1995 CASUALTY LOSS RESERVE SEMINAR

2F: Asset Liability Management Fundamentals - Session I

Moderator & Panelist: Stephen T. Morgan, Vice President
American Re-Insurance Company

Panelist: Bennett W. Golub, Partner
BlackRock Financial Management

ASSET LIABILITY MANAGEMENT FUNDAMENTALS-SESSION I

CASUALTY LOSS RESERVE SEMINAR

STEPHEN T. MORGAN

AMERICAN RE-INSURANCE COMPANY

SESSION 2F
10:30 A.M.- 12:00 P.M.
MONDAY, SEPTEMBER 18, 1995

CHART 1

RESERVES AT 12/31/94 1,000.00
DISCOUNT RATE 6.0%

(1) YEAR	(2) TIME(T)	(3) CAL. YR. PAYOUT	(4) CAL. YR. PYMTS.	(5) DISCOUNT FACTOR	(6) DISC PYMTS(DP)	(7) (2)*(6) DP* TIME	(8) (6)*(2)^2 DP* TIME^2
1995	0.5	0.100	100.00	0.9713	97.13	48.57	24.28
1996	1.5	0.170	170.00	0.9163	155.77	233.66	350.48
1997	2.5	0.120	120.00	0.8644	103.73	259.33	648.31
1998	3.5	0.090	90.00	0.8155	73.40	256.90	899.15
1999	4.5	0.080	80.00	0.7693	61.55	276.98	1,246.39
2000	5.5	0.050	50.00	0.7258	36.29	199.60	1,097.77
2001	6.5	0.049	49.00	0.6847	33.55	218.08	1,417.49
2002	7.5	0.047	47.00	0.6460	30.36	227.70	1,707.75
2003	8.5	0.046	46.00	0.6094	28.03	238.26	2,025.17
2004	9.5	0.045	45.00	0.5749	25.87	245.77	2,334.77
2005	10.5	0.044	44.00	0.5424	23.86	250.53	2,630.57
2006	11.5	0.042	42.00	0.5117	21.49	247.14	2,842.05
2007	12.5	0.041	41.00	0.4827	19.79	247.38	3,092.19
2008	13.5	0.040	40.00	0.4554	18.22	245.97	3,320.60
2009	14.5	0.036	36.00	0.4296	15.47	224.32	3,252.57
TOTAL		1.000	1,000.00		744.51	3,420.19	26,889.54

DURATION AT 6% =(7)/(6)=3420.19/744.51 4.59
DURATION AT 7% =(7)/(6)=3179.08/713.53 4.46

CONVEXITY AT 6% =(8)/(6)=26889.54/744.51 36.12
CONVEXITY AT 7% =(8)/(6)=24488.87/713.53 34.32

PRESENT VALUE OF PYMTS AT 6% 744.51
PRESENT VALUE OF PYMTS AT 7% 713.53
% CHANGE IN VALUE FOR 100BP CHANGE IN
INTEREST RATE =713.53/744.51-1 -4.16%

MODIFIED DURATION -4.59/1.06 -4.33%

CHANGE IN VALUE
MD+.5*CON*.01^2 -4.15%

BOND PRICE AND MACAULAY DURATION

P = price of a t-year bond

R = redemption value

t = time in years

c = coupon

i = yield

D_M = Macaulay duration

$$v = \frac{1}{(1+i)}$$

$$P = c \bullet v^1 + c \bullet v^2 + \cdots cv^t + R \bullet v^t$$

$$D_M = \frac{1 \bullet c \bullet v^1 + 2 \bullet c \bullet v^2 + \cdots + t \bullet c \bullet v^t + t \bullet R \bullet v^t}{P}$$

DERIVATION OF MODIFIED DURATION

A. Take the first derivative of the price function (P) with respect to i

$$\frac{d\,P}{d\,i} = -1 \bullet c \bullet v^{2} - 2 \bullet c \bullet v^{3} - \cdots - t \bullet c \bullet v^{t+1} - t \bullet R \bullet v^{t+1}$$

B. Factor out -v or $\frac{-1}{(1+i)}$ from right side of equation

$$\frac{d\,P}{d\,i} = \frac{-1}{(1+i)} \bullet \left[1 \bullet c \bullet v + 2 \bullet c \bullet v^{2} + \cdots + t \bullet c \bullet v^{t} + t \bullet R \bullet v^{t}\right]$$

C. Divide both sides by P

$$\frac{\frac{(d\,p)}{(d\,i)}}{P} = \frac{-1}{(1+i)} \bullet \left[\frac{(1 \bullet c \bullet v^{1} + 2 \bullet c \bullet v^{2} + \cdots + t\,c\,v^{t} + t \bullet R \bullet v^{t}}{P}\right]$$

$$\frac{\frac{(d\,p)}{(d\,i)}}{P} = \frac{-1}{(1+i)} \bullet D_M$$

CASH FLOW MATCHING

CHART 3

DISCOUNT RATE 6.0%

	COUPON	PRINC-IPAL	PRICE	TERM IN YRS.	DURATION	1	2	3	4	5	TOTALS
LIABILITY PAYOUT		$1,000.00	$880.71		2.136	$375.00	$275.00	$175.00	$100.00	$ 75.00	$1,000.00
BOND 1	12.0%	$ 66.96	$ 83.90	5	4.146	$ 8.04	$ 8.04	$ 8.04	$ 8.04	$ 75.00	$ 107.16
NET						$366.96	$266.96	$166.96	$ 91.96	$ 0.00	
BOND 2	11.0%	$ 82.85	$ 97.19	4	3.489	$ 9.11	$ 9.11	$ 9.11	$ 91.96		$ 119.29
NET						$357.85	$257.85	$157.85	$ 0.00	$ 0.00	
BOND 3	10.0%	$ 143.50	$158.84	3	2.749	$ 14.35	$ 14.35	$157.85			$ 186.55
NET						$343.50	$243.50	$ 0.00	$ 0.00	$ 0.00	
BOND 4	9.0%	$ 223.39	$235.69	2	1.920	$ 20.11	$243.50				$ 263.61
NET						$323.39	$ 0.00	$ 0.00	$ 0.00	$ 0.00	
BOND 5	0.0%	$ 323.39	$305.08	1	1.000	$323.39					$ 323.39
NET						$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	
TOTALS FOR BONDS		$ 840.09	$880.71		2.136						$1,000.00

DURATIONS MATCH

ASSUMPTIONS:

1. LIABILITY PAYOUT STREAM IS ASSUMED TO BE: 37.5%, 27.5%, 17.5%, 10.0% AND 7.5%.
2. ALL PAYMENTS AT END OF YEAR
3. BOTH LIABILITIES AND BONDS ARE DISCOUNTED AT 6%
4. SINCE DISCOUNT RATES ARE EQUAL, BOTH MACAULAY AND MODIFIED DURATIONS ARE EQUAL FOR LIABILITIES AND BONDS

Surplus Duration

Example

Assets = Liability + Surplus

$PV_A * D_A = PV_L * D_L + PV_S * D_S$

Assume

$PV_A = \$100$

$PV_L = \$90$

$PV_S = \$10$

$D_A = 5.15$

$D_L = 3.50$

$100 * 5.15 = 90 * 3.5 + 10 * Ds$

$10Ds = 100 * 5.15 - 90 * 3.5$

$Ds = 20.0$ years

if interest rates rise 1%, surplus drops 20%:

Revised PV_A = \$100 * .9485	= \$94.85
Revised PV_L = \$90 * .9650	= \$86.85
Revised PV_S =	\$8.00

Surplus Duration

Use amounts from prior example but $D_A = D_L$

$$(100)(3.5) = (90)(3.5) + 10 * Ds$$
$$350 = 315 + 10Ds$$
$$1.0Ds = 35$$
$$Ds = 3.5$$

The assets that support liabilities should be matched

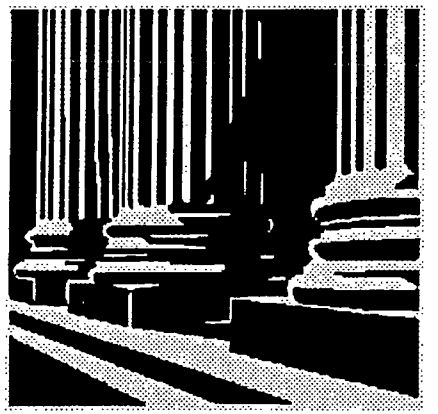
Discount	**D**ynamics
Understand	**U**nderwriting
Reserves	**R**isk
Actuarial	**A**nalysis
Time	**T**empo
Interest	**I**nvestment
Options	**O**utlook
Notional Value	**N**ominal Value

Asset Liability Management Fundamentals

Casualty Loss Reserve Seminar

Bennett W. Golub, Ph.D.

