Segal Consulting

Sacramento County Employees' Retirement System

Risk Assessment Including Review of Funded Status as of June 30, 2018

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Section 1: Introduction and Executive Summary

Introduction

The results included in our June 30, 2018 funding valuation report were prepared based on a single set of economic and non-economic actuarial assumptions under the premise that future experience of the Sacramento County Employees' Retirement System (SCERS) would match those assumptions. While those assumptions are reviewed every three years (with the assumptions from the last triennial experience study adopted by the Board of Retirement for use starting with the June 30, 2017 valuation), there is a risk that emerging results may differ significantly as actual experience proves to be different from the current assumptions.

The purpose of this report is to assist the Board of Retirement, participating employers and members and other stakeholders to better understand and assess the risks inherent in using a single set of actuarial assumptions in preparing the results in our June 30, 2018 funding valuation for SCERS.

New Actuarial Standard of Practice on Risk Assessment

The Actuarial Standards Board approved a new Actuarial Standard of Practice No. 51 (ASOP 51) regarding risk assessment when performing a funding valuation for a pension plan. While ASOP 51 will be effective with SCERS' June 30, 2019 actuarial valuation, SCERS has elected early implementation of the new Standard starting with the June 30, 2018 valuation. ASOP 51 requires actuaries to identify risks that "may reasonably be anticipated to significantly affect the plan's future financial condition". Investment risk, asset/liability mismatch risk, interest rate risk, longevity and other demographic risks and contribution risk are cited as examples in ASOP 51. The Standard does not require the actuary to evaluate the likelihood of contributing entities to make contributions when due, nor does it require the actuary to assess the likelihood or consequences of future changes in applicable law.

The actuary's assessment can be qualitative or quantitative (e.g., based on numerical demonstrations). The actuary may use non-numerical methods for assessing risks that might take the form of commentary about potential adverse

experience and the likely effect on future results. While the Standard does not require that every valuation include a quantitative risk assessment, the actuary may recommend that a more detailed risk assessment be performed. When making that decision, the actuary will take into account such factors as the Plan's design, maturity, size, funded status, asset allocation, cash flow, possible insolvency and current market conditions.

The Standard also requires disclosure of plan maturity measures and other historical information that are significant to understanding the risks associated with the plan. This information is included in this report.

In Section 2, we discuss some of the historical factors that have caused changes in SCERS' funded status and employer contribution rates.

In Section 3, we provide commentary on some risk factors that may result in future adverse experience and the likely effect they may have on future results. Even though we have not included a numerical analysis of all the risk factors, we have been directed by SCERS to illustrate the impact on the funded status and employer contribution rates using "Scenario Tests". These tests illustrate the effect of future investment returns on the portfolio coming in different from the current 7% annual investment return assumption used in the June 30, 2018 valuation. We have also included a projection of future results based on a stochastic modeling of future investment returns. The stochastic modeling is useful for assessing the distribution of future results based on random variations in actual investment returns each year.

Executive Summary

Historical Funded Status and Employer Contribution Rates

During the past 10 valuations from June 30, 2009 to 2018, the System's funded ratios measured on an actuarial value of assets basis have decreased from about 85% to about 80% while the funded ratios measured on a market value of assets basis have increased from about 65% to about 80%. From 2009 to 2018, the unfunded actuarial accrued liability (UAAL) measured on an actuarial value of asset basis has increased from about $900 million to about $2,100 million (and on a market value basis has decreased from about $2,300 million to about $2,000 million) primarily as a result of strengthening the actuarial assumptions used in preparing the valuations as well as from unfavorable investment

experience. The total aggregate employer contribution rates have increased from about 22% to about 27% of payroll from 2009 to 2018 for the same reasons.

During the past 10 valuations, the System has become more mature as evidenced by an increase in the ratio of members in pay status (retirees and beneficiaries) to active members and by an increase in the ratios of plan assets and liabilities to active member payroll. This is significant for understanding the volatility of the historical (and future) employer contribution rates because any increase in UAAL due to unfavorable investment and non-investment experience for a relatively larger group of non-active and active members would have to be amortized and funded using the payroll of a relatively smaller group of active members.

Future Funded Status and Employer Contribution Rates

In this report, we have outlined some factors that may be studied in future risk reports. As investment experience in the past 10 years has a significant impact on the funded status and employer contribution rates, we have provided illustrative results under hypothetical favorable and unfavorable future market experience so that the impact of market performance can be better understood.

The funded ratio is about 81% on an actuarial value of asset basis in the June 30, 2018 valuation. Using a "deterministic" projection and assuming that SCERS were to earn a single year of favorable market return of 14% or an unfavorable market return of 0% in 2018/2019 (compared to an expected investment return of 7.0%), the System would still be expected to reach full funding at the end of 20 years. Using a "stochastic" projection that models market return over the next 20 years by using expected return, standard deviation and other information about SCERS' asset portfolio, there is a 38% chance SCERS would be fully funded at the end of 10 years and 53% chance SCERS would be fully funded at the end of 20 years.

The total employer contribution rate is about 27% of payroll in the June 30, 2018 valuation. Using a "deterministic" projection and assuming that SCERS were to earn an favorable market return of 14% in 2018/2019, there would be a decrease in the total employer contribution rate of about 0.6% of payroll in the June 30, 2019 valuation and of about 5.3% of payroll in the June 30, 2025 valuation when all the investment gains are fully recognized at the end of the 7-year asset

smoothing period. Alternatively, an unfavorable market return of 0% in 2018/2019 would bring a comparable increase in the total employer contribution rate in those valuations.

Furthermore, under either favorable or unfavorable hypothetical market return scenarios for 2018/2019, the total employer contribution rate would be expected to approach about 11% of payroll at the end of 20 years. That 11% of payroll is the employer normal cost rate after SCERS' UAAL layers as of June 30, 2018 are paid off over periods ranging from 2 to 20 years and any new UAALs resulting from the hypothetical market experience in 2018/2019 are paid off over 20 years pursuant to the Board's actuarial funding policy. This means that the Board's funding policy is very effective in achieving the general policy goal of achieving the long-term full funding of the costs of the benefits paid by SCERS.

Using a "stochastic" projection that models market return over the next 20 years by using expected return, standard deviation and other information about SCERS' asset portfolio, there is a 50% chance that the employer contribution rates would be between 11% and 40% of payroll at the end of 10 years and between 11% and 34% of payroll at the end of 20 years.

Section 2: Factors That Have Historically Impacted Funded Status and Employer Contribution Rates

Funded Status and Change in Unfunded Actuarial Accrued Liabilities

One common measure of SCERS' financial status is the funded ratio. This ratio compares the actuarial[1] and market value of assets to the actuarial accrued liabilities[2] of SCERS. The overall level of funding of SCERS has declined as a result of strengthening of the economic and non-economic assumptions especially in the last triennial experience study. Those new actuarial assumptions were used in the June 30, 2017 and 2018 valuations. The unfavorable investment experience also has an impact. The funding ratios for the past 10 valuations from June 30, 2009 to 2018 measured using both actuarial and market value of assets bases and the unfunded actuarial accrued liabilities[3] (UAAL) measured using both the actuarial value of assets and market value of asset bases are provided in Chart 1.

The factors that caused the changes in the UAAL for the past 10 valuations from June 30, 2009 to 2018 are identified in Chart 2. The results in Chart 2 show that the changes in the investment return assumption from 7.50%

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1 The actuarial value of assets is equal to the market value of assets excluding unrecognized returns from the last few years. Unrecognized returns are based on the difference between actual and expected returns on a market value basis and are recognized over a seven-year period.

2 For the actives, the actuarial accrued liability is the value of the accumulated normal costs allocated to the years before the valuation date. For the pensionsers, beneficiaries and deferred vested members, the actuarial accrued liability is the single sum present value of the lifetime benefit expected to be paid to those members.

3 The amount by which the actuarial accrued liability of the plan exceeds (or is exceeded by) the assets of the plan.

to 7.00%[4] and other assumption changes from the last triennial experience study as part of the June 30, 2017 valuation have by far the most impact on the UAAL for SCERS, followed by the unfavorable investment experience during 2009 to 2018.

Chart 2 also shows that the unfavorable investment experience was offset to some extent by favorable non-investment experience. The non-investment experience included smaller salary increases received by active members and smaller cost-of-living-adjustment (COLA) increases received by retirees and beneficiaries than expected under the actuarial assumptions. The non-investment experience also included the one year scheduled delay in implementing the contribution rates determined in the annual valuation.

Finally, prior to 2016 Chart 2 shows some "negative amortization" under the longer amortization periods used in these years. Current amortization policy generally will not entail negative amortization in the future.

[4] Prior to the experience study as part of the June 30, 2017 valuation, the investment return assumption was lowered from 7.875% to 7.75% in the June 30, 2010 valuation and from 7.75% to 7.50% in the June 30, 2012 valuation.

Chart 1

Funded Ratio (Percentages) and Dollar UAAL ($ Millions)
In June 30, 2009 to 2018 Valuations

