What We Hope to Accomplish Today

• Refresh – Asset Liability Management Timeline (Progress and Goal)

• Discuss – Strategic Asset Allocation by Public Asset Segments

• Discuss – Benchmark Selection for Public Asset Segments

• Understand – Alternative Strategic Asset Allocation Approach
2017-18 ALM Timeline | Board Review & Decision Making

January Board Offsite
Public Asset: Roles, Segments, Benchmarks
  • Global Equity, Global Fixed Income, Inflation

February Investment Committee
Private Asset: Roles, Segments, Benchmarks
  • Private Equity

April Investment Committee
Private Asset: Roles, Segments, Benchmarks
  • Real Assets

July Board Offsite
Alternative Strategic Asset Allocation Approach
  • Public & Private Asset Segments
  • Use of Leverage

June Investment Committee
Adopt Capital Market Assumptions

February Board Meeting
Adopt Strategic Asset Allocation Policy Portfolio
  • Current Approach: Asset Class
  • Alternative Approach: Asset Segment

November ALM Board Workshop
Strategic Asset Allocation Approach
  • Current Approach: Asset Class
  • Alternative Approach: Asset Segment

July Implementation
Strategic Asset Allocation Policy Portfolio
Alternative Asset Allocation Approach - Why? | Portfolio Priorities

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

1. Protect the Funded Ratio (PP1)
   *(mitigate severe drawdowns)*

2. Stabilize Employer Contribution Rates (PP2)
   *(manage overall volatility)*

3. Achieve Long-term Required Rate of Return (PP3)
   *(over the long run, but not in every market environment)*
Public Assets | Primary Roles

**Global Equity**

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

**Global Fixed Income**

Serve as an economic diversifier to equity risk and be a reliable source of income.

- Diversification
- Income
- Liquidity
Public Assets | Primary Roles

**Inflation Assets**

Provide strong liquid protection against inflation.
- Inflation
- Liquidity

**Liquidity**

Exhibit safety and capital preservation properties.
- Liquidity
## Existing Asset Classes or Alternative Approach

The hypothetical alternative approach (by segment) described today almost doubles (from 4 to 7) the number of strategic building blocks.

### Option 1: Existing Asset Classes

<table>
<thead>
<tr>
<th>4 Building Blocks</th>
<th>Strategic Target Weight*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Equity</td>
<td>46%</td>
</tr>
<tr>
<td>Fixed Income</td>
<td>20%</td>
</tr>
<tr>
<td>Inflation</td>
<td>9%</td>
</tr>
<tr>
<td>Liquidity</td>
<td>4%</td>
</tr>
<tr>
<td>Public Asset Total</td>
<td>79%</td>
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</tbody>
</table>

### Option 2: Alternative Strategic Asset Allocation Approach

<table>
<thead>
<tr>
<th>7 Building Blocks (Asset Segments)</th>
<th>Strategic Target Weight*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Equity: <em>Market Cap Weighted</em></td>
<td>X%</td>
</tr>
<tr>
<td>Public Equity: <em>Non-Market Cap Weighted</em></td>
<td>X%</td>
</tr>
<tr>
<td>Fixed Income: <em>US Government Related (Treasury and Agency)</em></td>
<td>X%</td>
</tr>
<tr>
<td>Fixed Income: Spread Products (Corporates, Mortgages, Sovereigns)</td>
<td>X%</td>
</tr>
<tr>
<td>Fixed Income: <em>High Yield</em></td>
<td>X%</td>
</tr>
<tr>
<td>Inflation: <em>Inflation Linked Bonds, Commodities</em></td>
<td>X%</td>
</tr>
<tr>
<td>Liquidity</td>
<td>X%</td>
</tr>
<tr>
<td>Public Asset Total</td>
<td>79%</td>
</tr>
</tbody>
</table>

*Strategic target weights shown for illustrative purposes only.
Option 1: Existing Asset Classes | Total Fund Investment Policy*

**Global Equity**
100% FTSE CalPERS Global (All-World, All Capitalization)

**Global Fixed Income**
90% Barclays Long Liabilities
10% Barclays International Fixed Income Index (GDP Weighted ex-US)

**Inflation Assets**
75% Inflation Linked Bond
25% Commodities

**Liquidity**
100% 91 Day Treasury Bill

*As of June 30, 2016*
Option 2: Alternative Strategic Asset Allocation Approach | Public Assets

**Global Equity (Two Segments)**
- Market Cap Weighted
- Non-Market Cap Weighted (3 Building Blocks)

**Global Fixed Income (Three Segments)**
- US Government Related (Treasury and Agency)
- Spread Products (Corporates, Mortgages, Sovereigns)
- High Yield

**Inflation Assets (Two Segments)**
- Inflation Linked Bonds
- Commodities

**Liquidity (One Segment)**
- 91 Day Treasury Bill
Testing Asset Segments | Objectives

**Effectiveness**
Empirical evidence of asset segments’ ability to reduce drawdown risk in crisis and to capture upside in normal markets

**Distinctiveness**
Diversifying behavior during crisis based on economic intuition or persistent behavioral bias

**Robustness**
Patterns of predictable behavior in different crisis

**Materiality**
Implementable at sufficient scale to matter

**Commercially Available**
Readily available indices from independent index provider
Testing Segments | Defensiveness vs. Cyclicality

If segment, bows up, illustrates defensiveness

If segment, bows down, illustrates cyclicality
Benchmark Consideration | Global Equity Segments

What could a set of benchmarks look like for the following segments?

