Pension Risk Management

Modeling the Pension Liability

October 2004

William J. Marshall, Ph.D.
President

150 North Meramec Avenue
Suite 640
St. Louis, MO 63105
(314) 721-1900 phone
(314) 721-3041 fax
www.nisanet.com

All data presented are as of June 30, 2004, unless otherwise noted.
See important disclaimers on page 4.

The institutional setting	What characteristics of a pension liability differentiate this problem?
Current practice	How do plan sponsors and plan fiduciaries view the pension obligation?

Overview

- **The Institutional Setting** – Pension Investment Decisions
- **The Traditional View** – The Sponsor’s Liability
- **The Contemporary View** – The Fiduciary’s Liability
- **Implications** for Pension Risk Management
- **Current Practice** as Observed by NISA
- **Emerging Issues**

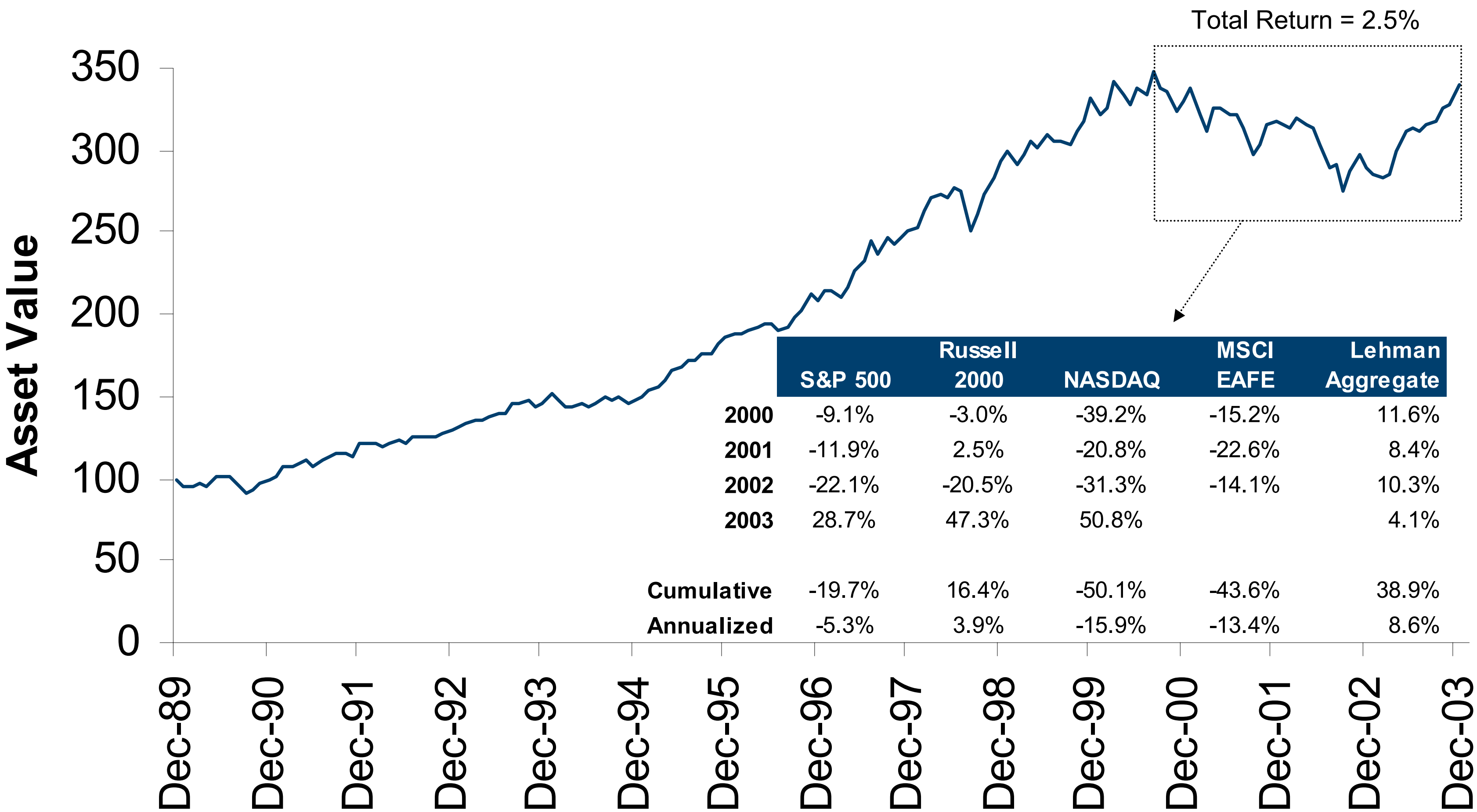
Disclaimer

I’m **not** an accountant!
I’m **not** an attorney!
I’m **not** an actuary!
I **am** an investment advisor, but
this is **not** investment advice!

Recent Evolution of the "Average Pension Plan"

Key Variable	1999	2004
Funded Status	Overfunded	Underfunded
Funding Requirements	Contribution Holiday	Required Contribution
Funding Liability	Actuarial Liability	Current Liability
Periodic Pension Cost	Pension Income	Pension Expense
Balance Sheet	No Liability	Additional Minimum Liability, Loss of Prepaid Pension Asset

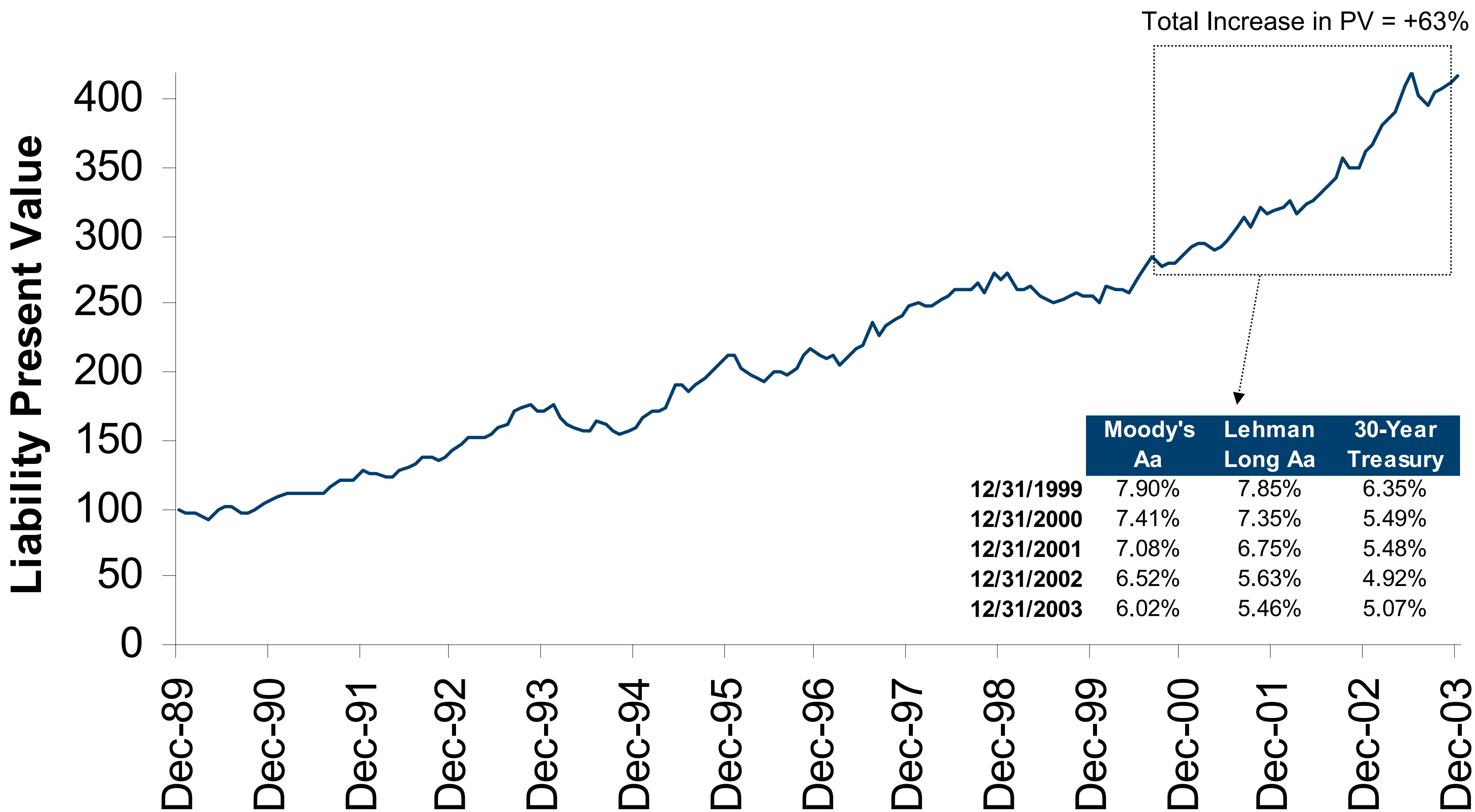
One Source of Deteriorating Funded Status: Poor Asset Performance



