CALSTRS

2018 Review of Funding Levels and Risks

Presented November 8, 2018

EXECUTIVE SUMMARY

The purpose of this report is to assist the board, stakeholders, policymakers and the public in assessing the soundness and sustainability of the CalSTRS Defined Benefit (DB) Program and to promote a better understanding of how well the funding plan is expected to achieve its goal in light of uncertainties related to investment risk, longevity risk and risk of declines in membership.

In May 2018, the Teachers' Retirement Board exercised its authority for the second year in a row to increase the state's contribution rate by the maximum allowed 0.5 percent of payroll. The employer contribution rate also increased based on the schedule laid out in the CalSTRS Funding Plan. A 9 percent investment return for fiscal year 2017–18 combined with faster than anticipated growth in membership and payroll have slightly improved funding levels and CalSTRS' capacity to withstand stress in the future.

As anticipated in the funding plan, it will be several years before the unfunded actuarial obligation (UAO) is expected to decrease. Further improvements in funding levels are expected to be minimal over the next decade while contribution rates for both employers and the state continue to increase. As a result, significant risk remains in the ability of CalSTRS to achieve full funding by 2046, especially if large drawdowns like the one experienced in the 2008–09 fiscal year were to occur once again.

Key results and findings of this report include:

- CalSTRS DB Program continues to mature, which increases the system's sensitivity to investment volatility, especially for the state contribution rate.
- A better than expected investment return in 2017–18 has improved projected funding levels and mitigated some of the expected increases to the state's contribution rates.
- The largest risk facing CalSTRS ability to reach full funding is risk from investment volatility.
- A recession resulting in both a decline in active membership and a period of lower investment returns would put significant strain on CalSTRS' ability to achieve full funding.
- Although not material and small in comparison to the overall size of CalSTRS, the trend of new charter schools not electing to participate in CalSTRS continues to increase.

When the funding plan was enacted by the California Legislature in 2014, it required CalSTRS to provide a report to the Legislature every five years regarding the progress of the plan. The first report to the Legislature is due by July 1, 2019. Although not required by statute, the report to the Legislature provides CalSTRS with an opportunity to highlight the risks faced by the system. This report will serve as a starting point for possible information that could be included in the report to the Legislature.

INTRODUCTION

This is the third annual report on CalSTRS funding levels and risk. This report is intended to assist the board in assessing the soundness and sustainability of the system. To better understand the risks associated with funding the system, this report examines a range of potential negative outcomes, both economic and demographic, that could endanger the long-term funding of the system and prevent the system from reaching full funding.

This report is based on the June 30, 2017, Annual Valuation and reflects the 9 percent investment return reported for the 2017–18 fiscal year. In this report, the focus is on:

- Measures of plan maturity and volatility.
- The path to full funding, including a discussion of significant changes in the past year, negative amortization and its impact on long term funding.
- Risks to long-term funding, including investment volatility, longevity risk and risks of membership decline.

MEASURES OF PLAN MATURITY AND VOLATILITY

Like other pension systems across the nation, CalSTRS continues to mature. As pension plans mature, they become more sensitive to risks than plans that are not mature. Understanding plan maturity and how it affects the ability of CalSTRS to tolerate risk is essential before a more in-depth analysis is performed on how investment return volatility, improvements in longevity or even a decline in active membership could impact the ability of CalSTRS to reach full funding.

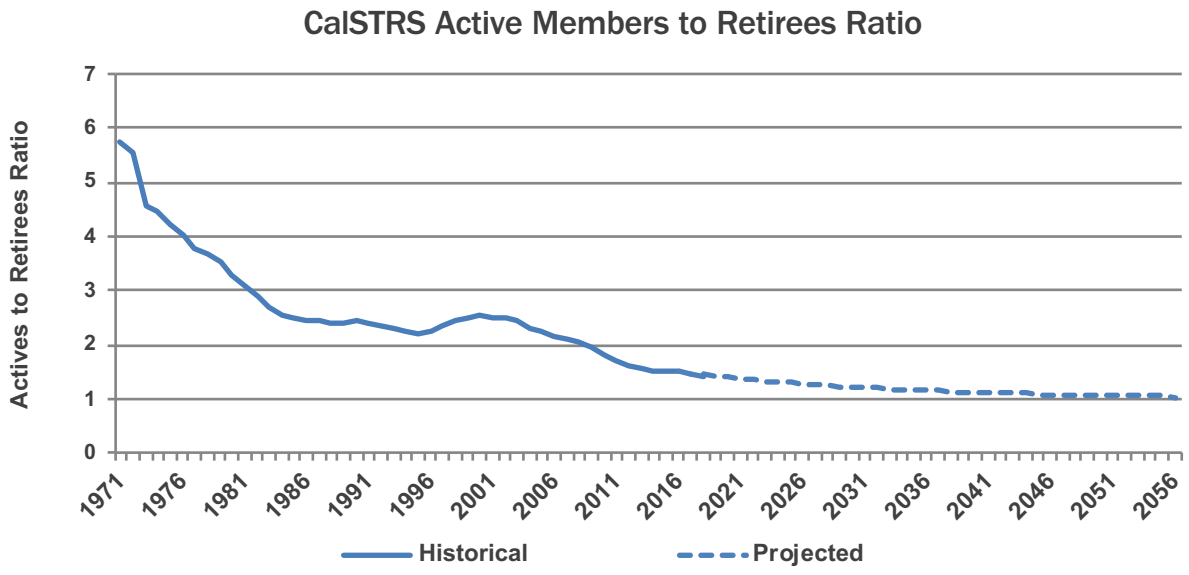
In this section, the maturity of the system is examined in the context of the number of active members to retirees, the projected cash flows, and the volatility ratios, which measure the volatility in contribution rates in response to the volatility in investment returns.

Active Members to Retiree Ratio

The aging of the population and the retirement of the baby boomers has been felt by all retirement systems across the nation. This demographic shift has long been predicted by actuaries and taken into account in the funding of the system. Even though it was anticipated, this demographic shift is impacting the system and has increased the amount of risk faced by the system, which will be demonstrated throughout this report.

There are various ways to assess the maturity level of a retirement system. One way is to look at the ratio of active members to retirees. In the early years of a retirement system, the ratio of active to retired members will be very high as the system will be mostly comprised of active members. As the system matures, the ratio starts declining. A mature system will often have a ratio near or below one. For CalSTRS and other retirement systems in the U.S., these ratios have been steadily declining in recent years.

The chart below illustrates CalSTRS historical and projected active member to retirees ratio.



As can be seen in the chart above, the ratio of active to retired members for CalSTRS was almost six back in 1971 and has steadily decreased over time. Today the ratio is about 1.5. The ratio is projected to drop to close to one over the next 40 years, but it is not expected to go below one over that time period.

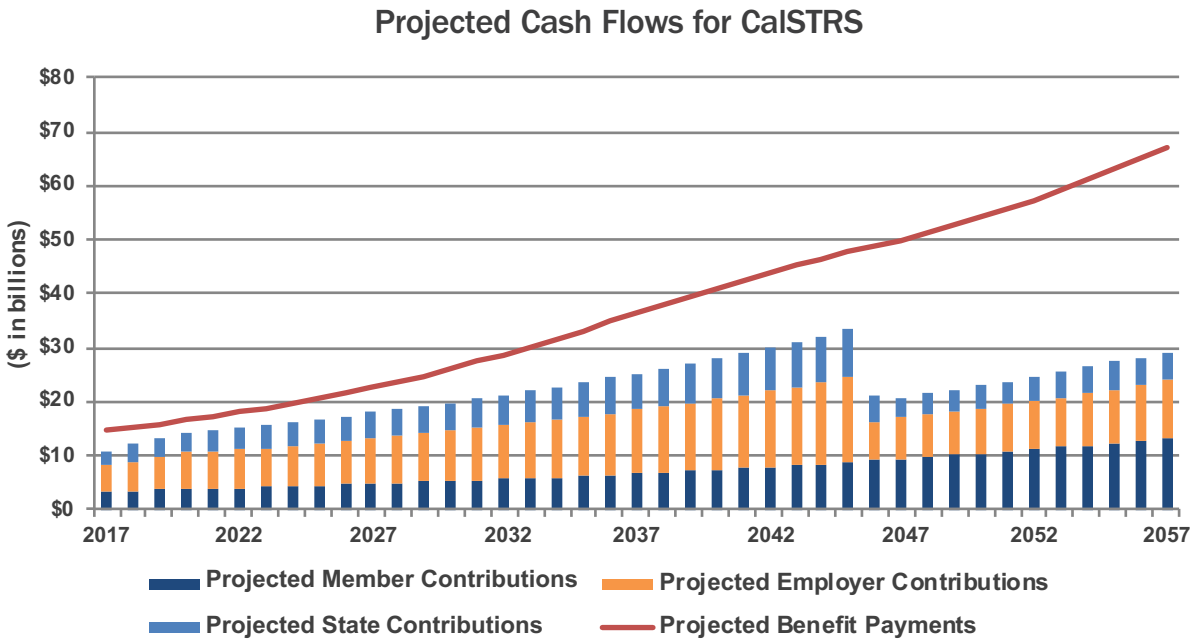
MEASURES OF PLAN MATURITY AND VOLATILITY

Note that the previous chart was prepared assuming the number of active members would remain constant in the future. A decline in the CalSTRS active population could accelerate this trend and also push the ratio below one. Similarly, if improvements in life expectancy end up being greater than the improvements currently built into the actuarial assumption, it would impact the active to retiree ratio and potentially bring the ratio closer to one over a shorter time period and even possibly below one.

Projected Cash Flows

The cash flows for a retirement system are another good indicator of the maturity level of the system. As a pension plan matures, it is normal for benefit payments to exceed contributions coming into the system. CalSTRS first experienced negative cash flows in 1999. The gap between contributions and benefits paid increased over time, peaking at about $6 billion in fiscal year 2013–14. With the passage of the funding plan and the increased contributions from members, the state and employers, the gap has narrowed the last few years. In 2017–18, the benefit payments exceeded the contributions by about $3 billion. Note that CalSTRS is expected to have negative cash flows in perpetuity. Even if negative cash flows are a natural state for any mature pension fund, they must be taken into account as part of the asset liability management process of a pension plan.

The following chart shows the projected cash flows for CalSTRS DB Program and Supplemental Benefit Maintenance Account (SBMA) combined.



