

Asset Liability Management: Creating and Assessing Candidate Portfolios

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Board of Administration Offsite
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Executive Summary

- In today's session, we discuss the ALM framework, and the tools we will use to help visualize risk and compare candidate portfolios.
- The CalPERS ALM process assists the Board in selecting a policy portfolio having a reasonable expectation of sustaining the plan. This choice balances the risks arising from the variability of three components: returns, liabilities, and contributions.
- The objective of the ALM process is to select a new strategic asset allocation and set a discount rate. Candidate portfolios support that objective, by providing the Board with different risk and return choices. Key visualizations focus on contribution and funding risk.
- CalPERS objectives and investment beliefs are reflected in many of the choices we've made in designing the ALM process.
- The ALM process is a collaborative effort of the Investment, Actuarial, and Financial Offices, working together to help the board select a portfolio that balances a variety of risks against the desire to minimize plan costs.
- Risk is multi-faceted, including those related to contributions and funding, ESG, and the portfolio.
- Visualizations are designed to aid the quantitative comparison of candidate portfolios and facilitate the final choice of a policy portfolio.

Contributions and funding ratio depend upon the liabilities, the long-term discount rate, and realized annual returns. This dependence on both realized returns and the estimate of “expected returns” introduces uncertainty into annual contributions.

Our Investment Beliefs Shape the ALM Process*

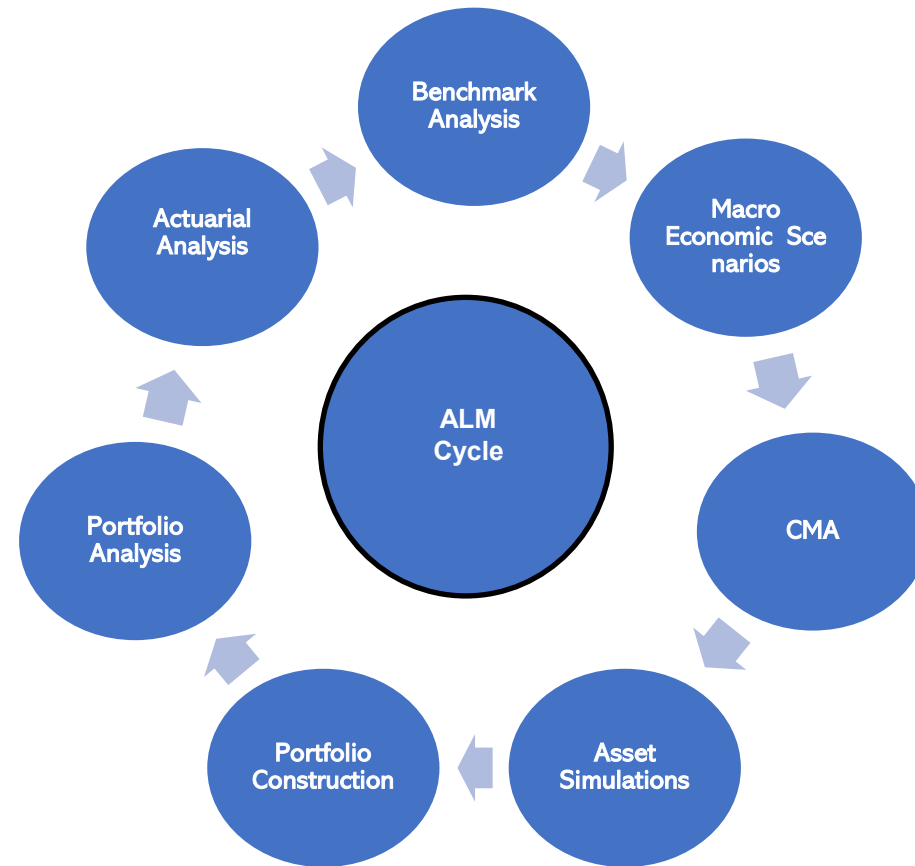
Liabilities must influence the asset structure.	Assessment of candidate portfolios will include material implications related to managing liabilities, contributions and funding ratios
A long time investment horizon is a responsibility and an advantage.	Our ALM process considers long term performance while facilitating opportunistic strategies, and sustaining appropriate levels of liquidity
CalPERS investment decisions may reflect wider stakeholder views, provided they are consistent with its fiduciary duty to members and beneficiaries	ESG implications of candidate portfolios will be assessed.
Long-term value creation requires effective management of three forms of capital: financial, physical and human	Financial and operational considerations influence the allocations within our Candidate portfolios
CalPERS must articulate its investment goals and performance measures and ensure clear accountability for their execution.	Our financial objectives are aligned with our constitutional objectives of maximizing returns while minimizing losses.
Strategic asset allocation is the dominant determinant of portfolio risk and return.	The ALM process focuses on efficiently harvesting long term risk premia associated with scalable risk factors
CalPERS will take risk only where we have a strong belief we will be rewarded for it	Our framework considers the range of expected returns, and the influence this uncertainty can have on total portfolio risk and return
Costs matter and need to be effectively managed.	Our analysis considers both employer and member costs, and the costs associated managing the portfolio
Risk to CalPERS is multi-faceted and not fully captured through measures such as volatility or tracking error.	We focus on contribution and funding risk, and how portfolio returns and volatility influence these two risks.
Strong processes and teamwork and deep resources are needed to achieve CalPERS goals and objectives.	The ALM process is a collaborative effort involving the investment and actuarial offices.

Investment beliefs represent the shared understanding of the factors we believe influence achieving our mission. These beliefs strongly influence our strategic decisions, including our culture, our investment strategy, and the design of our organization.



*California Public Employees' Retirement System Total Fund Investment Policy requires that as part of the rigor of the 4-year ALM cycle, the investment beliefs that guide us are reviewed and affirmed/modified if necessary.

ALM Process

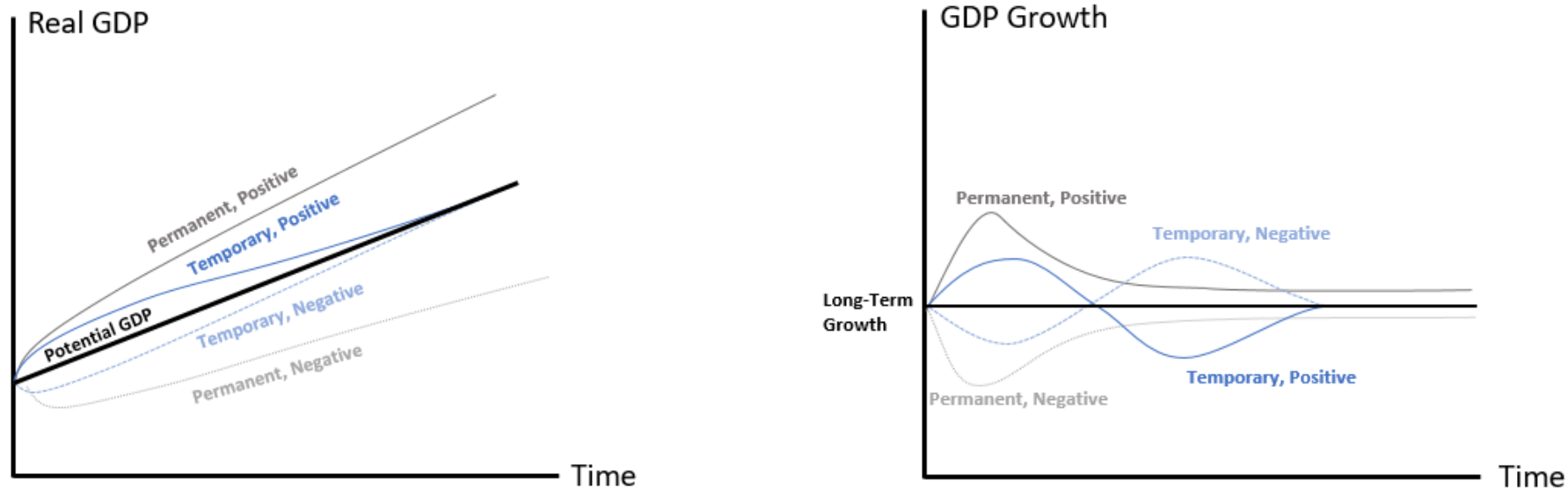


The CalPERS ALM process consists of a series of steps, each of which incorporates one or more of our beliefs. The process is a cycle, since the results of one step may lead to the need to review and possibly change assumptions in another step.

