(1,244)</b>	<b>-12%</b>	<b>55%</b>	<b>0%</b>	<b>5,006</b>	<b>3%</b>	<b>49%</b>
2028	10,644	75,367	1,032	5,441	(5,703)	76,136	41,503	6,152	2,080	(5,703)	44,032	32,104	(1,759)	-17%	58%	1%	5,469	9%	51%
2029	11,002	76,136	1,061	5,495	(5,869)	76,824	44,032	6,365	2,207	(5,869)	46,735	30,088	(2,015)	-18%	61%	1%	5,653	3%	51%
2030	11,372	76,824	1,091	5,544	(6,035)	77,424	46,735	7,242	2,360	(6,035)	50,301	27,122	(2,966)	-26%	65%	3%	6,500	15%	57%
2031	11,755	77,424	1,122	5,587	(6,203)	77,929	50,301	7,490	2,540	(6,203)	54,128	23,802	(3,320)	-28%	69%	3%	6,718	3%	57%
<b>2032</b>	<b>12,150</b>	<b>77,929</b>	<b>1,154</b>	<b>5,623</b>	<b>(6,365)</b>	<b>78,342</b>	<b>54,128</b>	<b>10,597</b>	<b>2,803</b>	<b>(6,365)</b>	<b>61,164</b>	<b>17,178</b>	<b>(6,624)</b>	<b>-55%</b>	<b>78%</b>	<b>8%</b>	<b>9,794</b>	<b>46%</b>	<b>81%</b>
2033	12,559	78,342	1,188	5,653	(6,519)	78,664	61,164	10,954	3,160	(6,519)	68,759	9,904	(7,274)	-58%	87%	7%	10,118	3%	81%
2034	12,982	78,664	1,222	5,677	(6,665)	78,897	68,759	3,084	3,342	(6,665)	68,520	10,378	473	4%	87%	-5%	2,215	-78%	17%
2035	13,418	78,897	1,258	5,694	(6,803)	79,047	68,520	3,196	3,329	(6,803)	68,241	10,806	428	3%	86%	-5%	2,292	3%	17%
2036	13,870	79,047	1,296	5,706	(6,932)	79,116	68,241	3,177	3,311	(6,932)	67,797	11,319	514	4%	86%	-6%	2,237	-2%	16%
<b>2037</b>	<b>14,337</b>	<b>79,116</b>	<b>1,334</b>	<b>5,712</b>	<b>(7,051)</b>	<b>79,112</b>	<b>67,797</b>	<b>3,291</b>	<b>3,288</b>	<b>(7,051)</b>	<b>67,325</b>	<b>11,787</b>	<b>467</b>	<b>3%</b>	<b>85%</b>	<b>-6%</b>	<b>2,315</b>	<b>3%</b>	<b>16%</b>
2038	14,819	79,112	1,374	5,713	(7,161)	79,039	67,325	3,325	3,262	(7,161)	66,752	12,287	501	3%	84%	-6%	2,311	0%	16%
2039	15,318	79,039	1,416	5,710	(7,261)	78,904	66,752	3,444	3,234	(7,261)	66,168	12,736	448	3%	84%	-6%	2,392	3%	16%
2040	15,833	78,904	1,459	5,702	(7,351)	78,714	66,168	3,484	3,203	(7,351)	65,505	13,209	474	3%	83%	-6%	2,393	0%	15%
2041	16,366	78,714	1,504	5,689	(7,431)	78,477	65,505	3,608	3,171	(7,431)	64,853	13,624	415	3%	83%	-6%	2,475	3%	15%
<b>2042</b>	<b>16,917</b>	<b>78,477</b>	<b>1,551</b>	<b>5,674</b>	<b>(7,502)</b>	<b>78,200</b>	<b>64,853</b>	<b>3,650</b>	<b>3,137</b>	<b>(7,502)</b>	<b>64,138</b>	<b>14,062</b>	<b>438</b>	<b>3%</b>	<b>82%</b>	<b>-6%</b>	<b>2,476</b>	<b>0%</b>	<b>15%</b>
2043	17,487	78,200	1,599	5,655	(7,564)	77,890	64,138	3,779	3,103	(7,564)	63,455	14,435	373	2%	81%	-6%	2,561	3%	15%
2044	18,075	77,890	1,650	5,634	(7,618)	77,556	63,455	5,667	3,113	(7,618)	64,617	12,938	(1,497)	-8%	83%	-3%	4,405	72%	24%
2045	18,684	77,556	1,702	5,610	(7,663)	77,204	64,617	5,861	3,175	(7,663)	65,990	11,214	(1,724)	-9%	85%	-3%	4,554	3%	24%
2046	19,313	77,204	1,756	5,584	(7,702)	76,842	65,990	6,934	3,268	(7,702)	68,491	8,351	(2,863)	-15%	89%	-1%	5,580	23%	29%
<b>2047</b>	<b>19,963</b>	<b>76,842</b>	<b>1,812</b>	<b>5,557</b>	<b>(7,734)</b>	<b>76,477</b>	<b>68,491</b>	<b>7,170</b>	<b>3,398</b>	<b>(7,734)</b>	<b>71,325</b>	<b>5,152</b>	<b>(3,199)</b>	<b>-16%</b>	<b>93%</b>	<b>-1%</b>	<b>5,767</b>	<b>3%</b>	<b>29%</b>

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports

# Exhibit 4

## Connecticut Retirement System 30 Year Projections

Plans included: State Employees' Retirement System, Teachers' Retirement System  
 Revenue constrained contribution policy under low rate of return (5%)