As can be seen on the chart, the gap between contributions and benefit payments is expected to remain fairly stable over the next 10 years as contributions from both the state and employers continue to increase per the funding plan. Beyond 10 years, the gap will start to widen and will increase further, especially after 2046 when contribution rates for both the state and employers will revert back to pre-funding plan levels.

MEASURES OF PLAN MATURITY AND VOLATILITY

Although negative cash flows need to be taken into account as part of the asset allocation decision process, negative cash flows do not necessarily imply the system will have to sell assets to make benefit payments. Cash generated from investments has to be considered as well as the relative size of the cash flows compared to the total assets in the fund.

Today, enough cash is being generated from investment income to cover the gap. The gap between projected benefit payments and future contributions is expected to represent between 1 percent and 2 percent of the assets for the next 30 years. Cash generated by assets would have to be at least 2 percent of assets to avoid having to sell assets to pay benefits. Over the last 20 years, cash generated by investments has been between 1.8 percent and 3.7 percent of assets, with an average of 2.7 percent.

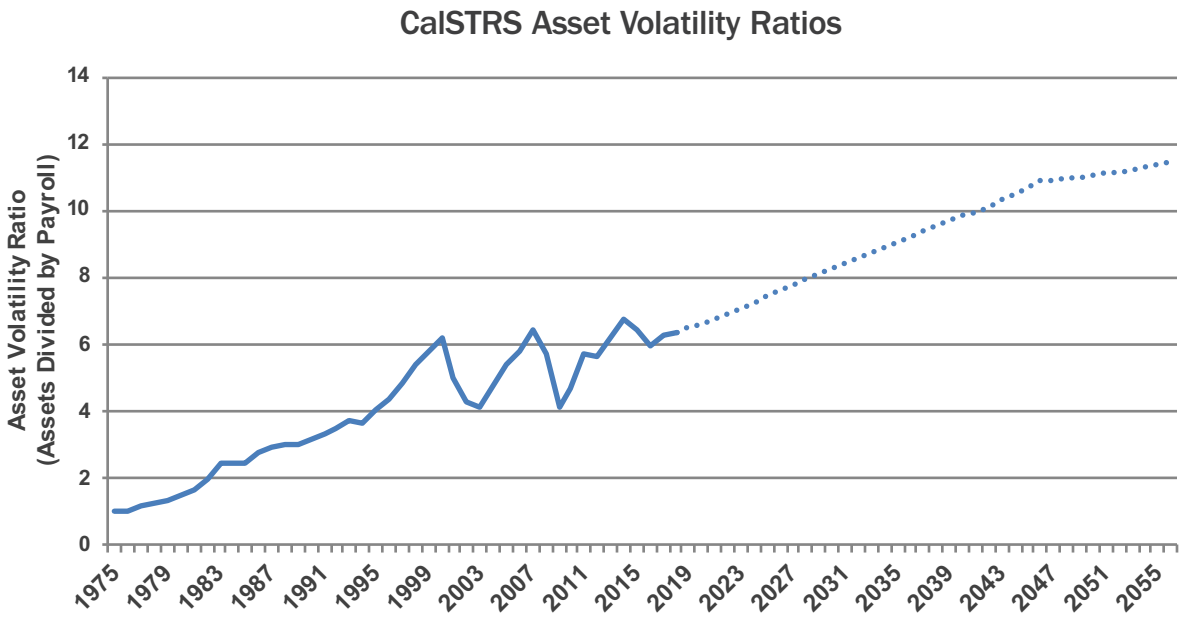
Increasing Volatility

As retirement systems become more mature, these systems are subject to increased volatility in the contributions needed to fully fund the benefits. The drop in the active to retiree ratio over the last decade has increased the contribution volatility risk for CalSTRS, and this volatility risk will continue to increase as the ratio continues to drop in the future.

One indicator of the contribution volatility is the Asset Volatility Ratio (AVR). The AVR is the ratio of the market value of assets over the total payroll for active members. Plans with a high ratio will be subject to higher contribution volatility.

The AVR for CalSTRS has increased significantly over the last 40 years. Back in 1975, the AVR was at about one and has steadily increased ever since. As of the most recent actuarial valuation, the AVR was six. This is typical for a mature System like CalSTRS. This means that the contribution volatility is currently six times higher than it was in 1975. The AVR is expected to continue to increase over time, reaching 11 over the next 40 years.

The following chart shows the historical AVR for CalSTRS along with a projection of the AVR for the next 40 years.



MEASURES OF PLAN MATURITY AND VOLATILITY

There are various reasons why the AVR is projected to increase over time. One reason is expected improvements in funding levels. Today the system is about 63 percent funded. If the system was 100 percent funded today, the AVR would be close to nine. As additional contributions flow into the system as per the funding plan, the funded ratio will improve and move toward the target of being 100 percent funded. As a result, the AVR will increase over time. In addition, the system has not yet reached its full maturity stage, and as more members retire, we expect the AVR to continue to increase slightly.

It is important to keep in mind that there is nothing to "fix" if the AVR is high. A high AVR simply indicates that there is more money invested for the plan—a good thing overall. It should, however, serve as a reminder that the more money invested, the more of an impact investment gains and losses will have on the contribution levels needed to fully fund the system.

With the expected increases in AVR over time, the funding risk of the system will be greater in 20 to 30 years than it is today, resulting in greater volatility in the level of contributions that would be needed to ensure the plan remains 100 percent funded long term.

To help demonstrate this increased contribution volatility, consider the cost to eliminate over a 30-year funding period the UAO created from a 10 percent investment loss. With an AVR of six, as CalSTRS has today, contributions would need to increase by 3 percent of payroll. In 30 years, with an AVR of 11, the same loss would require close to a 6 percent increase in the contribution rate, almost double what it would be today. Note that a 10 percent investment loss represents a return of -3 percent, or a return 10 percent less than the assumed 7 percent investment return. Over the last 20 years, the system has experienced a loss of this magnitude or worse on four occasions.

Further compounding contribution rate volatility is an aspect of the funding plan that is often overlooked. The fixed time frame for paying down the UAO by 2046 will result in a declining amortization period, increasing contribution volatility going forward. Today, the existing shortfall is amortized through 2046, over a period of 27 years. In 10 years, any remaining shortfall will be amortized over 17 years. If markets were to fall short of expectations in 20 years, the shortfall would have to be paid over a seven year period, requiring higher contributions than would normally be needed if the funding period was 30 years. As a result, the limited rate setting authority granted to the board is more likely to not be sufficient in 20 years as a result of the combined impact of the funding period shortening and maturity levels increasing.

PATH TO FULL FUNDING

One of CalSTRS main goals is to ensure a financially sound retirement system for California's educators. Progress towards this goal was made possible in 2014 with the passage of the CalSTRS Funding Plan. The funding plan set out a measured schedule of contribution rate increases for members, employers and the state with the goal of achieving full funding by 2046. Additionally, it provided the board with limited authority to adjust rates and ensure funding of the plan remains on schedule. Even with these changes, improvements in funding levels are expected to be minimal over the next decade as contribution rates from both employers and the state continue to increase. This section discusses the impact recent changes had on projected funding and contribution levels. This section also addresses the topic of negative amortization and discusses the rate-setting limitations and their impact on long-term funding.

Significant Changes in the Past Year

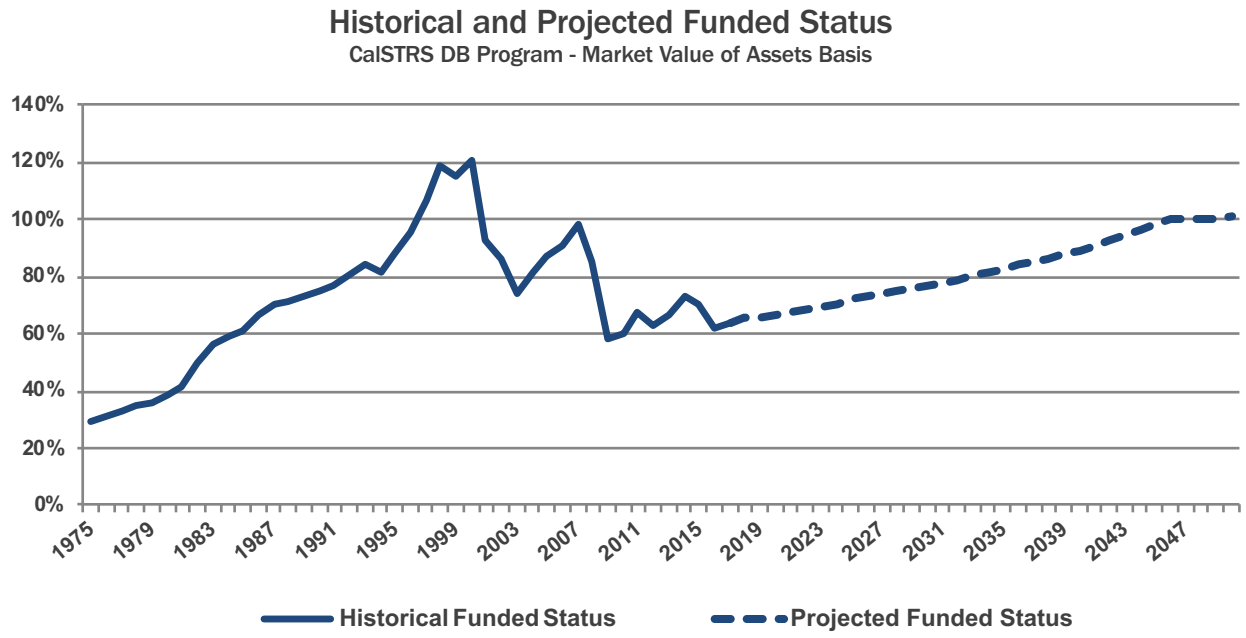
In May 2018, the board exercised its authority for the second year in a row to increase the state contribution rate by the maximum allowed 0.5 percent of payroll. Further increases are projected to occur in the coming years as discussed below. Additionally, the contribution rate for 2% at 62 members increased by 1 percent, from 9.205 percent to 10.205 percent, effective July 1, 2018. The increase was required by the Public Employees' Pension Reform Act of 2013 (PEPRA) to reflect the increase in total normal cost for those members as a result of the change in actuarial assumptions that was adopted by the board in February 2017.

