

**ACTUARIAL RESEARCH CLEARING HOUSE
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***REALIZED RETURN OPTIMIZATION
A NEW APPROACH TO LIABILITY FUNDING***

by

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(This presentation was made while the author was Vice President and Manager of the Insurance Strategies Group at Drexel Burnham Lambert.)

The following pages outline the presentation made at the 24th Actuarial Research Conference. The articles listed below describe Realized Return Optimization and its applications in greater detail.

1. 'Chapter 28: Realized Return Optimization: A Strategy for Targeted Total Return Investing in the Fixed Income Markets', by Miller, Rajan & Shimpi in *The Institutional Investor Focus on Investment Management*, edited by Fabozzi. Ballinger Publishing, 1989.
2. 'Chapter 14: Liability Funding Strategies', by Miller, Rajan & Shimpi in *Portfolio & Investment Management: State-of-the Art Research, Analysis and Strategies*, edited by Fabozzi. Probus Publishing, 1989.
3. 'Chapter 6: Optimal Funding of Guaranteed Investment Contracts', by Miller & Roth in *Fixed-Income Portfolio Strategies*, edited by Fabozzi. Probus Publishing, 1989.
4. 'Chapter 8: Funding SPDA Liabilities: An Application of Realized Return Optimization', by Miller, Shimpi & Rajan in *Fixed-Income Portfolio Strategies*, edited by Fabozzi. Probus Publishing, 1989.
5. 'Realized Return Optimization: An Alternate Approach To Funding Liabilities'. Society of Actuaries Investment Section Report. September 1989.

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REALIZED RETURN OPTIMIZATION

A NEW APPROACH TO LIABILITY FUNDING

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TRADING CRITERIA

PICK UP YIELD AND MAINTAIN DURATION

i.e., Increase PERFORMANCE For The Same RISK

QUESTIONS :

- 1. Is Yield An Appropriate Measure Of Performance?*
- 2. Can Duration Be Used To Measure Risk?*
- 3. Are Trading Criteria Consistent With Liability Funding?*

VALIDITY OF BOND YIELD COMPARISONS

VARIOUS DEFINITIONS :

- 1. Yield To Maturity***
- 2. Yield To Call***
- 3. Option-Adjusted Yield***
- 4. Stable Rate Yield***

COMPARISONS AFFECTED BY :

- 1. Different Maturities***
- 2. Different Coupons***
- 3. Different Credit Ratings***
- 4. Implicit Reinvestment Assumptions***
- 5. Liquidating Investments Before Maturity***

BOND YIELD VS. PORTFOLIO YIELD

YIELD : Equates Present Value Of Cash Flow To Market Value

Market Value Weighted Yield Of Bonds

$$= \frac{\sum \text{Market Value Of Bond} \times \text{Yield Of Bond}}{\sum \text{Market Value Of Bond}}$$

≠ Portfolio Yield

Dollar Duration Weighted Yield Of Bonds

$$= \frac{\sum \text{Market Value Of Bond} \times \text{Duration Of Bond} \times \text{Yield Of Bond}}{\sum \text{Market Value Of Bond} \times \text{Duration Of Bond}}$$

≡ Portfolio Yield

DEFINING DURATION

Macaulay Duration :

Present Value Weighted Average Time To Receipt Of Cash Flow

Modified Duration :

Price Sensitivity To Changes In Interest Rates

If Asset Is Option-Free :

- 1. Relationship Between Macaulay And Modified Duration***
- 2. Use Macaulay Duration To Calculate Modified Duration***

If Asset Has Options :

- 1. Macaulay Duration Has No Economic Interpretation***
- 2. Use Option Pricing Models To Calculate Modified Duration***

DURATION AS A RISK MEASURE

RISK : Possibility Of Not Achieving Desired Level Of Performance

DURATION MISMATCH : Used To Indicate Degree Of Risk

How Well Does Duration Mismatch Capture Risk?

