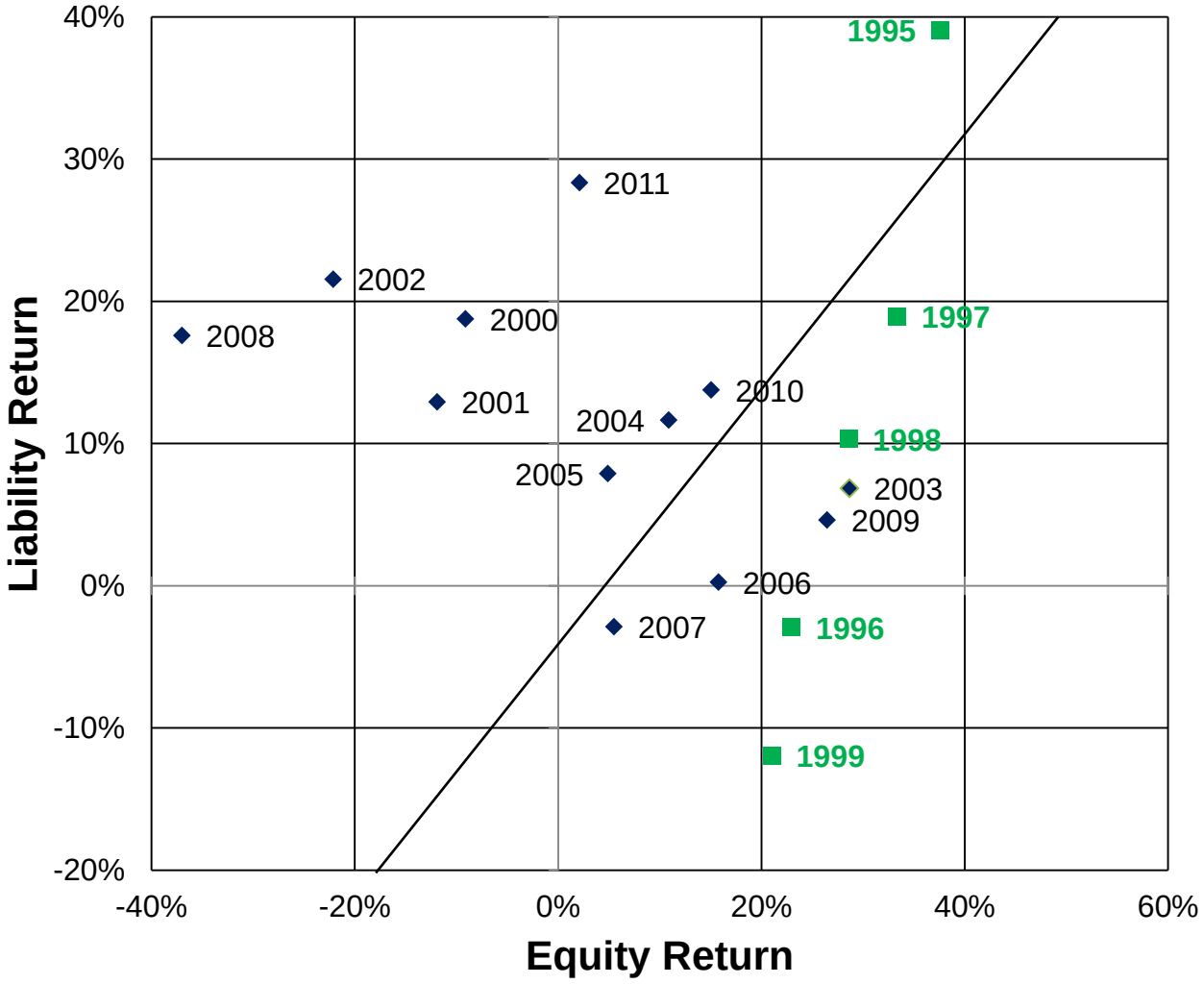
# A New Pension Risk Measurement Methodology

Jing Ai
Shidler College of Business
The University of Hawaii at Manoa
Patrick Brockett
The University of Texas and Austin
Allen Jacobson
USAA

Ninth International Longevity Risk and Capital Markets Solutions Conference,
Beijing, China, September 6, 2013

