

Overview

This pension stress test analysis is designed to aid legislators and other stakeholders in their assessment of the report required by Senate Bill 1502 and adopted in the 2018-2019 Budget and Appropriations Act. The results are based on projections for the State Employees' Retirement System (SERS) and Teachers' Retirement System (TRS). These two plans account for 99 percent of total pension liabilities of the plans included in Connecticut's comprehensive annual financial reports.

The analysis is informed by the Actuarial Standards Board's recent 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*.¹

We focus specifically on investment risk—the risk that investments deviate from expected performance; and contribution risk—the risk that contributions fall below the rate required to meet funding objectives. This resulting analysis is intended to be accessible to all stakeholders and was designed to inform planning and decision making.

Specifically, this report provides information designed to help policymakers: (1) plan for the possibility of an extended period of lower investment returns and higher budget costs; (2) prepare for the impact of the next recession on pension system solvency and government budgets; (3) assess whether current policies are sufficient to effectively manage financial market volatility throughout the business cycle; (4) estimate the impact of investment risk on the range of potential costs for current benefits and liabilities; and (5) provide budget officials and legislators with a tool to assess the impact of proposed and enacted policy changes.

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 are instead 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.

¹ 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 for Business and Government Working Paper No.92.

- **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 into a hybrid plan is projected to significantly mitigate risk of higher employer 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.²

The analysis examines the Connecticut State Employees' Retirement System (SERS) and the Connecticut Teachers' Retirement System (TRS) independently, and as they impact the state budget collectively. When comparing results from the two plans, it is important to consider their different discount rates: TRS' discount rate is 8 percent, while SERS' rate is 6.9 percent. The higher rate for TRS effectively lowers the present value of TRS' future liabilities relative to those of SERS, and therefore results in a higher funded status and lower required contribution levels than the plan would face if its discount rate equaled that of SERS.

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.

² Mennis, et al. (2018).

Summary of Methodology

To meet the goals and objectives outlined above, we employ a stress test simulation model that forecasts pension balance sheet, contribution, and cash flow metrics over a 30-year period, using both deterministic and stochastic methods. Deterministic simulations are used to test results under precise circumstances of our own design, for example, by measuring the impact of lower-than-expected investment returns on pension costs and fiscal position. Stochastic simulations are used to evaluate the probable impact of financial market volatility on pension plan finances and government budgets, highlighting the risk inherent in the system even if long-term return assumptions are met.

To examine the impact of investment risk on the Connecticut retirement systems we use two economic scenarios. In the fixed 5 percent return scenario, a single low rate of return is applied to the model for each year in the forecast period, providing estimates of pension costs to the state should long-term target returns not be met. In the asset shock scenario, we incorporate an initial decline in the stock market of approximately 25 percent with a three-year recovery followed by low returns over the long term.³ This scenario is designed to model the impact of a recession on asset levels and pension costs.

Although modeling market downturns is at the heart of stress testing, policymakers’ responses to investment losses are a source of equal risk to plans’ fiscal health. Our model examines two behavioral assumptions to assess this contribution risk. First, the state policy assumption, under which Connecticut increases funding to offset losses based on written state policy. And second, the revenue constrained assumption, under which contribution are set at a fixed percentage of state revenue (modeling a situation where policymakers choose to avoid crowding out other spending to allow for increased pension contributions). A more comprehensive discussion of our methodology can be found in our research paper, referenced above.⁴

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³ The asset shock scenario is based on the Federal Reserve’s “2017 Supervisory Scenarios for Annual Stress Tests Required under the Dodd-Frank Act Stress Testing Rules.”

⁴ Mennis, et al. (2018).

Glossary of Terms

Asset shock scenario: Economic scenario used in Pew's stress test analysis that incorporates an initial adverse shock followed by low returns over the long term. The scenario is based on the Federal Reserve's scenarios for stress testing under the Dodd-Frank Act.

Deterministic simulation: Simulation used in Pew's stress test analysis to illustrate how portfolios perform under precise circumstances of our own design, by modeling a single trial that strictly applies the same user-specified assumptions on investment returns and economic metrics to each year in the forecast.

Fixed 5 percent returns scenario: Scenario applied to Pew's stress test analysis that uses a low rate of return of 5 percent over an entire forecast period. The 5 percent return assumption represents an approximately 25th percentile scenario based on Pew's capital market assumptions. The purpose of this scenario is to assess how plans perform when investment returns are lower than expected over the long term.

Funded ratio: The level of assets at market value in proportion to accrued pension liability. This is an annual point-in-time measure, as of the valuation date. We refer to the funded ratio based on the plan's assumed rate of return as the Actuarial Funded Ratio, and the ratio using a lower rate to approximate state borrowing costs as a Defeasement Ratio.

Investment Risk Defeasement Measure: 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.

Normal Cost: The cost of benefits earned by employees in any given year. Also called service cost.

Operating cash flow ratio: A metric calculated as the difference between contributions and benefits (operating cash flow) divided by pension plan assets. Provides a benchmark from the rate of return required to ensure that asset balances do not decline. Measured as

$$\left[\frac{\text{Total Contributions} - \text{Benefit Payments}}{\text{Plan Assets at the Beginning of the Year}} \right]$$

Most public pension funds exhibit negative operating cash flow, and this ratio provides a benchmark for the rate of return required to ensure that assets do not decline. Plans with a negative operating cash flow ratio that is consistently greater than the assumed rate of return will face asset depletion.

State policy (behavioral) assumption: Condition applied to Pew's stress test analysis that assumes strict adherence to current funding requirements, actuarial or otherwise, based on states' written contribution policy.

Stochastic simulations: Simulations used in Pew's stress test analysis that model the probabilities of various financial outcomes given specified means and standard deviations of economic variables and market returns. Our stress test model generates 10,000 runs for each simulation, which yields a distribution of investment returns for each year.

Revenue Constrained (behavioral) assumption: Condition applied to Pew's stress test analysis that assumes contributions are set at a fixed percentage of state revenue. The revenue constrained assumption implicitly sets a limit on what is affordable so as not to place strain on other areas of the budget.