- 1. Not Directly Related To Performance Measure***
- 2. Presumes Symmetric Impact Of Interest Rate Changes***
- 3. Ignores Path Dependency Of Cash Flows***
- 4. Based On Marginal Instantaneous Changes In Rates***

LIABILITY FUNDING CRITERIA

Basic Requirements For Liability Funding :

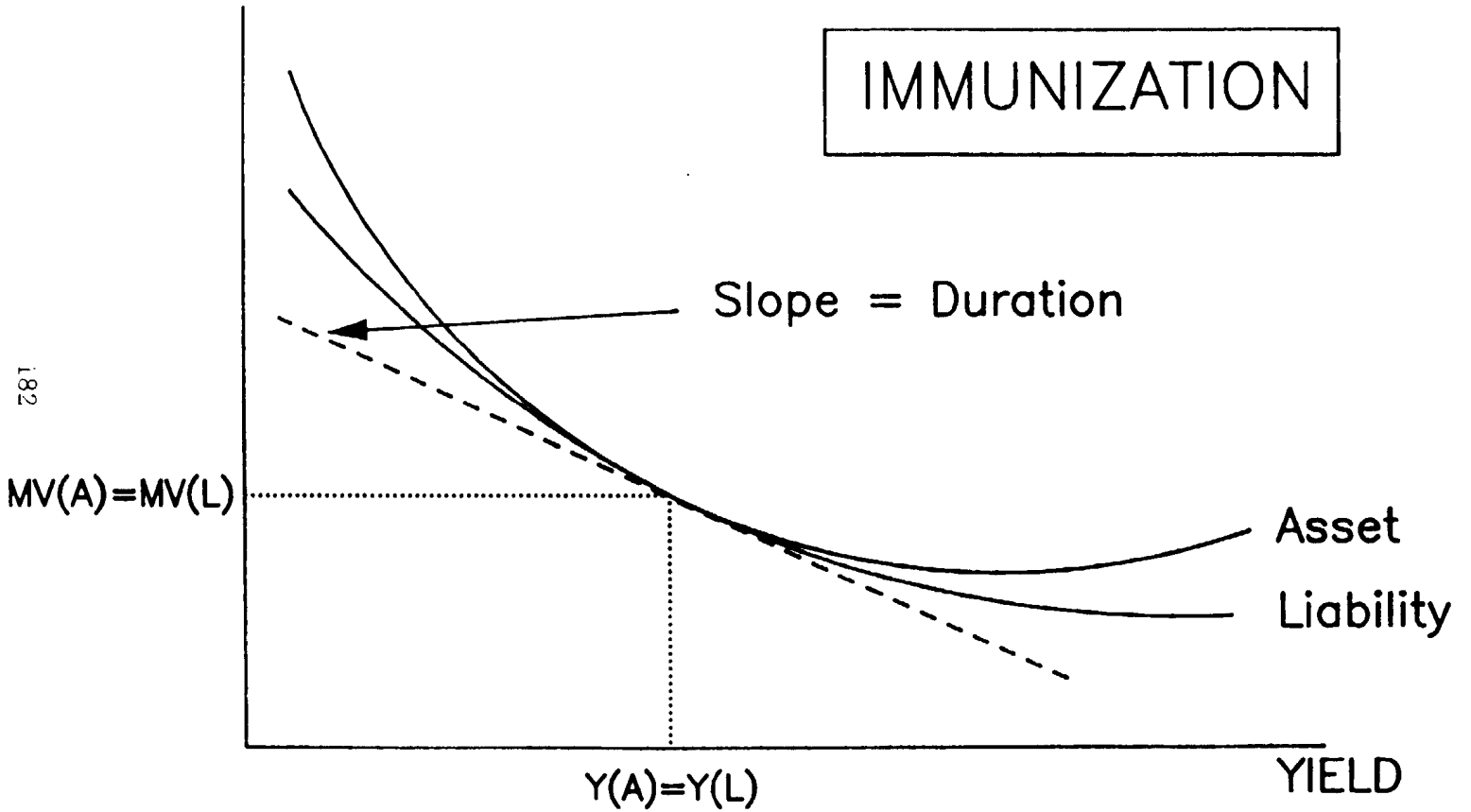
- 1. Meet Liability Payments As They Fall Due***
- 2. Maintain Sufficient Assets To Meet Unextinguished Liabilities***
- 3. Produce A Profit***