# Challenging Environment




Life Expectancy at Age 65 in the United States: Both Sexes

| Year | Expectancy in Years |
|---|---|
| 1950 | 13.9 |
| 1960 | 14.3 |
| 1970 | 15.2 |
| 1980 | 16.4 |
| 1990 | 17.2 |
| 2000 | 17.6 |
| 2010 | 19.1 |

Sources: Citigroup, Ibbotson, Centers for Disease Control and Prevention

# Risks In Pension Plans

## What Are The Risks?

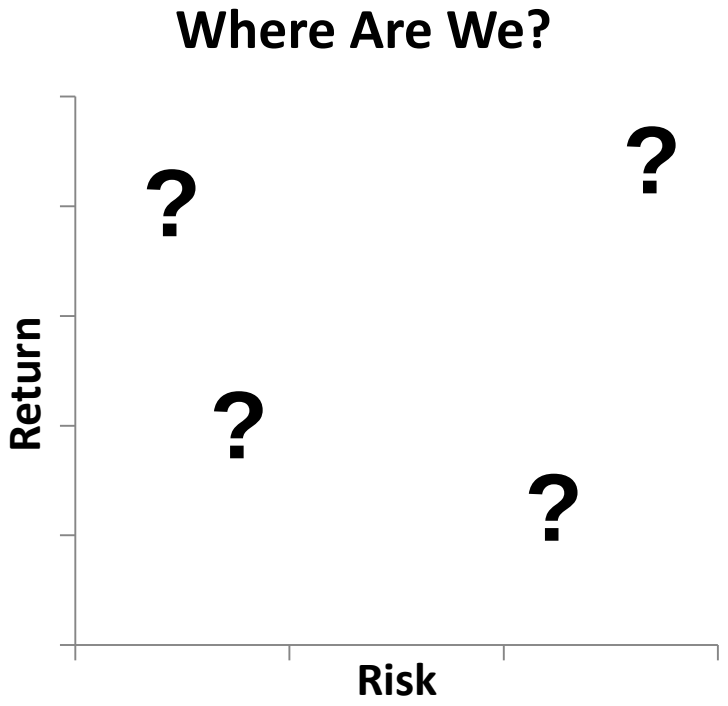
Longevity

Interest Rate

Equity Returns

Operational

## How Much Risk?



# Pensions and Life Insurers

Similarities Between Pension Plans and Life Insurers

- Subject to the same risks
- Make an economic exchange: Value today for promised payments in the future
- Must fulfill obligations to avoid bankruptcy

One Key Difference:

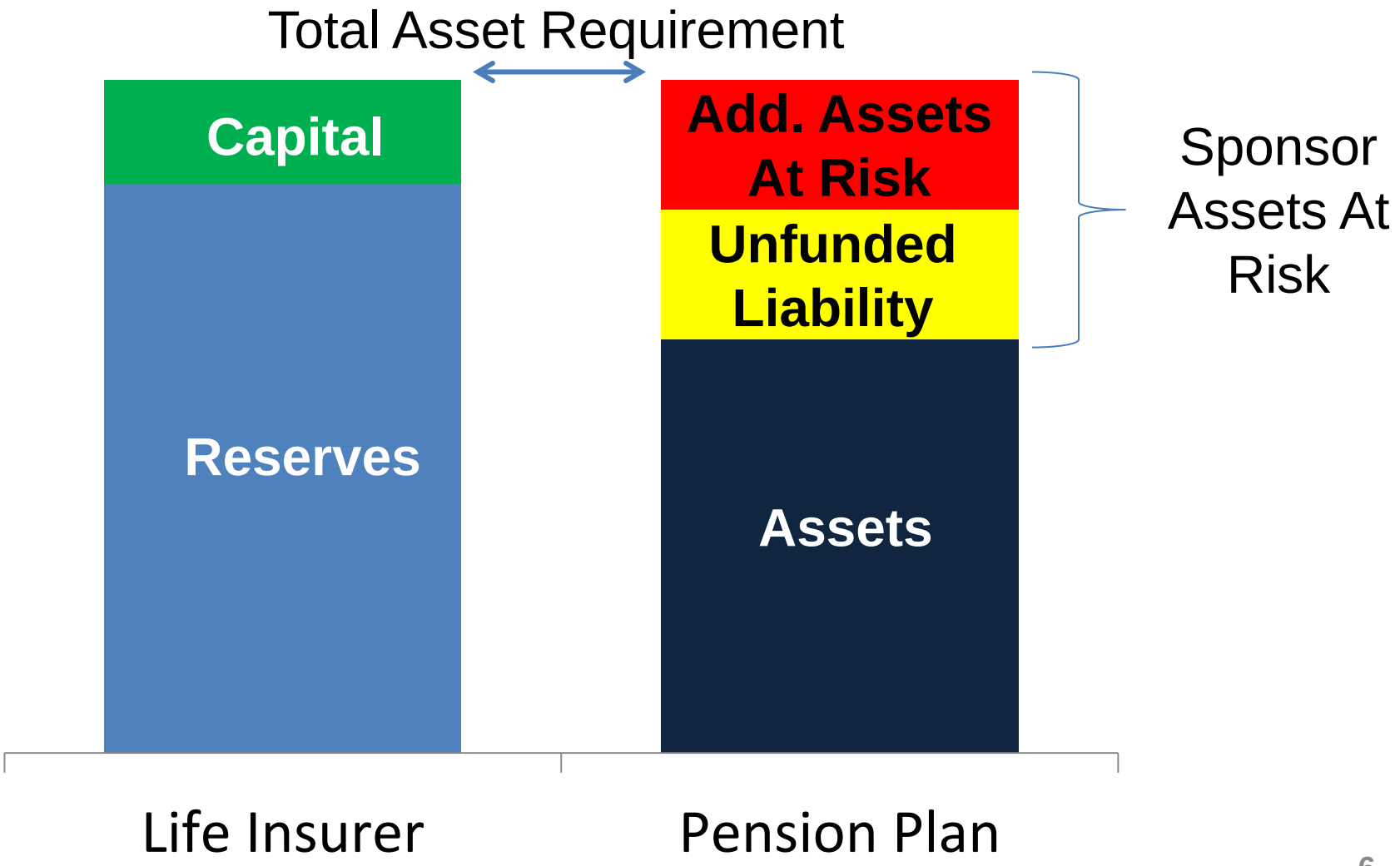
- Life Insurers are self contained
- Pension plan have a sponsor to provide additional resources