	S&P 500	Russell 2000	NASDAQ	MSCI EAFE	Lehman Aggregate
2000	-9.1%	-3.0%	-39.2%	-15.2%	11.6%
2001	-11.9%	2.5%	-20.8%	-22.6%	8.4%
2002	-22.1%	-20.5%	-31.3%	-14.1%	10.3%
2003	28.7%	47.3%	50.8%		4.1%
Cumulative	-19.7%	16.4%	-50.1%	-43.6%	38.9%
Annualized	-5.3%	3.9%	-15.9%	-13.4%	8.6%

Data Source: Bloomberg
Portfolio assumed to be invested 60%/40% S&P 500/Lehman Aggregate

Equally Important: Dramatic Increases in Liability Present Values



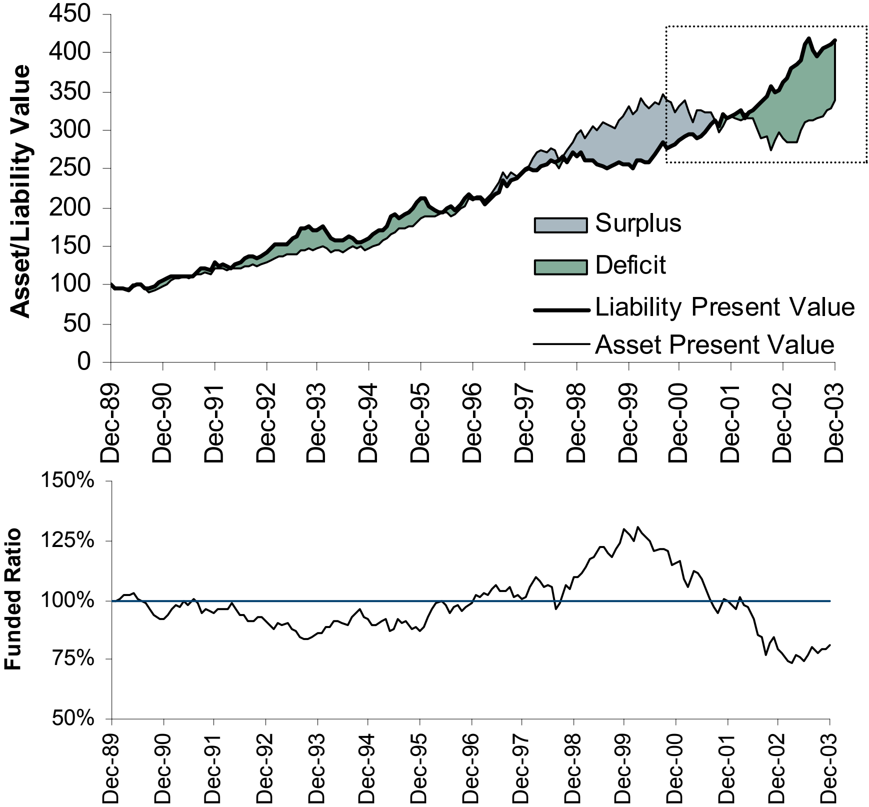
	Moody's Aa	Lehman Long Aa	30-Year Treasury
12/31/1999	7.90%	7.85%	6.35%
12/31/2000	7.41%	7.35%	5.49%
12/31/2001	7.08%	6.75%	5.48%
12/31/2002	6.52%	5.63%	4.92%
12/31/2003	6.02%	5.46%	5.07%

Liability Data Source: Towers Perrin
Asset Data Source: Bloomberg

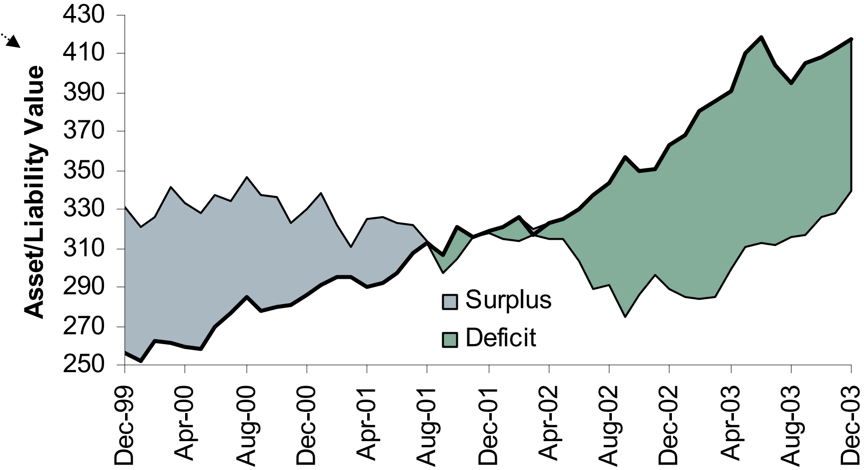
NISA

Surplus Volatility is Greater than Asset Volatility

A Hypothetical Plan's Funded Status



- Surplus = Assets – Liabilities
- Funded Status = Assets/Liabilities



Liability Data Source: Towers Perrin
Asset Data Source: Bloomberg

Sponsors are Seeking Prescriptions to Limit Their Risks

- Minimum required contributions
- Additional funding charges
- PBGC premiums
- "Forced, voluntary" contributions

Cash Flows

- Adjustments to expected returns on assets
- Smoothing mechanisms in accounting rules

Net Income

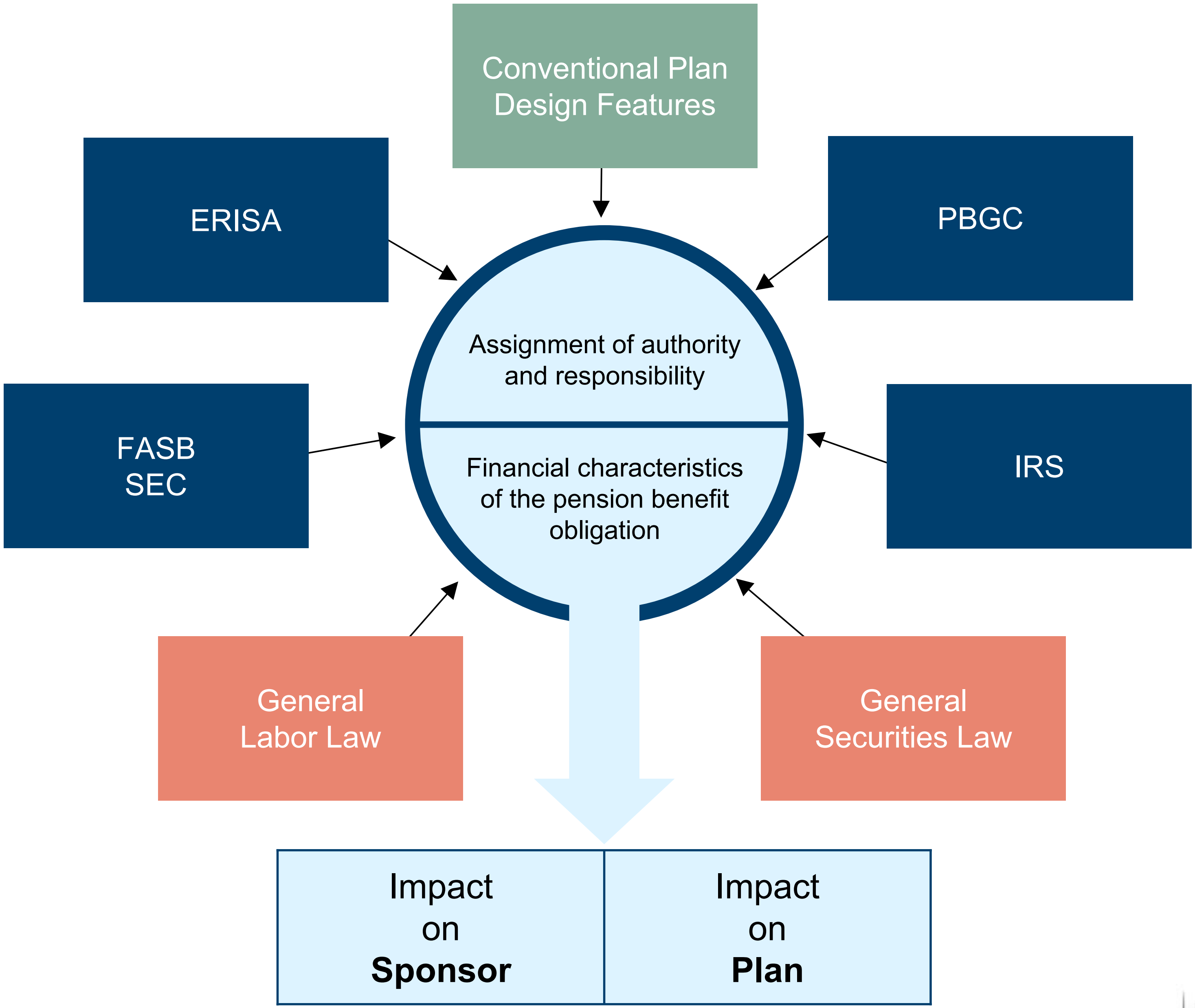
- Recognition of underfunded ABO
- Loss of prepaid pension asset