Speaker: Dr. Lionel Martellini, EDHEC Risk Institute

Global Equity (Two Segments)

• Market Cap Weighted

• Non-Market Cap Weighted (3 Potential Building Blocks)
  o Minimum/Low Volatility
  o Maximum Diversification | Maximum De-correlation
  o Multi-Factor
Limits of Cap-Weighted Equity Benchmarks

- While cap-weighted (CW) indices are most often used as default investment benchmarks, these benchmarks suffer from two main limitations.

- Shortcoming # 1: CW indices may provide inadequate diversification of unrewarded and specific risks – Due to a strong concentration in largest cap stocks, they contain an excess of uncompensated risks, which implies a sub-optimal reward per unit of risk.

- Shortcoming # 2: CW indices may provide inadequate allocation to rewarded systematic risks – Their set of factor exposures is not efficient (for example they exhibit outsized large cap, growth biases).
Implications

• As a result of these limitations, CW benchmarks may be complimented by alternative (also known as smart) benchmarks in terms of risk-adjusted performance, as confirmed by a large body of academic and practitioner research.

• On the other hand, CW indices enjoy two main important benefits that justify their predominant role in the investment process, namely their liquidity and scalability.

• Key insight: whatever their shortcomings and merits, we should recognize that CW indices, which result from aggregate trades by a large variety of investors, have never been engineered to address the specific needs of CalPERS, as translated in terms of the 3 portfolio priorities (back to this later).
Benefits of Alternative Beta Equity Benchmarks: Better Diversification (Shortcoming # 1)

- Weighting methods aim to improve diversification or effectively reduce volatility:
  - “Naïve” Diversification
    - **Equal Weighted** (equal dollar allocation)
    - **Equal Risk Contribution** (equal volatility-adjusted dollar allocation)
  - “Smart” Diversification
    - **Maximum Diversification / Maximum De-correlation**
      (maximize the diversifying benefits of correlations between stocks)
  - Volatility Reduction
    - **Efficient Minimum Volatility**
      (minimizes expected volatility while avoiding excessive concentration on low risk stocks)
- Such approaches do **not** target factor exposures explicitly:
  - They do lead to factor exposures that are different from cap-weighted indices.
  - However, these factor exposures are an implicit result of the weighting methodology.
Benefits of Alternative Beta Equity Benchmarks: Harvest Rewarded Risk Exposures (Shortcoming # 2)

• Individual stocks earn their risk premium through exposure to rewarded factors, while the remaining risk is uncompensated.

• Main rewarded equity factors (in addition to market factor):
  – Value factor (Fama-French (1993)): long value short growth stocks;
  – Size factor (Fama-French (1993)): long Small Cap short Large Cap stocks;
  – Momentum factor (Carhart (1997)): winners – losers stocks.
  – Quality factor (Asness et al. (2013)): quality stocks – junk stocks.

• These risk premia can best be harvested via alternative beta indices: “All we really say in finance is hold diversified portfolios along whatever tilt you choose.” (Eugene Fama).
On the Robustness of Alternative Beta Benefits

- While alternative beta indices are an attractive alternative to CW benchmarks, one should question the robustness of their benefits.

- Alternative beta features that are expected to be robust:
  - Better diversified portfolios will enjoy a higher risk-adjusted performance compared to more concentrated portfolios.
  - Excess returns that can be regarded as compensation for extra risk are not likely to vanish overnight.

- Alternative beta features that are not expected to be robust:
  - Well-rewarded factors can underperform (and they will at the worst possible times, which is the very reason why they are rewarded).
  - Anomalies such as the outperformance of low volatility stocks may eventually disappear when taken out of over-optimized track records.
Back to CalPERS Needs

- CalPERS portfolio priorities:
  - PP1: Protect funding ratio (mitigate severe drawdowns);
  - PP2: Stabilize contribution rate (reduce portfolio volatility);
  - PP3: Achieve long-term required rate of return (performance).

- One can envision the following blend of alternative betas (in addition to CW index):
  - Low vol selection with min vol weighting scheme (PP1 & PP2)
  - Max diversification index for better diversification (PP2 & PP3)
  - Multi-factor index for efficient risk premium harvesting (PP2 & PP3)
Benchmark Consideration | Global Fixed Income Segments

What could a set of benchmarks look like for the following segments?

