



THE
PEW
CHARITABLE TRUSTS

2005 Market Street, Suite 2800
Philadelphia, PA 19103-7077

215.575.9050 Phone

901 E Street NW
Washington, DC 20004

202.552.2000 Phone

www.pewtrusts.org

August 20th, 2020

Secretary Melissa McCaw
Office of Policy and Management
State of Connecticut
450 Capitol Avenue
Hartford, CT 06106

Dear Secretary McCaw:

Thank you for the opportunity to provide your office with a stress test analysis of the State Employees' Retirement System (SERS) and Teachers' Retirement System (TRS). This analysis is an update to the reports Pew provided in 2018 as required under Connecticut Code Title 4, Chapter 50m, sec. 4-68ee.

Based on our *Foundation for Public Pensions Risk Reporting*,¹ this report incorporates the most recent actuarial valuations for both pension systems as well as the TRS funding reforms enacted as part of the state's 2019 budget. Our analysis also includes updated revenue projections that reflect the impact of the COVID-19 pandemic.

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.

We hope you find our report informative. Please let us know if you have any questions or would like to set up some time to discuss our findings.

Sincerely,

Greg Mennis, Director
[Strengthening Public Sector Retirement Systems](#)
The Pew Charitable Trusts

CC: Greg Messner

¹ Pew's Foundation for Pension Risk Reporting is available on the Harvard Kennedy School Website here: <https://www.hks.harvard.edu/centers/mrcbg/programs/pension2018>. This framework is based on recommendations in the 2014 Report by the Blue Ribbon Panel on Public Pension Plan Funding commissioned by the Society of Actuaries, as well as existing and proposed government accounting and actuarial standards and includes input from other academics and experts in the field of public sector retirement systems.

Introduction

The Connecticut state legislature enacted SB 1502 in 2017, which calls for annual stress tests of the State Employees' Retirement System (SERS) and the Teachers Retirement Systems (TRS).¹ This report, prepared by Pew at the request of the Office of Policy and Management (OPM), was written in support of meeting this requirement. The analysis follows the recommendations outlined in Pew's *Foundation for Public Pension Risk Reporting*,² a framework for public pension risk assessment developed in collaboration with the Harvard Kennedy School of Government.

The Foundation is based on recent research and emerging guidelines in the field, including the Society of Actuaries Blue Ribbon Panel report³ and Actuarial Standard of Practice (ASOP) No. 51,⁴ and provides a roadmap for analysis that builds on existing projections from the plan's actuary and investment consultants. The Foundation was designed to provide accessible information to **all stakeholders**, with the specific intent to **inform budget planning and decision making**.

This report focuses primarily on **investment risk**—the risk that investment returns are not as expected; and **contribution risk**—the risk that contributions fall short of the rate required to meet funding objectives. The analysis examines the projected financial position and cash flows of the two largest plans in Connecticut – the State Employees' Retirement System (SERS) and the Teachers Retirement System (TRS). On a combined basis, the two plans account for roughly 99% of the state's total pension liability and administer benefits for over 99% of all state defined benefit plan participants.

Key findings of the analysis include:

- **Reforms enacted in 2019 have significantly reduced the cost volatility of the Connecticut Teachers Retirement System.** Connecticut's 2019 reforms to TRS mirrored those passed in 2017 for SERS, including a notable decrease in the plan's assumed rate of return from 8% to 6.9%; and changes in the amortization of legacy debt. The reforms were designed to eliminate the potential for dramatic increases in TRS required contributions if returns are lower than expected: our previous December 2018 stress-test analysis found that required contributions for TRS could spike to over 100% of payroll under a low, 5% return scenario. That would have translated into over 1 in 4 state revenue dollars going to both pension plans combined. This risk has been mitigated by the reforms. We now find the range of potential employer contributions over the next 20 years would reach a maximum of about 15% of own-source revenue (OSR) under a low, 5% return scenario.
- **The combined effect of planned increases in required contributions and declining revenue related to COVID-19 is likely to put significant pressure on the state budget over the next 5 years, regardless of market performance.** Based on the state's expected decline in revenue of 7.5% in 2021, the portion of state OSR required to fund planned contributions will increase from approximately 12% to 15% beginning in FY21.⁵ And even if the economy recovers and investment return assumptions are met in subsequent years, the benefit of rising revenue during recovery will be offset by increases in annual required contributions required by legacy debt amortization changes, keeping this ratio high. The end result could be a budget crowd-out of more than \$1 billion in spending over five years.
- **Both plans face a significant risk of permanent high costs well into the future.** Introducing market volatility into our analysis increases the potential peak contribution rates facing

Connecticut, which could cause additional budget pressures. We find a 7% chance that contributions could reach 50% of payroll – around 17% of OSR—during the 20-year forecast period. However, we find a 25% chance that they will be higher than the current rate of 36% of payroll even after 20 years.

The remainder of this report is divided into five sections:

- Baseline Projections for Connecticut’s State Retirement Systems
- Scenario Analysis of Investment Risk
- Scenario Analysis of Contribution Risk
- Simulating Additional Costs of Market Volatility Risk
- Assessing Sensitivity to Lower Discount Rates

Baseline Projections for Connecticut’s State Retirement Systems

Connecticut’s retirement systems remain significantly underfunded; in 2018 the state’s pensions were 47% funded, significantly lower than the national average. The state’s two main plans have been less than two-thirds funded for decades, although changes to the funding policy in 2011 — and, more recently, in 2017 and 2019 — have set in place a plan to sustainably move the state’s retirement systems to full funding.

The reforms of 2017 and 2019 made similar key changes to SERS and TRS, respectively. First, rather than a single funding period for both legacy pension debt and any new losses, which could lead to sharp spikes in contribution rates, new gains and losses will instead be given separate 25-year amortization periods. This change addressed the specific problem of contribution rates spikes. Second, the rate of return assumptions, which had previously been 8%—among the highest across state pension plans—were lowered to 6.9%, now among the lowest.⁶ Lower return assumptions increase the estimated actuarial liability and lower reported funded ratios of both plans; however, they make it more likely that the funds will meet investment targets and mitigate shortfalls during a downturn. Finally, the new funding policies were designed to lower total costs by paying down unfunded liabilities more quickly through level dollar debt payments rather than growing amortization contributions with payroll.

The above changes alone would have increased required pension contributions. So, to manage the immediate budgetary impact, the funding period for legacy pension debt was extended to 30 years and the shift to level dollar will be phased in over five years. In addition, the changes to SERS shared some of the cost increases with existing workers and retirees through the collective bargaining process and created a risk-managed hybrid plan for new hires.

Figure 1 below provides **baseline** 30-year projections for the two plans on a combined basis based on plan assumptions, including the assumed rate of return for each plan of 6.9%. Under these baseline projections — which do not yet reflect investment results for 2020 — the unfunded liability rises slightly until stabilizing in 2022, when contributions become sufficient to begin paying down existing debt. Both plans reach 100% funding individually by 2048, with SERS doing so two years earlier in 2046.

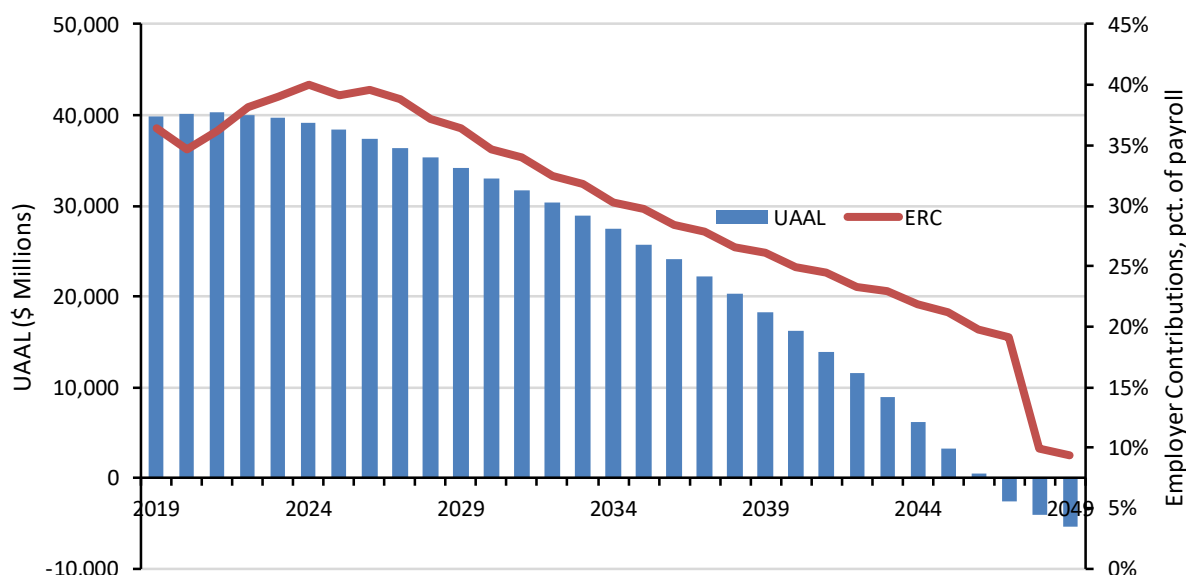
It is important to note that, although our revenue projections reflect estimated COVID-19 impacts -- including a contraction in 2020 and 2021 followed by a recovery from 2022 to 2025 -- we do not include

the impact of pandemic-related market volatility on investment returns. We address the impact of market volatility and lower than expected long-term returns in greater detail below.

FIGURE 1

UAAL and Employer Contributions as a Percent of Payroll under a Baseline Scenario, SERS and TRS Combined

SERS and TRS are on track for full funding if current policies are followed and all assumptions met



Source: The Terry Group and The Pew Charitable Trusts

Scenario Analysis of Investment Risk

Financial experts anticipate investments will perform below historical averages going forward, and we project a one-in-four chance that future long-term returns could be as low as 5% for the typical public pension fund. For this reason, we conduct a 30-year scenario analysis to examine how plans would perform under a **fixed 5% return scenario**, in which we apply a single low rate of return of 5% in each year of the forecast period.

In addition, we conduct a second, **asset shock scenario** that consists of an initial investment loss of approximately 25%, followed by three years of economic recovery and lower equity returns of 5% over the remaining years of the projection period. The purpose of this scenario, which is based on the 2017 “Adverse Scenario” in the Dodd-Frank Act stress tests, is to replicate the effects of a sudden market downturn followed by a recession.⁷

Figure 2 below illustrates the impact of both scenarios on the combined financial position and required employer contributions for TRS and SERS, revealing that **the reforms of 2019 have significantly reduced the cost volatility of TRS**. Pew’s prior stress-test analysis of the two plans, released in December 2018 before reforms to TRS were formulated, found that required contributions for the plans could spike to 30% of own-source revenue under a 5% return scenario.

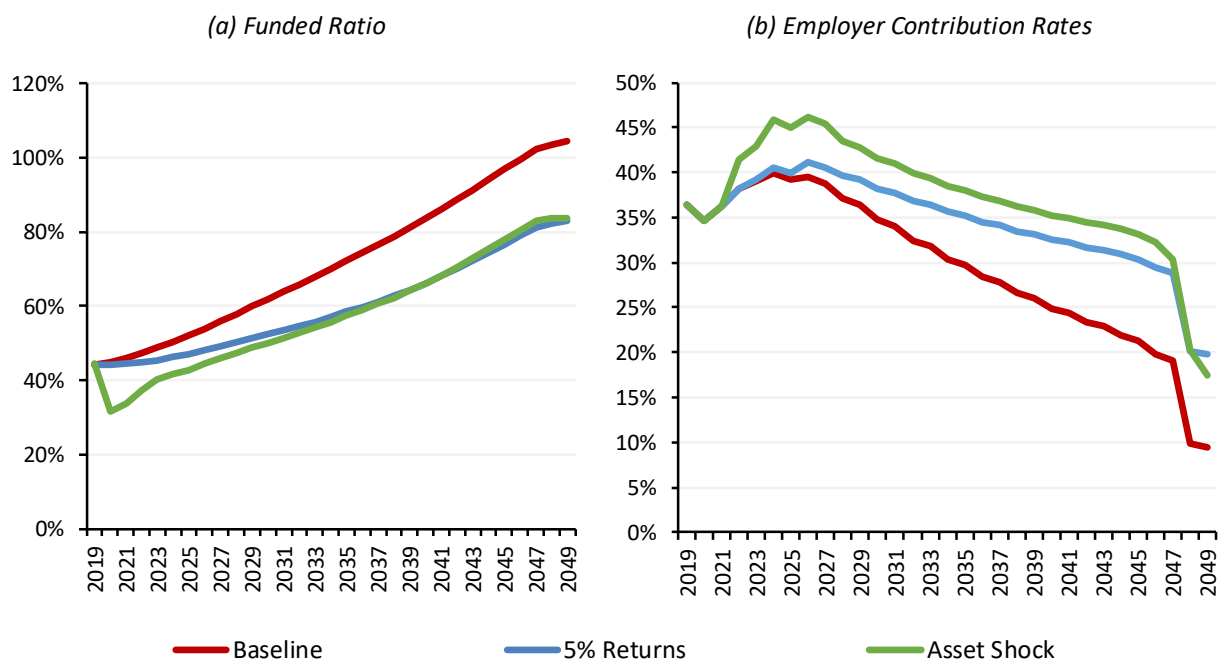
The recent reforms to both plans were designed to phase in increased costs over time. That said, costs will continue to rise over the next four years as a share of payroll, even if investment returns meet

expectations. Under the baseline scenario, costs would increase to 40% of payroll by 2024. And under the asset shock and 5% return scenarios, they would increase further, to 46% and 41% of payroll, respectively, before slowly decreasing toward the current level of 36% of payroll by the end of the forecast period. In other words, if long-term returns fall short of expectations, **Connecticut could be facing high pension costs for the foreseeable future**. Significantly, funded status for the two plans, combined, would increase over the forecast period if employers are able to make the required increase in contributions each year.

FIGURE 2

Funded Ratio and Employer Contributions as a Percent of Payroll under Baseline and Two Downside Scenarios, SERS and TRS Combined

Funded status would increase if employers consistently make the required increase in contributions



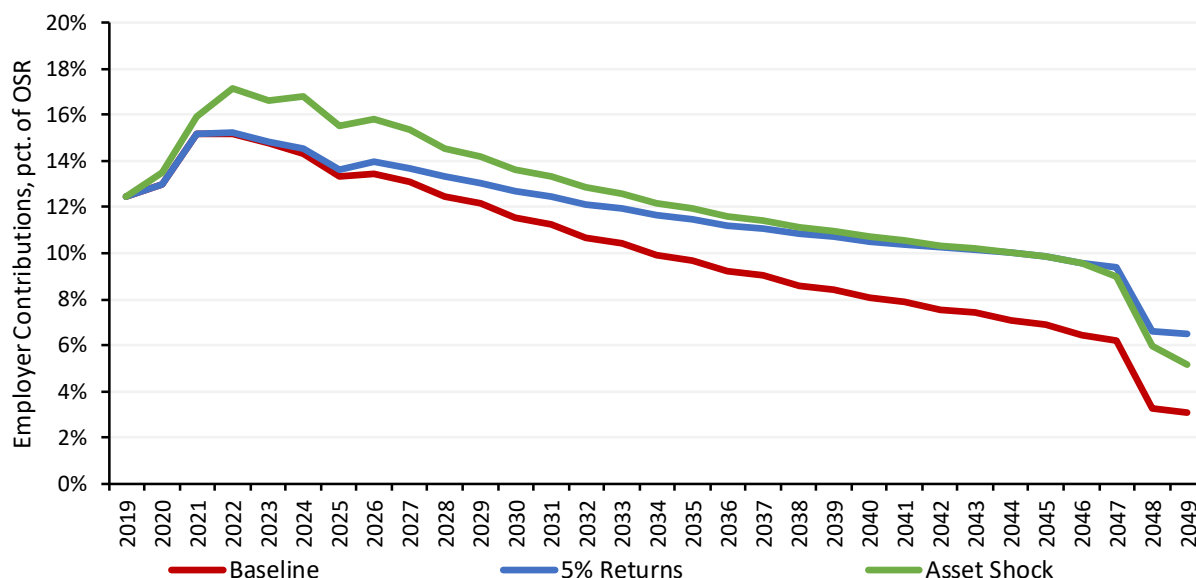
Source: The Terry Group and The Pew Charitable Trusts

However, policymakers may find that difficult to achieve given the revenue shortfalls Connecticut is projecting in the wake of the global pandemic. **The combined effect of planned increases in required contributions and declining revenue related to COVID-19 is likely to put significant pressure on the state budget over the next 5 years.** Based on the state's expected decline in revenue of 7.5% in 2021, the portion of state own-source revenue (OSR) required to fund planned contributions – already one of the highest in the nation – will increase from approximately 12% to 15% beginning in FY21 under a baseline scenario (**Figure 3**).⁸ And even if the economy recovers and investment return assumptions are met in subsequent years, the benefit of rising revenue during the recovery will be offset by increases in annual required contributions required by legacy debt amortization changes, keeping this ratio high. The result could be a budget crowd-out of more than \$1 billion in spending over 5 years. Policymakers may find these costs unacceptably high during a period in which significant budget cuts will be required.

