Portfolio Priorities – Asset Liability Management Considerations

July 18, 2016

CalPERS Board of Administration and Executive Offsite
What We Hope to Accomplish Today

- Refresh – Progress and Goals
- Discuss – More Risk-Aware Asset Allocation
- Discuss – Benchmark Review Methodology Enhancements
- Understand – Next steps and Asset Liability Management (ALM) Impacts
Where we are today

- **$295B Portfolio**: Stocks, bonds, real estate, private equity, and other public and private investment vehicles
- **Cost & Transparency**: Continual focus
- **Liquidity and Income**: Increasing challenge to manage risk and pay benefits in all market conditions
- **7.5% Return Target**: Very challenging
- **Cash-flow Gap**: Increasing annual shortfall (at an average of approx. $1B per year)
Collaboration: Asset Liability Management Advisory Committee (ALMAC) plans to bring further discussion forward to the Board including January and July 2017 Offsites to obtain feedback and share progress.

Chaired by the Chief Financial Officer, this multi-discipline advisory body oversees the planning, development, and execution of key business processes related to CalPERS’ cyclical asset-liability management (ALM) processes.
Portfolio Priorities | Reflects January 2016 Board Offsite Discussion

Portfolio Priorities are 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*)
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CalPERS Strategic Plan – Goal A (Supports Current and Future Board Planning)
Improve long-term pension and health benefit sustainability.

- Objective: Fund the System through an integrated view of pension assets and liabilities
- Strategic Initiative: Actively manage and assess funding risk through an asset liability management framework to guide investment strategy and actuarial policy

CalPERS Pension & Investment Beliefs
- Sound understanding and deployment of enterprise-wide risk management is essential to the ongoing success of a retirement system. (Pension Belief 9, Board Adopted May 2014)
- Liabilities must influence the asset structure. (Investment Belief 1, Board Adopted September 2013)

Asset & Liability Risk Factor Project Goal: Implement a more risk-aware ALM decision making process in relation to the Portfolio Priorities.
Key Messages | Today’s Presentation by EDHEC

1. What we have learned to date is that it is difficult, if not impossible, to have a single set of homogenous factors to clearly describe CalPERS assets and liabilities – regimes offer an integration path forward.

2. Project helps inform a cross-enterprise (ALMAC) understanding of the type of modeling environment necessary to achieve more enhanced ALM decision making process.

3. The impact of macro-economic factors on liabilities will be more direct while the impact on assets is less direct – today, EDHEC will focus on liabilities.

4. A regime aware strategic asset allocation process will provide a more explicit linkage between assets and liabilities that is economically meaningful.

5. An integrated and consistent ALM framework will provide a better understanding of the likelihood that the Portfolio Priorities will be achieved under alternative asset allocations and allow the Board to make more informed decisions regarding risk appetite and tolerance.
Progress | Risk Factor Analysis is Incremental

Runs parallel: to inform staff’s continued work related to how we allocate assets today by asset class, and the exploration of asset segments and relevant benchmarks for use in Board decision making at this upcoming ALM cycle (2018).
Progress | What does it look like?

1. Increasing Transparency and Awareness: of risk-return trade-off when considering interconnection of assets and liabilities throughout ALM cycle.

2. Enhanced Modeling Capability: to evolve knowledge of both asset and liability risk exposure specific to CalPERS.

3. More Focused Projection of Liabilities: to support the Board’s asset allocation decision making this upcoming ALM cycle (2018).

4. More Risk-Aware Board Decision Making: in relation to the Portfolio Priorities which takes into account both asset and liability risk exposure applicable to CalPERS in time for the Board’s next ALM cycle (2022).
## Milestones | To Support Board ALM Decision Making

<table>
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| November 2017 ALM Workshop | Stochastic model designed to provide:  
  – More flexible liability modeling to vary parameters  
  – More robust projections of liabilities and interconnection with asset performance  
  
