Los Angeles City Employees’ Retirement System: Pension Symposium - Risk Analysis

February 9, 2017

Presented by:
Paul Angelo
Agenda

1. Risk Analysis
   - Proposed Actuarial Standard on Risk
   - Quantitative Risk Analyses Requested by LACERS

2. Deterministic Projections for Retirement and Health Plans Combined
   - Baseline
   - Sensitivity Tests
     - Change Investment Return Assumption
     - Change Mortality Assumption
     - Combined

3. ALM/Stochastic Modeling Methodology
   - LACERS Results
Risk is one of the biggest concerns facing public sector pension plan sponsors, boards and stakeholders.

To identify and address risk requires an understanding of what the risks are and what information is needed to take action.

Certain tools can help identify and quantify the types of risk and their magnitude.

Plan sponsors and boards can then make more informed and better decisions for the long term.

In this presentation, Segal will discuss the risks we see today and unfolding in the future.
Public sector pension plans (including LACERS) have aging populations...

Plan Risks Increase as Liabilities Increase

Pension Payee to Active Ratio - LACERS

Pension UAAL Per Active Member - LACERS

Health Payee to Active Ratio - LACERS

Health UAAL Per Active Member - LACERS

Note: The number of health payees receiving a subsidy for 2003 – 2006 have been estimated, since that information is not readily available.
Plan Risks Increase as Liabilities Increase

➢ …and are getting larger relative to their sponsoring entities.

Notes:
(1) The contribution rates for valuation years 2011 and later are after additional employee contributions.
(2) The comparability of contribution rates is affected by changes in funding methods, changes in actuarial assumptions, and phase-in adjustments related to the impact of new actuarial assumptions.
Role of Actuarial Assumptions and Methods

\[ C + I = B + E \]

Contributions + Investment Income equals Benefit Payments + Expenses

- Actuarial valuation determines the current or “measured” cost, not the ultimate cost
- Assumptions and funding methods affect only the timing of costs
Assessment and Disclosure of Risk

Recent Actuarial Standards Board activities
- Pension Task Force recommendations
- Exposure Draft of new Actuarial Standard of Practice (ASOP) on risk assessment

Why is the standard needed?
- Actuarial calculations require use of assumptions regarding future economic and demographic experience
- Intended users of these measurements may not understand the effect of future experience differing from the assumptions

When does this standard apply to actuaries?
- When performing a funding valuation
- When performing a pricing valuation of a proposed change that would, in the actuaries’ opinion, significantly change the types or levels of risk

What does the actuary need to do to comply?
- Include an assessment of each of the risks that the actuary identifies
- Assessment need not be based on numerical calculations
- Assessment should account for applicable plan circumstances – funding policy, investment policy, funded status, demographics, etc.
Steps the Actuary Needs to Take

- **Identify and assess risks** that may affect the plan’s future financial conditions
- Recommend a more detailed assessment if actuary believes it would be beneficial to intended users
- Calculate and disclose **plan maturity measures**
- Identify and disclose **historical values of actuarial measurements** that are significant in understanding plan risks
- Prepare actuarial communication
Identification of Risks

Risks related to economic variables
- Investment return
- Inflation
  - Price inflation
  - Wage inflation

Risks related to demographic events
- Mortality
- Payroll and/or population changes
- Retirement, disability, termination

Risks related to external forces
- Governance risk
- Regulatory risk
- Litigation risk
- Political risk

These risks are challenging to manage effectively
**Risk is Very Much in the Eye of the Beholder**

<table>
<thead>
<tr>
<th>Investment Returns and Volatility</th>
<th>Mortality/Longevity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plan Sponsor:</strong> Contributions will fluctuate and may increase to unsustainable levels</td>
<td><strong>Plan Sponsor:</strong> Longer life expectancies translate to higher contributions</td>
</tr>
<tr>
<td><strong>Member:</strong> Contributions may increase</td>
<td><strong>Member:</strong> Benefits may not retain purchasing power</td>
</tr>
</tbody>
</table>
Methods for Assessing Risk