Another significant change since the prior report was the 9 percent investment return reported for the 2017–18 fiscal year. This return is greater than the long-term assumed rate of return of 7 percent and will have a positive impact on projected funding levels and reduce projected increases to the state contribution rate.

Throughout this report, the funded status displayed is calculated as the ratio of the market value of assets to the actuarial obligations since the market value of assets reflect the amount of assets in the fund at any given time that are available to pay benefits. For purposes of setting contribution rates, the board has adopted a rate smoothing method involving the use of an actuarial value of assets that recognizes investment experience over a three-year period. This approach results in a funded status measured using the actuarial value of assets that differs from the funded status on a market value of assets, sometimes higher and sometimes lower, depending on past investment performance.

PATH TO FULL FUNDING

The following chart shows the historical and projected funded status for the DB Program which reflects the 9 percent return in the 2017–18 fiscal year.

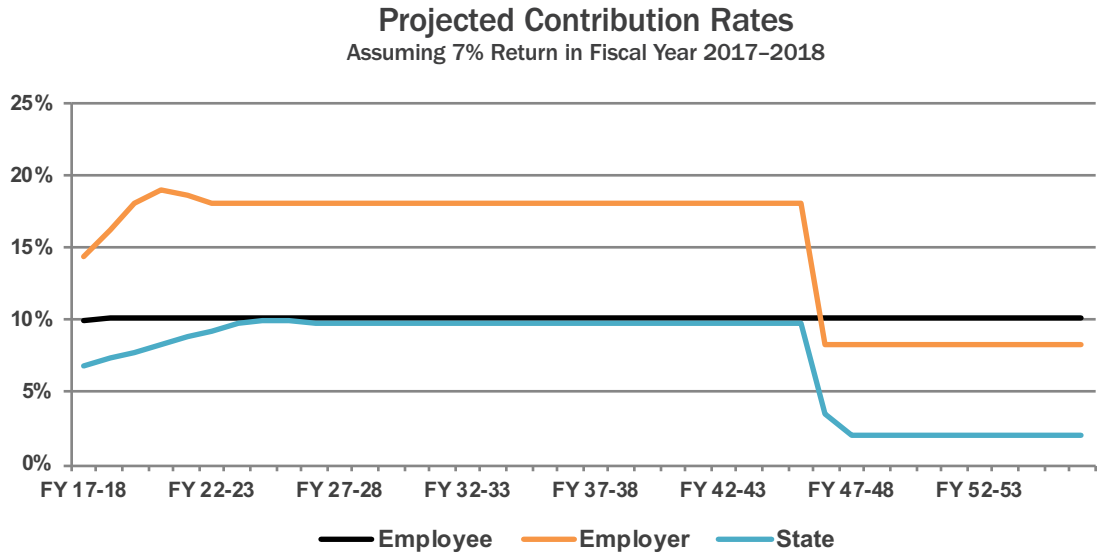


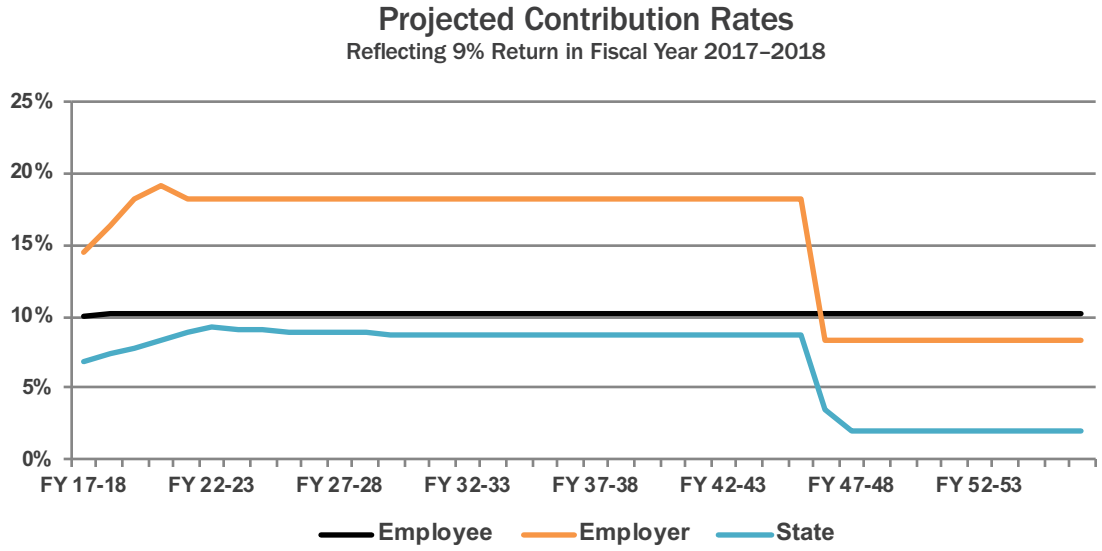
The 9 percent investment return for fiscal year 2017–18 is expected to increase the June 30, 2018 funded status by a little more than one percent, increasing from a projected rate of about 64 percent to about 65 percent. As a result, contribution rates for the state will not have to increase as much as previously estimated.

PATH TO FULL FUNDING

The following charts show projected contribution rates. The first one shows the projected contribution rates that were provided to the board in May 2018 as part of the annual actuarial valuation. The projected rates assumed the investment return for fiscal year 2017–18 would be 7 percent. The second chart shows the projected rates reflecting the 9 percent return in fiscal year 2017–18.

The state contribution rate is now projected to increase to about 9.2 percent. Last May, based on an assumed return of 7 percent for the fiscal year, the state contribution rate was expected to increase to about 9.8 percent of payroll. The reduction in projected contribution rates illustrates once again how investment volatility directly impacts contribution rate volatility, especially for the state.





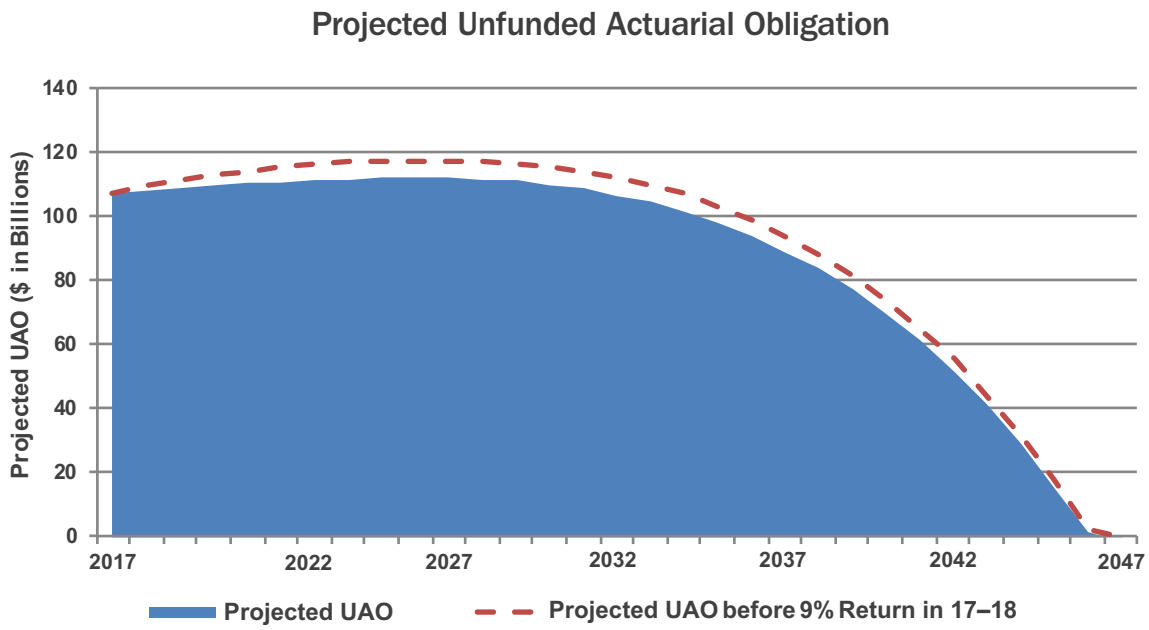
PATH TO FULL FUNDING

Note that due to rules and parameters set in statute for the CalSTRS Funding Plan, the state's nominal share of the assets actually exceed the total assets. Since the employers share of assets act as a balancing item, they effectively have negative assets. As a result, the state's contribution rate experiences far greater volatility as a result of investment volatility, and the employer's contribution rate tends to move, in most cases, in the opposite direction of the state contribution rate. This can be seen by comparing the two charts above. As a result of the 9 percent investment return, the long-term employer contribution rate is now expected to be slightly higher than previously projected, increasing from a projected rate of 18.1 percent to 18.2 percent of payroll.

Negative Amortization

Although the system is currently on a path to full funding, it is important to understand how the UAO is expected to change over time. When pension plans are less than 100 percent funded, contributions in excess of the normal cost are needed in order to pay down the UAO and to make progress toward being 100 percent funded. In order to ensure the UAO does not increase on a year to year basis, the payments toward the UAO have to be greater than the interest that will be accrued on the UAO. Failing to contribute an amount in excess of the interest will result in the UAO increasing from year to year. This is referred to as negative amortization. For CalSTRS, in order to avoid negative amortization, the payment toward the UAO has to be more than 7 percent of the UAO.

In 2018–19, the contributions toward paying down the UAO are expected to represent only 4.2 percent of the total UAO. As contribution rates for the State and employers continue to increase over the next few years, contributions will increase but they are not projected to exceed 7 percent of the total UAO until the 2026–27 fiscal year. As a result, the UAO is expected to increase until 2026 when it will start decreasing. The following chart shows the projected UAO in dollars reflecting the 9 percent investment return in fiscal year 2017–18. For comparison, the chart contains a dash line that illustrates the total UAO before the 9 percent return in 2017–18, assuming the return had been 7 percent.



As can be seen, the better than expected return in 2017–18 resulted in a decrease in the projected UAO. The UAO is now projected to increase to about $112 billion by 2026 after which it will start to decrease. Previously, it was expected to peak at about $118 billion.

Note that negative amortization is fairly common among public plans and is generally the result of the funding practice. For most public plans, contribution requirements are expressed as a percentage of the payroll. This has long been the preferred approach to provide budget stability. Because payroll is expected to increase over time, contribution amounts will increase as well. For CalSTRS, payroll is assumed to increase annually at a rate of 3.5 percent. This means that payments toward the UAO will be larger in 20 years than they are today even if the contribution rates remain the same. In a way, payments to eliminate the existing UAO are back loaded. As a result, the UAO is expected to increase in the short term before beginning to decrease after 2026. However, despite the short term increase in the UAO, the funded status is projected to improve each year as the growth in the total liabilities will be faster than the growth in the UAO, thus the UAO will represent a smaller percentage of the total liability.