  … leading to an enhanced understanding of the risks (percentage likelihoods) that during a defined period:  
  – Funded status will fall below a critical % threshold  
  – Contribution rates will increase to a critical % threshold  
  – Contribution rates will increase by a critical % threshold in any one year |
| November 2021 ALM Workshop | Scalable, repeatable, and integrated risk modeling process to:  
  – Translate macroeconomic factors impacting liabilities into factors which can be mapped to asset segments  
  – Enhance Board’s ability to establish its risk appetite and tolerances.  
  – Increase likelihood risks are fully understood, intended and compensated within and across asset classes and segments. |
INTRODUCING A CONSISTENT ASSET-LIABILITY MANAGEMENT FRAMEWORK

PROFESSOR LIONEL MARTELLINI
EDHEC RISK INSTITUTE
EDHEC BUSINESS SCHOOL

PROFESSOR JOHN M. MULVEY
OPERATIONS RESEARCH AND FINANCIAL ENGINEERING
BENDHEIM CENTER FOR FINANCE
PRINCETON UNIVERSITY

JULY 18, 2016
I. A Need for a Consistent, Regime-Aware Asset-Liability Management Framework

II. Impact of Macro-Economic Factors on Liabilities

III. Difficulty Explaining Both Assets and Liabilities with Macro-Economic Factors

IV. A Regime-Aware Asset-Liability Management Framework

V. A Consistent and Integrated Asset-Liability Management Framework
A Need for a Consistent, Regime-Aware Asset-Liability Management Framework
Our Goals

- **End Goal:** *Construct a more risk-aware Asset-Liability Management (ALM) decision making process*
  - Increase likelihood of achieving Portfolio Priorities
  - Inform risk tolerance
  - Apply consistent scenarios for both assets and liabilities

- **Mean Goal:** *Improve understanding of key drivers*
  - Explainable factors which link CalPERS liabilities and assets
  - ALM evolution (asset classes and segments)
What Do We Need?

- Enhance modeling ability
  - Stochastic modeling for both assets and liabilities
  - Enrich current liability modeling with more flexibility to vary parameters

- Design a scalable, repeatable and measurable system which can be validated to impact Portfolio Priorities

- Link micro-factors within CalPERS asset classes and/or asset segments to macro-economic regimes
Impact of Macro-Economic Factors on Liabilities
Two potential macro-economic factors that affect CalPERS Liabilities are:

- Gross Domestic Product (GDP) growth
  - U.S. and California
- Inflation

Impact on salaries and retirement benefits
History – Benefit Payments, US GDP and US Inflation

- The Public Employees’ Retirement Fund (PERF) benefit payments grew faster than US GDP and US Inflation

Inflation is represented by US CPI Urban Consumers NSA Index
Source: CalPERS Annual Financial Reports and Bloomberg.
History – Payroll, CA GDP and US Inflation

- The PERF payroll and CA GDP showed a strong relationship

Source: CalPERS Comprehensive Annual Financial Reports and Bloomberg.
Hypothetical Scenario – Study A*

- Increase inflation to 4.75% from 2.75%
- Limitations of this study
- Directional impacts
  - Higher employer contribution rates
  - High present value of contributions
  - Non linear relationship due to purchase power capture for retirees
- Inflation will not impact all assets in the same manner

* Study conducted in collaboration with CalPERS Actuarial Office
Hypothetical Scenario – Study B*

- Increase payroll growth to 5% (other parameters remained the same including inflation = 2.75%)

- Economic growth in California will have a beneficial impact near-term on the pension system
  - Active-to-retiree ratio improves since more people are hired with a higher GDP
  - Funding ratio improves somewhat faster
  - Average employer contribution rate drops initially

* Study conducted in collaboration with CalPERS Actuarial Office
Difficulty Explaining Both Assets and Liabilities with Macro-Economic Factors
Challenges in Factor-Based ALM

- **Liabilities:**
  - Are related to macro-economic factors (growth and inflation)
  - Are not marked-to-market
    - Smoothing of accrued liabilities
    - Salaries and benefits react slowly to changes in economic growth and inflation
    - Cash-flows are discounted at a fixed rate

- **Assets:**
  - Are discounted expected cash flows
  - Have poor linkage with macro-economic factors
Peers’ Approaches

- Statistical factors on the asset side in addition to macro-economic factors

- Asset returns as factors
  - Examples:
    - Equity Returns
    - Real Rates
    - Inflation Rates
    - Private Asset Returns (possible)

- Inconsistent
Maintaining Consistency

- Growth and inflation explain changes in liabilities
  - Employee salaries react to both factors (hard to separate, intertwined)

- Growth and inflation do not explain changes in assets, but they define meaningful economic regimes for asset returns
A Regime-Aware Asset-Liability Management Framework
A Regime-Aware ALM Framework

- Provide a consistent and meaningful linkage between asset return scenarios and liability cash flow scenarios.