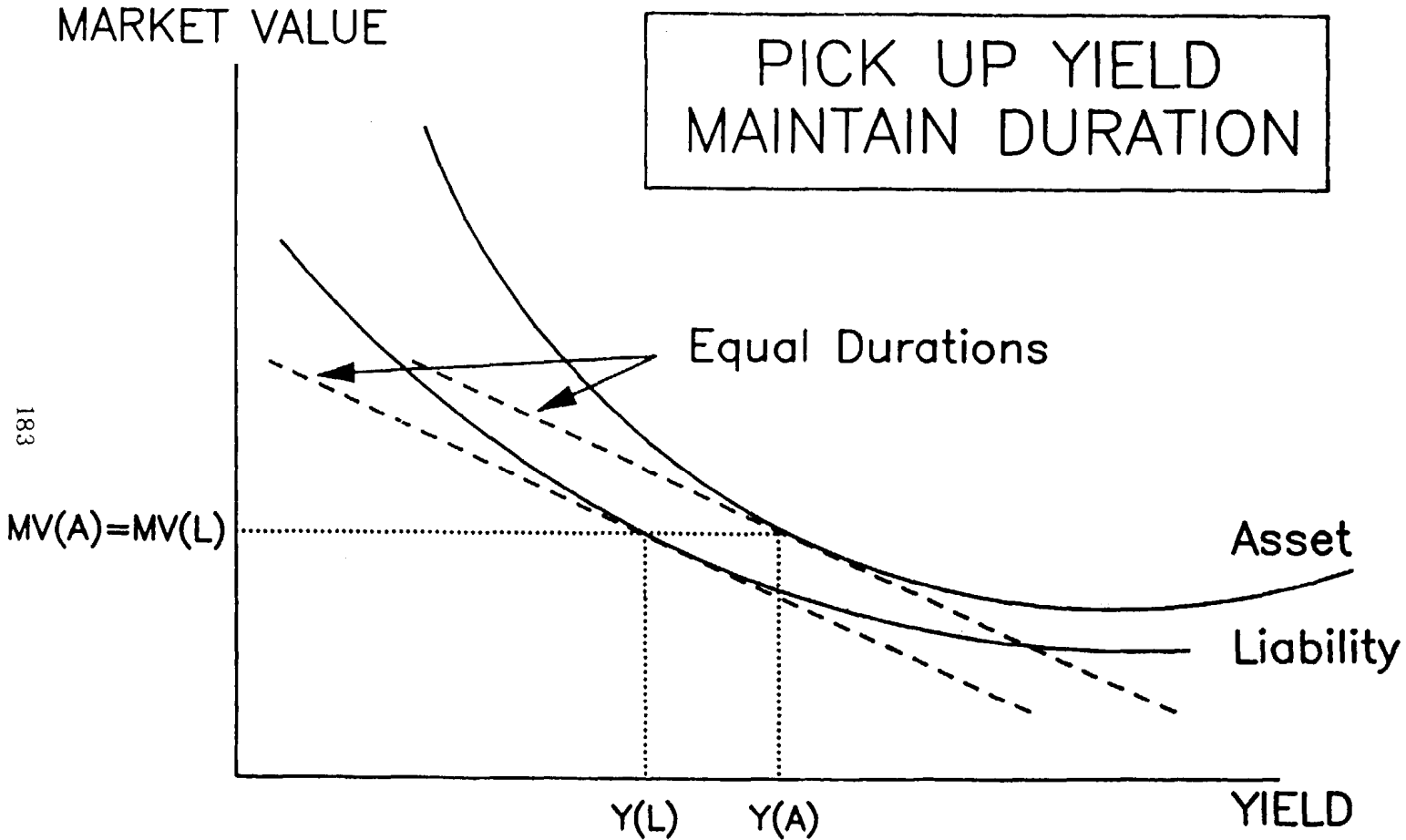
Immunization :