Unallocated UAO

While the funding plan has helped improve the long-term sustainability of the system, there are limitations in the plan as prescribed by statute. The constraints in the rate-setting authority provided to the board, as well as other provisions in the funding plan, mean the board cannot adjust contribution rates to pay for the entire UAO in place today.

Pursuant to statute, the state is responsible for any UAO related to all service but limited to benefits that were in effect prior to July 1, 1990. The board can increase, if necessary, the state contribution rate by 0.5 percent of payroll each year to pay down their share of the UAO.

The employers are responsible for any UAO that can be attributed to the new benefit structure i.e. any benefit increases on or after July 1, 1990—but that responsibility is limited to service accrued before July 1, 2014. Effective with fiscal year 2021–22, the board will be able, if necessary, to adjust the employer contribution rate by no more than 1 percent of payroll each year, never to exceed 20.25 percent of payroll, to pay down the employer's share of the UAO.

Since the employer's share of the UAO is limited to service earned prior to July 1, 2014, the board cannot adjust contribution rates for any UAO that may develop for the new benefit structure and service accrued on or after July 1, 2014. The UAO related to post 1990 benefit increases and post July 1, 2014, service is referred as the "unallocated UAO."

Since the start of the funding plan, a small unallocated UAO has developed resulting mostly from a combination of investment experience and the new actuarial assumptions adopted by the board in February 2017. The size of the unallocated UAO is very small relative to the overall UAO since it is only for service after July 1, 2014. It was estimated to be $369 million as of June 30, 2017, and is estimated to have decreased to about $200 million as a result of the 9 percent investment return in 2017–18. Since the board cannot adjust contribution rates to pay for the unallocated UAO, it is projected to increase to about $1 billion by 2046 due to interest alone. Because of the unallocated UAO and the constraints around the board's rate-setting authority, the system is projected to be just short of 100 percent funded by 2046.

The current unallocated UAO could be eliminated in a number of ways. For example, if investment returns were to exceed the expected return, the gains would offset some or all of the unallocated UAO. We estimate that another return of 9 percent in a single year would be sufficient to completely eliminate the unallocated UAO, as long as returns remained at or above 7 percent beyond that point. Alternatively, if the board had the authority to increase contribution rates for the unallocated portion, an estimated increase in the contribution rate of about 0.03 percent of payroll would need to be collected through 2046 in order to pay down the current unallocated UAO.

The risk related to the unallocated UAO is currently small and has shrunk over the past two years with the above expected returns. Today, it only represents about 0.4 percent of the total UAO. However, future negative investment experience or changes to actuarial assumptions could quickly change this picture.

THE RISK ENVIRONMENT

This section examines several risks that could pose challenges to CalSTRS ability to reach full funding by 2046. In order to understand the extent of the risks faced, several stress tests were performed to determine to what extent each risk would need to manifest itself in order to threaten the funding of the system. It is important to note that although each risk was examined in isolation, in reality the system has the potential to face these challenges in combination, which could have a compounding effect.

The following risks are considered in this section:

- Investment Risk
- Membership and Payroll Growth Risk
- Longevity Risk

Throughout this section, an emphasis is placed on the funding levels of the system. For these analyses, the funded status used is the one based on the fair market value of assets rather than the actuarial value of assets since the market value of assets reflects the actual amount of assets available to pay benefits.

Investment Risk

Investment return volatility is the greatest risk facing CalSTRS today. As the system continues to mature over time, investment returns will have a greater impact on the funding of the system than they do today. When investment returns are below expectations, the UAO increases and additional contributions are needed to bridge the gap. With the passage of the funding plan, the board can increase contribution rates for the state and employers within the limitations established in statute in order to pay down the unfunded liability by 2046.

This section updates several of the stress tests and risk measures related to investment return volatility that were performed in the 2017 report. In general, the analysis shows slight improvements in both the capacity to withstand stress and the risk measures, which reflects the improved funded status due to the 9 percent return for fiscal year 2017–18. It is important to emphasize that long term, as the expiration of the funding plan approaches, CalSTRS capacity to withstand economic stresses will be limited despite expected increases in funding levels. This section concludes with an analysis of the risks associated with changes to our economic assumptions, specifically potential reductions to the discount rate.

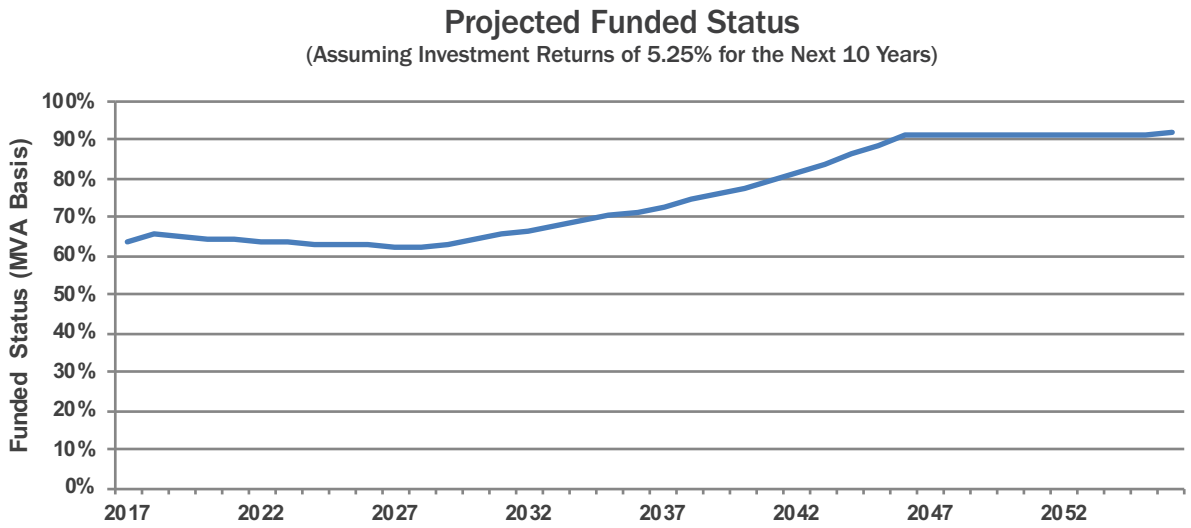
Risk of Sustained Low Returns

The first stress test determines the minimum investment return the system could sustain over the next five, 10 and 15 years and still recover and reach funding levels that are expected to remain stable by the end of the funding plan.

A sustained period of low returns could prevent the system from reaching full funding. For this report, thresholds were identified as the lowest returns that could be sustained over a short period of time to allow CalSTRS to reach funding levels that would be high enough to remain stable and not decline over time, following the end of the funding plan. It was determined that as long as the funded status reached about 90 percent by 2046, the base contribution rates set in statute would be enough to keep the funded status at stable levels beyond 2046.

Over a 10-year period, the funding plan would be able to absorb the impact of returns of 5.25 percent each year for 10 years. Assuming the board exercises its authority to increase contribution rates, funding levels would be about 90 percent in 2046 and remain stable beyond the end of the funding plan.

The following chart projects the funded status under this scenario.



The following table shows the lowest returns that could be sustained over five, 10 and 15 years with the system reaching funding levels that are expected to remain stable by the end of the funding plan. The table also shows the probability of seeing returns either equal or lower over the given period. In all three scenarios, funding levels would end up at about 90 percent in 2046 and would remain stable beyond that point, once the funding plan has ended. Anything lower and funding levels would slowly start declining following the end of the funding plan.

Table: Minimum Sustainable Investment Return over the Given Period

Period	Return	Probability
5 Years	3.75%	30%
10 Years	5.25%	32%
15 Years	5.75%	34%

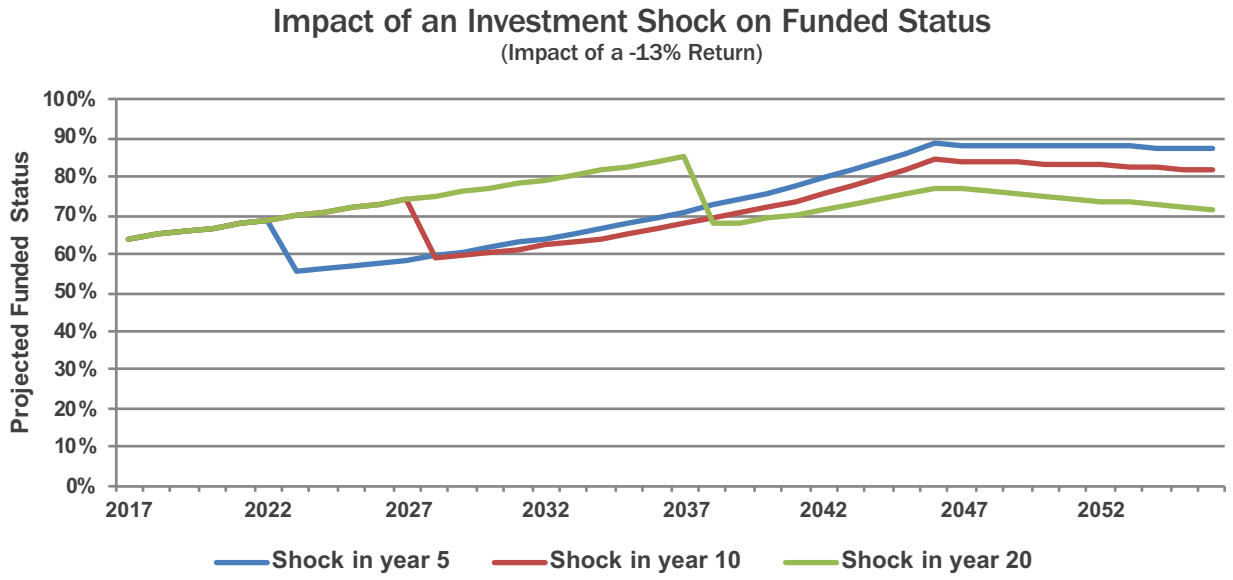
As a result of the 9 percent investment return for fiscal year 2017–18, the fund is now expected to be able to withstand lower sustained returns for each of the periods described than were reported in the 2017 report.