Book Value

- Ratings
- Low equity valuations
- PBGC oversight
- Participant notification

Business Activities

Institutional Arrangements that Distinguish the Pension



ERISA – Employee Retirement Security Act of 1974

Plan Sponsors Have Authority To

- Make contributions
- Terminate the plan
- Amend the benefit agreement
- Add participants
- Apply surplus funding to other plans

Sponsor acts as a fiduciary in all aspects of investment of plan assets

Fiduciary Responsibilities

- Manage assets of the plan solely in the interest of participants
- For the sole purpose of providing benefits
- Act prudently
- Avoid conflicts of interest

Fiduciaries who do not follow these principles of conduct may be personally liable to the plan

Conventional Plan Design Features

Common features of benefit agreements

- Benefits based on years of service
- Benefits based on final pay
- Annuity or lump sum payouts

Less common features of benefit agreements

- COLAs
- Ad hoc benefit increases
- Cash balance plans

IRS – Income Taxes

General features of
US Tax code

- Pension contributions deductible to a limit
- Asset earnings exempt from tax
- Surplus recovery subject to excise tax

PBGC – Insurance

The **Pension Benefit Guaranty Corporation** (PBGC) is a federal corporation that guarantees pension benefits in plans that clearly define benefits for more than 25 employees. The corporation administers terminated plans and places liens on the company's assets for any pension benefits that were promised but not delivered.*

PBGC Authority

- Contribution rules
- Participant notification
- Approval of new plans, plan mergers and plan terminations

Subject to override by Congress

Remaining Risks for Plan Beneficiaries

- Limits on covered benefits
- Insured *earned* benefit, uninsured *anticipated* benefit
- Creditworthiness of PBGC

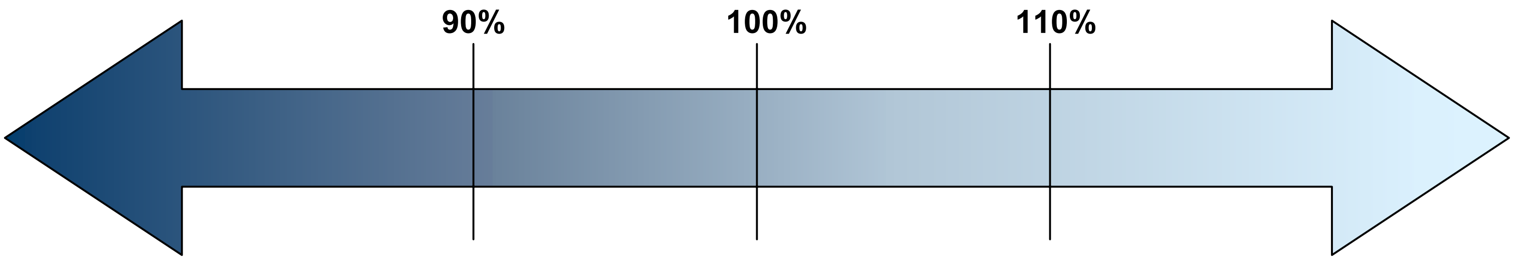
Can PBGC insurance be a consideration?

*Source: Bloomberg.

PBGC – Contribution Rules

Myriad Rules Governing Required Contributions
• Relevant liability measures: *Actuarial* liability and *Current* liability • Assets may be smoothed • Balance in Funded Standard Account may delay contributions

Funded Status

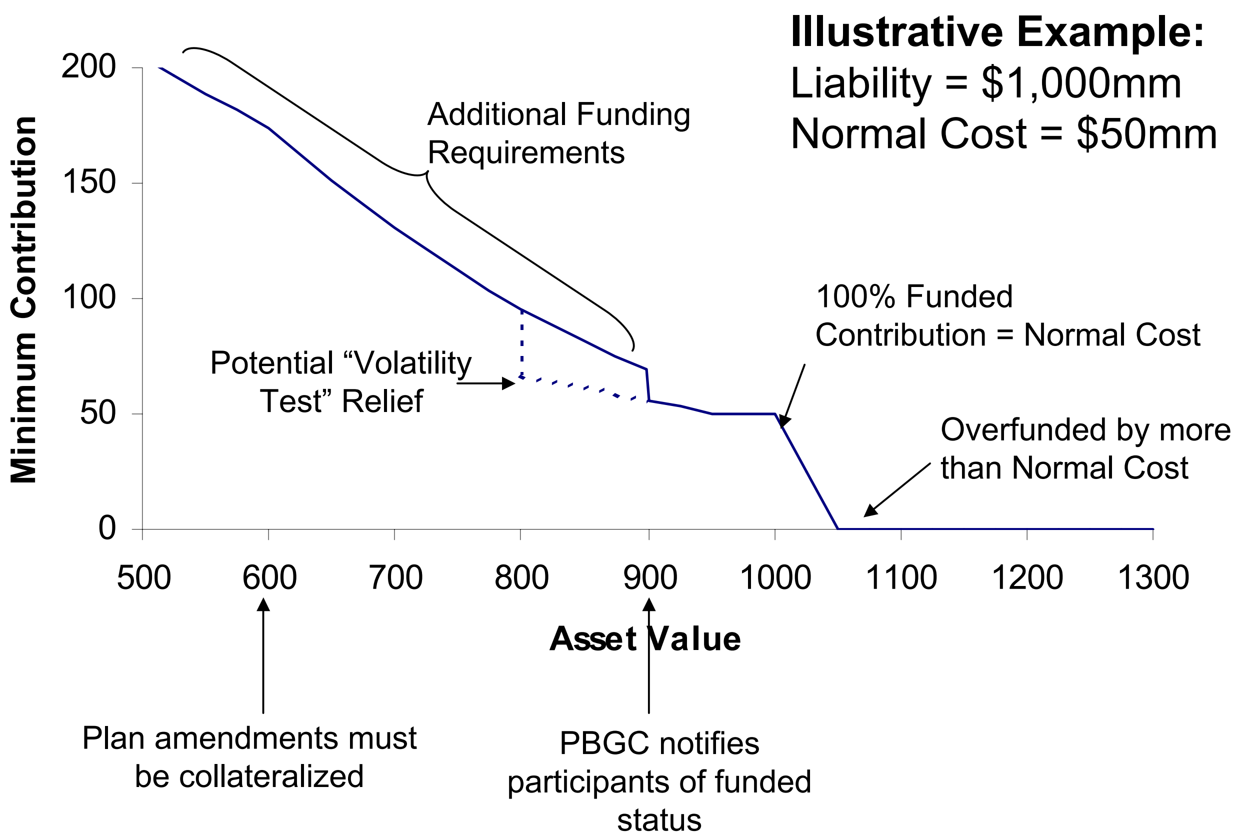


Contributions may be **required** if less than 90% funded

Amortization of deficit **allowed** if modestly underfunded

Contributions are **not allowed** if plan is overfunded

PBGC – The Asymmetry of Contributions



FASB/SEC – Accounting and Disclosure

Income Statement
Pension Expense

- PBO measure
- Expense depends on asset and liability performance
- Assets can be smoothed

Balance Sheet
Additional Minimum Liability

- ABO measure
- Deficit results in liability
- Surplus is not reported
- Asset values may not be smoothed
- Prepaid pension asset