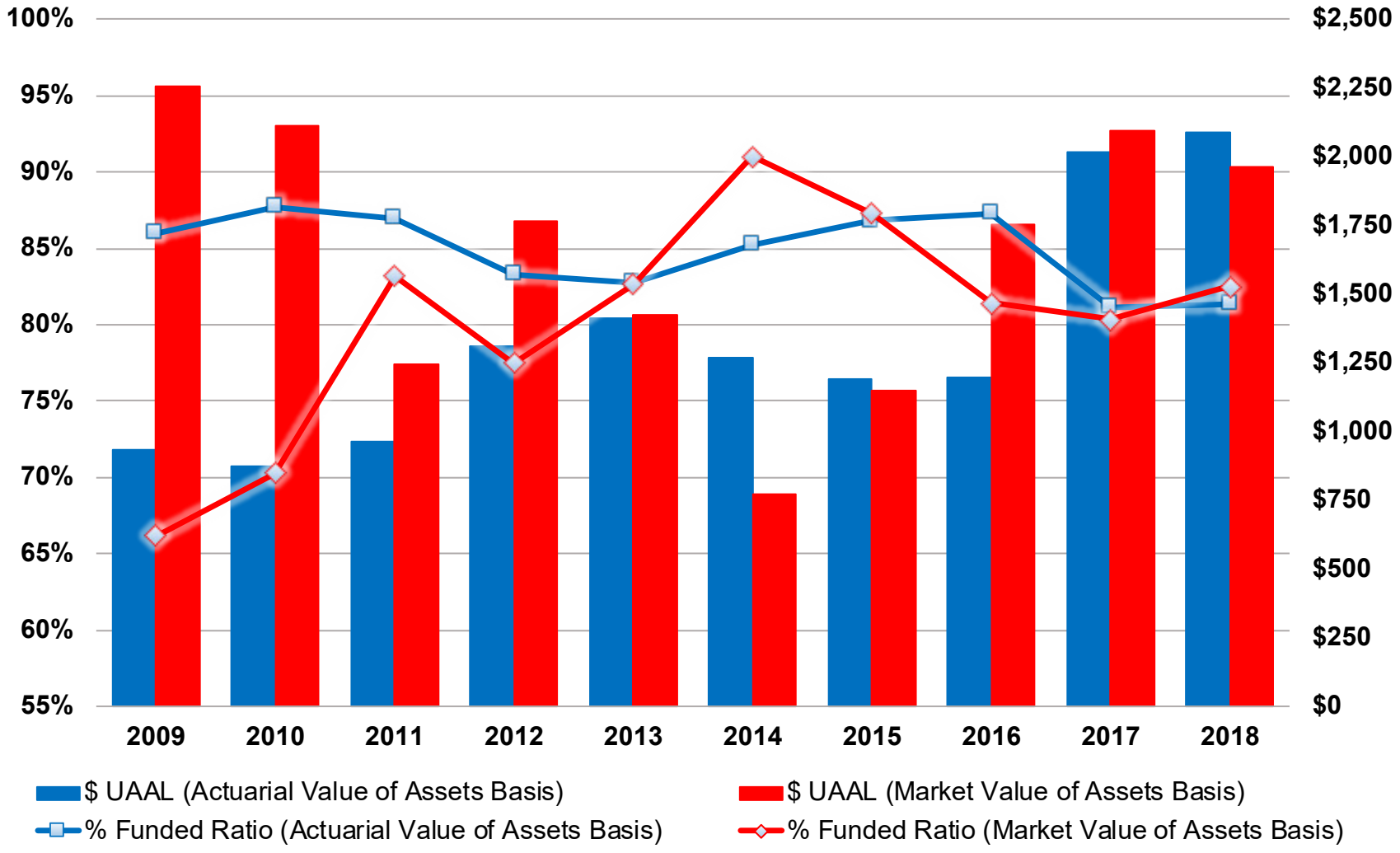
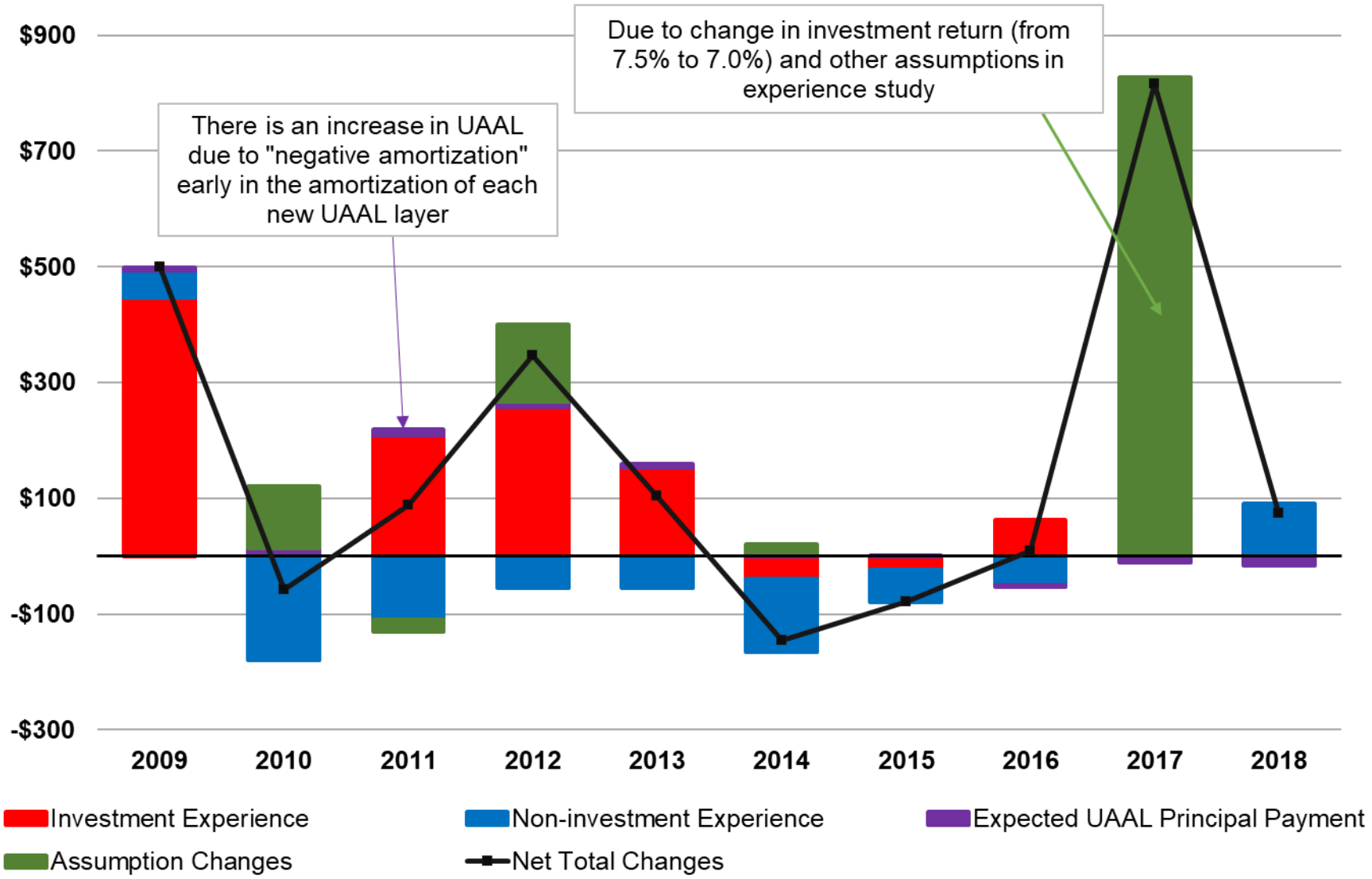


Chart 2

Factors that Changed UAAL in June 30, 2009 to 2018 Valuations ($ Millions)



Change in Employer Contribution Rates

The total (normal cost[5] plus UAAL) employer contribution rates determined in the June 30, 2009 to 2018 valuations are provided in Chart 3 and the factors that caused the changes in the total employer aggregate rates[6] are provided in Chart 4.

The gradual reduction in the employer aggregate normal cost rates in Chart 3 was primarily due to plan changes under the Public Employees' Pension Reform Act of 2013 (PEPRA) as County legacy members agreed to pay additional normal cost contributions and County and District new members were enrolled in lower cost PEPRA benefit tiers. Chart 4 shows that the changes in the investment return from 7.50% to 7.00% and other assumptions from the last triennial experience study as part of the June 30, 2017 valuation have by far the most impact on increasing the UAAL contribution rates for the employers followed by the unfavorable investment experience during 2009 to 2018. Based on the significant increase in the employer contribution rates in the June 30, 2017 valuation (of 7.76% of payroll or $76 million per year based on an annual payroll of $980 million in the 2017 valuation), the Board decided to phase-in the UAAL contribution rate increase due to the assumption changes over a 3-year period.[7]

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[5] The normal cost is the amount of contributions required to fund the level cost of the member's projected retirement benefit allocated to the current year of service.

[6] There are separate contribution rates determined in the valuation for the Miscellaneous and Safety membership groups and for the different benefit tiers. The aggregate rates have been calculated based on an average of those rates weighted by the payrolls of the active members reported in those valuations.

[7] As of the June 30, 2018 valuation, only two-thirds of the 5.8% UAAL contribution rate increase has been phased in. The last phase-in will increase the contribution rate by about 1.9% in the June 30, 2019 valuation.

Chart 3

Employer Contribution Rates in June 30, 2009 to 2018 Valuations (% of Payroll)