The state bears most of the responsibility when it comes to having to contribute more following investment performance below expectations. This is a direct result of the fact that the state is currently responsible for about 80 percent of CalSTRS overall actuarial obligation and the assets that support them. In all three scenarios, the state rate would have to increase each year by the maximum 0.5 percent of payroll allowed to a peak rate of 20.8 percent in fiscal year 2045–46. Even with these increases, funding levels would reach about 90 percent by 2046. In these three test scenarios, higher contributions or a longer funding period would be needed to achieve full funding.

Risk of a "Shock" in a Single Year

Following the financial market crash in 2008–09, the funded status of the system dropped by more than 30 percent in a single year, resulting in the need for the funding plan to avoid a future depletion in assets.

CalSTRS remains at risk if another investment return "shock" were to occur in the future. The impact of a decline will also depend greatly on the timing. As the system continues to mature, investment declines will be harder to absorb the later they occur in the duration of the funding plan. Over the next decade with funding levels expected to remain below 70 percent, a large shock could have a drastic impact on the long-term funding of the system, which brings with it additional risks, including political risk of low funding levels.



Based on the current asset allocation and capital market assumptions adopted by the board, there is a 5 percent probability that in any given year the investment return will be -13 percent or worse. The above chart shows the impact a -13 percent investment return in a single year would have on the system if it were to occur five, 10 or 20 years from now. To conduct this stress test, it was assumed that the fund would earn 7 percent in every year except for the year of the shock. Once again, the funded status was projected assuming the board exercises its authority to increase contribution rates.

The timing of the shock influences greatly the projected funded status at the end of the funding plan. For example, if the shock occurs five years from now, funding levels would drop to close to 50 percent but would have time to increase back to almost 90 percent by 2046. If the shock were to occur 20 years from now when funding levels are about 80 percent, funding levels would drop to close to 60 percent but would not have time to recover as much and would still be below 80 percent by 2046. The chart also shows that in all three cases, following the end of the funding plan, the funding levels would be expected to slightly decline each year in the future. The impact of shocks with a 1 percent and 10 percent probability were also analyzed. Based on the current asset allocation, there is a 10 percent probability that returns in a single year will be -8 percent or lower and a 1 percent probability the returns will be -25 percent (the return experienced in 2008–09). The following table shows the projected funded status in the year following the shock as well as the projected funded status in 2046.

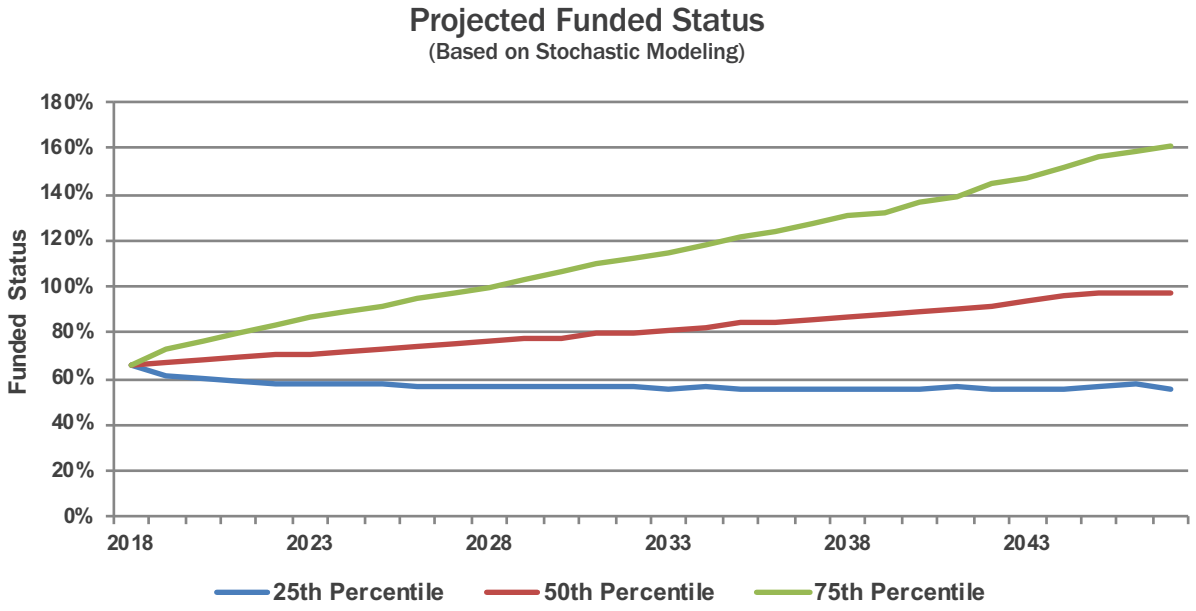
	-8 % Shock Return		-25% Shock Return	
Timing of Shock	Funded Status After Shock	Funded Status in 2046	Funded Status After Shock	Funded Status in 2046
In 5 Years	59%	91%	47%	74%
In 10 Years	63%	88%	50%	66%
In 20 Years	72%	84%	56%	62%

Once again, the above projections assumed financial markets would provide a return of 7 percent in all other years. It is also worth highlighting that if funding levels are at or below 70 percent in 2046, the system would once again be projected to run out of assets over the following 30 to 40 years. To avoid this situation, the resulting unfunded liability would need to be addressed, through higher contributions or through a longer funding period.

Impact of Long-Term Investment Performance

The analyses above focused on deterministic scenarios in which the expected return of 7 percent was met in most years. In reality, it is unlikely that the system will have a return of exactly 7 percent in any year due to year-to-year volatility. A stochastic model was used to assess the impact of long term investment performance on the funding levels. Five thousand sets of Monte Carlo simulations were performed based on the most recent asset allocation adopted by the board in November 2015 and further adjusted to reflect the change to the inflation assumptions adopted in 2017. For each simulation, the assets and liabilities for the System were projected for the next 30 years.

The following chart shows the 25th, 50th and 75th percentile of the projected funded status for the DB Program. Note that the compounded investment return over the 30-year period was just under 5.5 percent for the 25th percentile and just above 8.5 percent for the 75 percent percentile.



The goal of these stochastic simulations is to provide a realistic estimate of the range of possible future outcomes. In this report, the starting point of the fund has improved slightly from what was expected in the previous report due to the 9 percent investment return in 2017–18. As such the projected funded status has improved slightly from the previous report, reaching almost 100 percent by 2046 under the 50th percentile.

Furthermore, the range between the 75th and 25th percentiles is quite large. Ideally, this range would be tightly bound around a scenario reaching 100 percent by 2046. The size of this range is heavily influenced by both the structure of the funding plan, in particular how quickly contribution can be increased to make up for shortfalls, as well as the volatility of the simulated investment return scenarios. In 2019, the board will have the opportunity to review the underlying economic and market assumptions as part of the upcoming review of the asset allocation and review of actuarial assumptions.

THE RISK ENVIRONMENT

Risk Measures

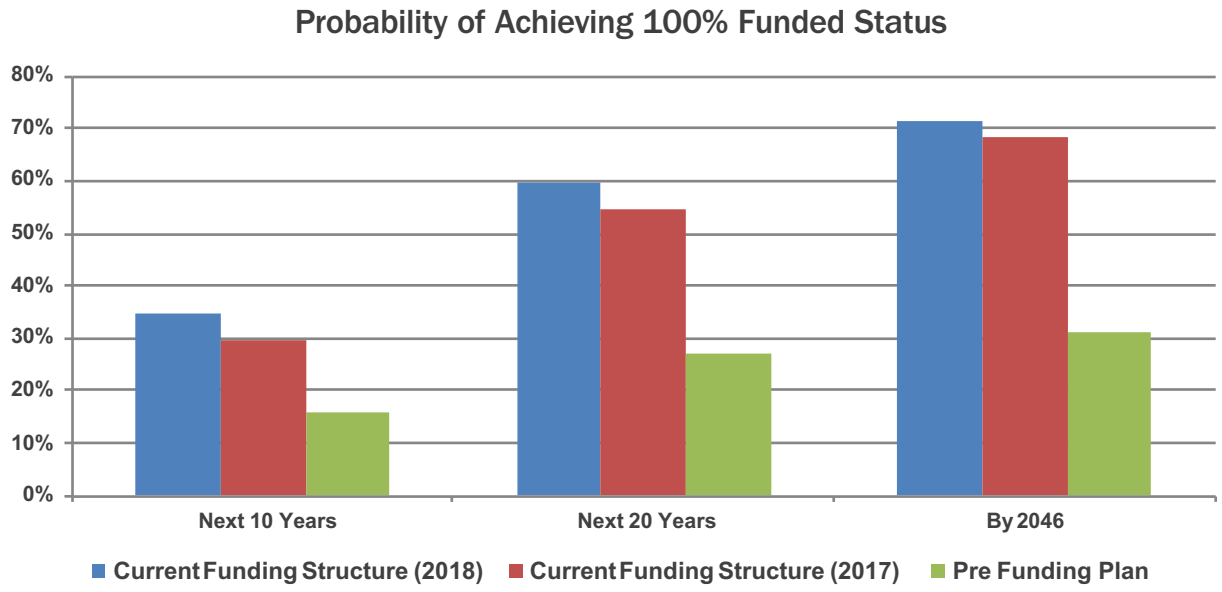
The previous funding levels and risk reports introduced a series of risk measures that focus on risks related to funding levels and contribution levels. Once again, the funded status used for risk measures is the one based on the fair market value of assets rather than the actuarial value of assets since the market value of assets reflects the actual amount of assets available to pay benefits.

Using the same 5,000 Monte Carlo simulations described earlier, several probability-based risk measures were developed to illustrate the various areas of risk.

Probability of Achieving Full Funding

The first risk measure studied in this report is the probability of achieving a 100 percent funded status over the next 10 or 20 years or anytime on or before 2046, the target set in the funding plan. As a result of the volatility inherent in CalSTRS asset allocation, there is a chance that the system may achieve full funding before 2046 if CalSTRS earns better than expected investment returns. Similarly, reaching 100 percent funded by or before 2046 cannot be guaranteed mostly due to the possibility of having long-term investment performance below the assumed 7 percent.

The impact of investment volatility on the ability for the system to achieve full funding is illustrated in the following chart. For comparison, the chart also shows the probabilities of achieving full funding from the 2017 report as well as assuming that the contribution rates were set at the pre-funding plan levels. As the chart illustrates, the system has experienced small improvements in this risk measure over the last year due primarily to the recent investment experience.