**Can we use a life insurance industry technique to measure risk in a pension plan?**

# Common View Of Risk

| Commonly Perceived Risks: Insurers vs. Pension Sponsors | | | |
|---|---|---|---|
| **Risk Type** | Insurance Company Description | Pension Plan Description | **Pension Sponsors' View of Risk** |
| **Investment Risk** | Default risk on fixed-income investments and market value risk on equity type investments | Equity market | **15%** |
| **Pricing Risk** | Longevity risk | Longevity | **21%** |
| **Interest Rate Risk** | Interest rate and asset-liability management risk | Interest rate<br>Inflation | **58%**<br>**6%** |
| **Operational Risk** | Operational risk | Not mentioned in survey | **Not mentioned in survey** |
| **Sources: Standard & Poor's Capital Model, 2010 Pension Risk Management Global Survey** | | | |

# Funding Of Pensions



# Required Capital Calculation

**Risks**

- Risk exposures
- Revenues, Liabilities and Assets

**Confidence Level**

- Confidence of Solvency
- Very High for Insurers

**Required Capital**

- Riskier profiles = More Capital
- Higher Confidence = More Capital

# Total Asset Requirement

| | |
|---|---|
| Accounting Liability | $ 100.0 |
| Assets | $ 80.0 |
| Unfunded Liability | $ 20.0 |
| | |
| Total Asset Requirement (AAA) | $147.3 |
| Additional Assets at Risk (AAA) | $ 47.3 |
| Total Sponsor Assets at Risk | $ 67.3 |