\$MMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2018	7,821	63,734	826	4,618	(3,990)	65,188	28,947	3,054	1,419	(3,990)	29,430	35,758	971	12%	45%	-3%	2,640	N/A	34%
2019	7,904	65,188	830	4,721	(4,160)	66,579	29,430	3,211	1,443	(4,160)	29,925	36,654	897	11%	45%	-3%	2,749	4%	35%
2020	8,169	66,579	835	4,819	(4,330)	67,903	29,925	3,292	1,466	(4,330)	30,352	37,550	896	11%	45%	-3%	2,809	2%	34%
2021	8,444	67,903	857	4,913	(4,503)	69,169	30,352	3,439	1,486	(4,503)	30,776	38,394	843	10%	44%	-4%	2,935	4%	35%
<b>2022</b>	<b>8,728</b>	<b>69,169</b>	<b>879</b>	<b>5,002</b>	<b>(4,675)</b>	<b>70,375</b>	<b>30,776</b>	<b>3,589</b>	<b>1,507</b>	<b>(4,675)</b>	<b>31,196</b>	<b>39,179</b>	<b>786</b>	<b>9%</b>	<b>44%</b>	<b>-4%</b>	<b>3,062</b>	<b>4%</b>	<b>35%</b>
2023	9,021	70,375	902	5,088	(4,849)	71,516	31,196	3,733	1,527	(4,849)	31,607	39,910	730	8%	44%	-4%	3,184	4%	35%
2024	9,325	71,516	926	5,168	(5,022)	72,589	31,607	3,876	1,546	(5,022)	32,008	40,582	672	7%	44%	-4%	3,304	4%	35%
2025	9,638	72,589	951	5,244	(5,194)	73,591	32,008	4,018	1,565	(5,194)	32,397	41,194	612	6%	44%	-4%	3,422	4%	35%
2026	9,963	73,591	977	5,315	(5,366)	74,517	32,397	4,159	1,584	(5,366)	32,774	41,744	549	6%	44%	-4%	3,538	3%	36%
<b>2027</b>	<b>10,298</b>	<b>74,517</b>	<b>1,004</b>	<b>5,380</b>	<b>(5,535)</b>	<b>75,367</b>	<b>32,774</b>	<b>4,302</b>	<b>1,602</b>	<b>(5,535)</b>	<b>33,142</b>	<b>42,225</b>	<b>481</b>	<b>5%</b>	<b>44%</b>	<b>-4%</b>	<b>3,655</b>	<b>3%</b>	<b>35%</b>
2028	10,644	75,367	1,032	5,441	(5,703)	76,136	33,142	4,459	1,620	(5,703)	33,518	42,618	394	4%	44%	-4%	3,787	4%	36%
2029	11,002	76,136	1,061	5,495	(5,869)	76,824	33,518	4,622	1,638	(5,869)	33,910	42,914	296	3%	44%	-4%	3,922	4%	36%
2030	11,372	76,824	1,091	5,544	(6,035)	77,424	33,910	4,784	1,658	(6,035)	34,316	43,107	193	2%	44%	-4%	4,056	3%	36%
2031	11,755	77,424	1,122	5,587	(6,203)	77,929	34,316	4,953	1,678	(6,203)	34,744	43,185	78	1%	45%	-4%	4,196	3%	36%
<b>2032</b>	<b>12,150</b>	<b>77,929</b>	<b>1,154</b>	<b>5,623</b>	<b>(6,365)</b>	<b>78,342</b>	<b>34,744</b>	<b>5,128</b>	<b>1,699</b>	<b>(6,365)</b>	<b>35,207</b>	<b>43,135</b>	<b>(50)</b>	<b>0%</b>	<b>45%</b>	<b>-4%</b>	<b>4,341</b>	<b>3%</b>	<b>36%</b>
2033	12,559	78,342	1,188	5,653	(6,519)	78,664	35,207	5,309	1,723	(6,519)	35,720	42,944	(191)	-2%	45%	-3%	4,490	3%	36%
2034	12,982	78,664	1,222	5,677	(6,665)	78,897	35,720	5,492	1,749	(6,665)	36,296	42,601	(343)	-3%	46%	-3%	4,642	3%	36%
2035	13,418	78,897	1,258	5,694	(6,803)	79,047	36,296	5,681	1,779	(6,803)	36,953	42,094	(508)	-4%	47%	-3%	4,798	3%	36%
2036	13,870	79,047	1,296	5,706	(6,932)	79,116	36,953	5,873	1,813	(6,932)	37,708	41,409	(685)	-5%	48%	-3%	4,956	3%	36%
<b>2037</b>	<b>14,337</b>	<b>79,116</b>	<b>1,334</b>	<b>5,712</b>	<b>(7,051)</b>	<b>79,112</b>	<b>37,708</b>	<b>6,075</b>	<b>1,852</b>	<b>(7,051)</b>	<b>38,584</b>	<b>40,528</b>	<b>(881)</b>	<b>-6%</b>	<b>49%</b>	<b>-3%</b>	<b>5,123</b>	<b>3%</b>	<b>36%</b>
2038	14,819	79,112	1,374	5,713	(7,161)	79,039	38,584	6,288	1,898	(7,161)	39,609	39,430	(1,098)	-7%	50%	-2%	5,299	3%	36%
2039	15,318	79,039	1,416	5,710	(7,261)	78,904	39,609	6,508	1,952	(7,261)	40,809	38,095	(1,334)	-9%	52%	-2%	5,483	3%	36%
2040	15,833	78,904	1,459	5,702	(7,351)	78,714	40,809	6,735	2,015	(7,351)	42,208	36,506	(1,589)	-10%	54%	-2%	5,672	3%	36%
2041	16,366	78,714	1,504	5,689	(7,431)	78,477	42,208	6,958	2,089	(7,431)	43,824	34,653	(1,853)	-11%	56%	-1%	5,856	3%	36%
<b>2042</b>	<b>16,917</b>	<b>78,477</b>	<b>1,551</b>	<b>5,674</b>	<b>(7,502)</b>	<b>78,200</b>	<b>43,824</b>	<b>7,181</b>	<b>2,173</b>	<b>(7,502)</b>	<b>45,675</b>	<b>32,524</b>	<b>(2,129)</b>	<b>-13%</b>	<b>58%</b>	<b>-1%</b>	<b>6,039</b>	<b>3%</b>	<b>36%</b>
2043	17,487	78,200	1,599	5,655	(7,564)	77,890	45,675	7,311	2,267	(7,564)	47,689	30,202	(2,323)	-13%	61%	-1%	6,229	3%	36%
2044	18,075	77,890	1,650	5,634	(7,618)	77,556	47,689	7,539	2,371	(7,618)	49,981	27,574	(2,627)	-15%	64%	0%	6,420	3%	36%
2045	18,684	77,556	1,702	5,610	(7,663)	77,204	49,981	7,771	2,490	(7,663)	52,579	24,625	(2,949)	-16%	68%	0%	6,613	3%	35%
2046	19,313	77,204	1,756	5,584	(7,702)	76,842	52,579	8,007	2,624	(7,702)	55,508	21,334	(3,291)	-17%	72%	1%	6,809	3%	35%
<b>2047</b>	<b>19,963</b>	<b>76,842</b>	<b>1,812</b>	<b>5,557</b>	<b>(7,734)</b>	<b>76,477</b>	<b>55,508</b>	<b>8,244</b>	<b>2,775</b>	<b>(7,734)</b>	<b>58,793</b>	<b>17,684</b>	<b>(3,650)</b>	<b>-18%</b>	<b>77%</b>	<b>1%</b>	<b>7,005</b>	<b>3%</b>	<b>35%</b>

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports



# Exhibit 5

## Connecticut Retirement System 30 Year Projections

Plans included: State Employees' Retirement System, Teachers' Retirement System  
State contribution policy under asset shock

SMMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2018	7,821	63,734	826	4,618	(3,990)	65,188	28,947	3,321	(7,122)	(3,990)	21,156	44,031	9,245	118%	32%	-2%	2,907	N/A	37%
2019	7,904	65,188	830	4,541	(4,140)	66,420	21,156	3,366	2,579	(4,140)	22,961	43,459	(573)	-7%	35%	-4%	2,904	0%	37%
2020	8,169	66,420	835	4,649	(4,293)	67,610	22,961	3,943	3,130	(4,293)	25,741	41,869	(1,589)	-19%	38%	-2%	3,461	19%	42%
2021	8,384	67,610	857	4,651	(4,448)	68,670	25,741	3,970	2,790	(4,448)	28,054	40,616	(1,253)	-15%	41%	-2%	3,469	0%	41%
<b>2022</b>	<b>8,604</b>	<b>68,670</b>	<b>873</b>	<b>4,691</b>	<b>(4,599)</b>	<b>69,634</b>	<b>28,054</b>	<b>4,616</b>	<b>1,260</b>	<b>(4,599)</b>	<b>29,331</b>	<b>40,303</b>	<b>(313)</b>	<b>-4%</b>	<b>42%</b>	<b>0%</b>	<b>4,097</b>	<b>18%</b>	<b>48%</b>
2023	8,830	69,634	889	4,783	(4,754)	70,552	29,331	4,749	1,421	(4,754)	30,747	39,806	(497)	-6%	44%	0%	4,207	3%	48%
2024	9,063	70,552	907	4,844	(4,909)	71,394	30,747	5,389	1,501	(4,909)	32,727	38,666	(1,140)	-13%	46%	2%	4,833	15%	53%
2025	9,302	71,394	925	4,898	(5,064)	72,152	32,727	5,530	1,597	(5,064)	34,791	37,362	(1,305)	-14%	48%	1%	4,962	3%	53%
2026	9,547	72,152	943	4,945	(5,217)	72,823	34,791	5,660	1,697	(5,217)	36,930	35,894	(1,468)	-15%	51%	1%	5,074	2%	53%
<b>2027</b>	<b>9,805</b>	<b>72,823</b>	<b>962</b>	<b>4,995</b>	<b>(5,370)</b>	<b>73,411</b>	<b>36,930</b>	<b>5,815</b>	<b>1,801</b>	<b>(5,370)</b>	<b>39,176</b>	<b>34,235</b>	<b>(1,659)</b>	<b>-17%</b>	<b>53%</b>	<b>1%</b>	<b>5,210</b>	<b>3%</b>	<b>53%</b>
2028	10,071	73,411	983	5,030	(5,520)	73,904	39,176	6,167	1,914	(5,520)	41,737	32,167	(2,068)	-21%	56%	2%	5,541	6%	55%
2029	10,344	73,904	1,004	5,059	(5,669)	74,297	41,737	6,337	2,039	(5,669)	44,444	29,853	(2,313)	-22%	60%	2%	5,691	3%	55%
2030	10,624	74,297	1,025	5,080	(5,820)	74,582	44,444	7,064	2,184	(5,820)	47,871	26,711	(3,143)	-30%	64%	3%	6,397	12%	60%
2031	10,912	74,582	1,048	5,092	(5,973)	74,749	47,871	7,256	2,351	(5,973)	51,506	23,244	(3,467)	-32%	69%	3%	6,568	3%	60%
<b>2032</b>	<b>11,208</b>	<b>74,749</b>	<b>1,071</b>	<b>5,096</b>	<b>(6,120)</b>	<b>74,796</b>	<b>51,506</b>	<b>9,928</b>	<b>2,587</b>	<b>(6,120)</b>	<b>57,901</b>	<b>16,894</b>	<b>(6,349)</b>	<b>-57%</b>	<b>77%</b>	<b>7%</b>	<b>9,218</b>	<b>40%</b>	<b>82%</b>
2033	11,512	74,796	1,095	5,090	(6,261)	74,720	57,901	10,191	2,900	(6,261)	64,732	9,988	(6,907)	-60%	87%	7%	9,459	3%	82%
2034	11,824	74,720	1,119	5,076	(6,394)	74,521	64,732	2,961	3,055	(6,394)	64,353	10,168	180	2%	86%	-5%	2,205	-77%	19%
2035	12,145	74,521	1,145	5,053	(6,520)	74,199	64,353	3,049	3,035	(6,520)	63,917	10,282	114	1%	86%	-5%	2,269	3%	19%
2036	12,474	74,199	1,171	5,022	(6,638)	73,754	63,917	3,013	3,010	(6,638)	63,302	10,452	170	1%	86%	-6%	2,209	-3%	18%
<b>2037</b>	<b>12,813</b>	<b>73,754</b>	<b>1,198</b>	<b>4,981</b>	<b>(6,746)</b>	<b>73,188</b>	<b>63,302</b>	<b>3,102</b>	<b>2,980</b>	<b>(6,746)</b>	<b>62,638</b>	<b>10,550</b>	<b>98</b>	<b>1%</b>	<b>86%</b>	<b>-6%</b>	<b>2,274</b>	<b>3%</b>	<b>18%</b>
2038	13,161	73,188	1,227	4,933	(6,844)	72,503	62,638	3,119	2,945	(6,844)	61,858	10,645	95	1%	85%	-6%	2,265	0%	17%
2039	13,518	72,503	1,256	4,876	(6,932)	71,703	61,858	3,211	2,908	(6,932)	61,044	10,659	13	0%	85%	-6%	2,332	3%	17%
2040	13,885	71,703	1,286	4,812	(7,009)	70,791	61,044	3,234	2,867	(7,009)	60,135	10,655	(3)	0%	85%	-6%	2,329	0%	17%
2041	14,262	70,791	1,317	4,740	(7,076)	69,772	60,135	3,329	2,823	(7,076)	59,212	10,560	(95)	-1%	85%	-6%	2,397	3%	17%
<b>2042</b>	<b>14,650</b>	<b>69,772</b>	<b>1,349</b>	<b>4,662</b>	<b>(7,132)</b>	<b>68,650</b>	<b>59,212</b>	<b>3,354</b>	<b>2,778</b>	<b>(7,132)</b>	<b>58,211</b>	<b>10,439</b>	<b>(121)</b>	<b>-1%</b>	<b>85%</b>	<b>-6%</b>	<b>2,394</b>	<b>0%</b>	<b>16%</b>
2043	15,048	68,650	1,382	4,577	(7,179)	67,430	58,211	3,452	2,730	(7,179)	57,214	10,216	(224)	-1%	85%	-6%	2,464	3%	16%
2044	15,457	67,430	1,416	4,485	(7,215)	66,115	57,214	3,548	2,684	(7,215)	56,231	9,885	(331)	-2%	85%	-6%	2,532	3%	16%
2045	15,877	66,115	1,451	4,386	(7,244)	64,709	56,231	3,652	2,638	(7,244)	55,277	9,433	(452)	-3%	85%	-6%	2,606	3%	16%
2046	16,309	64,709	1,488	4,281	(7,265)	63,213	55,277	4,827	2,619	(7,265)	55,458	7,755	(1,677)	-10%	88%	-4%	3,751	44%	23%
<b>2047</b>	<b>16,753</b>	<b>63,213</b>	<b>1,525</b>	<b>4,167</b>	<b>(7,291)</b>	<b>61,614</b>	<b>55,458</b>	<b>4,961</b>	<b>2,631</b>	<b>(7,291)</b>	<b>55,758</b>	<b>5,857</b>	<b>(1,899)</b>	<b>-11%</b>	<b>90%</b>	<b>-4%</b>	<b>3,855</b>	<b>3%</b>	<b>23%</b>

