2017 Asset Liability Management Workshop
Overview

- Asset Liability Management Objectives & Review
- Review of Candidate Portfolios
- Review of Investment Decision Factors
- Review of Actuarial Decision Factors
- ALM Model Results (Cost vs. Volatility Trade-off)
- Recap & Next Steps
Today’s Objective

Conduct the Asset Liability Management (ALM) Workshop

- Evaluate potential policy portfolios that best balance the long-term investment objectives, risk tolerances, and liquidity constraints of the Public Employees’ Retirement Fund (PERF)

- Gather feedback from the CalPERS Board and stakeholders

- Prepare for December 2017 Action item resulting in CalPERS Board Policy Portfolio selection
Steps to Obtain Policy Portfolio

**Assets**

- Step 1: Determine Asset Class Roles and Benchmarks
- Step 2: Determine Capital Market Assumptions and Constraints
- Step 3: Create distinct Candidate Portfolios along efficient frontier
- Step 4: Create simulated annual returns for each distinct Candidate Portfolio
- Step 5: Illustrate key risk considerations for each Candidate Portfolio
- Step 6: Conduct Workshop
- Step 7: Board chooses a Candidate Portfolio based on analysis
- Step 8: Implement Strategic Asset Allocation Policy Targets and Ranges
- Step 9: Mid-Cycle Capital Markets Review

**Liabilities**

- Forecast changes in benefit payments
- Create simulated liabilities, contributions, and payroll costs

[Diagram with green boxes indicating steps completed and blue boxes indicating ongoing steps]
Candidate Portfolios

With the 2013 Capital Market Assumptions, the ALM Policy Portfolio had an expected compound return of 7.15% for years 1 through 10, expected compound return of 8.39% for the long term (i.e., years greater than 10), blended return of 7.56%, and expected volatility of 11.76%.

Blended Return is the weighted expected compound rate of return of years 1 though 10 and the long term, minus 15 bps for admin fees.

Triangles correspond to Candidate Portfolio C, which is most similar to Current Allocation. Symbols illustrated on pages 6 and 7.

### Asset Allocation of Preliminary Candidate Portfolios

<table>
<thead>
<tr>
<th>Asset Class Component</th>
<th>Candidate A</th>
<th>Candidate B</th>
<th>Candidate C</th>
<th>Candidate D</th>
<th>Allocation 9/30/2017</th>
<th>Interim Policy 9/30/2016</th>
<th>ALM Policy 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Equity</td>
<td>34%</td>
<td>42%</td>
<td>50%</td>
<td>59%</td>
<td>50%</td>
<td>46%</td>
<td>47%</td>
</tr>
<tr>
<td>Private Equity</td>
<td>8%</td>
<td>8%</td>
<td>8%</td>
<td>8%</td>
<td>8%</td>
<td>8%</td>
<td>12%</td>
</tr>
<tr>
<td>Fixed Income</td>
<td>44%</td>
<td>36%</td>
<td>28%</td>
<td>19%</td>
<td>19%</td>
<td>20%</td>
<td>19%</td>
</tr>
<tr>
<td>Real Assets</td>
<td>13%</td>
<td>13%</td>
<td>13%</td>
<td>13%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Real Estate</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>9%</td>
<td>11%</td>
<td>11%</td>
</tr>
<tr>
<td>Infrastructure/Forestland</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2%</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>Inflation Assets</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>8%</td>
<td>9%</td>
<td>6%</td>
</tr>
<tr>
<td>Liquidity</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>4%</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Expected Compound Return (1-10 yrs.)</td>
<td>5.6%</td>
<td>5.8%</td>
<td>6.1%</td>
<td>6.4%</td>
<td>6.0%</td>
<td>5.9%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Long Term Expected Return (11-60 yrs.)</td>
<td>7.8%</td>
<td>8.0%</td>
<td>8.3%</td>
<td>8.5%</td>
<td>8.1%</td>
<td>8.0%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Blended Return (1-60 yrs.)</td>
<td>6.50%</td>
<td>6.75%</td>
<td>7.00%</td>
<td>7.25%</td>
<td>6.85%</td>
<td>6.77%</td>
<td>7.09%</td>
</tr>
<tr>
<td>Expected Volatility</td>
<td>9.1%</td>
<td>10.2%</td>
<td>11.4%</td>
<td>12.8%</td>
<td>11.5%</td>
<td>11.0%</td>
<td>12.0%</td>
</tr>
<tr>
<td>Cash Yield:</td>
<td>3.1%</td>
<td>3.0%</td>
<td>2.9%</td>
<td>2.7%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