Section 1: Planning for Lower Returns and Higher Costs

Fixed 5 Percent Return Scenario

Financial experts expect investments to perform below historical averages going forward, and we project a one-in-four chance that long-term returns could be as low as 5 percent for the typical public pension fund in the future. In the fixed 5 percent return scenario, a single low rate of return is applied to the model for each year in the forecast period to generate estimates of pension costs to the state, and the projected funded status of the state's pension plans, should long-term target returns not be met. This scenario was designed to provide a reasonably likely downside scenario and a close approximation for the 25th percentile of 20-year projected returns (i.e., plans face a one-in-four chance of earning 5 percent or less over a 20-year time horizon).

For this scenario, we estimate the impact on the state budget and retirement system financials under both the **state policy** and **revenue constrained** contribution assumptions as described in the methodology. The analysis below is based on the results provided in the legislative stress test report.

Impact to State Budget if Required Contributions under State Policy are Made

We analyze the potential impact of lower returns on the state budget by applying a **fixed 5 percent** return (i.e. **deterministic**) scenario, and assuming that all required pension contributions are made in accordance with **state policy**. Under these conditions, total employer contribution rates for SERS and TRS combined are projected to increase from 13 percent of state own-source revenue in 2017 to 19 percent in 2028, peaking at 30 percent of revenue in 2032 and potentially crowding-out more than \$10 billion in other government spending over that time.⁵ By way of comparison, the estimated maximum share of state revenue required to fund Connecticut's pensions under a baseline scenario using plan assumed rates of return is 16 percent (see **Figure 1**).

At a plan level, contribution rates are assessed as a percentage of participant payroll rather than state revenue. **Figure 2** illustrates that the bulk of the projected increase in state contributions under this scenario can be attributed to TRS: contributions from the plan are projected to increase from 24 percent of payroll in 2017 to 46 percent in 2027 and over 100 percent in 2032. The results for SERS are much more stable, with contributions increasing from 42 percent of payroll in 2017 to 51 percent in 2027.

⁵ Projections of government spending crowd-out were estimated using the difference in projected growth rates for Connecticut own-source revenues and employer contributions under this scenario.

Figure 1

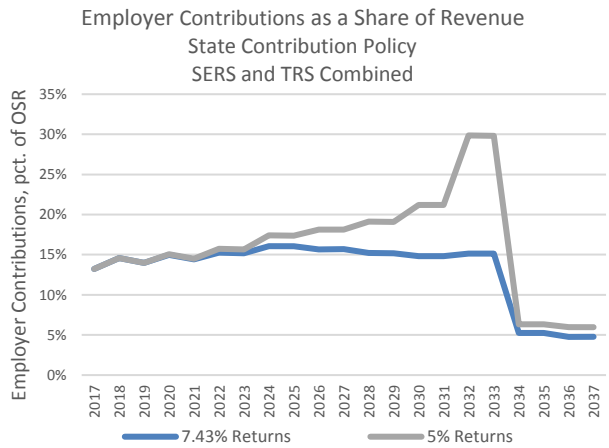
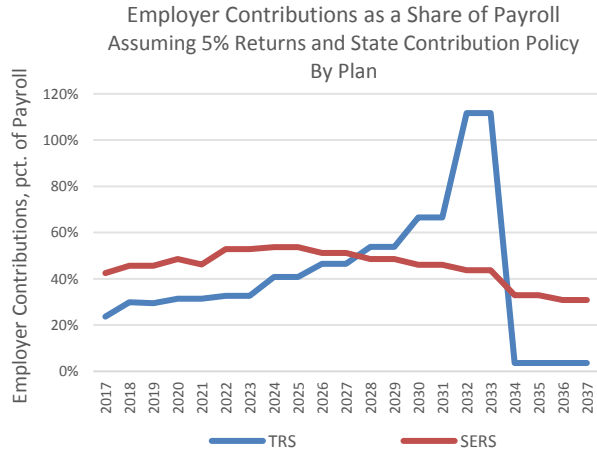


Figure 2



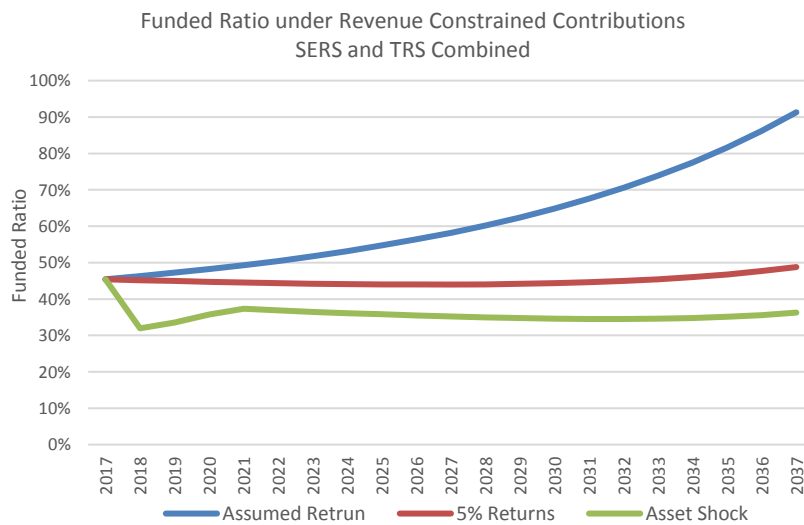
Note: See “Legislative Stress Test Report for Connecticut Public Pensions,” Exhibits 1 & 3 (for Figure 1) and Exhibits 7 & 8 (for Figure 2).
 Source: The Terry Group and The Pew Charitable Trusts

These results are consistent with statements made by public officials suggesting that required contributions under current state policy — particularly those for TRS under the terms of the 2008 Pension Obligation Bond (POB) covenants — may not be affordable.

Impact to State Pension Balance Sheet if Contributions Fall Short of Required Amounts

We also assess the potential impact on state plans’ balance sheets should employer contributions fall short of required levels during a prolonged market downturn. Using the **5 percent return** scenario and the **revenue constrained** assumption, in which annual contributions increase only at the rate of revenue growth, we project a relatively static **funded ratio** for both plans combined of between 44 percent and 49 percent over the 20-year forecast period (**Figure 3**). Asset levels would increase modestly from \$29 billion in 2017 to \$33 billion in 2027 under this scenario (see detailed financial metrics in the Appendix).