BlackRock Financial Management



September 18, 1995

Overview of Presentation

- Overview of Asset Liability Management
- Duration
  - Alternative Approaches to Measuring Duration
  - Impact of Leverage
- Optionality
- Measuring Yield Curve Risk
- Conclusions

Asset/Liability Management (ALM) is the process of regularly managing the financial risk of a company's surplus by measuring and then rebalancing the composition and risk characteristics of its financial assets and liabilities.

Typical P/C Balance Sheet

Assets	Liabilities
Short Term Assets	***Short Term Liabilities***
Cash	Loss balance in course of payment
Short term investments	Accounts and notes payable
Accrued investment income	***Policy Liabilities***
Accounts and notes receivable	Loss reserves and LAE
Long Term Assets	Unearned premium reserve
Equities	Funds held by company
Fixed Income Securities	***Long Term Debt***
Policy Loans	
	Surplus
TOTAL ASSETS	**TOTAL LIABILITIES AND SURPLUS**

Types of Financial Risk

Fixed Income Securities

- Interest Rate Risk
- Cash Flow Risk and Optionality
- Credit Risk

Equity Securities

- Equity Market Risk

Liquidity Risk

Complexity Risk

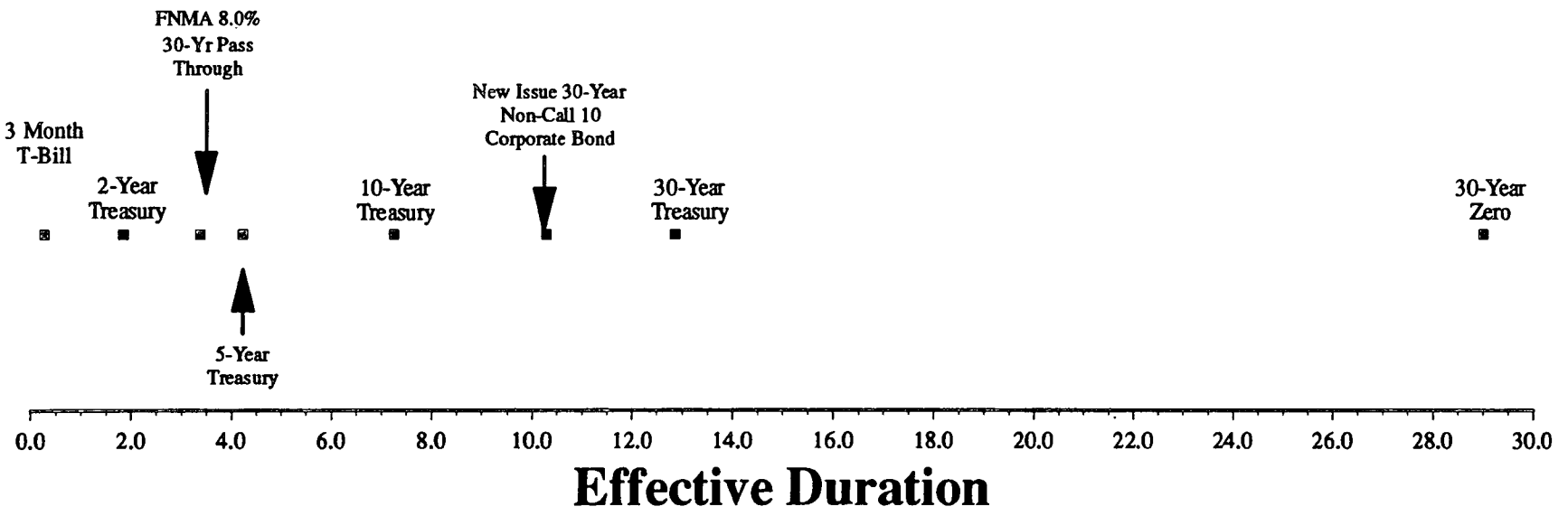
Overview--Asset/Liability Management

- The vast majority of Property/Casualty companies' assets are invested in bonds.
  - 66.55% as of 12/31/93
- Most Property/Casualty companies have future insurance liabilities that can be modeled, via actuarial analysis, as cash flow streams which resemble fixed income securities.
- Using risk management techniques, the expected timing and magnitude of asset and liability cash flows and their respective sensitivities to interest rate changes can be measured.
- The relationship between the risks of the assets and liabilities, and therefore the risk to a company's surplus, is both measurable and manageable.

Duration

- Interest rates risk occurs when the value of an asset or liability depends on the level of interest rates.
- Duration is a measure of market value interest rate risk. It is quoted as the percentage change in price an asset or liability would move if interest rates moved up or down one percentage point.
    - i.e., a bond with a duration of 5 years would lose 5% of its value if rates rose 100 basis points (1%).
- In general, the longer the maturity of a security, the greater the price risk and therefore its duration.
- Duration can be determined through a variety of approaches:
    - Formulas;
    - Option models;
    - Regressions on actual price measurements; and
    - The judgment of experienced professionals.

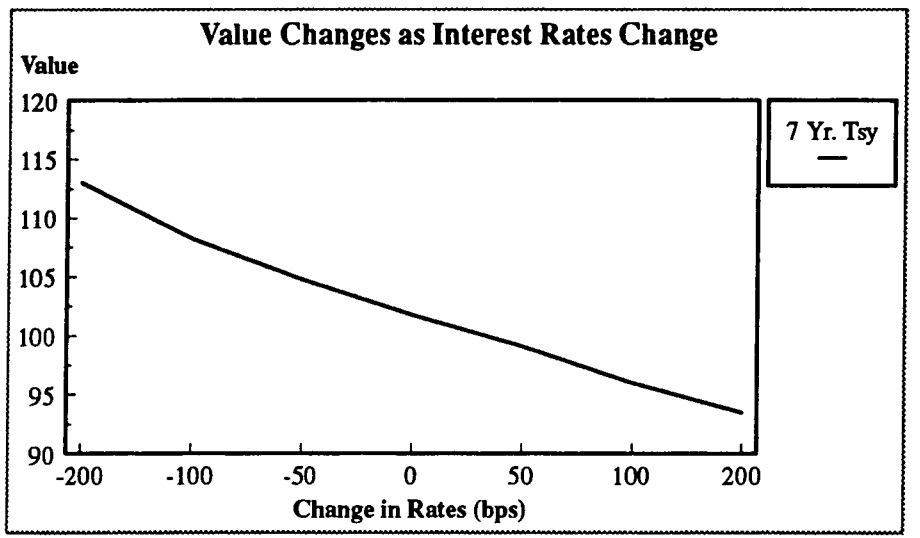
Duration


FNMA 8.0%
30-Yr Pass
Through
New Issue 30-Year
Non-Call 10
Corporate Bond
3 Month
T-Bill
2-Year
Treasury
10-Year
Treasury
30-Year
Treasury
30-Year
Zero
5-Year
Treasury
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
26.0
28.0
30.0
Effective Duration

Duration

Example: 7 Year Treasury

7 Year Treasury	Instantaneous Change in Interest Rates (basis points)						
Yield = 6.05 %	-200	-100	-50	0	50	100	200
Price	113.97	107.73	104.76	101.90	99.12	96.44	91.34
% Change from Base Price	11.85%	5.73%	2.81%	0.00%	-2.72%	-5.35%	-10.36%
Duration (years)	5.65	5.60	5.57	5.53	5.50	5.47	5.43