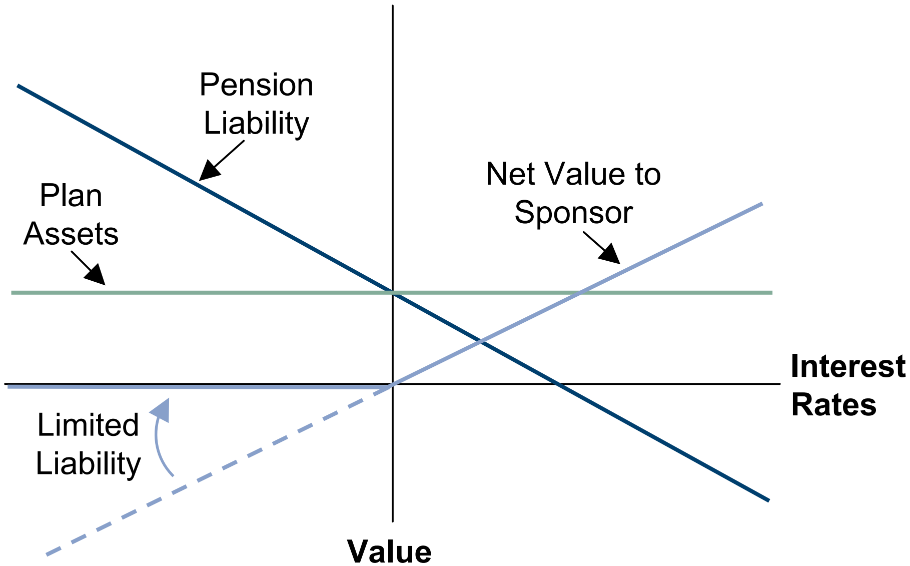
The SEC's authority extends beyond disclosure requirements.
Certain data required to be disclosed can be challenged – for example, expected investment returns, as false and misleading.

The Traditional View – The Sponsor's Liability

Corporate sponsor's perspective

- Maximize equity value
- Limited liability
- Exploitable insured benefits
- Tax shelter

Pension Liability as a Bond



Analogy to corporate debt is natural

Recall:

ERISA:

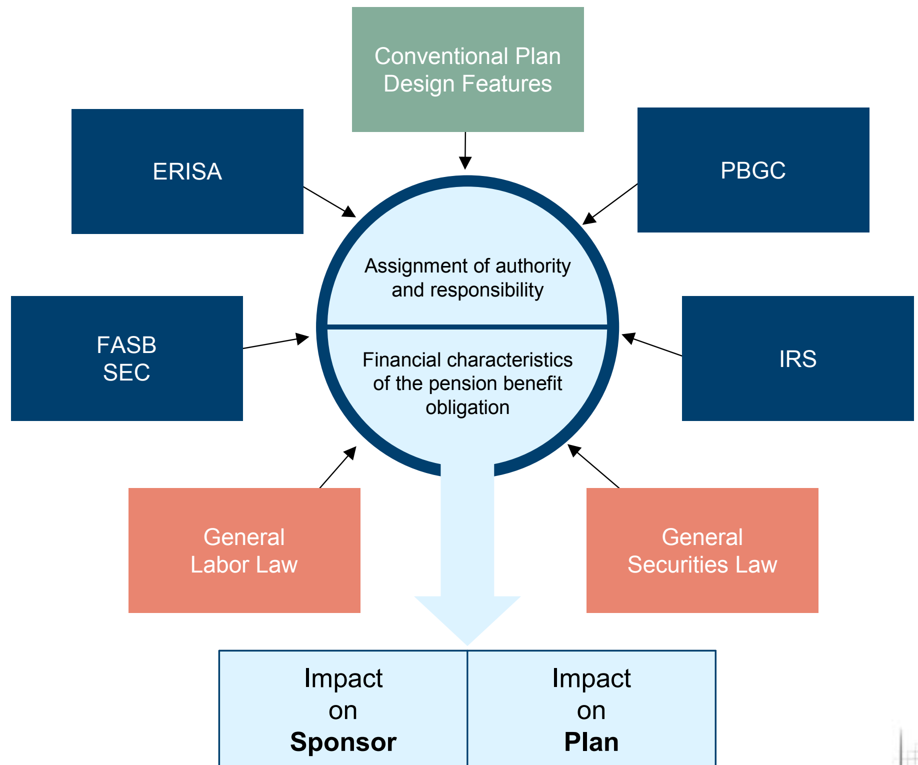
Plan Sponsors Have Authority To

- Make contributions
- Terminate the plan
- Amend the benefit agreement
- Add participants
- Apply surplus funding to other plans

Fiduciary Responsibilities

- Manage assets of the plan solely in the interest of participants
- For the sole purpose of providing benefits
- Act prudently
- Avoid conflicts of interest

Institutional Arrangements:



NISA

Recognize Separate Responsibilities and Authorities

Plan Sponsor	vs.	Plan Fiduciary

- A sponsor will attempt to **capture a funding surplus**, if any develops.

- A fiduciary's position is analogous to that of a **secured lender** who controls the investment of collateral.

Contrast to the conventional model:

- Fiduciary as an investor has **no incentive to produce surplus**.
- Fiduciary as an investor views potential additions to benefits (e.g., from **salary inflation, future service, etc)** as a risk factor since they may diminish collateral coverage.

The Contemporary View – The Fiduciary's Liability

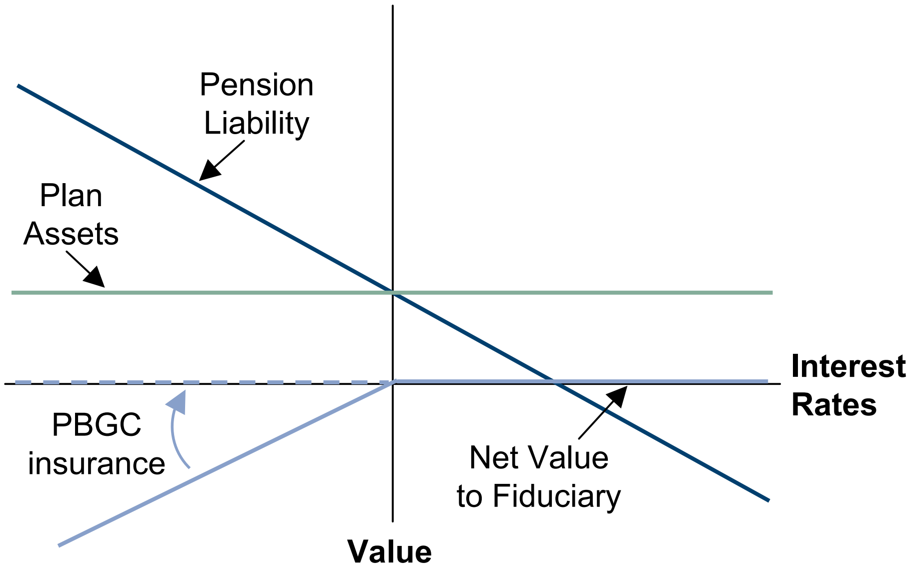
Fiduciary's perspective

- Minimal to no benefit from surplus
- Participants have no claim on surplus
- Fiduciaries are not to take into account potential sponsor benefits from surplus

How should a fiduciary view the surplus?