- Scenario tests
  - Impact of one possible event, several simultaneous events, or several sequential events

- Sensitivity tests
  - Impact of change in actuarial assumption or method

- Stress tests
  - Impact of adverse changes in one or a few factors (assumptions or events)

- Stochastic modeling
  - Estimate probability distributions of potential outcomes by allowing for random variation in one or more inputs over time, such as investment returns
Examples of Plan Maturity Measures

- Ratio of market value of assets to payroll
- Ratio of actuarial accrued liability to payroll
- Ratio of retiree liability to total liability
- Ratio of net cash flow to market value of assets
- Ratio of benefit payments to contributions
- Duration of actuarial accrued liability
Examples of Historical Information

- Funded ratio
- Actuarially determined contribution
- Actuarial gains and losses
- Normal cost
- Plan settlement liability
- Comparison of actual contributions to actuarially determined contributions
- Plan participant count
- Covered payroll
Creating a 7.5% Return Portfolio - Illustration

Rolling the Dice
Investors grappling with lower interest rates have to take bigger risks if they want to equal returns of two decades ago.

<table>
<thead>
<tr>
<th></th>
<th>1995</th>
<th>2005</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonds</td>
<td>100%</td>
<td>52%</td>
<td>12%</td>
</tr>
<tr>
<td>U.S. Large Cap</td>
<td>20%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>U.S. Small Cap</td>
<td>5%</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>Non-U.S. Equity</td>
<td>14%</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>Real Estate</td>
<td>5%</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>Private Equity</td>
<td>4%</td>
<td>12%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expected return</th>
<th>7.5%</th>
<th>7.5%</th>
<th>7.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard deviation</td>
<td>6.0%</td>
<td>8.9%</td>
<td>17.2%</td>
</tr>
</tbody>
</table>

- Reduced inflation expectation has reduced investment returns
- More risk is needed now to achieve 7.5% expected return
- 7.5% portfolio has standard deviation of 17% now vs. 6% twenty years ago

*Likely amount by which returns could vary

Source: Calliau Associates

THE WALL STREET JOURNAL.
Investment Returns

Sample information provided by Segal Marco Advisors:

<table>
<thead>
<tr>
<th>Capital Market – Expected Long-Term Returns</th>
<th>Sample Portfolio Returns</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asset Class (%)</strong></td>
<td><strong>Year</strong></td>
</tr>
<tr>
<td>Domestic Equity (41%)</td>
<td>2014</td>
</tr>
<tr>
<td></td>
<td>2015</td>
</tr>
<tr>
<td></td>
<td>2016</td>
</tr>
<tr>
<td>Intl. Equity (22%)</td>
<td>2014</td>
</tr>
<tr>
<td>Core Fixed (12%)</td>
<td>2015</td>
</tr>
<tr>
<td>Core Real Estate (13%)</td>
<td>2016</td>
</tr>
<tr>
<td>Private Equity (12%)</td>
<td>2014</td>
</tr>
<tr>
<td></td>
<td>2015</td>
</tr>
<tr>
<td></td>
<td>2016</td>
</tr>
</tbody>
</table>

Expected return for same portfolio drifts down over time with increasing standard deviation
Continued improvements in mortality = longer periods of payment and higher costs

- An increase in the margin from approximately 10% to 20% would increase the employer contribution rate determined as of June 30, 2016 for the retirement plan by about 1.3% of pay, under the tables noted above.*

* A margin of 10% means actual deaths were 10% more than expected under the assumed mortality.