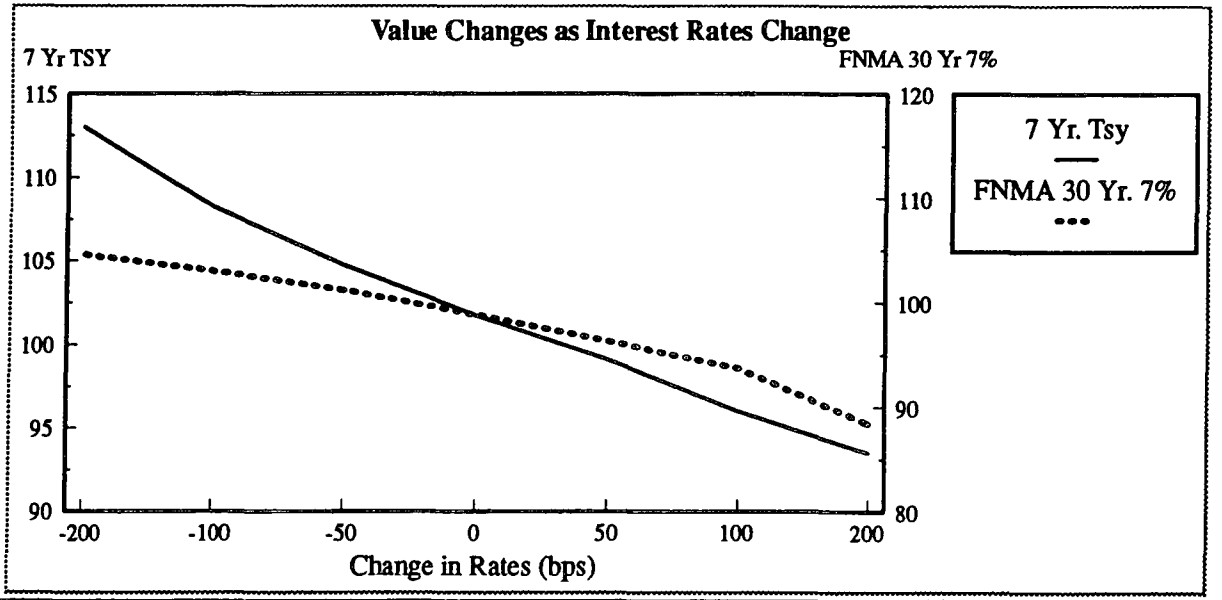


Duration

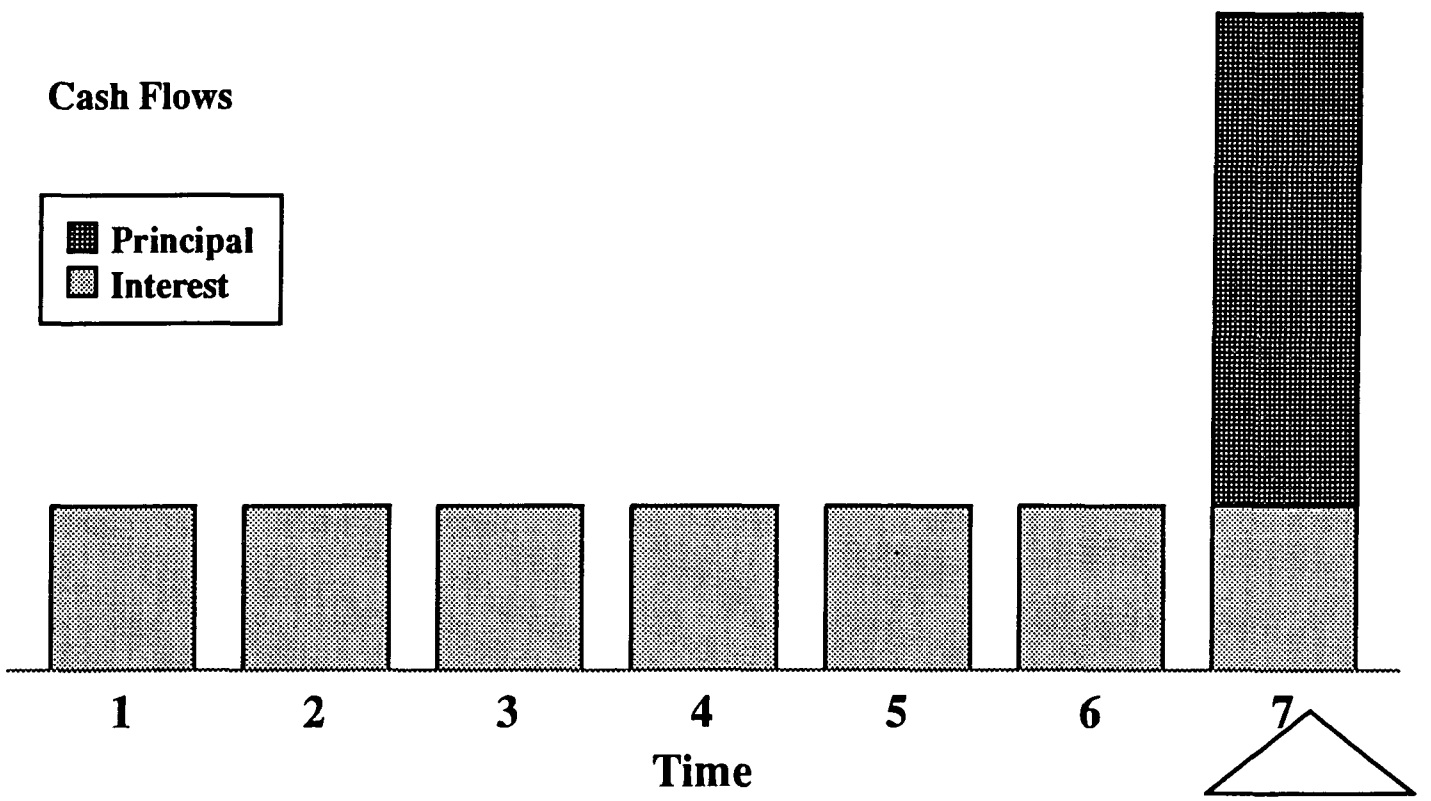
Example: Mortgage-Backed Securities (FNMA 30 Year 7%)

➡ Although this pass-through security has 30 years of cash flows, its duration is much more similar to that of a 7 year Treasury.

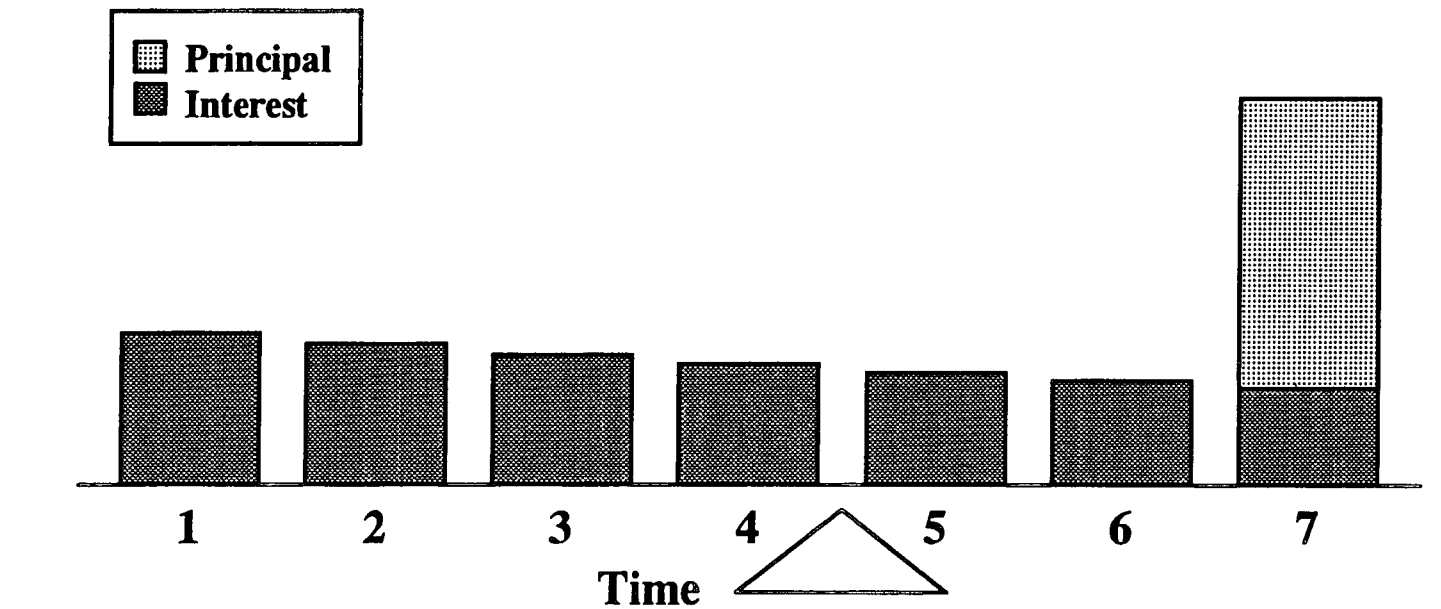
FNMA 30 Year 7%	Instantaneous Change in Interest Rates (basis points)						
	-200	-100	-50	0	50	100	200
Price	104.60	103.05	101.19	98.86	96.32	93.68	88.41
% Change from Base Price	5.81%	4.24%	2.36%	0.00%	-2.57%	-5.24%	-10.57%
Duration (years)	0.96	2.82	4.20	4.96	5.39	5.64	5.92