- Anticipated increments to benefits
- Anticipated contributions
- "Game" between sponsor and fiduciary

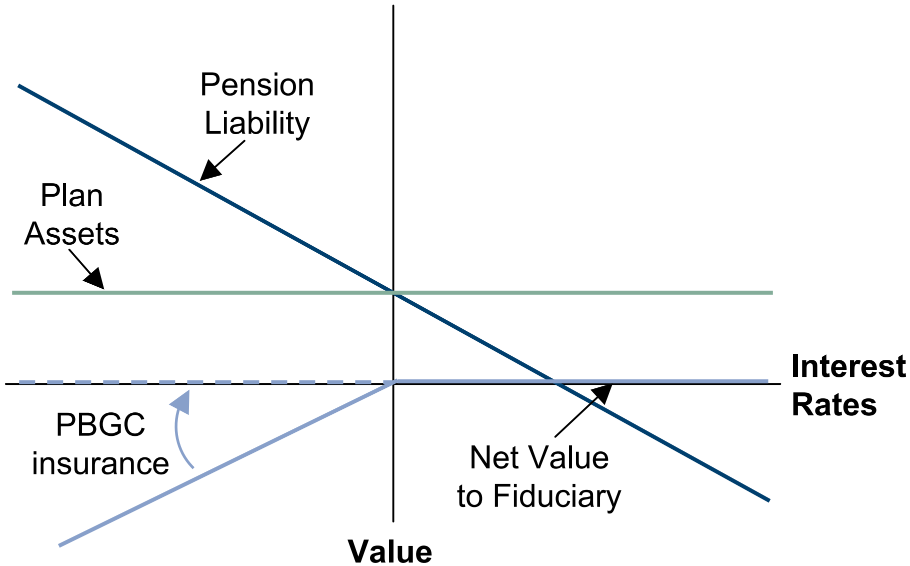
Pension Liability – Revised Model



Analogy to a cap on surplus

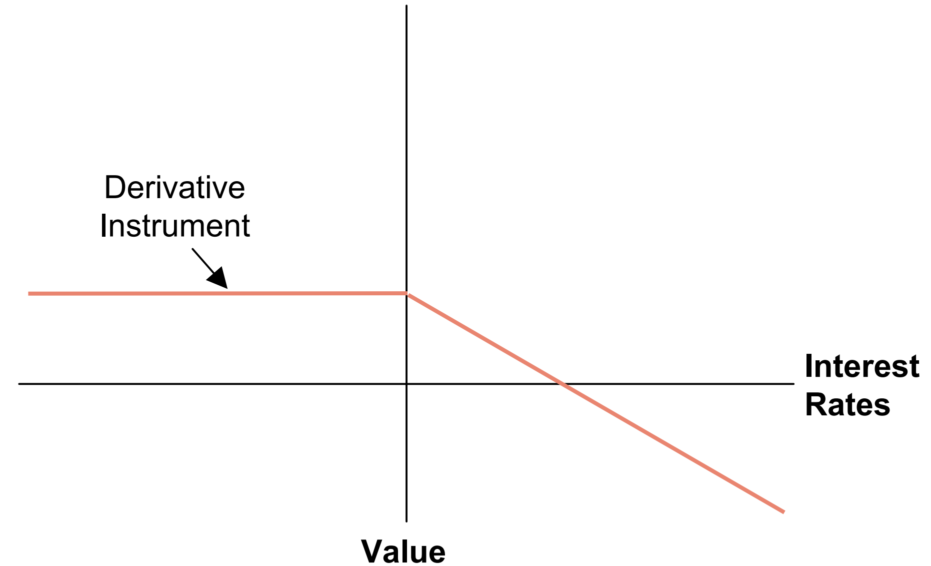
How Can a Fiduciary Capture the Benefit of a Potential Surplus?

Pension Liability – Revised Model



- Can a sponsor “monetize” its natural position?

One Possibility



- One example: Sell claims on returns in states of the world where surplus will develop.

What Liability Management Strategies Does NISA See Clients Using?

Long Bonds

- Long Treasury and corporate bonds, STRIPS, agency zeros
- Relatively easy to implement
- Challenges: Convexity matching, funding the strategy

Bonds + Derivatives

- Treasury and corporate bonds, interest rate swaps and Treasury futures
- Larger universe of bonds to exploit
- Challenges: Monitoring and management of combined, overlapping strategies

Derivatives

- Interest rate swaps, Treasury futures
- Plan assets can be invested in other instruments (equities, alternative investments, etc.)
- Challenges: Spread duration matching, OTC relationships with counterparties, comfort with derivatives

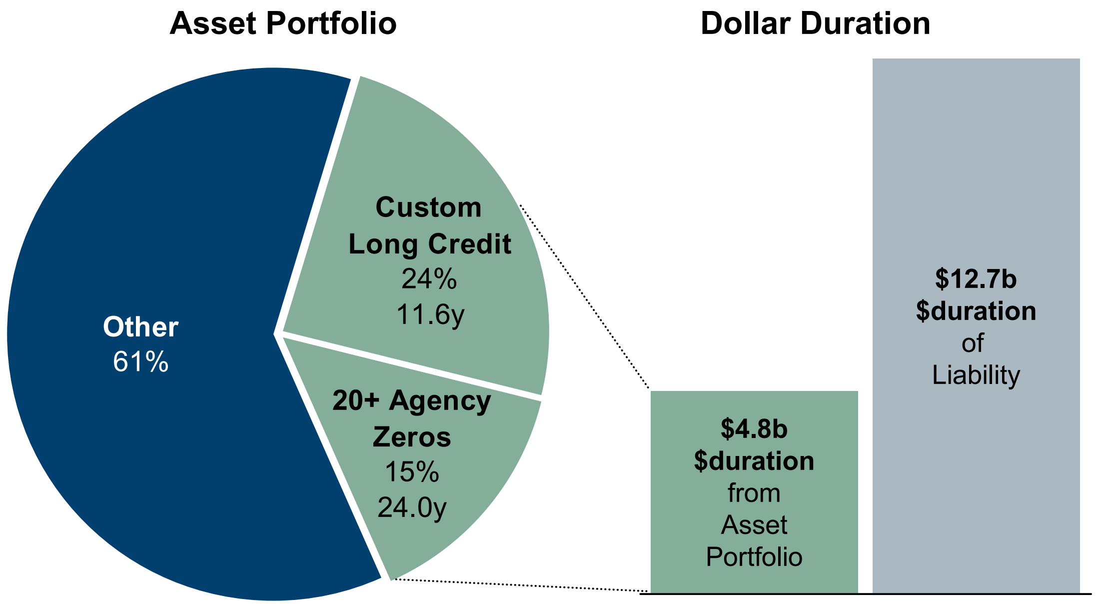
Exotics

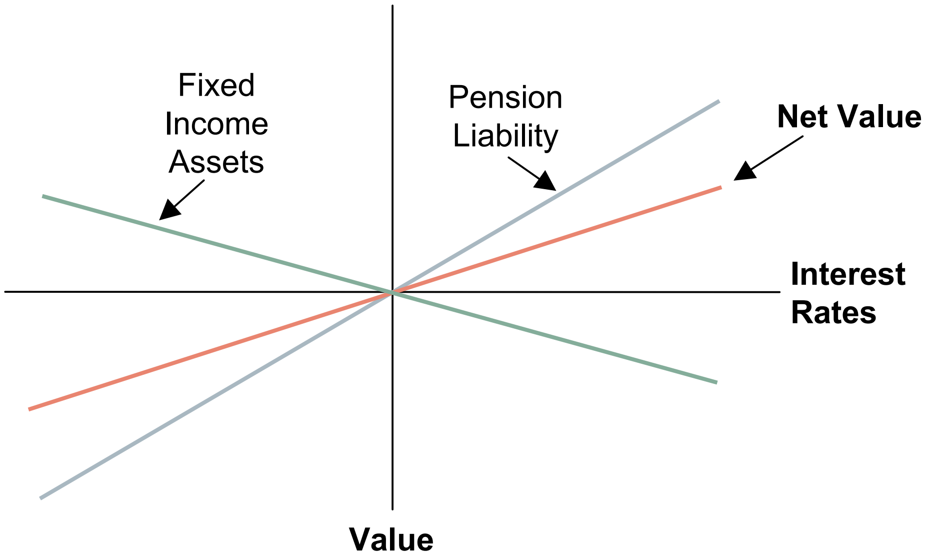
- Interest rate swaptions, total return swaps, credit derivatives
- Can be used to express a view through a non-linear payoff profile
- Challenges: Trading and valuation of thinly traded OTC instruments

Example #1 – Long Bonds

Client Background

- Corporate pension plan
- CCC-rated sponsor
- **12.7y duration liability**
- 77% funded ratio



