Trends in Liability Driven Investing
CFA Society of Pittsburgh

January 12, 2011

Jim Moore
I. Why Has Pension Investing Changed?

II. Trends Among Current Clients In LDI Take Up And Implementation

III. Case Study: LDI Vs 60/40 – Dec. 2007 thru Nov. 2010

IV. The Road Ahead: Understanding And Dynamically Managing Risk Factors In Response To “Key Control Variables”
   - Glide Paths
   - Factor Risk Attribution
   - Using non-linear Instruments

V. The Endogeneity Problem
Why Has The Game Changed?

- The Lost Decade in Equity Markets: No more “Stocks for the Long Run”

- Sarbanes-Oxley: Off balance sheet matters – In some cases A LOT!

- That which is measured, will get managed (eventually)
  - FAS158 (2006): Full mark-to-market accounting through shareholder’s equity

- The Long Run? Not what is used to be
  - Pension Protection Act (2006): Seven years to fix your mess
The Traditional “Policy Portfolio” - The Point of Departure

- Significant weightings to risk assets, particularly equities
  - High volatility and high expected return potential
  - Little or no duration
  - Low correlation to liabilities

- Limited exposure to fixed income, typically benchmarked to an Aggregate Index
  - Low correlation to equity (may provide portfolio diversification)
  - Low duration and low potential yield
  - Underweight duration vs. liabilities

SOURCE: Credit Suisse, P&I, PIMCO (As of September 30, 2010)
Refer to Appendix for additional index information.
Pension Exposures Are Leveraged to the Business Cycle

High Growth
High Rates

Equities perform well in rising growth environments

Liabilities fall faster than short duration bonds

FUNDING PEAKS

Low Growth
Low Rates

Equities perform poorly in low or negative growth environments

Liabilities outperform assets

FUNDING BOTTOMS

FUNDING PEAKS

U.S. Equities, 36%
International Equities, 18%
Fixed Income, 35%
Real Estate, 5%
Private Equity, 3%
Absolute Return (Hedge Funds), 3%

SOURCE: Credit Suisse, P&I, PIMCO (As of September 30, 2010)
Refer to Appendix for additional index information.
## Key Business Issues for Plan Sponsors

<table>
<thead>
<tr>
<th>Topic</th>
<th>Business Objective</th>
<th>Pension Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise Risk Management (ERM)</td>
<td>▪ Identify and quantify risks across the entire business</td>
<td>▪ Increases volatility of Shareholders equity and cash contributions</td>
</tr>
<tr>
<td></td>
<td>▪ Eliminate risks that are not compensated</td>
<td>▪ Discount rate is the assumed cost of financing – low or high?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Do the fixed income assets keep pace?</td>
</tr>
<tr>
<td>Capital Structure</td>
<td>▪ Manage balance sheet leverage</td>
<td>▪ Pension underfunding is net debt</td>
</tr>
<tr>
<td></td>
<td>▪ Manage duration of corporate debt</td>
<td>▪ Liability duration increases net debt duration</td>
</tr>
<tr>
<td></td>
<td>▪ Manage fixed/floating mix of the debt</td>
<td>▪ Liability shifts the debt mix towards fixed rate</td>
</tr>
<tr>
<td>Cash Flow</td>
<td>▪ Limit uncertainty around cash flow from operations</td>
<td>▪ Pension contributions are exposed to downside risk in the performance of plan funded status</td>
</tr>
<tr>
<td>Income Statement</td>
<td>▪ Stabilize operating income at the highest possible level</td>
<td>▪ Expected return on assets flows through the income statement via Net Pension Expense line item</td>
</tr>
</tbody>
</table>

*LDI will impact all of these key business decisions*
PIMCO Clients & LDI Evolution From 2007 To 2009

Extended Duration in Defined Benefit Plan?