FIGURE 3

Employer Contributions as a Share of Revenue, State Contribution Policy, SERS and TRS Combined

The portion of OSR required to fund planned contributions could approach 18 percent in the next five years and exceed 10 percent for at least 25 years if plan assumptions are not met



Source: The Terry Group and The Pew Charitable Trusts

Scenario Analysis of Contribution Risk

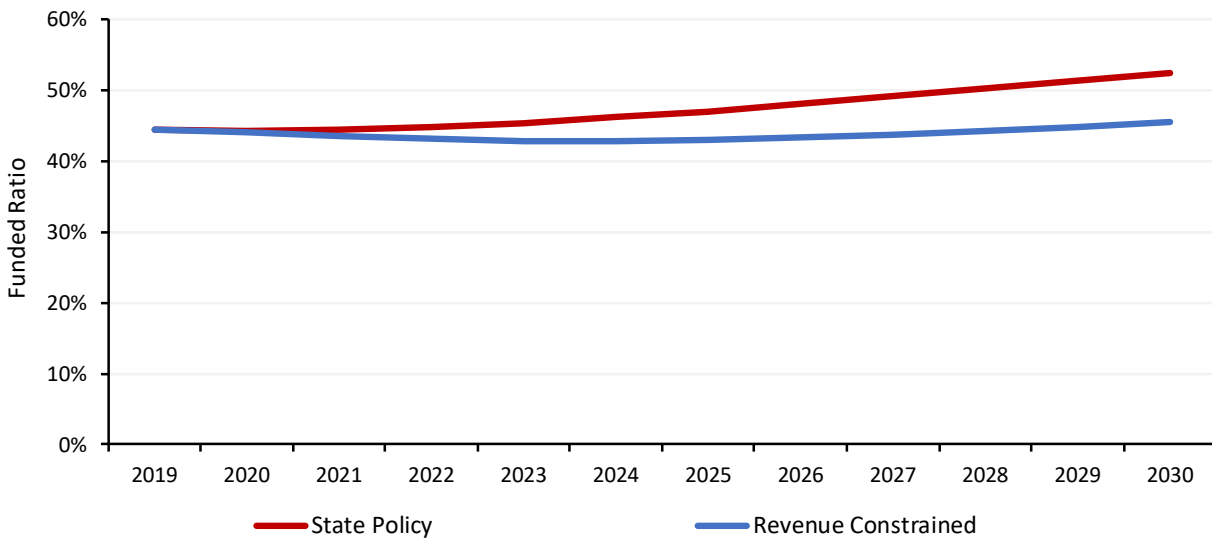
Although modeling investment risk is at the heart of stress testing, policymakers' responses to addressing lower returns, in terms of making annual required contributions, can also be a source of risk to plans' fiscal health. To examine the impact of contribution risk, we assess the potential impact on plan health under different economic scenarios, assuming that employer contributions are held constant as a share of revenue in each year of the forecast period. We refer to this as a **revenue-constrained contribution policy** assumption.

Figure 4 below focuses on our fixed 5% return scenario to compare the plans' combined funded ratio under both our revenue-constrained contribution policy and the state's current funding policy. The relatively stable outcome under the revenue-constrained assumption is a function of an already-high ratio of employer contributions to OSR for Connecticut plans combined – 12.5% in 2019. The high ratio helps to insulate the state's pension systems from the risk of fiscal distress, even under conditions in which both returns and state contributions fall short of plan assumptions and policies. However, unlike the state policy assumption – under which contributions would increase to an average of 14% of OSR over the 10-year forecast period, keeping the state on a path towards full funding and lower costs over the long-term – the revenue-constrained policy assumption would leave the funded ratio below 50% through 2030, and effectively lock in permanent high costs.

FIGURE 4

Funded Ratios under 5% Return Scenario, Revenue-Constrained and State Policy, SERS and TRS Combined

Already high contribution rates decrease the risk of fiscal distress, but may result in permanently high costs



Note: Funded Ratio is MVA/AAL

Source: The Terry Group and The Pew Charitable Trusts

Measuring the Impact of Market Volatility through Stochastic Analysis

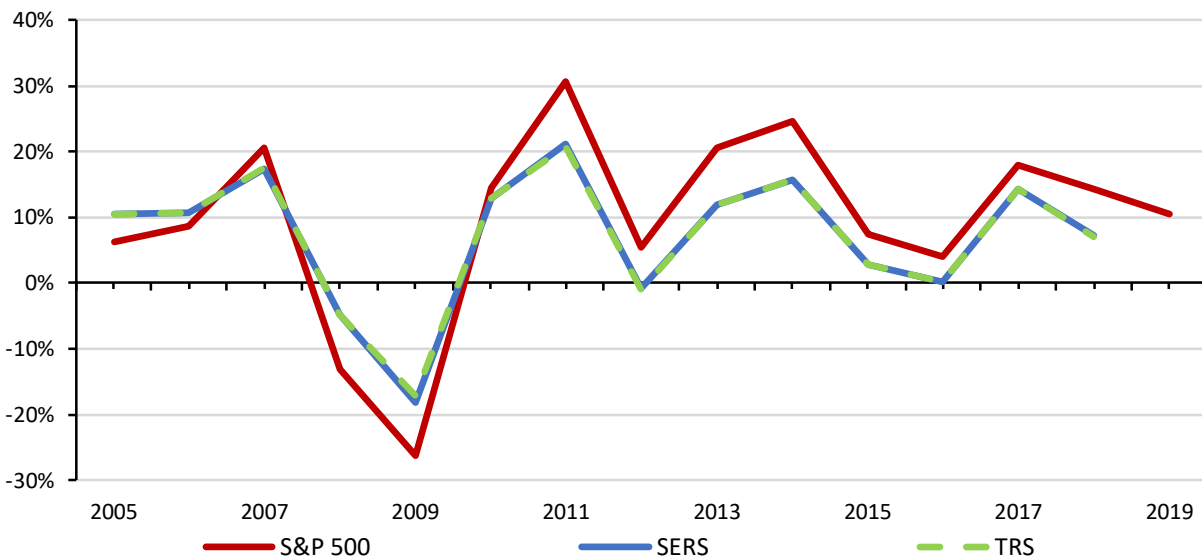
Investment risk can be significantly amplified when market swings are included in stress test analysis. Between 2000 and 2010, for example, two stock market corrections and recessions had the effect of lowering Connecticut's funded ratio from 72% to 53%. Volatility can also be a factor even when plan assumptions are met. While returns averaged roughly 7.3% between fiscal years 2012 and 2019 (i.e., since the Great Recession and recovery), they ranged from roughly -1% to 14% on an annual basis (see **Figure 5**).

This section applies stochastic analysis to assess the impact of annual fluctuations in investment returns, or market volatility.⁹ By generating thousands of forward-looking trials of possible market performance, stochastic analysis allows us to evaluate the probability of various financial outcomes when annual returns are allowed to fluctuate. We specifically focus on three concepts: (1) **sequencing of returns**; (2) the **range of possible outcomes** for plan funded status; and (3) the **range of required contribution levels** over a 20-year forecast period. We summarize our findings on each of these points below.

FIGURE 5

Annual Investment Returns for the S&P 500, SERS, and TRS

Pension fund investment returns are volatile and move with the stock market



Source: Wilshire TUCS and plan financial reports

Sequencing of Returns

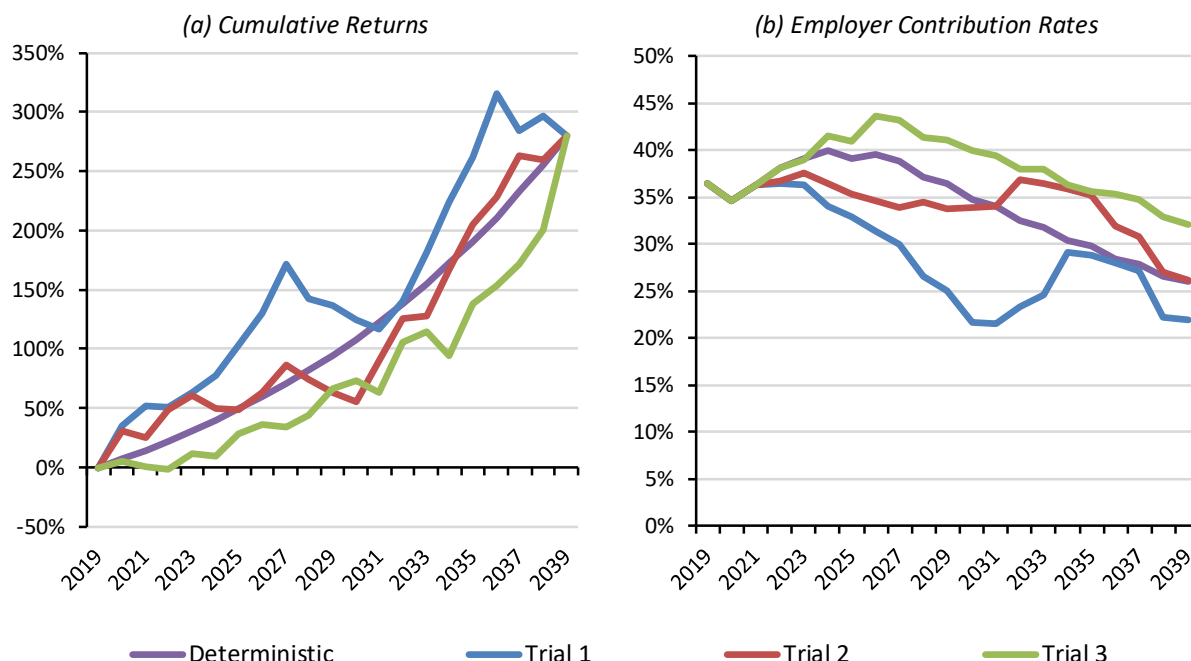
The first takeaway from stochastic analysis is that the sequence of returns matters. Even when returns average the target rate over time, sequences in which higher returns occur first often lead to lower employer costs over time due to the impact of compounding returns. However, when lower returns occur first, it may result in a smaller asset base for investment gains later on unless offsetting increases in contributions are made. The reason is the impact of compounding returns. When lower returns occur first, it results in a smaller asset base for investment gains later on.

As an example, see **Figure 6a**, which illustrates 4 trials in which TRS and SERS could meet their investment return target over a 20-year timeframe. Each line represents a different sequence of returns, or trial, that meets the target rate of return of 6.90% for the two plans. Returns fluctuate from that assumed rate annually, except for the deterministic trial, in which they are constant. In the end, the combined assumed rate of return is achieved in each case; however, as illustrated in **Figure 6b**, outcomes for required contributions vary in each trial due to differences in the sequence of returns.

FIGURE 6

Cumulative Returns and Employer Contributions as a Percent of Payroll for 4 Trials Averaging the Assumed Rate of Return

Required employer contribution rates vary in each trial due to sequencing of returns



Source: The Terry Group and The Pew Charitable Trusts

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 1 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.

A Wide Range of Possible Outcomes

The analysis above illustrates the impact of market volatility on employer contributions using a limited set of simulations, in which 20-year returns meet the combined expected rate of return of 6.9% for TRS and SERS.

Examining the full range of 10,000 stochastic trials produced by Pew's stress test model provides a more complete picture of the **range of possible outcomes** given the impact of both short-term market volatility and long-term economic trends. **Figure 7** shows the results of that analysis and reinforces the assessment that current funding policy should be sufficient to improve funding levels over time. Note that the analysis uses fiscal year 2019 as a starting point for both plans. Thus, the results shown here do not account for the recent market volatility specific to the COVID-19 pandemic.

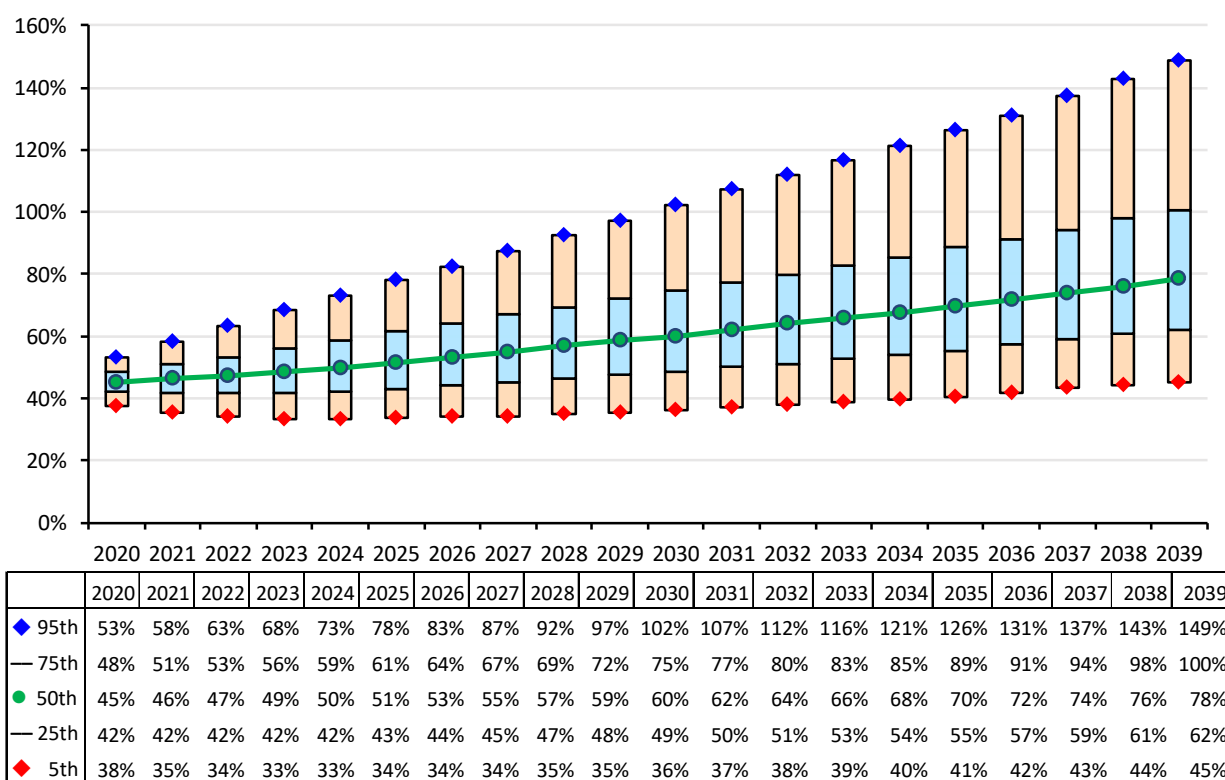
The green line in the figure illustrates the median outcome expected, given Pew’s capital market assumptions, and shows a steady increase in the plans’ funded status over time, absent any changes to the current funding policy. Our capital market assumptions result in a median 20-year annualized return of 6.3% for the two plans combined – roughly 0.6 of a percentage point lower than current TRS and SERS assumptions.¹⁰

Many of the trials from our stochastic analysis show positive results – for example, in approximately 25% of scenarios we see full funding by 2039 if required contributions are met, and a full 96% yield improved financial position for both plans combined. However, it is important to note that market volatility – particularly during a downturn – may prompt higher contribution requirements that must be made if these outcomes are to be realized.