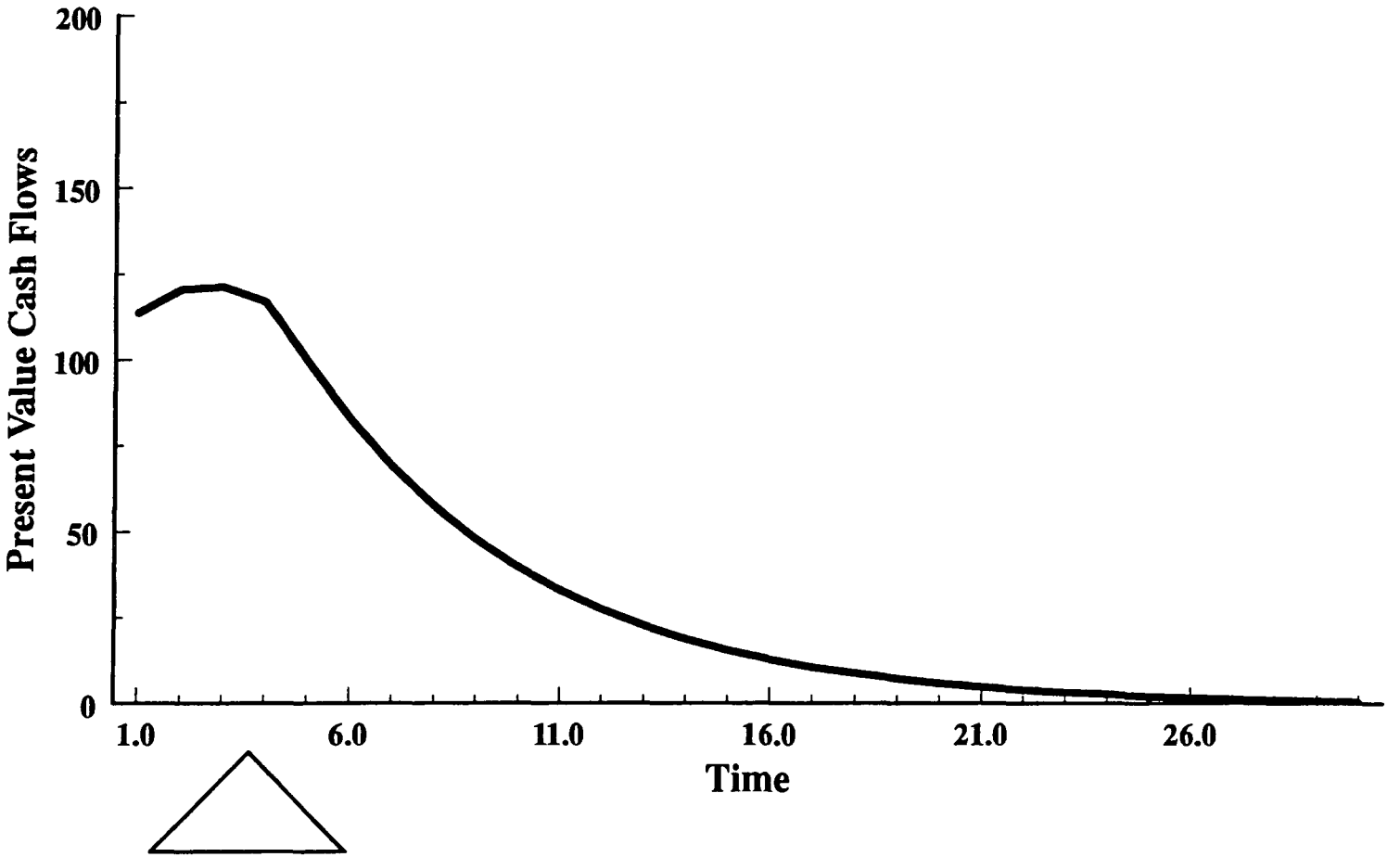
Alternative Approaches to Measuring Duration:
Average Life of a Bond



Alternative Approaches to Measuring Duration:
Modified Duration of a Bond



Alternative Approaches to Measuring Duration: *Modified Duration of a Liability Given an Actuarial Projection*



Impact of Leverage on Duration

- Leverage increases the sensitivity of the market value of surplus (i.e., the duration of surplus) relative to the duration of the unlevered asset.
- At the same time, the levered ROE will vary dramatically due to changes in the cost of financing.
- The surplus duration and ROE analysis assumes:
  - 4:1 leverage; and
  - Funding at short-term rates.
- These examples will highlight the importance to insurance companies of a disciplined asset/liability management process.

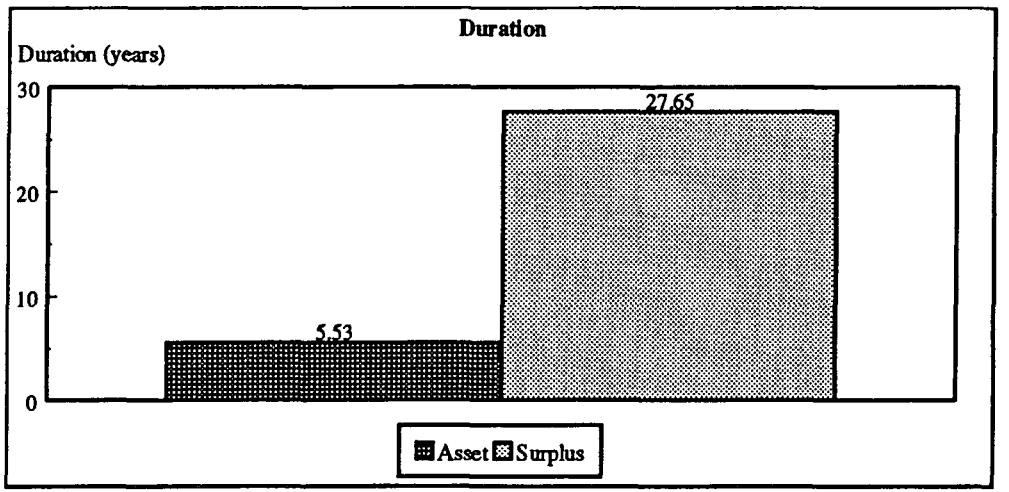
Impact of Leverage on Duration

Example: 7 Year Treasury

- The value of surplus is more sensitive the greater the mismatch between the duration of the asset (in this case, 5.53 years) and the duration of the funding (assumed to be zero for commercial paper).
- ROE increases as the earnings "spread" increases, although the sensitivity of ROE also increases.

7 Year Treasury	Instantaneous Change in Interest Rates (basis points)						
	-200	-100	-50	0	50	100	200
Yield on 7 Yr Tsy	6.05%	6.05%	6.05%	6.05%	6.05%	6.05%	6.05%
Cost of Financing	3.70%	4.70%	5.20%	5.70%	6.20%	6.70%	7.70%
Spread	2.35%	1.35%	0.85%	0.35%	-0.15%	-0.65%	-1.65%
Before Tax ROE (Levered at 4:1)	15.45%	11.45%	9.45%	7.45%	5.45%	3.45%	-0.55%
After Tax ROE @ 40% (Levered at 4:1)	9.27%	6.87%	3.78%	4.47%	3.27%	1.38%	-0.33%

Change in Value of Surplus	59.26%	28.63%	14.03%	0.00%	-13.60%	-26.76%	-51.79%
Assets Duration Unleveraged	5.65	5.60	5.57	5.53	5.50	5.47	5.43
Surplus Duration Leveraged	28.25	28.00	27.85	27.65	27.50	27.35	27.15