### Sample Life Expectancy

<table>
<thead>
<tr>
<th>Age</th>
<th>Sample Life Expectancy</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current LACERS Tables: RP-2000 Combined Healthy Family of Mortality Tables</td>
<td>65</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20.1</td>
<td>12.4</td>
<td>21.5</td>
</tr>
<tr>
<td>New Hypothetical Tables: RP-2014 Healthy Annuitant Family of Mortality Tables</td>
<td>65</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20.6</td>
<td>13.2</td>
<td>22.2</td>
</tr>
</tbody>
</table>
Workforce Demographic Risk

- Pension plan populations are getting older
  - Baby boomers aging

- Ratio of non-actives to actives
  - Only one measure of Plan maturity
  - Harder to restore financial health after losses
    - Less contributions to increase

- Higher ratios of market value of assets to payroll exacerbates the impact of investment losses on contributions

- Higher ratios of actuarial accrued liability to payroll exacerbates the impact of assumption changes on contributions
Questions and Discussions
Deterministic Projections – In General

- Projections provide a meaningful way to assess the long-term health of a pension plan
  - Not only provides information on what future funding measures might look like, but also their value relative to the current valuation date

- Deterministic projections are based on a defined set of inputs
  - “If this happens, then this is the result”
  - Useful for evaluating expected values for a given set of parameters
    - Quite often, inputs are based on all assumptions being met, with perhaps one or two deviations to demonstrate sensitivity
Deterministic Projections – LACERS Baseline

- Assumptions used in the June 30, 2016 valuations
- Reflects anticipated future savings associated with new hires entering the lower cost Tier 3
- Increased contribution rates for the 2029 – 2031 valuations reflect expiration of the amortization layers for the UAAL experience gains from the 2014 – 2016 valuations
Deterministic Projections – Sensitivity Tests

- What if we:

1) Decrease the investment return assumption from 7.50% to 7.25%, effective with the June 30, 2016 valuations

2) Change the mortality table assumption from the RP-2000 Combined Healthy family of tables to the RP-2014 Healthy Annuitant family of tables, effective with the June 30, 2016 valuations

3) Do 1) and 2) at the same time

- All projections reflect anticipated future savings associated with new hires entering the lower cost Tier 3
Decrease the investment return assumption from 7.50% to 7.25%
Deterministic Projections - Mortality

- Change mortality table assumption from RP-2000 to RP-2014 family of tables
Deterministic Projections – Combined

➢ Change investment return assumption and mortality assumption

![Fund Ratio](image1.png)

![Employer Rate](image2.png)

![Fund Ratio Combined](image3.png)

![Employer Rate Combined](image4.png)

Segal Consulting 24
What is Stochastic Asset Liability Modeling (ALM)?

- A projection of the System’s assets, liabilities and their interaction, enabling analysis of key fund characteristics over a period of time.
- A series of valuations which are performed each year into the future based on a variety of projected future economic scenarios.
- An illustration of the variability of projected future economic scenarios derived from the asset classes and their inherent characteristics.
- A display of many different valuations performed each year with results ranked from highest to lowest.
- A final product consisting of a series of events with associated probabilities of occurrence.
Specific ALM Methodologies and Assumptions

- Examine probable employer contribution rate changes under different asset return scenarios
- Used LACERS’ current target asset allocation, which has remained unchanged from that used in our 2014 Experience Study
- Expected returns, standard deviations, and other economic assumptions provided by Segal Marco Advisors (SMA)
- Project investment returns using 10,000 Monte Carlo simulations
- Developed projected contribution rates, UAAL, and funded ratio for retirement and health plans combined from June 30, 2016 through 2031 (15-year period)
Specific ALM Methodologies and Assumptions

- Expected indexed returns provided by SMA. No adjustments for:
  - Additional return (alpha)
  - Expense from active portfolio management

- 7.3% geometric rate of return at the 50th percentile return over the next 15 years using current SMA capital market assumptions

- Note that Segal valuation uses 7.5% investment return assumption:
  - Using capital market assumptions from 9 investment firms
  - 3.25% inflation assumption
  - 0.40% adjustment for investment and administrative expenses

- For illustrative purposes, this analysis uses SMA expected returns
Segal’s 7.5% investment return assumption for LACERS was developed in 2014 based on the latest asset allocation as of that date:

- 24% U.S. equity (20.40% large cap and 3.60% small cap)
- 21.75% developed international equity
- 7.25% emerging market equity
- 16.53% core bonds
- 2.47% high yield bonds
- 5% private real assets
- 5% credit opportunities
- 1% cash
- 5% public real assets
- 12% private equity
Stochastic Projections

- Stochastic projections provide a view of expected outcomes with an element of probability attached.
- Capital Market Assumptions (CMAs) are estimates for expected risk and return for a given set of asset classes, as well as the expected relationship between classes.