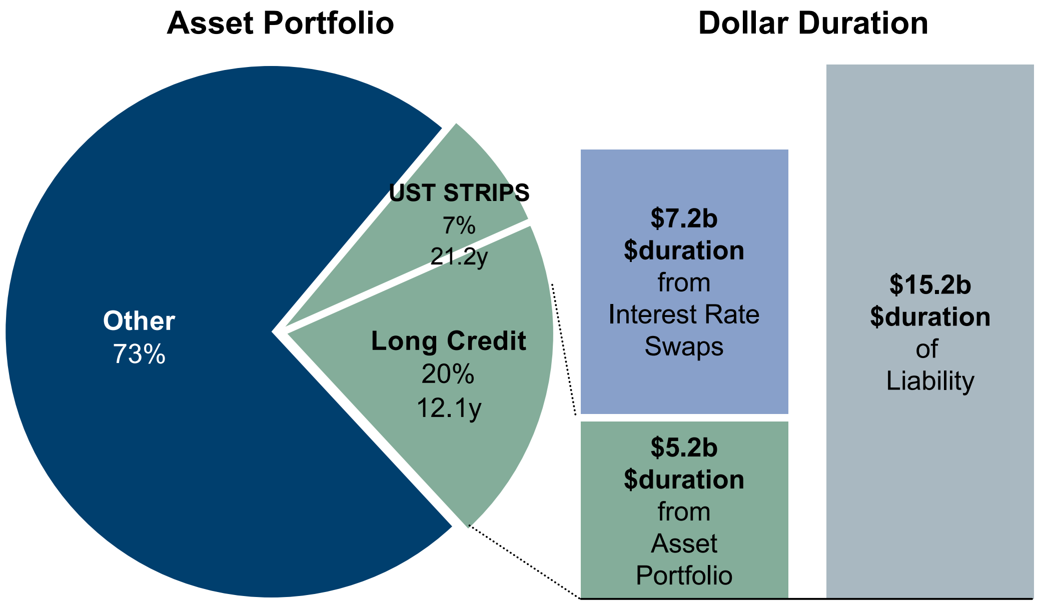


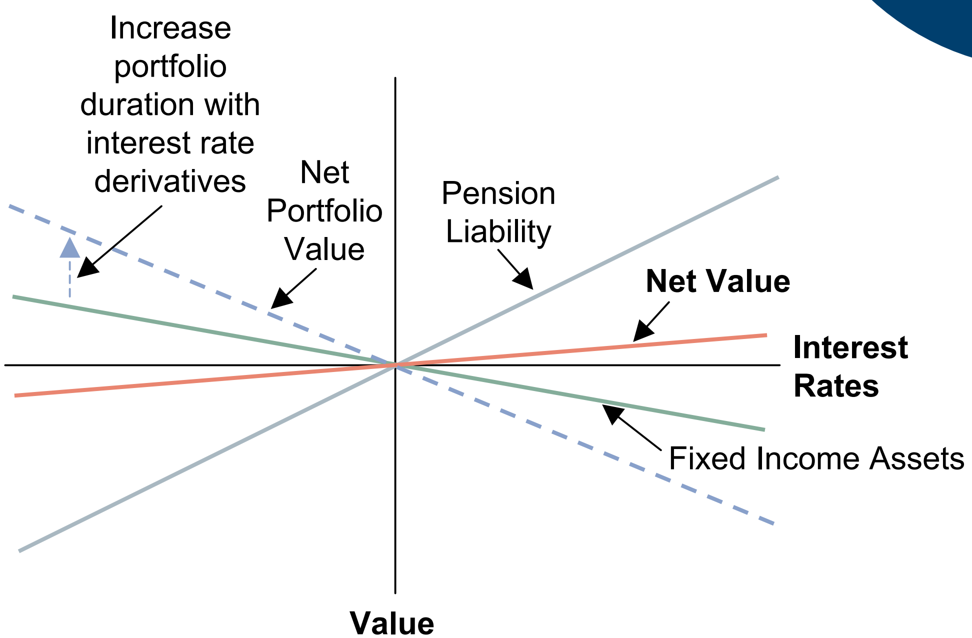
The allocation to long duration fixed income hedges approximately 38% of the liability.

Example #2 – Long Bonds + Derivative Overlay

Client Background

- Corporate pension plan
- BB-rated sponsor
- **15.2y duration liability**
- 138% funded ratio
- Overlay of interest rate swaps



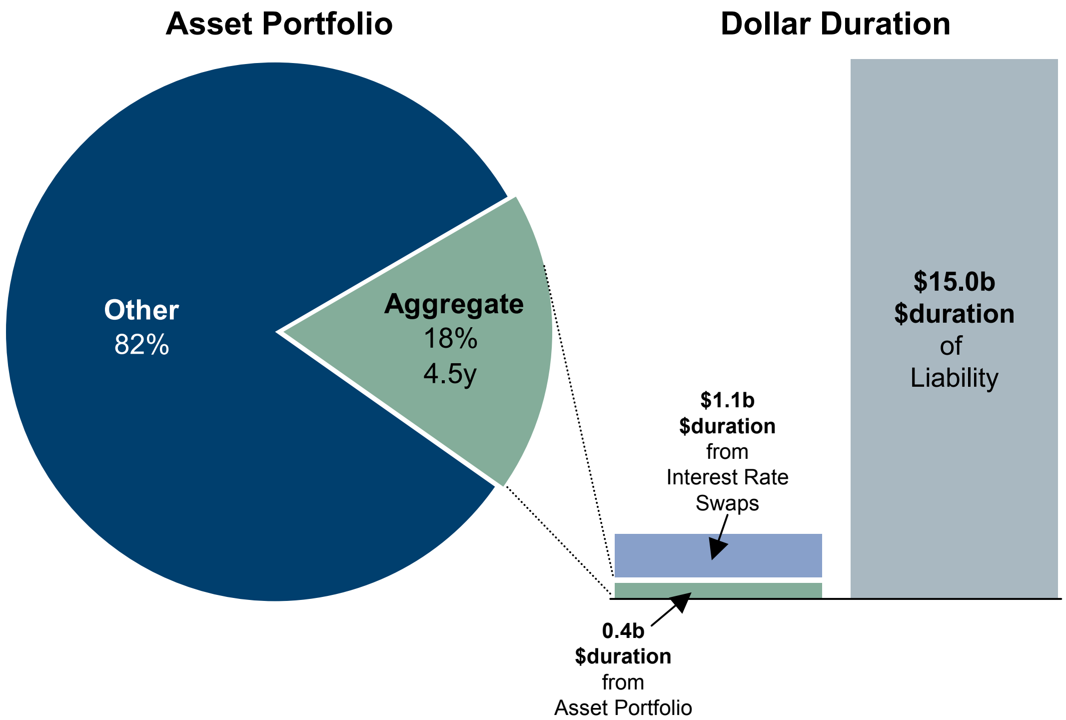


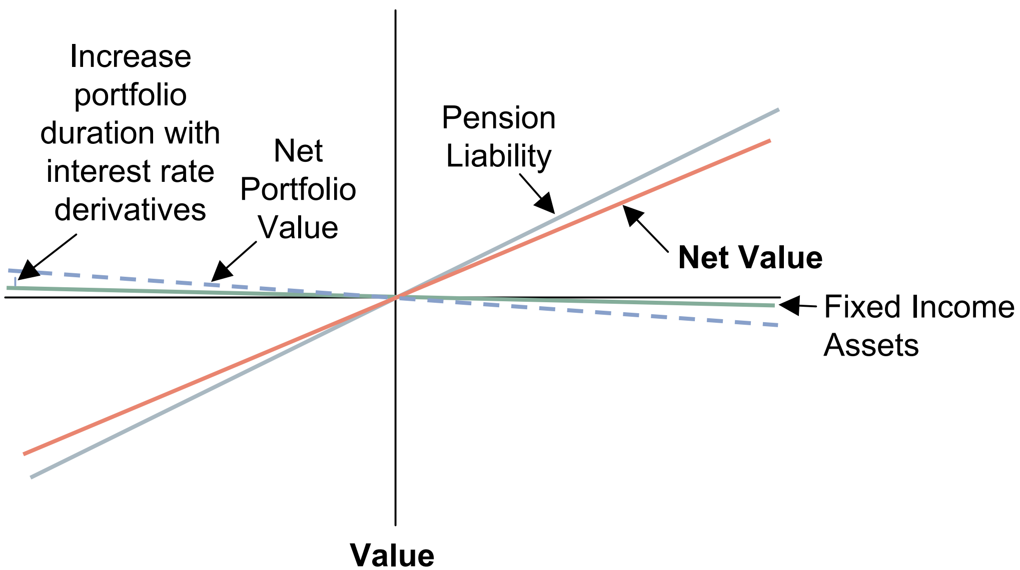
The allocation to long duration fixed income plus the interest rate swap overlay hedges approximately 82% of the liability.

