Introduction
CalPERS, CalSTRS, and UCRS together administer the pensions of approximately 2.6 million Californians. Between June 2008 and June 2009, these three public pension funds lost a combined $109.7 billion in portfolio value (see Table 1). The ability of these three funds to meet their future obligations has significant implications for the fiscal health of the state and public employers, the effective underwriters of many public pensions.

In this policy brief, we ask two questions: (1) what is the current funding shortfall of CalPERS, CalSTRS, and UCRS, and (2) what policies would prevent a similar shortfall in the future?

The data presented in this report are all from publicly available sources, primarily the quarterly and annually published financial reports of each fund. In addition, we sought and received input from economists and faculty advisors at Stanford University and other institutions to support our analysis and conclusions.

Measuring Today’s Funding Status
Complying with Governmental Accounting Standards Board (GASB) Statement #25, public pension funds discount future pension liabilities at the same rate they expect to earn every year on invested assets. We believe this rule leads to understated publicly reported pension liabilities.

About the Authors
Howard Bornstein, Stan Markuze, Cameron Percy, Lisha Wang, and Moritz Zander are graduate students in the Public Policy Program at Stanford. Lisha Wang and Moritz Zander are graduate students in Stanford’s International Policy Studies Program. This graduate team prepared this report on California public employee pensions as part of the graduate Practicum in Public Policy, a two-quarter sequence required for Master’s students in both the Public Policy and International Policy Studies Programs. The client for this project was the Office of Governor Arnold Schwarzenegger. The full report can be obtained from the Public Policy Program at publicpolicy@stanford.edu.

Joe Nation served as the instructor and an advisor for this research team and directs the graduate student Practicum at Stanford University. He teaches climate change, health care policy, and public policy. Nation represented Marin and Sonoma Counties in the State Assembly from 2000-2006. He received a Ph.D. in Public Policy Analysis from the Pardee RAND Graduate School; his graduate work focused on budget modeling and long-term budget projections.

---

1. The California Public Employees’ Retirement System (CalPERS), California State Teachers’ Retirement System (CalSTRS), and University of California Retirement System (UCRS).
When making an apples-to-apples comparison of pension obligations today relative to invested fund assets, choosing the correct discount rate for future liabilities is critical. Financial liabilities have to be discounted at the rate that most accurately reflects their inherent risk. What is the risk associated with public pensions in California? California law affirms vested public pensions are a form of deferred compensation and cannot be reduced: “A public employee's pension constitutes an element of compensation, and a vested contractual right to pension benefits accrues upon acceptance of employment. Such a pension right may not be destroyed, once vested, without impairing a contractual obligation of the employing public entity.”

Since pension liabilities are effectively riskless, we believe they should be discounted and reported at risk-free rates. Adjusting the discount rate used on liabilities to a risk-free rate, we estimate the combined funding shortfall of CalPERS, CalSTRS, and UCRS prior to the 2008/2009 recession at $425.2 billion (see Table 2).

At the time of this writing, the funds have not released more recent financial reports, but due to the previously mentioned $109.7 billion loss the three funds collectively sustained, we estimate the current shortfall at more than half a trillion dollars.

The traditional metric of pension fund health is the funding ratio (assets divided by liabilities). The target funding ratio for a plan considered fully funded is 100 percent. When the ratio is above or below 100 percent, pension plans amortize over- or under-funding by making adjustments to annual contributions.

### Table 1 — Fund Summaries

<table>
<thead>
<tr>
<th></th>
<th>Active/Inactive Members</th>
<th>Current Retirees</th>
<th>Portfolio Value Change (SB) (FY ending 6/30/09)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CalPERS</td>
<td>1,134,000</td>
<td>493,000</td>
<td>−$56.9 (−23.7%)</td>
</tr>
<tr>
<td>CalSTRS</td>
<td>609,000</td>
<td>224,000</td>
<td>−$43.1 (−25.0%)</td>
</tr>
<tr>
<td>UCRS</td>
<td>171,000</td>
<td>43,000</td>
<td>−$9.7 (−23.0%)</td>
</tr>
<tr>
<td>TOTALS</td>
<td>1,914,000</td>
<td>760,000</td>
<td>−$109.7</td>
</tr>
</tbody>
</table>

Sources: CalPERS, CalSTRS, UCRS financial reports, FY2008-2009.