2007
- Yes: 30%
- No: 70%

2008
- Yes: 43%
- No: 57%

2009
- Yes: 45%
- No: 55%

SOURCE: PIMCO
Likelihood of Extending Duration

2008

- Currently Extended: 43%
- Highly Likely to Extend: 13%
- Moderately Likely to Extend: 18%
- Unlikely to Extend: 26%

2009

- Currently Extended: 55%
- Moderately Likely to Extend: 8%
- Highly Likely to Extend: 11%
- Unlikely to Extend: 26%

SOURCE: PIMCO
Additional Analysis Of Clients

SOURCE: PIMCO
Data collected in July 2009-August 2009.
Funding status is based on 62 of PIMCO’s largest clients.
Recent Trends Amongst PIMCO Clients Pursuing LDI In The New Normal

How Have Clients That Are Currently Extended Changed Their Approach to LDI?

- Market dislocations have caused clients to re-think implementation of LDI strategies
- For example, as a result of significant swap spread tightening, surveyed PIMCO clients that removed swap exposure increased exposure to long corporates to help achieve better liability matching

SOURCE: PIMCO
How would a traditional “60/40” Strategy have fared versus a basic “LDI” approach?

- We assume a plan begins 2008 with assets equal to 100% of pension benefit obligation (PBO) liability
- The plan is open and has a liability duration of 15 years

SOURCE: PIMCO

Hypothetical example for illustrative purposes only.

* 2/3 U.S. Equity (S&P 500) / 1/3 International Equities (MSCI EAFE)
Refer to Appendix for additional hypothetical example, index, and risk information.
Assumes plan is fully funded and has a duration of 15 years

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Surplus Volatility</th>
<th>Duration Coverage</th>
</tr>
</thead>
</table>
| **Option 1**
40% Fixed Income Benchmark (100% Barclays Aggregate) | 11.94% | 11% |
| **Option 2**
40% Fixed Income Benchmark (100% Barclays Long Gov/Credit) | 10.73% | 32% |
| **Option 3**
40% Fixed Income Benchmark with Swap Overlay (75% Duration Coverage) | 8.36% | 75% |
| **Option 4**
60% Fixed Income Benchmark (100% Barclays Long Gov/Credit) | 7.95% | 48% |
| **Option 5**
60% Fixed Income Benchmark with Swap Overlay (75% Duration Coverage) | 6.28% | 75% |

Source: PIMCO, Barclays Capital

Surplus Volatility = Tracking error of assets to liabilities

Hypothetical Example for illustrative purposes only.

Refer to Appendix for additional hypothetical example, investment strategy and index information.
2008 Performance Of 60/40 And LDI Strategies

January – August
- Equity markets down
- Discount rates rise

September – November
- Equities down further
- Swaps outperform

December
- Modest equity recovery
- Discount rate falls

SOURCE: Barclays Capital, PIMCO
Hypothetical example for illustrative purposes only.

1 60% equities (2/3 U.S. Equity (S&P 500) / 1/3 International Equities (MSCI EAFE)), 40% BCAG
2 40% equities (2/3 U.S. Equity (S&P 500) / 1/3 International Equities (MSCI EAFE)), 60% BLGC

Refer to Appendix for additional hypothetical example, index, and risk information.

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Impact On The Plan Sponsor

Starting Point

<table>
<thead>
<tr>
<th>Shareholders</th>
<th>Equity</th>
<th>Liabilities Grow by 13%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>100</td>
<td>Liability 113</td>
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<tr>
<td>Shareholders</td>
<td>200</td>
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</table>

60/40 Endpoint

<table>
<thead>
<tr>
<th>Loss</th>
<th>Shareholders</th>
<th>Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>GAP</td>
<td>42</td>
<td>158</td>
</tr>
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</table>

LDI Endpoint

<table>
<thead>
<tr>
<th>Loss</th>
<th>Shareholders</th>
<th>Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>96</td>
<td></td>
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<tr>
<td>GAP</td>
<td>17</td>
<td>183</td>
</tr>
</tbody>
</table>