Economic Scenarios: Short-Term vs. Long-Term

Shocks or surprises contain different information.

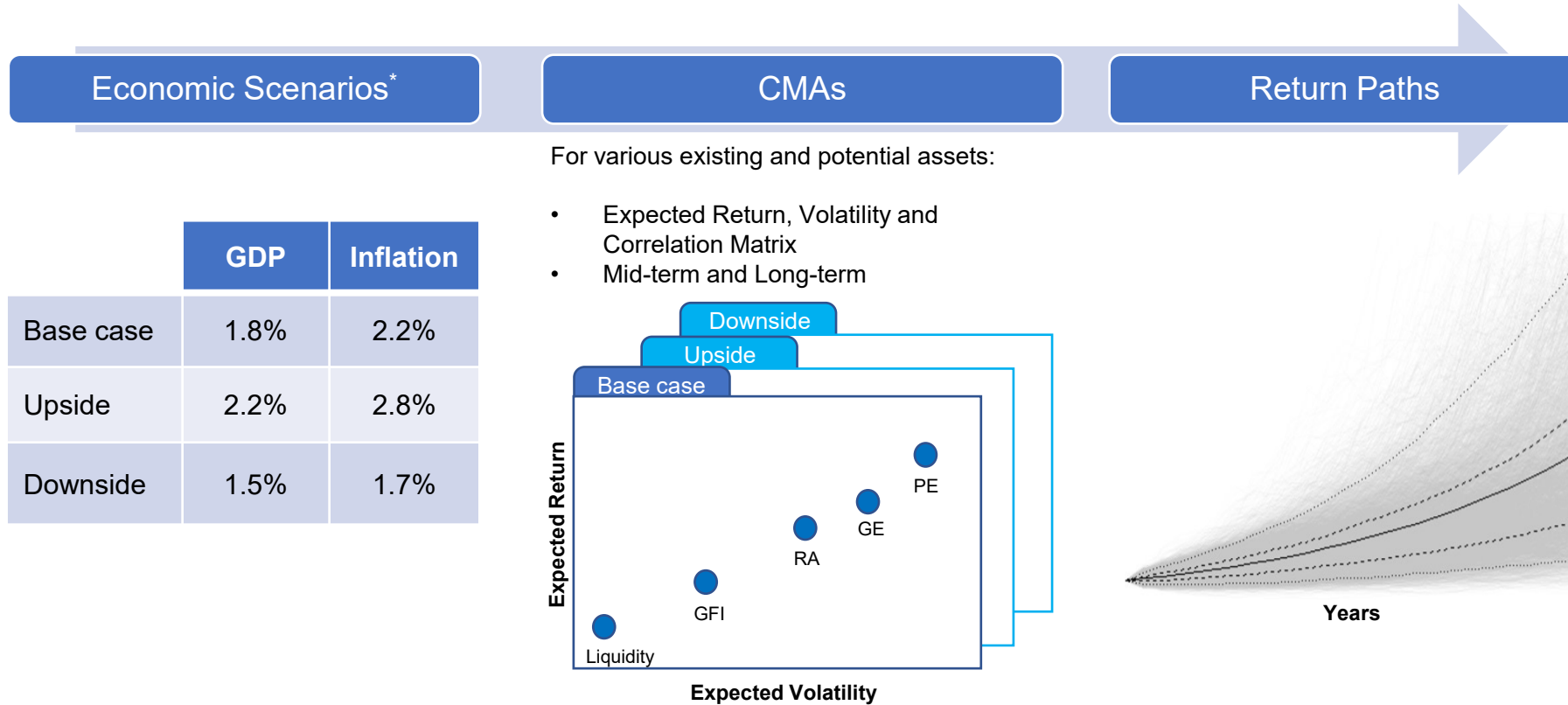
- Some shocks are short-lived - the surprise is large but contains little long-lived effects on the economy's GDP growth rate (blue lines).
- Other surprises feature very persistent effects (grey lines), which may impact the long-run equilibrium growth rate.
- Each of these shocks, or surprises are a separate scenario.



Our CMA survey results reflect the diversity of expert opinion regarding the influence of both short-term shocks and long-term factors on long-term expected returns. As long-term investors, we use the CMA survey to see past the short-term noise and better understand the potential for long term expected returns. Shorter term projections are more sensitive than long term projections to short term shocks.

What's in a scenario

Each scenario has the information needed to construct optimal portfolios, and to estimate discount rates, liabilities, and contributions.



Though each scenario has deterministic long term economic assumptions, the returns in the scenarios are not deterministic. For each scenario, returns are described by the expected returns, as well as other parameters representing the variability of returns.

Choosing Asset Classes

Qualitative Considerations

- Investment thesis
- Risk / return drivers
- Size of opportunity
- Priors on risk / return behavior
- Alignment with Investment Beliefs and Portfolio Priorities*
- Thematic considerations

Quantitative Metrics

- Risk / Return statistics
- Drawdown characteristics
- Income generation
- Diversification – relative to Total Portfolio and other asset classes
- Macro sensitivity (e.g. growth, inflation)
- Climate Risk/Sustainability profile

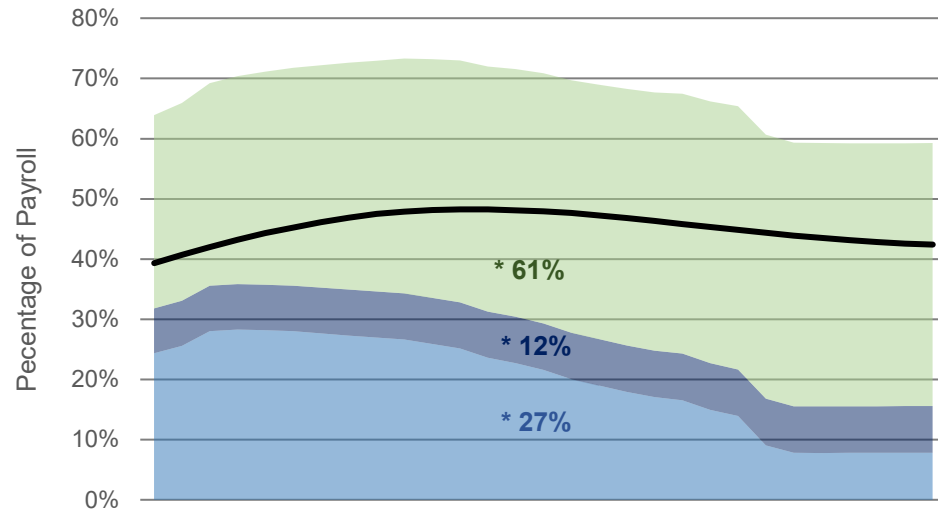
Implementation

- Scalability / Liquidity
- Implementation costs
- Operational considerations
- Expertise (Internal vs. External)

To ensure the CalPERS Policy Portfolio is feasible, we consider qualitative, quantitative and implementation factors when considering asset class allocations. For example, the competition for private investments is high, and so our allocation will balance our desire for higher returns against realistic expectations for fulfilling an allocation.