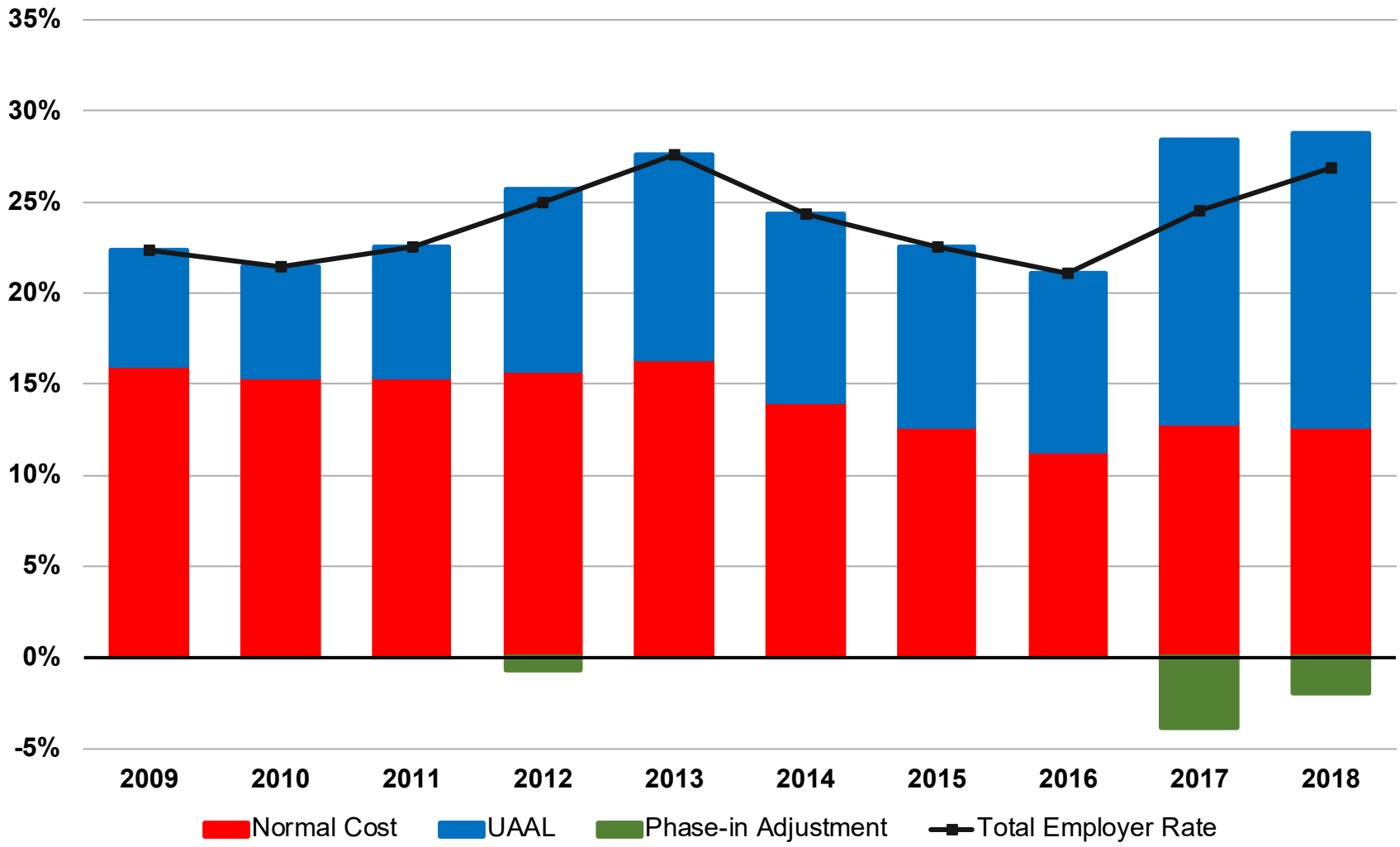
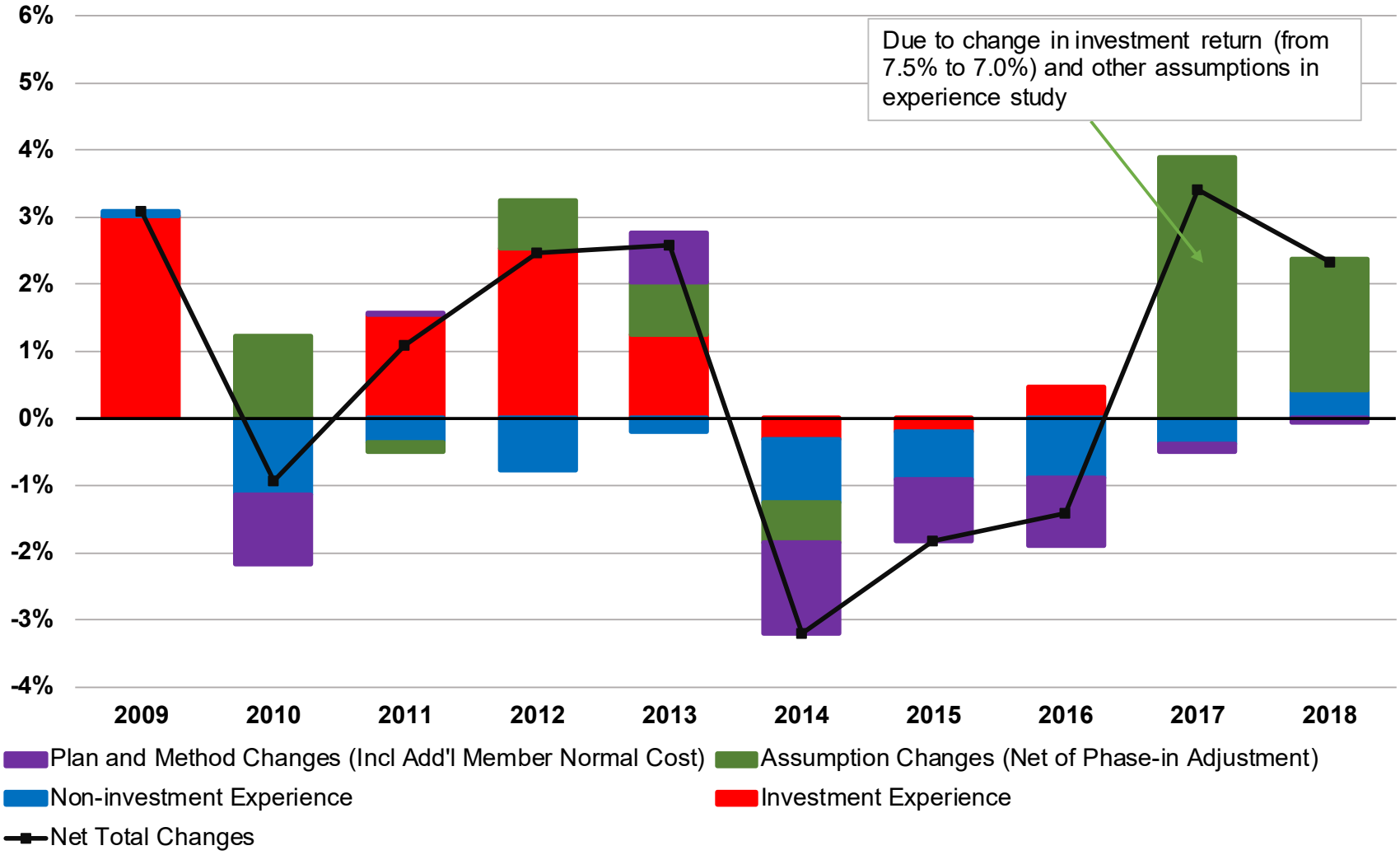


Chart 4

Change in Employer Contribution Rates in June 30, 2009 to 2018 Valuations (% of Payroll)



Plan Maturity Factors That Contribute to Fluctuation in Employer Contribution Rates

The annual actuarial valuation considers the number and demographic characteristics of covered members, including active members and non-active members (vested terminated members, retired members and beneficiaries). In the past 10 valuations from June 30, 2009 to 2018, SCERS has become more mature, indicated by the continued increase in the ratio of non-active to active members covered by the System as shown in Chart 5. The Chart also shows the ratio of members in pay status (retirees and beneficiaries) to active members. This ratio excludes the vested terminated members who have relatively smaller liabilities. The increase in the ratios is significant because any increase in UAAL due to unfavorable future investment and non-investment experience for a relatively larger group of non-active (and active) members would have to be amortized and funded using the payroll of a relatively smaller group of active members.

Besides the ratio of non-active to active members, another indicator of a more mature retirement plan is relatively larger amounts of assets and/or liabilities compared to active member payroll and increasing volatility in the level of required contributions. The Asset Volatility Ratio (AVR), which is equal to the market value of assets divided by total payroll, provides an indication of the potential contribution volatility for any given level of investment volatility. The Liability Volatility Ratio (LVR), which is equal to the actuarial accrued liability divided by payroll, provides an indication of the longer-term potential for contribution volatility for any given level of liability volatility.

In particular, SCERS' AVR was 9.2 as of June 30, 2018. This means that a 1% asset gain or loss in 2018/2019 (relative to the assumed investment return) would amount to 9.2% of one-year's payroll. Similarly, SCERS' LVR was 11.1 as of June 30, 2018, so a 1% liability decrease or increase in 2018/2019 would amount to 11.1% of one year's payroll.

Based on SCERS' policy to amortize actuarial experience over a period of 20 years, there would be a 0.70% of payroll decrease or increase in the required contribution rate for each 1% asset gain or loss and a 0.80% of payroll decrease or increase in the required contribution rate for each 1% liability gain or loss.

Chart 5

Ratios of Non-Active Members (Vested Terminated, Retirees and Beneficiaries) to Active Members & Members in Pay-Status (Retirees and Beneficiaries) to Active Members