FIGURE 7

Range of Projected Funded Ratios, SERS and TRS Combined

Future funded levels will vary significantly depending on the level of returns and their order



Source: The Terry Group and The Pew Charitable Trusts

Range of Potential Required Contributions

Stochastic analysis can also be used to evaluate the budget uncertainty implicit in projections for future plan funding. Indeed, **we find a significant probability of permanent high costs – 30% of payroll or higher – for the two plans over the next 20 years.**

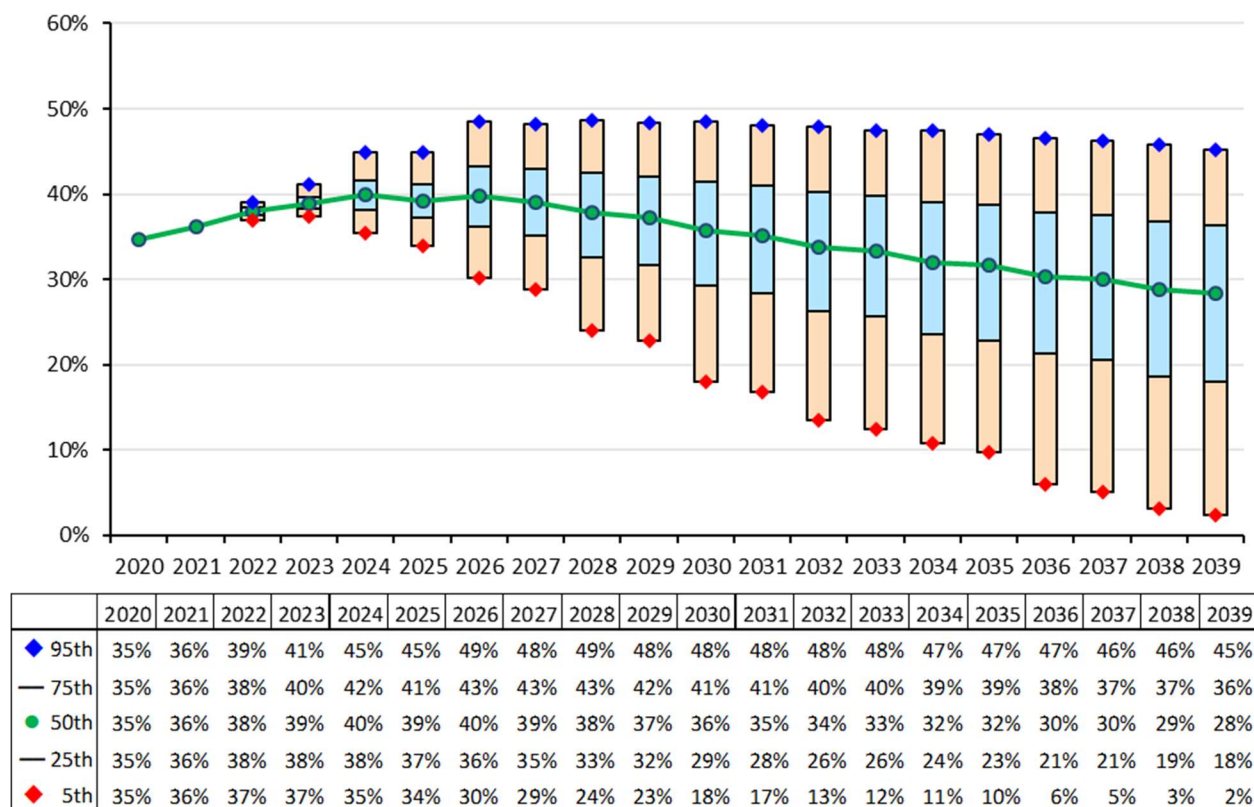
For example, **Figure 8** illustrates the estimated range of projected required contributions over the 20-year forecast period given the same market volatility and economic cycles examined above. The median

required contribution hovers around 35 to 40% of payroll through most of the forecast period, dropping below 30% only in the last two years. We find a 7% probability that contributions could reach 50% of payroll – around 17% of OSR -- and a 25% probability that they will be higher than the current rate of 36% of payroll even after 20 years.

FIGURE 8

Range of Projected Employer Contributions as a Percent of Payroll, SERS and TRS Combined

Future employer contribution rates will vary significantly depending on the level of returns and their order



Source: The Terry Group and The Pew Charitable Trusts

Measuring the Impact of Investment Risk through Sensitivity Analysis

The final section of this report uses sensitivity analysis to illustrate how lower investment returns would impact reporting of the state's unfunded pension liability, as well as the normal cost for new benefits accrued. Plans typically discount future obligations by the rate of return they expect on investments, as supported by GASB. By projecting liabilities at other discount rates, we can see how the liability would respond to changes in investment return expectations. In addition, we project liabilities based on proposed changes to current actuarial standards, which call for disclosure of plan liabilities at a risk-free or near risk-free rate.

Figure 9 below presents the net pension liability of both plans as reflected in the most recent GASB disclosure, along with an estimated calculation based on the definition of a Low-Default-Risk Obligation Measure (LDROM) included in proposed changes to ASOP No. 4, using a discount rate of 3.5%.¹¹

FIGURE 9

2019 Net Pension Liability Sensitivity Analysis to Alternative Investment Return Assumptions*Plan funded ratios are highly sensitive to the assumed rate of return*

<i>\$ in Millions</i>	Expected Returns	High Returns (+1%)	Low Returns (-1%)	LRDOM 3.50%
<u>SERS</u>				
Assets (Fiduciary Net Position)	\$13,276	\$13,276	\$13,276	\$13,276
Liability (Total Pension Liability)	\$36,088	\$32,391	\$40,520	\$55,225
Net Pension Liability (NPL)	\$22,812	\$19,116	\$27,244	\$41,949
Funded Ratio	37%	41%	33%	24%
<u>TRS</u>				
Assets (Fiduciary Net Position)	\$18,493	\$18,493	\$18,493	\$18,493
Liability (Total Pension Liability)	\$35,566	\$32,015	\$39,790	\$53,606
Net Pension Liability (NPL)	\$17,073	\$13,522	\$21,297	\$35,112
Funded Ratio	52%	58%	46%	34%

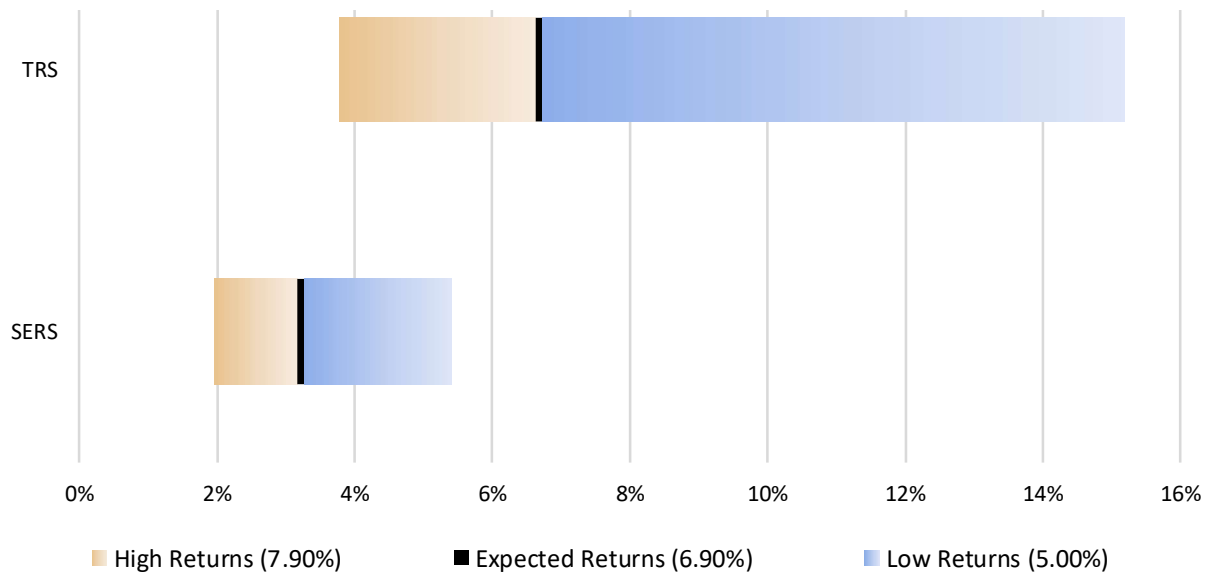
Note: Assumed returns are 6.9 percent for SERS and TRS. LRDOM is the low-default-risk obligation measure, as outlined in proposed changes to ASOP No. 4.

Figure 10 below presents the employer normal cost for new hires in the most recent tier of both plans, based on their 2019 actuarial valuations. The cost is calculated at the plans' respective discount rates, as well as rates one percentage point higher than the current assumption and 5%. The normal cost is an estimate of the contributions needed to finance annual benefit accruals by current employees. Along with debt service payments, it is one of two components that drive overall contribution rates. While normal costs are captured as part of full actuarial projections, it is useful to assess them separately given their significance as the core, ongoing cost of financing pension benefits. In addition, analyses like these can be especially useful for comparing the cost of different benefit structures – for example, in assessing plan reform options.

FIGURE 10

Employer Normal Cost for New Employees (Based on 2019 AVs), SERS Tier IV and TRS

Cost of financing new benefits significantly higher when returns are expected to be less



		Expected Returns	Low Returns	Change
SERS	Total Normal Cost	9.26%	13.42%	4.16%
	Employee Contribution	6.00%	8.00%	2.00%
	Employer Normal Cost	3.26%	5.42%	2.16%
TRS	Total Normal Cost	13.73%	22.19%	8.46%
	Employee Contribution	7.00%	7.00%	0.00%
	Employer Normal Cost	6.73%	15.19%	8.46%

Note: Assumed returns are 6.9 percent for SERS and TRS. Results include a 1% employer and 1% employee contribution to the SERS DC account.

Source: The Terry Group and The Pew Charitable Trusts

The results indicate that employer costs for the most recent tier of benefits could increase by approximately 2.2% of payroll in a low return scenario for SERS and 8.5% for TRS. If plan assumptions are met, employee contributions are expected to pay for the bulk of benefits earned by members in the current tier; however, plan sponsors bear the primary risk of any shortfalls, including those due to lower-than expected investment performance or demographic factors. The lower contribution rate risk for SERS reflects the hybrid plan design and the variable employee contribution for new SERS members as well as differences in workforce dynamics and demographics across the two retirement systems.

¹ Senate Bill 1502 is available at <https://www.cga.ct.gov/2017/TOB/s/2017SB-01502-R00-SB.htm>

² The Pew Charitable Trusts. (2018). The Foundation for Public Pension Risk Reporting. Available at [https://www.hks.harvard.edu/sites/default/files/centers/mrcbg/programs/Foundation%20for%20Pensions%20Risk%20Reporting%20\(Strawman\).pdf](https://www.hks.harvard.edu/sites/default/files/centers/mrcbg/programs/Foundation%20for%20Pensions%20Risk%20Reporting%20(Strawman).pdf).

³ Society of Actuaries. (2014). Report of the Blue Ribbon Panel on Public Pension Plan Funding. Available at <https://www.soa.org/Files/Newsroom/brp-report.pdf>.

⁴ Actuarial Standards Board. (2017). Actuarial Standard of Practice No. 51: Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions. Available at <http://www.actuarialstandardsboard.org/asops/assessment-disclosure-risk-associated-measuring-pension-obligations-determining-pension-plan-contributions-3/>.

⁵ According to April 2020 estimates, Connecticut General Fund revenue less federal grants and Budget Reserve Fund transfers is forecast to be 7.5% less in FY 2021 than in FY 2020. See Office of Policy and Management and Office of Fiscal Analysis. April 30, 2020. Consensus Revenue Estimate. Available at: www.cga.ct.gov/ofa/Documents/year/CR/2020CR-20200430_April%2030%2C%202020%20Consensus%20Revenue%20Estimates.pdf.

⁶ The average assumed rate of return across the 50 states was 7.2% in 2018. <https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2020/06/the-state-pension-funding-gap-2018>

⁷ The shock and ensuing recovery are based on the “Adverse Scenario” in the 2017 Dodd-Frank Act stress tests conducted by the Federal Reserve Board (Fed). We modify the scenario beyond the 12 quarters in the Fed guidance by (1) extending the recovery through year 4, and (2) applying 5% equity returns in years 5 through 30 to replicate the effect on long-term returns (beyond the initial shock and recovery) that also fall short of the investment return target.

⁸ The state has revised its General Fund revenue estimates for fiscal year 2021 from \$20.3 billion to \$18.1 billion, an estimated 11% loss in expected 2021 revenues. Assuming the nation experiences a U-shaped recovery, as experts are increasingly projecting, we estimate that over the years FY 2020 through FY 2024 revenues will be nominally \$9.3 billion lower than expected before the pandemic. See Revenue Projection Method Appendix for a detailed discussion of the methodology used to estimate post-pandemic own-source revenue projections.

⁹ Stochastic simulations are used in Pew’s stress test analysis to 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. For more information, see: Mennis, Greg, Susan Banta and David Draine. (2018). Assessing the Risk of Fiscal Distress for Public Pensions: State Stress Test Analysis. Mossavar-Rahmani Center for Business and Government Working Paper Series, no. 92. Available at https://www.hks.harvard.edu/sites/default/files/centers/mrcbg/files/AWP_92_final.pdf.

¹⁰ For a detailed description of Pew’s capital market assumptions, see Mennis et al. (2018).

¹¹ The LDROM, formerly called the Investment Risk Defeasement Rate, is a market-based liability measure consistent with financial economic theory, which holds that future obligations should be discounted at a rate reflecting their probability of being met. Currently, plans discount liabilities at the rate of return they expect on investments – a practice with a basis in public finance.

Appendix 1: Revenue Projection Method

Forecasts of future state revenues are necessary for presenting forward-looking risk metrics in relation to available state resources. We estimate Own Source Revenue (OSR) — defined as total revenues minus any revenues from intergovernmental transfers, utilities, liquor stores and insurance trusts — using three sources of data: the Census’s Survey of State Finances,ⁱ state-provided projected changes in general fund revenues as of January and April 2020,ⁱⁱ and Moody’s December and May 2020 projections of Gross State Product (GSP).ⁱⁱⁱ First, we observe historical OSR; second, we estimate OSR pre-pandemic; third, we project OSR post-pandemic.

Specifically, historical OSR is observed using Census data through 2018, the latest year for which Survey of State Finances data have been released.

For pre-COVID-19 pandemic estimates, we then use state-provided growth rates as of January 2020 for the General Fund, less federal grants and transfers to the Budget Reserve Fund, to estimate OSR for 2019 and 2020. Finally, for years after 2020, we use rates of growth in GSP, as provided by Moody’s as of December 2019, to calculate how OSR was expected to grow before the COVID-19 pandemic emerged.

Based on the most recent analysis by the Congressional Budget Office,^{iv} we estimate that any COVID-19-related decline in revenue will occur during 2020 and 2021, after which a subsequent recovery will span 2022 through 2025. These effects are implicitly incorporated into our OSR estimates in three ways. First, revenues for 2020 and 2021 were estimated using the state’s revised revenue estimate as of April 2020, which projects that, as a result of the pandemic, Connecticut’s revenue will be 3.8 percent lower than previously estimated for 2020; and 15 percent lower than previously estimated for 2021. Second, the Moody’s projections of GSP as of May 2020, which include estimates of the impact of the COVID-19 pandemic, are used to estimate OSR growth in the years after 2021. Third, the estimated revenues for 2022 to 2025 were calculated based on the historical relationship between revenue and GSP during past recoveries.

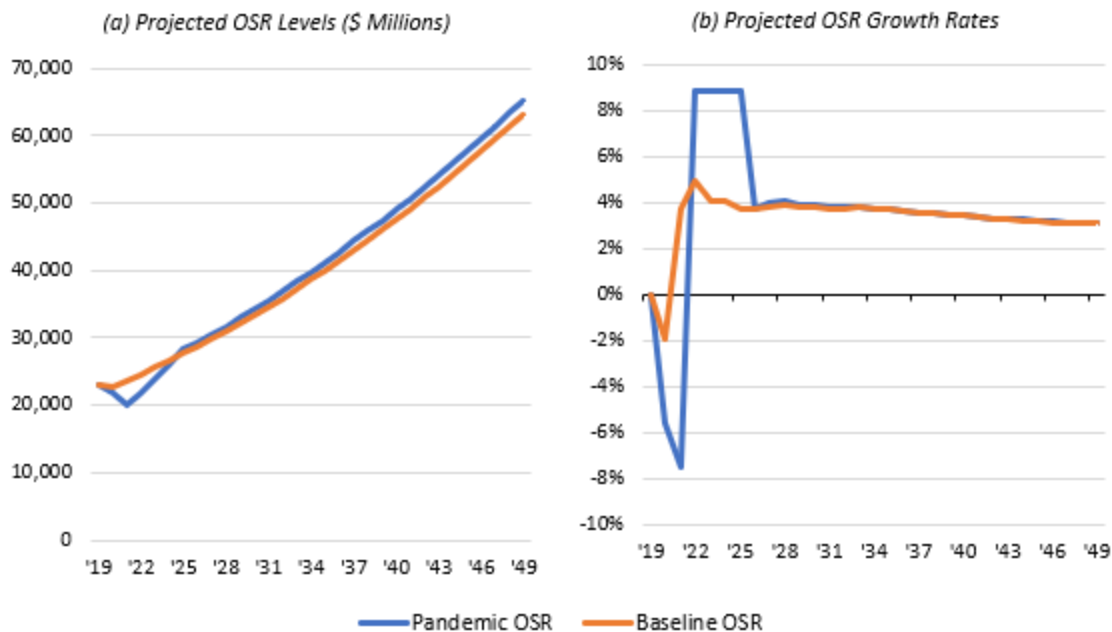
We estimate the relationship between GSP and OSR during the recession and recovery by using both state provided OSR estimates and Moody’s GSP growth rates. Connecticut’s estimated 15 percent decline in revenue due to the COVID-19 pandemic in 2021 is significantly higher than Moody’s forecast of a 9 percent decline in the state’s GSP for that same year. However, based on past experience, we expect revenue growth to exceed that of GSP during the recovery period, “catching up” to the growth predicted by GSP by 2025.^v We approximate this effect by using a 9 percent growth rate for OSR from 2022 to 2025, which is faster than the growth in GSP during that period, which is expected to average 5.2 percent.