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports

# Exhibit 6

## Connecticut Retirement System 30 Year Projections

Plans included: State Employees' Retirement System, Teachers' Retirement System  
Revenue constrained contribution policy under asset shock

\$MMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2018	7,821	63,734	826	4,618	(3,990)	65,188	28,947	2,937	(7,071)	(3,990)	20,823	44,364	9,578	122%	32%	-4%	2,523	N/A	32%
2019	7,904	65,188	830	4,541	(4,140)	66,420	20,823	3,054	2,518	(4,140)	22,256	44,164	(201)	-3%	34%	-5%	2,592	3%	33%
2020	8,169	66,420	835	4,649	(4,293)	67,610	22,256	3,202	2,984	(4,293)	24,148	43,462	(702)	-9%	36%	-5%	2,718	5%	33%
2021	8,384	67,610	857	4,651	(4,448)	68,670	24,148	3,358	2,583	(4,448)	25,641	43,029	(434)	-5%	37%	-5%	2,854	5%	34%
<b>2022</b>	<b>8,604</b>	<b>68,670</b>	<b>873</b>	<b>4,691</b>	<b>(4,599)</b>	<b>69,634</b>	<b>25,641</b>	<b>3,485</b>	<b>1,127</b>	<b>(4,599)</b>	<b>25,653</b>	<b>43,981</b>	<b>952</b>	<b>11%</b>	<b>37%</b>	<b>-4%</b>	<b>2,962</b>	<b>4%</b>	<b>34%</b>
2023	8,830	69,634	889	4,783	(4,754)	70,552	25,653	3,621	1,215	(4,754)	25,736	44,817	836	9%	36%	-4%	3,080	4%	35%
2024	9,063	70,552	907	4,844	(4,909)	71,394	25,736	3,752	1,219	(4,909)	25,797	45,597	780	9%	36%	-4%	3,196	4%	35%
2025	9,302	71,394	925	4,898	(5,064)	72,152	25,797	3,877	1,221	(5,064)	25,831	46,321	724	8%	36%	-5%	3,310	4%	36%
2026	9,547	72,152	943	4,945	(5,217)	72,823	25,831	4,009	1,222	(5,217)	25,845	46,979	658	7%	35%	-5%	3,422	3%	36%
<b>2027</b>	<b>9,805</b>	<b>72,823</b>	<b>962</b>	<b>4,995</b>	<b>(5,370)</b>	<b>73,411</b>	<b>25,845</b>	<b>4,141</b>	<b>1,222</b>	<b>(5,370)</b>	<b>25,838</b>	<b>47,573</b>	<b>594</b>	<b>6%</b>	<b>35%</b>	<b>-5%</b>	<b>3,536</b>	<b>3%</b>	<b>36%</b>
2028	10,071	73,411	983	5,030	(5,520)	73,904	25,838	4,288	1,222	(5,520)	25,828	48,076	503	5%	35%	-5%	3,663	4%	36%
2029	10,344	73,904	1,004	5,059	(5,669)	74,297	25,828	4,440	1,221	(5,669)	25,820	48,477	401	4%	35%	-5%	3,794	4%	37%
2030	10,624	74,297	1,025	5,080	(5,820)	74,582	25,820	4,590	1,221	(5,820)	25,812	48,770	294	3%	35%	-5%	3,923	3%	37%
2031	10,912	74,582	1,048	5,092	(5,973)	74,749	25,812	4,747	1,221	(5,973)	25,806	48,943	172	2%	35%	-5%	4,058	3%	37%
<b>2032</b>	<b>11,208</b>	<b>74,749</b>	<b>1,071</b>	<b>5,096</b>	<b>(6,120)</b>	<b>74,796</b>	<b>25,806</b>	<b>4,909</b>	<b>1,221</b>	<b>(6,120)</b>	<b>25,816</b>	<b>48,979</b>	<b>37</b>	<b>0%</b>	<b>35%</b>	<b>-5%</b>	<b>4,199</b>	<b>3%</b>	<b>37%</b>
2033	11,512	74,796	1,095	5,090	(6,261)	74,720	25,816	5,076	1,222	(6,261)	25,854	48,866	(113)	-1%	35%	-5%	4,343	3%	38%
2034	11,824	74,720	1,119	5,076	(6,394)	74,521	25,854	5,246	1,225	(6,394)	25,930	48,591	(275)	-2%	35%	-4%	4,490	3%	38%
2035	12,145	74,521	1,145	5,053	(6,520)	74,199	25,930	5,420	1,230	(6,520)	26,060	48,139	(452)	-4%	35%	-4%	4,641	3%	38%
2036	12,474	74,199	1,171	5,022	(6,638)	73,754	26,060	5,597	1,238	(6,638)	26,257	47,497	(642)	-5%	36%	-4%	4,794	3%	38%
<b>2037</b>	<b>12,813</b>	<b>73,754</b>	<b>1,198</b>	<b>4,981</b>	<b>(6,746)</b>	<b>73,188</b>	<b>26,257</b>	<b>5,783</b>	<b>1,249</b>	<b>(6,746)</b>	<b>26,543</b>	<b>46,645</b>	<b>(853)</b>	<b>-7%</b>	<b>36%</b>	<b>-4%</b>	<b>4,955</b>	<b>3%</b>	<b>39%</b>
2038	13,161	73,188	1,227	4,933	(6,844)	72,503	26,543	5,979	1,266	(6,844)	26,944	45,559	(1,086)	-8%	37%	-3%	5,126	3%	39%
2039	13,518	72,503	1,256	4,876	(6,932)	71,703	26,944	6,182	1,288	(6,932)	27,483	44,220	(1,339)	-10%	38%	-3%	5,303	3%	39%
2040	13,885	71,703	1,286	4,812	(7,009)	70,791	27,483	6,391	1,318	(7,009)	28,183	42,608	(1,612)	-12%	40%	-2%	5,486	3%	40%
2041	14,262	70,791	1,317	4,740	(7,076)	69,772	28,183	6,596	1,356	(7,076)	29,058	40,713	(1,895)	-13%	42%	-2%	5,664	3%	40%
<b>2042</b>	<b>14,650</b>	<b>69,772</b>	<b>1,349</b>	<b>4,662</b>	<b>(7,132)</b>	<b>68,650</b>	<b>29,058</b>	<b>6,801</b>	<b>1,402</b>	<b>(7,132)</b>	<b>30,129</b>	<b>38,521</b>	<b>(2,192)</b>	<b>-15%</b>	<b>44%</b>	<b>-1%</b>	<b>5,841</b>	<b>3%</b>	<b>40%</b>
2043	15,048	68,650	1,382	4,577	(7,179)	67,430	30,129	7,012	1,459	(7,179)	31,421	36,009	(2,512)	-17%	47%	-1%	6,025	3%	40%
2044	15,457	67,430	1,416	4,485	(7,215)	66,115	31,421	7,163	1,525	(7,215)	32,893	33,222	(2,787)	-18%	50%	0%	6,210	3%	40%
2045	15,877	66,115	1,451	4,386	(7,244)	64,709	32,893	7,859	1,613	(7,244)	35,122	29,587	(3,635)	-23%	54%	2%	6,880	11%	43%
2046	16,309	64,709	1,488	4,281	(7,265)	63,213	35,122	8,752	1,743	(7,265)	38,353	24,861	(4,727)	-29%	61%	4%	7,745	13%	47%
<b>2047</b>	<b>16,753</b>	<b>63,213</b>	<b>1,525</b>	<b>4,167</b>	<b>(7,291)</b>	<b>61,614</b>	<b>38,353</b>	<b>8,996</b>	<b>1,906</b>	<b>(7,291)</b>	<b>41,963</b>	<b>19,651</b>	<b>(5,209)</b>	<b>-31%</b>	<b>68%</b>	<b>4%</b>	<b>7,961</b>	<b>3%</b>	<b>48%</b>