- With the 2013 Capital Market Assumptions, the ALM Policy Portfolio had an expected compound return of 7.15% for years 1 through 10, expected compound return of 8.39% for the long term (i.e., years greater than 10), blended return of 7.56%, and expected volatility of 11.76%.
- Blended Return is the weighted expected compound rate of return of years 1 though 10 and the long term, minus 15 bps for admin fees.
- Circles correspond to Candidate Portfolios A, B, and D. Squares correspond to Current Allocation, Interim Policy, and ALM policy portfolios.
- Triangle corresponds to Candidate Portfolio C, which is most similar to Current Allocation. Symbols illustrated on pages 6 and 7.
Candidate Portfolios - Efficient Frontier

- Candidate A
- Candidate B
- Candidate C
- Candidate D

Expected Return (1-10 Years) vs. Expected Volatility

- Current Allocation
- Interim Policy
- 2013 ALM Policy
Each Candidate Portfolio Represents a Range of Outcomes

The graph illustrates the efficient frontier for asset allocation, with each candidate portfolio representing a range of outcomes. The expected returns (1-10 years) are plotted against expected volatility. The efficient frontier is denoted by the solid blue line, with +1 and -1 standard deviation lines shown in green and red, respectively.

- **Candidate A**
- **Candidate B**
- **Candidate C**
- **Candidate D**

The graph also includes the current allocation, interim policy, and 2013 ALM policy, indicated by the shaded area and markers.
Scenario Analysis (Dot Com Crisis & Recovery)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cumulative Returns</td>
</tr>
<tr>
<td>A</td>
<td>64%</td>
<td>85%</td>
</tr>
<tr>
<td>B</td>
<td>66%</td>
<td>82%</td>
</tr>
<tr>
<td>C</td>
<td>68%</td>
<td>80%</td>
</tr>
<tr>
<td>D</td>
<td>70%</td>
<td>77%</td>
</tr>
<tr>
<td>Equity Only</td>
<td>75%</td>
<td>44%</td>
</tr>
</tbody>
</table>

- Analysis assumes no rebalancing.
- The Funded Status calculation assumes a liability growth rate of 7.9%.
Scenario Analysis (Global Financial Crisis & Recovery)

<table>
<thead>
<tr>
<th>Candidate Portfolios</th>
<th>Initial Funded Status</th>
<th>Cumulative Returns</th>
<th>Annualized Returns</th>
<th>Funded Status</th>
<th>Δ Funded Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>64%</td>
<td>63%</td>
<td>5.0%</td>
<td>49%</td>
<td>-15%</td>
</tr>
<tr>
<td>B</td>
<td>66%</td>
<td>60%</td>
<td>4.9%</td>
<td>50%</td>
<td>-16%</td>
</tr>
<tr>
<td>C</td>
<td>68%</td>
<td>58%</td>
<td>4.7%</td>
<td>51%</td>
<td>-17%</td>
</tr>
<tr>
<td>D</td>
<td>70%</td>
<td>56%</td>
<td>4.6%</td>
<td>51%</td>
<td>-19%</td>
</tr>
<tr>
<td>Equity Only</td>
<td>75%</td>
<td>53%</td>
<td>4.4%</td>
<td>54%</td>
<td>-21%</td>
</tr>
</tbody>
</table>