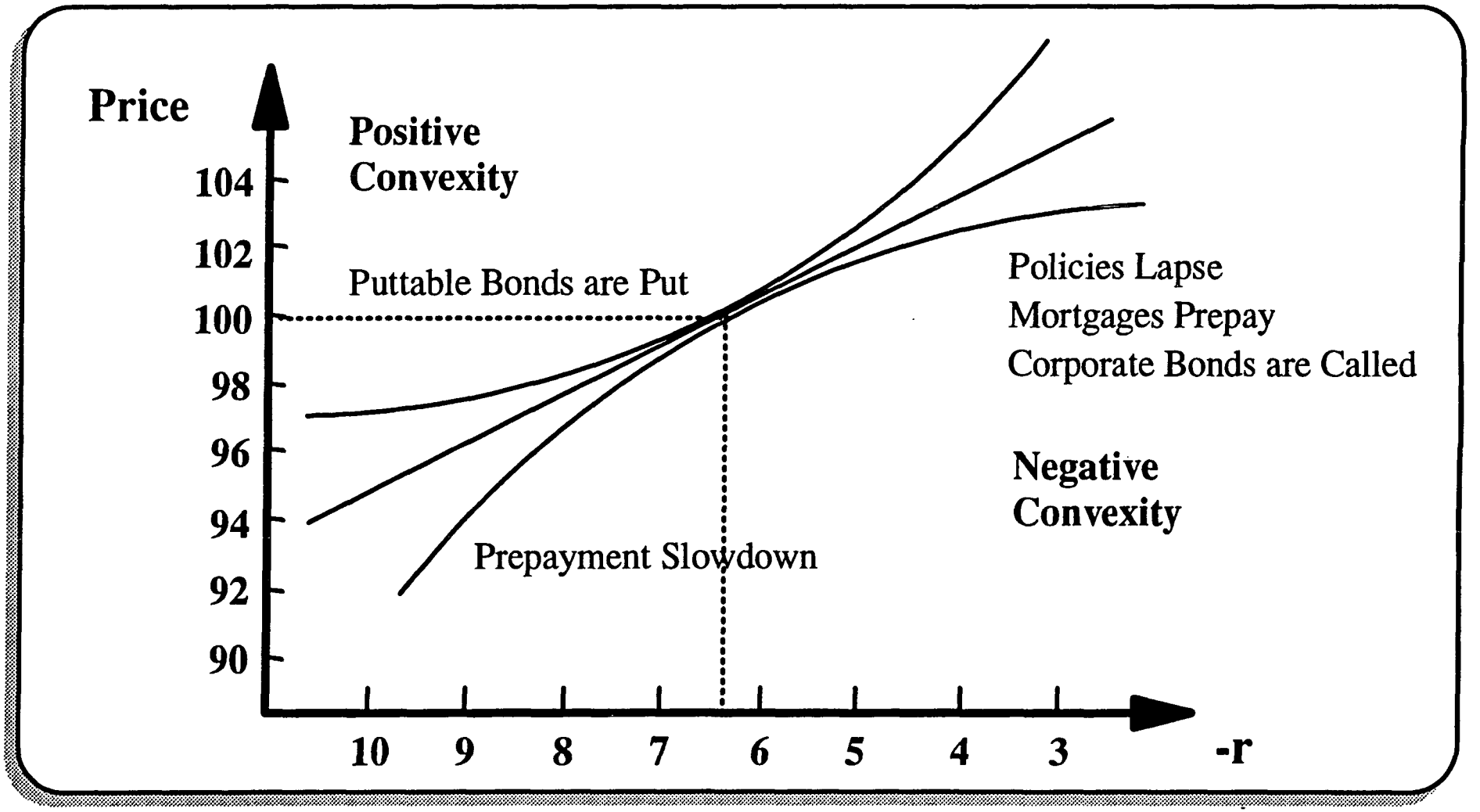
Optionality

- Assets and Liabilities with options will tend to appreciate less in value than otherwise similar non-callable fixed rate securities in falling interest rate environments.
  - The option granted to home owners by holders of mortgage-backed securities will lead mortgagors to prepay their mortgages when interest rates fall.
  - The option granted to policy holders by insurers will lead policy holders to lapse their policies as interest rates decline.
- One common way to measure the impact of this optionality is through *convexity*.

$$\Delta P/P = - D\Delta r + 1/2\, C(\Delta r)^2$$

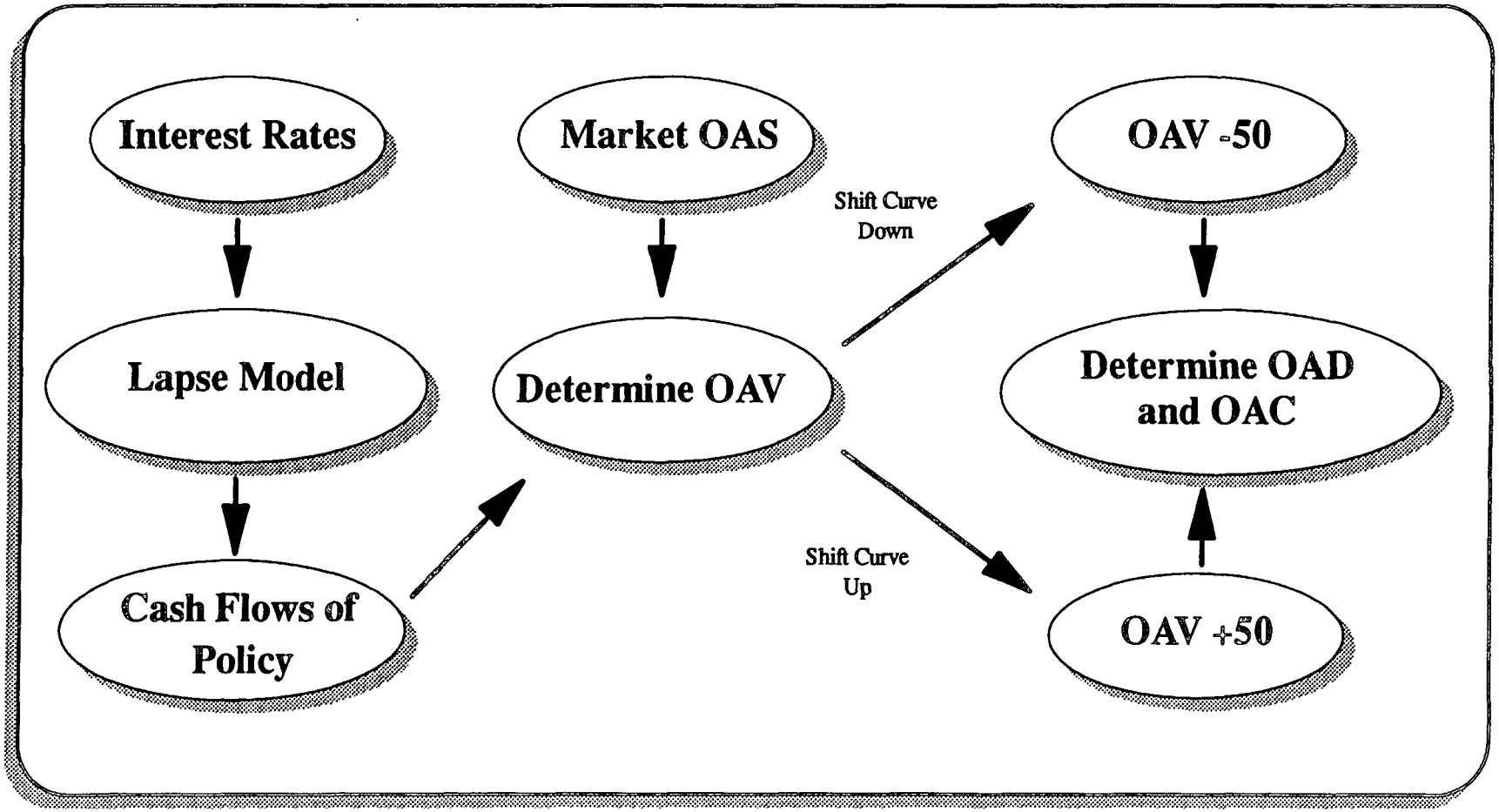
- Robust ALM strategies need to address the impact of optionality as well as duration.