SOURCE: PIMCO
Sample for illustrative purposes only.
## Impact Of Hedge Outperformance: Duration Lengthening

<table>
<thead>
<tr>
<th></th>
<th>12/31/07</th>
<th>12/31/08</th>
<th>Δ Rate (bps)</th>
<th>Δ PV (%)</th>
<th>Δ Duration (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate Discount Rate (Citi AA)</td>
<td>5.72%</td>
<td>7.28%</td>
<td>↑155</td>
<td>↓23%</td>
<td>↓0.25</td>
</tr>
<tr>
<td>Swap Rate (2/3 30 Yr. + 1/3 20 Yr.)</td>
<td>5.01%</td>
<td>2.79%</td>
<td>↓222</td>
<td>↑33%</td>
<td>↑2.70</td>
</tr>
</tbody>
</table>

- Swaps and corporates moving in opposite direction caused the percent of liability duration hedge to grow from 75% to 91%

SOURCE: Bloomberg Financial Markets
PV (Present Value)
Refer to Appendix for additional risk information.
Liability Interest Rate Sensitivity

SOURCE: Bloomberg
Long Credit spread (Barclays Capital Long Credit Index Yield - Barclays Long Treasury Index Yield). Long Treasury Yield (Barclays Capital Long Treasury Index). Refer to Appendix for additional index information.
Revisiting The Strategy Circa Late December 2008 An Adaptive LDI Approach

- Treasuries are low and swap spreads were near all time lows
  - 10yr Tsy yield: 2.10%
  - 30yr Tsy yield: 2.60%
  - 30yr swap spread: negative and volatile

- Long investment grade credit spreads were near all time wides: 300-600 bps* 

→ Balance of Risks between interest rate risk and credit spread tightening has shifted

1) Plan to decrease overlay so that 60% of rate risk is covered
   (moderate bet on rising rates over time, but still largely hedged)

2) Look to switch bond portfolio to long credit

3) Plan to allocate gains from swaps across asset portfolio

* Long investment grade credit spreads are represented by the Barclays Capital U.S. Long Credit Index and is measured against Treasuries (Nov. 2008 through June 2009).
Refer to Appendix for additional investment strategy and risk information.
Adaptive LDI And Post-Crisis Performance Through May

SOURCE: MSCI, S&P, Barclays Capital, PIMCO

Hypothetical example for illustrative purposes only.

1 60% equities (2/3 US (S&P 500) and 1/3 International (MSCI EAFE)), 40% BCAG
2 60% Long Gov/Credit (BLGC), 40% equities (2/3 US (S&P 500) and 1/3 International (MSCI EAFE)), swap overlays to get 75% duration as of 12/07
3 Move Long Gov/Credit to Long Credit as of 12/08, and rebalance swap overlay to cover 60% of total duration, 12/09 bring swap overlay back up to 75% duration cover.

Refer to Appendix for additional hypothetical example, index, investment strategy and risk information.
Current Factor Exposures

SOURCE: PIMCO (As of November 30, 2010)

Hypothetical example for illustrative purposes only


2 Liabilities= Based on a sample pension plan as illustrated on page 10. Refer to Appendix for additional hypothetical example, index, investment strategy, and portfolio analysis information.
Impact of Funding Ratio

Volatility Contributions (Surplus)

Estimated Total Carry (bps)  
-426  
-251  
-146

SOURCE: PIMCO (As of November 30, 2010)

Hypothetical example for illustrative purpose only.