Although achieving 100 percent funding long term is our funding goal, we want to ensure we make progress toward being fully funded. With the board's ability to adjust contribution rates under the funding plan, we expect the system to make progress toward full funding, even if investment returns are below expectations. In fact, the system has almost an 80 percent chance of reaching a 90 percent funded status between now and 2046 and over an 85 percent chance of reaching 80 percent funded.

THE RISK ENVIRONMENT

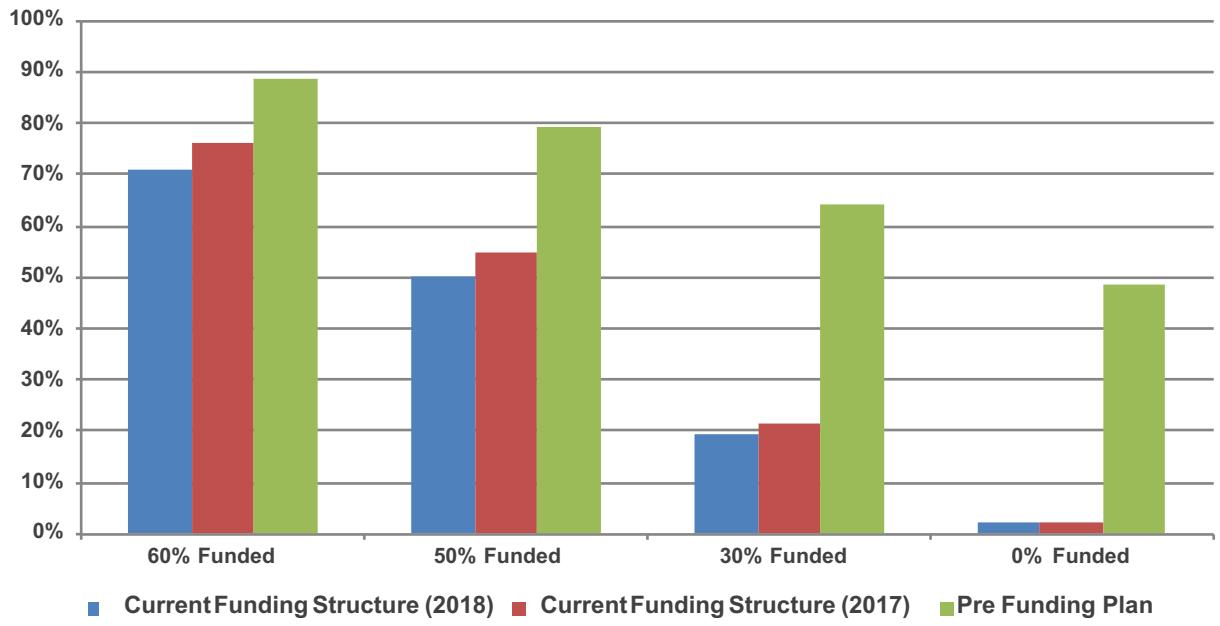
The funding plan has greatly reduced the funding risk facing the system with probabilities of reaching higher funding levels having more than doubled with the passage of the funding plan. Although the probabilities have improved greatly, the probabilities are less than 100 percent. It is important to realize these probabilities are not expected to ever reach 100 percent as a result of the investment volatility inherent in an asset allocation with an expected return of 7 percent and the board's limited rate setting ability.

Probability of Low Funding Levels

The second risk measure being studied is the probability of the system reaching low funding levels or even running out of money. The risk has been reduced considerably over the last few years with the adoption of the funding plan. However, that risk has not been completely eliminated and may never be fully eliminated as a result of the maturity level of the system, investment volatility and the board's limited rate setting ability.

The following chart shows the probability of the system reaching lower funding levels over the next 30 years.

Probability of Funded Status Dropping Below Various Levels Over the Next 30 Years



The bars on the right hand side of the chart show the probability of the system running out of money. Three years ago this was an almost inevitable scenario. Today, that probability is very low. Of the 5,000 simulations that were performed, the system ran out of assets in only 2 percent of these simulations. Prior to the funding plan, the probability of running of assets was about 50 percent.

Although improved slightly from the prior year, the probability of falling below 60 percent or even 50 percent funded is still quite large. This is driven mostly by the current funding level of the system and the fact short-term contributions toward the UAO are not expected to be sufficient to cover the interest on the UAO as was discussed earlier in the report. In May, the board was informed that the funded status on a market value basis was 64 percent as of June 30, 2017, and although the 9 percent investment return in fiscal year 2017–18 has increased our projected June 30, 2018, funded status, it is still expected to only be about 65.5 percent. It would take only one or two years of lower than expected returns in the near term to push the funded status below 60 percent or even below 50 percent.

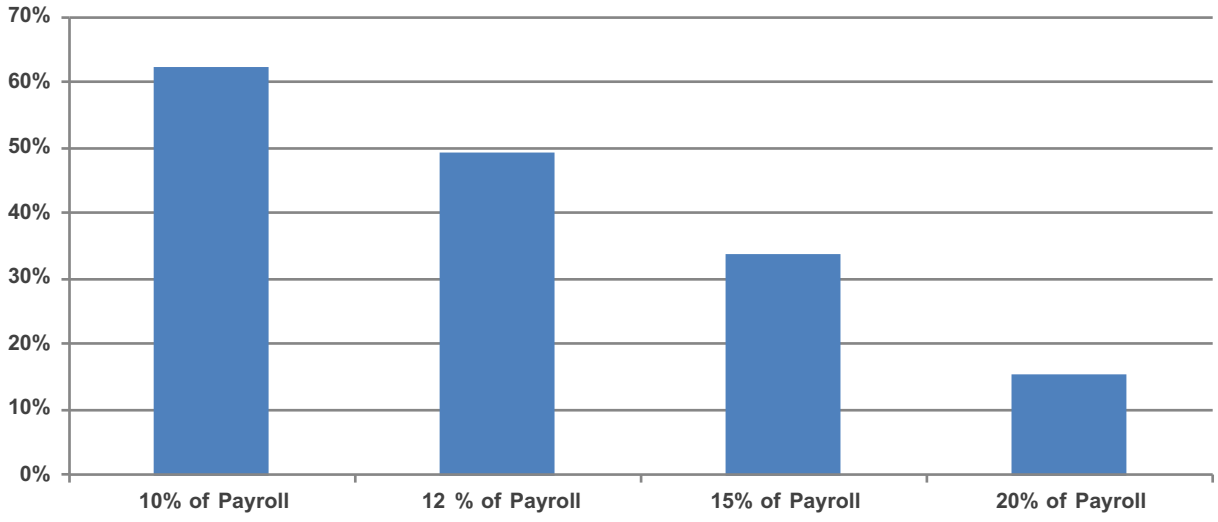
Probability of High Contribution Rates

The last risk measure relates to the probability of seeing high contribution rates for the state. Because of the 20.25 percent cap on the employer contribution rate, only the state contribution rate is being analyzed in this section.

The state contribution rate can increase each year by no more than 0.5 percent of payroll with no limit on the actual rate. In May 2018, the board again exercised its authority to increase the state's supplemental rate by 0.5 percent to 5.811 percent of payroll for the 2018–19 fiscal year. In addition, the state pays a fixed base rate of 2.017 percent of payroll to fund DB benefits and 2.5 percent of payroll to fund the SBMA. The state currently pays 7.328 percent of payroll to fund DB benefits in fiscal year 2018–19. For each fiscal year between 2019–20 and 2045–46, the board will have the ability to adjust that rate by up to 0.5 percent each year if needed to eliminate the state's share of the UAO. As a result, the highest rate the state could be required to pay is a rate of 20.828 percent of payroll in fiscal year 2045–46. Note that the state supplemental contribution rate will never be less than 4.311 percent of payroll as long as there is a UAO related to benefits that were in effect prior to 1990.

The following chart provides probabilities for the state contribution rate to reach certain levels as a percentage of payroll over the next 30 years. For context, the state's contribution rate is currently projected to reach 9.2 percent of payroll by fiscal year 2022–23 and remain approximately level thereafter.

Probability of State Contribution Rate to Exceed Certain Rate Thresholds Over the Next 30 Years



Once again, the contribution rates in the above chart include the fixed base rate of 2.017 percent of payroll the state currently pays to fund the DB Program but exclude the 2.5 percent of payroll contribution rate the state pays each year to fund the SBMA.

Review of the Asset Allocation and Actuarial Assumptions

Every four years, the board conducts an extensive review of the asset allocation of CalSTRS fund as well as the capital market assumptions used to determine the appropriate balance of risk and return for the portfolio. The last asset allocation study occurred in 2015, and the next review is scheduled to occur in 2019.

As the board contemplates the appropriate asset allocation, it is important to keep in mind the impact such a decision could have on the funding of the system. Changes in economic forecasts reflected in the capital market assumption could result in the need for a change to the long-term expected return on assets, also known as the discount rate. Alternatively, the board may decide it is prudent to reduce its appetite for investment risk, either through changing the asset allocation or by adopting a margin in the discount rate, which would result in a lower return assumption.

There is a risk that if it was deemed necessary to lower the discount rate assumption, that the limitations placed on rate setting could prevent contribution rates from being set to the levels necessary to ensure full funding. With this in mind, it is instructive to look at how sensitive the system and its funding plan are to changes to the discount rate.

It is estimated that each 0.25 percent reduction in the discount rate would increase the UAO by about $10 billion. The funded status would also initially decrease by about 2 percent for each 0.25 percent reduction in the discount rate.

If the discount rate were reduced to 6.75 percent, both the state and employers' share of the UAO could still be eliminated by 2046 as prescribed by the funding plan. However, the unallocated UAO associated with service performed after July 1, 2014, would increase initially upon lowering the discount rate and would continue to increase through 2046 since CalSTRS does not have the ability to increase contribution rates to eliminate the unallocated UAO. As a result, under a 6.75 percent discount rate, CalSTRS would fall slightly short of reaching full funding by 2046.

Under a 6.5 percent discount rate assumption, the state would not be able eliminate its share by 2046 while the employers would still be able to eliminate theirs. Once again, the unallocated UAO would increase initially upon lowering the discount rate and would continue to increase through 2046. Under a 6.5 percent discount rate assumption, the CalSTRS DB Program would never reach full funding and would be expected to reach a funding level of about 97 percent by 2046.