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports

# Exhibit 7

## Connecticut Retirement System 30 Year Projections

Plans included: State Employees' Retirement System

SMMs	State Contribution Policy										Revenue Constrained Contributions									
	5% Returns					Asset Shock Scenario					5% Returns					Asset Shock Scenario				
	Fiscal Year	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded	Operating Cash Flow to Assets Ratio	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded	Operating Cash Flow to Assets Ratio	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded	Operating Cash Flow to Assets Ratio	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded
2018	3,610	1,648	46%	37%	-1.2%	3,610	1,648	46%	26%	-1.2%	3,610	1,630	45%	37%	-1.4%	3,610	1,558	43%	26%	-2.0%
2019	3,556	1,624	46%	37%	-1.9%	3,556	1,624	46%	28%	-2.6%	3,556	1,697	48%	37%	-1.3%	3,556	1,600	45%	28%	-2.9%
2020	3,680	1,786	49%	38%	-1.2%	3,680	1,928	52%	31%	0.0%	3,680	1,734	47%	38%	-1.6%	3,680	1,678	46%	30%	-2.6%
2021	3,809	1,759	46%	38%	-1.9%	3,787	1,899	50%	34%	-0.9%	3,809	1,812	48%	38%	-1.5%	3,787	1,762	47%	33%	-2.2%
<b>2022</b>	<b>3,942</b>	<b>2,084</b>	<b>53%</b>	<b>40%</b>	<b>0.0%</b>	<b>3,897</b>	<b>2,226</b>	<b>57%</b>	<b>36%</b>	<b>1.3%</b>	<b>3,942</b>	<b>1,891</b>	<b>48%</b>	<b>39%</b>	<b>-1.5%</b>	<b>3,897</b>	<b>1,829</b>	<b>47%</b>	<b>33%</b>	<b>-2.1%</b>
2023	4,080	2,157	53%	41%	0.0%	4,010	2,291	57%	37%	1.2%	4,080	1,966	48%	40%	-1.4%	4,010	1,902	47%	33%	-2.0%
2024	4,223	2,268	54%	43%	0.2%	4,127	2,456	59%	40%	1.7%	4,223	2,041	48%	41%	-1.4%	4,127	1,974	48%	34%	-2.0%
2025	4,371	2,348	54%	44%	0.2%	4,247	2,527	59%	42%	1.6%	4,371	2,113	48%	42%	-1.4%	4,247	2,044	48%	35%	-2.1%
2026	4,524	2,314	51%	46%	-0.5%	4,371	2,421	55%	44%	0.3%	4,524	2,185	48%	43%	-1.4%	4,371	2,113	48%	35%	-2.1%
<b>2027</b>	<b>4,682</b>	<b>2,395</b>	<b>51%</b>	<b>48%</b>	<b>-0.4%</b>	<b>4,501</b>	<b>2,492</b>	<b>55%</b>	<b>46%</b>	<b>0.3%</b>	<b>4,682</b>	<b>2,257</b>	<b>48%</b>	<b>44%</b>	<b>-1.4%</b>	<b>4,501</b>	<b>2,183</b>	<b>49%</b>	<b>36%</b>	<b>-2.0%</b>
2028	4,846	2,350	48%	49%	-1.1%	4,636	2,418	52%	47%	-0.6%	4,846	2,338	48%	46%	-1.3%	4,636	2,262	49%	37%	-1.9%
2029	5,016	2,433	48%	51%	-1.0%	4,774	2,490	52%	49%	-0.6%	5,016	2,422	48%	47%	-1.2%	4,774	2,343	49%	38%	-1.8%
2030	5,191	2,390	46%	53%	-1.5%	4,916	2,436	50%	51%	-1.3%	5,191	2,505	48%	49%	-1.1%	4,916	2,423	49%	40%	-1.7%
2031	5,373	2,474	46%	55%	-1.4%	5,063	2,509	50%	53%	-1.2%	5,373	2,591	48%	51%	-1.0%	5,063	2,506	50%	41%	-1.6%
<b>2032</b>	<b>5,561</b>	<b>2,434</b>	<b>44%</b>	<b>57%</b>	<b>-1.9%</b>	<b>5,214</b>	<b>2,465</b>	<b>47%</b>	<b>55%</b>	<b>-1.7%</b>	<b>5,561</b>	<b>2,681</b>	<b>48%</b>	<b>53%</b>	<b>-0.8%</b>	<b>5,214</b>	<b>2,593</b>	<b>50%</b>	<b>43%</b>	<b>-1.4%</b>
2033	5,756	2,520	44%	59%	-1.7%	5,369	2,538	47%	58%	-1.6%	5,756	2,773	48%	56%	-0.6%	5,369	2,682	50%	45%	-1.1%
2034	5,957	1,962	33%	59%	-4.3%	5,530	1,978	36%	59%	-4.4%	5,957	2,866	48%	59%	-0.4%	5,530	2,773	50%	47%	-0.8%
2035	6,166	2,030	33%	60%	-4.1%	5,694	2,037	36%	60%	-4.3%	6,166	2,963	48%	62%	-0.1%	5,694	2,866	50%	50%	-0.4%
2036	6,382	1,968	31%	61%	-4.5%	5,864	1,971	34%	61%	-4.6%	6,382	3,061	48%	66%	0.3%	5,864	2,960	50%	53%	0.0%
<b>2037</b>	<b>6,605</b>	<b>2,037</b>	<b>31%</b>	<b>62%</b>	<b>-4.2%</b>	<b>6,039</b>	<b>2,030</b>	<b>34%</b>	<b>62%</b>	<b>-4.4%</b>	<b>6,605</b>	<b>3,163</b>	<b>48%</b>	<b>71%</b>	<b>0.6%</b>	<b>6,039</b>	<b>3,060</b>	<b>51%</b>	<b>57%</b>	<b>0.5%</b>
2038	6,836	2,024	30%	63%	-4.2%	6,219	2,015	32%	63%	-4.5%	6,836	3,273	48%	76%	1.0%	6,219	3,165	51%	61%	1.0%
2039	7,075	2,095	30%	65%	-3.8%	6,405	2,076	32%	65%	-4.1%	7,075	3,386	48%	82%	1.5%	6,405	3,275	51%	66%	1.5%
2040	7,323	2,086	28%	66%	-3.6%	6,596	2,066	31%	66%	-4.0%	7,323	3,503	48%	88%	1.9%	6,596	3,388	51%	72%	2.1%
2041	7,579	2,159	28%	68%	-3.1%	6,793	2,128	31%	69%	-3.5%	7,579	3,616	48%	96%	2.2%	6,793	3,498	51%	79%	2.6%
<b>2042</b>	<b>7,845</b>	<b>2,149</b>	<b>27%</b>	<b>70%</b>	<b>-2.8%</b>	<b>6,995</b>	<b>2,119</b>	<b>30%</b>	<b>71%</b>	<b>-3.3%</b>	<b>7,845</b>	<b>3,729</b>	<b>48%</b>	<b>104%</b>	<b>2.6%</b>	<b>6,995</b>	<b>3,607</b>	<b>52%</b>	<b>87%</b>	<b>3.0%</b>
2043	8,119	2,224	27%	73%	-2.2%	7,204	2,182	30%	74%	-2.6%	8,119	3,846	47%	113%	2.6%	7,204	3,720	52%	96%	3.5%
2044	8,403	2,282	27%	76%	-1.6%	7,419	2,243	30%	78%	-2.0%	8,403	3,964	47%	123%	2.9%	7,419	3,835	52%	107%	3.6%
2045	8,697	2,362	27%	80%	-0.9%	7,640	2,310	30%	82%	-1.3%	8,697	4,084	47%	134%	3.2%	7,640	3,950	52%	118%	4.0%
2046	9,002	2,311	26%	83%	-0.6%	7,868	2,126	27%	86%	-1.6%	9,002	4,205	47%	146%	3.4%	7,868	4,067	52%	131%	4.2%
<b>2047</b>	<b>9,317</b>	<b>2,392</b>	<b>26%</b>	<b>88%</b>	<b>0.1%</b>	<b>8,102</b>	<b>2,190</b>	<b>27%</b>	<b>91%</b>	<b>-0.9%</b>	<b>9,317</b>	<b>4,326</b>	<b>46%</b>	<b>159%</b>	<b>3.6%</b>	<b>8,102</b>	<b>4,184</b>	<b>52%</b>	<b>145%</b>	<b>4.4%</b>