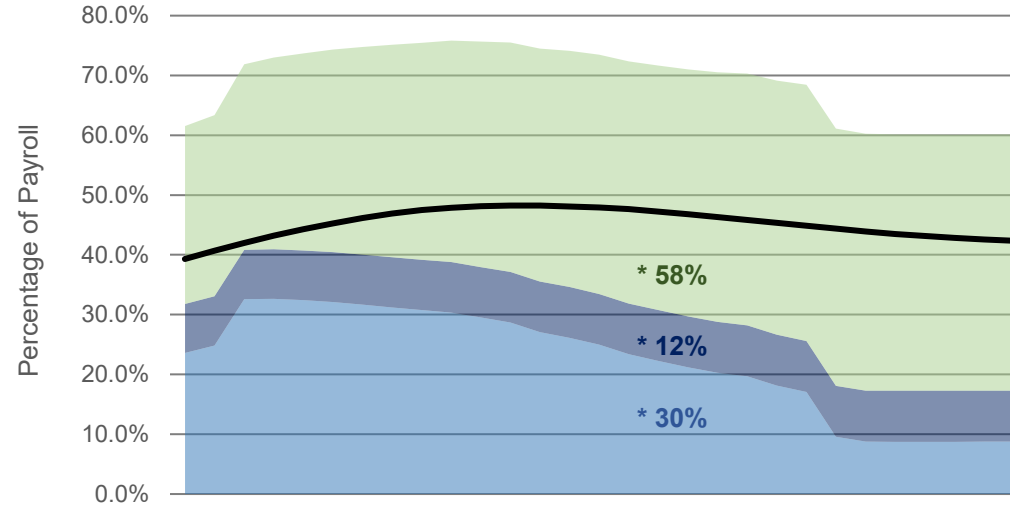
Illustrative Cash Flow Projection – 30 Years

Expected Investment Return



■ Employer Contributions ■ Employee Contributions
■ Investment Income — Benefit Payments

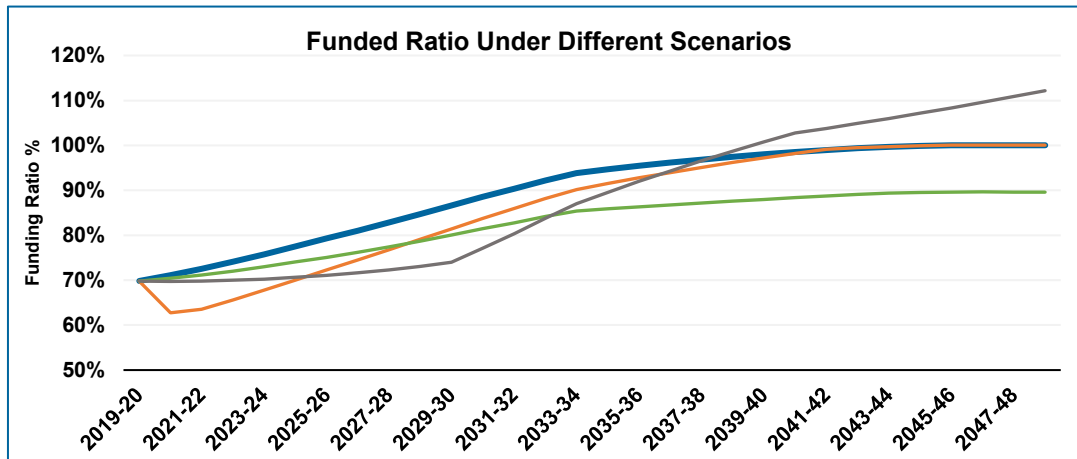
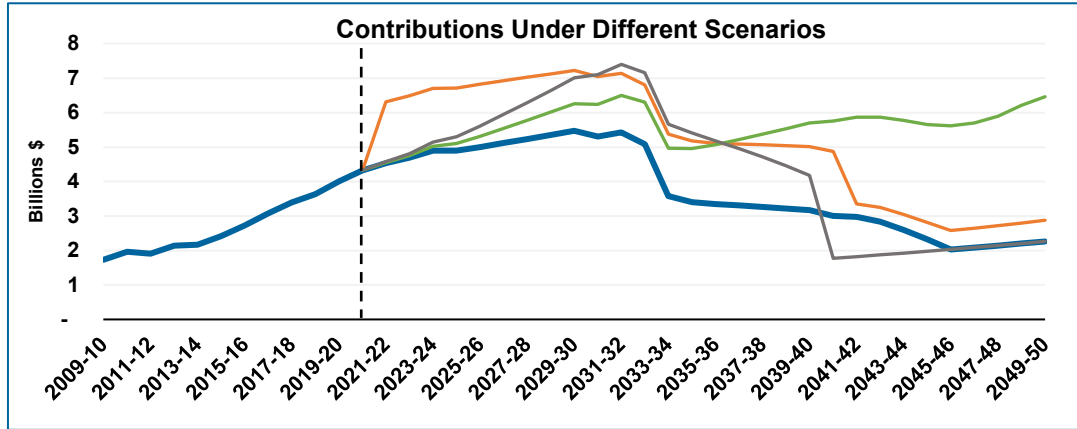
50 Basis Point Decrease in Expected Return



■ Employer Contributions ■ Employee Contributions
■ Investment Income — Benefit Payments

The combination of contributions and returns pays benefits and contributes to the funding status over time. Improving the funding status of a plan should lead to returns meeting a greater proportion of total payments. A planned decrease in expected returns leads to increases in contributions. On the next page we review in more detail the relationship between contributions, expected and actual returns, and funding ratio.

Returns & discount rate: examples from March presentation

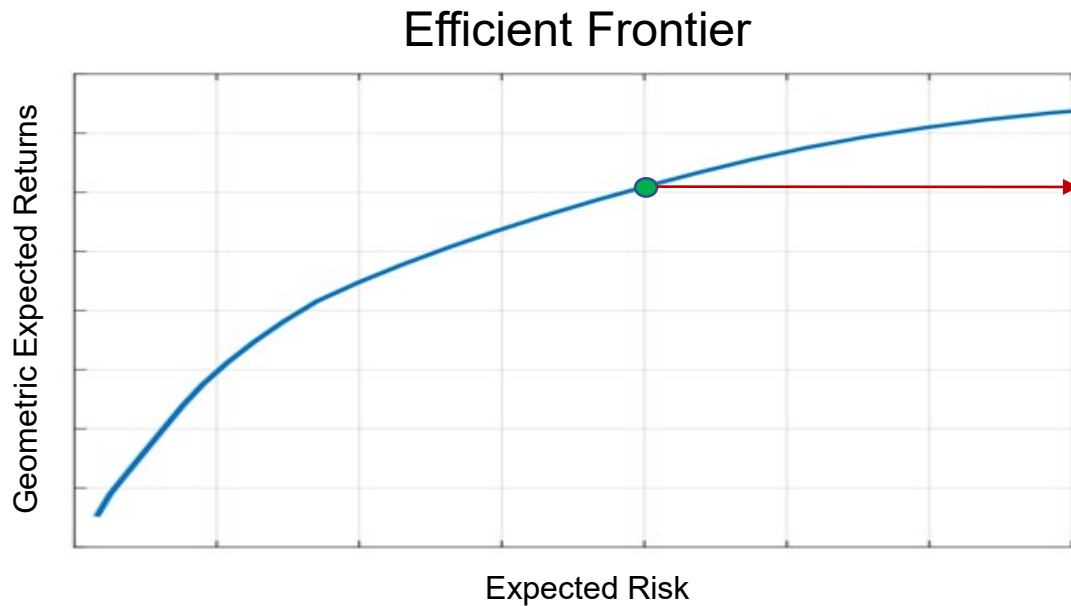


The path of expected contributions depends upon both the discount rate and the actual expected returns. (These examples ignore annual fluctuations caused by return variability)

<p>Example 1: Discount rate = 7% Expected Returns = 7% (Blue Lines)</p>	<ul style="list-style-type: none"> Contributions increase slowly from \$4.3B to \$5.4B in 2032, then decline when prior amortization amounts begin to roll off. Over twenty years, the funding ratio increases to 100%
<p>Example 2: Discount rate = 6% Expected Returns = 6% (Orange Lines)</p>	<ul style="list-style-type: none"> Contributions jump immediately by \$2.0B, then rise slowly to \$7.1B in 2032, after which contributions decline. After 20 years, contributions are similar to those in Example 1. Over twenty years, the funding ratio increases to 100%
<p>Example 3: Discount rate = 7% Expected Returns = 6% (Green Lines)</p>	<ul style="list-style-type: none"> Contributions increase from \$4.3B to \$6.5B in 2032, decline for a short period before rising again. Over twenty years, the funding ratio increases to 90%.
<p>Example 4: Discount rate = 7% Expected returns = 5% for 10 years, 8% for 20 years (Grey Lines)</p>	<ul style="list-style-type: none"> Contributions increase from \$4.3B to \$7.4 in 2032, decline for a short period before rising again. Over twenty years, the funding ratio increases to over 100%.