Example #3 – Derivative Overlay

Client Background

- Corporate pension plan
- CCC-rated sponsor
- **15.0y duration liability**
- 54% funded ratio
- Overlay of interest rate swaps



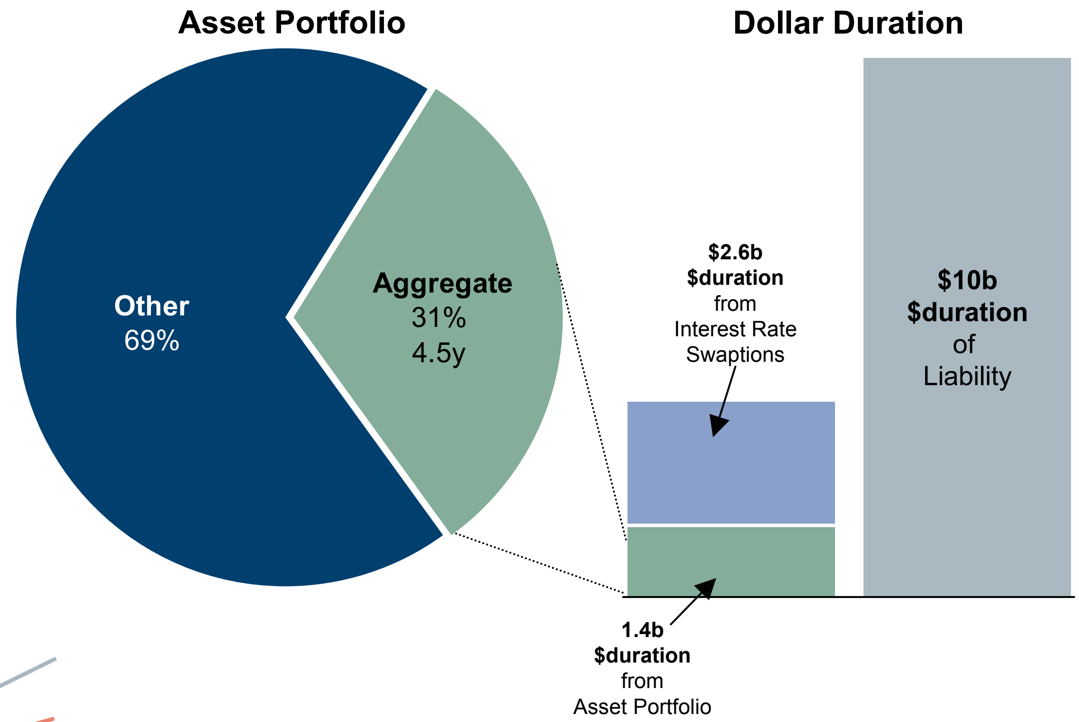


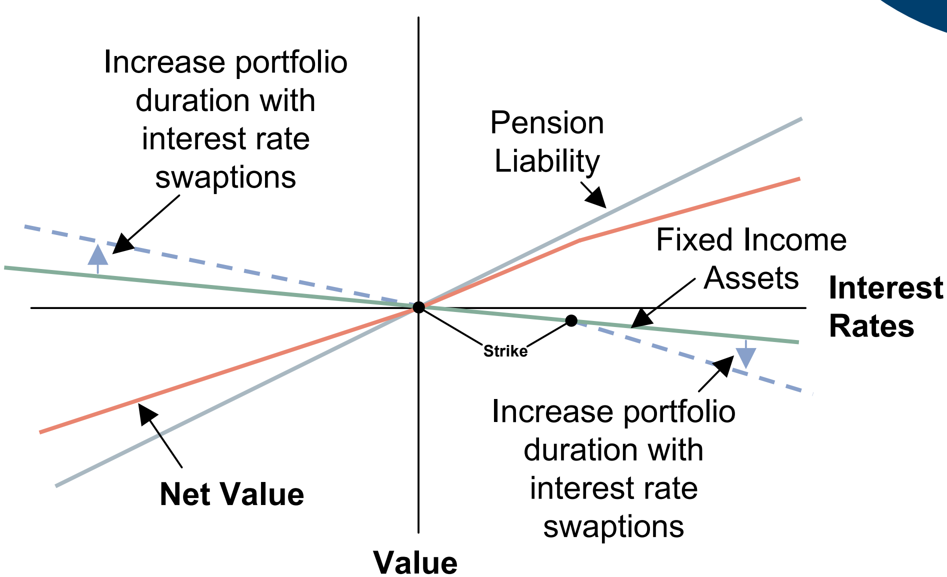
The allocation to fixed income plus the interest rate swap overlay hedges approximately 10% of the liability.

Example #4 – Derivative Overlay

Client Background

- Corporate pension plan
- BBB-rated sponsor
- **10.0y duration liability**
- 99% funded ratio
- Overlay of interest rate swaptions



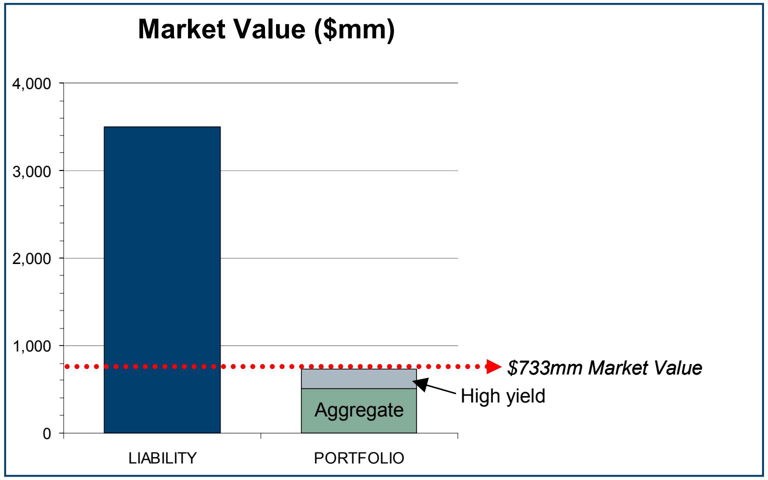


The allocation to fixed income plus the interest rate swaption overlay hedges approximately 40% of the liability.

A Representative Pension Hedge Engagement – For Illustration Purposes Only

Client Background

- Corporate pension plan
- BBB+ rated sponsor
- **$3.5b, 12y duration liability**
- $3.2b assets
- $733m fixed income assets: $506mm Aggregate and $227mm high yield



	Current Allocation	1-year VaR	Assumed Volatility
Domestic Equity	**$1,520**	**-$502**	
Large Cap	$774	-$243	19.0%
Mid Cap	$359	-$120	20.3%
Small Cap	$354	-$126	21.5%
Company Stock	$33	-$13	24.6%
International Equity	**$468**	**-$166**	
Int'l Core	$319	-$101	19.2%
Int'l EM	$149	-$65	26.4%
Specialty Investments	**$438**	**-$126**	
Hedge Funds	$264	-$40	9.1%
Private Equity	$174	-$86	30.0%
Fixed Income	**$733**	**-$71**	
Core	$506	-$40	4.8%
Hi-yield	$227	-$31	8.4%
Cash	$130		
Total Assets	**$3,219**	**-$679**	12.8%
Current Liability	$3,500	**$655**	11.3%
Surplus	-$281	**-$1,030**	17.8%

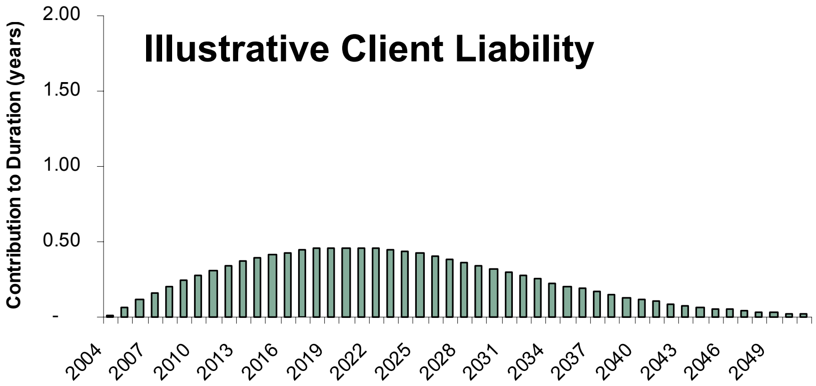
Comparison of the Fixed Income Assets vs. the Liability

Portfolio Components	[A] Market Value ($mm)	Yield	[B] Duration	[C] Convexity	[D] Spread "Beta"	[A x B] $Duration ($mm)	[A x B x D] $Spd Dur ($mm)	[A x C] $Convexity ($mm)
Lehman Aggregate	506	4.18	4.49	(0.22)	0.50	2,272	1,136	(111)
High Yield	227	8.48	4.77	0.14	3.00	1,080	3,241	32
TOTAL PORTFOLIO	**733**	**5.51**	**4.58**	**(0.11)**	**1.31**	**3,352**	**4,377**	**(80)**
LIABILITY	**3,500**	**6.00**	**12.00**	**3.00**	**1.00**	**41,996**	**41,996**	**10,499**
					DIFFERENCE	**(38,643)**	**(37,618)**	**(10,578)**
					% Hedged vs. Liability	**8%**	**10%**	**(1%)**