* Other factors include: Idiosyncratic (specific), Country, Industry, Sector, and "Style" factors such as Value, Size, Momentum, Liquidity, and Leverage. Refer to Appendix for additional hypothetical example and portfolio analysis information.
LDI Glide Path Solutions
Optimizing Fixed Income Structure and Duration Hedge Target

- Scenario 1: Gradual de-risking from risk assets to liability hedging fixed income as funded status improves
- Scenario 2: Glide path that optimizes fixed income allocation at each trigger point (determined by funding ratio) to minimize surplus volatility
- Scenario 3: Glide path optimizes fixed income allocation in addition to replacing prior equity allocations with a long bonds & equity overlay structure

SOURCE: PIMCO (November 30, 2010)

Hypothetical example for illustrative purposes only
* Tracking error of assets to liabilities
Glide path is based on a sample pension plan (see slide 10 & 11 for additional information)
Refer to Appendix for additional hypothetical example and investment strategy information.
Growing role for non-linear derivatives for LDI

- **Equity/Credit options**
  - Disaster Protection: Tail Risk Hedging to help manage downside
  - Income Generation: Put writing / covered calls to help generate income through vol sales
  - Cost Potential / Benefit of Equity Options can vary widely in time

- **Interest Rate Options**
  - Getting Paid To Wait: “I Want To Extend Duration, Just Not At These Rate Levels” (Sell Payer Swaptions / Bond Puts)
  - Buy Protection Against Falling Rates (Buy Receiver Swaptions / Bond Calls)
  - Combine A & B To Create (Costless) Collars To Limit Rate Exposure

* A Steep Yield Curve May Be The Plan Sponsor’s Best Friend
...Impact of Adding Swaption Collars (Step 4)

<table>
<thead>
<tr>
<th>Key Risk Factors</th>
<th>Current - Surplus</th>
<th>Step 4 - Surplus</th>
<th>Change in Volatility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weight (bps)</td>
<td>Weight (bps)</td>
<td></td>
</tr>
<tr>
<td><strong>Equity Factors</strong></td>
<td></td>
<td></td>
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<tr>
<td>World Equity</td>
<td>0.63</td>
<td>0.48</td>
<td>171</td>
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<tr>
<td>Volatility</td>
<td>0.03</td>
<td>0.03</td>
<td>-1</td>
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<tr>
<td>Size(^1)</td>
<td>0.14</td>
<td>0.09</td>
<td>-2</td>
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<tr>
<td>Growth</td>
<td>-0.03</td>
<td>-0.03</td>
<td>0</td>
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<tr>
<td>Value(^2)</td>
<td>0.00</td>
<td>-0.01</td>
<td>-1</td>
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<tr>
<td>Momentum</td>
<td>-0.01</td>
<td>0.00</td>
<td>1</td>
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<tr>
<td><strong>Interest Rate Factors</strong></td>
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<tr>
<td>Nominal Duration</td>
<td>-15.42</td>
<td>-6.07</td>
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<tr>
<td>Real Duration</td>
<td>0.00</td>
<td>0.00</td>
<td>0</td>
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<tr>
<td>2-10 Slope</td>
<td>0.44</td>
<td>0.08</td>
<td>0</td>
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<tr>
<td>10-30 Slope</td>
<td>4.46</td>
<td>11.97</td>
<td>-215</td>
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<td><strong>Spread Duration Factors</strong></td>
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<tr>
<td>EM Spread</td>
<td>0.04</td>
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<td>Mtge Spread</td>
<td>0.42</td>
<td>0.00</td>
<td>-2</td>
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<td>Corp Spread</td>
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<td>-8.01</td>
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<td>HY Spread</td>
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<td>0</td>
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<tr>
<td>Swap Spread</td>
<td>0.10</td>
<td>0.28</td>
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<td><strong>Other Key Factors</strong></td>
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<tr>
<td>Real Estate</td>
<td>0.05</td>
<td>0.05</td>
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<td>Commodity</td>
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<td>Developed Currency</td>
<td>0.14</td>
<td>0.09</td>
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<tr>
<td>EM Currency</td>
<td>0.01</td>
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<td>Other Equity Industry</td>
<td>0.49</td>
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<td>Other Factors</td>
<td>0.00</td>
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<td>Estimated Total Volatility</td>
<td>1901</td>
<td>1269</td>
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<tr>
<td><strong>Volatility Contributions</strong></td>
<td></td>
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</tr>
</tbody>
</table>