Figure 3



Note: See “Legislative Stress Test Report for Connecticut Public Pensions,” Exhibits 2, 4, & 6. Assumed return is calculated using the liability-weighted average of expected returns for SERS (6.9%) and TRS (8%).
 Source: The Terry Group and The Pew Charitable Trusts

These relatively stable outcomes are primarily a function of an already-high ratio of total contributions to benefit payments for Connecticut plans combined — the 5th highest among the 50 states at 84 percent in 2016. The high ratio helps to insulate the state’s pension systems against the risk of fiscal distress, even under conditions in which both returns and state contributions fall short of plan assumptions and policies. However, the persistent low funded ratio also means that Connecticut’s employer contributions as a percentage of payroll – again, 5th highest among states at 32 percent — could potentially persist for decades if returns fall short of expectations and policymakers are unable to increase the current share of state resources used to pay for pension costs.⁶

It is important to recognize that these results are for Connecticut’s largest two plans combined; however, as shown in Section 2, SERS and TRS have very different financial positions and could respond very differently to economic downturns in the future

⁶ See Mennis, et al. (2018), for a further discussion of the likelihood of persistent high costs for Connecticut public retirement systems.

Section 2: Preparing for the Next Recession

Asset Shock Scenario

Evaluating the risk of a steep decline in asset values – as typically occurs during the onset of a recession – is a primary function of public pension stress test analysis. The asset shock scenario is based on assumptions used by the Federal Reserve Bank to stress test financial institutions as required under the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010. When applied to Connecticut’s state pension plans, these assumptions result in an initial 25 percent drop in asset value, followed by a 3-year recovery period with an average of 12 percent returns. To further test long-term resiliency, we assume long-term equity returns of approximately 5 percent after the period of economic recovery. We also assume an initial decline in state revenues, followed by steady recovery, for purposes of assessing impacts to the state budget under an asset shock scenario.⁷

Measuring Solvency Risk

The asset shock scenario can be used to evaluate potential pressures on state budgets, as well as the likelihood of plan fiscal distress, during an economic downturn. We define fiscal distress using three criteria: (1) declining asset levels, due to negative operating cash flows that exceed the offsetting impact of annual investment earnings; (2) a high probability that system assets will be depleted within 20 years; and (3) the resulting transition to pay-go funding, which would require substantial increases in contributions from the state budget.

The ratio of operating cash flow to assets is an important early indicator of long-term fiscal solvency for poorly funded plans. This metric is based on the difference between contributions and benefits (operating cash flow) and is calculated as a ratio of plan assets. The ratio serves as a benchmark for the rate of return that a plan must earn to prevent assets from declining.

Most mature public pension funds exhibit negative operating cash flow – in aggregate, US state pension plans had an operating cash flow ratio of -3.2 percent in 2016. We closely monitor states with a cash flow ratio below -5 percent, as they are more likely to experience declining assets – an early signal of potential insolvency.

Impact of Asset Shock on Connecticut Plans

We first analyze the potential for insolvency in Connecticut’s pension plans by applying the **asset shock** scenario assuming **revenue constrained** employer contributions. Under these conditions, the analysis reveals very different trajectories for SERS and TRS. The analysis for SERS projects a substantial improvement in the cash flow ratio over time: plan funding levels increase over the forecast period despite low returns and the constraint on employer contributions (see **Figure 4**). This result can be attributed in part to funding and benefit reforms enacted in 2017 designed to stabilize the state’s budget outflows to the system over time. However, the stability in fiscal position and asset levels is mainly driven by the plan’s high contribution rates – equal to 84 percent of annual benefit payments in 2016 – that ultimately constrain government spending on other services.

Conversely, TRS, with an 8 percent long-term expected return well above SERS’ 6.9 percent assumption, does not fare well under an asset shock scenario with revenue constrained contributions. Under these

⁷ See Mennis, et al. (2018), for a detailed description of scenario and revenue forecast methodologies.

assumptions, TRS' funded ratio would decline to approximately 18 percent in 2037 and, with an operating cash flow ratio of -14 percent, faces a clear risk of insolvency (see **Figure 5**). Analysis of TRS in the previous section of this report provided strong evidence that changes in plan funding policy are necessary to eliminate contribution spikes and ensure contributions remain affordable every year. At the same time, the results presented here suggests that current TRS funding levels may still need to be increased as a share of the state's revenue over time to ensure the fiscal sustainability of the plan.

Figure 4

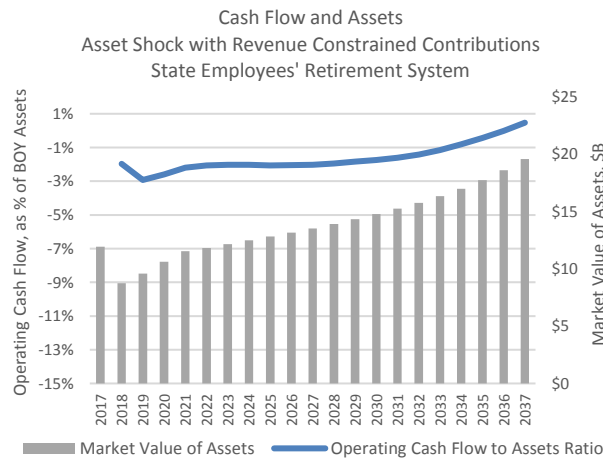
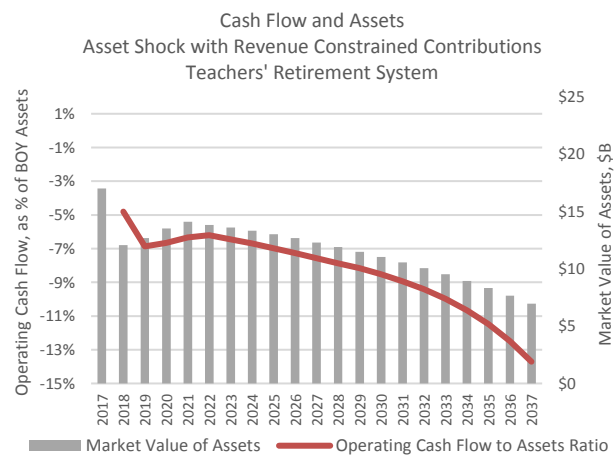