- Substantial influence (albeit highly non-linear) of macro-economic regimes on asset returns.

- Capture the influence through macro-economic regimes:
  - Expected returns and volatilities across the regimes are different.
An Illustrative Example*

- Assume that the current state of the economy is defined by GDP growth and inflation:

<table>
<thead>
<tr>
<th>Economic State</th>
<th>Inflation</th>
<th>GDP Growth</th>
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<tbody>
<tr>
<td>Economic State 1</td>
<td>High</td>
<td>High</td>
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<tr>
<td>Economic State 2</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Economic State 3</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Economic State 4</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

* See the appendix for a preliminary analysis of regimes
An Illustrative Example (continued)

- Risk and return parameters of asset classes are related to regimes

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Source: AQR, “Inflation in 2010 and Beyond? Practical Considerations for Institutional Asset Allocation”, July 2010
A Consistent and Integrated Asset-Liability Management Framework
How to Use an ALM System?

- Focus on CalPERS Portfolio Priorities:
  1. Protect the Funded Ratio
  2. Stabilize Employer Contribution Rates
  3. Achieve Long-term Required Rate of Return

- A key tool in the decision-making process:
  - Identify candidate policy portfolios
  - Generate meaningful estimates related to the Portfolio Priorities
    - Probability and magnitude of a large shortfall
    - Volatility of contribution rates
    - Expected return
Issues to Address When Constructing a Consistent ALM System

- Macro-economic factors and regimes
  - Inflation
  - Economic growth

- Pension plan structure and rules
  - Benefits, retirement dates, cost-of-living-adjustment
  - Funding ratio (discount rates, asset performance)
  - Demographics (longevity, workforce composition)

- Goal: Identify candidate policy portfolios based on Portfolio Priorities
Regime/Factor Models Are Well Placed to Support ALM

- Regimes imply inflation/economic growth patterns
  - Stochastic scenarios for both asset performance and liability cash flows (consistent)

- Asset allocation decisions are modeled with reference to CalPERS Portfolio Priorities
  - Search for improving allocation

- ALM system output
  - Candidate policy portfolios
  - Risk profiles of significant issues
  - Summary statistics (e.g. volatility of employer contribution)
Next Steps

Investigate (2017)

• Identify regimes
• Link micro-factors within asset classes and segments to regimes
• Further analysis of how factors impact liabilities and assets over different time horizons

Illustrative purposes only – not based on actual data
Next Steps (continued)

Extend ALM System (2017)

- Continue to study existing ALM systems
- Develop consistent set of scenarios between asset performance and liabilities
- Apply robust optimization across regimes
- Stochastic model

Evaluate Regime Switching and Other Improvements (2019 and beyond)

- Scalable, repeatable, and integrated risk mitigation process
Wrap-Up

- What we have learned to date is that it is difficult, if not impossible, to have a single set of homogenous factors to clearly describe CalPERS assets and liabilities – regimes offer an integrated path forward.

- Project helps inform a cross-enterprise (ALMAC) understanding of the type of modeling environment necessary to achieve more enhanced ALM decision making process.

- The impact of macro-economic factors on liabilities will be more direct while the impact on assets is less direct.

- A regime-aware strategic asset allocation process will provide a more explicit linkage between assets and liabilities that is economically meaningful.