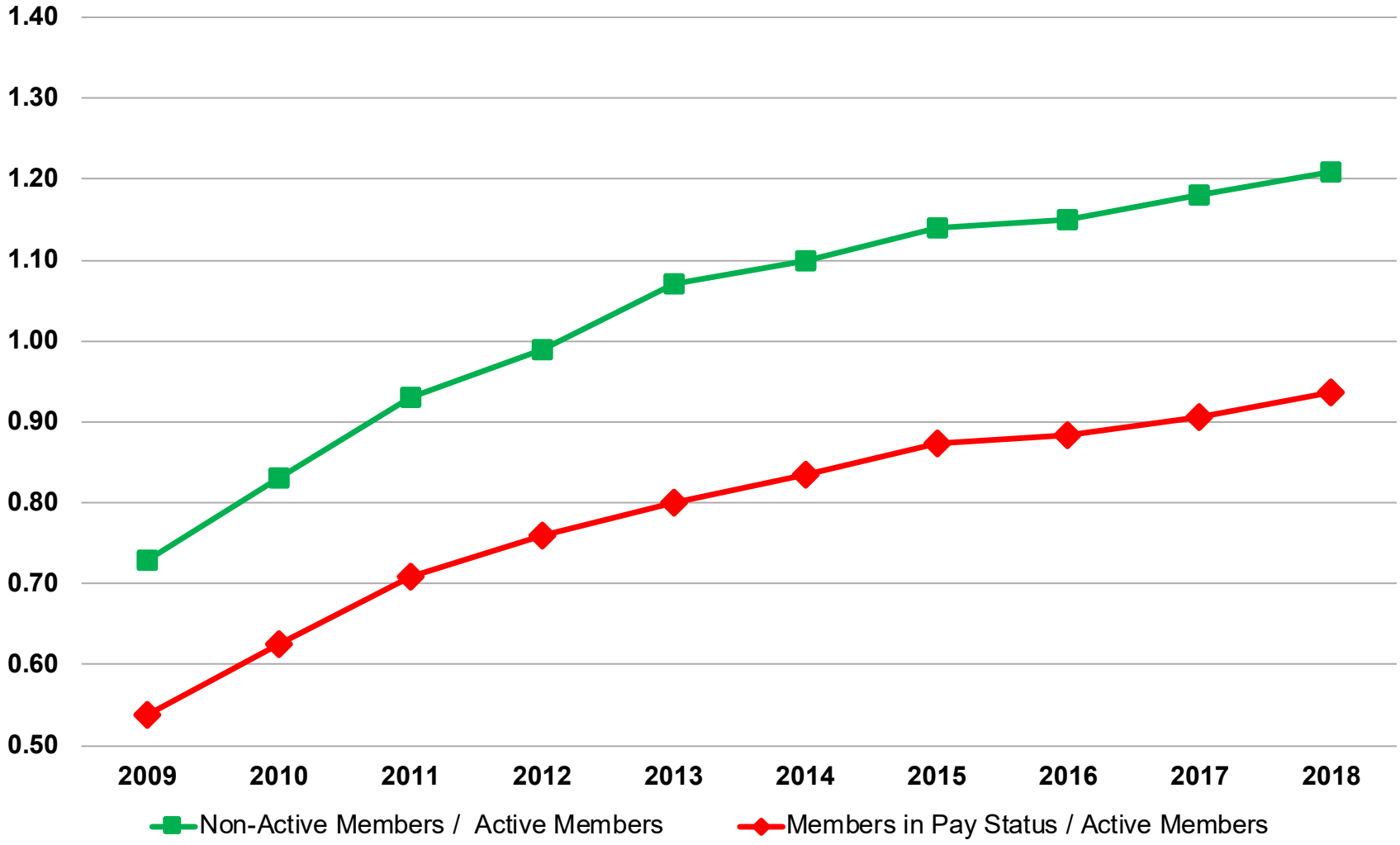
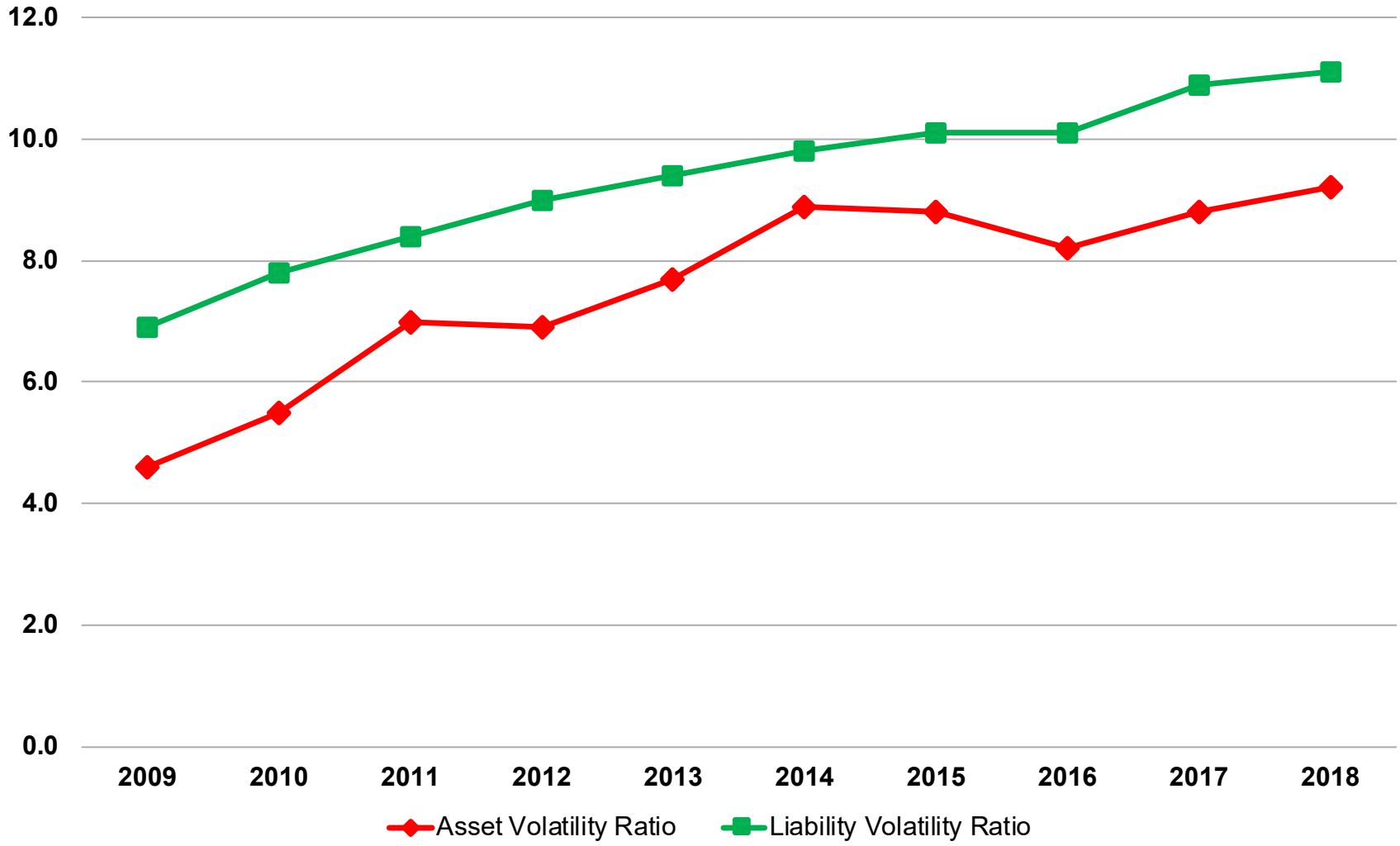


Chart 6

Asset Volatility Ratio and Liability Volatility Ratio in June 30, 2009 to 2018 Valuations



Section 3: Factors that May Impact Future Funded Status and Employer Contribution Rates

Future Risk Factors

As we discussed in Section 2, in the 2009 to 2018 valuations the funded ratios and the employer contribution rates have changed mainly as a result of changes in actuarial assumptions and investment experience.

In general, we would anticipate the following risk factors to have an influence on those two metrics in our future valuations:

- Investment risk – the potential that future market returns will be different from expected by the current 7.00% annual return assumption.

  We have included results from the "Scenario Tests" (see discussion later in this Section) so that SCERS can better understand the risk associated with earnings either more/less than the assumed rate.

- Asset/liability mismatch risk – the potential that changes in asset values are not matched by changes in the value of liabilities.

  Since the majority of the liabilities of SCERS are valued in a manner independent of the actual performance of the investment portfolio, SCERS' asset/liability mismatch risk[8] is the investment risk just discussed. The System might want to also use the AVR and LVR and associated contribution rate impacts provided in

[8] During 2017/2018, SCERS paid benefits of about $468 million. Out of that total amount, only about $3 million was made in refund of employee contributions where the liabilities associated with the growth in the members' employee contribution account bear some relationship to the rate of return on short term US Treasury Securities in SCERS' investment portfolio.

Section 2 when discussing with the employers the effect of unfavorable or favorable actuarial experience on the assets and the liabilities of SCERS.

- Interest rate risk – the potential that changes in interest rate will affect assets and/or liabilities.

  As just discussed above, changes in interest rates do not immediately affect the valuation of SCERS' liabilities. However, changes in the investment return assumption can affect both liabilities and contribution rates. During the last triennial experience study as part of the June 30, 2017 valuation, we estimated that the total (employer and employee) contribution rate would increase by about 3.7% of payroll for a 0.25% reduction in the investment return assumption.

  Since the Board has a policy of reviewing the investment return and the other actuarial assumptions every three years, we intend to include a "Sensitivity Test" showing the impact of changes in economic assumptions when we prepare next year's risk report in early 2020 (based on the June 30, 2019 actuarial valuation). Then, if the Board were to consider a change in SCERS' investment return assumption, the impact on employer and employee contribution rates would be available before we complete the next triennial experience study (recommending assumptions for the June 30, 2020 actuarial valuation).

- Longevity and other demographic risks – the potential that mortality or other demographic experience will be different than expected.

  Aside from updates to the mortality tables to anticipate continued improvement in life expectancy for the System's members, there were no major changes in the other non-economic assumptions in the last experience study. As can be observed from Charts 2 and 4, there had been relatively small impact on the UAAL and employer contribution rates due to unfavorable non-investment related experience relative to the assumptions used in the last 10 valuations. However, in the last triennial experience study in 2017, we alerted the Board that they should consider a new benefit weighted mortality basis when choosing the next mortality table, pending the availability of mortality experience from the Society of Actuaries (SOA) that included data from public sector retirement plans.

In January 2019, the SOA adopted the public sector mortality tables. While it is premature to estimate the impact of applying those new mortality tables on employer and employee contribution rates until we perform the next triennial experience study recommending assumptions for the June 30, 2020 valuation, the Board should still be aware that there will likely be an increase in liabilities and contribution rates.

- Contribution risk – ASOP 51 does not require the actuary to evaluate the ability or willingness of the plan sponsor or other contributing entity to make contributions to the plan when due. However, the SCERS employers have a well established practice of making the Actuarially Determined Contributions (ADC) determined in the annual actuarial valuation using the Board of Retirement's Actuarial Funding Policy.

  Furthermore, when ADCs determined in accordance with the SCERS Actuarial Funding Policy are made in the future by the employers (and contributions required by the statute are made by the employees), it is anticipated that the System would have enough assets to provide all future benefits promised to the current members enrolled in the System, if all of the actuarial assumptions used in the valuation are met.

Scenario Tests

Since the funded ratio, UAAL and the employer contribution rates have fluctuated as a result of deviation in investment experience in the last 10 valuations, we have examined the risk for SCERS associated with earnings either higher or lower than the assumed rate of 7.00% in future valuations using projections under a deterministic approach and a stochastic approach.

Deterministic Projection

To measure such risk, we have included a "Scenario Test" to study the change in liabilities and contribution rates if SCERS were to earn market return higher or lower than 7.00% in the next year following the June 30, 2018 valuation. In Charts 7, 8 and 9, we show the results assuming alternatively that the portfolio's market return in 2018/2019 will be: 14%, 7% (baseline) or 0%. Chart 7 provides the funded ratios, Chart 8 provides the UAAL and Chart 9 provides the aggregate employer contribution rates projected under the three hypothetical market return scenarios.

If SCERS were to earn a market return in 2018/2019 which is either 7% higher or lower than the current investment return assumption (of 7.0%), it would cause a decrease or increase in the employer contribution rates of about 0.6% of payroll in the June 30, 2019 valuation and of about 5.3% of payroll in the June 30, 2025 valuation when all of the investment gains or losses are fully recognized in the (smoothed) actuarial value of assets.

Furthermore, under either favorable or unfavorable hypothetical market return scenarios for 2018/2019, the total employer contribution rate would be expected to approach about 11% of payroll at the end of 20 years. That 11% of payroll is the employer normal cost rate after SCERS' UAAL layers as of June 30, 2018 are paid off over periods ranging from 2 to 20 years and any new UAALs resulting from the hypothetical market experience in 2018/2019 are paid off over 20 years pursuant to the Board's actuarial funding policy. This means that the Board's funding policy is very effective in achieving the general policy goal of achieving the long-term full funding of the costs of the benefits paid by SCERS.

While we have not assigned a probability on the 2018/2019 market return coming in at these rates, the Board and other stakeholders monitoring SCERS should still be able to prorate and estimate the funded status and employer contribution rates for the June 30, 2019 and next several valuations as the actual investment experience for 2018/2019 year becomes available throughout the year.