Contributions and funding ratio depend upon the liabilities, the long-term discount rate, and realized annual returns. This dependence on both realized returns and the estimate of “expected returns” introduces uncertainty into annual contributions.

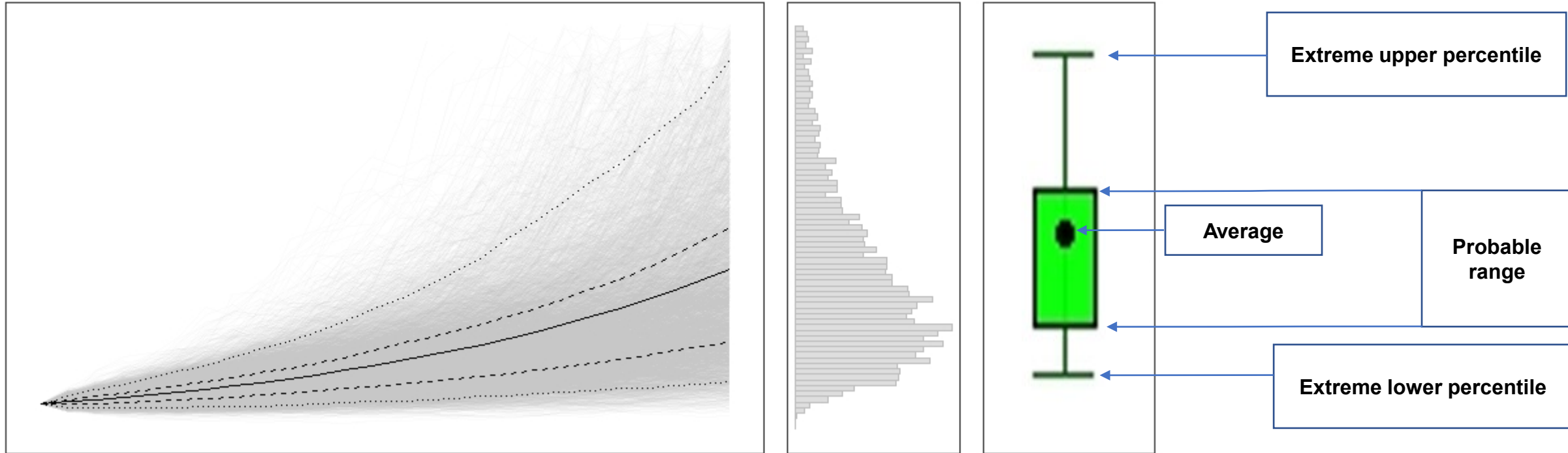
Candidate Portfolios



- The illustrative diagram to the left is constructed using a single set of capital market assumptions. Consistent with our constitutional objectives, we start by designing candidate portfolios to achieve an expected return, while ‘minimizing’ risk.
- Each point on the line represents the portfolio having the least risk for a given target return. The portfolios have different asset mixes.
- Each portfolio is considered “efficient” in that it represents the best tradeoff between risk and return. The universe of these efficient portfolios represent the “efficient” frontier.
- For this example, the green dot (•) indicates a portfolio with a specific expected return and risk. Any other portfolio with the same expected return will have higher risk (represented by the line ending with the red arrow (→)).

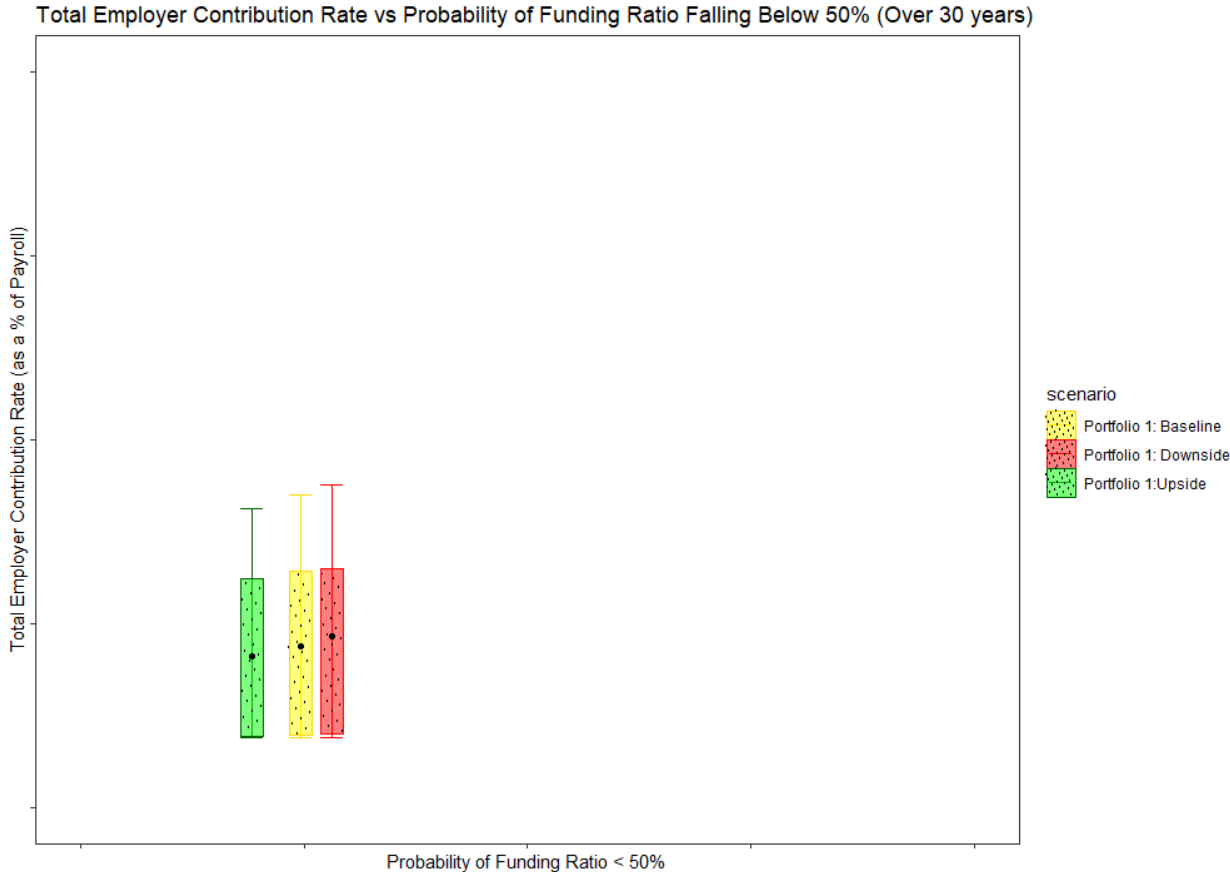
Finding the efficient portfolio is just the starting point, since it was designed based on expected returns and risk. We believe risk is multi-faceted, and so the other risk aspects of each candidate portfolio must also be assessed.