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Appendix: Major Risk: Higher Inflation Regime

(Equities suffer, liabilities increase)

High Inflation
(beware!)
Historical Patterns

Time Series of Inflation and GDP

- Economic State 1: (High Growth, High Inflation)
- Economic State 2: (Low Growth, High Inflation)
- Economic State 3: (Low Growth, Low Inflation)
- Economic State 4: (High Growth, Low Inflation)

Economic States colored:
- Yellow: Economic State 1
- Red: Economic State 2
- Blue: Economic State 3
- Green: Economic State 4

Graph shows the time series of inflation and GDP from 1970 to 2015.
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### Progress From January 2016 | Check In

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<td>Multiple Benchmarks are Considered Important to Form a Mosaic of Assessment</td>
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Benchmarks Defined from Total Fund Perspective

Consider industry best practices and CalPERS’ Investment Beliefs and Portfolio Priorities

The Portfolio Priorities are listed on slide 5 of this presentation
Portfolio Priority 1 | Drawdown Illustrative Example

- Example fixed income (FI) and public equities (Equities) benchmarks plotted for illustrative purposes only. Drawdown is the maximum loss from a peak to a trough.
- Caveat: this chart does not consider correlation. When correlation between two assets is negative (Long Treasuries and Equities), higher volatility may be desirable as it results in better diversification.
Portfolio Priorities Orientation | Economic Regime

Understand the behavior of asset classes in different economic regimes

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<thead>
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<th>Economic State 1</th>
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<tr>
<td>Inflation: Low</td>
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<td>GDP Growth: High</td>
<td>GDP Growth: High</td>
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<table>
<thead>
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<th>Economic State 3</th>
<th>Economic State 2</th>
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<td>Inflation: Low</td>
<td>Inflation: High</td>
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<tr>
<td>GDP Growth: Low</td>
<td>GDP Growth: Low</td>
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</table>

Inflation: High
GDP Growth: High

Inflation: Low
GDP Growth: Low

Inflation: Low
GDP Growth: High

Inflation: High
GDP Growth: Low
Benchmark Review Oriented to CalPERS’ Portfolio Priorities
Illustrative Example| Fixed Income Benchmark Comparison

**Example Fixed Income Roles:**
- **Diversification**
- **Income**
- **Liquidity**

### Example Fixed Income Roles:
- **Diversification**
- **Income**
- **Liquidity**

### Legend (relative ranking)
- ◐ Best
- ○ Middle
- ○ Worst

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<td>Drawdown</td>
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<tr>
<td>Total Return Volatility</td>
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<td>Sensitivity to Equities</td>
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<tr>
<td><strong>Role: Income</strong></td>
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<td>Income Return</td>
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<td><strong>Role: Liquidity</strong></td>
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<td>Liquidity (cost of 5-day 5% sale of benchmark)</td>
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*Portfolio Priorities (PP) 1 through 3 are listed on slide 5 of this presentation*
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Next Steps | January 2017 Board Offsite

**Offsite Session:** To share progress and obtain Board feedback on staff’s continued work related to the exploration of asset allocation by segment and relevant benchmarks for use in Board decision making at this upcoming ALM cycle (2018).

- **Role of Asset Classes**
- **Benchmark Methodology Review**
- **Asset Segment Analysis**
- **ALM Planning**
- **2017-18 ALM Analysis & Engagements**
- **Risk Factor Analysis**
- **Alignment with Portfolio Priorities**
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– Glossary of Terms
Glossary

- This glossary is intended to provide “at hand” access to terms that will support discussion as part of this session.

- The definitions in this document are focused on their context within this session. Some terms may have additional meaning or uses not addressed in this document.
  - Definitions may have been adapted from their original sources for ease of reading or to better reflect the primary focus of the session.
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Asset-Liability Management (ALM)

Definition

Integrated approach to managing CalPERS’ assets and liabilities for the purpose of achieving a sound and sustainable pension fund.
Macro-Economic Factor

Definition

Measures related to the broader economy such as Gross Domestic Product (GDP) and Inflation.
Micro-Economic Factor

Definition

Measures that capture security (especially stock) characteristics such as industry membership, country membership, valuation ratios, and technical indicators. Today, the most commonly referenced micro factors are Value, Growth, Size and Momentum.
Asset Class

Definition:
A group of financial instruments that exhibit similar characteristics, behave similarly in the marketplace, and are subject to the same laws and regulations. ¹

CalPERS Example:

¹ Source: Adapted from Investopedia
Asset Class Role

Definition:
Different asset classes have different characteristics (i.e. risk and return profile, relative liquidity, etc.). Part of CalPERS' Asset Allocation Strategy is to ensure that these different characteristics are managed to efficiently support the long-term return target at an acceptable level of risk, while maintaining a well-diversified pool of assets.

