Agenda

Overview of Investment Topics

- Building Blocks of Asset Class Returns
  - Components of returns
  - Contributions to investment forecasts

- Why are things so different now?
  - Review of current conditions in the context of history

- Pension Asset Allocation Evolution "It’s not your Grandpa’s portfolio"
  - Reactions institutional investors to changing asset market conditions

- Are more changes to come?
  - Possible evolution of the building blocks

- Asset Allocation Process & Goal
  - Motivation for asset allocation analysis
  - Steps in the asset allocation analysis

- Where do we go from here? Things to ponder
  - Forecast asset class performances
  - Current asset allocation
  - Forecast ranges of returns
Building blocks

Contributors to Return

● Investment markets are complex

● It is advantageous for the forecasting process to break markets down into “building blocks”

● Risk Premia Building Blocks
  – Investments span the risk spectrum from very safe Treasury bills to volatile emerging markets equity
  – Theoretically, investors should require more compensation in terms of higher returns in order to invest in riskier markets
  – Forecasts are based on historical return “spreads” across the range of risky assets

● Economic and Financial Building Blocks
  – Generally speaking, investments are either debt or equity
    – *Investors are either lenders or owners*
  – Investors are compensated for their contributions to economic activity (e.g., businesses, governments, mortgage borrowers)
  – Economic and financial building blocks look at the sources of funds to compensate investors
    – *Revenues to pay government bond investors*
    – *Cash flow to pay interest to corporate bondholders and dividends to shareholders*
    – *Reinvestment to promote profit growth*
  – Forecasts are based on the opportunities available to generate cash flow and how much investors are willing to pay to receive these cash flows
Asset Class Returns

Building Blocks

Risk Premia Building Blocks

● Investors require greater return for taking greater levels of risk: “risk premia”

● Risk premia have varied widely historically
  – In some periods, e.g., during and immediately after the financial crisis, equities returned less than bonds
  – What are the “right” levels for risk premia? How should they change through time?

● Treasury bills provide “risk-free” returns
  – If purchased and held to maturity the return is known in advance
  – The U.S. government is not going to default

● Bond risk premia
  – Term Risk: More time to maturity means greater uncertainty
  – Credit Risk: Higher probability of default means more uncertainty for future interest payments, and the repayment of principal
  – The additional risk means that bonds need to offer a higher return than Treasury bills

● Equity risk premia
  – Stocks pay dividends which are not fixed in advance like bond interest rate payments
  – Stock values can fluctuate substantially, more widely than most bonds
  – The additional risk means that stocks need to offer a higher return than bonds
Asset Class Returns

Risk Premia Building Blocks

For 30 years the S&P 500 has averaged a 6.3% return premium over 3-month Treasury bills

The highest return premium was 14.5% at the peak of the tech bubble

The lowest return premium was -6.4% at the nadir of the financial crisis

The forecast should be somewhere in between these extremes, but it is unclear where

- The historical time period is decisive in determining the forecast
Asset Class Returns

Building Blocks

Economic and Financial Building Blocks

- Economic factors play an important role
  - GDP growth and its underlying components
  - Inflation and its underlying components
  - These values tend to move up and down together
    - More growth leads to more inflation
    - Less growth leads to less inflation

- Treasury bills are still “risk-free” returns
  - Yields depend on inflation over their brief time to maturity
  - Investors normally want a positive after-inflation “real” return

- Projected bond returns will be high if investors anticipate high growth and inflation
  - Bond investors also want a positive real rate of return
  - Credit spreads will be low if growth reduces the probability of corporate default

- Projected equity returns will be higher if investors anticipate high growth and inflation
  - Higher economic growth rates generally mean higher profits, dividends and capital appreciation

- Still, uncertainty over “right” levels of real bond and stock returns fluctuate as conditions change over time

- Investors still require greater return for taking greater levels of risk
GDP Growth

- Gross domestic product has fluctuated substantially over time
  - The graph shows trailing 1-year “real” (after inflation) growth rates
  - The shaded areas are recessions which are defined as at least two consecutive quarters of negative growth

- Growth rates depend on increases in capital, labor and productivity

- The financial crisis created a long, deep recession

- The last two periods of expansion have seen relatively slow growth rates

Source: U.S. Bureau of Economic Analysis
fred.stlouisfed.org
Capital Market Projections – Economic Foundations

Components of GDP Growth

- GDP growth depends on the growth rates of labor and the productivity of that labor.
- Labor growth comes from multiple sources:
  - Fertility
  - Immigration
  - Workforce participation
- Productivity growth comes from two primary sources:
  - Increases in capital equipment
  - Improvements in technology
- Both components of GDP growth have lagged over the last decade.