### Sample CMAs

<table>
<thead>
<tr>
<th>Class</th>
<th>Expected Return</th>
<th>Risk/Volatility</th>
<th>Core Fixed</th>
<th>Non-Core Fixed</th>
<th>US Equity</th>
<th>Non-US Equity</th>
<th>Emerging Equity</th>
<th>Real Estate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Fixed</td>
<td>2.6%</td>
<td>4.75%</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Core Fixed</td>
<td>4.3%</td>
<td>14.25%</td>
<td>0.43</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US Equity</td>
<td>6.7%</td>
<td>19.00%</td>
<td>-0.07</td>
<td>0.64</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-US Equity</td>
<td>9.1%</td>
<td>24.00%</td>
<td>0.05</td>
<td>0.77</td>
<td>0.86</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emerging Equity</td>
<td>11.2%</td>
<td>29.75%</td>
<td>0.09</td>
<td>0.77</td>
<td>0.76</td>
<td>0.92</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Real Estate</td>
<td>6.3%</td>
<td>18.75%</td>
<td>0.28</td>
<td>0.54</td>
<td>0.49</td>
<td>0.45</td>
<td>0.44</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**Correlation Coefficients**
Stochastic Projections

- Portfolio investment returns are simulated using CMAs and the results of thousands of “trials” are tabulated into percentiles
  - **95th percentile**—5% chance of exceeding this value, 95% chance of falling below
  - **75th percentile**—25% chance of exceeding this value, 75% chance of falling below
  - **50th percentile** (i.e., mean value)—50/50 chance of exceeding or falling below this value
  - **25th percentile**—75% chance of exceeding this value, 25% chance of falling below
  - **5th percentile**—95% chance of exceeding this value, 5% chance of falling below

- Items can be modeled stochastically:
  - Expected investment return
  - **Unfunded actuarial accrued liability**
  - Funded ratio
  - Employer contribution rate
  - Effective amortization period (for plans with fixed contribution rates)
  - Many others
Below are two graphs that show the funded ratio and employer contribution for a sample pension plan.

**Stochastic Projections**

- For example, the sample tables above illustrate that there is a 25% probability of being less than 63% funded by 2025 and the contribution rate exceeding 41.6%.

Stochastic modeling can be used to establish and assess parameters for monitoring the health and direction of a System.
In 50% of the trials, the employer contribution rate is between 4% and 51% in 15 years.
In 50% of the trials, the UAAL is between -$3B and $12B in 15 years.

Baseline deterministic projection using current 7.50% investment return assumption.
In 50% of the trials, the funded ratio is between 71% and 107% in 15 years.
Stochastic Projections

**Caveat:** Projections, by their nature, are not a guarantee of future results. The modeling projections are intended to serve as illustrations of future financial outcomes that are based on the information available to us at the time the modeling is undertaken and completed, and the agreed-upon assumptions and methodologies described herein. Emerging results may differ significantly if the actual experience proves to be different from these assumptions or if alternative methodologies are used. Actual experience may differ due to such variables as demographic experience, the economy, stock market performance and the regulatory environment.

Capital market assumptions represent estimates of returns and standard deviations for the various asset classes. There can be significant differences in assumptions among investment advisors. Using a different set of assumptions could have a material impact on the calculations and the implications of this study.
Questions and Discussions
Appendix: Forecast Assumptions

- Asset allocations, returns, risk factors and correlations provided by Segal Marco Advisors (SMA) are summarized on the following pages.

- LACERS’ actual 2016/2017 return on market value of assets has not been reflected in these projections.

- Employment levels remain constant, with new entrants having characteristics similar to those reported in June 30, 2016 valuations.