- Analysis assumes no rebalancing.
- The Funded Status calculation assumes a liability growth rate of 7.9%.
Key Risk Considerations

- Accepting investment risk will be rewarded
- Historic hierarchy of risk premia will be stable
- Short-term and long-term expected return variance
- Market valuation levels
- No certainty of any market outcome
### Pros/Cons Relative to Current Interim Policy Target

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>+/-</th>
<th>Context</th>
</tr>
</thead>
</table>
| A and B   | +   | - Exposure to interest rate risk  
|           |     | - Reduced overall expected blended return  
|           |     | - Discount rate reduction  
|           |     | - Material transition activity required |
| C¹        | +   | - Maintains current concentration of equity risk  
|           |     | - Maintains current expected volatility and potential for contribution changes |
| D         | +   | - Increased expected blended return  
|           |     | - Supports increase in discount rate or maintain at 7% (December 2016 Board decision) with a margin for adverse deviation |
|           | -   | - More equity risk concentration  
|           |     | - Subject to more drawdown in an equity sell-off  
|           |     | - Material transition activity required |

¹ Candidate Portfolio C is most similar to our current allocation and current path towards a 7% discount rate.
Difference in Short and Long Term CMAs

Current low real yield is primary driver of difference

*Source: Wilshire Associates*
Total Fund Cash Flows are Improving

Historic & Projected PERF Cash Flow Analysis

- Data Source: Historical information from Comprehensive Annual Financial Report (CAFR). Contribution estimates assume a 7% discount rate. Benefit Payments incorporate changes in actuarial assumptions to be presented in Finance and Administration Committee on 11/14/2017.
- Investment Income assumes implementation of “Candidate Portfolio C.” Investment income only includes income from Global Equity (dividends), Global Fixed Income (coupons) and Real Assets (rent).
- Other Costs include refunds, administrative costs of retirement and investment base fees.
Reduced Reliance on Investment Cash Flows

Net Non-Investment Cash Flows defined as follows:
Estimated Contributions - Estimated Benefit Payments - Refunds - Administrative costs

- $10.3
- $11.2
- $12.2
- $13.1
- $14.1
-$2.9
-$3.4
-$2.9
-$3.4
-$2.8
-$4.1
-$4.9
- $0


($ Billions)

2013 ALM Projection
2017 ALM Projection

Net Non-Investment Cash Flows defined as follows:
Estimated Contributions - Estimated Benefit Payments - Refunds - Administrative costs
2016 Vs. Today – Market Valuations

As of September 2016

Valuation Metrics versus Historical Range
A Measure of Risk

As of September 2017

Valuation Metrics versus Historical Range
A Measure of Risk

Source: Pension Consulting Alliance
Historical CAPE Measure

Cyclically Adjusted Price-to-Earnings Ratio (CAPE)

- Data Source: Stock Market Data Used in "Irrational Exuberance" Princeton University Press, Robert J. Shiller
Historical CAPE and 3, 5, 7 and 10-year Subsequent Average S&P 500 Annualized Total Returns

CAPE as of August 2017 is at 95th percentile

- CAPE data: September 1917 – August 2007
- Data Source: Stock Market Data Used in "Irrational Exuberance" Princeton University Press, Robert J. Shiller
Historical CAPE and 3, 5, 7 and 10-year Subsequent Average S&P 500 Maximum Drawdowns

CAPE data: September 1917 – August 2007
Data Source: Stock Market Data Used in "Irrational Exuberance" Princeton University Press, Robert J. Shiller

<table>
<thead>
<tr>
<th>Starting CAPE Percentile</th>
<th>Avg 3y Max Drawdowns</th>
<th>Avg 5y Max Drawdowns</th>
<th>Avg 7y Max Drawdowns</th>
<th>Avg 10y Max Drawdowns</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPE ≤ 50%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50% &lt; CAPE ≤ 70%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70% &lt; CAPE ≤ 90%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAPE &gt; 90%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CAPE as of August 2017 is at 95th percentile