### Table 2 — Risk-Adjusted Pension Shortfall as of July 1, 2008 ($B)

<table>
<thead>
<tr>
<th></th>
<th>STATED</th>
<th>ADJUSTED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Discount Rate</td>
<td>Assets</td>
</tr>
<tr>
<td>CalPERS</td>
<td>7.75%</td>
<td>238.6</td>
</tr>
<tr>
<td>CalSTRS</td>
<td>8%</td>
<td>161.5</td>
</tr>
<tr>
<td>UCRS</td>
<td>7.5%</td>
<td>42.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>442.1</td>
<td>497.5</td>
</tr>
</tbody>
</table>

Sources: CalPERS, CalSTRS, UCRS financial reports, FY2008-2009, Team analysis.

3 Betts vs. Board of Administration (1978) 21 Cal.3d 859.
4 We re-estimate liabilities, adjusted for risk, by using the average duration of liabilities, which at CalPERS is 16 years. For CalSTRS and UCRS we assume a similar 16-year duration. Knowing the present value of liabilities discounted at the fund’s official rates, we can compound liabilities 16 years out, and discount back at the risk-free rate. As a proxy for the risk-free rate we use the yield-to-maturity (YTM) of 10-year US Treasury Bills in February 2010. Since public pensions include cost-of-living-adjustment (COLA) provisions, there remains an inflation risk mismatch. If we adjust for inflation using the yield of Treasury Inflation Protected Bonds (TIPS), liabilities and the shortfall would be significantly higher.
contributions. We believe funding ratios constructed under GASB #25 belie the truth of fund health, because discounting liabilities above the risk-free rate ignores the risk that actual rates of return will be permanently below the expected level. More specifically, we estimate that the likelihood of a “fully funded” pension plan (i.e., one with a funding ratio of 100 percent) will be unable to cover all of its liabilities is more than 50 percent due to geometric compounding.5

Instead of funding ratios, we believe a more relevant question for policymakers is — given current assets, projected liabilities, and the expected growth of assets — how likely is it that a pension fund will be able to cover its liabilities in the future. Under the GASB reporting rules there are no required “stress tests” for public pension funds that project scenarios in which actual investment returns are below expectations. We performed portfolio growth simulations for each of the three funds, assuming portfolios that achieve stated average investment returns and similar volatilities of returns as exhibited in the past. Assuming the funds’ future liabilities have a 16-year duration,6 compounded forward at official discount rates, we estimate the probabilities of different funding levels using a Monte Carlo simulation.7 Figure 1 displays our findings. By example, our model indicates a 71 percent chance that CalPERS will have a deficit in 16 years and a 44 percent chance that deficit will exceed $250 billion. To make the funds more comparable regardless of size, we also calculated deficits as percentages of liabilities (Figure 2).

---

5 Geometric compounding means that if a portfolio increases by 10% in year 1 and decreases 10% in year 2, the net result is negative, not zero.
6 The 16-year duration of CalPERS was informally given to us by a senior executive at CalPERS in a personal conversation. We assumed the same duration for CalSTRS and UCRS.
7 We ran Monte Carlo simulations to create 16-year investment portfolio outcomes, each employing 16 random rates of return, assuming a normal distribution around each of the expected rates and retaining historical standard deviation. We repeated random draws for a total sample size of 25,000 outcomes. Of the 25,000 different portfolio outcomes we then counted the number of observations for which net assets (assets minus liabilities) were above or below different threshold values. To determine probabilities we divided this number by the total number of observations. For example, our first threshold value is 0. To determine the probability that each of the three funds would end up in surplus by the average duration, (i.e. the average time pensions come due), we counted the number of times net assets were positive and divided this number by all observations.
Using this insight for policymaking, we propose an “80/80 strategy” as a prudent funding target: pension funds should contribute and invest their portfolios so that net assets limit the chance of a deficit greater than 20 percent to a likelihood of no more than 20 percent, (i.e., an 80 percent likelihood that a fund will be able to cover at least 80 percent of its liabilities). Even under this strategy, given the current investment portfolios and wide variance of returns, there is only a 60 percent chance of a surplus. Hence, we consider an 80/80 approach at the low end of cautious. (If under an 80/80 scheme a pension ends up overfunded, any surplus should only be allowed to be used to repay state debt, however in a prudent way such that an 80/80 strategy would always be preserved.)

We estimate that adopting an 80/80 strategy for all three funds as of June 2008 would have required a collective infusion of $200 billion. Under conventional funding metrics, this would translate into a funding ratio of 130 percent.

Avoiding Future Shortfalls
We believe there are three key determinants of avoiding future shortfalls: following prudent contributions policies, managing assets in a way that limits volatility, and setting sustainable benefit levels. We address each in turn.