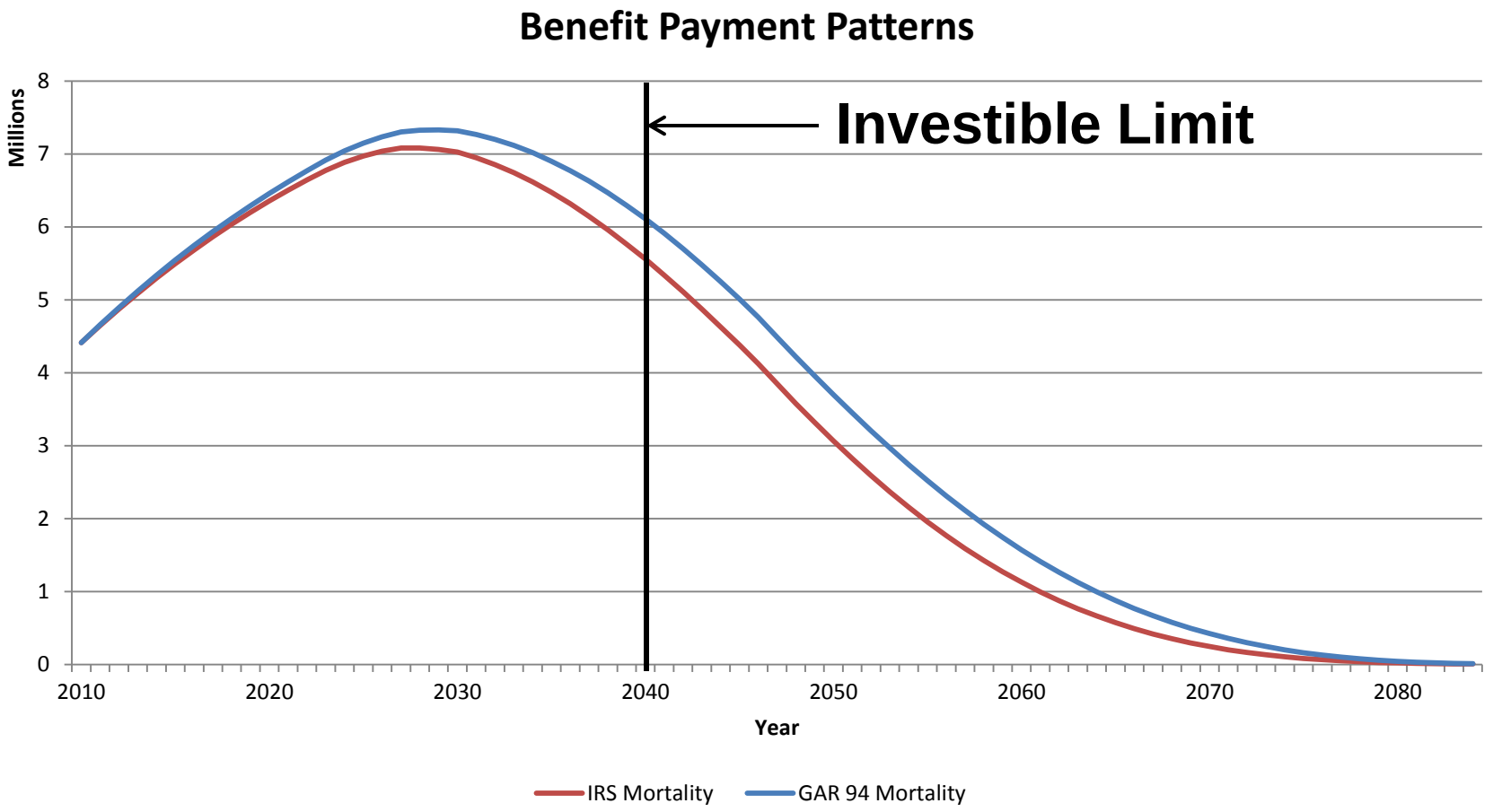
Source: Standard & Poor's

# Total Asset Requirement

| | Reserves | Capital Required | Total Asset Requirement |
|---|---|---|---|
| Accounting Liability | $ 100.0 | | |
| Reflect Reserve Interest Rate and Mortality Assumptions | $ 15.9 | | |
| Reserve Liability | | | $ 115.9 |
| | | | |
| Asset Risk | | $ 22.1 | |
| Interest Rate Risk | | $ 5.0 | |
| Operational Risk | | $ 0.2 | |
| “Unspecified Assets” | | $ 4.1 | |
| Total Capital Required | | | $ 31.4 |
| Total Asset Requirement (AAA) | | | $ 147.3 |

# Mortality Table Change

Longevity Impact Most Prominent at Difficult Years for Investment



# Pensions and Life Insurers

Differences Between Pension Plans and Life Insurers

- Investment philosophies very different – asset/liability mismatch common in pension plans
- Differences in liability profiles
- Pension liabilities and assets revalued annually