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports

# Exhibit 8

## Connecticut Retirement System 30 Year Projections

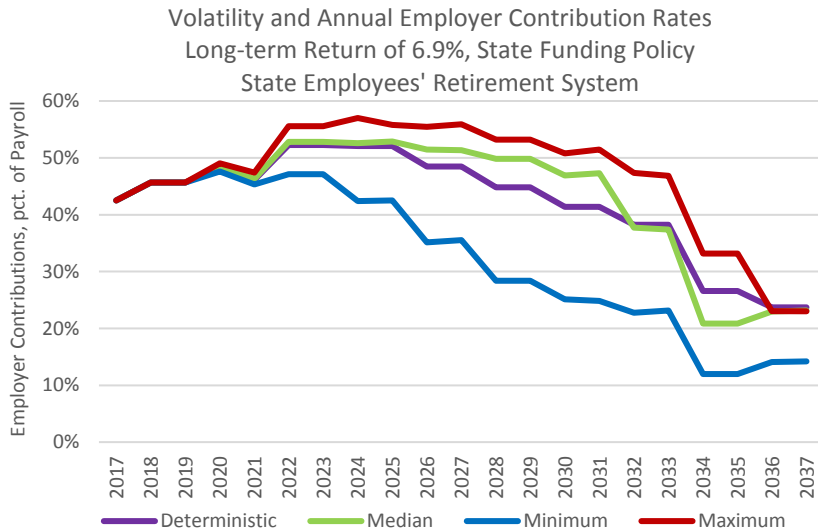
Plans included: Teachers' Retirement System