-60% -50% -40% -30% -20% -10% 0% 10% 20% 30% 40% 50% 60%
Review of Actuarial Decision Factors
2013 Vs. Today – Drivers of Lower Funded Ratio

**Attribution of Change in Funded Status**

- **6/30/2014**
  - Investment Returns minus Discount Rate¹: 76%
  - Demographic Experience: +1%
  - Actuarial Assumption Changes: +1%
  - Discount Rate Change: -6%
  - Attribution: 68%

**Discount Rate for State**

- **FY 2012-13**: 7.50%
- **FY 2017-18**: 7.375%
- **FY 2018-19**: 7.25%
- **FY 2019-20**: 7.00%

¹4.64% Compound Return for the Total Fund over the last 3 fiscal years:
(FY2014-15: 2.41%; FY2015-16: 0.62%; FY2016-17: 11.18%)
2013 Vs Today – Drivers of Higher Contribution Rates

- Payroll estimated to grow at 2.75%
## Key Risk Considerations

<table>
<thead>
<tr>
<th>Risk Consideration</th>
<th>Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funded Status</td>
<td>The market value of assets divided by the accrued liabilities</td>
</tr>
<tr>
<td>Employer Contribution Rate</td>
<td>The payment rate made to the plan by the employer</td>
</tr>
<tr>
<td>Employer Contribution Rate Volatility</td>
<td>The annual change of the payment rate made to the plan by the employer</td>
</tr>
</tbody>
</table>

### Key Risk Consideration Thresholds

(2013 Strategic Asset Allocation breaching the thresholds)

<table>
<thead>
<tr>
<th>Risk Consideration</th>
<th>State Misc.</th>
<th>PA Misc.</th>
<th>Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2013 ALM Workshop Probability</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funded Status Falling Below 50%</td>
<td>40%</td>
<td>32%</td>
<td>32%</td>
</tr>
<tr>
<td>Employer Contribution Rate Volatility Exceeding 3%</td>
<td>51%</td>
<td>38%</td>
<td>34%</td>
</tr>
<tr>
<td>Employer Contribution Rate Exceeding 35%</td>
<td>38%</td>
<td>14%</td>
<td>8%</td>
</tr>
<tr>
<td><strong>Current Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated Funded Status (June 30, 2017)</td>
<td>66.0%</td>
<td>70.5%</td>
<td>70.2%</td>
</tr>
<tr>
<td>Employer Contribution Rate Volatility</td>
<td>2.7%²</td>
<td>1.8%²</td>
<td></td>
</tr>
<tr>
<td>Employer Contribution Rate</td>
<td>28.325% (FY 2017-18)</td>
<td>15.531% (FY 2017-18)</td>
<td></td>
</tr>
</tbody>
</table>

1 Public Agency (PA)
2 FY 2013-14 to FY 2017-18
Data Source: CalPERS Actuarial Valuations
### Key Risk Considerations

#### Funded Status
The market value of assets divided by the accrued liabilities

#### Employer Contribution Rate
The payment rate made to the plan by the employer

#### Employer Contribution Rate Volatility
The annual change of the payment rate made to the plan by the employer

<table>
<thead>
<tr>
<th>Key Risk Consideration Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2013 Strategic Asset Allocation breaching the thresholds)</td>
</tr>
<tr>
<td>CHP(^1)</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td><strong>2013 ALM Workshop Probability</strong></td>
</tr>
<tr>
<td>Funded Status Falling Below 50%</td>
</tr>
<tr>
<td>Employer Contribution Rate Volatility Exceeding 5%</td>
</tr>
<tr>
<td>Employer Contribution Rate Exceeding 55%</td>
</tr>
<tr>
<td><strong>Current Level</strong></td>
</tr>
<tr>
<td>Estimated Funded Status (June 30, 2017)</td>
</tr>
<tr>
<td>Employer Contribution Rate Volatility</td>
</tr>
</tbody>
</table>
| Employer Contribution Rate | 52.785%  
(FY 2017-18) |  | 42.598%  
(FY 2017-18) |