Source: JP Morgan Asset Management
Capital Market Projections – Economic Foundations

Consumer Spending

- Consumer spending accounts for about 2/3 of GDP
- Consumer spending has not been strong since the financial crisis
  - Some of the weakness is exaggerated since the data do not take into account inflation which has been low since the financial crisis

Source: US. Bureau of Economic Analysis
fred.stlouisfed.org
myf.red/g/6UCs
Capital Market Projections – Economic Foundations

Wage Growth

- Consumers get money to spend from a variety of sources
  - Wages and salaries ("compensation") are the largest component
  - Investments
  - Rental income
  - Transfer payments
- The growth in real compensation has been relatively weak since 2000 which has limited consumer spending

Source: US. Bureau of Labor Statistics
fred.stlouisfed.org
The consumer price index is one measure of inflation. It represents the changes in prices of a representative basket of goods that consumers buy.

Inflation occurs when the demand for products exceeds the supply.

Inflation rose in the 1960s (Viet Nam) and 1970s (Arab oil embargo) and was high on average through the 1980s.

Inflation has been relatively low since 1990.

Inflation has been particularly low since the financial crisis.

Source: US, Bureau of Labor Statistics
fred.stlouisfed.org

myf.red/g/6UEB
Lower growth and inflation have accommodated lower Treasury bill yields.

Treasury bill yields are currently especially low due to strong demand:
- Treasury bills have negative real yields.
- Demand comes from overseas investors who face negative real yields in their own countries.
- Demand also comes from the Fed which is attempting to keep interest rates low to promote economic growth.

Source: Board of Governors of the Federal Reserve System (US)
fred.stlouisfed.org
Capital Market Projections – Economic Foundations

10-Year Treasury Bond Yields

- Treasury bond yields are also historically low
- Lower inflation allows lower nominal yields to provide a positive real yield
- Current real yields are close to zero
- Like Treasury bills, low bond yields are driven by demand
  - Many countries have negative real yields even on their 10-year bonds
  - The Fed purchased longer-dated Treasury bonds to boost the economy
Global Central Bank Activity

Monthly Fed, ECB, and BoJ asset purchases

USD bln

BoE  Fed  BoJ  ECB  Total

0  50  100  150  200  250


Note: 12m moving average.

Approx $180bn per month
Capital Market Projections – Economic Foundations

U.S. Corporate Profits

- Corporate profits generally fall in advance of a recession
  - Corporate profits fell significantly and for an extended period around the financial crisis

- Corporate profits generally rebound after a recession
  - This pattern held true for a relatively brief period after the financial crisis
  - After the initial bounce profit growth has been anemic
  - Recent quarters have seen declines in profits

Source: US. Bureau of Economic Analysis
fred.stlouisfed.org

myf.red/g/6UFV
Capital Market Projections – Equity Valuations

S&P 500 Operating Earnings Per Share

- Earnings patterns for the S&P 500 have followed those of U.S. corporations generally
- Index earnings per share on a nominal basis are where they were in 2011
  - Earnings have fallen on a real basis
The price-earnings ratio (P/E) is the number of dollars investors pay for a dollar of earnings
  - The “forward” means that the P/E is based on forecast earnings

While earnings have stagnated, the price of the S&P 500 has risen driving up the P/E
  - The higher the P/E, the less the opportunity for additional increases in stock prices
  - The current P/E is above the 25-year average but is not nearly as high as it was during the tech bubble

Other valuation measures are mixed
Capital Market Projections – Equity Valuations

S&P 500 Dividends Per Share

- Corporate profits have two broad uses
  - They can be reinvested in the firm in an effort to further increase future corporate profits
  - They can be returned to shareholders in the form of dividends

- Corporations generally increase dividends when they don’t see attractive investment opportunities to promote future profit growth
Bond returns are made up of capital appreciation and yield
  - When yields fall, bond prices increase and vice versa