Chart 7

Projected Funded Ratios (on Actuarial Value of Assets Basis) under Three Hypothetical Market Return Scenarios for 2018/2019

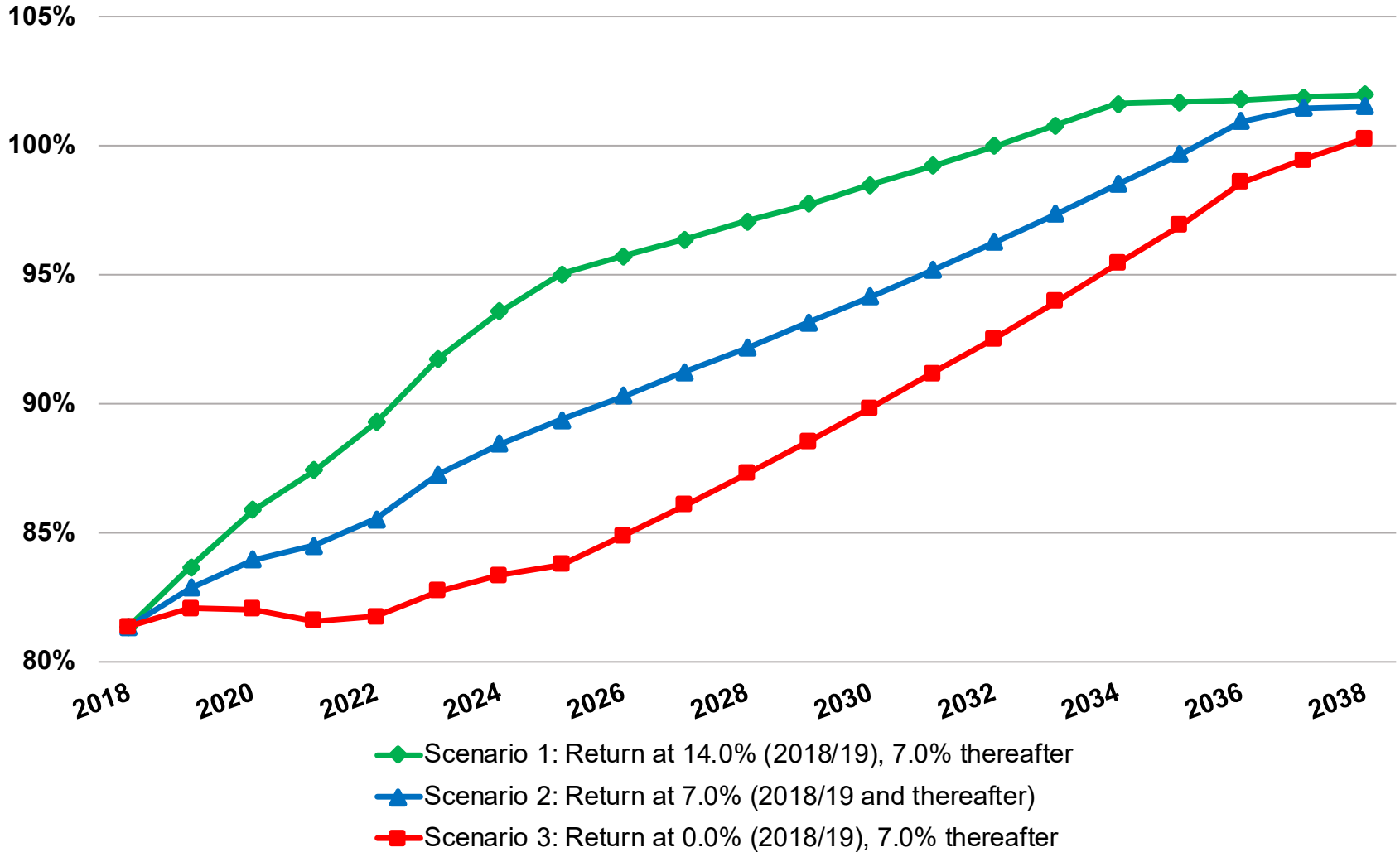


Chart 8

Projected UAAL (on Actuarial Value of Assets Basis) Under
Three Hypothetical Market Return Scenarios for 2018/2019 ($ Millions)

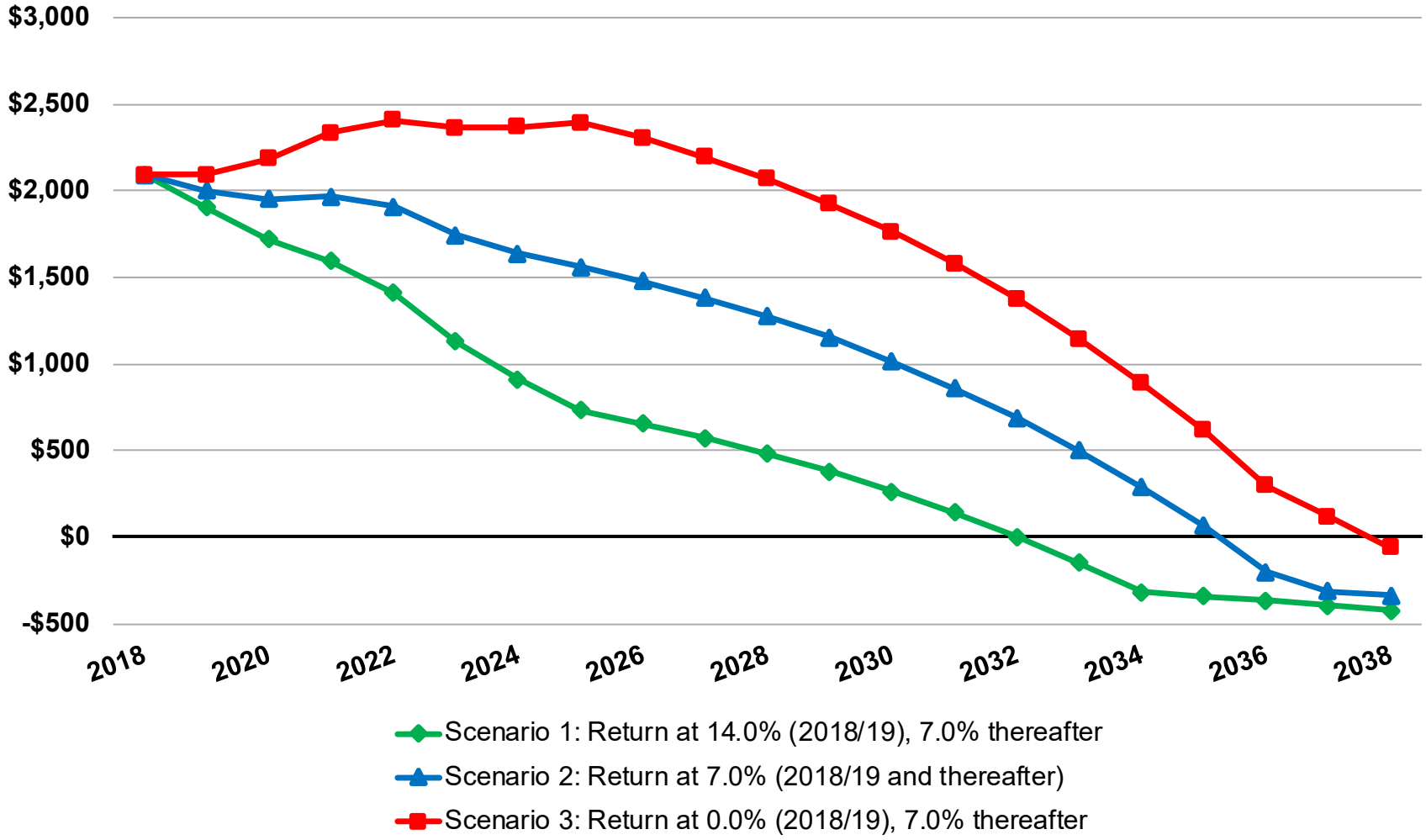
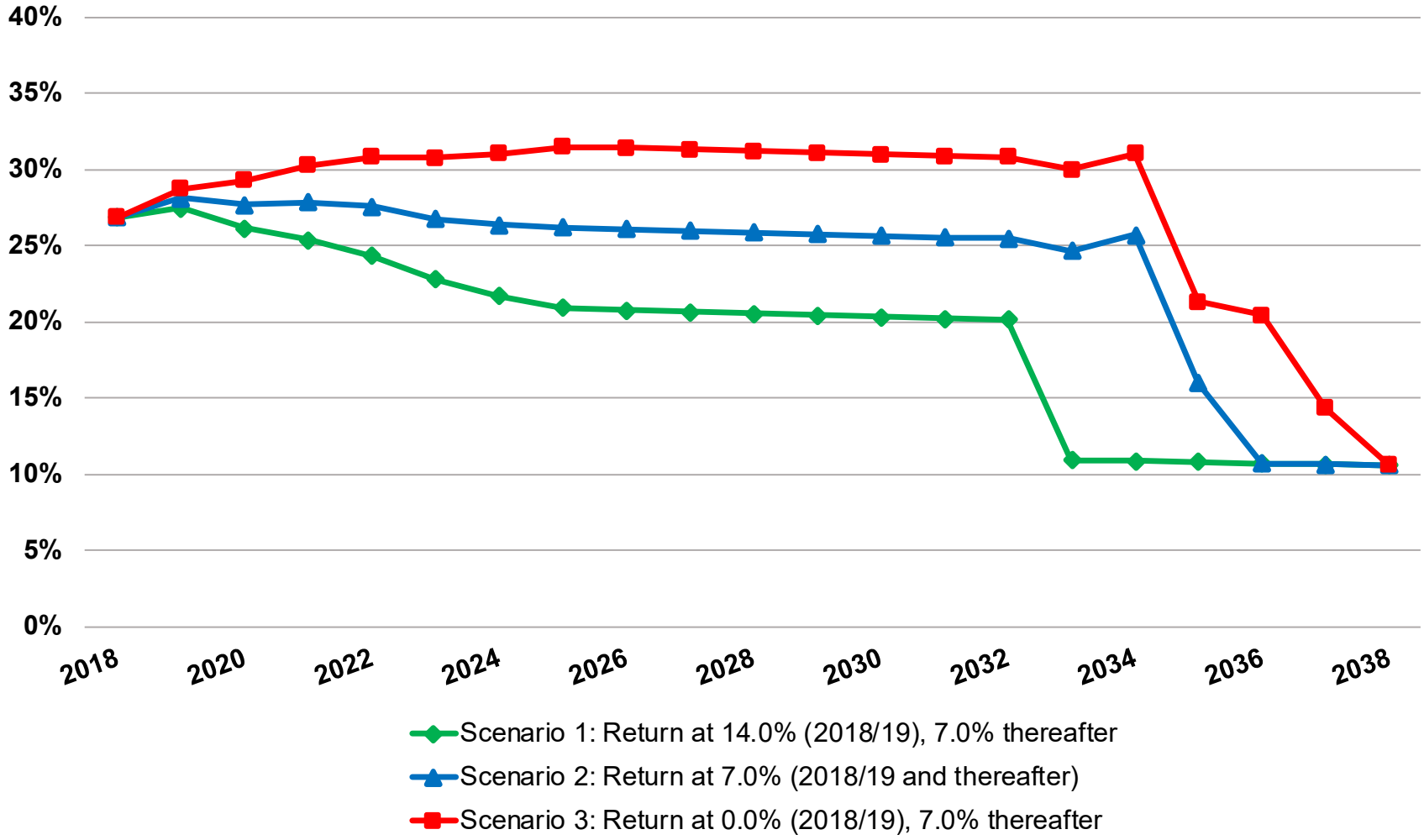