- 1. Requires Duration Matching***
- 2. Indirect Consideration Of Liability Requirements***

MARKET VALUE

IMMUNIZATION





MARKET VALUE

NOT IDENTIFIED
BY IMMUNIZATION

Unequal Durations

Asset

Liability

MV(A)

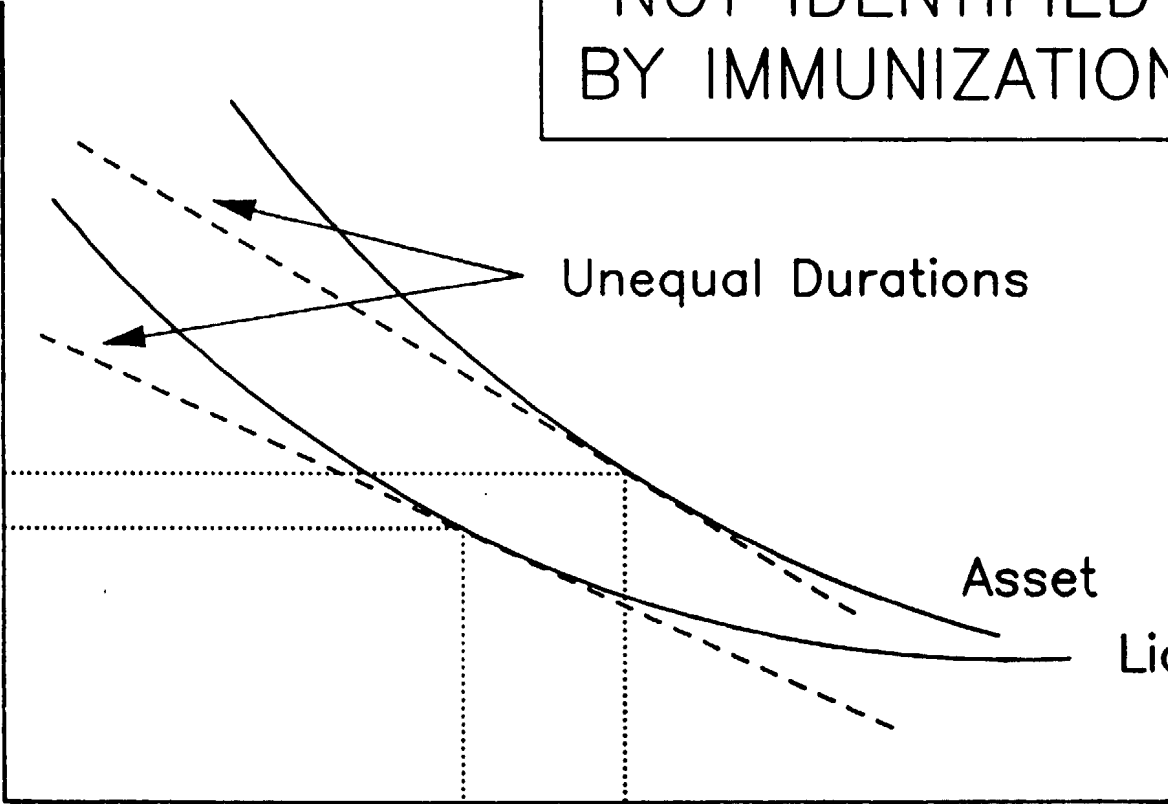
MV(L)

Y(L)

Y(A)

YIELD

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FORMULATING AN INVESTMENT STRATEGY

Build A Framework For Measuring Performance And Risk :

- 1. Consider Multiple Scenarios Explicitly***
- 2. Consider Multiple Horizons Explicitly***
- 3. Performance Measure Valid For Both Assets and Liabilities***
- 4. Risk Measure Calculated From Performance Measure***
- 5. Quantifiable Risk-Return Trade-Off***
- 6. Flexibility To Incorporate Margins For Error And Profit***

SCENARIOS

Defining Scenarios :

- 1. Primarily Interest Rate Scenarios*
- 2. Other Factors Can Define Scenarios*
- 3. Can Be Generated By Stochastic Models e.g., Binomial Process*
- 4. Can Incorporate Investor's Preferences*