Following our previous research, we continue to assume that the relationship in growth between OSR and GSP will hold over the long run. Therefore, starting in 2025, we assume OSR will grow at the same rate as projected GSP. Although projected OSR is lower in 2025 than it would have been in the absence of the COVID-19 pandemic, we estimate that it will be higher in the longer-run due to slightly higher long-term growth rates in projected GSP over the forecast period. Figure 1 illustrates the differences between pre- and post-pandemic projections of OSR levels and growth rates.

APPENDIX FIGURE 1

Connecticut Own-Source Revenue (OSR)

Pre-COVID-19 projections compared with revenue estimates accounting for the anticipated impact of the pandemic



Source: Pew analysis of Moody's and U.S. Census data

ⁱ Own Source Revenue is all revenue except for transfers from federal and local government, liquor stores, utilities, and revenue from trusts such as pension and workers compensation. Available at www.census.gov/programs-surveys/state.html.

ⁱⁱ General revenue less federal grants and transfers to/from other funds.

ⁱⁱⁱ Available at <https://economy.com/>.

^{iv} Available at <https://www.cbo.gov/publication/56351>.

^v See Chernick, H., Reimers, C., & Tennant, J. (2014). Tax Structure and Revenue Instability: The Great Recession and the States. *IZA Journal of Labor Policy*, 3, 1-22. doi.org/10.1186/2193-9004-3-3, Kodrzycki, Yolanda K. *Proceedings of the Annual Conference on Taxation*. 11/13/2014, Issue 107, preceding p1-37, McGranahan, L., & Mattoon, R.H. (2012). State Tax Revenues Over the Business Cycle: Patterns and Policy Responses. *Chicago Fed Letter*, 299, 1-4, and Stinson, T.F. (2006). Sources of Error in State Revenue Forecasts or How Can the Forecast Possibly Be So Far Off. *Journal of Public Budgeting, Accounting & Financial Management*, 18(1), 100-126. doi.org/10.1108/JBAFM-18-01-2006-B005.

Appendix 2: Stress Test Model Output

Exhibit	Plans Included	Description
1	SERS & TRS	30-year projections: assumed (6.90%) returns
2	SERS & TRS	30-year projections: fixed 5% returns scenario
3	SERS & TRS	30-year projections: asset shock scenario
4	SERS	30-year projections: assumed (6.90%) returns
5	SERS	30-year projections: fixed 5% returns scenario
6	SERS	30-year projections: asset shock scenario
7	TRS	30-year projections: assumed (6.90%) returns
8	TRS	30-year projections: fixed 5% returns scenario
9	TRS	30-year projections: asset shock scenario
10	SERS & TRS	Comparison of key fiscal metrics at 5-, 10-, and 20-year intervals across all scenarios
11	SERS	Comparison of key fiscal metrics at 5-, 10-, and 20-year intervals across all scenarios
12	TRS	Comparison of key fiscal metrics at 5-, 10-, and 20-year intervals across all scenarios

Notes and Disclosures

The information in this report is based on the valuation results of the State Employees' Retirement System (SERS) as of June 30, 2019 and the Teachers Retirement System (TRS) as of June 30, 2018, revised June 18, 2019. The return of 6.90 percent is based on the assumed rates of return for SERS and TRS. Projections are based on a roll-forward model using publicly available actuarial data and assumptions.

Exhibit 1

Connecticut Retirement System 30-Year Projections

Plans included: State Employees' Retirement System and Teachers Retirement System
State contribution policy at assumed rate of return (6.90%)

\$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
2020	8,161	71,624	944	4,821	(4,261)	73,129	31,774	3,297	2,159	(4,261)	32,969	40,159	309	4%	45%	-3%	2,825	N/A	35%
2021	8,435	73,129	972	4,920	(4,419)	74,602	32,969	3,555	2,245	(4,419)	34,350	40,252	93	1%	46%	-3%	3,055	8%	36%
2022	8,719	74,602	1,002	5,018	(4,578)	76,043	34,350	3,855	2,345	(4,578)	35,972	40,071	(181)	-2%	47%	-2%	3,328	9%	38%
2023	9,013	76,043	1,032	5,113	(4,737)	77,451	35,972	4,072	2,459	(4,737)	37,766	39,685	(386)	-4%	49%	-2%	3,518	6%	39%
2024	9,316	77,451	1,064	5,205	(4,895)	78,825	37,766	4,305	2,585	(4,895)	39,761	39,064	(621)	-7%	50%	-2%	3,724	6%	40%
2025	9,630	78,825	1,096	5,296	(5,051)	80,166	39,761	4,381	2,720	(5,051)	41,810	38,355	(709)	-7%	52%	-2%	3,772	1%	39%
2026	9,954	80,166	1,130	5,384	(5,207)	81,473	41,810	4,574	2,862	(5,207)	44,040	37,433	(922)	-9%	54%	-2%	3,937	4%	40%
2027	10,290	81,473	1,166	5,470	(5,360)	82,749	44,040	4,656	3,014	(5,360)	46,349	36,399	(1,034)	-10%	56%	-2%	3,990	1%	39%
2028	10,636	82,749	1,202	5,554	(5,511)	83,994	46,349	4,644	3,168	(5,511)	48,650	35,344	(1,055)	-10%	58%	-2%	3,950	-1%	37%
2029	10,995	83,994	1,240	5,636	(5,659)	85,211	48,650	4,727	3,324	(5,659)	51,042	34,169	(1,175)	-11%	60%	-2%	4,004	1%	36%
2030	11,365	85,211	1,280	5,716	(5,804)	86,403	51,042	4,697	3,483	(5,804)	53,418	32,985	(1,184)	-10%	62%	-2%	3,944	-1%	35%
2031	11,748	86,403	1,321	5,795	(5,945)	87,574	53,418	4,781	3,645	(5,945)	55,899	31,675	(1,311)	-11%	64%	-2%	3,998	1%	34%
2032	12,143	87,574	1,363	5,872	(6,086)	88,723	55,899	4,752	3,811	(6,086)	58,375	30,348	(1,327)	-11%	66%	-2%	3,938	-2%	32%
2033	12,552	88,723	1,408	5,948	(6,219)	89,859	58,375	4,838	3,980	(6,219)	60,974	28,886	(1,462)	-12%	68%	-2%	3,993	1%	32%
2034	12,975	89,859	1,453	6,024	(6,344)	90,992	60,974	4,812	4,154	(6,344)	63,596	27,396	(1,489)	-11%	70%	-3%	3,934	-1%	30%
2035	13,412	90,992	1,500	6,099	(6,459)	92,132	63,596	4,901	4,334	(6,459)	66,371	25,761	(1,635)	-12%	72%	-2%	3,991	1%	30%
2036	13,864	92,132	1,549	6,175	(6,565)	93,292	66,371	4,877	4,521	(6,565)	69,204	24,088	(1,673)	-12%	74%	-3%	3,933	-1%	28%
2037	14,331	93,292	1,600	6,254	(6,660)	94,486	69,204	4,968	4,716	(6,660)	72,228	22,258	(1,830)	-13%	76%	-2%	3,990	1%	28%
2038	14,814	94,486	1,653	6,334	(6,745)	95,727	72,228	4,948	4,921	(6,745)	75,352	20,375	(1,882)	-13%	79%	-2%	3,935	-1%	27%
2039	15,314	95,727	1,707	6,419	(6,819)	97,034	75,352	5,043	5,138	(6,819)	78,713	18,321	(2,054)	-13%	81%	-2%	3,993	1%	26%
2040	15,830	97,034	1,763	6,508	(6,882)	98,424	78,713	5,026	5,367	(6,882)	82,224	16,200	(2,121)	-13%	84%	-2%	3,939	-1%	25%
2041	16,363	98,424	1,822	6,604	(6,934)	99,915	82,224	5,123	5,610	(6,934)	86,024	13,892	(2,308)	-14%	86%	-2%	3,998	1%	24%
2042	16,914	99,915	1,882	6,707	(6,976)	101,529	86,024	5,111	5,871	(6,976)	90,030	11,498	(2,393)	-14%	89%	-2%	3,946	-1%	23%
2043	17,485	101,529	1,944	6,819	(7,007)	103,285	90,030	5,212	6,149	(7,007)	94,385	8,900	(2,598)	-15%	91%	-2%	4,006	2%	23%
2044	18,074	103,285	2,008	6,941	(7,027)	105,208	94,385	5,203	6,449	(7,027)	99,010	6,198	(2,702)	-15%	94%	-2%	3,956	-1%	22%
2045	18,683	105,208	2,075	7,076	(7,039)	107,319	99,010	5,257	6,769	(7,039)	103,998	3,322	(2,876)	-15%	97%	-2%	3,967	0%	21%
2046	19,313	107,319	2,144	7,223	(7,042)	109,645	103,998	5,163	7,110	(7,042)	109,229	416	(2,905)	-15%	100%	-2%	3,827	-4%	20%
2047	19,964	109,645	2,215	7,386	(7,037)	112,210	109,229	5,153	7,471	(7,037)	114,816	(2,606)	(3,023)	-15%	102%	-2%	3,819	0%	19%
2048	20,637	112,210	2,289	7,566	(7,024)	115,040	114,816	3,432	7,798	(7,024)	119,022	(3,981)	(1,375)	-7%	103%	-3%	2,052	-46%	10%
2049	21,332	115,040	2,365	7,780	(7,017)	118,169	119,022	3,437	8,089	(7,017)	123,531	(5,362)	(1,380)	-6%	105%	-3%	2,010	-2%	9%

Exhibit 2

Connecticut Retirement System 30-Year Projections

Plans included: State Employees' Retirement System and Teachers Retirement System
State contribution policy at 5% return

\$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
2020	8,161	71,603	944	4,796	(4,256)	73,088	31,777	3,297	1,564	(4,256)	32,382	40,706	879	11%	44%	-3%	2,825	N/A	35%
2021	8,435	73,088	972	4,894	(4,412)	74,542	32,382	3,555	1,597	(4,412)	33,122	41,420	714	8%	44%	-3%	3,055	8%	36%
2022	8,719	74,542	1,002	4,990	(4,568)	75,965	33,122	3,868	1,638	(4,568)	34,060	41,905	485	6%	45%	-2%	3,335	9%	38%
2023	9,013	75,965	1,032	5,083	(4,724)	77,356	34,060	4,103	1,687	(4,724)	35,125	42,231	326	4%	45%	-2%	3,533	6%	39%
2024	9,316	77,356	1,064	5,174	(4,880)	78,714	35,125	4,390	1,743	(4,880)	36,379	42,335	105	1%	46%	-1%	3,781	7%	41%
2025	9,630	78,714	1,096	5,264	(5,034)	80,040	36,379	4,486	1,804	(5,034)	37,635	42,405	69	1%	47%	-2%	3,844	2%	40%
2026	9,954	80,040	1,130	5,350	(5,187)	81,334	37,635	4,770	1,871	(5,187)	39,089	42,245	(160)	-2%	48%	-1%	4,095	7%	41%
2027	10,290	81,334	1,166	5,435	(5,338)	82,598	39,089	4,878	1,942	(5,338)	40,572	42,026	(219)	-2%	49%	-1%	4,170	2%	41%
2028	10,636	82,598	1,202	5,518	(5,486)	83,832	40,572	4,963	2,015	(5,486)	42,064	41,768	(257)	-2%	50%	-1%	4,222	1%	40%
2029	10,995	83,832	1,240	5,599	(5,632)	85,040	42,064	5,079	2,088	(5,632)	43,600	41,440	(328)	-3%	51%	-1%	4,304	2%	39%
2030	11,365	85,040	1,280	5,678	(5,774)	86,223	43,600	5,151	2,163	(5,774)	45,140	41,084	(356)	-3%	52%	-1%	4,341	1%	38%
2031	11,748	86,223	1,321	5,756	(5,913)	87,387	45,140	5,275	2,240	(5,913)	46,741	40,646	(438)	-4%	53%	-1%	4,431	2%	38%
2032	12,143	87,387	1,363	5,832	(6,052)	88,530	46,741	5,353	2,319	(6,052)	48,361	40,169	(476)	-4%	55%	-1%	4,474	1%	37%
2033	12,552	88,530	1,408	5,907	(6,184)	89,661	48,361	5,485	2,400	(6,184)	50,061	39,599	(570)	-5%	56%	-1%	4,569	2%	36%
2034	12,975	89,661	1,453	5,981	(6,307)	90,788	50,061	5,572	2,484	(6,307)	51,811	38,978	(622)	-5%	57%	-1%	4,620	1%	36%
2035	13,412	90,788	1,500	6,055	(6,421)	91,923	51,811	5,712	2,572	(6,421)	53,674	38,250	(728)	-5%	58%	-1%	4,723	2%	35%
2036	13,864	91,923	1,549	6,130	(6,525)	93,078	53,674	5,810	2,665	(6,525)	55,624	37,454	(795)	-6%	60%	-1%	4,783	1%	34%
2037	14,331	93,078	1,600	6,207	(6,619)	94,267	55,624	5,958	2,763	(6,619)	57,727	36,540	(914)	-6%	61%	-1%	4,891	2%	34%
2038	14,814	94,267	1,653	6,286	(6,703)	95,503	57,727	6,066	2,869	(6,703)	59,959	35,544	(996)	-7%	63%	-1%	4,959	1%	33%
2039	15,314	95,503	1,707	6,369	(6,775)	96,804	59,959	6,223	2,983	(6,775)	62,390	34,414	(1,130)	-7%	64%	-1%	5,075	2%	33%
2040	15,830	96,804	1,763	6,457	(6,837)	98,187	62,390	6,343	3,106	(6,837)	65,001	33,186	(1,228)	-8%	66%	-1%	5,152	2%	33%
2041	16,363	98,187	1,822	6,551	(6,888)	99,671	65,001	6,508	3,239	(6,888)	67,860	31,811	(1,375)	-8%	68%	-1%	5,274	2%	32%
2042	16,914	99,671	1,882	6,652	(6,928)	101,277	67,860	6,640	3,384	(6,928)	70,956	30,321	(1,490)	-9%	70%	0%	5,362	2%	32%
2043	17,485	101,277	1,944	6,763	(6,958)	103,026	70,956	6,815	3,543	(6,958)	74,357	28,669	(1,651)	-9%	72%	0%	5,491	2%	31%
2044	18,074	103,026	2,008	6,884	(6,977)	104,942	74,357	6,961	3,716	(6,977)	78,056	26,885	(1,784)	-10%	74%	0%	5,589	2%	31%
2045	18,683	104,942	2,075	7,017	(6,986)	107,047	78,056	7,098	3,904	(6,986)	82,072	24,975	(1,910)	-10%	77%	0%	5,678	2%	30%
2046	19,313	107,047	2,144	7,163	(6,987)	109,368	82,072	7,167	4,106	(6,987)	86,358	23,009	(1,966)	-10%	79%	0%	5,697	0%	29%
2047	19,964	109,368	2,215	7,325	(6,979)	111,929	86,358	7,292	4,324	(6,979)	90,995	20,934	(2,075)	-10%	81%	0%	5,770	1%	29%
2048	20,637	111,929	2,289	7,504	(6,965)	114,758	90,995	5,740	4,517	(6,965)	94,288	20,470	(464)	-2%	82%	-1%	4,165	-28%	20%
2049	21,332	114,758	2,365	7,763	(6,954)	117,931	94,288	5,873	4,686	(6,954)	97,892	20,039	(431)	-2%	83%	-1%	4,243	2%	20%

Exhibit 3

Connecticut Retirement System 30-Year Projections

Plans included: State Employees' Retirement System and Teachers Retirement System
State contribution policy with asset shock returns