SOURCE: PIMCO (As of November 30, 2010)

Hypothetical example for illustrative purposes only

1. Negative (Positive) Size factor weight implies Small cap bias.
2. Negative (Positive) Value factor weight implies Value bias.
3. Spread Duration factors are measured against Treasuries.
5. Other factors include: Idiosyncratic (specific), Country, Industry, Sector, and “Style” factors such as Value, Size, Momentum, Liquidity, and Leverage.
6. Impact of Funding Ratio at 75%

Refer to Appendix for additional hypothetical example and portfolio analysis information.
The Endogeneity Problem

- Size of Corporate DB Plan Asset Base: $1.8 Tn.
- Size of Long US Corporate Universe: $936 Bn.
- Estimate Required Contributions to US Corporate DB Plans over next 3 years: $380Bn.-$450Bn.
- Estimated Long Bond purchase by Corporate DB Plans over next 5 years: $400 Bn.

SOURCE: Barclays’ Capital, Towers Watson, Morgan Stanley
30 Year Swaps spread as of September 30, 2010
Conclusions

- LDI has developed into a robust set of investment strategies across multiple market sectors

- LDI is dynamic – it is NOT the policy portfolio
  - It reflects changes in the plans funded status
  - It reflects changes in the composition of liability risk
  - It reflects changing opportunity risk/reward choice set on the asset side

- Derivatives can be useful and an increasingly important tool, but not a magic bullet without complications
  - Specific tools for specific objectives – It’s hard to loosen a nut with a hammer
  - Useful for managing certain risks, but create potential risks of their own (e.g.: liquidity, counterparty, operational)

- LDI is not a product, it is a process and one that is constantly evolving

Refer to Appendix for additional risk information.
James Moore, Ph.D.
Dr. Moore is an executive vice president in the Newport Beach office. He leads the global liability driven investments product management team and is a member of the asset allocation team. He is also PIMCO's pension strategist. Prior to joining PIMCO in 2003, he was in the corporate derivative and asset liability strategy groups at Morgan Stanley and responsible for asset-liability, strategic risk management and capital structure advisory work for key clients in the Americas and Pacific Rim. Dr. Moore also taught courses in investments and employee benefit plan design and finance while at the Wharton School of the University of Pennsylvania, where he earned his Ph.D. with concentrations in finance, insurance and risk management. He has 16 years of investment experience and holds undergraduate degrees from Brown University.
Past performance is not a guarantee or a reliable indicator of future results.

Hypothetical Example
No representation is being made that any account, product, or strategy will or is likely to achieve profits, losses, or results similar to those shown. Hypothetical or simulated performance results have several inherent limitations. Unlike an actual performance record, simulated results do not represent actual performance and are generally prepared with the benefit of hindsight. There are frequently sharp differences between simulated performance results and the actual results subsequently achieved by any particular account, product, or strategy. In addition, since trades have not actually been executed, simulated results cannot account for the impact of certain market risks such as lack of liquidity. There are numerous other factors related to the markets in general or the implementation of any specific investment strategy, which cannot be fully accounted for in the preparation of simulated results and all of which can adversely affect actual results.

Investment Strategy
There is no guarantee that these investment strategies will work under all market conditions and each investor should evaluate their ability to invest for a long-term especially during periods of downturn in the market.

No representation is being made that any account, product, or strategy will or is likely to achieve profits, losses, or results similar to those shown. Hypothetical or simulated performance results have several inherent limitations. Unlike an actual performance record, simulated results do not represent actual performance and are generally prepared with the benefit of hindsight. There are frequently sharp differences between simulated performance results and the actual results subsequently achieved by any particular account, product, or strategy. In addition, since trades have not actually been executed, simulated results cannot account for the impact of certain market risks such as lack of liquidity. There are numerous other factors related to the markets in general or the implementation of any specific investment strategy, which cannot be fully accounted for in the preparation of simulated results and all of which can adversely affect actual results.