Return Paths Lead to Variability of Contributions & Funding Ratios



Each of 5,000 paths will have both portfolio returns and contributions. Our understanding of future outcomes is best represented by the range of outcomes, and not by any single path. We summarize detailed path information using a histogram (middle chart) or a whisker box (on the right). The whisker box represents the wide range of outcomes, the probable range of outcomes, and the average outcome.

Scenario Risk Analysis of a Portfolio



For this illustration we look at a single plan using three scenarios*.

The probability of the funding ratio dropping below 50% is plotted along the horizontal axis. Contribution rates are plotted along the vertical axis.

Looking at the base line (yellow) whisker box and comparing it with the vertical axis, the average contribution rate (the black dot) is around 20%, while probable values (the yellow box) range from 10% to 30%. An extreme value is over 40%. The lower extreme is aligned with the bottom of the box because there is a floor on contribution rates.

Looking at the horizontal axis, there is a roughly 24% probability the funding ratio will drop below 50% some time over the next 20 years.

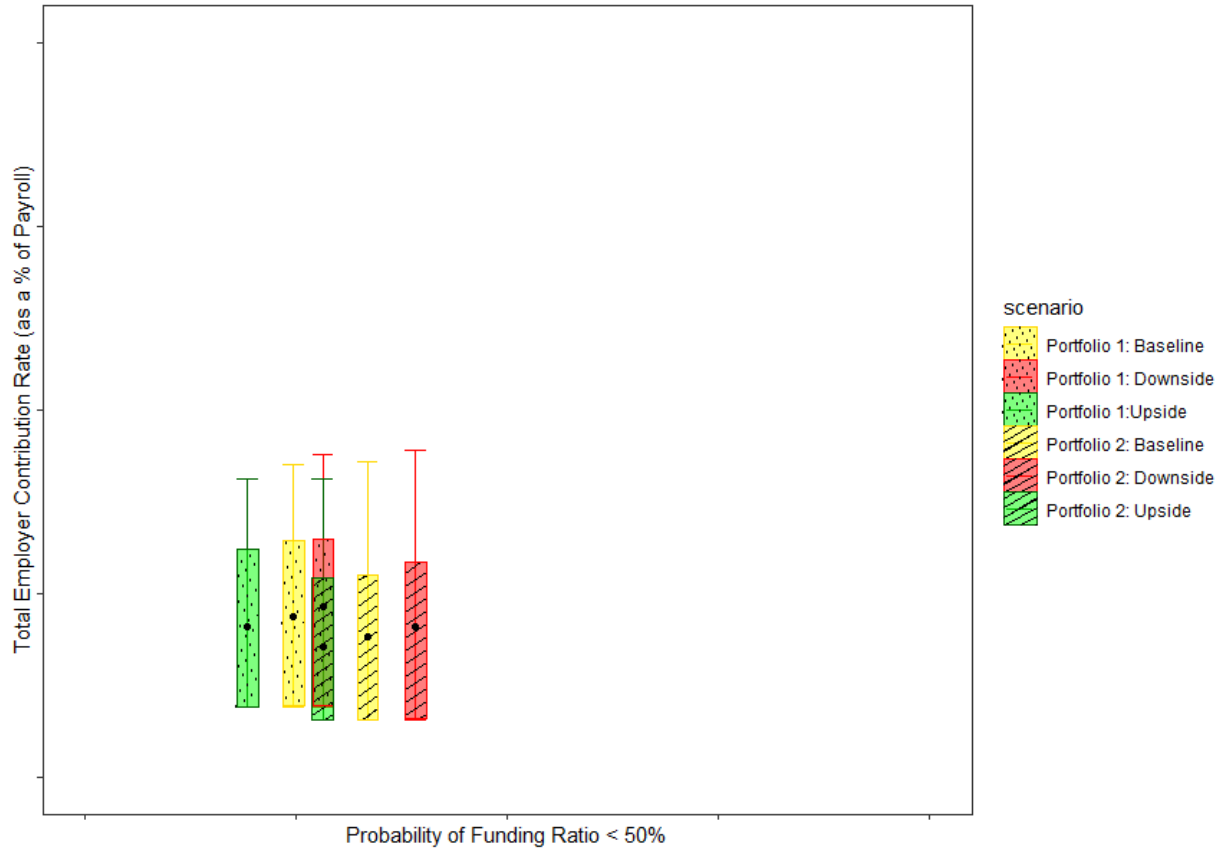
The red and green whisker boxes convey similar information.

Taken together, we can see the sensitivity of this plan to changes in economic outlook. This sensitivity assumes we do not change the portfolio or discount rate for twenty years. CalPERS does regularly review its ALM assumptions, so would have regular opportunities to change its portfolio and change these risk profiles.

The whisker chart helps us to visualize contribution and funding risk. This visualization shows key risk relationships for a plan and how these risks can vary across scenarios.

Visually Comparing Risks of Candidate Portfolios

Total Employer Contribution Rate vs Probability of Funding Ratio Falling Below 50% (Over 30 years)



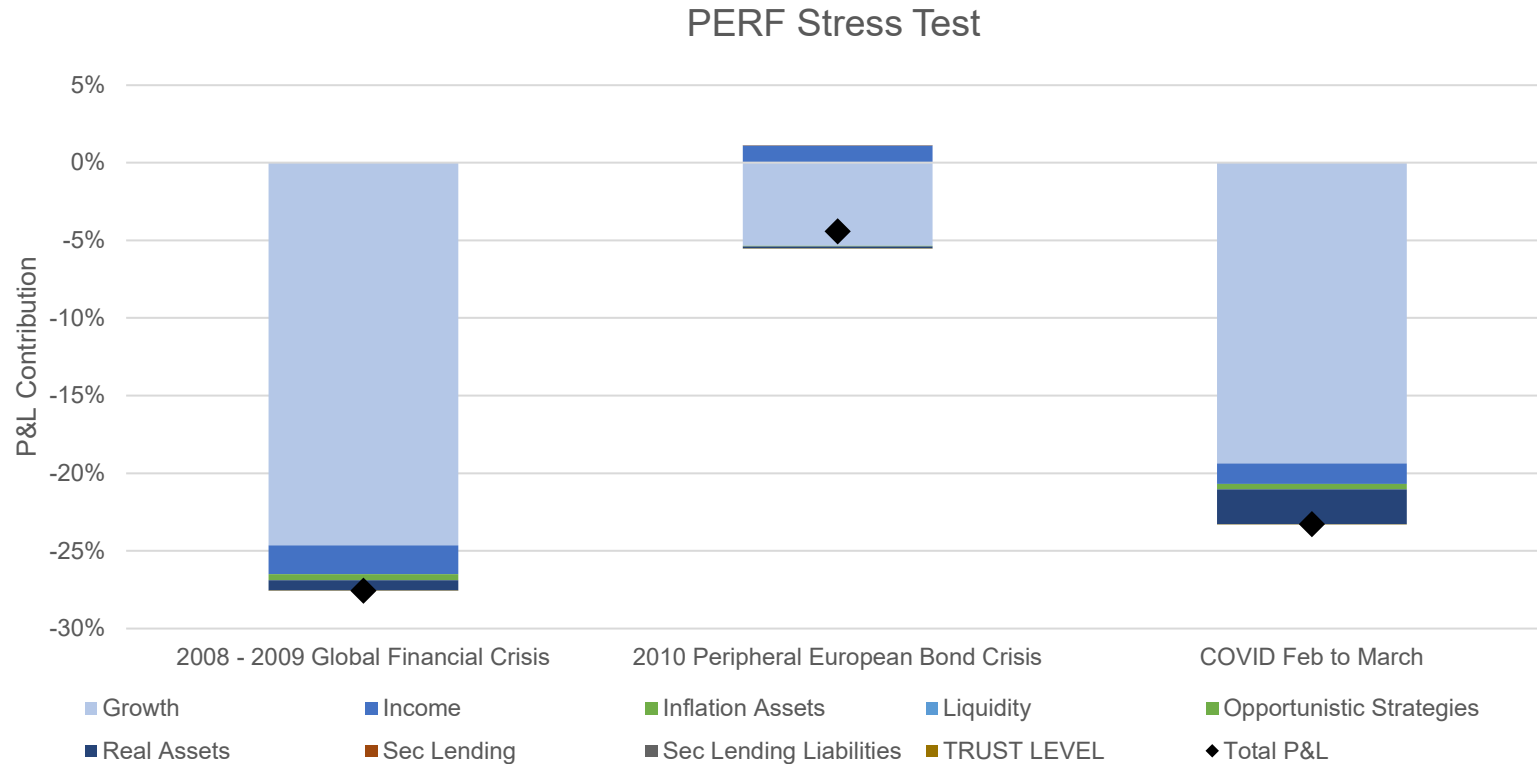
When we present our candidate portfolios, we will use our whisker boxes to compare their risk profiles.