\$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
2020	8,161	71,529	944	4,658	(4,234)	72,897	31,785	3,297	(7,789)	(4,234)	23,059	49,838	10,095	124%	32%	-3%	2,825	N/A	35%
2021	8,435	72,897	972	4,716	(4,373)	74,213	23,059	3,555	2,817	(4,373)	25,059	49,154	(684)	-8%	34%	-4%	3,055	8%	36%
2022	8,719	74,213	1,002	4,827	(4,514)	75,527	25,059	4,145	3,422	(4,514)	28,111	47,416	(1,738)	-20%	37%	-1%	3,612	18%	41%
2023	8,961	75,527	1,032	4,844	(4,656)	76,748	28,111	4,409	3,067	(4,656)	30,932	45,816	(1,600)	-18%	40%	-1%	3,843	6%	43%
2024	9,209	76,748	1,057	4,889	(4,793)	77,901	30,932	4,826	1,395	(4,793)	32,360	45,541	(275)	-3%	42%	0%	4,224	10%	46%
2025	9,465	77,901	1,084	4,994	(4,933)	79,046	32,360	4,884	1,572	(4,933)	33,883	45,163	(378)	-4%	43%	0%	4,253	1%	45%
2026	9,728	79,046	1,111	5,067	(5,071)	80,152	33,883	5,139	1,649	(5,071)	35,599	44,553	(610)	-6%	44%	0%	4,492	6%	46%
2027	9,998	80,152	1,139	5,135	(5,208)	81,219	35,599	5,196	1,730	(5,208)	37,318	43,901	(652)	-7%	46%	0%	4,536	1%	45%
2028	10,277	81,219	1,168	5,201	(5,342)	82,247	37,318	5,155	1,810	(5,342)	38,941	43,306	(595)	-6%	47%	-1%	4,469	-1%	43%
2029	10,570	82,247	1,198	5,274	(5,474)	83,244	38,941	5,238	1,887	(5,474)	40,592	42,652	(653)	-6%	49%	-1%	4,526	1%	43%
2030	10,871	83,244	1,230	5,335	(5,604)	84,205	40,592	5,252	1,965	(5,604)	42,205	42,000	(652)	-6%	50%	-1%	4,514	0%	42%
2031	11,181	84,205	1,264	5,393	(5,731)	85,130	42,205	5,345	2,042	(5,731)	43,861	41,269	(731)	-7%	52%	-1%	4,580	1%	41%
2032	11,500	85,130	1,298	5,448	(5,859)	86,018	43,861	5,379	2,121	(5,859)	45,503	40,515	(754)	-7%	53%	-1%	4,588	0%	40%
2033	11,828	86,018	1,333	5,500	(5,979)	86,872	45,503	5,481	2,200	(5,979)	47,204	39,668	(847)	-7%	54%	-1%	4,662	2%	39%
2034	12,165	86,872	1,369	5,550	(6,093)	87,698	47,204	5,529	2,281	(6,093)	48,921	38,777	(891)	-7%	56%	-1%	4,683	0%	38%
2035	12,512	87,698	1,407	5,598	(6,198)	88,504	48,921	5,639	2,364	(6,198)	50,726	37,779	(999)	-8%	57%	-1%	4,765	2%	38%
2036	12,869	88,504	1,445	5,644	(6,295)	89,299	50,726	5,699	2,451	(6,295)	52,581	36,718	(1,061)	-8%	59%	-1%	4,797	1%	37%
2037	13,236	89,299	1,485	5,689	(6,382)	90,091	52,581	5,816	2,542	(6,382)	54,557	35,534	(1,184)	-9%	61%	-1%	4,885	2%	37%
2038	13,614	90,091	1,526	5,735	(6,459)	90,893	54,557	5,888	2,638	(6,459)	56,624	34,269	(1,265)	-9%	62%	-1%	4,928	1%	36%
2039	14,002	90,893	1,569	5,781	(6,526)	91,716	56,624	6,013	2,740	(6,526)	58,851	32,866	(1,403)	-10%	64%	-1%	5,023	2%	36%
2040	14,401	91,716	1,612	5,830	(6,583)	92,576	58,851	6,096	2,848	(6,583)	61,213	31,364	(1,502)	-10%	66%	-1%	5,076	1%	35%
2041	14,812	92,576	1,657	5,882	(6,627)	93,488	61,213	6,229	2,965	(6,627)	63,779	29,709	(1,655)	-11%	68%	-1%	5,178	2%	35%
2042	15,235	93,488	1,703	5,939	(6,661)	94,470	63,779	6,325	3,092	(6,661)	66,535	27,935	(1,774)	-12%	70%	-1%	5,241	1%	34%
2043	15,670	94,470	1,751	6,003	(6,683)	95,541	66,535	6,465	3,228	(6,683)	69,546	25,995	(1,940)	-12%	73%	0%	5,349	2%	34%
2044	16,117	95,541	1,800	6,074	(6,694)	96,721	69,546	6,574	3,377	(6,694)	72,803	23,918	(2,078)	-13%	75%	0%	5,425	1%	34%
2045	16,577	96,721	1,850	6,154	(6,694)	98,031	72,803	6,675	3,538	(6,694)	76,322	21,709	(2,209)	-13%	78%	0%	5,491	1%	33%
2046	17,050	98,031	1,902	6,244	(6,685)	99,492	76,322	6,707	3,710	(6,685)	80,054	19,438	(2,271)	-13%	80%	0%	5,489	0%	32%
2047	17,536	99,492	1,956	6,346	(6,667)	101,127	80,054	6,574	3,889	(6,667)	83,849	17,278	(2,160)	-12%	83%	0%	5,319	-3%	30%
2048	18,037	101,127	2,011	6,461	(6,642)	102,957	83,849	4,940	4,034	(6,642)	86,182	16,775	(503)	-3%	84%	-2%	3,649	-31%	20%
2049	18,552	102,957	2,067	6,950	(6,621)	105,353	86,182	4,486	4,137	(6,621)	88,184	17,169	394	2%	84%	-2%	3,245	-11%	17%

Exhibit 4

Connecticut Retirement System 30 Year Projections

Plans included: State Employees' Retirement System
State contribution policy at assumed rate of return (6.90%)

\$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
2020	3,815	36,088	376	2,431	(2,115)	36,779	13,276	1,784	904	(2,115)	13,848	22,931	119	3%	38%	-2%	1,616	N/A	42%
2021	3,949	36,779	386	2,476	(2,200)	37,441	13,848	1,993	948	(2,200)	14,589	22,852	(79)	-2%	39%	-1%	1,807	12%	46%
2022	4,087	37,441	396	2,519	(2,286)	38,071	14,589	2,176	1,002	(2,286)	15,482	22,589	(263)	-6%	41%	-1%	1,974	9%	48%
2023	4,230	38,071	407	2,560	(2,372)	38,666	15,482	2,339	1,066	(2,372)	16,515	22,151	(438)	-10%	43%	0%	2,119	7%	50%
2024	4,378	38,666	418	2,599	(2,458)	39,224	16,515	2,364	1,135	(2,458)	17,556	21,668	(483)	-11%	45%	-1%	2,128	0%	49%
2025	4,531	39,224	430	2,635	(2,545)	39,743	17,556	2,377	1,205	(2,545)	18,592	21,151	(517)	-11%	47%	-1%	2,125	0%	47%
2026	4,690	39,743	442	2,668	(2,632)	40,221	18,592	2,388	1,274	(2,632)	19,622	20,599	(552)	-12%	49%	-1%	2,120	0%	45%
2027	4,854	40,221	455	2,698	(2,719)	40,656	19,622	2,399	1,342	(2,719)	20,645	20,011	(588)	-12%	51%	-2%	2,114	0%	44%
2028	5,024	40,656	469	2,726	(2,805)	41,045	20,645	2,410	1,410	(2,805)	21,660	19,386	(625)	-12%	53%	-2%	2,108	0%	42%
2029	5,200	41,045	483	2,750	(2,890)	41,388	21,660	2,420	1,477	(2,890)	22,667	18,721	(665)	-13%	55%	-2%	2,103	0%	40%
2030	5,382	41,388	498	2,772	(2,975)	41,683	22,667	2,431	1,544	(2,975)	23,668	18,015	(706)	-13%	57%	-2%	2,097	0%	39%
2031	5,570	41,683	513	2,790	(3,059)	41,927	23,668	2,442	1,611	(3,059)	24,662	17,265	(750)	-13%	59%	-3%	2,091	0%	38%
2032	5,765	41,927	530	2,804	(3,141)	42,120	24,662	2,453	1,677	(3,141)	25,651	16,469	(796)	-14%	61%	-3%	2,085	0%	36%
2033	5,967	42,120	546	2,816	(3,214)	42,268	25,651	2,465	1,743	(3,214)	26,645	15,623	(846)	-14%	63%	-3%	2,080	0%	35%
2034	6,176	42,268	564	2,824	(3,277)	42,379	26,645	2,477	1,810	(3,277)	27,655	14,724	(898)	-15%	65%	-3%	2,076	0%	34%
2035	6,392	42,379	583	2,831	(3,330)	42,462	27,655	2,490	1,878	(3,330)	28,693	13,769	(955)	-15%	68%	-3%	2,071	0%	32%
2036	6,616	42,462	602	2,836	(3,372)	42,528	28,693	2,503	1,949	(3,372)	29,773	12,755	(1,015)	-15%	70%	-3%	2,067	0%	31%
2037	6,847	42,528	622	2,840	(3,402)	42,588	29,773	2,517	2,023	(3,402)	30,911	11,677	(1,078)	-16%	73%	-3%	2,063	0%	30%
2038	7,087	42,588	642	2,844	(3,420)	42,655	30,911	2,531	2,101	(3,420)	32,124	10,531	(1,146)	-16%	75%	-3%	2,059	0%	29%
2039	7,335	42,655	664	2,849	(3,426)	42,743	32,124	2,547	2,185	(3,426)	33,430	9,312	(1,219)	-17%	78%	-3%	2,056	0%	28%
2040	7,592	42,743	686	2,857	(3,419)	42,866	33,430	2,562	2,276	(3,419)	34,850	8,017	(1,296)	-17%	81%	-3%	2,052	0%	27%
2041	7,858	42,866	709	2,866	(3,400)	43,042	34,850	2,579	2,375	(3,400)	36,404	6,638	(1,379)	-18%	85%	-2%	2,049	0%	26%
2042	8,133	43,042	734	2,880	(3,369)	43,286	36,404	2,596	2,484	(3,369)	38,115	5,172	(1,466)	-18%	88%	-2%	2,046	0%	25%
2043	8,417	43,286	758	2,900	(3,327)	43,618	38,115	2,615	2,604	(3,327)	40,007	3,611	(1,561)	-19%	92%	-2%	2,044	0%	24%
2044	8,712	43,618	784	2,925	(3,272)	44,055	40,007	2,634	2,737	(3,272)	42,105	1,950	(1,661)	-19%	96%	-2%	2,041	0%	23%
2045	9,017	44,055	811	2,958	(3,207)	44,617	42,105	2,604	2,883	(3,207)	44,385	233	(1,717)	-19%	99%	-1%	1,990	-3%	22%
2046	9,332	44,617	839	3,001	(3,132)	45,325	44,385	2,533	3,040	(3,132)	46,826	(1,500)	(1,733)	-19%	103%	-1%	1,896	-5%	20%
2047	9,659	45,325	868	3,054	(3,047)	46,200	46,826	2,438	3,208	(3,047)	49,425	(3,225)	(1,725)	-18%	107%	-1%	1,825	-4%	19%
2048	9,997	46,200	898	3,118	(2,954)	47,262	49,425	735	3,333	(2,954)	50,540	(3,278)	(52)	-1%	107%	-4%	100	-95%	1%
2049	10,347	47,262	929	3,195	(2,863)	48,524	50,540	758	3,414	(2,863)	51,849	(3,325)	(48)	0%	107%	-4%	100	0%	1%

Exhibit 5

Connecticut Retirement System 30 Year Projections

Plans included: State Employees' Retirement System

State contribution policy at 5% returns

\$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
2020	3,815	36,088	376	2,431	(2,115)	36,779	13,276	1,784	655	(2,115)	13,599	23,180	368	10%	37%	-2%	1,616	N/A	42%
2021	3,949	36,779	386	2,476	(2,200)	37,441	13,599	1,993	674	(2,200)	14,066	23,375	195	5%	38%	-2%	1,807	12%	46%
2022	4,087	37,441	396	2,519	(2,286)	38,071	14,066	2,186	700	(2,286)	14,667	23,404	29	1%	39%	-1%	1,977	9%	48%
2023	4,230	38,071	407	2,560	(2,372)	38,666	14,667	2,367	732	(2,372)	15,394	23,272	(132)	-3%	40%	0%	2,132	8%	50%
2024	4,378	38,666	418	2,599	(2,458)	39,224	15,394	2,416	768	(2,458)	16,120	23,104	(168)	-4%	41%	0%	2,153	1%	49%
2025	4,531	39,224	430	2,635	(2,545)	39,743	16,120	2,448	803	(2,545)	16,825	22,918	(186)	-4%	42%	-1%	2,163	0%	48%
2026	4,690	39,743	442	2,668	(2,632)	40,221	16,825	2,480	837	(2,632)	17,509	22,712	(207)	-4%	44%	-1%	2,174	0%	46%
2027	4,854	40,221	455	2,698	(2,719)	40,656	17,509	2,514	869	(2,719)	18,174	22,482	(230)	-5%	45%	-1%	2,186	1%	45%
2028	5,024	40,656	469	2,726	(2,805)	41,045	18,174	2,550	901	(2,805)	18,821	22,225	(257)	-5%	46%	-1%	2,202	1%	44%
2029	5,200	41,045	483	2,750	(2,890)	41,388	18,821	2,588	932	(2,890)	19,450	21,938	(287)	-6%	47%	-2%	2,218	1%	43%
2030	5,382	41,388	498	2,772	(2,975)	41,683	19,450	2,628	963	(2,975)	20,066	21,617	(321)	-6%	48%	-2%	2,237	1%	42%
2031	5,570	41,683	513	2,790	(3,059)	41,927	20,066	2,670	993	(3,059)	20,669	21,258	(359)	-6%	49%	-2%	2,258	1%	41%
2032	5,765	41,927	530	2,804	(3,141)	42,120	20,669	2,714	1,022	(3,141)	21,264	20,856	(402)	-7%	50%	-2%	2,281	1%	40%
2033	5,967	42,120	546	2,816	(3,214)	42,268	21,264	2,760	1,051	(3,214)	21,861	20,407	(448)	-8%	52%	-2%	2,305	1%	39%
2034	6,176	42,268	564	2,824	(3,277)	42,379	21,861	2,808	1,080	(3,277)	22,471	19,908	(499)	-8%	53%	-2%	2,331	1%	38%
2035	6,392	42,379	583	2,831	(3,330)	42,462	22,471	2,858	1,111	(3,330)	23,109	19,353	(555)	-9%	54%	-2%	2,360	1%	37%
2036	6,616	42,462	602	2,836	(3,372)	42,528	23,109	2,910	1,143	(3,372)	23,789	18,739	(615)	-9%	56%	-2%	2,389	1%	36%
2037	6,847	42,528	622	2,840	(3,402)	42,588	23,789	2,963	1,177	(3,402)	24,528	18,060	(678)	-10%	58%	-2%	2,420	1%	35%
2038	7,087	42,588	642	2,844	(3,420)	42,655	24,528	3,018	1,215	(3,420)	25,341	17,314	(747)	-11%	59%	-2%	2,452	1%	35%
2039	7,335	42,655	664	2,849	(3,426)	42,743	25,341	3,076	1,257	(3,426)	26,249	16,494	(820)	-11%	61%	-1%	2,486	1%	34%
2040	7,592	42,743	686	2,857	(3,419)	42,866	26,249	3,136	1,304	(3,419)	27,269	15,597	(897)	-12%	64%	-1%	2,522	1%	33%
2041	7,858	42,866	709	2,866	(3,400)	43,042	27,269	3,197	1,357	(3,400)	28,423	14,619	(978)	-12%	66%	-1%	2,558	1%	33%
2042	8,133	43,042	734	2,880	(3,369)	43,286	28,423	3,261	1,417	(3,369)	29,731	13,555	(1,064)	-13%	69%	0%	2,597	2%	32%
2043	8,417	43,286	758	2,900	(3,327)	43,618	29,731	3,326	1,485	(3,327)	31,216	12,402	(1,153)	-14%	72%	0%	2,636	2%	31%
2044	8,712	43,618	784	2,925	(3,272)	44,055	31,216	3,395	1,562	(3,272)	32,900	11,155	(1,247)	-14%	75%	0%	2,678	2%	31%
2045	9,017	44,055	811	2,958	(3,207)	44,617	32,900	3,416	1,648	(3,207)	34,757	9,860	(1,295)	-14%	78%	1%	2,672	0%	30%
2046	9,332	44,617	839	3,001	(3,132)	45,325	34,757	3,398	1,742	(3,132)	36,765	8,560	(1,300)	-14%	81%	1%	2,626	-2%	28%
2047	9,659	45,325	868	3,054	(3,047)	46,200	36,765	3,400	1,845	(3,047)	38,963	7,237	(1,323)	-14%	84%	1%	2,599	-1%	27%
2048	9,997	46,200	898	3,118	(2,954)	47,262	38,963	1,748	1,916	(2,954)	39,674	7,588	352	4%	84%	-3%	918	-65%	9%
2049	10,347	47,262	929	3,195	(2,863)	48,524	39,674	1,779	1,955	(2,863)	40,545	7,979	391	4%	84%	-3%	918	0%	9%