Optionality



Alternative Approaches to Measuring Duration:

Option Adjusted Duration of a Liability with Optionality



OAS: Option Adjusted Spread
OAD: Option Adjusted Duration
OAC: Option Adjusted Convexity
OAV: Option Adjusted Value

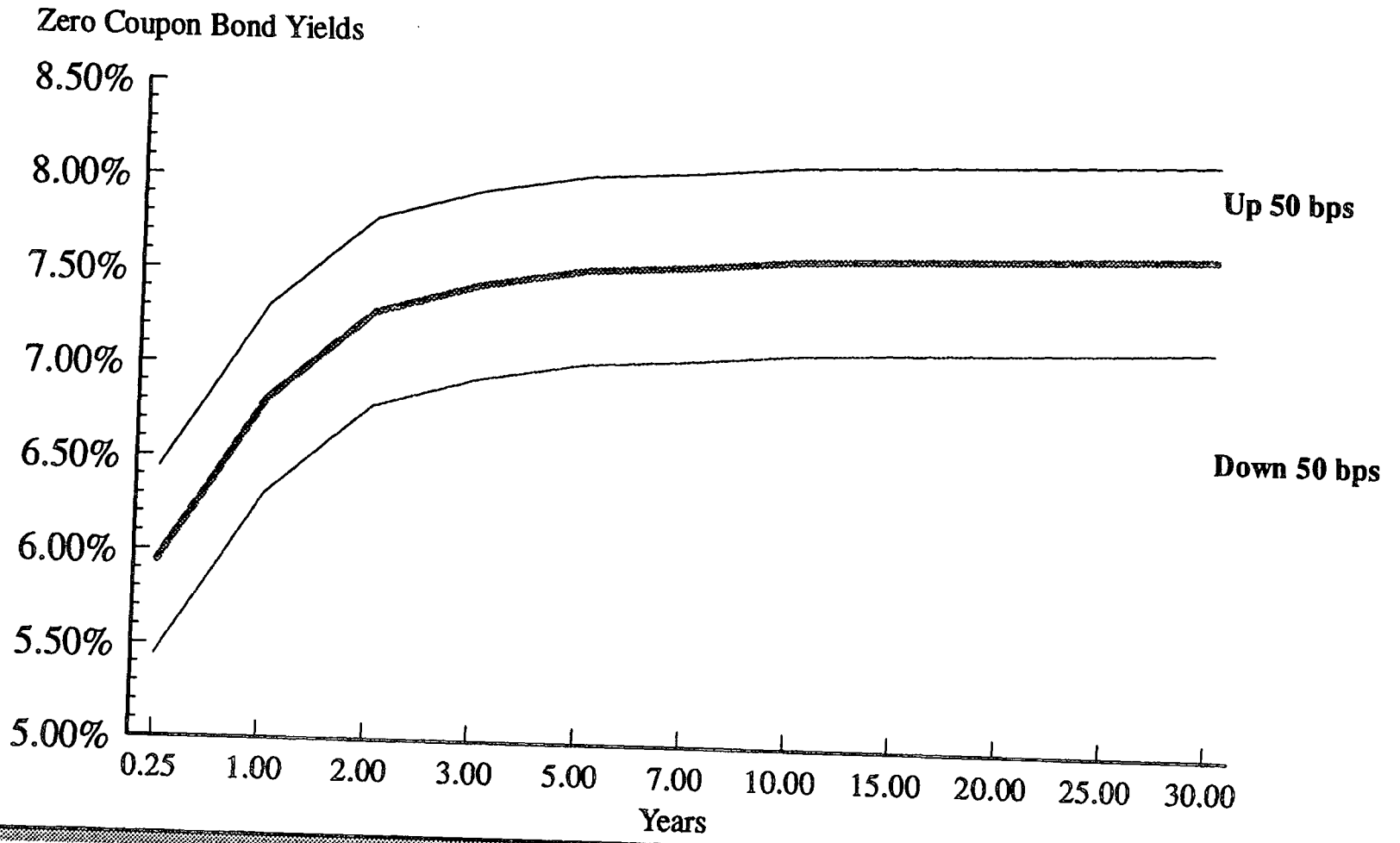
Measuring Yield Curve Risk

- Yield curve risk arises from non-parallel changes in the shape of the yield curve.
- Numerous methodologies exist for measuring yield curve risk.
- The *key rate duration*[1] approach measures a liability's sensitivity to eleven different points on the yield curve which are aggregated into four "buckets".
- Key rate durations break up parallel spot curve shifts into independent components.

[1] See S.Y. Ho, "Key Rate Durations: Measures of Interest Rate Risk," *Journal of Finance*, September 1992.

Measuring Yield Curve Risk

Option Adjusted Duration Curve Shocks



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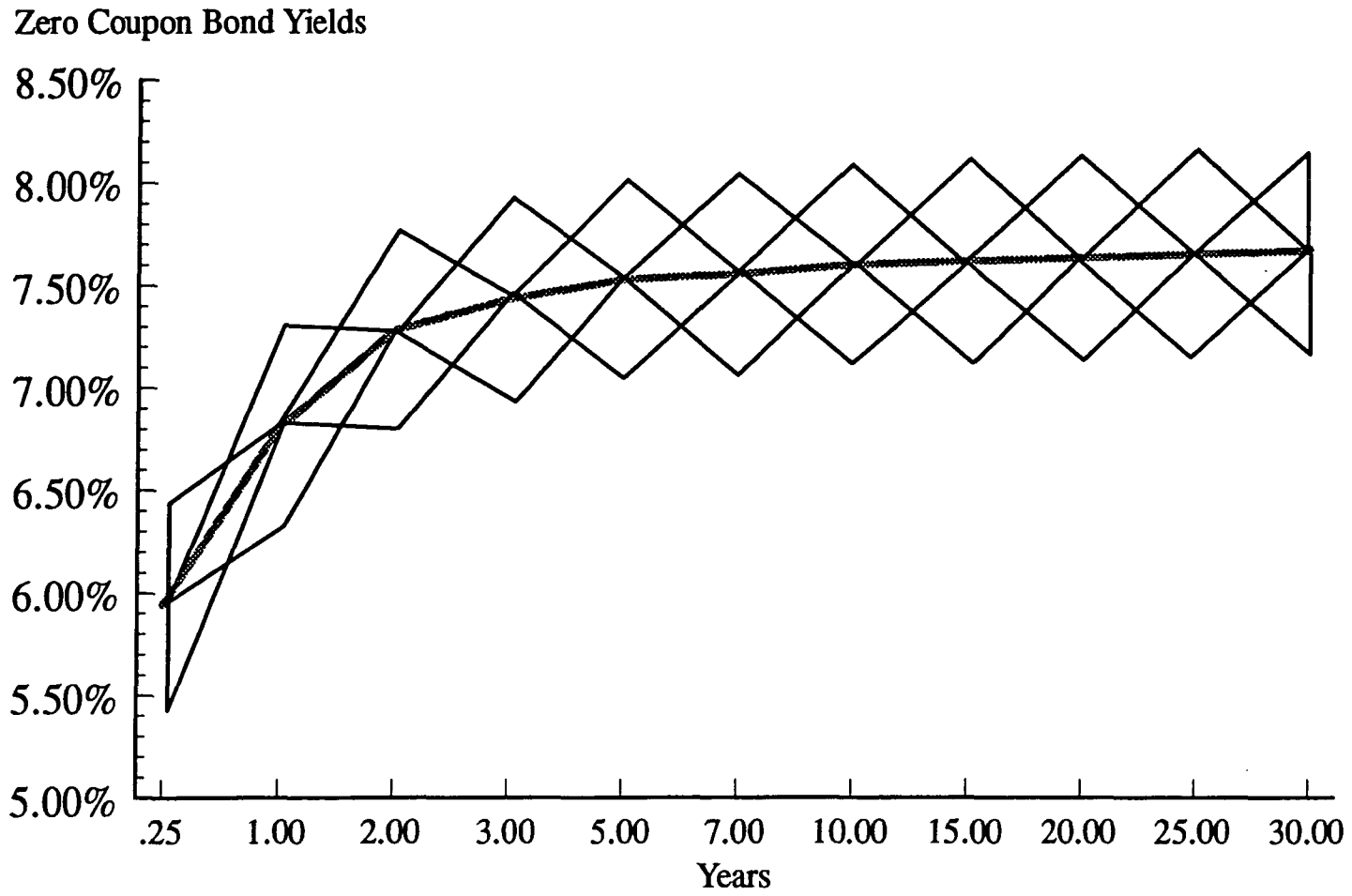
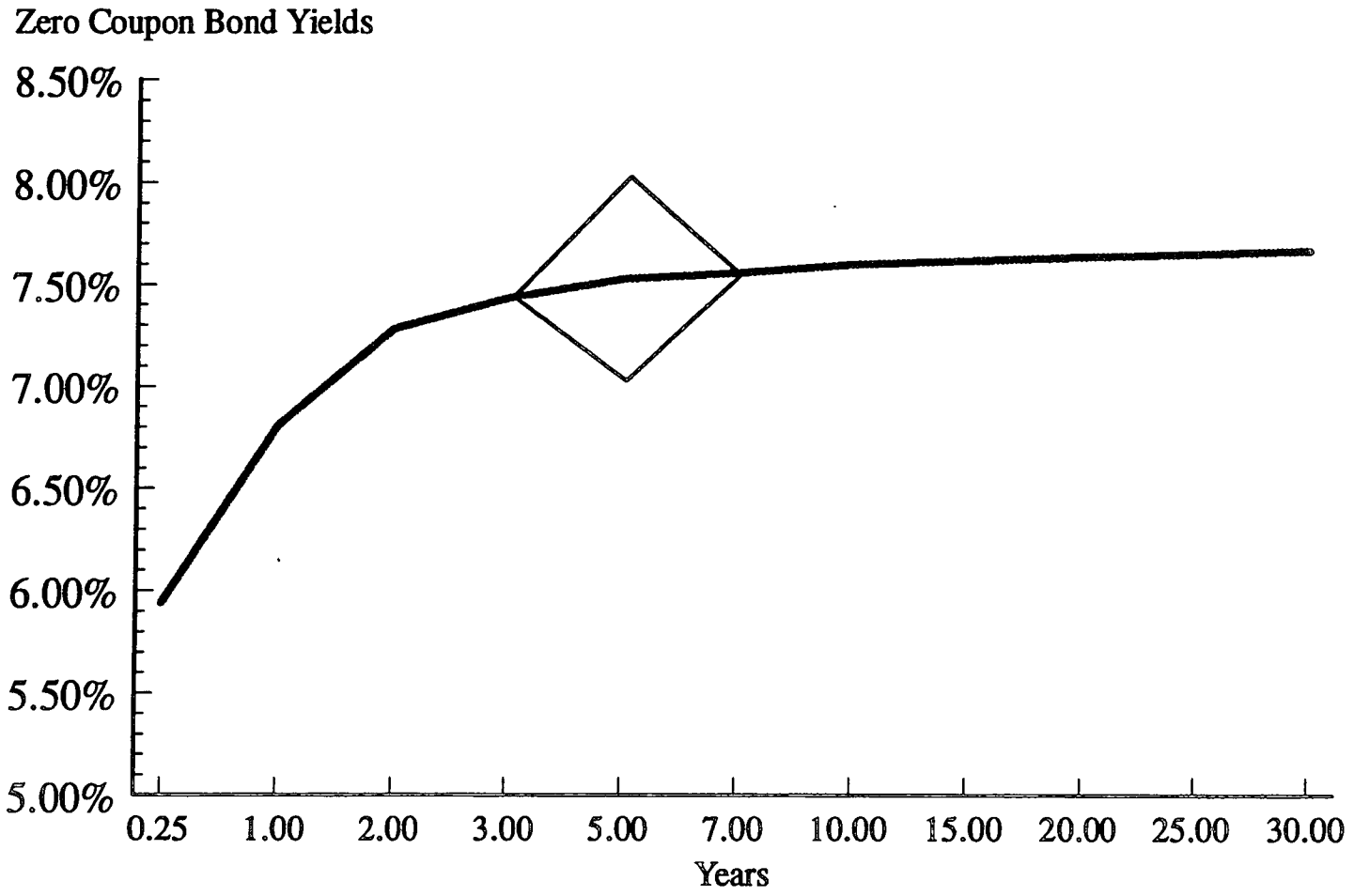
Measuring Yield Curve Risk