Broad bond market yields have followed Treasury yields down
  - Bond returns over the last 35 years have been supported by increasing prices due to falling yields

When bond yields increase prices will fall
  - The rate of increase will determine future bond returns
The sensitivity of bond prices to changes in interest rates is known as “duration”
- Duration is defined as the percentage change in bond price due to a 1% change in yield
- If a bond has a duration of 5, a 1% decline in yield will increase the price of the bond by 5% but a 1% increase in yield will decrease the bond price by 5%

Bond durations tend to increase when yields fall
- Bond prices are more susceptible to interest rate increases when yields start from lower levels
Return Projections: Major Asset Classes

1989 – 2015

- Private Equity
- Non-U.S. Equity
- Broad U.S. Equity
- Real Estate
- U.S. Fixed
- Inflation
Risk Projections: Major Asset Classes

1989 – 2015

Private Equity
Non-U.S. Equity
Broad U.S. Equity
Real Estate
U.S. Fixed
Inflation
Increasing Volatility and Complexity
10-Year Projected versus Actual Returns over the Past 20 Years

Increasing Complexity

1995

- Fixed Income 100%

Expected Return: 7.5%
Projected Std Deviation: 6.0%

Actual Return (95-04): 7.7%
Actual Std Dev (95-04): 4.0%

2005

- Fixed Income 52%
- U.S. Large Cap 20%
- Non-U.S. Equity 14%
- U.S. Small Cap 5%
- Private Equity 4%
- Real Estate 5%

Expected Return: 7.5%
Projected Std Deviation: 8.9%

Actual Return (05-14): 6.2%
Actual Std Dev (05-14): 7.7%

2015

- U.S. Large Cap 33%
- U.S. Small Cap 8%
- Non-U.S. Equity 14%
- Private Equity 12%
- Fixed Income 12%
- Real Estate 13%

Expected Return: 7.5%
Projected Std Deviation: 17.2%

Increasing Risk

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Knowledge. Experience. Integrity.

PERS Investments Yesterday, Today and Tomorrow
Same Risk, Decreasing Returns

When target risk is held at 6.0%, expected returns fall from 7.5% in 1995 to 4.8% in 2015

1995
- Fixed Income 100%
  - Expected Return: 7.5%
  - Standard Deviation: 6.0%

2005
- Fixed Income 70%
- U.S. Large Cap 13%
- Non-U.S. Equity 9%
- Real Estate 3%
- Private Equity 2%
  - Expected Return: 6.5%
  - Standard Deviation: 6.0%

2015
- Fixed Income 71%
- U.S. Large Cap 11%
- Non-U.S. Equity 8%
- Real Estate 4%
- Private Equity 3%
  - Expected Return: 4.8%
  - Standard Deviation: 6.0%

Returns Lowered Over Time

Increasing Complexity
Declining Discount Rates for Public Funds

Range of Surveyed Discount Rates

- In response to declining returns some public funds have reduced their discount rates
- The migration to lower discount rates has been slow and painful
  - Higher liabilities
  - Greater unfunded liabilities
  - Larger contribution requirements
Plan Investments by Plan Type

Historical Average Asset Allocations (20 Years) – Callan Fund Sponsor Database

Public Funds

Corporate Funds

Endowment/Foundations

Taft-Hartley

Source: Callan. Callan’s database includes the following groups: public defined benefit, corporate defined benefit, endowments/ foundations, and Taft-Hartley plans. Approximately 10-15% of the database constituents are Callan’s clients. All database group returns presented gross of fees. Past performance is no guarantee of future results.
What Return and Risk Would These Allocations Generate?

Callan Public Fund Database Asset Allocations, Historical and Projected Model Results

Actual Results 1995-2004
Avg. annual return: 10.10%
Annual std. dev.: 9.11%

Actual Results 2005-2014
Avg. annual return: 6.51%
Annual std. dev.: 10.59%

Projected 2015-2024
Avg. annual return: 6.52%
Annual std. dev.: 12.98%
What Returns Did Fund Sponsors Actually Achieve?