This example is a mockup using two portfolios, illustrating how we can combine information for two portfolios and the three scenarios.

Though the actual details will differ from case to case, the visualization itself should prove useful in understanding the risk return trade-offs of different portfolios.

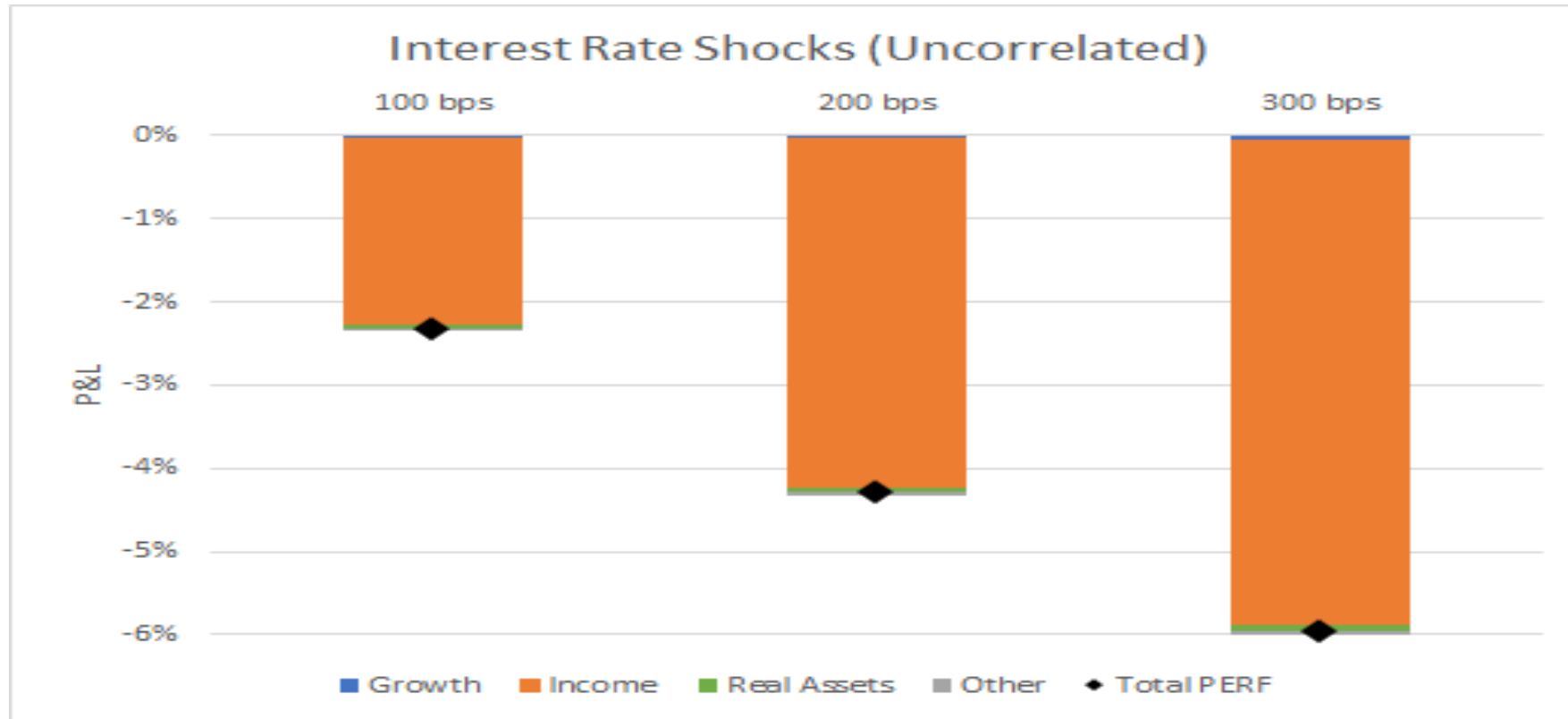
Our whisker chart can also be used to compare the risk characteristics of multiple portfolios in different scenarios. In this example the whisker chart tells us about long term contribution and funding risks. Risk is multi-faceted, and no single chart can tell the whole story.