Advantages Of Scenario-Based Approach :

- 1. Explicit Evaluation Of A Range Of Possible Outcomes*
- 2. Incorporates Path Dependency Of Cash Flows*
- 3. Identifies Risky Environments Well In Advance*
- 4. Allows For Changes In Factors Other Than Interest Rates*

MULTIPLE HORIZONS

- *Multiple Horizons Cater To Multiple Concerns*
- *Investor Has Short, Medium And Long Term Requirements*
- *Conventional Strategies Target Only One Horizon*
- *Desirable Strategy Should Target Multiple Horizons*

TOTAL RETURN AS A PERFORMANCE MEASURE

CONVENTIONAL APPROACH

Total Return = Measure Past Performance

Yield/Spread = Forecast Future Performance

Duration = Aggregate Risk Control

DBL APPROACH - REALIZED RETURN OPTIMIZATION (RRO)

Total Return = Measure Past Performance

AND Forecast Future Performance

AND Risk Control

RRO STRATEGY

REQUIRED RETURN = INVESTMENT TARGET :

Total Return Required To Be Earned In A Scenario Over A Particular Horizon So That Liability Payments Are Made When Due And Sufficient Assets Remain To Cover Unextinguished Liabilities.

REALIZED RETURN = PERFORMANCE MEASURE :

Total Return Earned By The Assets In A Scenario Over A Particular Horizon

INVESTMENT STRATEGY :

In Each Scenario And Over Every Horizon

REALIZED RETURN \geq REQUIRED RETURN

EXAMPLE 1

SELECTING A PORTFOLIO

(12-MONTH HORIZON)

<i>SCENARIO</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>AVERAGE</i>
<i>PROBABILITY</i>	<i>10%</i>	<i>20%</i>	<i>30%</i>	<i>20%</i>	<i>20%</i>	
<i>LIABILITY RETURN</i>	<i>7.5%</i>	<i>8.0%</i>	<i>10.0%</i>	<i>10.5%</i>	<i>11.5%</i>	<i>9.75%</i>
<i>MARGIN</i>	<i>0.5%</i>	<i>1.0%</i>	<i>0.0%</i>	<i>0.5%</i>	<i>1.5%</i>	<i>0.65%</i>
<i>REQUIRED RETURN</i>	<i>8.0%</i>	<i>9.0%</i>	<i>10.0%</i>	<i>11.0%</i>	<i>13.0%</i>	<i>10.40%</i>
 <i><u>REALIZED RETURNS:</u></i>						
<i>PORTFOLIO A</i>	<i>10.0%</i>	<i>10.5%</i>	<i>11.0%</i>	<i>11.5%</i>	<i>13.0%</i>	<i>11.30%</i>
<i>PORTFOLIO B</i>	<i>8.0%</i>	<i>9.5%</i>	<i>12.0%</i>	<i>12.0%</i>	<i>14.0%</i>	<i>11.50%</i>

IDENTIFYING AND MEASURING RISK

RISK : Possibility Of Not Achieving Target

RISK MEASUREMENT :

- 1. Standard Deviation About Average Portfolio Return***
 - Ignores Liability Requirements***

- 2. Total Deviation About Required Returns***
 - Penalizes Both Underperformance And Overperformance***

- 3. Downside Deviation About Required Returns***
 - Penalizes Only Underperformance***

EXAMPLE 2

RISK VS. RETURN

(12-MONTH HORIZON)