Figure 5

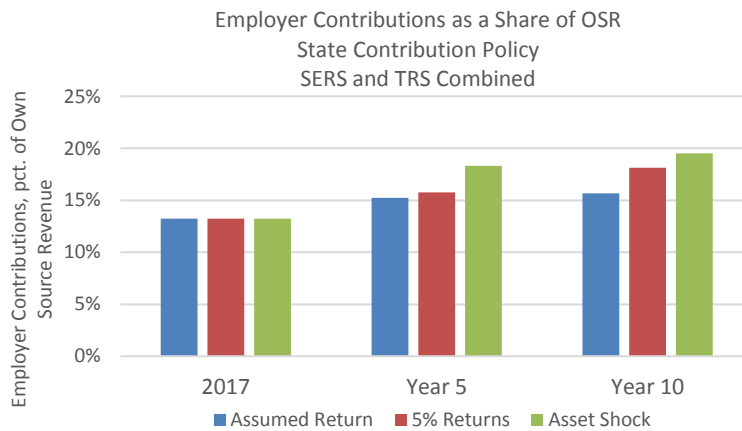


Note: See "Legislative Stress Test Report for Connecticut Public Pensions," Exhibits 7 & 8.
 Source: The Terry Group and The Pew Charitable Trusts

Budget Impact if State Policy Contributions are Made

We also employ an **asset shock** scenario under which full contributions are made based on **state policy** to assess the potential impact of an economic downturn on the Connecticut state budget. In this analysis, we see a more pronounced version of the spike in employer contributions calculated for Connecticut plans under the 5 percent return scenario discussed in Section 1. Specifically, we estimate that state pension costs for SERS and TRS combined would increase from 13 percent of Connecticut's own-source revenue (OSR) in 2017 to nearly 20 percent in 2027 (**Figure 6**).

Figure 6



Note: See "Legislative Stress Test Report for Connecticut Public Pensions," Exhibits 1, 3, & 5. Assumed return is calculated using the liability-weighted average of expected returns for SERS (6.9%) and TRS (8%).
 Source: The Terry Group and The Pew Charitable Trusts

Section 3: Managing Financial Market Volatility

Stochastic Simulation Analysis

Annual fluctuations in market returns can cause volatility in required employer contributions or result in decreased pension plan funding even if long-term returns match the assumptions used by plan actuaries. Indeed, the cost of investment and contribution risks can be significantly amplified when market swings are included in stress test analysis.

The analyses presented in Sections 1 and 2 of this report do not capture this effect, as they are calculated using a single rate of return or similar pre-determined return scenario throughout the forecast period. However, we can also estimate financial outcomes using stochastic analysis, a simulation tool that generates thousands of possible forward-looking trials to examine the probable impact of market uncertainty on financial outcomes. This simulation method can provide policymakers with vital information on how the volatility of annual returns is likely to impact plan solvency and state budgets.

For example, **Figures 7 and 8** illustrate how future market volatility may affect Connecticut’s public plans by comparing results from stochastic simulations that all reach the long-term rate of return assumed for each plan, but yield returns in any given year that deviate from that assumed rate. Each line in **Figure 7** represents a sequence of returns, or trial, that averages to 7.43 percent – the average assumed rate of return for Connecticut SERS and TRS, weighted by liabilities – over a 20-year forecast period. These trials were selected from the 10,000 simulations produced by Pew’s model and illustrate how the path of lower- and higher-than-expected returns can vary over the forecast period. Trial 3, for example, projects low returns in the first half of the forecast period, while Trial 2 has strong initial investment performance followed by low returns in the latter part of the period.⁸

Figure 7

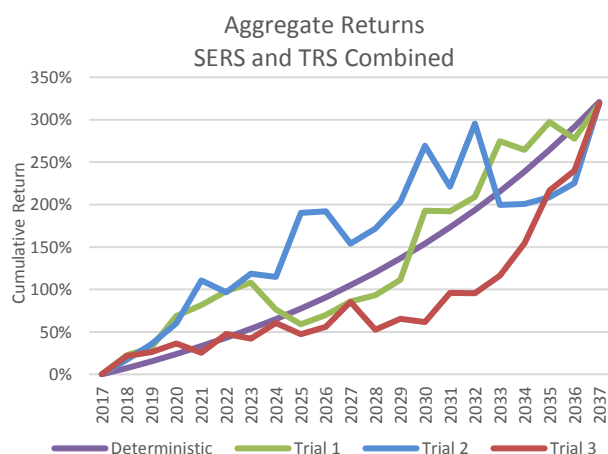
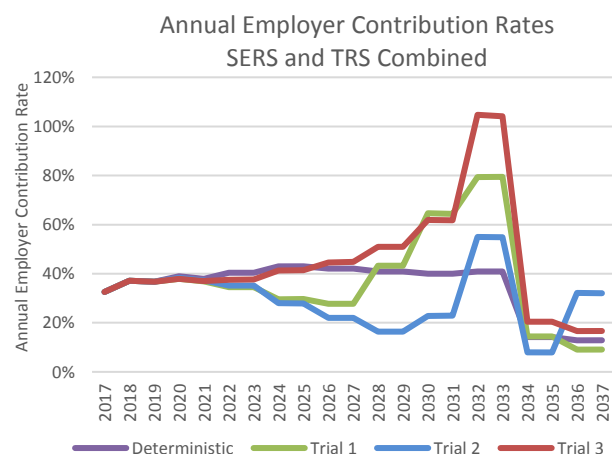


Figure 8



Note: Based on 3 trials with 7.43 percent returns over a 20-year period.
Source: The Terry Group and The Pew Charitable Trusts

⁸ See Mennis, et al. (2018) for a more detailed discussion of stochastic methods as they apply to stress testing public pensions. See, also, Yin, Y., & Boyd, D. (2018). Analyzing the Interplay Between Public-Pension Finances and Governmental Finances: Lessons from Linking an Economic Model to a Pension Fund Model. Brookings Municipal Finance Conference.

Figure 8 illustrates the corresponding annual required employer contribution rates for each of those trials, highlighting just how significantly market volatility can impact plan finances. In Trial 3, for example, low returns in the first years of the forecast period slow initial asset growth, and prompt higher-than-expected required contributions throughout the period. Conversely, higher early returns in Trial 2 contribute to a larger-than-expected asset base, resulting in significantly lower-than-anticipated employer contributions during the 20-year forecast period. In all cases, the employer contribution rate is more volatile in the stochastic simulation analysis than when using a fixed, stable rate of return.

This analysis illustrates the value of stochastic simulation analysis: its capacity to generate a range of probable plan and state budget financial outcomes caused by financial market volatility.