Speaker: Rose Dean, Vice President - Wilshire Associates

Global Fixed Income (Three Segments)

- US Government Related (Treasury and Agency)
- Spread Products ( Corporates, Mortgages, Sovereigns)
- High Yield
Asset Class Roles and Macroeconomic Environments

- Asset segments within the GFI portfolio have a range of exposures to macroeconomic factors.
Benchmark Consideration | Inflation Assets Segments

What could a set of benchmarks look like for the following segments?

Speaker: Ron Lagnado, Investment Director – Asset Allocation & Risk Management

Inflation Assets (Two Segments)

• Inflation Linked Bonds

• Commodities
Inflation Asset Segments | Distinctiveness

Inflation Assets
Cumulative De-trended Compound Returns Sorted by Global Equity (1997 to 2016)

US Treasury Inflation Protected Securities
Global Equity
US Government 20+ Year
Commodities

Inflation Asset Segments | Distinctiveness

Inflation Assets
Cumulative De-trended Compound Returns Sorted by US Inflation
(1997 to 2016)

Break
Testing GE & GFI Segments | Distinctiveness

GE and GFI Segments
Cumulative De-trended Compound Returns Sorted by Global Equity
(2000-2016)


Testing GE Segments | Robustness
Cumulative Returns Over Market Events

Illustration goes to the end of the equity recovery
Testing GFI Segments | Robustness
Cumulative Returns Over Market Events

**Drawdown #1:** Dot-com Bubble
**Drawdown #2:** Global Financial Crisis


Illustration goes to the end of the equity recovery
Efficient Frontiers – All Segments

2016 Ten Year Horizon Expected Returns & Volatilities

- 2016 Existing Asset Classes
- 2016 with Global Equity Segments
- 2016 with Global Fixed Income Segments
- 2016 with All Segments

<table>
<thead>
<tr>
<th></th>
<th>Same Volatility Level</th>
<th>Same Return Level</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Expected Return</td>
<td>Expected Volatility</td>
</tr>
<tr>
<td>2016 Existing Asset Classes</td>
<td>6.13%</td>
<td>11.00%</td>
</tr>
<tr>
<td>2016 with Global Equity Segments</td>
<td>6.23% (+0.10%)</td>
<td>11.00%</td>
</tr>
<tr>
<td>2016 with Global Fixed Income Segments</td>
<td>6.29% (+0.16%)</td>
<td>11.00%</td>
</tr>
<tr>
<td>2016 with All Segments</td>
<td>6.39% (+0.27%)</td>
<td>11.00%</td>
</tr>
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### Next Steps | 2017 Milestones To Support Board ALM Decision Making

<table>
<thead>
<tr>
<th>Delivery Date</th>
<th>Decision Point</th>
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| February 21, 2017      | Agenda Item (Information): To support alternative asset allocation approach  
|                        |   — Follow-up to address takeaways from January Board Offsite discussion on Public Assets (GE/GFI/Inflation)  
|                        |   — Introduce Private Equity (PE) Role, Segments, and Benchmarks  
| Investment Committee* |                                                                                                                                            |
| April 17, 2017         | Agenda Item (Information): To support alternative asset allocation approach  
|                        |   — Follow-up to address takeaways from February IC discussion on Public Assets (GE/GFI/Inflation) plus Private Assets (PE)  
|                        |   — Introduce Real Assets (RA) Roles, Segments, and Benchmarks  
| Investment Committee* |                                                                                                                                            |
| June 19, 2017          | Agenda Item (Action): To adopt capital market assumptions (CMAs)  
|                        |   — CMAs will support current and alternative (segment) approaches to ALM decision making  
| Investment Committee* |                                                                                                                                            |
| July 17, 2017          | Workshop Session: To support alternative asset allocation approach  
| Board Workshop*        |   — Propose alternative asset allocation approach using both public and private asset segments  
|                        |   — Introduce use of leverage, if applicable, in strategic ALM decision making  
|                        |                                                                                                                                            |
| November 13, 2017      | Workshop Session: To present candidate portfolios  
| ALM Workshop*          |   — Under current asset allocation approach: Asset Class  
|                        |   — Under alternative asset allocation approach: Segments  

*May need Closed Session for segments chosen to allow for asset allocation deployment.
Board Q&A
## Appendix: Definitions

<table>
<thead>
<tr>
<th>Role</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Income</td>
<td>Generate current cash flow</td>
</tr>
<tr>
<td>Inflation</td>
<td>Provide protection against inflation</td>
</tr>
<tr>
<td>Diversification</td>
<td>Reduce risk associated with public equity exposure</td>
</tr>
<tr>
<td>Growth</td>
<td>Increase sensitivity to economic growth</td>
</tr>
<tr>
<td>Liquidity</td>
<td>Ability to convert assets into cash</td>
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