Chart 9

Projected Employer Contribution Rates Under
Three Hypothetical Market Return Scenarios for 2018/2019 (% of Payroll)



Stochastic Projection

Based on our discussions with SCERS, we have also been directed to supplement the Scenario Tests by another analysis that shows the range of possible changes in funded status and contribution rates under a statistical distribution of potential market returns for 20 years following the June 30, 2018 valuation. We have accomplished the "stochastic modeling" of future market returns by using the expected return, standard deviation and other information about SCERS' asset portfolio as provided in the Appendix of this report.

In Chart 10, we summarize the cumulative compounded rate of return of SCERS' investment portfolio over the next 20 years based on performing 10,000 trial outcomes of future market returns. The projected funded ratios for those trials are provided in Chart 11. The UAAL and the resultant employer contribution rates are provided in Charts 12 and 13.

At the end of 20 years, there is a 50% chance[9] that the annual return of SCERS' investment portfolio would average between 5.2% and 8.8%, the funded ratio would be between 82% and 140% and the corresponding UAAL would be between $3.9 billion and a surplus (or a negative UAAL) of $8.6 billion

The funded ratio is about 81% the June 30, 2018 valuation. There is a 38% chance SCERS would be fully funded at the end of 10 years and a 53% chance SCERS would be fully funded at the end of 20 years. The probabilities that the funded ratio would fall below 40%, 50% or 60% at any point in the next 20 years are as follows:

	Funded Ratio		
	Below 40%	Below 50%	Below 60%
Probability	<1%	1%	3%

At the end of 10 years (i.e., the June 30, 2028 valuation), there is a 50% chance that the employer contribution rates would be between 11% and 40% of payroll. At the end of 20 years (i.e., the June 30, 2038 valuation), there is a 50% chance that the employer contribution rates would be between 11% and 34% of payroll. 11% of payroll is

[9] This is based on the 25th to the 75th percentile results.

about the level of the employer normal cost rate. Note that we have not offset the normal cost by any available actuarial surplus.[10]

The total employer contribution rate is about 27% payroll in the June 30, 2018 valuation. The probabilities that the total employer contribution rate would increase at least by 5%, 10% or 15% of payroll at any point in the next 20 years are as follows:

	Total Employer Rate Increases by at least		
	5% of Payroll (To 32% of Payroll)	10% of Payroll (To 37% of Payroll)	15% of Payroll (To 42% of Payroll)
Probability	30%	22%	16%

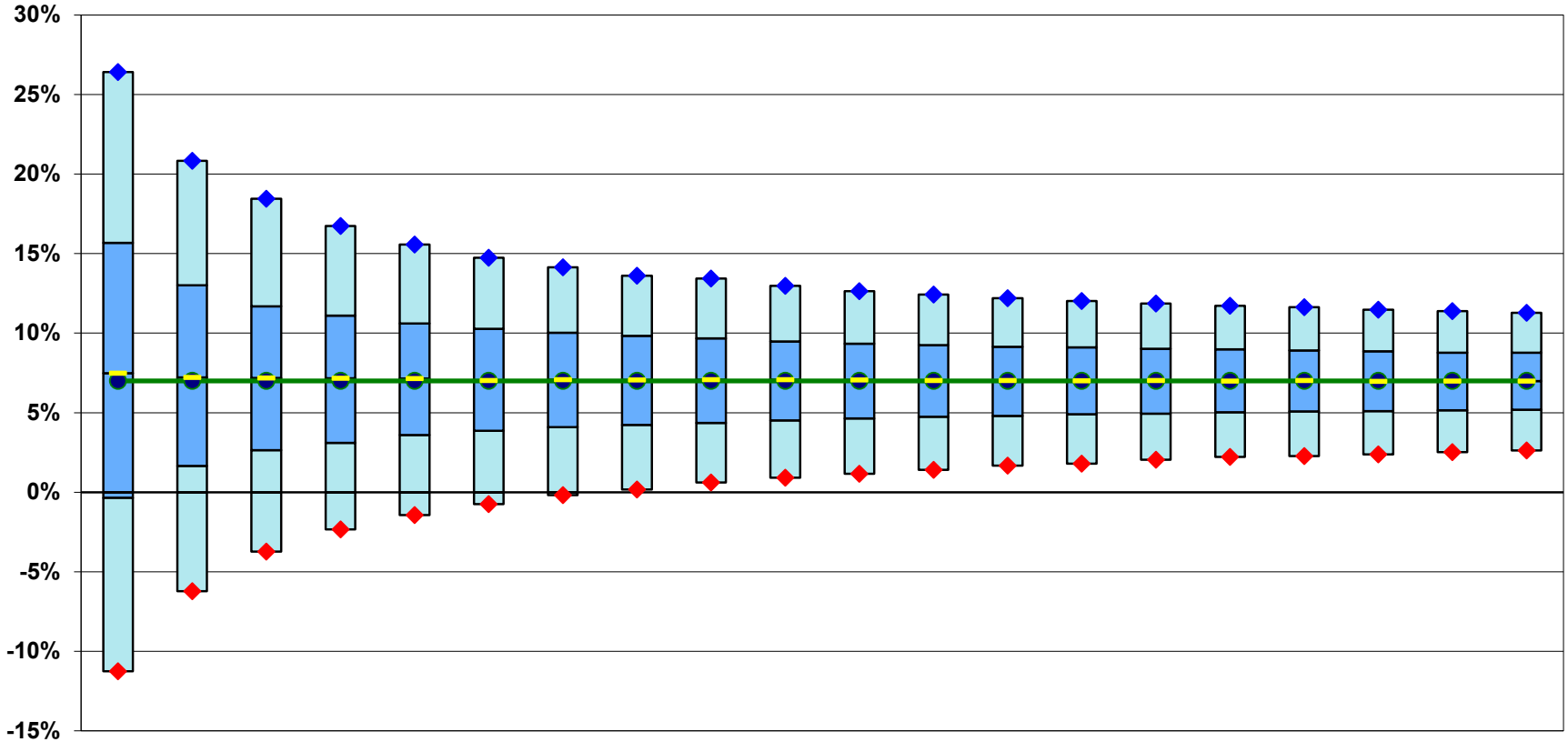
Finally, the probabilities that the total employer contribution rate would spike by 3%, 5% or 7% of payroll in any single year during the next 20 years are as follows:

	Total Employer Rate Spike in a Single Year by		
	3% of Payroll	5% of Payroll	7% of Payroll
Probability	10%	3%	2%

[10] Under PEPRA, the System has an actuarial surplus when the funded ratio is at or over 120% and certain other conditions are met. For the purposes of these projections, we have assumed that those other conditions have not been met and therefore we did not amortize such actuarial surplus over a rolling (non-decreasing) 30-year period as described under the Board's funding policy.