Although both the state and employers would see a higher peak rate if the discount rate is lowered, the state contribution rate would be the most impacted by a change in discount rate. Under a 6.75 percent assumption, the state contribution rate would peak about 3.5 percent higher than currently projected at 12.5 percent of payroll. Under a 6.5 percent assumption, the state contribution rate would have to increase each year by the maximum 0.5 percent allowed until reaching 20.8 percent in 2045–46.

Lowering the investment return assumption would also impact member contribution rates. Under PEPRA, members subject to the 2% at 62 benefit formula are required to pay half of the normal cost. Changes in their contribution rate are triggered when the normal cost changes by more than 1 percent since the last time the contribution rate was set. CalSTRS 2% at 62 members currently contribute 10.205 percent of their salary. It is estimated that for each decrease of 0.25 percent in the discount, the 2% at 62 member contribution rate will have to increase by 0.5 percent.

The following table summarizes the impact of lowering the discount rate on projected funding levels, peak contribution rates and the 2% at age 62 member contribution rate.

Discount Rate	Projected 2046 Funded Status	Peak Employer Contribution Rate	Peak State Contribution Rate	2% at 62 Member Rate
7.00%	99.8%	19.1%	9.2%	10.205%
6.75%	99.7%	20.1%	12.5%	10.705%
6.50%	97.0%	20.25%	20.8%	11.205%

Over the next year, as the board reviews the asset allocation, asset allocations being considered by the board will be analyzed and compared using the various risk measures discussed in this report. Using these risk measures will allow the board to better understand how each asset allocation would be expected to impact CalSTRS ability to reach full funding while minimizing the risks of low funding levels.

Membership and Payroll Growth Risk

One of the key actuarial assumptions in the funding of the system is the assumed growth in payroll. The current payroll growth assumption adopted by the board is 3.5 percent annually. Implicit in this assumption is that the number of active members in the system will remain stable over time. The funding of the system could be impacted if there was a sudden material shift in CalSTRS active membership. Note that even if the number of active working teachers remains stable over time, CalSTRS total membership is expected to continue to grow. In fact, as the ratio of active members to retirees continues to drop, CalSTRS total membership is expected to increase by at least 150,000 members over the next 30 years.

When the payroll of CalSTRS active members declines, it requires increases in contribution rates to ensure full funding, even if the UAO has remained the same. The overall cost to fund retirement benefits is not increasing and the contributions required to eliminate the UAO are still the same in dollar terms. However, since contributions are collected as a percentage of payroll, the contribution rates have to increase to collect the same dollar amount. There is a risk that the rate setting limitations combined with declines in payroll could prevent the board from being able to set contribution rates to the levels necessary to ensure full funding.

Similarly, faster than expected growth in active membership and payroll could help the long-term funding of the system resulting in lower contribution rates to collect the same amount of contributions.

A decline in CalSTRS active membership could occur for a number of reasons. If the state experiences severe and prolonged fiscal troubles, staffing levels might be reduced as occurred between 2009 and 2013. Alternatively, the state might experience a decline in the student population, reducing the necessity for as many teachers. Based on the most recent student projection prepared by the California Department of Finance, the overall student population of California is expected to slowly decline by a minimal amount for the next 10 years. At this time, this projected decline is not expected to have a material impact on long-term payroll projections.

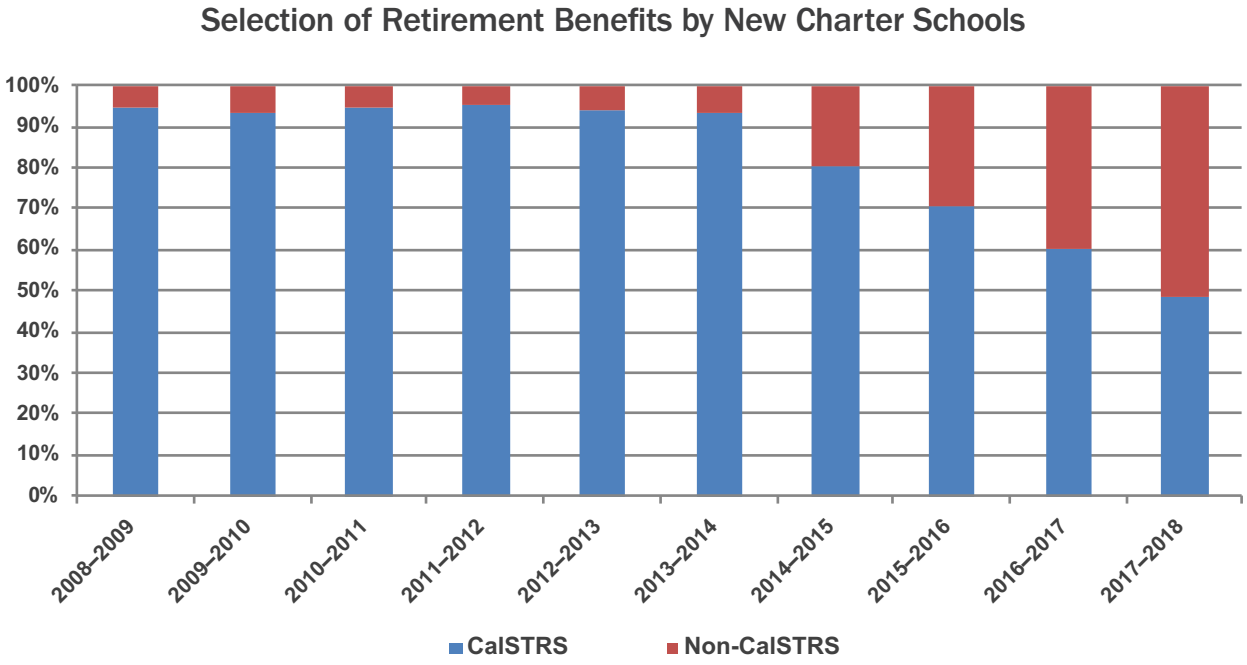
Another possibility is a shift in technology and the way education is delivered in California. For example, increased offering of online courses could potentially decrease the need for teachers in the classroom, especially at the community college level.

In addition, a continued growth in the number of charter schools in California could also impact future membership levels since charter schools have a choice whether or not to participate in the CalSTRS DB Program at the time of their creation.

Of the above risks, a future recession causing a decline in membership combined with lower investment returns could have the most impact on the ability of CalSTRS to reach full funding. Although charter schools still represent a small portion of all schools in California and do not yet pose an issue, the recent growing trend in charter schools not electing CalSTRS could eventually pose an issue. These two risks are discussed in further detail below.

Recent Growth in Charter Schools Not Electing CalSTRS

When a charter school is created, it must decide, as part of the chartering process, whether or not to provide CalSTRS benefits to its employees. In recent years, the percentage of newly created charter schools not electing CalSTRS has been increasing. The following chart shows the percentage of charter schools that elected to participate and not participate in CalSTRS for the last 10 years.



As the chart illustrates, 10 years ago, about 95 percent of new charter schools elected to participate in CalSTRS. The percentage remained above 90 percent up until the time of the adoption of the funding plan in 2014. In 2014–15, the first year following the adoption of the funding plan, about 80 percent of new charter schools elected CalSTRS. The percentage has continued to drop each year since, and for the first time ever, in 2017–18, more than 50 percent of new charter schools have elected not to participate in CalSTRS.

Although the percentage of new charter schools electing CalSTRS has been trending down, most charter schools in operation today participate in CalSTRS. In June 2018, there were 1,239 charter schools in operation in California. Of these, 1,070, or about 86 percent, had elected CalSTRS while 169 charter schools, or about 14 percent, had not elected CalSTRS. For 2017–18, charter school employees were estimated to number about 34,000. Of these, about 30,000 currently participate in CalSTRS while about 4,000 do not participate in CalSTRS. Overall, teachers and administrators working for charter schools not covered by CalSTRS represent about 1 percent of CalSTRS active membership.

If all these charter schools had instead elected to provide CalSTRS benefits to their employees, the payroll for CalSTRS active members would probably be 1 percent higher today. If the total payroll was 1 percent higher, contribution rates required for both the state and the employers to fully fund their share of the UAO by 2046 would be projected to be lower. For employers, the

contribution rate would be lower by about 0.17 percent of payroll starting in fiscal year 2021–22. For the state, the contribution rate would be lower by about 0.08 percent of payroll. Note that for the state, the amount needed to eliminate their share of the existing UAO would not be impacted and the dollar impact on the overall state's budget would be unchanged.

CalSTRS will continue to monitor this risk and will provide updates on the charter school population annually as part of this report.

Risk of a Recession and Decline in Active Membership

Historically, staffing levels in schools have been reduced during periods of severe and prolonged fiscal troubles. Following the 2008–09 global financial crisis, the number of active CalSTRS members decreased by about 45,000 over a five year span. If a similar decline were to occur once again following a recession, contribution rates would have to increase for both employers and the state simply to be able to keep collecting the same amount of contribution to eliminate the UAO. Depending on how quickly a reduction in staffing occurred and how large it would be, the rate setting authority granted to the board may be insufficient to reach full funding. In addition, increases in the supplemental rate during a time when employers and the state are attempting to cut costs could lead to a further decrease in staff.

The following table shows how various decreases in active membership over time would impact the ability for CalSTRS to reach full funding by 2046. For the purposes of these projections, the number of active members was assumed to remain stable following the initial decline.

Scenario (Projection of Active Membership)	**Decrease in Membership**	**2046 Funded Status**
No reduction in active population	0	99%
2% reduction per year for 5 years	45,000	99%
4% reduction per year for 5 years	82,000	95%
5% reduction per year for 5 years	101,000	92%
2% reduction per year for 10 years	85,000	97%
3% reduction per year for 10 years	117,000	91%

In each of the above scenarios, the limitations imposed by statute would prevent the board from increasing the employer contribution rate to the levels necessary to pay down the employers' share of the unfunded liability by 2046. The same issue does not exist for the state contribution rate since it does not have an upper bound and the board would have sufficient authority in each of the scenarios to raise the state contribution rate to levels high enough to eliminate the state's share of the unfunded liability by 2046, despite the decreases in payroll.

It is important to emphasize that if the CalSTRS active membership were to significantly decline, it would not increase the UAO. It would simply reduce CalSTRS ability to fund that obligation. If the system were to experience a significant decrease in membership, the unfunded liability would need to be addressed, through higher contributions than currently prescribed or through a longer funding period.