Key Rate Duration Curve Shocks

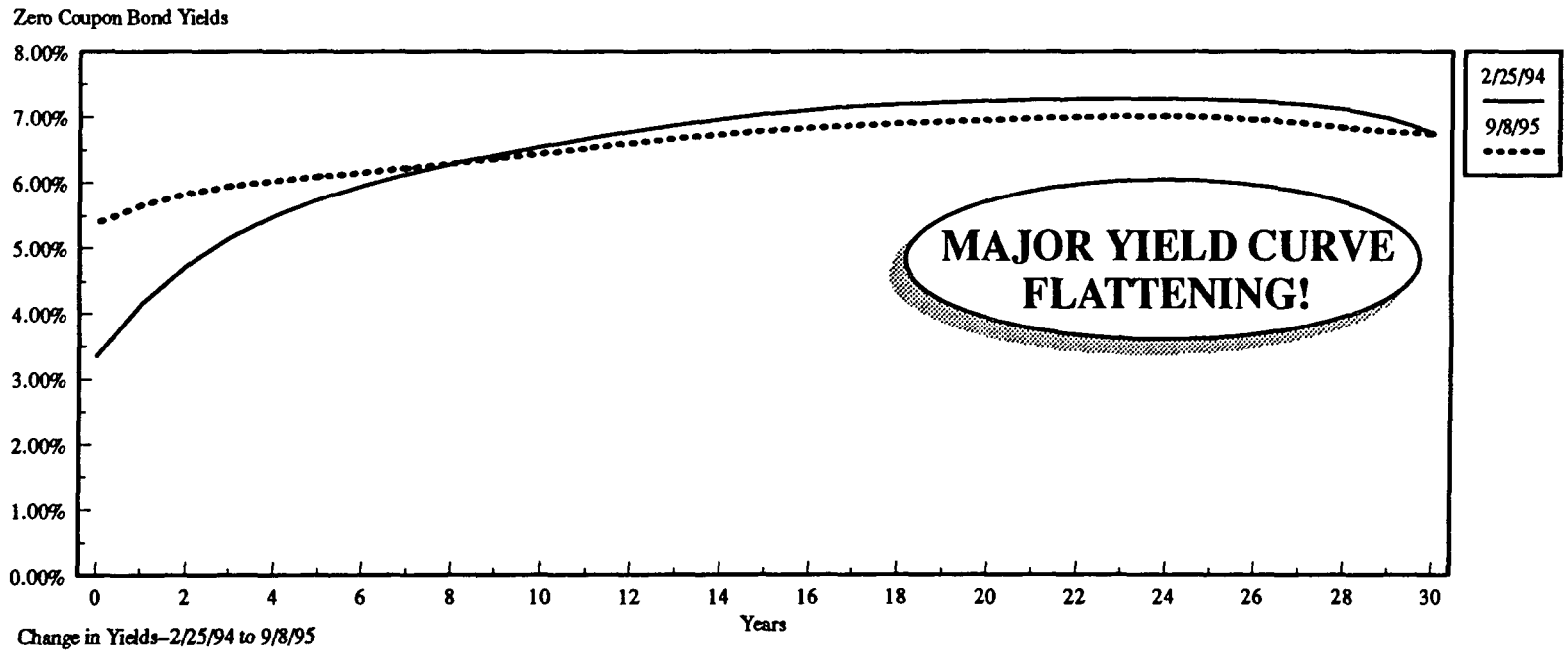


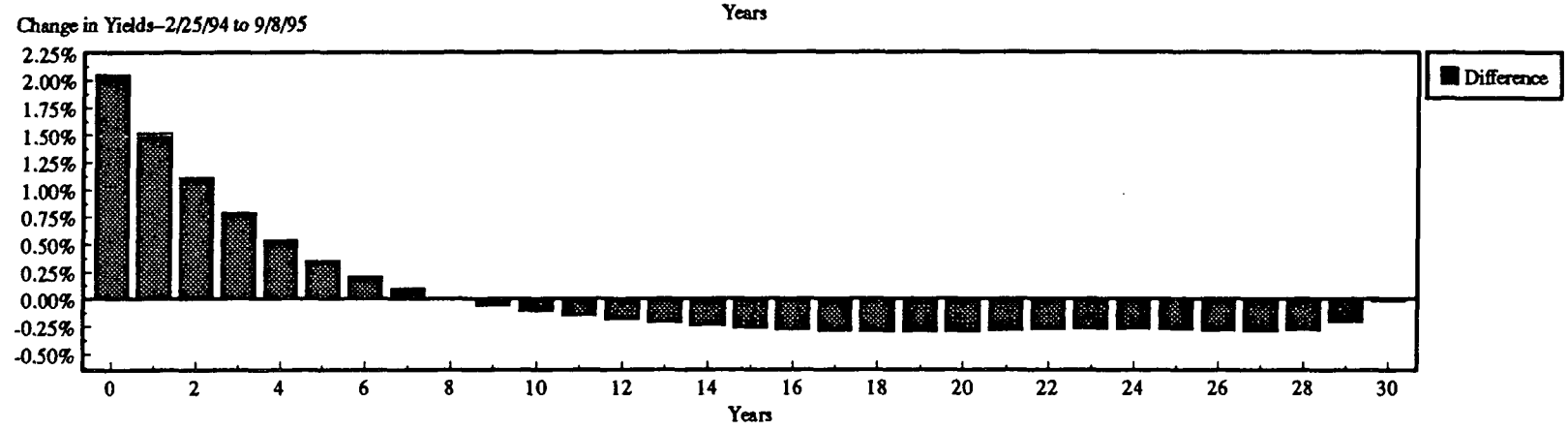
Measuring Yield Curve Risk

Example: 5 Year Key Rate Duration Shocks



Yield Curve Risk





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Measuring Yield Curve Risk

Key Rate Duration (Years)