Exhibit 6

Connecticut Retirement System 30 Year Projections

Plans included: State Employees' Retirement System

State contribution policy with asset shock returns

\$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
2020	3,815	36,088	376	2,382	(2,110)	36,735	13,276	1,784	(3,261)	(2,110)	9,689	27,047	4,234	111%	26%	-2%	1,616	N/A	42%
2021	3,949	36,735	386	2,423	(2,190)	37,354	9,689	1,993	1,195	(2,190)	10,686	26,667	(379)	-10%	29%	-2%	1,807	12%	46%
2022	4,087	37,354	396	2,463	(2,270)	37,942	10,686	2,391	1,481	(2,270)	12,288	25,654	(1,014)	-25%	32%	1%	2,182	21%	53%
2023	4,206	37,942	407	2,470	(2,351)	38,468	12,288	2,608	1,364	(2,351)	13,909	24,558	(1,096)	-26%	36%	2%	2,375	9%	56%
2024	4,328	38,468	415	2,503	(2,432)	38,953	13,909	2,646	633	(2,432)	14,756	24,197	(361)	-8%	38%	2%	2,386	0%	55%
2025	4,454	38,953	425	2,532	(2,513)	39,397	14,756	2,646	724	(2,513)	15,613	23,784	(413)	-9%	40%	1%	2,366	-1%	53%
2026	4,583	39,397	434	2,560	(2,595)	39,796	15,613	2,635	764	(2,595)	16,417	23,379	(405)	-9%	41%	0%	2,348	-1%	51%
2027	4,717	39,796	445	2,583	(2,675)	40,149	16,417	2,626	801	(2,675)	17,169	22,980	(399)	-8%	43%	0%	2,335	-1%	50%
2028	4,854	40,149	455	2,604	(2,756)	40,452	17,169	2,634	836	(2,756)	17,883	22,569	(411)	-8%	44%	-1%	2,328	0%	48%
2029	4,999	40,452	466	2,625	(2,836)	40,707	17,883	2,648	869	(2,836)	18,564	22,143	(426)	-9%	46%	-1%	2,326	0%	47%
2030	5,148	40,707	478	2,638	(2,915)	40,908	18,564	2,666	901	(2,915)	19,216	21,693	(450)	-9%	47%	-1%	2,328	0%	45%
2031	5,302	40,908	491	2,648	(2,994)	41,054	19,216	2,688	931	(2,994)	19,841	21,212	(480)	-9%	48%	-2%	2,335	0%	44%
2032	5,460	41,054	504	2,654	(3,071)	41,141	19,841	2,713	961	(3,071)	20,444	20,697	(515)	-9%	50%	-2%	2,344	0%	43%
2033	5,623	41,141	518	2,657	(3,139)	41,176	20,444	2,742	989	(3,139)	21,036	20,140	(557)	-10%	51%	-2%	2,358	1%	42%
2034	5,790	41,176	532	2,656	(3,198)	41,165	21,036	2,773	1,017	(3,198)	21,628	19,537	(603)	-10%	53%	-2%	2,373	1%	41%
2035	5,963	41,165	546	2,652	(3,247)	41,116	21,628	2,807	1,046	(3,247)	22,234	18,882	(655)	-11%	54%	-2%	2,392	1%	40%
2036	6,141	41,116	561	2,646	(3,285)	41,038	22,234	2,844	1,075	(3,285)	22,868	18,171	(712)	-12%	56%	-2%	2,413	1%	39%
2037	6,324	41,038	577	2,639	(3,312)	40,943	22,868	2,883	1,107	(3,312)	23,546	17,397	(773)	-12%	58%	-2%	2,436	1%	39%
2038	6,513	40,943	593	2,632	(3,327)	40,841	23,546	2,925	1,140	(3,327)	24,284	16,557	(841)	-13%	59%	-2%	2,462	1%	38%
2039	6,707	40,841	610	2,624	(3,331)	40,745	24,284	2,969	1,178	(3,331)	25,100	15,645	(912)	-14%	62%	-1%	2,490	1%	37%
2040	6,907	40,745	627	2,618	(3,322)	40,669	25,100	3,015	1,219	(3,322)	26,012	14,656	(988)	-14%	64%	-1%	2,519	1%	36%
2041	7,113	40,669	645	2,614	(3,301)	40,627	26,012	3,064	1,265	(3,301)	27,040	13,587	(1,069)	-15%	67%	-1%	2,551	1%	36%
2042	7,325	40,627	664	2,613	(3,268)	40,637	27,040	3,115	1,317	(3,268)	28,205	12,432	(1,155)	-16%	69%	-1%	2,585	1%	35%
2043	7,544	40,637	683	2,617	(3,223)	40,714	28,205	3,168	1,376	(3,223)	29,526	11,188	(1,244)	-16%	73%	0%	2,621	1%	35%
2044	7,769	40,714	703	2,626	(3,166)	40,877	29,526	3,224	1,444	(3,166)	31,028	9,849	(1,339)	-17%	76%	0%	2,659	1%	34%
2045	8,000	40,877	723	2,642	(3,099)	41,143	31,028	3,233	1,519	(3,099)	32,681	8,462	(1,387)	-17%	79%	0%	2,650	0%	33%
2046	8,239	41,143	745	2,666	(3,021)	41,533	32,681	3,203	1,601	(3,021)	34,464	7,069	(1,393)	-17%	83%	1%	2,601	-2%	32%
2047	8,485	41,533	766	2,699	(2,934)	42,065	34,464	2,974	1,685	(2,934)	36,189	5,876	(1,193)	-14%	86%	0%	2,353	-10%	28%
2048	8,738	42,065	789	2,743	(2,838)	42,759	36,189	1,268	1,730	(2,838)	36,349	6,410	534	6%	85%	-4%	627	-73%	7%
2049	8,998	42,759	812	2,885	(2,745)	43,710	36,349	740	1,727	(2,745)	36,070	7,640	1,230	14%	83%	-6%	167	-73%	2%

Exhibit 7

Connecticut Retirement System 30 Year Projections

Plans included: Teachers Retirement System

State contribution policy at assumed rate of return (6.90%)

\$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
2020	4,345	35,536	568	2,390	(2,145)	36,349	18,499	1,513	1,255	(2,145)	19,121	17,228	190	4%	53%	-3%	1,209	N/A	28%
2021	4,486	36,349	587	2,444	(2,219)	37,161	19,121	1,562	1,297	(2,219)	19,761	17,399	172	4%	53%	-3%	1,248	3%	28%
2022	4,632	37,161	606	2,498	(2,292)	37,972	19,761	1,679	1,343	(2,292)	20,490	17,482	82	2%	54%	-3%	1,354	9%	29%
2023	4,783	37,972	625	2,552	(2,365)	38,785	20,490	1,733	1,392	(2,365)	21,251	17,534	52	1%	55%	-3%	1,398	3%	29%
2024	4,938	38,785	646	2,607	(2,436)	39,601	21,251	1,941	1,450	(2,436)	22,205	17,396	(138)	-3%	56%	-2%	1,595	14%	32%
2025	5,099	39,601	667	2,661	(2,506)	40,423	22,205	2,004	1,515	(2,506)	23,218	17,205	(191)	-4%	57%	-2%	1,647	3%	32%
2026	5,264	40,423	688	2,716	(2,575)	41,252	23,218	2,186	1,589	(2,575)	24,418	16,835	(370)	-7%	59%	-2%	1,817	10%	35%
2027	5,435	41,252	711	2,772	(2,642)	42,093	24,418	2,257	1,672	(2,642)	25,705	16,388	(446)	-8%	61%	-2%	1,876	3%	35%
2028	5,612	42,093	734	2,828	(2,706)	42,949	25,705	2,234	1,758	(2,706)	26,990	15,958	(430)	-8%	63%	-2%	1,841	-2%	33%
2029	5,795	42,949	758	2,886	(2,769)	43,823	26,990	2,307	1,847	(2,769)	28,375	15,448	(510)	-9%	65%	-2%	1,901	3%	33%
2030	5,983	43,823	782	2,945	(2,829)	44,721	28,375	2,266	1,939	(2,829)	29,750	14,970	(478)	-8%	67%	-2%	1,847	-3%	31%
2031	6,177	44,721	808	3,005	(2,887)	45,647	29,750	2,339	2,034	(2,887)	31,237	14,410	(561)	-9%	68%	-2%	1,907	3%	31%
2032	6,378	45,647	834	3,068	(2,945)	46,603	31,237	2,299	2,133	(2,945)	32,724	13,879	(530)	-8%	70%	-2%	1,852	-3%	29%
2033	6,585	46,603	861	3,132	(3,005)	47,591	32,724	2,373	2,237	(3,005)	34,329	13,263	(616)	-9%	72%	-2%	1,912	3%	29%
2034	6,799	47,591	889	3,199	(3,067)	48,613	34,329	2,335	2,344	(3,067)	35,941	12,672	(591)	-9%	74%	-2%	1,859	-3%	27%
2035	7,020	48,613	918	3,268	(3,129)	49,670	35,941	2,411	2,456	(3,129)	37,678	11,992	(680)	-10%	76%	-2%	1,919	3%	27%
2036	7,249	49,670	948	3,340	(3,193)	50,764	37,678	2,374	2,572	(3,193)	39,431	11,333	(659)	-9%	78%	-2%	1,866	-3%	26%
2037	7,484	50,764	979	3,413	(3,259)	51,897	39,431	2,451	2,693	(3,259)	41,316	10,581	(752)	-10%	80%	-2%	1,927	3%	26%
2038	7,727	51,897	1,010	3,490	(3,325)	53,072	41,316	2,417	2,820	(3,325)	43,228	9,844	(737)	-10%	81%	-2%	1,876	-3%	24%
2039	7,978	53,072	1,043	3,569	(3,393)	54,292	43,228	2,496	2,952	(3,393)	45,283	9,009	(835)	-10%	83%	-2%	1,937	3%	24%
2040	8,238	54,292	1,077	3,652	(3,463)	55,558	45,283	2,464	3,091	(3,463)	47,374	8,183	(826)	-10%	85%	-2%	1,887	-3%	23%
2041	8,505	55,558	1,112	3,738	(3,534)	56,874	47,374	2,544	3,235	(3,534)	49,620	7,254	(930)	-11%	87%	-2%	1,949	3%	23%
2042	8,782	56,874	1,148	3,827	(3,606)	58,242	49,620	2,515	3,387	(3,606)	51,916	6,327	(927)	-11%	89%	-2%	1,900	-2%	22%
2043	9,067	58,242	1,186	3,919	(3,680)	59,668	51,916	2,597	3,545	(3,680)	54,378	5,289	(1,037)	-11%	91%	-2%	1,962	3%	22%
2044	9,362	59,668	1,224	4,016	(3,755)	61,153	54,378	2,570	3,712	(3,755)	56,905	4,248	(1,041)	-11%	93%	-2%	1,915	-2%	20%
2045	9,666	61,153	1,264	4,117	(3,832)	62,702	56,905	2,653	3,886	(3,832)	59,613	3,089	(1,159)	-12%	95%	-2%	1,977	3%	20%
2046	9,980	62,702	1,305	4,223	(3,910)	64,320	59,613	2,630	4,070	(3,910)	62,403	1,917	(1,172)	-12%	97%	-2%	1,931	-2%	19%
2047	10,305	64,320	1,347	4,333	(3,990)	66,010	62,403	2,715	4,263	(3,990)	65,391	619	(1,298)	-13%	99%	-2%	1,994	3%	19%
2048	10,640	66,010	1,391	4,448	(4,071)	67,778	65,391	2,696	4,465	(4,071)	68,482	(704)	(1,323)	-12%	101%	-2%	1,951	-2%	18%
2049	10,985	67,778	1,436	4,585	(4,154)	69,645	68,482	2,679	4,675	(4,154)	71,682	(2,036)	(1,333)	-12%	103%	-2%	1,910	-2%	17%

Exhibit 8

Connecticut Retirement System 30 Year Projections

Plans included: Teachers Retirement System

State contribution policy at 5% returns

\$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
2020	4,345	35,515	568	2,365	(2,141)	36,308	18,501	1,513	910	(2,141)	18,783	17,525	511	12%	52%	-3%	1,209	N/A	28%
2021	4,486	36,308	587	2,418	(2,212)	37,101	18,783	1,562	923	(2,212)	19,056	18,045	519	12%	51%	-3%	1,248	3%	28%
2022	4,632	37,101	606	2,470	(2,283)	37,894	19,056	1,681	938	(2,283)	19,393	18,501	457	10%	51%	-3%	1,357	9%	29%
2023	4,783	37,894	625	2,523	(2,352)	38,690	19,393	1,736	954	(2,352)	19,731	18,959	458	10%	51%	-3%	1,401	3%	29%
2024	4,938	38,690	646	2,576	(2,421)	39,490	19,731	1,974	976	(2,421)	20,259	19,231	272	6%	51%	-2%	1,628	16%	33%
2025	5,099	39,490	667	2,629	(2,489)	40,297	20,259	2,038	1,002	(2,489)	20,810	19,487	256	5%	52%	-2%	1,681	3%	33%
2026	5,264	40,297	688	2,683	(2,555)	41,113	20,810	2,290	1,034	(2,555)	21,580	19,533	47	1%	52%	-1%	1,922	14%	36%
2027	5,435	41,113	711	2,737	(2,619)	41,942	21,580	2,364	1,073	(2,619)	22,398	19,544	10	0%	53%	-1%	1,984	3%	37%
2028	5,612	41,942	734	2,792	(2,681)	42,787	22,398	2,413	1,113	(2,681)	23,243	19,543	(1)	0%	54%	-1%	2,020	2%	36%
2029	5,795	42,787	758	2,849	(2,741)	43,651	23,243	2,492	1,156	(2,741)	24,150	19,502	(41)	-1%	55%	-1%	2,086	3%	36%
2030	5,983	43,651	782	2,906	(2,799)	44,541	24,150	2,523	1,201	(2,799)	25,074	19,467	(35)	-1%	56%	-1%	2,104	1%	35%
2031	6,177	44,541	808	2,966	(2,855)	45,460	25,074	2,605	1,248	(2,855)	26,072	19,388	(79)	-1%	57%	-1%	2,173	3%	35%
2032	6,378	45,460	834	3,028	(2,911)	46,410	26,072	2,639	1,297	(2,911)	27,097	19,314	(75)	-1%	58%	-1%	2,193	1%	34%
2033	6,585	46,410	861	3,091	(2,970)	47,393	27,097	2,725	1,349	(2,970)	28,201	19,192	(122)	-2%	60%	-1%	2,264	3%	34%
2034	6,799	47,393	889	3,157	(3,029)	48,409	28,201	2,765	1,404	(3,029)	29,340	19,070	(122)	-2%	61%	-1%	2,289	1%	34%
2035	7,020	48,409	918	3,224	(3,090)	49,461	29,340	2,854	1,461	(3,090)	30,565	18,896	(173)	-2%	62%	-1%	2,363	3%	34%
2036	7,249	49,461	948	3,294	(3,153)	50,550	30,565	2,901	1,522	(3,153)	31,835	18,715	(181)	-2%	63%	-1%	2,393	1%	33%
2037	7,484	50,550	979	3,367	(3,217)	51,679	31,835	2,995	1,586	(3,217)	33,199	18,479	(236)	-3%	64%	-1%	2,471	3%	33%
2038	7,727	51,679	1,010	3,442	(3,283)	52,848	33,199	3,048	1,654	(3,283)	34,618	18,230	(250)	-3%	66%	-1%	2,507	1%	32%
2039	7,978	52,848	1,043	3,520	(3,350)	54,061	34,618	3,147	1,726	(3,350)	36,141	17,920	(310)	-4%	67%	-1%	2,588	3%	32%
2040	8,238	54,061	1,077	3,600	(3,418)	55,320	36,141	3,207	1,802	(3,418)	37,732	17,589	(331)	-4%	68%	-1%	2,630	2%	32%
2041	8,505	55,320	1,112	3,684	(3,488)	56,629	37,732	3,311	1,882	(3,488)	39,437	17,192	(397)	-5%	70%	0%	2,716	3%	32%
2042	8,782	56,629	1,148	3,772	(3,559)	57,990	39,437	3,379	1,967	(3,559)	41,225	16,765	(427)	-5%	71%	0%	2,765	2%	31%
2043	9,067	57,990	1,186	3,863	(3,631)	59,408	41,225	3,489	2,058	(3,631)	43,141	16,267	(498)	-5%	73%	0%	2,854	3%	31%
2044	9,362	59,408	1,224	3,959	(3,704)	60,887	43,141	3,566	2,154	(3,704)	45,156	15,730	(537)	-6%	74%	0%	2,911	2%	31%
2045	9,666	60,887	1,264	4,058	(3,779)	62,430	45,156	3,682	2,255	(3,779)	47,315	15,115	(615)	-6%	76%	0%	3,005	3%	31%
2046	9,980	62,430	1,305	4,162	(3,855)	64,042	47,315	3,770	2,364	(3,855)	49,593	14,449	(666)	-7%	77%	0%	3,071	2%	31%
2047	10,305	64,042	1,347	4,272	(3,932)	65,729	49,593	3,892	2,479	(3,932)	52,032	13,697	(752)	-7%	79%	0%	3,171	3%	31%
2048	10,640	65,729	1,391	4,386	(4,011)	67,495	52,032	3,992	2,601	(4,011)	54,614	12,882	(816)	-8%	81%	0%	3,247	2%	31%
2049	10,985	67,495	1,436	4,567	(4,091)	69,407	54,614	4,095	2,731	(4,091)	57,348	12,060	(822)	-7%	83%	0%	3,326	2%	30%