Fiscal Year	State Contribution Policy										Revenue Constrained Contributions									
	5% Returns					Asset Shock Scenario					5% Returns					Asset Shock Scenario				
	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded	Operating Cash Flow to Assets Ratio	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded	Operating Cash Flow to Assets Ratio	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded	Operating Cash Flow to Assets Ratio	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded	Operating Cash Flow to Assets Ratio
2018	4,211	1,259	30%	55%	-3.1%	4,211	1,259	30%	39%	-3.1%	4,211	1,010	24%	54%	-4.5%	4,211	965	23%	38%	-4.8%
2019	4,348	1,280	29%	55%	-3.2%	4,348	1,280	29%	42%	-4.4%	4,348	1,051	24%	53%	-4.6%	4,348	991	23%	40%	-6.9%
2020	4,489	1,408	31%	55%	-2.9%	4,489	1,533	34%	45%	-2.6%	4,489	1,074	24%	52%	-4.9%	4,489	1,039	23%	41%	-6.7%
2021	4,635	1,454	31%	55%	-3.0%	4,597	1,570	34%	48%	-2.6%	4,635	1,122	24%	51%	-5.0%	4,597	1,091	24%	43%	-6.3%
<b>2022</b>	<b>4,786</b>	<b>1,561</b>	<b>33%</b>	<b>55%</b>	<b>-2.7%</b>	<b>4,707</b>	<b>1,871</b>	<b>40%</b>	<b>49%</b>	<b>-0.9%</b>	<b>4,786</b>	<b>1,171</b>	<b>24%</b>	<b>50%</b>	<b>-5.2%</b>	<b>4,707</b>	<b>1,133</b>	<b>24%</b>	<b>41%</b>	<b>-6.2%</b>
2023	4,941	1,611	33%	55%	-2.8%	4,820	1,916	40%	50%	-0.9%	4,941	1,218	25%	49%	-5.4%	4,820	1,178	24%	40%	-6.5%
2024	5,102	2,080	41%	56%	-0.6%	4,936	2,378	48%	53%	1.4%	5,102	1,264	25%	47%	-5.5%	4,936	1,222	25%	38%	-6.7%
2025	5,267	2,148	41%	58%	-0.6%	5,054	2,435	48%	55%	1.3%	5,267	1,309	25%	46%	-5.7%	5,054	1,266	25%	37%	-7.0%
2026	5,439	2,528	46%	60%	0.9%	5,176	2,652	51%	58%	2.1%	5,439	1,353	25%	45%	-5.9%	5,176	1,309	25%	36%	-7.3%
<b>2027</b>	<b>5,615</b>	<b>2,611</b>	<b>46%</b>	<b>63%</b>	<b>0.9%</b>	<b>5,304</b>	<b>2,718</b>	<b>51%</b>	<b>61%</b>	<b>2.0%</b>	<b>5,615</b>	<b>1,398</b>	<b>25%</b>	<b>44%</b>	<b>-6.1%</b>	<b>5,304</b>	<b>1,352</b>	<b>25%</b>	<b>34%</b>	<b>-7.6%</b>
2028	5,798	3,119	54%	66%	2.8%	5,435	3,124	57%	66%	3.4%	5,798	1,448	25%	42%	-6.3%	5,435	1,401	26%	33%	-7.9%
2029	5,986	3,220	54%	71%	2.7%	5,570	3,201	57%	70%	3.2%	5,986	1,500	25%	41%	-6.5%	5,570	1,451	26%	31%	-8.2%
2030	6,181	4,110	67%	77%	5.6%	5,708	3,961	69%	77%	5.7%	6,181	1,551	25%	40%	-6.6%	5,708	1,501	26%	30%	-8.5%
2031	6,382	4,244	66%	84%	5.2%	5,849	4,059	69%	84%	5.3%	6,382	1,605	25%	38%	-6.8%	5,849	1,552	27%	28%	-8.9%
<b>2032</b>	<b>6,589</b>	<b>7,359</b>	<b>112%</b>	<b>99%</b>	<b>13.9%</b>	<b>5,994</b>	<b>6,753</b>	<b>113%</b>	<b>99%</b>	<b>13.1%</b>	<b>6,589</b>	<b>1,660</b>	<b>25%</b>	<b>37%</b>	<b>-7.1%</b>	<b>5,994</b>	<b>1,606</b>	<b>27%</b>	<b>27%</b>	<b>-9.4%</b>
2033	6,803	7,599	112%	114%	12.1%	6,142	6,921	113%	114%	11.4%	6,803	1,717	25%	36%	-7.3%	6,142	1,661	27%	25%	-10.0%
2034	7,024	253	4%	112%	-5.6%	6,294	227	4%	113%	-5.7%	7,024	1,775	25%	34%	-7.6%	6,294	1,717	27%	23%	-10.7%
2035	7,253	261	4%	110%	-5.8%	6,450	232	4%	111%	-6.0%	7,253	1,835	25%	33%	-7.9%	6,450	1,775	28%	22%	-11.5%
2036	7,488	270	4%	107%	-6.0%	6,610	238	4%	109%	-6.2%	7,488	1,896	25%	31%	-8.2%	6,610	1,834	28%	20%	-12.5%
<b>2037</b>	<b>7,732</b>	<b>278</b>	<b>4%</b>	<b>105%</b>	<b>-6.2%</b>	<b>6,774</b>	<b>244</b>	<b>4%</b>	<b>107%</b>	<b>-6.4%</b>	<b>7,732</b>	<b>1,959</b>	<b>25%</b>	<b>30%</b>	<b>-8.6%</b>	<b>6,774</b>	<b>1,895</b>	<b>28%</b>	<b>18%</b>	<b>-13.7%</b>
2038	7,983	287	4%	102%	-6.5%	6,941	250	4%	105%	-6.7%	7,983	2,027	25%	28%	-9.0%	6,941	1,961	28%	16%	-15.2%
2039	8,243	297	4%	100%	-6.7%	7,113	256	4%	103%	-7.0%	8,243	2,097	25%	27%	-9.5%	7,113	2,028	29%	14%	-17.2%
2040	8,510	306	4%	97%	-7.0%	7,289	262	4%	101%	-7.4%	8,510	2,169	25%	25%	-10.0%	7,289	2,098	29%	12%	-19.9%
2041	8,787	316	4%	94%	-7.4%	7,470	269	4%	99%	-7.8%	8,787	2,240	25%	24%	-10.7%	7,470	2,166	29%	10%	-23.8%
<b>2042</b>	<b>9,073</b>	<b>327</b>	<b>4%</b>	<b>91%</b>	<b>-7.7%</b>	<b>7,655</b>	<b>276</b>	<b>4%</b>	<b>96%</b>	<b>-8.2%</b>	<b>9,073</b>	<b>2,310</b>	<b>25%</b>	<b>22%</b>	<b>-11.6%</b>	<b>7,655</b>	<b>2,234</b>	<b>29%</b>	<b>7%</b>	<b>-30.0%</b>
2043	9,367	337	4%	88%	-8.2%	7,844	282	4%	94%	-8.8%	9,367	2,382	25%	20%	-12.6%	7,844	2,304	29%	5%	-40.9%
2044	9,672	2,123	22%	89%	-4.0%	8,038	289	4%	91%	-9.4%	9,672	2,455	25%	18%	-13.8%	8,038	2,375	30%	2%	-65.7%
2045	9,986	2,192	22%	90%	-4.1%	8,237	297	4%	88%	-10.1%	9,986	2,529	25%	16%	-15.4%	8,237	2,930	36%	0%	N/A
2046	10,311	3,269	32%	94%	-1.5%	8,441	1,625	19%	89%	-6.6%	10,311	2,604	25%	14%	-17.6%	8,441	3,678	44%	0%	N/A
<b>2047</b>	<b>10,646</b>	<b>3,375</b>	<b>32%</b>	<b>98%</b>	<b>-1.4%</b>	<b>8,650</b>	<b>1,665</b>	<b>19%</b>	<b>90%</b>	<b>-7.0%</b>	<b>10,646</b>	<b>2,679</b>	<b>25%</b>	<b>12%</b>	<b>-20.6%</b>	<b>8,650</b>	<b>3,777</b>	<b>44%</b>	<b>0%</b>	<b>N/A</b>