---

1 California Highway Patrol (CHP)  
2 Public Agency (PA)  
3 Peace Officers and Fire Fighters (POFF)  
4 FY 2013-14 to FY 2017-18

Data Source: CalPERS Actuarial Valuations
ALM Model Building Blocks

- Starting Point
  - Assets and Liabilities at June 30, 2016
  - Benefit payments for FY 2016-2017
  - Contributions for FY 2016-2017
  - Investment return for FY 2016-17 (11.2%)

- Liability Projection for 30 Years
  - Liabilities projected for each discount rate
  - Open Group (New members join in future years)

- Asset Projection for 30 Years
  - For each discount rate 5,000 investment return paths over 30 years are randomly simulated
Discount Rate Determination

Starting Point

- CMAs Year 1 to 10 (short term)
- CMAs Year 10 and Beyond (long term)
  - Foundation of CMAs Year 10 and Beyond is long term average per asset class
  - Examples of historical measures used:

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>Source</th>
<th>Period</th>
<th>Number of Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Equity</td>
<td>S&amp;P 500</td>
<td>1926 – 2016</td>
<td>90 years</td>
</tr>
<tr>
<td>Fixed Income</td>
<td>US Aggregate Bond Index</td>
<td>1926 – 2016</td>
<td>90 years</td>
</tr>
<tr>
<td>Real Assets</td>
<td>Average REIT</td>
<td>1972 – 2016</td>
<td>44 years</td>
</tr>
</tbody>
</table>
Discount Rate Determination (continued)

- Based on Blended CMA rates and projected Cash Flows

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Discount Rate(^1)</th>
<th>Volatility</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6.50%</td>
<td>9.1%</td>
</tr>
<tr>
<td>B</td>
<td>6.75%</td>
<td>10.2%</td>
</tr>
<tr>
<td>C</td>
<td>7.00%</td>
<td>11.4%</td>
</tr>
<tr>
<td>D</td>
<td>7.25%</td>
<td>12.8%</td>
</tr>
</tbody>
</table>

\(^1\) Does not include any provision for adverse deviation.
Generating Investment Return Paths

- Develop Expected Returns & Volatility
  - For first 10 years
  - For years 11 and beyond
    - Performed for each potential candidate portfolio

- Generate 30 Year simulations using statistical modeling techniques
  - 5,000 paths generated for each potential discount rate
ALM Model Improvements since 2013

Simulations Reflect Mean Reversion

- Capital market annual returns are not independent and identically distributed (IID)

- Simulations consistent with historical market returns reflecting negative serial correlation

- Realistic long-term investment scenarios
  - Overly optimistic/pessimistic scenarios removed
Historical Returns Exhibit Mean Reversion

Historical Returns - Reversion to Mean
60% Equity/40% Fixed Income

SD = 4.71%
SD = 3.53%
SD = 2.20%
SD = 1.23%

-3.5%
-2.4%
-8.9%
-16.0%
20.4%
9.0%
11.9%
14.8%
19.6%
24.4%
30 Year
20 Year
10 Year
5 Year
0.0%
5.0%
10.0%
15.0%
20.0%
25.0%
-5.0%
Simulations with Mean Reversion

Simulated Annual Investment Returns

Years

Series 1

Series 2

Series 3

Series 4

Series 5

Series 6

Series 7

Series 8

Series 9
ALM Model Results
Cost vs. Volatility Trade-off
State Miscellaneous

Measure 1:
Probability of PERF funded status falling below 50% or 60% over the next 30 years

Measure 2:
Probability of high employer contribution rates over 30% / 35% / 40%

Measure 3:
Probability of sharp increase in annual employer contribution rates over 3%
Schools

Measure 1:
Probability of PERF funded status falling below 50% or 60% over the next 30 years

Measure 2:
Probability of high employer contribution rates over 30% / 35% / 40%

Measure 3:
Probability of sharp increase in annual employer contribution rates over 3%
Public Agency Miscellaneous