Exhibit 9

Connecticut Retirement System 30 Year Projections

Plans included: Teachers' Retirement System
State contribution policy with asset shock returns

\$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
2020	4,345	35,441	568	2,277	(2,123)	36,162	18,510	1,513	(4,529)	(2,123)	13,371	22,792	5,860	135%	37%	-3%	1,209	N/A	28%
2021	4,486	36,162	587	2,293	(2,183)	36,859	13,371	1,562	1,622	(2,183)	14,372	22,486	(305)	-7%	39%	-5%	1,248	3%	28%
2022	4,632	36,859	606	2,365	(2,244)	37,585	14,372	1,754	1,941	(2,244)	15,823	21,762	(724)	-16%	42%	-3%	1,430	15%	31%
2023	4,755	37,585	625	2,374	(2,305)	38,280	15,823	1,801	1,703	(2,305)	17,022	21,258	(504)	-11%	44%	-3%	1,468	3%	31%
2024	4,881	38,280	642	2,387	(2,361)	38,948	17,022	2,180	762	(2,361)	17,603	21,344	86	2%	45%	-1%	1,838	25%	38%
2025	5,011	38,948	659	2,462	(2,419)	39,649	17,603	2,238	848	(2,419)	18,270	21,379	35	1%	46%	-1%	1,887	3%	38%
2026	5,145	39,649	676	2,507	(2,477)	40,356	18,270	2,503	885	(2,477)	19,182	21,174	(205)	-4%	48%	0%	2,143	14%	42%
2027	5,282	40,356	695	2,552	(2,532)	41,070	19,182	2,570	930	(2,532)	20,149	20,921	(253)	-5%	49%	0%	2,200	3%	42%
2028	5,422	41,070	713	2,598	(2,586)	41,794	20,149	2,521	974	(2,586)	21,058	20,737	(184)	-3%	50%	0%	2,141	-3%	39%
2029	5,571	41,794	732	2,649	(2,638)	42,537	21,058	2,590	1,018	(2,638)	22,028	20,510	(227)	-4%	52%	0%	2,200	3%	39%
2030	5,723	42,537	752	2,696	(2,689)	43,297	22,028	2,586	1,064	(2,689)	22,989	20,308	(202)	-4%	53%	0%	2,186	-1%	38%
2031	5,879	43,297	773	2,745	(2,737)	44,077	22,989	2,657	1,111	(2,737)	24,020	20,057	(251)	-4%	54%	0%	2,245	3%	38%
2032	6,040	44,077	794	2,794	(2,788)	44,876	24,020	2,666	1,160	(2,788)	25,058	19,818	(239)	-4%	56%	-1%	2,243	0%	37%
2033	6,205	44,876	815	2,844	(2,840)	45,696	25,058	2,739	1,211	(2,840)	26,168	19,527	(291)	-5%	57%	0%	2,305	3%	37%
2034	6,375	45,696	838	2,894	(2,894)	46,533	26,168	2,756	1,264	(2,894)	27,293	19,240	(288)	-5%	59%	-1%	2,310	0%	36%
2035	6,549	46,533	861	2,945	(2,951)	47,388	27,293	2,831	1,319	(2,951)	28,492	18,896	(344)	-5%	60%	0%	2,373	3%	36%
2036	6,728	47,388	884	2,997	(3,009)	48,260	28,492	2,855	1,376	(3,009)	29,713	18,547	(349)	-5%	62%	-1%	2,384	0%	35%
2037	6,912	48,260	908	3,050	(3,070)	49,148	29,713	2,933	1,435	(3,070)	31,011	18,137	(410)	-6%	63%	0%	2,449	3%	35%
2038	7,101	49,148	933	3,103	(3,132)	50,052	31,011	2,963	1,497	(3,132)	32,340	17,712	(425)	-6%	65%	-1%	2,466	1%	35%
2039	7,295	50,052	959	3,157	(3,196)	50,971	32,340	3,044	1,562	(3,196)	33,750	17,221	(491)	-7%	66%	0%	2,534	3%	35%
2040	7,495	50,971	985	3,212	(3,261)	51,907	33,750	3,081	1,630	(3,261)	35,200	16,707	(514)	-7%	68%	-1%	2,556	1%	34%
2041	7,699	51,907	1,012	3,268	(3,327)	52,861	35,200	3,165	1,700	(3,327)	36,739	16,122	(586)	-8%	70%	0%	2,626	3%	34%
2042	7,910	52,861	1,039	3,326	(3,393)	53,833	36,739	3,210	1,774	(3,393)	38,330	15,503	(619)	-8%	71%	0%	2,656	1%	34%
2043	8,126	53,833	1,068	3,386	(3,460)	54,827	38,330	3,298	1,852	(3,460)	40,020	14,807	(696)	-9%	73%	0%	2,729	3%	34%
2044	8,348	54,827	1,097	3,448	(3,528)	55,844	40,020	3,350	1,933	(3,528)	41,776	14,068	(739)	-9%	75%	0%	2,766	1%	33%
2045	8,577	55,844	1,127	3,512	(3,596)	56,887	41,776	3,442	2,019	(3,596)	43,641	13,247	(822)	-10%	77%	0%	2,841	3%	33%
2046	8,811	56,887	1,158	3,578	(3,664)	57,959	43,641	3,504	2,109	(3,664)	45,590	12,369	(877)	-10%	79%	0%	2,887	2%	33%
2047	9,052	57,959	1,189	3,647	(3,733)	59,062	45,590	3,600	2,204	(3,733)	47,661	11,402	(968)	-11%	81%	0%	2,966	3%	33%
2048	9,299	59,062	1,222	3,718	(3,804)	60,198	47,661	3,672	2,304	(3,804)	49,833	10,365	(1,037)	-11%	83%	0%	3,021	2%	32%
2049	9,554	60,198	1,255	4,065	(3,876)	61,643	49,833	3,746	2,410	(3,876)	52,114	9,529	(836)	-9%	85%	0%	3,077	2%	32%

Exhibit 10

Fiscal Metrics

Model Output

State

Connecticut

Plans Included

State Employees' Retirement System

Teachers Retirement System

Metrics	State Policy (Current Contribution Policy)						Sustainable Budget (Fixed % of OSR)						State Policy (Current Contribution Policy)			Sustainable Budget (Fixed % of OSR)		
	Deterministic 6.9%			Deterministic 5%			Deterministic 6.9%			Deterministic 5%			Deterministic			Deterministic		
	Current Plan Assumptions			Low Return			Current Plan Assumptions			Low Return			"Asset Shock" Economic Scenario			"Asset Shock" Economic Scenario		
	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039
Balance Sheet Measures																		
Market Value of Assets (MVA)	39,761	51,042	78,713	36,379	43,600	62,390	37,095	46,507	84,017	33,684	38,085	56,698	32,360	40,592	58,851	27,696	30,187	43,133
Actuarial Accrued Liability (AAL)	78,825	85,211	97,034	78,714	85,040	96,804	78,825	85,211	97,034	78,714	85,040	96,804	77,901	83,244	91,716	77,901	83,244	91,716
Accrued Liability at 4% Discount Rate (DR)	112,022	121,097	137,899	111,864	120,853	137,572	112,022	121,097	137,899	111,864	120,853	137,572	110,708	118,302	130,342	110,708	118,302	130,342
Unfunded Actuarial Accrued Liability (UAAL)	39,064	34,169	18,321	42,335	41,440	34,414	41,730	38,704	13,017	45,030	46,955	40,105	45,541	42,652	32,866	50,205	53,057	48,584
Unfunded Liability at 4% DR	72,261	70,055	59,186	75,485	77,253	75,182	74,926	74,590	53,882	78,180	82,769	80,873	78,348	77,710	71,491	83,012	88,114	87,209
Funded Ratio	50.4%	59.9%	81.1%	46.2%	51.3%	64.4%	47.1%	54.6%	86.6%	42.8%	44.8%	58.6%	41.5%	48.8%	64.2%	35.6%	36.3%	47.0%
Funded Ratio at 4% Discount Rate	35.5%	42.1%	57.1%	32.5%	36.1%	45.4%	33.1%	38.4%	60.9%	30.1%	31.5%	41.2%	29.2%	34.3%	45.2%	25.0%	25.5%	33.1%
AAL Compound Annual Growth Rate	1.9%	1.8%	1.5%	1.9%	1.7%	1.5%	1.9%	1.8%	1.5%	1.9%	1.7%	1.5%	1.7%	1.5%	1.2%	1.7%	1.5%	1.2%
Change in AAL from Prior Year (%)	1.8%	1.4%	1.4%	1.8%	1.4%	1.4%	1.8%	1.4%	1.4%	1.8%	1.4%	1.4%	1.5%	1.2%	0.9%	1.5%	1.2%	0.9%
Unfunded Liability / Own Source Revenue at 4% DR	278%	212%	125%	291%	234%	159%	288%	226%	114%	301%	251%	171%	312%	244%	156%	330%	276%	190%
Cash Flow Measures																		
Benefit Payments	4,895	5,659	6,819	4,880	5,632	6,775	4,895	5,659	6,819	4,880	5,632	6,775	4,793	5,474	6,526	4,793	5,474	6,526
Total Contributions	4,305	4,727	5,043	4,390	5,079	6,223	3,816	4,829	6,953	3,816	4,829	6,953	4,826	5,238	6,013	3,722	4,667	6,670
Negative Operating Cash Flow	590	932	1,776	490	553	553	1,079	830	(134)	1,064	802	(177)	(33)	237	513	1,071	807	(143)
Benefit Payments / Beginning of Period MVA	13.0%	11.6%	9.0%	13.9%	13.4%	11.3%	13.7%	12.8%	8.7%	14.7%	15.2%	12.6%	15.5%	14.1%	11.5%	17.4%	18.5%	15.9%
Operating Cash Flow to Assets Ratio	-1.6%	-1.9%	-2.4%	-1.4%	-1.3%	-0.9%	-3.0%	-1.9%	0.2%	-3.2%	-2.2%	0.3%	0.1%	-0.6%	-0.9%	-3.9%	-2.7%	0.3%
Change in MVA from Prior Year (%)	5.3%	4.9%	4.5%	3.6%	3.7%	4.1%	3.8%	5.0%	7.1%	1.7%	2.8%	5.3%	4.6%	4.2%	3.9%	0.5%	2.1%	5.2%
Own Source Revenue (OSR)	25,973	32,969	47,398	25,973	32,969	47,398	25,973	32,969	47,398	25,973	32,969	47,398	25,124	31,891	45,849	25,124	31,891	45,849
OSR Compound Annual Growth Rate	2.4%	3.6%	3.7%	2.4%	3.6%	3.7%	2.4%	3.6%	3.7%	2.4%	3.6%	3.7%	1.7%	3.3%	3.5%	1.7%	3.3%	3.5%
Change in OSR from Prior Year (%)	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%
Employer Contributions / OSR	14.3%	12.1%	8.4%	14.6%	13.1%	10.7%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	16.8%	14.2%	11.0%	12.5%	12.5%	12.5%
Total Contributions / OSR	16.6%	14.3%	10.6%	16.9%	15.4%	13.1%	14.7%	14.6%	14.7%	14.7%	14.6%	14.7%	19.2%	16.4%	13.1%	14.8%	14.6%	14.5%
Payment and Contribution Measures																		
Employer Contributions (ERC)	3,724	4,004	3,993	3,781	4,304	5,075	3,235	4,106	5,903	3,235	4,106	5,903	4,224	4,526	5,023	3,129	3,972	5,710
Change in ERC from Prior Year (%)	5.9%	1.4%	1.5%	7.0%	1.9%	2.3%	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%	9.9%	1.3%	1.9%	8.9%	3.9%	3.5%
Employee Contributions (EEC)	581	724	1,050	609	775	1,148	581	724	1,050	581	724	1,050	602	712	990	593	696	960
Payroll	9,316	10,995	15,314	9,316	10,995	15,314	9,316	10,995	15,314	9,316	10,995	15,314	9,209	10,570	14,002	9,209	10,570	14,002
Employer Contribution / Payroll	40.0%	36.4%	26.1%	40.6%	39.1%	33.1%	34.7%	37.3%	38.5%	34.7%	37.3%	38.5%	45.9%	42.8%	35.9%	34.0%	37.6%	40.8%
Employee Contribution / Payroll	6.2%	6.6%	6.9%	6.5%	7.1%	7.5%	6.2%	6.6%	6.9%	6.2%	6.6%	6.9%	6.5%	6.7%	7.1%	6.4%	6.6%	6.9%
Total Contributions / Payroll	46.2%	43.0%	32.9%	47.1%	46.2%	40.6%	41.0%	43.9%	45.4%	41.0%	43.9%	45.4%	52.4%	49.6%	42.9%	40.4%	44.2%	47.6%
Normal Cost	1,064	1,240	1,707	1,064	1,240	1,707	1,064	1,240	1,707	1,064	1,240	1,707	1,057	1,198	1,569	1,057	1,198	1,569
Normal Cost (4% DR)	1,957	2,282	3,141	1,957	2,282	3,141	1,957	2,282	3,141	1,957	2,282	3,141	1,946	2,205	2,886	1,946	2,205	2,886
Net amortization \$	613	1,166	2,043	526	1,087	2,217	(32)	972	4,233	(206)	483	2,548	735	1,188	2,231	(640)	(48)	1,831
Net amortization \$ (4% DR)	(498)	(335)	(488)	(511)	(231)	112	(1,077)	(405)	1,584	(1,177)	(686)	611	(188)	(25)	287	(1,449)	(981)	331
Net amortization \$ / Payroll	6.6%	10.6%	13.3%	5.6%	9.9%	14.5%	-0.3%	8.8%	27.6%	-2.2%	4.4%	16.6%	8.0%	11.2%	15.9%	-6.9%	-0.5%	13.1%
Net amortization \$ / Payroll (4% DR)	-5.3%	-3.1%	-3.2%	-5.5%	-2.1%	0.7%	-11.6%	-3.7%	10.3%	-12.6%	-6.2%	4.0%	-2.0%	-0.2%	2.0%	-15.7%	-9.3%	2.4%
Investment Performance																		
Compounded Annual Growth - From Start Date	6.90%	6.90%	6.90%	5.00%	5.00%	5.00%	6.90%	6.90%	6.90%	5.00%	5.00%	5.00%	2.2%	3.5%	4.2%	2.2%	3.5%	4.2%
Compounded Annual Growth - Segments	6.90%	6.90%	6.90%	5.00%	5.00%	5.00%	6.90%	6.90%	6.90%	5.00%	5.00%	5.00%	2.2%	4.9%	4.9%	2.2%	4.9%	4.9%