Contributions
Prudent levels of annual contributions are generally defined as “the portion of the cost of projected benefits allocated to the current plan year.” The regular contributions required to fund fully an employee’s retirement plan by the time he or she retires, allowing for investment gains, is referred to as the “Normal Cost.” An additional metric usually used by managers is the “Level Percent Normal Cost”: “the level percentage of payroll amount that would fund the projected benefit if it were paid annually from date of employment until retirement.”

Although Normal Cost calculations are made with the expectation that employers and employees will make regular contributions every year, contributions to CalPERS, CalSTRS, and UCRS have been highly inconsistent over the past 20 years, falling in times of market windfalls and rising when investments fall short. Figure 3 shows CalPERS’ contributions relative to the calculated Normal Cost contributions that should have been made.

Based on approximate annual investment returns achieved by CalPERS, contributing at the Normal Cost from 2000 through 2009 would have resulted in assets with a value of $33.8 billion at the end of 2009 versus the value of the actual contributions, which totaled $36.6 billion at the end of 2009, a $2.8 billion difference. The total nominal dollars contributed under CalPERS’ policy was $39.8 billion, while the Normal Cost method would have required $34.6 billion in contributions, or $5.2 billion less. Here, CalPERS’ actual policy cost $5.2 billion more than a more prudent policy of consistently contributing at Normal Cost.

More surprisingly, under UCRS’ funding policy, adopted in the fiscal year ending June 30, 1991, no contributions are made to the pension fund when “the market value or the actuarial
value of plan assets (whichever is less) exceeds the lesser of the actuarial accrued liability plus Normal Cost or 150 percent of current liability plus Normal Cost.\textsuperscript{10} In short, contributions to UCRS are suspended when the fund value is deemed sufficiently high relative to liabilities. Since UCRS was overfunded in 1991, contributions dropped to below 1 percent of covered payroll per year for every year between 1994 and 2007. UCRS does not disclose its Normal Cost in its annual report; however, it alludes to its Normal Cost being close to 16 percent of covered earnings.\textsuperscript{11}

CalSTRS’ contributions have been far more consistent than those of CalPERS and UCRS. CalSTRS follows a relatively prudent approach by making consistent contributions, achieving a standard deviation of contributions that was approximately one-fourth that of CalPERS.

Contributions to pension funds must be made consistently at the pre-determined Normal Cost level, which takes into account long-run investment return expectations, in order for the funds to meet their obligations to pension beneficiaries. Acknowledging that investment strategies can be wildly successful, we believe if investments exceed expectations by more than 20 percent per year for at least five years, a prudent strategy is to continue contributing at the Normal Cost rate and to use the excess returns to pay down state debt. However, in the case of a large market loss, we recommend making replenishing contributions rapidly so that they have a chance to grow before the liabilities they are marked against come due. We believe repayments should be amortized across a period that is no longer than half the duration of liabilities, (eight years in the case of CalPERS).

**Investment Performance**

As mentioned earlier, the pressing nature of California pension shortfalls is due in part to the losses CalPERS, CalSTRS, and UCRS sustained in the markets over the past 18 months. CalPERS expects an average annual investment return of 7.75 percent\textsuperscript{12}, CalSTRS targets 8.00 percent\textsuperscript{13}, and UCRS expects 7.50 percent\textsuperscript{14}. Investment professionals at each fund have created asset allocations meant to achieve those targets.

Understanding how pension fund assets are allocated can provide insight into how the losses occurred.

Again using CalPERS as an example, Figure 4 shows the asset allocation of the CalPERS portfolio. As we can see, a significant portion of the CalPERS portfolio is invested in “equities” and “alternative assets,” which are largely equity instruments. This pattern is repeated at CalSTRS and UCRS, with no fund having more than one-quarter of its portfolio invested in fixed-income assets.