**Measure 1:**
Probability of PERF funded status falling below 50% or 60% over the next 30 years

**Measure 2:**
Probability of high employer contribution rates over 30% / 35% / 40%

**Measure 3:**
Probability of sharp increase in annual employer contribution rates over 3%
Average Employer Contribution Rates Over Next 30 years (percentage of payroll)
State Peace Officers and Fire Fighters (POFF)

Measure 1:
Probability of PERF funded status falling below 50% or 60% over the next 30 years

Measure 2:
Probability of high employer contribution rates over 50% / 55% / 60%

Measure 3:
Probability of sharp increase in annual employer contribution rates over 5%
California Highway Patrol (CHP)

Measure 1:
Probability of PERF funded status falling below 50% or 60% over the next 30 years

Measure 2:
Probability of high employer contribution rates over 50% / 55% / 60%

Measure 3:
Probability of sharp increase in annual employer contribution rates over 5%
Public Agency Safety

Measure 1:
Probability of PERF funded status falling below 50% or 60% over the next 30 years

Measure 2:
Probability of high employer contribution rates over 50% / 55% / 60%

Measure 3:
Probability of sharp increase in annual employer contribution rates over 5%
Average Employer Contribution Rates Over Next 30 yrs (percentage of payroll)
CalPERS Pension Beliefs

- **Pension Belief 4**
  A retirement plan should...have professionally managed funds with a long-term horizon, and incorporate pooled investments and pooled risks

- **Pension Belief 5**
  Funding policies should be applied in a fair, consistent manner, accommodate investment return fluctuations and support rate stability

- **Pension Belief 7**
  Retirement system decisions must give precedence to the fiduciary duty owed to members, but should also consider the interests of other stakeholders
Recap and Next Steps
2017-18 ALM Timeline

2017

- **Monday, November 13th**
  - Board Meeting
  - Asset Liability Management Workshop

- **Tuesday, November 14th**
  - Finance & Administration Committee
  - Review Actuarial Assumptions and Methods

- **Monday, December 18th**
  - Investment Committee
  - Adopt Strategic Asset Allocation for Ratifications by the Board

- **Tuesday, December 19th**
  - Finance & Administration Committee
  - Adopt Strategic Asset Allocation for Ratifications by the Board
  - Adopt Discount Rate for Ratifications by the Board

2018

- **Monday, February 12th**
  - Investment Committee
  - Review Transition and Implementation Plan
  - Review Amendments to Statement of Investment Policy

- **Wednesday, December 20th**
  - Board of Administration Meeting
  - Select Strategic Policy Portfolio
## Appendix

### Asset Liability Management Related Activities – Workshop and Open Session

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul 2015</td>
<td>Offsite Workshop - Investment Portfolio Priorities</td>
</tr>
<tr>
<td>Jul 2015</td>
<td>Offsite Workshop – Investment Beliefs</td>
</tr>
<tr>
<td>Sep 2015</td>
<td>Investment Committee – Investment Beliefs Implementation Findings</td>
</tr>
<tr>
<td>Nov 2015</td>
<td>Investment Committee Workshop – Private Equity</td>
</tr>
<tr>
<td>Jan 2016</td>
<td>Offsite Workshop - Investment Portfolio Priorities (three identified)</td>
</tr>
<tr>
<td>Apr 2016</td>
<td>Investment Committee – Private Asset Class Roles and Benchmarks</td>
</tr>
<tr>
<td>May 2016</td>
<td>Investment Committee – Private Asset Class Roles and Benchmarks</td>
</tr>
<tr>
<td>Jun 2016</td>
<td>Investment Committee – Interim Asset Allocation Targets Review</td>
</tr>
<tr>
<td>Jul 2016</td>
<td>Offsite Workshop – Investment Portfolio Priorities (EDHEC Risk Factor review, Benchmark review)</td>
</tr>
<tr>
<td>Sep 2016</td>
<td>Investment Committee - Risk reduction</td>
</tr>
<tr>
<td>Nov 2016</td>
<td>Finance and Administration Committee – Securing CalPERS Future – Managing Funding Risks, Stakeholder Outreach and Engagement</td>
</tr>
<tr>
<td>Dec 2016</td>
<td>Finance and Administration Committee Workshop – Securing CalPERS Future – Managing Funding Risks, Stakeholder Outreach and Engagement (Phase in discount rate reduction to 7%)</td>
</tr>
<tr>
<td>Apr 2017</td>
<td>Investment Committee – Private Asset Class Roles and Benchmarks</td>
</tr>
<tr>
<td>May 2017</td>
<td>Investment Committee – Private Asset Class Roles and Benchmarks</td>
</tr>
<tr>
<td>Jun 2017</td>
<td>Investment Committee – Adoption of Capital Markets Assumptions</td>
</tr>
<tr>
<td>Jul 2017</td>
<td>Offsite Workshop – Use of Leverage in Strategic Asset Allocation</td>
</tr>
</tbody>
</table>
Investment Portfolio Priorities