**Factors reflecting the reality of pension plans would be more useful**

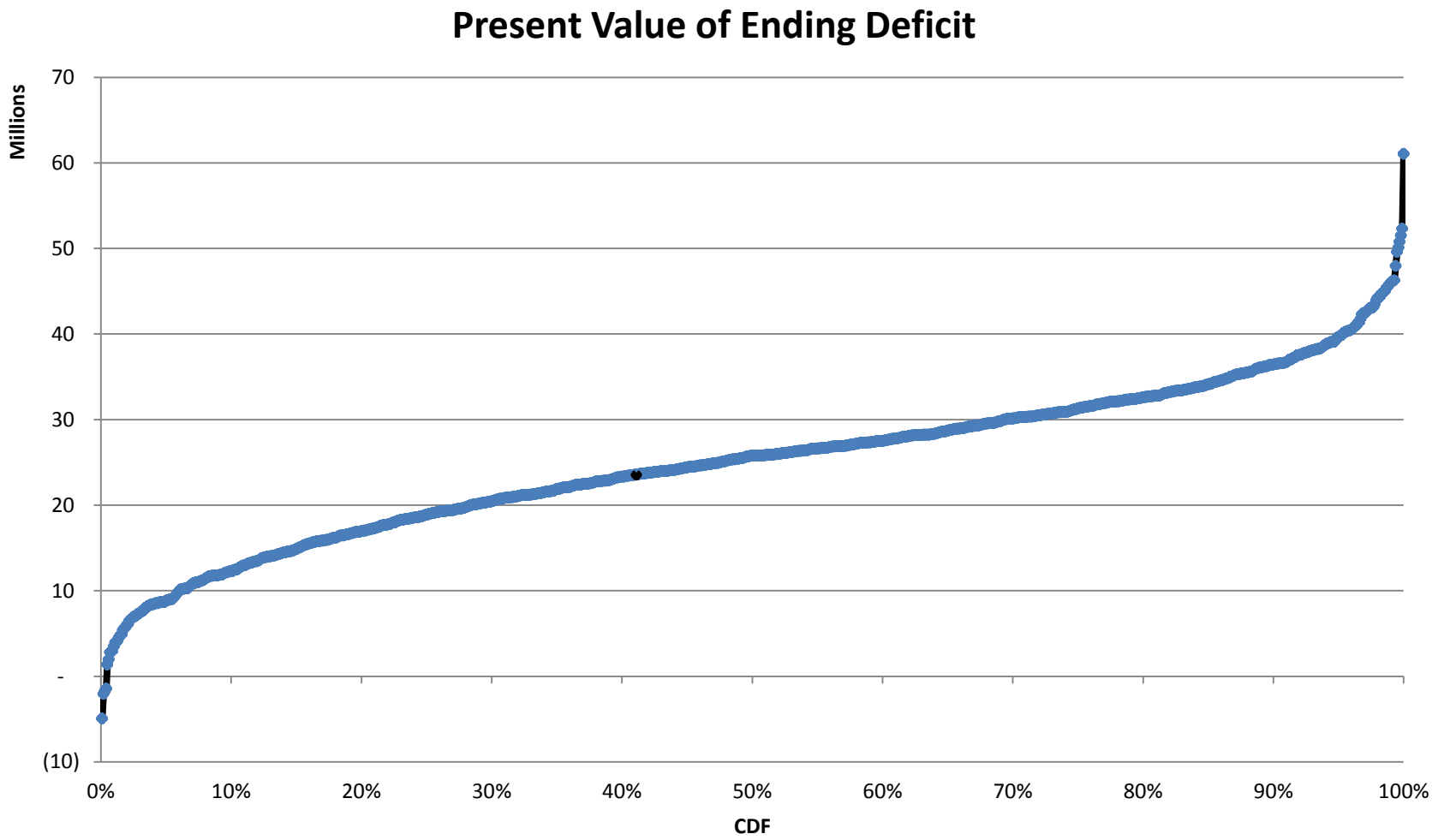
# Implementing the Method

Monte Carlo Simulation Impact on Funding Status
One Year Out Due to Changes in Major Risk Drivers