Chart 10

Projected Cumulative Investment Return for Plan Years Ending June 30

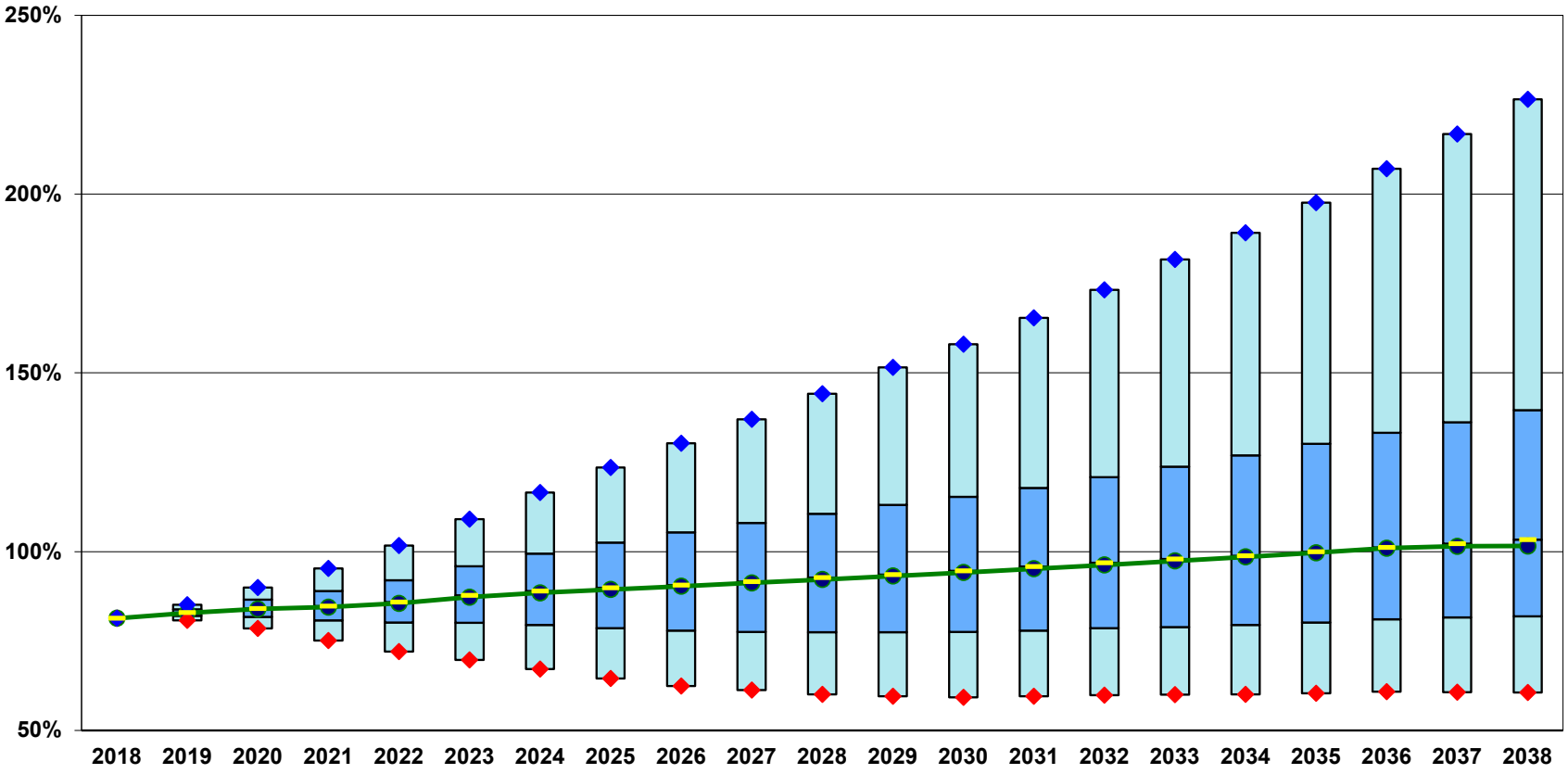


	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
95th	26.4%	20.8%	18.4%	16.7%	15.6%	14.7%	14.1%	13.6%	13.4%	13.0%	12.6%	12.4%	12.2%	12.0%	11.9%	11.7%	11.6%	11.5%	11.4%	11.3%
75th	15.7%	13.0%	11.7%	11.1%	10.6%	10.3%	10.0%	9.8%	9.7%	9.5%	9.3%	9.2%	9.1%	9.1%	9.0%	9.0%	8.9%	8.9%	8.8%	8.8%
50th	7.5%	7.2%	7.2%	7.2%	7.1%	7.0%	7.1%	7.1%	7.1%	7.1%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%
25th	-0.4%	1.7%	2.6%	3.1%	3.6%	3.9%	4.1%	4.2%	4.4%	4.5%	4.6%	4.7%	4.8%	4.9%	4.9%	5.0%	5.1%	5.1%	5.2%	5.2%
5th	-11.3%	-6.2%	-3.7%	-2.3%	-1.4%	-0.7%	-0.2%	0.2%	0.6%	0.9%	1.2%	1.4%	1.7%	1.8%	2.0%	2.2%	2.3%	2.4%	2.5%	2.6%
	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%	7.0%	7.0%

● Current investment return assumption

Chart 11

Projected Funded Ratios (on Actuarial Value of Assets Basis)

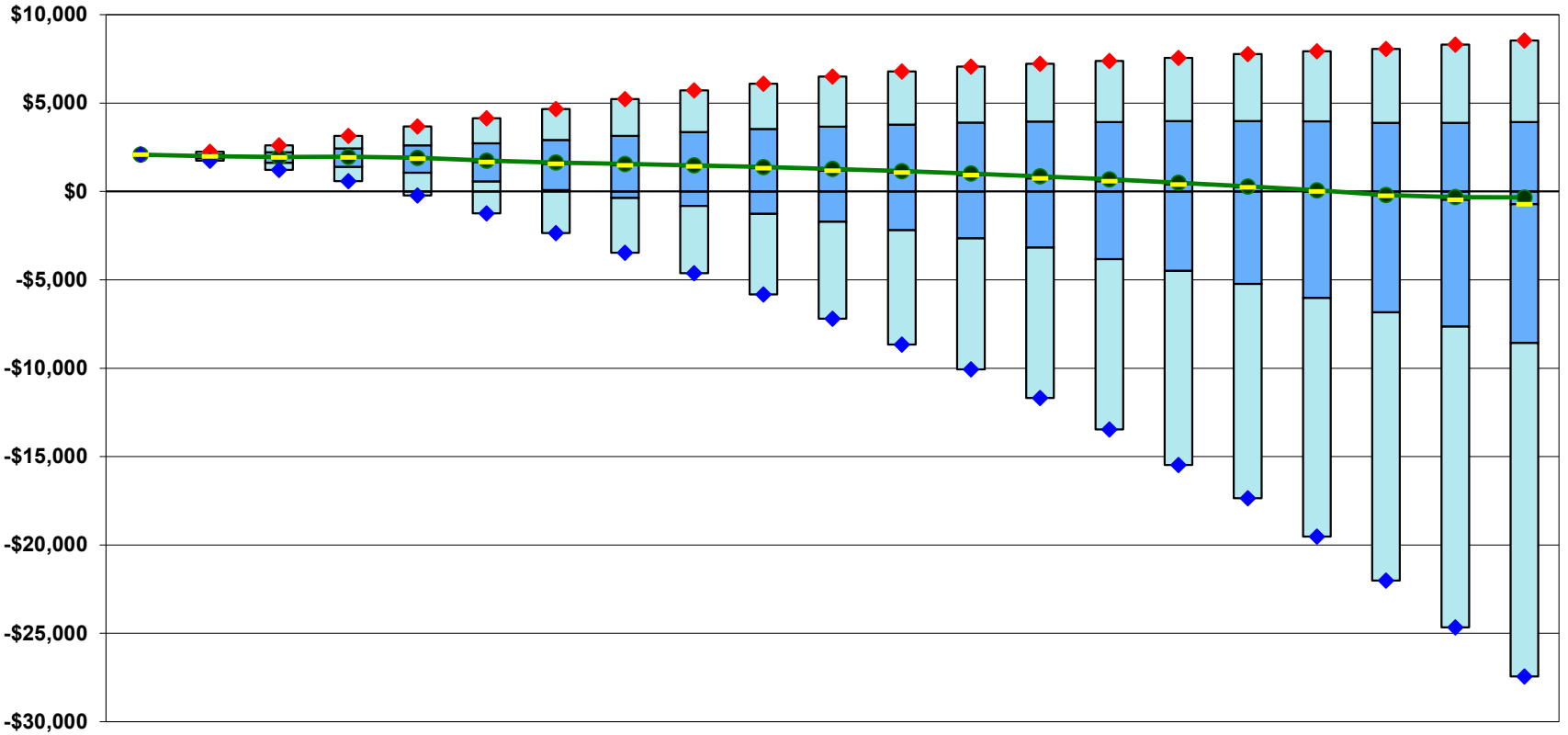


	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
95th	81.4%	85.1%	90.0%	95.3%	101.7%	109.1%	116.5%	123.5%	130.3%	137.0%	144.2%	151.5%	158.0%	165.4%	173.2%	181.8%	189.2%	197.6%	207.1%	216.8%	226.6%
75th	81.4%	83.9%	86.6%	89.0%	92.0%	95.9%	99.4%	102.5%	105.4%	108.0%	110.6%	113.1%	115.3%	117.8%	120.9%	123.8%	126.9%	130.1%	133.2%	136.2%	139.6%
50th	81.4%	82.9%	84.1%	84.7%	85.9%	87.8%	89.0%	89.9%	90.6%	91.6%	92.7%	93.6%	94.7%	95.8%	96.9%	97.9%	98.8%	100.0%	101.2%	102.2%	103.3%
25th	81.4%	82.0%	81.8%	80.8%	80.2%	80.1%	79.5%	78.6%	77.9%	77.5%	77.5%	77.5%	77.5%	77.9%	78.6%	78.9%	79.5%	80.1%	81.1%	81.6%	81.9%
5th	81.4%	80.8%	78.5%	75.1%	72.0%	69.7%	67.2%	64.5%	62.4%	61.3%	60.1%	59.5%	59.2%	59.5%	59.9%	60.0%	60.1%	60.3%	60.8%	60.7%	60.6%
	81.4%	82.9%	84.0%	84.5%	85.5%	87.3%	88.5%	89.4%	90.3%	91.2%	92.2%	93.2%	94.2%	95.2%	96.3%	97.4%	98.5%	99.7%	101.0%	101.5%	101.6%

Baseline deterministic projection with current assumptions

Chart 12

Projected UAAL (on Actuarial Value of Asset Basis) ($ Millions)