Impact of Market Volatility on Connecticut SERS and TRS

Changes to both pension costs and plan solvency from two primary sources can be estimated for Connecticut’s pension plans: the volatility and timing of returns over the forecast period; and the state’s pension contribution policy in response to that volatility. Comparing simulation results for SERS and TRS also illustrates how the impact of volatility differs based on contribution policy, assumptions, and plan design.

Figure 9 below illustrates employer contributions estimated under a deterministic trial in which CT SERS’s expected return of 6.9 percent is met each year; and the range of projected annual employer contribution rates generated by 10 stochastic simulation trials that all yield a 20-year return equal to that target. As shown in **Figure 10**, if the plan meets that target each and every year, employer contributions would equal 44 percent of payroll over the 20-year forecast period, and the funded ratio would reach 80 percent in 2037. However, introducing variability in returns over the same period can produce very different results. Specifically, we find that contributions throughout the forecast period could range from 35 to 48 percent of payroll depending on the sequence of annual returns; and that the funded ratio in 2037 could fall anywhere between 60 and 102 percent.

Figure 9

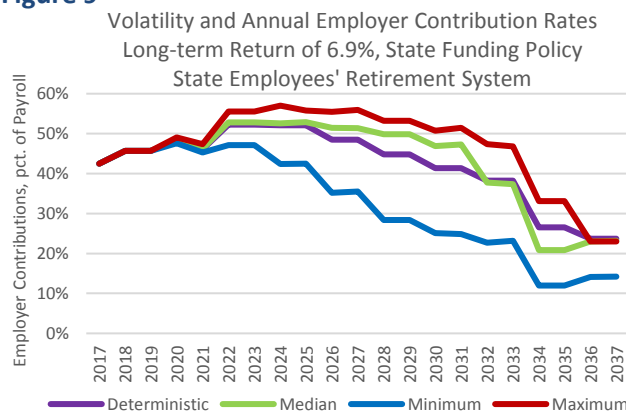


Figure 10

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

Note: Similar analyses are included in “Legislative Stress Test Report for Connecticut Public Pensions,” Exhibits 9 & 10. In a previous version of this report, Figure 9 did not properly reflect the median outcome. This report has been modified to more clearly represent it.

Source: The Terry Group and The Pew Charitable Trusts

Similarly, results for TRS are provided in **Figures 11** and **12**. Note that expected contributions for TRS are generally lower as a share of payroll than those estimated for SERS due to TRS’s higher discount rate of 8 percent and funded ratio of 56 percent (SERS funded ratio is 36 percent); however, TRS’s peak employer contribution rate could reach over 80 percent of payroll during the forecast period due to a strict contribution policy required by covenants to the pension obligation bond issued to improve TRS funding in 2008.

Figure 11 Volatility and Annual Employer Contribution Rates
Long-term Return of 8.0%, State Funding Policy
Teachers' Retirement System

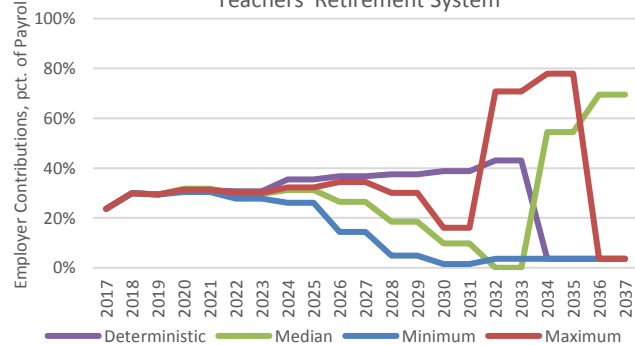


Figure 12 Simulation Analysis of Employer Contributions
Percent of Payroll and Plan Funded Ratio
Teachers' Retirement System

	Cumulative 10-Year Contribution Rate	Funded Ratio in 2027	Cumulative 20-Year Contribution Rate	Funded Ratio in 2037
10 trials with 8.0% returns				
Minimum	26%	64%	18%	81%
Maximum	38%	118%	34%	150%
Median	30%	86%	29%	124%
Deterministic: 8.0% Returns	32%	78%	30%	115%

Note: Similar analyses are included in “Legislative Stress Test Report for Connecticut Public Pensions,” Exhibits 9 & 10.
Source: The Terry Group and The Pew Charitable Trusts

Lower-Than-Expected Returns with Market Volatility

Of course, plans do not always meet their target returns. **Figures 13** and **14** below illustrate 20-year contribution rates for each plan at three rates of return: the plan’s expected return, and the 50th and 25th percentile returns generated by applying our capital market assumptions to plan asset allocations.⁹ For each rate, we analyze a deterministic trial, and 10 stochastic trials with the same 20-year performance, to assess the probable range of total required employer contributions over the forecast period.

We find that, over the range of return scenarios, SERS has higher expected costs but that TRS is exposed to more cost volatility due to overall investment shortfalls and the potential for adverse timing of market downturns. The more predictable costs for SERS are due, in part, to recent reforms of the plan’s contribution policy, assumptions, and plan provisions.

⁹ Pew’s capital market assumptions, when applied to the SERS and TRS portfolios, yield projected 20-year returns of 6.4 and 6.3 percent, respectively. The difference between this estimate and SERS target of 6.9 percent can largely be explained by differences in inflation assumptions. The TRS has a much higher assumed rate of 8.0 percent, although its asset allocation is essentially the same as SERS. See Mennis, et al. (2018) for more information on our capital market assumptions.

Figure 13

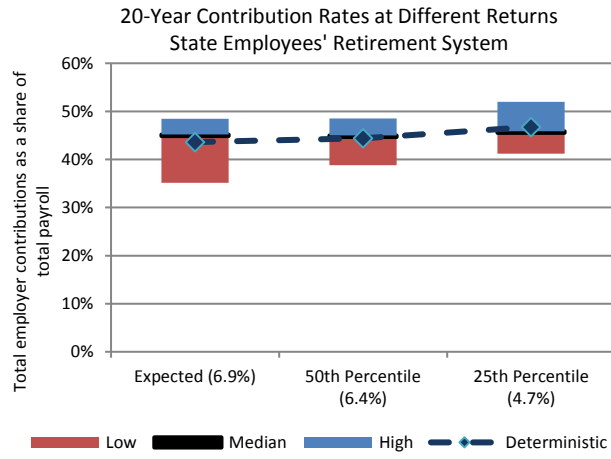
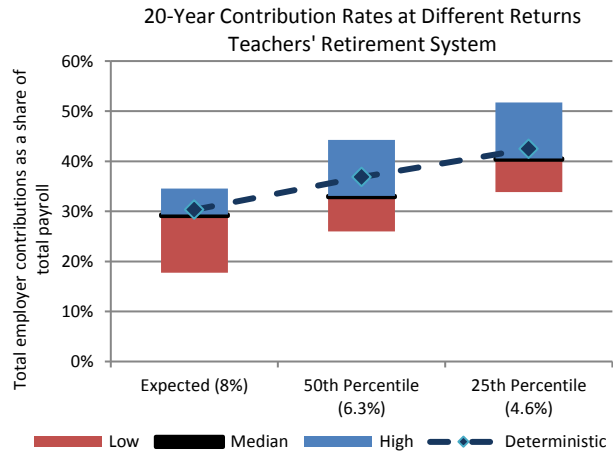