Specific to CalPERS, implementable, and will influence portfolio construction:

1. Protect the Funded Ratio
   (mitigate severe drawdowns)

2. Stabilize Employer Contribution Rates
   (manage overall volatility)

3. Achieve Long-term Required Rate of Return
   (over the long run, but not in every market environment)

“Asset allocation is the dominant determinant of portfolio risk and return”
Investment Belief 6
Asset Liability Decision-Making Framework

**INPUTS**
- Investment Landscape
- Plan Specification
- Actuarial Parameters

**OUTPUTS**
- Contribution Rate
- Contribution Rate Volatility
- Funded Status

Decision Framework

CalPERS
## ALM Objectives Reflect Investment Beliefs

<table>
<thead>
<tr>
<th>Short Name</th>
<th>Investment Belief</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liabilities</td>
<td>Liabilities must influence the asset structure.</td>
</tr>
<tr>
<td>Long-Term Horizon</td>
<td>A long time investment horizon is a responsibility and an advantage.</td>
</tr>
<tr>
<td>Stakeholders</td>
<td>CalPERS investment decisions may reflect wider stakeholder views.</td>
</tr>
<tr>
<td>Three Forms of Capital</td>
<td>Long-term value creation requires effective management of three forms of capital: financial, physical, and human.</td>
</tr>
<tr>
<td>Accountability</td>
<td>CalPERS must articulate its investment goals and performance measure and ensure clear accountability for their execution.</td>
</tr>
<tr>
<td>Strategic Allocation</td>
<td>Strategic asset allocation is the dominant determinant of portfolio risk and return.</td>
</tr>
<tr>
<td>Risk Reward</td>
<td>CalPERS will take risk only where we have a strong belief we will be rewarded.</td>
</tr>
<tr>
<td>Costs Matter</td>
<td>Costs matter and need to be effectively managed.</td>
</tr>
<tr>
<td>Multi-faceted Risk</td>
<td>Risk of CalPERS is multi-faceted and not fully captured through measures such as volatility or tracking error.</td>
</tr>
<tr>
<td>Resources / Process</td>
<td>Strong processes and teamwork and deep resources are needed to achieve CalPERS' goals and objectives.</td>
</tr>
</tbody>
</table>
Asset Class Roles & Benchmarks

Global Equity

- Role: Total return oriented and to capture the equity risk premium (ERP), defined as the excess return over risk-free Government Bonds, by means of ownership risk in companies and exposure to corporate earnings growth. The major driver is appreciation, with some cash yield.
  - Growth
  - Liquidity

- Benchmark: Global All-World All Capitalization

Private Equity

- Role: Enhance equity returns through an active, value-added approach. The major driver for returns is appreciation, aided by leverage, with negligible cash yield.
  - Growth

- Benchmark: Global All-World All Capitalization + Return Premium
Asset Class Roles & Benchmarks - Continued