As part of the 2013-14 ALM process asset class roles were defined based on their expected characteristics in five key areas:

1. Growth – How well does the asset class capture economic growth realized in the broad capital market
2. Risk Protection – How well does the asset class offset systematic equity risk
3. Inflation Protection – How well does the asset class hedge (attempt to offset the effects of) inflation
4. Liquidity – How fast can the asset be converted to cash without materially affecting the asset's price
5. Cash Yield – How well does the asset class support CalPERS' ongoing cash flow needs by providing sufficient and steady income
Asset Segment

Definition

Investable portions within traditional asset classes which carry stable and distinguishable characteristics of risk and returns which can be used to address Portfolio Priorities
Benchmark

Definition

A standard or point of reference against which things may be compared or assessed.¹ A comparison portfolio; a point of reference or comparison.²

Benchmarks can serve multiple roles, such as:

– Defining the investment opportunity set
– Measuring performance
– Expressing program goals³

Sources: ¹Adapted from Google.
² CFA Institute Glossary
³ January 2015 Board and Executive Offsite, Portfolio Priorities and Benchmarks Session
Capitalization-weighted Benchmark

Definition:
A type of market index in which individual components are weighted according to their market capitalization, so that companies with larger market values carry a larger percentage weighting.¹

CalPERS Example:
CalPERS’ Global Equity and Private Equity policy benchmarks are based on capitalization-weighted benchmarks.

¹ Source: Adapted from Investopedia
Correlation

Definition:

A statistical measure of how two securities move in relation to each other. Correlation is computed into what is known as the correlation coefficient, which ranges between -1 and +1.

– Perfect positive correlation (a correlation co-efficient of +1) implies that as one security moves, either up or down, the other security will move identically, in the same direction.

– Alternatively, perfect negative correlation means that if one security moves, the security that is perfectly negatively correlated will move in the opposite direction.

– If the correlation is 0, the movements of the securities are said to have no correlation; their co-movements are completely random.

Perfectly correlated securities are rare, rather investors typically find that securities have some degree of positive correlation. ¹

¹ Source: Adapted from Investopedia
Total Return

Definition

The rate of return taking into account capital appreciation/depreciation and income. Often qualified as follows: Nominal returns are unadjusted for inflation; real returns are adjusted for inflation.¹

For example, say you purchase a share for $10, which paid a dividend of a $1 per share, and the share is now trading at $12. Your capital appreciation in the investment is $2 or 20%, as the price of the share has increased $2 over your purchase price or cost basis. Your income return is $1, or 10%, for a total return on the shares is $3 or 30%.²

¹ Source: CFA Institute Glossary
² Source: Adapted from Investopedia
Capital Appreciation (as a component of Total Return)

Definition
A rise in the value of an asset based on a rise in market price.

Investments targeted for capital appreciation tend to have more risk than assets chosen for capital preservation and income generation, such as government bonds, municipal bonds, or dividend-paying stocks. Because of this, capital appreciation funds are considered appropriate for risk-tolerant investors.

Capital appreciation is one of two main sources of investment returns with the other being income (dividends, interest etc.).

Source: Adapted from Investopedia
Income (as a component of Total Return)

Definition

As a component of Total Return, income includes interest and dividends paid.

Source: Adapted from Investopedia
Maximum Drawdown

Definition

The maximum loss of a portfolio from a peak to a trough in portfolio value. Maximum drawdown is an indicator of downside risk.

Source: Adapted from Investopedia
Stochastic Modeling

Definition

A method of financial modeling in which one or more variables within the model are random.

Source: Adapted from Investopedia
Volatility

**Definition:**
A statistical measure of the dispersion of returns for a given security, portfolio or market index. Volatility is typically measured by using the standard deviation of the security, portfolio, or index returns. Commonly, the higher the volatility, the riskier the security.

*Source: Adapted from Investopedia*