Figure 14



Note: Similar analyses are included in "Legislative Stress Test Report for Connecticut Public Pensions," Exhibits 9 & 10.

Source: The Terry Group and The Pew Charitable Trusts

Section 4: Sensitivity of Costs and Liabilities to Investment Returns

Employer Service Costs and Net Pension Liabilities

We also estimate the potential range of service costs and net pension liabilities under different long-term investment returns.

Figures 15 and 16 show the range of benefit cost for new hires enrolled in SERS and TRS, respectively. The SERS results incorporate estimates of changes to employee contributions in a low return scenario based on the provisions of the new plan design. Note that the results for SERS reflect Tier IV benefits, accounting for the impact of reforms passed in 2017, and include the cost of an employer contribution of 1 percent of pay into worker’s DC accounts. An analysis of the cost of new employee benefits using the prior benefit tier for SERS is included in sample output in Section 5.

Figure 15

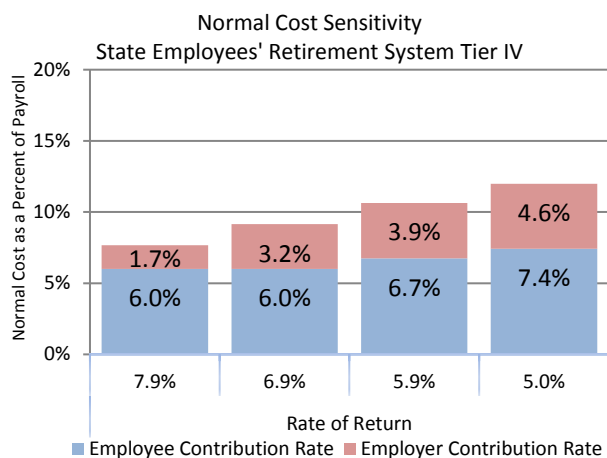
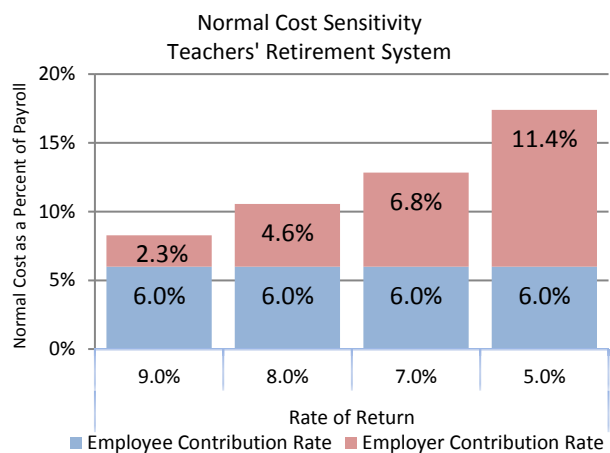


Figure 16



Note: Similar analyses are included in “Legislative Stress Test Report for Connecticut Public Pensions,” Exhibits 11 & 12. A previous version of this report included TRS sensitivity analysis at different rates of return. This report has been adjusted to be more consistent with the plan’s assumed rate of return.

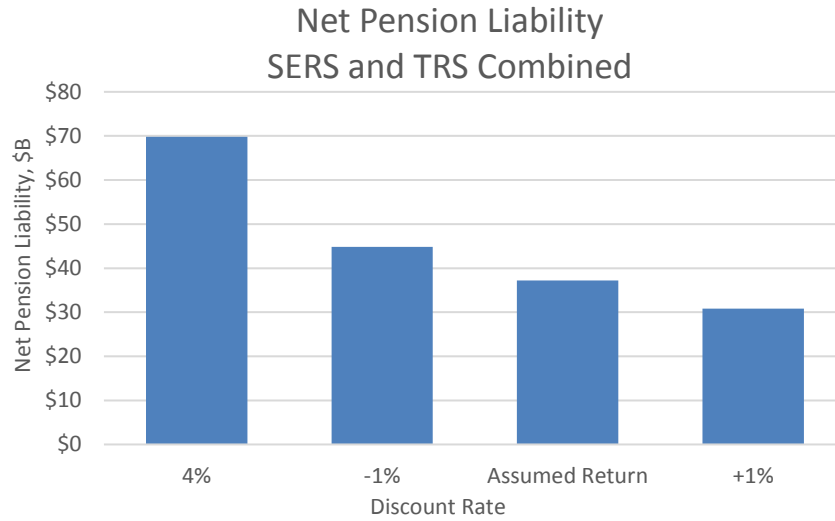
Source: The Terry Group and The Pew Charitable Trusts

Current reporting required by the Government Accounting Standards Board (GASB) includes a calculation of plan net pension liabilities at a range of discount rates 1 percent above and 1 percent below the expected rate of return. In addition, proposed changes to Actuarial Standards of Practice (ASOP) 4 recommends the disclosure of an Investment Risk Defeasement Measure at a lower, near risk-free rate.¹⁰ For the purpose of approximating the Investment Risk Defeasement Measure, we applied a 4% discount rate and used the reported total pension liability from plan disclosures.

Figure 17 summarizes the results of these liability sensitivity analyses from both existing and proposed reporting requirements, highlighting the aggregate unfunded pension liability for SERS and TRS on a combined basis (see Appendix for more detailed calculations).

¹⁰ Proposed Revision of Actuarial Standard of Practice Number 4, Measuring Pension Obligations and Determining Pension Plan Costs or Contributions, Exposure Draft (March 2018).