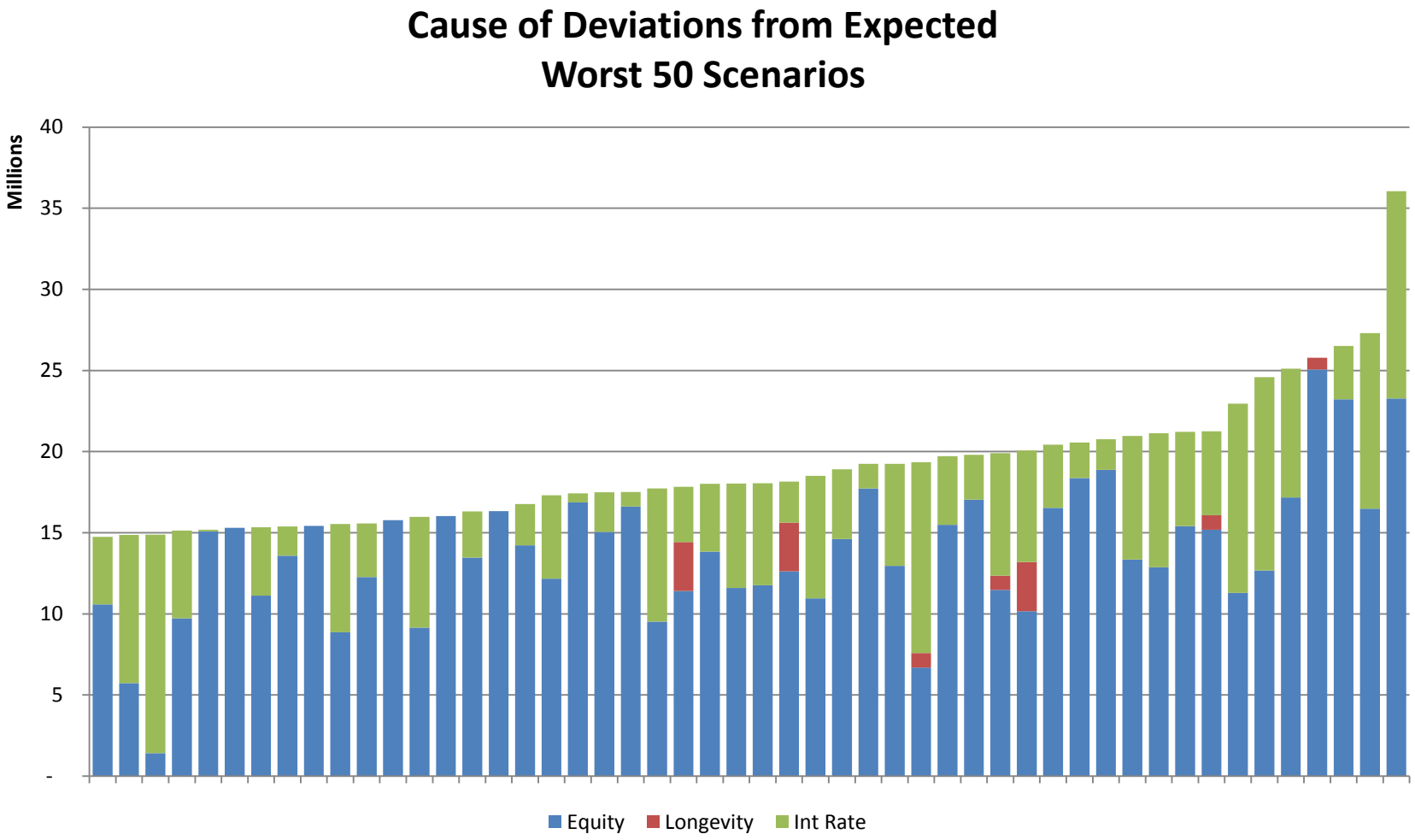
| Risk | Simulation Engine |
|---|---|
| Equity Returns | SOA/AAA Economic Scenario Generator |
| Interest Rates | SOA/AAA Economic Scenario Generator |
| Longevity | 90% - No Change<br>5% - 5 Years of AA Scale<br>5% - 10 Years of AA Scale |