10-Year Returns by Fund Sponsor Type: Point in Time Comparison

<table>
<thead>
<tr>
<th>Public Funds</th>
<th>Corporate Fund</th>
<th>Endowments/Foundations</th>
<th>Taft-Hartley</th>
<th>Total Fund Sponsors</th>
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<tbody>
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<td>75th Percentile</td>
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<td>5.26</td>
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<td>90th Percentile</td>
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<td>7.01</td>
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<td>10.54</td>
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</table>

Source: Callan. Callan’s database includes the following groups: public defined benefit, corporate defined benefit, endowments/foundations, and Taft-Hartley plans. Approximately 10-15% of the database constituents are Callan’s clients. All database group returns presented gross of fees. Past performance is no guarantee of future results.
What Level of Risk Did Fund Sponsors Actually Experience?

10-Year Standard Deviation by Fund Sponsor Type: Point in Time Comparison

<table>
<thead>
<tr>
<th>10th Percentile</th>
<th>25th Percentile</th>
<th>Median</th>
<th>75th Percentile</th>
<th>90th Percentile</th>
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<tr>
<td>Public Funds</td>
<td>Corporate Fund</td>
<td>Endowments/ Foundations</td>
<td>Taft-Hartley</td>
<td>Total Fund Sponsors</td>
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<tr>
<td>8.75</td>
<td>10.93</td>
<td>11.63</td>
<td>10.51</td>
<td>12.06</td>
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</table>

Source: Callan. Callan’s database includes the following groups: public defined benefit, corporate defined benefit, endowments/foundations, and Taft-Hartley plans. Approximately 10-15% of the database constituents are Callan’s clients. All database group returns presented gross of fees. Past performance is no guarantee of future results.
PERS Total Fund Returns

30 Years

- Over the last 3 decades, PERS investment program has been very successful.
- The average 10-year return has been almost 9.25%.
- This performance exceeds the current 7.75% investment return assumption.
  - Historical return assumptions were higher.
- What is the likelihood of meeting this return hurdle going forward?

Returns

- 30 Years Ended June 30, 2016
- Rolling 40 Quarter Returns

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Benefits of an Asset Allocation Review

- The cornerstone of a prudent process for fiduciaries is a careful and thorough examination of their long-term strategic plan
- Explicitly acknowledge change and uncertainty in the capital markets
- Establish reasonable rate-of-return and risk expectations for individual investments
- Establish reasonable rate-of-return and risk expectations for investment portfolios
- Confirm an investment policy to meet return and risk objectives in relation to goals
Capital Market Projections

Guiding Objectives

- Cornerstones of strategic planning—expectations and time horizon
- Projections represent our best thinking regarding the long-term (5 to 10-year) outlook, recognizing our median projections represent the midpoint of a range, rather than a specific number
- Develop results that are readily defensible both for individual asset classes and for total portfolios
- Be conscious of the level of change suggested in strategic allocations for long-term investors
- Reflect common sense and recent market developments
- Balance conflicting goals and conflicting opinions
2016 Capital Market Projections

Return and Risk

- The basis for asset allocation are the long-term expected characteristics of each asset class and how they interact with each other.

- Most capital market expectations represent passive exposure (beta only); however, return expectations for real estate, private equity, and hedge funds reflect active management premiums.

- All return expectations are net of fees.

<table>
<thead>
<tr>
<th>Summary of Callan's Long-Term Capital Market Projections (2016 - 2025)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asset Class</strong></td>
</tr>
<tr>
<td>Equities</td>
</tr>
<tr>
<td>Broad Domestic Equity</td>
</tr>
<tr>
<td>Large Cap</td>
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<td>Small/Mid Cap</td>
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<tr>
<td>Global ex-US Equity</td>
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<td>International Equity</td>
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<td>Emerging Markets Equity</td>
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<td>Fixed Income</td>
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<td>Short Duration</td>
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<td>Domestic Fixed</td>
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<td>Long Duration</td>
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<td>TIPS</td>
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<td>High Yield</td>
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<td>Non-US Fixed</td>
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<td>Emerging Market Debt</td>
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<td>Other</td>
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<td>Hedge Funds</td>
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<td>Commodities</td>
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<td>Cash Equivalents</td>
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<td>Inflation</td>
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</tbody>
</table>

* Geometric returns are derived from arithmetic returns and the associated risk (standard deviation).
2016 Capital Market Projections