Global Fixed Income

• Role: Serve as an economic diversifier to equity risk and be a reliable source of income.
  • Diversification
  • Income
  • Liquidity

• Benchmark: 90% Long Liabilities + 10% International Fixed Income Index

Real Assets

• Role: Own real assets with stable cash yield and act as an economic diversifier to equity risk.
  • Diversification
  • Income
  • Inflation

• Benchmark: U.S. Core Fund Index
Asset Class Roles & Benchmarks - Continued

### Inflation Assets
- Role: Provide strong liquid protection against inflation.
  - Inflation
  - Liquidity
- Benchmark: 75% Inflation Linked Bond + 25% Commodities

### Liquidity
- Role: Exhibit safety and capital preservation properties.
  - Liquidity
- Benchmark: 91 Day Treasury Bill
Common Factors for Liabilities & Assets

- PERF Payroll Growth
- Inflation Growth
- CA GDP Growth

Data Source: CalPERS Comprehensive Annual Financial Reports and Bloomberg
### 2017 Capital Market Assumptions

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>Arithmetic Return</th>
<th>Compound Return</th>
<th>Volatility (Std. Dev)</th>
<th>Correlation</th>
<th>Constraints (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Global Equity</td>
<td>Private Equity</td>
</tr>
<tr>
<td>Global Equity</td>
<td>8.14%</td>
<td>6.80%</td>
<td>17.00%</td>
<td>1.00</td>
<td>0.81</td>
</tr>
<tr>
<td>Private Equity</td>
<td>11.26%</td>
<td>8.30%</td>
<td>25.50%</td>
<td>0.81</td>
<td>1.00</td>
</tr>
<tr>
<td>Fixed Income</td>
<td>3.21%</td>
<td>3.00%</td>
<td>6.58%</td>
<td>0.01</td>
<td>0.00</td>
</tr>
<tr>
<td>Real Asset</td>
<td>6.49%</td>
<td>5.75%</td>
<td>12.55%</td>
<td>0.59</td>
<td>0.48</td>
</tr>
<tr>
<td>Inflation Asset</td>
<td>3.08%</td>
<td>2.77%</td>
<td>8.00%</td>
<td>0.39</td>
<td>0.33</td>
</tr>
<tr>
<td>Liquidity</td>
<td>2.00%</td>
<td>2.00%</td>
<td>1.00%</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**U.S. Inflation Assumption: 2.00%**
Cash Flows with 7.5% Discount Rate and 2013 Allocation

Historic & Projected PERF Cash Flow Analysis in 2013

- Total Contributions & Investment Income
- Benefit Payments & Other Costs

- Investment Income has an assumed cash yield of 2.37% based on PERF policy asset allocation.
- Investment income only includes income from Global Equity (dividends), Global Fixed Income (coupons), and Real Assets (rent).
- Other Costs include refunds, administrative costs of retirement, and investment base fees
Cash Flows with 7.5% Discount Rate and 2013 Allocation

Projected PERF Non-Investment Cash Flow in 2013

($ Billions)

- Net Non-Investment Cash Flows defined as follows:
  - Estimated Contributions - Estimated Benefit Payments - Refunds - Administrative costs
- Other Costs include refunds, administrative costs of retirement, and investment base fees
Contribution, Benefit Payments and Investment Income  2013 and Today

Data Source: 2013 and 2017 Contribution and Benefit Payments are from ACTO.

- Investment Income assumes implementation of “Candidate Portfolio C.” Investment income only includes income from Global Equity (dividends), Global Fixed Income (coupons), and Real Assets (rent).
Stability of Investment Income

Realized Investment Income and Total Return

($ Billions)

Investment income

FY13/14 FY14/15 FY15/16 FY16/17

$6.3 $6.5 $7.3 $7.1

18% 2% 1% 11%

Investment Income (LHS) Fund Total Return (RHS)

- Investment income defined as cash income from:
  Global Equity (dividends), Global Fixed Income (coupons), Real Assets (rent)