Scenarios of Market Stress Events



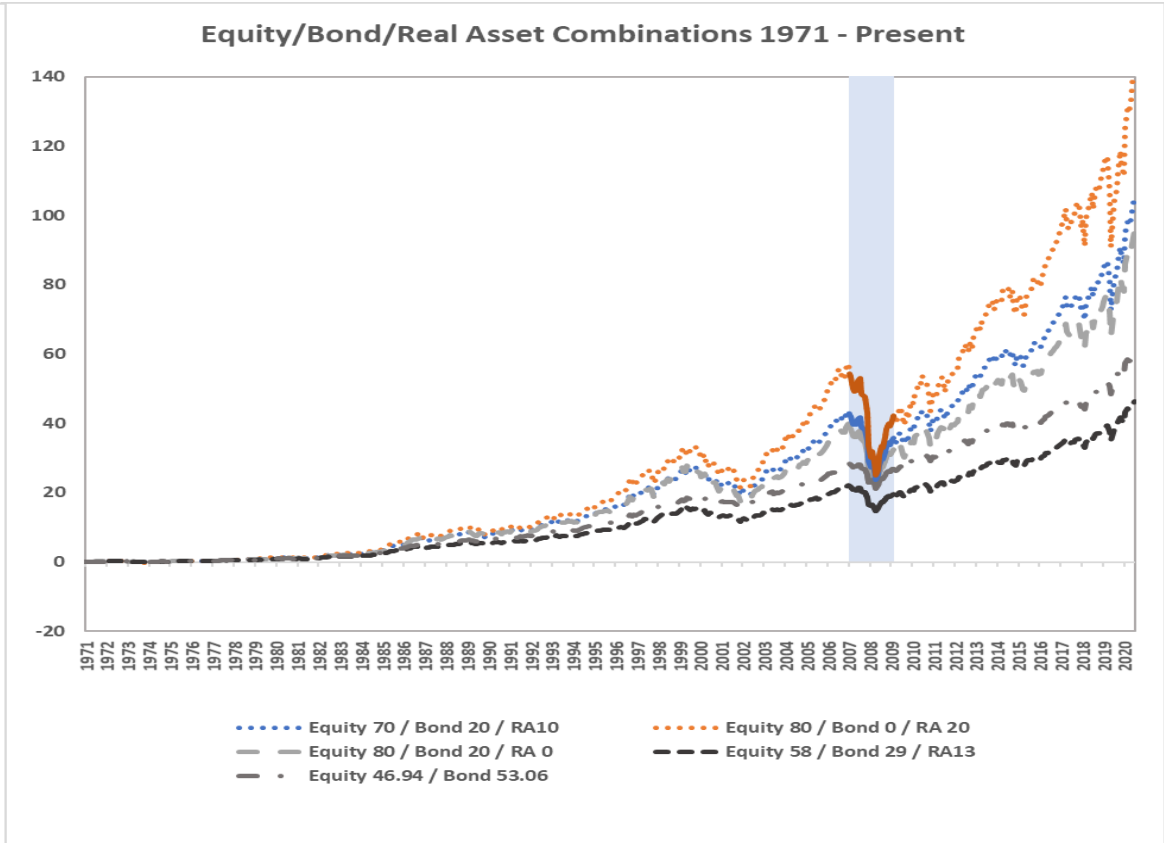
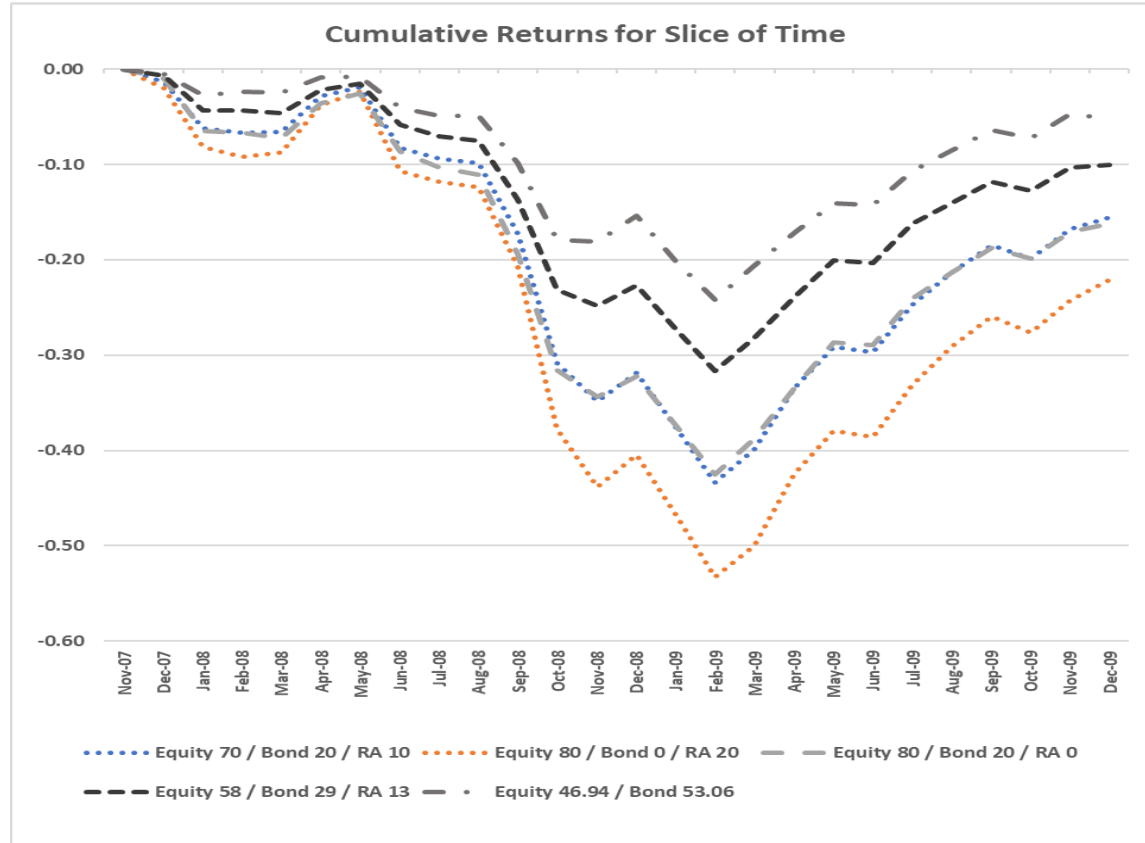
Stress tests are examples of extreme outcomes. In the case of these three historical stress tests, we can ask what would happen to our portfolio if history repeated itself. These stress tests are often shorter term, occurring over a period of years rather than decades. Stress tests help us understand the extreme short-term risks we may have to endure and manage if we are to achieve our long-term goals.

Scenarios of Hypothetical Stress Events



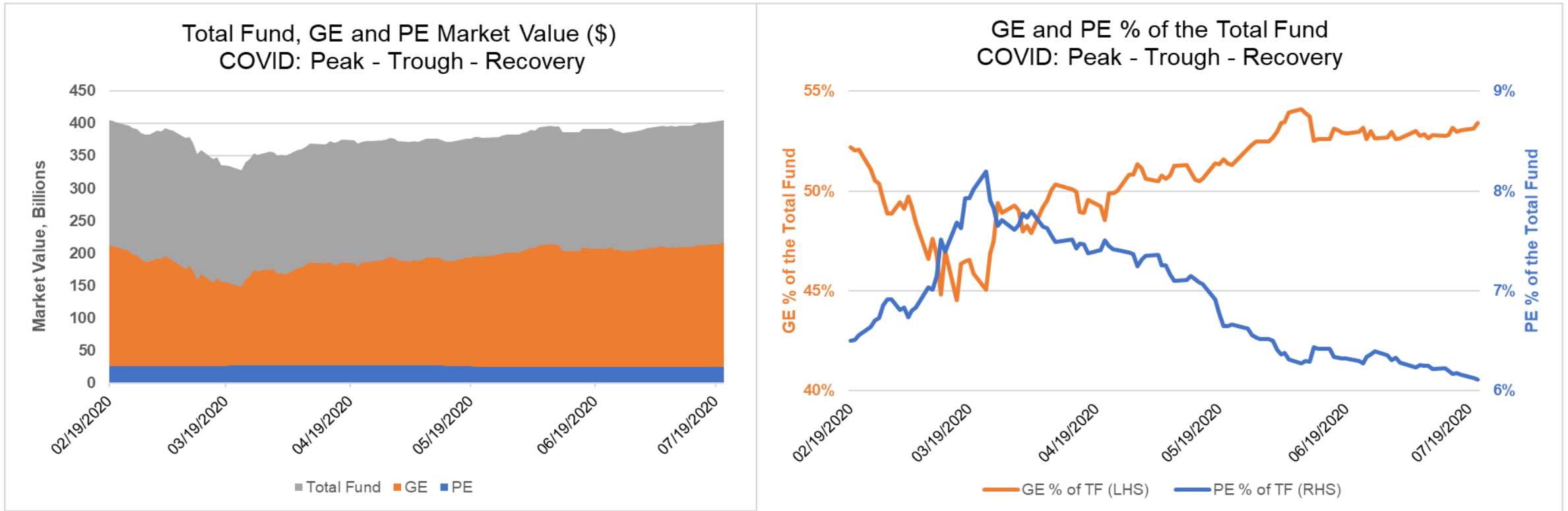
Stress tests can also be hypothetical, rather than historical. In this example, we consider the implications of interest rate shocks on the value of the portfolio. The stress test is not specific about the duration of the shock, only that it occurs.

2008 - 2009 Global Financial Crisis (Oct 2007 to Mar 2009)



Stress tests, like the whisker charts, can be used to compare portfolios. In this example, the performance of five different portfolios is compared during the Global Financial Crisis. Through stress tests we may determine a portfolio is too risky and choose to avoid the excessive exposures that could lead to those losses.

2020 COVID: % vs \$ Allocation



Policy portfolio allocations are expressed as percentages and bands, indicating a preferred range. As discussed in other Board meetings, private assets are opportunistic and managed in dollar terms. We therefore expect the actual percentages for private assets can and will vary over time, as we rebalance the total portfolio around the private assets. In general, we will not sell private assets to rebalance the portfolio.