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports

**Exhibit 9**

**Connecticut Retirement System  
State Employees' Retirement System  
Simulation Analysis**



Source: The Terry Group and The Pew Charitable Trusts

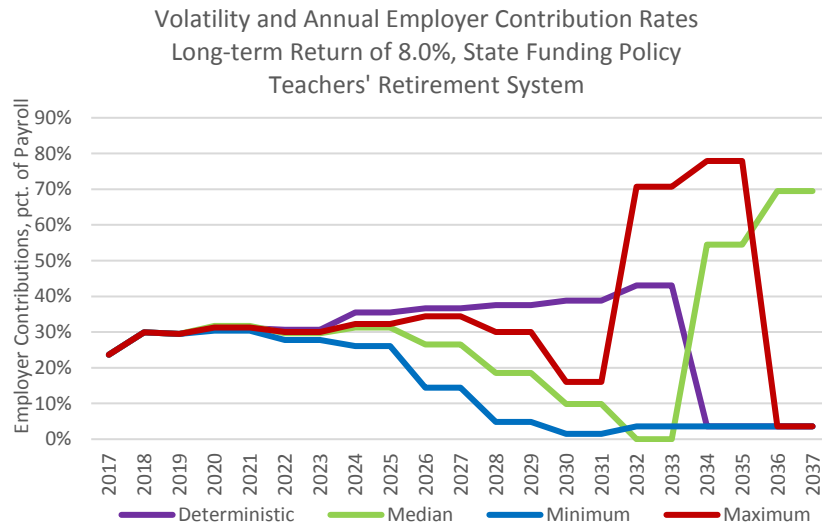
Note: Minimum, Maximum, and Median employer contribution rates are identified using the cumulative 20-year contribution rate.

Simulation Analysis of Employer Contributions Percent of Payroll and Plan Funded Ratio State Employees' Retirement System				
10 trials with 6.9% returns	Cumulative 10-Year Contribution Rate		Cumulative 20-Year Contribution Rate	
	Funded Ratio in 2027	Funded Ratio in 2037	Funded Ratio in 2027	Funded Ratio in 2037
Minimum	43%	44%	35%	60%
Maximum	52%	76%	48%	102%
Median	49%	51%	45%	82%
Deterministic: 6.9% Returns	49%	56%	44%	80%

With fixed returns of 6.9 percent, employer contributions to SERS are expected to take up 49 percent of payroll over the next 10 years and 44 percent over the next 20. Examining 10 trials, each with 20-year returns of about 6.9 percent, but simulated volatility in investment returns each year, employer costs can range 35 percent to 48 percent of payroll across a 20-year period where overall returns meet the plan's assumed rate of return.

**Exhibit 10**

**Connecticut Retirement System  
Teachers' Retirement System  
Simulation Analysis**



Source: The Terry Group and The Pew Charitable Trusts

Note: Minimum, Maximum, and Median employer contribution rates are identified using the cumulative 20-year contribution rate.

Simulation Analysis of Employer Contributions Percent of Payroll and Plan Funded Ratio Teachers' Retirement System				
10 trials with 8.0% returns	Cumulative 10-Year		Cumulative 20-Year	
	Contribution Rate	Funded Ratio in 2027	Contribution Rate	Funded Ratio in 2037
Minimum	26%	64%	18%	81%
Maximum	38%	118%	34%	150%
Median	30%	86%	29%	124%
Deterministic: 8.0% Returns	32%	78%	30%	115%

With fixed returns of 8 percent, employer contributions to TRS are expected to take up 32 percent of payroll over the next 10 years and 30 percent over the next 20. Examining 10 trials, each with 20-year returns of about 8 percent, but simulated volatility in investment returns each year, employer costs can range 18 percent to 34 percent of payroll across a 20-year period where overall returns meet the plan's assumed rate of return.

**Exhibit 11****Connecticut Retirement System  
State Employees' Retirement System****Sensitivity of Liabilities**

	<b>Approximate Defeasement Rate (4.00%) [1]</b>	<b>1% Decrease (5.90%)</b>	<b>Current Discount Rate (6.90%)</b>	<b>1% Increase (7.90%)</b>
System's total pension liability	\$48,651,487	\$37,903,890	\$33,616,716	\$30,048,806
System's net pension liability	\$37,997,695	\$27,250,098	\$22,962,924	\$19,395,014
Funded ratio	22%	28%	32%	35%

**Sensitivity of Normal Cost**

	<b>Low Discount Rate (5.00%)</b>	<b>1% Decrease (5.90%)</b>	<b>Current Discount Rate (6.90%)</b>	<b>1% Increase (7.90%)</b>
Total service cost as a percentage of covered payroll	12.0%	10.6%	9.2%	7.7%
Employee service cost as a percentage of covered payroll	7.4%	6.7%	6.0%	6.0%
Employer service cost as a percentage of covered payroll	4.6%	3.9%	3.2%	1.7%

Notes: Numbers in thousands. Normal cost includes costs associated with DC benefits. Liability and funded ratio as of fiscal year 2016.

[1] A measure calculated using benefits accrued, discounted at a lower rate based on draft amendments to Actuarial Standard of Practice (ASOP) No. 4, which would require this measure. Pew's analysis uses a discount rate of 4 percent using reported actuarial liabilities (preserving the plan's actuarial cost method) to approximate this.

**Exhibit 12****Connecticut Retirement System  
Teachers' Retirement System****Sensitivity of Liabilities**

	<b>Approximate Defeasement Rate (4.00%) [1]</b>	<b>1% Decrease (7.00%)</b>	<b>Current Discount Rate (8.00%)</b>	<b>1% Increase (9.00%)</b>
System's total pensions liability	\$47,427,975	\$33,169,271	\$29,839,923	\$27,025,483
System's net pension liability	\$31,833,103	\$17,574,399	\$14,245,051	\$11,430,611
Funded Ratio	33%	47%	52%	58%

**Sensitivity of Normal Cost**

	<b>Low Discount Rate (5.00%)</b>	<b>1% Decrease (7.00%)</b>	<b>Current Discount Rate (8.00%)</b>	<b>1% Increase (9.00%)</b>
Total service cost as a percentage of covered payroll	17.4%	12.8%	10.6%	8.3%
Employee service cost as a percentage of covered payroll	6.0%	6.0%	6.0%	6.0%
Employer service cost as a percentage of covered payroll	11.4%	6.8%	4.6%	2.3%

Notes: Numbers in thousands. Normal cost includes costs associated with DC benefits. Liability and funded ratio as of fiscal year 2016.

[1] A measure calculated using benefits accrued, discounted at a lower rate based on draft amendments to Actuarial Standard of Practice (ASOP) No. 4, which would require this measure. Pew's analysis uses a discount rate of 4 percent using reported actuarial liabilities (preserving the plan's actuarial cost method) to approximate this.