Note: Dollar Figures in Millions

Exhibit 11

Fiscal Metrics

Model Output

State

Connecticut

Plans Included

State Employees' Retirement System

Metrics	State Policy (Current Contribution Policy)						Sustainable Budget (Fixed % of OSR)						State Policy (Current Contribution Policy)			Sustainable Budget (Fixed % of OSR)		
	Deterministic 6.9%			Deterministic 5%			Deterministic 6.9%			Deterministic 5%			Deterministic			Deterministic		
	Current Plan Assumptions			Low Return			Current Plan Assumptions			Low Return			"Asset Shock" Economic Scenario			"Asset Shock" Economic Scenario		
	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039
Balance Sheet Measures																		
Market Value of Assets (MVA)	17,556	22,667	33,430	16,120	19,450	26,249	15,386	19,445	36,388	13,943	15,857	24,582	14,756	18,564	25,100	11,325	12,298	18,109
Actuarial Accrued Liability (AAL)	39,224	41,388	42,743	39,224	41,388	42,743	39,224	41,388	42,743	39,224	41,388	42,743	38,953	40,707	40,745	38,953	40,707	40,745
Accrued Liability at 4% Discount Rate (DR)	56,077	59,171	61,108	56,077	59,171	61,108	56,077	59,171	61,108	56,077	59,171	61,108	55,690	58,197	58,251	55,690	58,197	58,251
Unfunded Actuarial Accrued Liability (UAAL)	21,668	18,721	9,312	23,104	21,938	16,494	23,838	21,943	6,355	25,281	25,532	18,160	24,197	22,143	15,645	27,628	28,409	22,636
Unfunded Liability at 4% DR	38,521	36,504	27,677	39,958	39,721	34,859	40,691	39,726	24,720	42,134	43,315	36,525	40,934	39,633	33,151	44,365	45,899	40,142
Funded Ratio	44.8%	54.8%	78.2%	41.1%	47.0%	61.4%	39.2%	47.0%	85.1%	35.5%	38.3%	57.5%	37.9%	45.6%	61.6%	29.1%	30.2%	44.4%
Funded Ratio at 4% Discount Rate	31.3%	38.3%	54.7%	28.7%	32.9%	43.0%	27.4%	32.9%	59.5%	24.9%	26.8%	40.2%	26.5%	31.9%	43.1%	20.3%	21.1%	31.1%
AAL Compound Annual Growth Rate	1.7%	1.4%	0.8%	1.7%	1.4%	0.8%	1.7%	1.4%	0.8%	1.7%	1.4%	0.8%	1.5%	1.2%	0.6%	1.5%	1.2%	0.6%
Change in AAL from Prior Year (%)	1.4%	0.8%	0.2%	1.4%	0.8%	0.2%	1.4%	0.8%	0.2%	1.4%	0.8%	0.2%	1.3%	0.6%	-0.2%	1.3%	0.6%	-0.2%
Unfunded Liability / Own Source Revenue at 4% DR	148%	111%	58%	154%	120%	74%	157%	120%	52%	162%	131%	77%	163%	124%	72%	177%	144%	88%
Cash Flow Measures																		
Benefit Payments	2,458	2,890	3,426	2,458	2,890	3,426	2,458	2,890	3,426	2,458	2,890	3,426	2,432	2,836	3,331	2,432	2,836	3,331
Total Contributions	2,364	2,420	2,547	2,416	2,588	3,076	2,014	2,575	3,737	2,014	2,575	3,737	2,646	2,648	2,969	1,972	2,489	3,589
Negative Operating Cash Flow	94	470	879	42	303	349	444	315	(311)	444	315	(311)	(214)	188	361	460	347	(258)
Benefit Payments / Beginning of Period MVA	14.9%	13.3%	10.7%	16.0%	15.4%	13.5%	16.6%	15.6%	10.2%	17.9%	18.8%	14.8%	17.5%	15.9%	13.7%	21.5%	23.5%	19.6%
Operating Cash Flow to Assets Ratio	-0.6%	-2.2%	-2.7%	-0.3%	-1.6%	-1.4%	-3.0%	-1.7%	0.9%	-3.2%	-2.0%	1.3%	1.5%	-1.1%	-1.5%	-4.1%	-2.9%	1.5%
Change in MVA from Prior Year (%)	6.3%	4.7%	4.1%	4.7%	3.3%	3.6%	3.8%	5.1%	7.8%	1.7%	2.9%	6.4%	6.1%	3.8%	3.4%	0.3%	1.9%	6.4%
Own Source Revenue (OSR)	25,973	32,969	47,398	25,973	32,969	47,398	25,973	32,969	47,398	25,973	32,969	47,398	25,124	31,891	45,849	25,124	31,891	45,849
OSR Compound Annual Growth Rate	2.4%	3.6%	3.7%	2.4%	3.6%	3.7%	2.4%	3.6%	3.7%	2.4%	3.6%	3.7%	1.7%	3.3%	3.5%	1.7%	3.3%	3.5%
Change in OSR from Prior Year (%)	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%
Employer Contributions / OSR	8.2%	6.4%	4.3%	8.3%	6.7%	5.2%	6.8%	6.8%	6.8%	6.8%	6.8%	6.8%	9.5%	7.3%	5.4%	6.8%	6.8%	6.8%
Total Contributions / OSR	9.1%	7.3%	5.4%	9.3%	7.8%	6.5%	7.8%	7.8%	7.9%	7.8%	7.8%	7.9%	10.5%	8.3%	6.5%	7.8%	7.8%	7.8%
Payment and Contribution Measures																		
Employer Contributions (ERC)	2,128	2,103	2,056	2,153	2,218	2,486	1,778	2,258	3,246	1,778	2,258	3,246	2,386	2,326	2,490	1,720	2,184	3,139
Change in ERC from Prior Year (%)	0.4%	-0.3%	-0.1%	1.0%	0.7%	1.4%	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%	0.5%	-0.1%	1.1%	8.9%	3.9%	3.5%
Employee Contributions (EEC)	236	318	491	264	370	590	236	318	491	236	318	491	261	322	479	251	306	449
Payroll	4,378	5,200	7,335	4,378	5,200	7,335	4,378	5,200	7,335	4,378	5,200	7,335	4,328	4,999	6,707	4,328	4,999	6,707
Employer Contribution / Payroll	48.6%	40.4%	28.0%	49.2%	42.7%	33.9%	40.6%	43.4%	44.2%	40.6%	43.4%	44.2%	55.1%	46.5%	37.1%	39.8%	43.7%	46.8%
Employee Contribution / Payroll	5.4%	6.1%	6.7%	6.0%	7.1%	8.0%	5.4%	6.1%	6.7%	5.4%	6.1%	6.7%	6.0%	6.4%	7.1%	5.8%	6.1%	6.7%
Total Contributions / Payroll	54.0%	46.5%	34.7%	55.2%	49.8%	41.9%	46.0%	49.5%	50.9%	46.0%	49.5%	50.9%	61.1%	53.0%	44.3%	45.6%	49.8%	53.5%
Normal Cost	418	483	664	418	483	664	418	483	664	418	483	664	415	466	610	415	466	610
Normal Cost (4% DR)	774	895	1,230	774	895	1,230	774	895	1,230	774	895	1,230	770	864	1,130	770	864	1,130
Net amortization \$	484	666	1,220	461	643	1,300	5	608	2,562	(71)	395	1,829	612	699	1,297	(266)	133	1,436
Net amortization \$ (4% DR)	71	75	189	79	132	457	(354)	107	1,467	(398)	(17)	1,041	270	221	511	(523)	(174)	852
Net amortization \$ / Payroll	11.1%	12.8%	16.6%	10.5%	12.4%	17.7%	0.1%	11.7%	34.9%	-1.6%	7.6%	24.9%	14.1%	14.0%	19.3%	-6.2%	2.7%	21.4%
Net amortization \$ / Payroll (4% DR)	1.6%	1.4%	2.6%	1.8%	2.5%	6.2%	-8.1%	2.1%	20.0%	-9.1%	-0.3%	14.2%	6.2%	4.4%	7.6%	-12.1%	-3.5%	12.7%
Investment Performance																		
Compounded Annual Growth - From Start Date	6.90%	6.90%	6.90%	5.00%	5.00%	5.00%	6.90%	6.90%	6.90%	5.00%	5.00%	5.00%	2.2%	3.5%	4.2%	2.2%	3.5%	4.2%
Compounded Annual Growth - Segments	6.90%	6.90%	6.90%	5.00%	5.00%	5.00%	6.90%	6.90%	6.90%	5.00%	5.00%	5.00%	2.2%	4.9%	4.9%	2.2%	4.9%	4.9%

Note: Dollar Figures in Millions

Exhibit 12

Fiscal Metrics

Model Output

State
Connecticut
Plans Included
Teachers Retirement System

Metrics	State Policy (Current Contribution Policy)						Sustainable Budget (Fixed % of OSR)						State Policy (Current Contribution Policy)			Sustainable Budget (Fixed % of OSR)		
	Deterministic 6.9%			Deterministic 5%			Deterministic 6.9%			Deterministic 5%			Deterministic			Deterministic		
	Current Plan Assumptions			Low Return			Current Plan Assumptions			Low Return			"Asset Shock" Economic Scenario			"Asset Shock" Economic Scenario		
	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039
Balance Sheet Measures																		
Market Value of Assets (MVA)	22,205	28,375	45,283	20,259	24,150	36,141	21,709	27,062	47,630	19,741	22,228	32,116	17,603	22,028	33,750	16,371	17,889	25,023
Actuarial Accrued Liability (AAL)	39,601	43,823	54,292	39,490	43,651	54,061	39,601	43,823	54,292	39,490	43,651	54,061	38,948	42,537	50,971	38,948	42,537	50,971
Accrued Liability at 4% Discount Rate (DR)	55,943	61,907	76,696	55,786	61,665	76,370	55,943	61,907	76,696	55,786	61,665	76,370	55,020	60,091	72,005	55,020	60,091	72,005
Unfunded Actuarial Accrued Liability (UAAL)	17,396	15,448	9,009	19,231	19,502	17,920	17,892	16,761	6,662	19,749	21,424	21,945	21,344	20,510	17,221	22,577	24,648	25,948
Unfunded Liability at 4% DR	33,738	33,532	31,413	35,527	37,515	40,229	34,234	34,845	29,066	36,046	39,437	44,254	37,416	38,063	38,255	38,649	42,201	46,982
Funded Ratio	56.1%	64.7%	83.4%	51.3%	55.3%	66.9%	54.8%	61.8%	87.7%	50.0%	50.9%	59.4%	45.2%	51.8%	66.2%	42.0%	42.1%	49.1%
Funded Ratio at 4% Discount Rate	39.7%	45.8%	59.0%	36.3%	39.2%	47.3%	38.8%	43.7%	62.1%	35.4%	36.0%	42.1%	32.0%	36.7%	46.9%	29.8%	29.8%	34.8%
AAL Compound Annual Growth Rate	2.2%	2.1%	2.1%	2.1%	2.1%	2.1%	2.2%	2.1%	2.1%	2.1%	2.1%	2.1%	1.9%	1.8%	1.8%	1.9%	1.8%	1.8%
Change in AAL from Prior Year (%)	2.1%	2.0%	2.3%	2.1%	2.0%	2.3%	2.1%	2.0%	2.3%	2.1%	2.0%	2.3%	1.7%	1.8%	1.8%	1.7%	1.8%	1.8%
Unfunded Liability / Own Source Revenue at 4% DR	130%	102%	66%	137%	114%	85%	132%	106%	61%	139%	120%	93%	149%	119%	83%	154%	132%	102%
Cash Flow Measures																		
Benefit Payments	2,436	2,769	3,393	2,421	2,741	3,350	2,436	2,769	3,393	2,421	2,741	3,350	2,361	2,638	3,196	2,361	2,638	3,196
Total Contributions	1,941	2,307	2,496	1,974	2,492	3,147	1,802	2,254	3,216	1,802	2,254	3,216	2,180	2,590	3,044	1,750	2,178	3,081
Negative Operating Cash Flow	495	462	898	447	250	203	634	515	177	619	487	134	181	49	152	611	461	115
Benefit Payments / Beginning of Period MVA	11.5%	10.3%	7.8%	12.3%	11.8%	9.7%	11.6%	10.7%	7.6%	12.5%	12.7%	10.9%	13.9%	12.5%	9.9%	14.5%	15.1%	13.3%
Operating Cash Flow to Assets Ratio	-2.3%	-1.7%	-2.1%	-2.3%	-1.1%	-0.6%	-3.0%	-2.0%	-0.4%	-3.2%	-2.3%	-0.4%	-1.1%	-0.2%	-0.5%	-3.8%	-2.6%	-0.5%
Change in MVA from Prior Year (%)	4.5%	5.1%	4.8%	2.7%	3.9%	4.4%	3.8%	4.8%	6.5%	1.7%	2.7%	4.6%	3.4%	4.6%	4.4%	0.7%	2.1%	4.4%
Own Source Revenue (OSR)	25,973	32,969	47,398	25,973	32,969	47,398	25,973	32,969	47,398	25,973	32,969	47,398	25,124	31,891	45,849	25,124	31,891	45,849
OSR Compound Annual Growth Rate	2.4%	3.6%	3.7%	2.4%	3.6%	3.7%	2.4%	3.6%	3.7%	2.4%	3.6%	3.7%	1.7%	3.3%	3.5%	1.7%	3.3%	3.5%
Change in OSR from Prior Year (%)	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%
Employer Contributions / OSR	6.1%	5.8%	4.1%	6.3%	6.3%	5.5%	5.6%	5.6%	5.6%	5.6%	5.6%	5.6%	7.3%	6.9%	5.5%	5.6%	5.6%	5.6%
Total Contributions / OSR	7.5%	7.0%	5.3%	7.6%	7.6%	6.6%	6.9%	6.8%	6.8%	6.9%	6.8%	6.8%	8.7%	8.1%	6.6%	7.0%	6.8%	6.7%
Payment and Contribution Measures																		
Employer Contributions (ERC)	1,595	1,901	1,937	1,628	2,086	2,588	1,456	1,848	2,657	1,456	1,848	2,657	1,838	2,200	2,534	1,409	1,788	2,571
Change in ERC from Prior Year (%)	14.1%	3.3%	3.2%	16.2%	3.3%	3.2%	8.9%	3.9%	3.5%	8.9%	3.9%	3.5%	25.2%	2.7%	2.7%	8.9%	3.9%	3.5%
Employee Contributions (EEC)	346	406	558	346	406	558	346	406	558	346	406	558	342	390	511	342	390	511
Payroll	4,938	5,795	7,978	4,938	5,795	7,978	4,938	5,795	7,978	4,938	5,795	7,978	4,881	5,571	7,295	4,881	5,571	7,295
Employer Contribution / Payroll	32.3%	32.8%	24.3%	33.0%	36.0%	32.4%	29.5%	31.9%	33.3%	29.5%	31.9%	33.3%	37.7%	39.5%	34.7%	28.9%	32.1%	35.2%
Employee Contribution / Payroll	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
Total Contributions / Payroll	39.3%	39.8%	31.3%	40.0%	43.0%	39.4%	36.5%	38.9%	40.3%	36.5%	38.9%	40.3%	44.7%	46.5%	41.7%	35.9%	39.1%	42.2%
Normal Cost	646	758	1,043	646	758	1,043	646	758	1,043	646	758	1,043	642	732	959	642	732	959
Normal Cost (4% DR)	1,180	1,384	1,906	1,180	1,384	1,906	1,180	1,384	1,906	1,180	1,384	1,906	1,173	1,337	1,751	1,173	1,337	1,751
Net amortization \$	129	501	822	65	444	917	(37)	365	1,671	(135)	88	719	123	490	934	(373)	(180)	396
Net amortization \$ (4% DR)	(565)	(406)	(668)	(587)	(359)	(336)	(720)	(507)	126	(775)	(665)	(422)	(455)	(242)	(216)	(924)	(804)	(513)
Net amortization \$ / Payroll	2.6%	8.6%	10.3%	1.3%	7.7%	11.5%	-0.8%	6.3%	20.9%	-2.7%	1.5%	9.0%	2.5%	8.8%	12.8%	-7.6%	-3.2%	5.4%
Net amortization \$ / Payroll (4% DR)	-11.5%	-7.0%	-8.4%	-11.9%	-6.2%	-4.2%	-14.6%	-8.8%	1.6%	-15.7%	-11.5%	-5.3%	-9.3%	-4.3%	-3.0%	-18.9%	-14.4%	-7.0%
Investment Performance																		
Compounded Annual Growth - From Start Date	6.90%	6.90%	6.90%	5.00%	5.00%	5.00%	6.90%	6.90%	6.90%	5.00%	5.00%	5.00%	2.2%	3.5%	4.2%	2.2%	3.5%	4.2%
Compounded Annual Growth - Segments	6.90%	6.90%	6.90%	5.00%	5.00%	5.00%	6.90%	6.90%	6.90%	5.00%	5.00%	5.00%	2.2%	4.8%	4.8%	2.2%	4.8%	4.8%

Note: Dollar Figures in Millions