Understanding ALM Risk : Liquidity

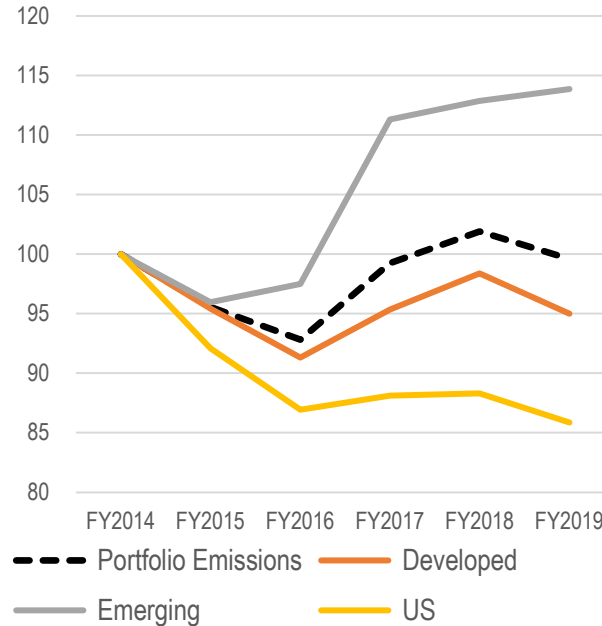
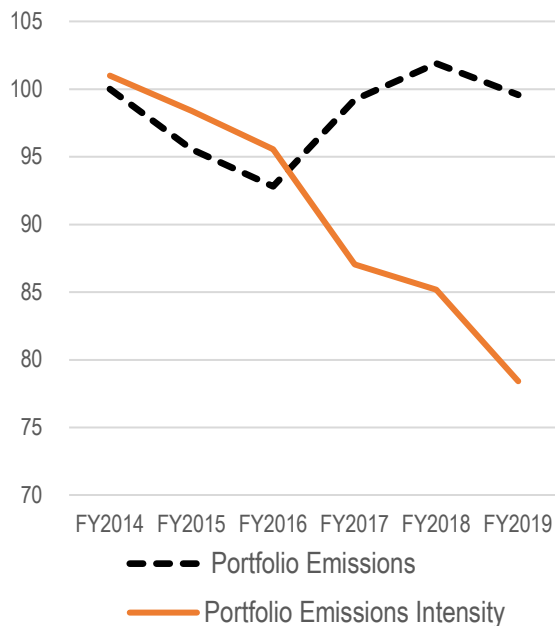
- Liquidity risk is modeled in the ALM to gain understanding of our ability to meet all pension obligations (a requirement) while maintaining our desired strategic policy risk exposures required to generate returns
- We will use our simulations and stress tests to assess the adequacy of portfolio liquidity
- Utilize a variety of portfolio analysis and processes including our liquidity framework to understand these effects:
 - Stress scenarios like 2008-09 GFC run on candidate portfolios (including leverage considerations) to visualize impacts on cash flows and rebalancing
 - Examination of pension cash flow forecasts of candidate portfolios under different economic scenarios
 - Examination of inherent income generation capability of candidate portfolios vs. net pension outflows
 - Consideration of potential drawdowns against private asset commitments.

We will also assess the liquidity risk of the portfolios, important to ensuring CalPERS can meet its obligations. These obligations include the need to pay benefits, to meet capital calls for private assets, and to meet other obligations related to the financing of the portfolio.

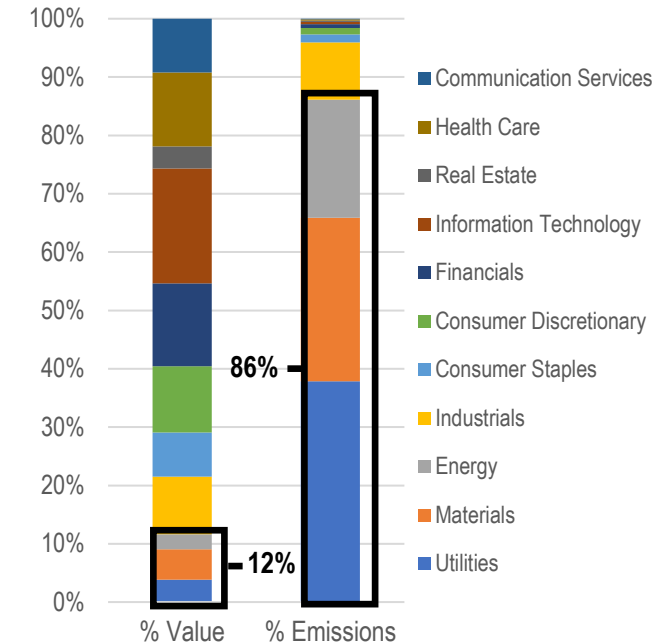
Trends in Climate Metrics for Global Equities

- Emissions intensity (tons of CO2 per USD millions of revenue) have declined by over 20% since 2014.
- Absolute levels of portfolio-owned emissions remain unchanged since 2014 as decreasing emissions in developed markets have been offset by significant increases in emerging markets.
- Three sectors (utilities, materials, energy) accounting for 12% of the portfolio value drive 86% of the emissions; the 10 largest emission contributors account for 18.5% of total emissions and 1.6% of the portfolio

CalPERS' Global Equity (GE) Portfolio Historical Carbon Emissions*



GE Portfolio Value and Emissions by Sector

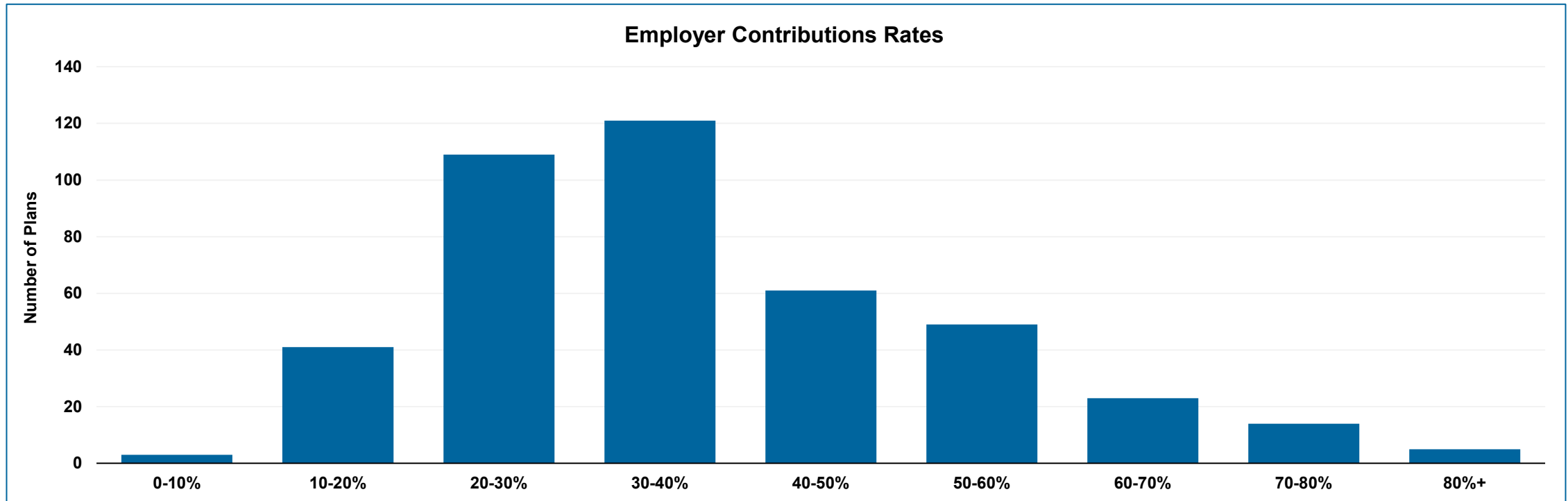


Each portfolio will also have ESG implications, and where available we will include measures illustrating any differences in ESG implications between the candidate portfolios.



*Based on portfolio holdings as of 06/07/21, rolled back historically, assuming constant weights.

Distribution of Employer Contribution Rates



The candidate portfolios may also have differing implications for the contributions and funding of specific employers. We will quantify the range of outcomes.

Conclusions

- The CalPERS ALM process assists the Board in selecting a policy portfolio having a reasonable expectation of sustaining the plan. This choice balances the risks arising from the variability of three components: returns, liabilities, and contributions.
- The objective of the ALM process is to select a new strategic asset allocation and set a discount rate. Candidate portfolios support that objective, by providing the Board with different risk and return choices.
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