Treasury	OAD	3 M	1	2	3	5	7	10	15	20	25	30
2 Year	1.78	0.01	0.13	1.64								
5 Year	4.16	0.01	0.05	0.11	0.40	3.60						
10 Year	7.16	0.01	0.05	0.11	0.25	0.45	0.93	5.35				
30 Year	12.10	0.01	0.06	0.11	0.26	0.47	0.75	1.37	1.76	1.63	1.72	3.94
Mortgage												
FNMA 7.0	4.93	0.03	0.13	0.27	0.53	0.76	0.91	1.05	0.74	0.36	0.13	0.02
FNMA 8.0	3.23	0.05	0.20	0.28	0.47	0.60	0.64	0.36	0.33	0.21	0.07	0.01
FNMA 9.0	1.62	0.10	0.24	0.27	0.38	0.42	0.37	-0.30	0.00	0.11	0.04	0.01
FNMA 10.0	1.85	0.09	0.23	0.29	0.44	0.52	0.48	-0.20	-0.07	0.06	0.00	-0.00
Corporate												
30-Yr/NC 10	10.27	0.02	0.07	0.15	0.33	0.59	1.15	2.00	2.11	1.71	1.31	0.84
30-Yr/NC 2	7.42	0.02	0.12	0.28	0.47	0.67	0.85	1.29	1.37	0.98	1.14	0.23
30-Yr/Put 13	9.23	0.01	0.07	0.13	0.29	0.52	0.79	3.47	1.22	0.61	0.86	1.27

Conclusions

- The risk to surplus comes from mismatches between the characteristics of the assets and the liabilities.
- Each firm needs to determine its optimal tolerance for risk.
  - ► Firms typically determine a target surplus duration.
  - ► Higher surplus duration generally results in higher earnings.
- The ALM process should address the duration, convexity, yield curve exposure, and the liquidity risk of a company's surplus.
- Actuaries need to measure the risks of the liability streams:
  - ► Duration;
  - ► Optionality; and
  - ► Yield Curve Risk.

Biography of Guest Speaker

Bennett W. Golub, Ph.D.

Ben Golub is a Managing Director at BlackRock Financial Management, head of the Risk Management Group, co-head of the Analytics and Analysis Group, and co-chair of the Credit Committee. Dr. Golub is also a member of the firm's Management Committee and Investment Strategy Committee. Dr. Golub's primary responsibility is to monitor the interest rate, basis, credit, and tax risk of BlackRock's portfolios. He also shares responsibility for developing the analytical infrastructure that supports BlackRock's investment management and portfolio advisory businesses. Under Dr. Golub's direction, BlackRock has developed proprietary tools to analyze the risk of securities and portfolios and to monitor portfolios relative to their benchmarks.

From 1985 to 1988, Dr. Golub was a Vice President at The First Boston Corporation where he was responsible for establishing the Financial Engineering Group. His group helped create over $25 billion of structured securities including many innovative collateralized mortgage obligations and asset-backed securities. From 1984 to 1985, Dr. Golub developed analytical tools to structure securities at Lepercq de Neuflize & Co., Inc.

Among his publications are "Towards a New Approach to Measuring Mortgage Duration," "Now is the Time for Mark-to-Market Regulation of Financial Institutions," "Mortgage Prepayments and an Analysis of the Wharton Prepayment Model," "Investing in Residuals: 'The Basics'," and "High Yield Mortgage Securities". Dr. Golub is a frequent speaker at industry conferences and been a repeat lecturer at the Casualty Loss Reserve Seminar. He is a member of the American Economics Association, the American Finance Association, the Financial Management Association, and the International Association of Financial Engineers.

Dr. Golub received his Degree of Bachelor and Master of Science in Management and his Degree of Doctor of Philosophy in Applied Economics and Finance from the Sloan School of Management at the Massachusetts Institute of Technology.

BlackRock Financial Management

BlackRock Financial Management (BlackRock) is an independent investment advisor based in New York City that specializes in managing high quality fixed income portfolios. BlackRock currently manages over $32 billion of government, mortgage-backed, corporate, asset-backed, and municipal securities. In addition, BlackRock served as advisor to General Electric Corporation on the management strategy for Kidder Peabody's substantial holdings of mortgage securities.

BlackRock was founded in 1988 on the belief that experienced professionals using a disciplined process and advanced analytical tools will consistently add value to client portfolios. The firm's founding partners each had extensive experience creating, analyzing and trading complex mortgage-backed and asset-backed securities. These individuals created the first collateralized mortgage obligation (CMO), the first floating rate CMO, the first senior/subordinated structure, and the first asset-backed securities. At BlackRock, these professionals have applied the same innovative approach to developing products for institutional and individual investors by introducing the first closed-end mortgage securities fund, the first fund rated AAA by Standard and Poor's, and the first funds sponsored overseas by Fannie Mae and Freddie Mac.

From inception in 1988, BlackRock has managed its growth into new product areas and new markets through a disciplined business planning process. As a result of these strategic reviews, BlackRock has broadened its professional expertise in both the corporate bond and the municipal bond sectors. The firm has over 100 professionals, including 16 portfolio managers, a credit research team, and a quantitative research team.

In 1994, in response to changing market trends, BlackRock decided to seek a strategic partner that would combine BlackRock's fixed income capabilities with a larger distribution system and large scale processing capabilities. In February 1995, BlackRock merged with PNC Bank, one of the nation's largest banking organizations. As a result, BlackRock is now a subsidiary of PNC Asset Management Group. The merger has been structured to emphasize continuity of performance and service through stability of the organization.

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BlackRock Financial Management Investment Philosophy

Experienced Investment Managers Specializing in Insurance Clients' Needs

BlackRock began managing insurance funds in 1990 and currently manages over $10 billion in insurance company assets. Since then, BlackRock has become well-versed in a wide variety of issues faced by insurance companies and incorporated them into the firm's management strategy. Book yield requirements, gain/loss constraints, multiple sector and security constraints, FLUX or FFIEC requirements and asset/liability duration positioning can be considered on a daily basis. In addition, BlackRock can become significantly involved in the liability side of the insurance business if necessary. For example, we frequently consult our clients on various issues and have even developed an annuity pricing model for one of our clients.

BlackRock maintains a team that is dedicated to providing asset management and advisory services to the insurance industry. This team is responsible for developing and maintaining a thorough and up-to-date understanding of all relevant regulatory issues facing the industry. In this connection, BFM maintains frequent contact with regulatory bodies such as the National Association of Insurance Commissions (NAIC) and its Securities Valuation Office (SVO). Further, BFM has close relationships with the leading insurance-related research and statistical organizations from which we have access to data on the current regulatory environment as well as the projected impact of expected changes in insurance regulations. BlackRock has been periodically consulted by A.M. Best on the risks of certain security types (e.g. CMOs) and maintains a close relationship with this rating agency which aids BFM in understanding the ratings implications of industry developments. BlackRock can meet with regulators and rating agencies on clients' behalf to discuss investment philosophy and specific portfolio strategies.

The Investment Strategy Committee sets the broad investment strategy of all client portfolios by setting duration parameters and establishing guidelines for sector weightings, yield curve positioning and convexity positioning. This overall investment strategy is implemented when managing insurance portfolios while, at the same time, incorporating each client's specific accounting, tax, regulatory, liquidity and risk-based capital considerations. Accordingly, BlackRock tailors its investment management services to meet the specific investment objectives and constraints of each client.

Proprietary Quantitative Tools and Independent Research

BlackRock's analytic systems are an integral part of the investment decision-making process, as the portfolio managers use BlackRock's proprietary state-of-the-art technology to compare securities to identify relative value and to understand the impact of any buy/sell decision on the applicable portfolio. BlackRock is unique among asset management firms in the significant investment the firm has made in developing proprietary analytical and other research capabilities. The Risk Management Group has spent over sixty man-years creating proprietary analytical software to evaluate portfolio risk and market opportunities on an on-line basis. This state-of-the-art technology and analytic systems include proprietary option-adjusted spread and duration models, convexity analysis, and portfolio optimization. All of these models and software were developed in-house by BlackRock, and the firm maintains exclusive rights. *We know of no other money manager who has this comprehensive capability.*

Excellent Performance Record

BlackRock has enjoyed excellent performance across fixed income products. We believe that BlackRock's disciplined approach to investment management, consistently applied, will lead to long-term outperformance in our client portfolios.