1,000 Simulations of Ending Funding Deficit = Liability - Assets

# Simulated Deficits



# Drivers of Worst Outcomes

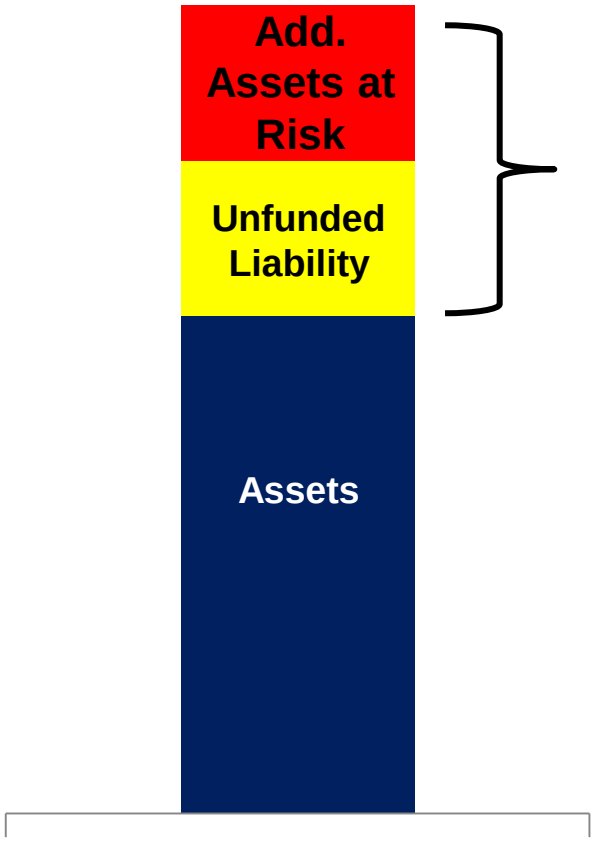


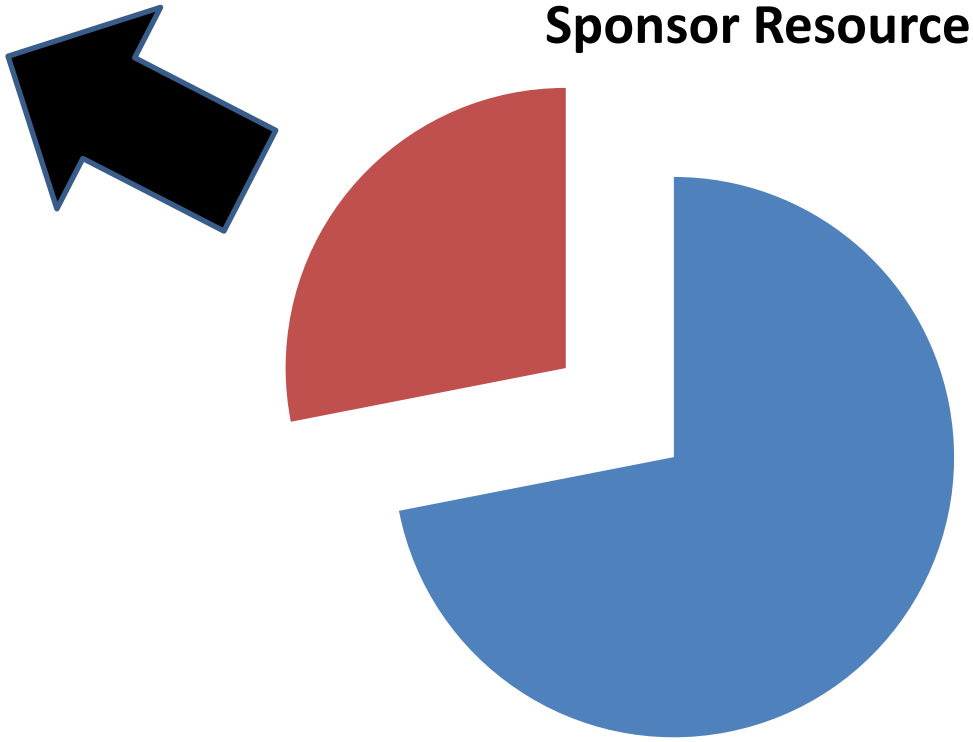
# Converting Simulations to Factors

| | Equity | Longevity | Interest Rates |
|---|---|---|---|
| **Exposure Metric** | Dollars Invested | Present Value of Liabilities | Duration Measure of Benefits less Fixed Income Cash Flows |
| **Exposure Amount** | 48,000,000 | 100,000,000 | 11,669,669 |
| **Scaled Sum of Deviations to 99.4 Risk of Ruin** | 14,506,636 | 626,194 | 7,012,173 |
| **Factor for A Rating** | 30.22% | 0.63% | 60.09% |
| **Percentile Rank of Deviation within Risk Driver** | 97.6% | 94.2% | 96.3% |

# Benefits of Methodology

What Level of Sponsor Assets at Risk is Prudent?



# Benefits of Methodology


A Better Understanding Of Risk

# Thank you!

Allen Jacobson
Allenjacobson@yahoo.com

Dr. Jing Ai
jing.ai@hawaii.edu