Note that the above table reflects only the anticipated impact of a decline in active membership. During recessions, investment returns are often lower than in periods of economic growth. Having lower investment performance combined with a decline in active membership would compound the impact of these events, making it even harder for CalSTRS to reach full funding, unless an economic recovery occurred shortly thereafter, returning membership and payroll levels to be in line with what they are today.

To show the impact of experiencing both a decline in membership and lower investment returns, the following table displays the same decrease in active membership scenarios as the previous table, but this table shows these same scenarios combined with lower investment returns. Investment returns averaging 3.5 percent over five years and 5 percent over 10 years were selected for this analysis.

Scenario (Projection of Active Membership)	**Decrease in Membership**	**Average Investment Return Over the Time period**	**2046 Funded Status**
No reduction in active population	0	7% for all years	99%
2% reduction per year for 5 years	45,000	3.5% for next 5 years, followed by 7%	89%
4% reduction per year for 5 years	82,000	3.5% for next 5 years, followed by 7%	80%
5% reduction per year for 5 years	101,000	3.5% for next 5 years, followed by 7%	74%
2% reduction per year for 10 years	85,000	5.0% for next 10 years, followed by 7%	80%
3% reduction per year for 10 years	117,000	5.0% for next 10 years, followed by 7%	70%

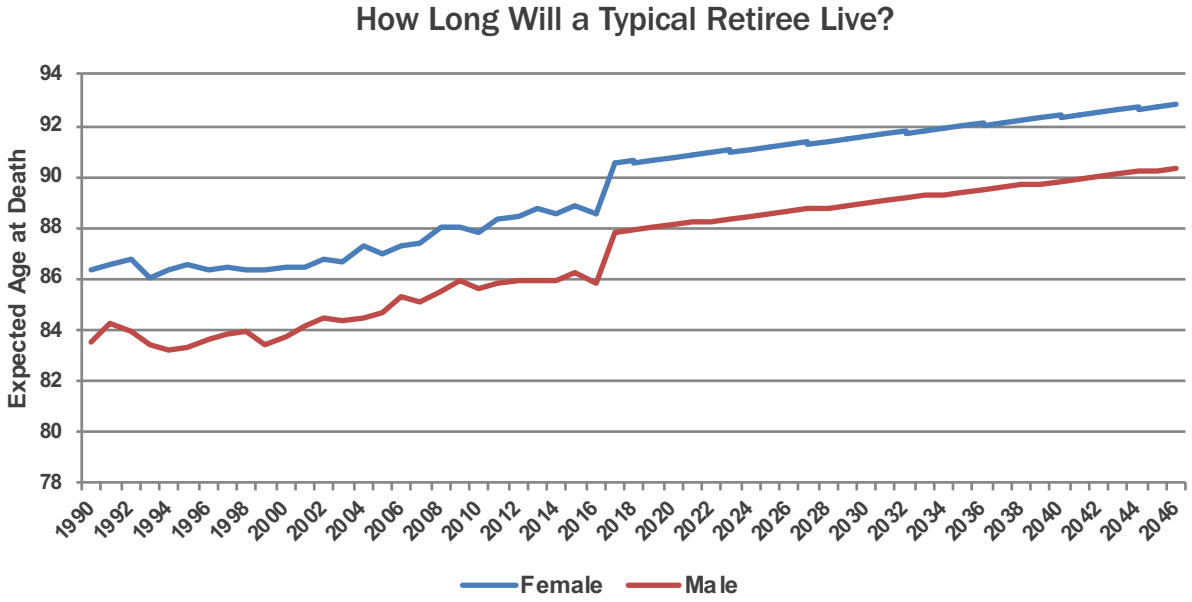
As demonstrated, any sustained period of decreases in membership along with lower investment returns would greatly impact CalSTRS' ability to reach full funding. If such a scenario were to occur, only a strong economic recovery or additional contributions would allow CalSTRS to reach full funding by 2046.

Longevity Risk

Longevity risk refers to the risk borne by the system from increasing life expectancy of its members. Compared to investment risk, in which a shock in a single year can have a significant and lasting impact, longevity risk is a slowly developing demographic phenomenon that will potentially take decades before it is recognized. Longevity improvements historically have occurred with incremental improvements in public health and advancement in medical technology, and these changes take time to impact whole populations.

Despite the slow nature of longevity risk, it is important that it is not ignored. In February 2017, the board took an important step by adopting assumptions that recognize that teachers' life expectancies have been increasing over time and will most likely continue to do so in the future. CalSTRS adopted the use of generational mortality using a mortality improvement factor of 1.1 percent in each year for most ages.

With the adoption of generational mortality, CalSTRS is anticipating future improvements in life expectancy in the funding of the system. This assumption has strengthened the ability of CalSTRS to reach full funding by 2046 by recognizing ahead of time potential improvements in life expectancy. The chart below shows the historical life expectancy for a CalSTRS member retiring at age 62 as well as the projected future life expectancy based on the assumptions adopted by the board in February 2017.



When considering that CalSTRS paid close to $15 billion in benefits in fiscal year 2017–18, one can see how improvements in life expectancy have a direct impact on long term cost. As shown above, a member retiring at age 62 today is expected to collect benefits for four to five years longer than someone who retired at age 62 in 1990. In terms of benefits paid by CalSTRS today, this is equivalent to an additional $60 billion to $75 billion in benefits. A member retiring at age 62 in 2046 is projected to live two to three years longer than someone retiring at age 62 today.

THE RISK ENVIRONMENT

Monitoring life expectancy of CalSTRS members is extremely important for the long-term sustainability of the system, and CalSTRS monitors any changes on an annual basis. In addition, CalSTRS performs a full review of all actuarial assumptions every four years through the experience study.

In recent years, CalSTRS has experienced a slowdown in mortality improvement, particularly among its male members. Life expectancy is still improving but not as fast as assumed. It is important not to read too much into short term trends. Over the past 30 years, periods in which mortality improvements slowed down were often followed by periods of faster improvements. Over the last 30 years, the average mortality improvement for CalSTRS members has been over 1.5 percent per year. Over the last century, mortality rates have improved on average at a rate of about 1 percent per year for the U.S. population, consistent with the assumption of 1.1 percent adopted by the board.

If mortality rates improve faster than assumed, costs will increase over time, and the improvements may also impact CalSTRS ability to reach full funding by 2046. Currently, it is estimated that the funding plan has enough flexibility to sustain mortality improvements of up to 2 percent per year on average. However, there would be very little room left in the funding plan if financial markets failed to deliver investment returns in line with the assumed return of 7 percent.

In the past year, CalSTRS has developed a stochastic mortality model in an attempt to understand how likely it is that mortality rates will improve above the current assumptions given the historical data. Initial results from this model suggest that CalSTRS would have less than a 5 percent chance that mortality rates would improve by more than 2 percent per year, each year into the future.

Although it appears that the likelihood of not being able to reach full funding is low when looking at longevity risk alone, a combination of faster than expected increases in longevity combined with a sustained period of decline in membership and low investment returns could have an undesirable impact on the long-term funding of the system. CalSTRS will continue to monitor mortality improvements annually and report back its finding as part of this report.

REVIEW OF THE CALSTRS FUNDING PLAN

When the funding plan was adopted by the Legislature in 2014, it contained a provision requiring CalSTRS to provide a report to the Legislature every five years on the progress of the plan. The first report to the Legislature is due July 1, 2019.

Over the last few years, CalSTRS has monitored the funding plan and provided annual updates on its progress through the annual review of funding levels and risk report. The funding plan, as currently implemented, is working and the DB Program is on the path to full funding by 2046. The risk of low funded status or even running out of money has been reduced considerably with the adoption of the funding plan.

Since the passage of the funding plan, the board has taken steps to further strengthen the funding of the system. In 2015, the board recognized the importance to mitigate against equity market downturns by creating and investing in a Risk Mitigating Strategies asset class. In 2017, the board adopted new actuarial assumptions. The board will have the opportunity to once again review both the asset allocation and the actuarial assumptions in 2019–20.

Financial markets have also provided better than assumed returns, positively impacting projected funding levels and contribution rates and putting the system in a stronger financial position long term. The strong economy that has persisted since the funding plan was adopted has also contributed to a faster growth in CalSTRS membership and payroll than was initially projected, contributing in part to the fact the employer rate is now expected to be lower than originally anticipated.

However, as illustrated in this report, several risks could still impact the long-term funding of the system and the contribution rates needed to achieve full funding by 2046.

The report to the Legislature provides CalSTRS with an opportunity to make sure the rules set in the funding plan are understood, including how they impact annual contribution rate changes. It also provides the opportunity to highlight the risks that could impact CalSTRS' ability to reach full funding.

CONCLUSION

This report discusses a variety of risks associated with the funding of the system. Even if the Defined Benefit Program is on a path to reach full funding, significant risks remain that could prevent the system from reaching full funding by 2046. Although the risks related to longevity and decline in membership are real and important, the fact remains that the largest risk facing CalSTRS is risk from investment volatility. This risk will continue to increase over time simply due to the natural maturing of the system.

CalSTRS has several ways to manage and monitor these risks.

CalSTRS continually monitors these risks and reports to the board twice a year on the funding progress of the system: once in the spring through the annual actuarial valuation process and again in the fall through this report. Monitoring these risks is important to identify trends that could impact the long term funding of the system early and to ensure they are understood by the board and CalSTRS stakeholders.

In 2017–18, CalSTRS created an internal Asset Liability Management (ALM) team and implemented an ALM Framework that integrates assets and liabilities in order to manage and assess funding risk. The ALM Framework was established as a tool to help guide future board decisions related to investment strategy, cash management and actuarial policies.

In 2019, the board will take on the very important task of reviewing the asset allocation to decide the most appropriate way to invest the assets to best fulfill the CalSTRS mission. Also in 2019, CalSTRS will begin working on an experience study to review the appropriateness of the actuarial assumptions used in the funding of the system. Board decisions related to the asset allocation and actuarial assumptions are expected to occur in the fall of 2019 and winter of 2020.

Finally, with the first ever report on the progress of the funding plan due to the Legislature no later than July 1, 2019, it will be important to continue our education and outreach to ensure the risks CalSTRS faces and ways to further strengthen CalSTRS' ability to reach full funding are fully understood.