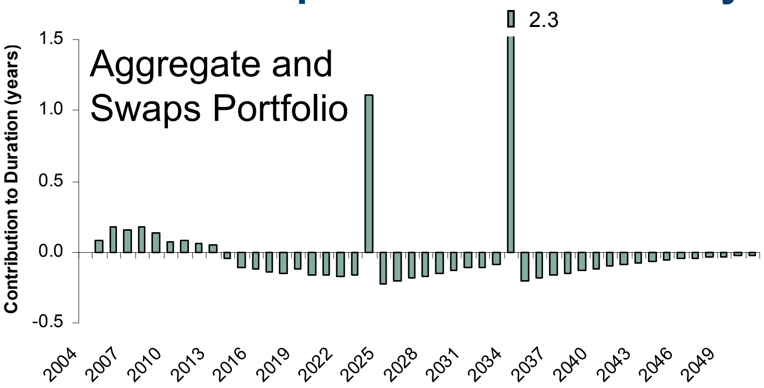
Portfolio Components	Market Value ($mm)	Yield	Duration	Convexity	Spread "Beta"	$Duration ($mm)	$Spd Dur ($mm)	$Convexity ($mm)
Lehman Aggregate	506	4.18	4.49	(0.22)	0.50	2,272	1,136	(111)
High Yield	227	8.48	4.77	0.14	3.00	1,080	3,241	32
IR Swaps ($1160 mm notional)	0	0.00	11.68	2.29	0.25	13,543	3,386	2,657
TOTAL PORTFOLIO	**733**	**4.18**			**0.46**	**16,896**	**7,763**	**2,577**
LIABILITY	**3,500**	**6.00**	**12.00**	**3.00**	**1.00**	**41,996**	**41,996**	**10,499**
					DIFFERENCE	**(25,100)**	**(34,232)**	**(7,921)**
					% Hedged vs. Liability	**40%**	**18%**	**25%**
					% Improvement vs. Aggregate Portfolio	**32%**	**8%**	**25%**

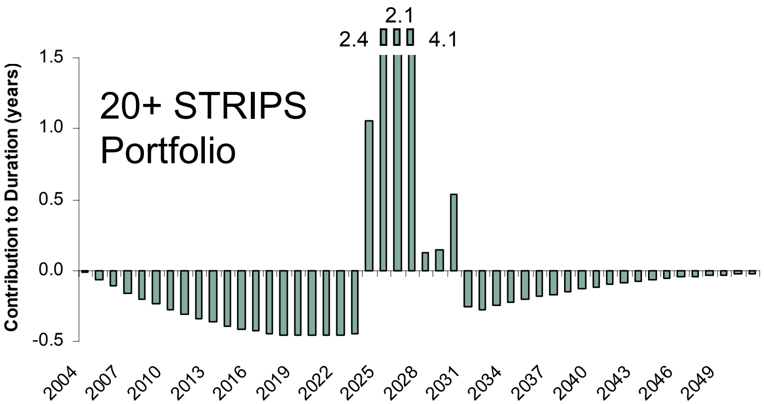
Cashflow Evaluation of Alternative Strategies

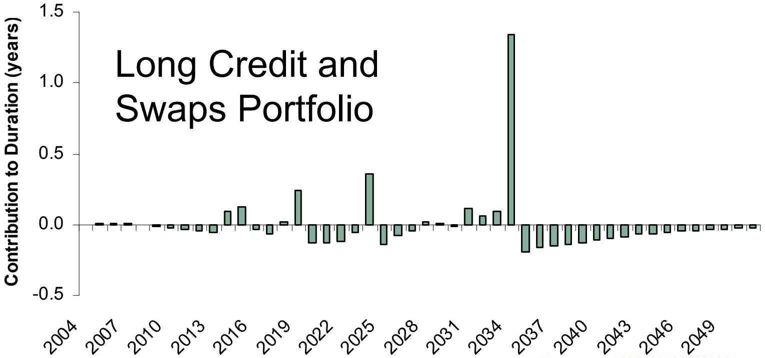
Cashflow Exposure Net of Liability



VS.







Dynamic Simulation Model

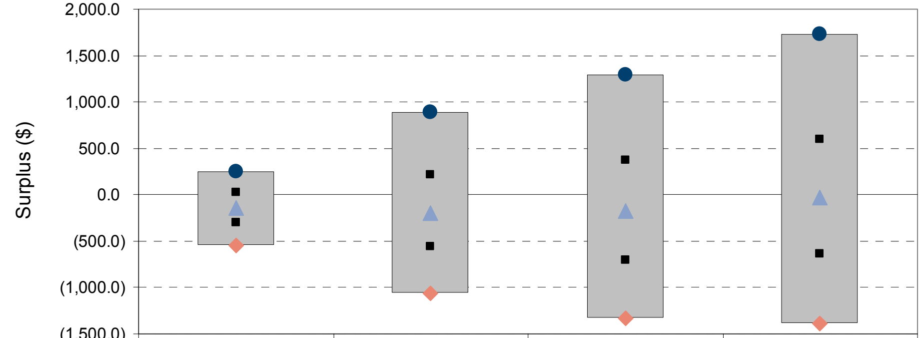
Pension Fund Simulation

- Useful to compare different strategies
- Inputs include (among others): asset returns, correlations, actuarial factors, accounting rules
- Multi-period, dynamic model

Illustrative Output

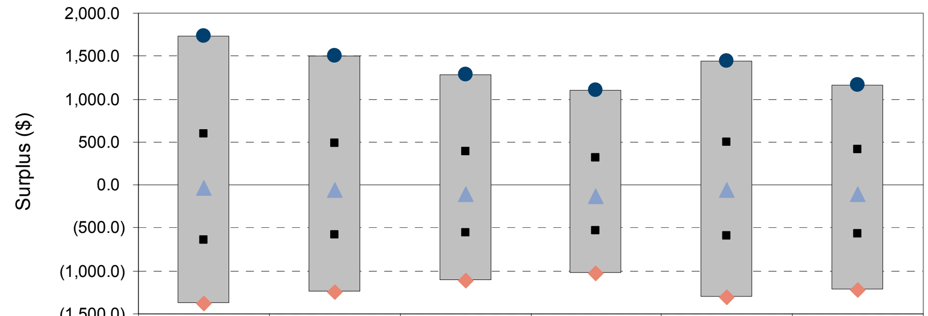
- Mark to Market Surplus (Assets minus ABO Liability)
- Surplus Less PV of Contributions
- Smoothed Assets to Smoothed Liability

Marked-to-Market minus ABO Liability (Surplus)
Base Allocation (No Hedge)



	2003	2004	2005	2006
● 95th pctle	255.6	894.0	1,295.2	1,734.5
■ 75th pctle	24.7	213.1	372.1	596.9
Average	(139.3)	(169.9)	(129.9)	28.6
▲ 50th pctle	(140.3)	(196.7)	(179.2)	(33.6)
■ 25th pctle	(298.4)	(560.2)	(702.9)	(640.2)
◆ 5th pctle	(550.3)	(1,058.8)	(1,328.7)	(1,382.6)

Marked-to-Market minus ABO Liability (Surplus)
2006



	Base Allocation (No Hedge)	Current FI Hedge	70% FI Hedge	Complete FI Hedge	25% Equity Hedge	50% Equity Hedge
● 95th pctle	1,734.5	1,502.2	1,280.4	1,106.0	1,441.8	1,159.3
■ 75th pctle	596.9	487.6	390.6	310.9	497.7	409.9
Average	28.6	(4.3)	(33.4)	(59.6)	(22.9)	(71.6)
▲ 50th pctle	(33.6)	(60.8)	(106.7)	(132.3)	(63.9)	(102.4)
■ 25th pctle	(640.2)	(581.4)	(549.9)	(533.0)	(590.4)	(561.9)
◆ 5th pctle	(1,382.6)	(1,241.1)	(1,118.2)	(1,030.0)	(1,306.7)	(1,219.2)

Emerging Issues

- Strategies for troubled plans
- Choice of pension liability to hedge
- Price level sensitivity of the pension obligation
- Interest rate sensitivity of equity
- The strategies of sponsor and participant