Figure 17



Source: Plans' comprehensive annual financial reports, FY 2016.

Note: TRS discount rate equals 8%. SERS Discount rate equals 6.9%. Average (weighted by liability) is approximately 7.43%. In place of the investment risk defeasement calculation, per the proposed amendment to ASOP 4, a discount rate of 4% was applied to the total pension liability as reported in plan financial reports.

The GASB data provides policymakers and other stakeholders with basic information around the risk associated with investment return assumptions for public plans. These data may be particularly useful for states with plans that are at or near full funding under current actuarial assumptions by highlighting the riskiness of the assets used to prefund liability, reinforcing the need to maintain strong funding practices, and the potential cost of unfunded benefit increases. Separately, the Investment Risk Defeasement Measure provides an estimate of unfunded liability that is more comparable to state bond obligations and provides an estimate of the overall level of risk taken on by plan sponsors and tax payers.

Section 5: Applying Stress Testing to Measure the Impact of Policy Changes

Reform Impact Analysis

Sections 1 through 4 of this report are designed to aid budget officials and policymakers in planning for the potential impact of lower investment returns and financial market volatility on pension balance sheets and government budgets. This section provides an example of how the elements of a standardized stress test report can also be used to aid decision-making, by providing a framework to analyze the impact of proposed policy changes.

Sensitivity analysis of benefit costs, for example, can provide a straightforward and reasonably accurate method to assess the potential fiscal impact of changes to benefit plan design under different economic conditions. Other elements of the stress test could be equally useful to assess proposed changes to funding policy (e.g. the proposal to dedicate lottery assets or revenue to TRS). Here we examine the projected impact of recent changes to SERS pension benefits included in the 2017 SEBAC agreement, drawing from the normal cost sensitivity analysis included in Section 4 of this report.¹¹

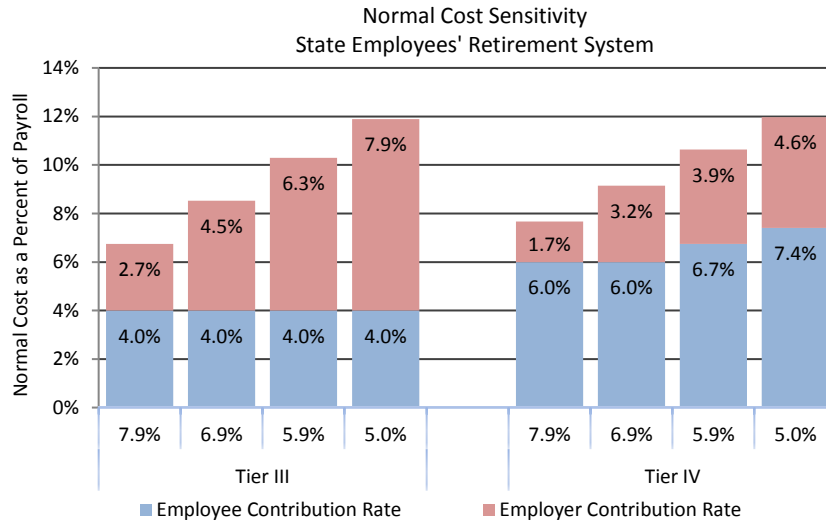
Using Sensitivity Analysis to Assess the Impact of SERS Tier IV Benefit Reform

Connecticut SERS' Tier IV defined benefit/defined contribution (DB/DC) hybrid plan for new employees is projected to substantially lower costs and risk for taxpayers over time using a "risk-managed" design that includes a smaller defined benefit component, a significant increase in employee contributions, and a risk sharing component that raises contributions if investment returns fall short of the plan target rate.

Using Pew's stress test model, we can assess the fiscal impact of those changes by comparing the total normal cost and employer share of cost for SERS employees in Tier IV – identical to information presented in Section 4 above – to those for Tier III employees. As seen in **Figure 18**, SERS employer normal costs decreased by an estimated 1.3 percent of payroll under the new Tier IV when compared with Tier III at the assumed 6.9 percent rate of return. And if investments earn only 5 percent, the savings would exceed 3 percent of payroll.

¹¹ See the agreement between the State of Connecticut (State) and the State Employees Bargaining Agent Coalition (SEBAC), ratified on July 17, 2017.

Figure 18



Source: The Pew Charitable Trusts

We can also illustrate this savings in dollars over time at both 6.9 percent (**Figure 19**) and 5 percent returns (**Figure 20**). Over a 30-year forecast period, the impact increases significantly as more new workers join Tier IV. The savings total between \$1 billion and \$2.5 billion over 30 years, or from \$500 million to \$1 billion on a present value basis, depending on investment performance during the period.

Figure 19

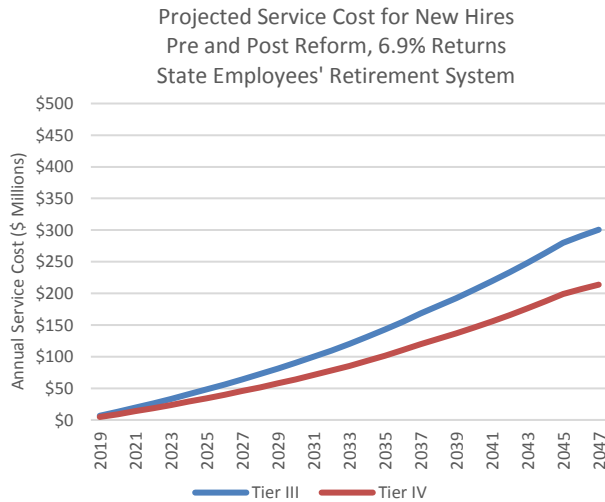
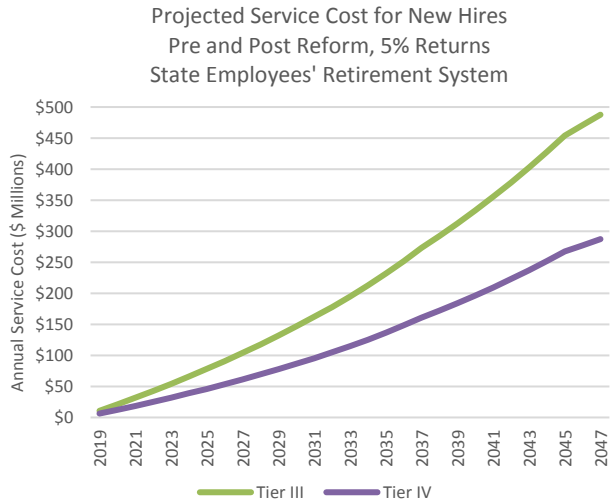