Correlations

2016 Correlation Matrix

<table>
<thead>
<tr>
<th></th>
<th>Broad</th>
<th>Lg Cap</th>
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<th>Emerge</th>
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<td>0.735</td>
<td>0.740</td>
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<td>0.080</td>
<td>0.303</td>
<td>0.055</td>
<td>0.570</td>
<td>0.080</td>
<td>0.540</td>
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<td>0.770</td>
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<td>Commodities</td>
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<td>0.165</td>
<td>0.165</td>
<td>0.177</td>
<td>0.170</td>
<td>0.175</td>
<td>-0.220</td>
<td>-0.120</td>
<td>0.100</td>
<td>0.005</td>
<td>0.190</td>
<td>0.050</td>
<td>0.190</td>
<td>0.010</td>
<td>0.070</td>
<td>0.210</td>
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<tr>
<td>Cash Equivalents</td>
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<td>-0.080</td>
<td>-0.040</td>
<td>-0.010</td>
<td>-0.100</td>
<td>0.300</td>
<td>0.100</td>
<td>-0.049</td>
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<td>-0.110</td>
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<td>0.000</td>
<td>0.070</td>
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<tr>
<td>Inflation</td>
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<td>-0.020</td>
<td>0.020</td>
<td>0.010</td>
<td>0.000</td>
<td>0.030</td>
<td>-0.200</td>
<td>-0.280</td>
<td>0.180</td>
<td>0.070</td>
<td>-0.150</td>
<td>0.000</td>
<td>0.100</td>
<td>0.000</td>
<td>0.200</td>
<td>0.400</td>
<td>0.000</td>
<td>1.00</td>
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</tbody>
</table>

- Relationships between asset classes are as important, or more important, than the level of individual asset class assumptions.
- These relationships will have a large impact on the generation of efficient asset mixes using mean-variance optimization.
- Correlations are what define the diversification benefit – or lack thereof – of asset combinations.
Asset Allocation

Range of Asset Mixes

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>Target</th>
<th>Constraints</th>
<th>Optimal Asset Mixes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>US Broad Equity</td>
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<tr>
<td>Global Ex-US Equity</td>
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<td>100</td>
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<tr>
<td>Domestic Fixed</td>
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<tr>
<td>Real Estate</td>
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<td>Private Equity</td>
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<td>0</td>
<td>100</td>
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<tr>
<td>Cash Equivalents</td>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>10-Year Compound Return</td>
<td>7.02%</td>
<td>6.50%</td>
<td>6.75%</td>
</tr>
<tr>
<td>Risk (Standard Deviation)</td>
<td>15.50%</td>
<td>12.75%</td>
<td>14.02%</td>
</tr>
</tbody>
</table>

- Allocations were modeled with target returns ranging from 6.5% to 7.5% in 0.25% increments.
- The existing target mix is very close to optimal mix 3.
  - Differences in the global ex-U.S. and real estate allocations are not significant enough to warrant change
- The target mix has an expected return below the long-term target.
  - The target mix has an expected 10-year compound return of 7.02%
  - The long-term target is 7.75%
- Investors are unlikely to be compensated for taking additional risk given the current low rates of expected return and substantial uncertainty in the capital markets.
The target mix lies on the efficient frontier
- The target mix is constructed such that no rearrangement of the asset allocation could increase return without also increasing risk
The graph above shows the range of asset values for each mix in any one year in the next ten-year period. The center dotted line is the median asset value while the bottom of the bar is the 95th percentile. The range is created by 5,000 simulations based on the returns, risks and correlations shown earlier.

The positions and sizes of the bars depend on forecasted asset class performances.

Asset mixes have close to a 50% probability of achieving the 7.75% return goal in any one year.

All of the asset mixes have more than a 5% probability of a double digit one-year loss.
The ten-year ranges of return result from continuing the 5,000 simulations for a full 10 years.

The median return is lower over ten years than over any one year due to “volatility drag.”

The probability of achieving the return target falls to about 44% for both the target and mix 3.

The annualized range of returns is compressed over 10 years relative to one year.
  - Very good or poor returns in any one year are unlikely in other years diluting the extreme outcomes
  - There is still more than a 5% probability of a negative annualized return over the entire time period
The exhibit above is based on the same data as the prior exhibit but the returns are not annualized.

Over the next ten years the assets would be expected to approximately double in size in the median outcomes if cash flows are not considered.

Double digit nominal cumulative losses are possible in poor markets.

- Not only are these absolute losses but they also represent considerable underperformance relative to the expected returns.
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