Aside from the cash, fixed-income, and inflation-linked assets, each portfolio is subject to significant volatility, especially since many of the investments are correlated with each other. (Here, correlation means that a significant drop in the value of equity investments is likely to be reflected in the value of private equity and venture capital investments as well.) Figure 5 demonstrates the risk/return

---

\textsuperscript{10} 2008 UCRS CAFR, p. 6.
\textsuperscript{11} Ibid.; Based on statement that one of the changes approved in March 2006 was “a multi-year contribution strategy under which contribution rates will increase gradually over time to 16 percent of covered earnings, based on UCRP’s current Normal Cost.”
\textsuperscript{12} CalPERS Comprehensive Annual Financial Report 2009.
\textsuperscript{13} CalSTRS 2008 Comprehensive Annual Financial Report.
While above-average returns are available for savvy investors, taking risk, particularly in correlated asset classes, opens up the possibility of large investment shortfalls. Again using CalPERS as an example, as we can observe in Figure 6, the CalPERS portfolio has had returns averaging 7.91 percent over the last 25 years, with a standard deviation of 11.91 percent. As expected, the high standard deviation means that 68 percent of the time, returns range from –4.0 percent to 19.82 percent. Historically, if CalPERS had simply invested in investment-grade corporate bonds, the fund could have earned 7.25 percent, only .66 percent less than it has earned with its highly volatile portfolio. This small reduction in earnings would have allowed CalPERS to reduce volatility by a full 7.68 percentage points.

Therefore, in order to avoid future severe underfunded scenarios, we recommend that CalPERS, CalSTRS, and UCRS allocate more of their investment portfolios to fixed-income asset classes, thereby reducing risk with a minimal loss of long-term investment performance.

**Benefit Levels**

Benefit levels are yet another determinant of pension shortfalls. Public pension benefits are calculated for each retiree by multiplying years of service, benefit factor, and final compensation. In 1999 California passed Senate Bill 400 (SB400), substantially raising benefit factors and lowering retirement ages for public employees (see Table 3). Based on a National Institute on Retirement Security report, average monthly public pension benefits in California were $2,008 in 2006, the eighth highest nationwide.

Many states experience increasing pension costs. The New York State Teacher Retirement System (NYSTRS) recently adopted a two-tier system to address the issue. Under Chapter 504 of the Laws of 2009, anyone entering New York State employment on or after January 1, 2010, will belong in “Tier 5,” which features modified benefits criteria based on age and pension benefit factor. The rules of Tier 5 effectively reduced benefit levels for future employees.

Another option to reduce benefit costs is to move away from the defined benefits system, common to most public pensions where retirees receive benefits indefinitely, to a 401(k)-style system with individual accounts. A partial solution is a hybrid defined benefits and 401(k)-style plan. By way of example, first-time public employees hired on or after August 29, 2003 in Oregon became part of the Oregon Public Service Retirement System (OPSRP). OPSRP is a hybrid plan with

---


16 7.25% is the return on corporate bonds over the period from 1990 to 2005. Bond returns between 1984 and 2009 were not available.

Figure 6 — CalPERS Returns

Table 3 — Comparison of Current Benefit Levels vs. Pre-SB-400

<table>
<thead>
<tr>
<th>Retirement Category</th>
<th>Current Retirement Formulas</th>
<th>Pre SB-400 Formulas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miscellaneous</td>
<td>2.5% at age 63+</td>
<td>2.0% at age 63+</td>
</tr>
<tr>
<td>State Safety</td>
<td>2.5% at age 55+</td>
<td>2.0% at age 55+</td>
</tr>
<tr>
<td>Peace Officer</td>
<td>3.0% at age 50+</td>
<td>2.5% at age 55+</td>
</tr>
<tr>
<td>Firefighter</td>
<td>3.0% at age 50+</td>
<td>3.0% at age 55+</td>
</tr>
<tr>
<td>Highway Patrol</td>
<td>3.0% at age 50+</td>
<td>3.0% at age 55+</td>
</tr>
</tbody>
</table>

Key Policy Recommendations

- Adopt probability-based funding targets.
- At a minimum, funds should be 80% certain of covering at least 80% of liabilities, (an “80/80 strategy”).
- Make contributions at the Normal Rate without exception.
- Amortize shortfall repayments over at most half the duration of liabilities.
- Invest in less volatile asset classes (predominantly fixed income).
- Offer employees a hybrid system of both defined benefits and a 401(k)-style system.
About SIEPR
The Stanford Institute for Economic Policy Research (SIEPR) conducts research on important economic policy issues facing the United States and other countries. SIEPR’s goal is to inform policymakers and to influence their decisions with long-term policy solutions.

Policy Briefs
SIEPR Policy Briefs are meant to inform and summarize important research by SIEPR faculty. Selecting a different economic topic each month, SIEPR will bring you up-to-date information and analysis on the issues involved. SIEPR Policy Briefs reflect the views of the author. SIEPR is a non-partisan institute and does not take a stand on any issue.

For Additional Copies
Please see SIEPR website at http://SIEPR.stanford.edu.