Portfolio Analysis
The portfolio analysis is based on a sample pension plan's asset allocation and no representation is being made that the structure of the average portfolio or any account will remain the same or that similar returns will be achieved. Results shown may not be attained and should not be construed as the only possibilities that exist. Different weightings in the asset allocation illustration will produce different results. Actual results will vary and are subject to change with market conditions. There is no guarantee that results will be achieved. No fees or expenses were included in the estimated results and distribution. The scenarios assume a set of assumptions that may, individually or collectively, not develop over time. The analysis reflected in this information is based upon data at time of analysis. Forecasts, estimates, and certain information contained herein are based upon proprietary research and should not be considered as investment advice or a recommendation of any particular security, strategy or investment product.

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Risk
Investing in the bond market is subject to certain risks including market, interest-rate, issuer, credit, and inflation risk. Investing in foreign denominated and/or domiciled securities may involve heightened risk due to currency fluctuations, and economic and political risks, which may be enhanced in emerging markets. Equities may decline in value due to both real and perceived general market, economic, and industry conditions. High-yield, lower-rated, securities involve greater risk than higher-rated securities; portfolios that invest in them may be subject to greater levels of credit and liquidity risk than portfolios that do not. Derivatives may involve certain costs and risks such as liquidity, interest rate, market, credit, management and the risk that a position could not be closed when most advantageous. Investing in derivatives could lose more than the amount invested. Swaps are a type of privately negotiated derivative; there is no central exchange or market for swap transactions and therefore they are less liquid than exchange-traded instruments.

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Index Descriptions

Barclays Capital U.S. Long Credit Index is the credit component of the Barclays Capital US Government/Credit Index, a widely recognized index that features a blend of US Treasury, government-sponsored (US Agency and supranational), and corporate securities limited to a maturity of more than ten years.

Barclays Capital Long Term Government/Credit Index is an unmanaged index of U.S. Government or Investment Grade Credit Securities having a maturity of 10 years or more.

Barclays Capital Long-Term Treasury consists of U.S. Treasury issues with maturities of 10 or more years.

Barclays Capital U.S. Aggregate Index represents securities that are SEC-registered, taxable, and dollar denominated. The index covers the U.S. investment grade fixed rate bond market, with index components for government and corporate securities, mortgage pass-through securities, and asset-backed securities. These major sectors are subdivided into more specific indices that are calculated and reported on a regular basis.

Barclays Capital U.S. Long Credit Index is the credit component of the Barclays Capital US Government/Credit Index, a widely recognized index that features a blend of US Treasury, government-sponsored (US Agency and supranational), and corporate securities limited to a maturity of more than ten years.

The HFRI Fund Weighted Composite Index is comprised of over 2000 domestic and offshore constituent funds. All funds report assets in USD and report net of fees returns on a monthly basis. There is no Fund of Funds included in the index and each has at least $50 million under management or have been actively trading for at least twelve months.

S&P Listed Private Equity Index is an unmanaged index comprised of 30 leading listed private equity companies that meet size, liquidity and activity requirements. The index is designed to provide tradable exposure to the leading exposed publicly listed companies in the private equity space.

The MSCI EAFE (Morgan Stanley Capital International Europe, Australasia, Far East Index) is an unmanaged index of over 900 companies, and is a generally accepted benchmark for major overseas markets. Index weightings represent the relative capitalizations of the major overseas markets included in the index on a U.S. dollar adjusted basis.

The S&P 500 Index is an unmanaged market index generally considered representative of the stock market as a whole. The index focuses on the Large-Cap segment of the U.S. equities market.

It is not possible to invest directly in an unmanaged index.