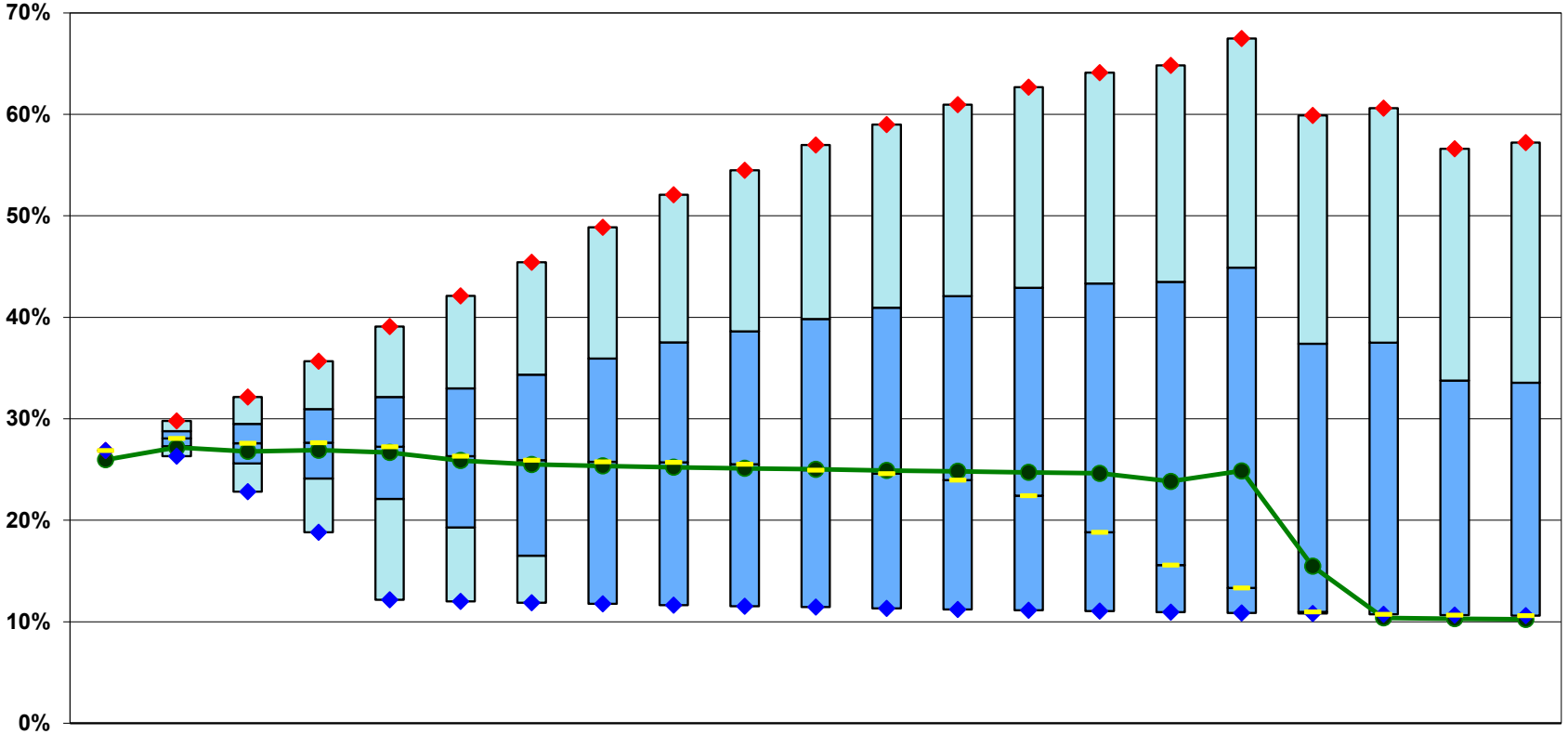


	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
95th	2,090	1,738	1,218	592	-227	-1,241	-2,348	-3,465	-4,618	-5,827	-7,193	-8,656	-10,062	-11,684	-13,463	-15,473	-17,357	-19,526	-22,015	-24,657	-27,440
75th	2,090	1,882	1,634	1,399	1,059	564	84	-375	-818	-1,263	-1,722	-2,198	-2,660	-3,175	-3,835	-4,495	-5,234	-6,028	-6,832	-7,640	-8,576
50th	2,090	1,992	1,932	1,934	1,858	1,676	1,566	1,487	1,426	1,322	1,183	1,078	927	750	579	398	234	9	-237	-472	-720
25th	2,090	2,097	2,217	2,434	2,612	2,730	2,914	3,148	3,364	3,539	3,669	3,784	3,894	3,952	3,935	3,990	3,990	3,974	3,884	3,891	3,931
5th	2,090	2,244	2,611	3,150	3,683	4,150	4,663	5,225	5,726	6,102	6,499	6,800	7,071	7,227	7,382	7,565	7,773	7,934	8,059	8,305	8,547
	2,090	1,999	1,950	1,964	1,909	1,745	1,638	1,562	1,477	1,382	1,273	1,151	1,013	860	688	497	286	65	-200	-313	-337

Baseline deterministic projection with current assumptions

Chart 13

Projected Contribution Rates for the Employers



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
95th	26.9%	26.3%	22.8%	18.8%	12.2%	12.0%	11.9%	11.8%	11.6%	11.5%	11.4%	11.3%	11.2%	11.1%	11.0%	11.0%	10.9%	10.8%	10.7%	10.7%	10.6%
75th	26.9%	27.3%	25.6%	24.1%	22.1%	19.3%	16.5%	11.8%	11.6%	11.5%	11.4%	11.3%	11.2%	11.1%	11.0%	11.0%	10.9%	10.8%	10.7%	10.7%	10.6%
50th	26.9%	28.1%	27.6%	27.6%	27.3%	26.3%	25.9%	25.8%	25.7%	25.5%	24.9%	24.6%	24.0%	22.4%	18.8%	15.6%	13.3%	11.0%	10.7%	10.7%	10.6%
25th	26.9%	28.8%	29.5%	30.9%	32.1%	33.0%	34.3%	35.9%	37.5%	38.6%	39.8%	40.9%	42.1%	42.9%	43.3%	43.5%	44.9%	37.4%	37.5%	33.8%	33.5%
5th	26.9%	29.8%	32.1%	35.7%	39.1%	42.1%	45.4%	48.9%	52.1%	54.5%	57.0%	59.0%	60.9%	62.7%	64.1%	64.8%	67.5%	59.9%	60.6%	56.6%	57.2%
	26.9%	28.1%	27.7%	27.8%	27.6%	26.8%	26.4%	26.2%	26.1%	26.0%	25.9%	25.8%	25.7%	25.6%	25.5%	24.6%	25.7%	16.0%	10.7%	10.7%	10.6%

Baseline deterministic projection with current assumptions

Appendix: Actuarial Assumptions, Methods and Actuarial Certification

Actuarial Assumptions and Methods

Unless otherwise noted, the results included in this report have been prepared based on the assumptions and methods used in preparing the June 30, 2018 valuation.

Deterministic Projection

In addition, we have prepared the deterministic projection using the following assumptions and methods applied in the June 30, 2018 valuation:

- Non-economic assumptions will remain unchanged.
- Retirement benefit formulas will remain unchanged.
- 1937 Act and PEPRA statutes will remain unchanged.
- UAAL amortization method will remain unchanged (i.e., 20-year layers and level percent of pay).
- Economic assumptions will remain unchanged, including the annual 7.00% investment earnings and 3.25% active payroll assumptions.
- Deferred investment gains and losses will be recognized over a 7-year period.
- Using a simplifying assumption, we assume in all scenarios tested in this report that the amount in the Contingency Reserve as of June 30, 2018 will be utilized in the June 30, 2019 valuation and that the Contingency Reserve will not be restored.
- All other actuarial assumptions used in the June 30, 2018 actuarial valuation will be realized.

Stochastic Projection

Besides the assumptions and methods discussed above for the deterministic projection, the following additional assumptions or parameters are used in projecting SCERS' investment portfolio over the next 20 years based on performing 10,000 trial outcomes of future market returns.

Target Asset Allocation Percentage

The target asset allocation is based on that provided by SCERS at the last triennial experience study and used by Segal to set the investment return assumption of 7.0% that was applied in the June 30, 2017 and 2018 valuations. That target asset allocation is as follows:

Asset Class	Target Allocation
U.S. Large Cap Equity	17.00%
U.S. Small Cap Equity	4.00%
International Developed Equity	16.00%
Emerging Markets Equity	4.00%
High Yield Bonds	1.00%
Bank Loans	1.00%
Growth Oriented Absolute Return	3.00%
Private Equity	9.00%
Private Credit/Private Debt	4.00%
Core/Core Plus Bonds	10.00%
Global Bonds	3.00%
U.S. Treasury	5.00%
Diversifying Absolute Return	7.00%
Private Real Estate	7.00%
Private Assets	7.00%
Commodities	2.00%
Total	100.00%

Simulation of Future Returns

In preparing the 10,000 trial outcomes of future market returns, we performed simulations using assumptions regarding the 20-year arithmetic returns, standard deviations and correlation matrix that were found in the 2018 survey prepared by Horizon Actuarial Services.[11] We used the assumptions that were closest to the asset classes found in SCERS' investment portfolio.

A summary of the 20-year arithmetic returns,[12,13] standard deviations and correlation matrix for each of the different asset classes used in the modeling is as follows:

	Asset Class	20-Year Arithmetic Return	Standard Deviation
1	U.S. Large Cap Equity	8.73%	16.39%
2	U.S. Small Cap Equity	10.13%	20.20%
3	International Developed Equity	9.46%	18.67%
4	Emerging Markets Equity	11.94%	24.89%
5	Core/Core Plus Bonds	4.63%	5.71%
6	Bank Loans	5.14%	10.83%
7	High Yield Bonds, Private Credit/Private Debt	6.44%	10.24%
8	Global Bonds	3.56%	6.86%
9	U.S. Treasury	3.10%	2.74%
10	Private Real Estate	7.67%	13.86%
11	Growth Oriented Abs. Return, Diversifying Abs. Return	6.61%	7.87%
12	Commodities	6.47%	17.60%
13	Private Equity, Private Real Assets	12.17%	22.16%

Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1.00												
2	0.89	1.00											
3	0.84	0.76	1.00										
4	0.72	0.67	0.79	1.00									
5	0.12	0.07	0.14	0.14	1.00								
6	0.11	0.05	0.13	0.10	0.83	1.00							
7	0.61	0.60	0.60	0.62	0.36	0.26	1.00						
8	0.17	0.11	0.30	0.24	0.55	0.55	0.24	1.00					
9	(0.10)	(0.12)	(0.09)	(0.07)	0.33	0.28	(0.03)	0.26	1.00				
10	0.44	0.41	0.40	0.33	0.10	0.11	0.30	0.09	0.03	1.00			
11	0.66	0.64	0.68	0.67	0.14	0.06	0.58	0.15	(0.07)	0.35	1.00		
12	0.31	0.29	0.39	0.43	0.10	0.03	0.35	0.22	0.02	0.24	0.42	1.00	
13	0.73	0.69	0.70	0.61	0.03	0.03	0.48	0.10	(0.08)	0.39	0.60	0.30	1.00

[11] That survey included responses from 34 investment advisors, including SCERS' investment advisor at Verus.

[12] Note that only 13 investment advisors provided long-term (e.g. 20-year) capital market assumptions in the survey.

[13] These returns are gross of inflation and before any adjustment for administrative and investment expenses. The annual inflation assumption based on the Horizon Survey was 2.48%. The annual adjustment for administrative and investment expenses was 0.65%.

Other Considerations

We emphasize that both deterministic and stochastic projections, by their nature, are not a guarantee of future results. The modeling projections are intended to serve as illustrations of future financial outcomes that are based on the information available to us at the time the modeling is undertaken and completed, and the agreed-upon assumptions and methodologies described herein. Emerging results may differ significantly if the actual experience proves to be different from these assumptions or if alternative methodologies are used. Actual experience may differ due to such variables as demographic experience, the economy, stock market performance and the regulatory environment.

Actuarial Certification

The actuarial calculations in this report were completed under the supervision of Andy Yeung, ASA, MAAA, FCA, Enrolled Actuary.

The actuarial opinions expressed in this report were prepared by Paul Angelo, FSA, MAAA, FCA, Enrolled Actuary and Andy Yeung, ASA, MAAA, FCA, Enrolled Actuary. They are members of the American Academy of Actuaries and they meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion herein.

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