Figure 20



Source: The Terry Group and The Pew Charitable Trusts

Appendix

CT COMBINED - 10 YEAR STRESS TEST FORECAST RESULTS UNDER STATE POLICY CONTRIBUTIONS (\$ in Millions)

	Expected Return		Low Return		Asset Shock		Stochastic Baseline	
	2017	Deterministic 7.43%	Deterministic 5%	Economic Scenario	50th Percentile	25th Percentile		
<i>Fiscal year ending June 30, 2017</i>	2017	2027	2027	2027	2027	2027	2027	
Balance Sheet Measures								
Market Value of Assets (MVA)	\$ 28,947	\$ 50,358	\$ 41,503	\$ 39,176	\$ 45,366	\$ 38,128		
Actuarial Accrued Liability (AAL)	63,734	75,367	75,367	73,411	73,538	73,458		
Unfunded Actuarial Accrued Liability (UAAL)	34,787	25,009	33,863	34,235	28,172	35,330		
Accrued Liability at Approximate Defeasement Rate	94,082	111,254	111,254	108,367	108,554	108,436		
Unfunded Liability at Approximate Defeasement Rate	65,135	60,896	69,751	69,191	63,188	70,308		
Funded Ratio	45%	67%	55%	53%	62%	52%		
Defeasement Ratio	31%	45%	37%	36%	42%	35%		
Cash Flow Measures								
Benefit Payments	\$ 3,823	\$ 5,535	\$ 5,535	\$ 5,370	\$ 5,395	\$ 5,397		
Total Contributions	2,907	4,967	5,661	5,815	4,916	5,662		
Negative Operating Cash Flow	916	569	(126)	(446)	480	(265)		
Operating Cash Flow to Assets Ratio	n.a.	-1.2%	0.3%	1.2%	-1.1%	0.7%		
Own Source Revenue (OSR)	19,053	27,616	27,616	26,712	27,415	27,399		
Employer Contributions / OSR	13.2%	15.7%	18.1%	19.5%	15.8%	18.5%		
Payment and Contribution Measures								
Payroll	\$ 7,743	\$ 10,298	\$ 10,298	\$ 9,805	\$ 9,800	\$ 9,756		
Employer Contribution / Payroll	33%	42%	49%	53%	44%	52%		
Employee Contribution / Payroll	5.0%	6.2%	6.4%	6.2%	6.1%	6.2%		
Total Contributions / Payroll	38%	48%	55%	59%	50%	58%		
Net amortization \$	n.a.	2,131	2,214	2,361	1,951	2,127		
Minimum Employer Contribution / Payroll (over 10 years)	n.a.	37%	37%	37%	27%	32%		
Maximum Employer Contribution / Payroll (over 10 years)	n.a.	43%	49%	53%	61%	66%		
Investment Performance								
Compounded Annual Growth: 2017-2027	n.a.	7.4%	5.0%	3.5%	6.4%	3.9%		
Compounded Annual Growth: 2022-2027	n.a.	7.4%	5.0%	4.9%	6.4%	4.9%		

See Methodology section for a complete description of economic and behavioral scenarios.

Source: The Terry Group and The Pew Charitable Trusts

CT COMBINED - 10 YEAR STRESS TEST FORECAST
RESULTS UNDER REVENUE CONSTRAINED CONTRIBUTIONS
(\$ in Millions)

	2017	Expected Return	Low Return	Asset Shock	Stochastic Baseline	
		Deterministic 7.43%	Deterministic 5%	Economic Scenario	50th Percentile	25th Percentile
<i>Fiscal year ending June 30, 2017</i>		2027	2027	2027	2027	2027
Balance Sheet Measures						
Market Value of Assets (MVA)	\$ 28,947	\$ 43,850	\$ 33,142	\$ 25,838	\$ 39,141	\$ 29,065
Actuarial Accrued Liability (AAL)	63,734	75,367	75,367	73,411	73,561	73,451
Unfunded Actuarial Accrued Liability (UAAL)	34,787	31,517	42,225	47,573	34,420	44,385
Accrued Liability at Approximate Defeasement Rate	94,082	111,254	111,254	108,367	108,588	108,426
Unfunded Liability at Approximate Defeasement Rate	65,135	67,404	78,112	82,529	69,447	79,361
Funded Ratio	45%	58%	44%	35%	53%	40%
Defeasement Ratio	31%	39%	30%	24%	36%	27%
Cash Flow Measures						
Benefit Payments	\$ 3,823	\$ 5,535	\$ 5,535	\$ 5,370	\$ 5,396	\$ 5,397
Total Contributions	2,907	4,292	4,302	4,141	4,227	4,231
Negative Operating Cash Flow	916	1,243	1,234	1,228	1,169	1,166
Operating Cash Flow to Assets Ratio	n.a.	-3.0%	-3.8%	-4.8%	-3.0%	-4.1%
Own Source Revenue (OSR)	19,053	27,616	27,616	26,712	27,424	27,382
Employer Contributions / OSR	13.2%	13.2%	13.2%	13.2%	13.2%	13.2%
Payment and Contribution Measures						
Payroll	\$ 7,743	\$ 10,298	\$ 10,298	\$ 9,805	\$ 9,808	\$ 9,753
Employer Contribution / Payroll	33%	35%	35%	36%	37%	37%
Employee Contribution / Payroll	5.0%	6.2%	6.3%	6.2%	6.1%	6.2%
Total Contributions / Payroll	38%	42%	42%	42%	43%	43%
Net amortization \$	n.a.	1,008	311	(199)	852	115
Minimum Employer Contribution / Payroll (over 10 years)	n.a.	34%	34%	32%	33%	33%
Maximum Employer Contribution / Payroll (over 10 years)	n.a.	36%	36%	36%	38%	39%
Investment Performance						
Compounded Annual Growth: 2017-2027	n.a.	7.4%	5.0%	3.5%	6.4%	3.9%
Compounded Annual Growth: 2022-2027	n.a.	7.4%	5.0%	4.9%	6.4%	4.9%

See Methodology section for a complete description of economic and behavioral scenarios.

Source: The Terry Group and The Pew Charitable Trusts