- Demographic experience matches actuarial assumptions and liabilities calculated match those determined using the deterministic assumptions applied in the actuarial valuations.

- All other assumptions are the same as stated in the June 30, 2016 actuarial valuation reports.

- All calculations were completed under the supervision of Andy Yeung, ASA, MAAA, Enrolled Actuary and Thomas Bergman, ASA, MAAA, Enrolled Actuary who are members of the American Academy of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion herein.
LACERS asset allocation used in this stochastic study

<table>
<thead>
<tr>
<th>Asset Class Name</th>
<th>Target Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Equity</td>
<td>24%</td>
</tr>
<tr>
<td>Non-U.S. Equity</td>
<td>29%</td>
</tr>
<tr>
<td>Core Fixed Income</td>
<td>19%</td>
</tr>
<tr>
<td>Credit Opportunities</td>
<td>5%</td>
</tr>
<tr>
<td>Private Equity</td>
<td>12%</td>
</tr>
<tr>
<td>Public Real Assets</td>
<td>5%</td>
</tr>
<tr>
<td>Private Real Assets</td>
<td>5%</td>
</tr>
<tr>
<td>Cash</td>
<td>1%</td>
</tr>
</tbody>
</table>
Asset Information

- Capital market assumptions, as provided by SMA, are shown to the right.

- **Return**
  - Assumed average rate of return
  - Based on market indexes
  - Excluded additional return and associated expense from active management

- **Risk**
  - A measure of how much the returns may vary
  - Also called the standard deviation

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>Return</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Equity</td>
<td>8.8%</td>
<td>18.5%</td>
</tr>
<tr>
<td>Non-U.S. Equity</td>
<td>9.1%</td>
<td>18.9%</td>
</tr>
<tr>
<td>Core Fixed Income</td>
<td>3.8%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Credit Opportunities</td>
<td>7.0%</td>
<td>12.5%</td>
</tr>
<tr>
<td>Private Equity</td>
<td>13.5%</td>
<td>24.5%</td>
</tr>
<tr>
<td>Public Real Assets</td>
<td>8.5%</td>
<td>15.0%</td>
</tr>
<tr>
<td>Private Real Assets</td>
<td>6.6%</td>
<td>12.0%</td>
</tr>
<tr>
<td>Cash</td>
<td>3.2%</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

1 Arithmetical mean.
**Asset Information**

**Correlation Coefficients**

- A measure of how each asset class moves relative to movements in other asset classes
- Numbers represent direction only, not magnitude
- 1.00 means movement in the same direction; -1.00 means movement in the opposite direction

<table>
<thead>
<tr>
<th></th>
<th>Domestic Equity</th>
<th>Non-U.S. Equity</th>
<th>Core Fixed Income</th>
<th>Credit Opportunities</th>
<th>Private Equity</th>
<th>Public Real Assets</th>
<th>Private Real Assets</th>
<th>Cash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Equity</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-U.S. Equity</td>
<td>0.97</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core Fixed Income</td>
<td>0.06</td>
<td>0.11</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Credit Opportunities</td>
<td>0.75</td>
<td>0.78</td>
<td>0.26</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Private Equity</td>
<td>0.85</td>
<td>0.85</td>
<td>-0.34</td>
<td>0.67</td>
<td>1.00</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Public Real Assets</td>
<td>0.81</td>
<td>0.87</td>
<td>0.31</td>
<td>0.70</td>
<td>0.73</td>
<td>1.00</td>
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<tr>
<td>Private Real Assets</td>
<td>0.25</td>
<td>0.22</td>
<td>-0.25</td>
<td>-0.06</td>
<td>0.56</td>
<td>0.22</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Cash</td>
<td>-0.15</td>
<td>-0.11</td>
<td>-0.12</td>
<td>-0.18</td>
<td>-0.03</td>
<td>-0.03</td>
<td>0.11</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Stochastically Determined Investment Returns

- Current assumption is 7.5% per annum for actuarial valuations

Baseline deterministic projection using current 7.50% investment return assumption.