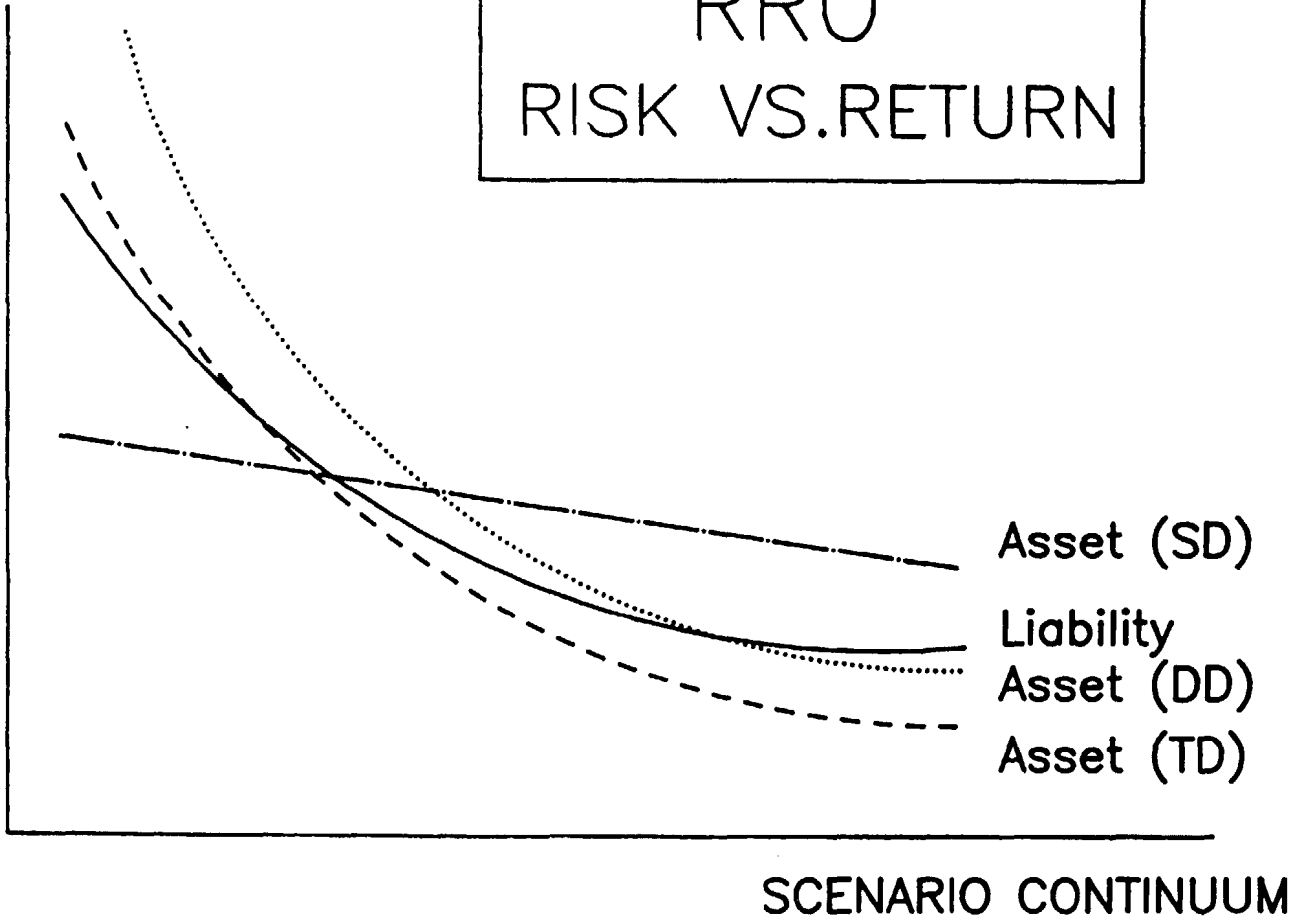
<i>SCENARIO</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>AVERAGE</i>	<i>RISK</i> (x 1000)			
<i>PROBABILITY</i>	<i>10%</i>	<i>20%</i>	<i>30%</i>	<i>20%</i>	<i>20%</i>					
<i>LIABILITY RETURN</i>	<i>7.5%</i>	<i>8.0%</i>	<i>10.0%</i>	<i>10.5%</i>	<i>11.5%</i>	<i>9.75%</i>				
<i>MARGIN</i>	<i>0.5%</i>	<i>1.0%</i>	<i>0.0%</i>	<i>0.5%</i>	<i>1.5%</i>	<i>0.65%</i>				
<i>REQUIRED RETURN</i>	<i>8.0%</i>	<i>9.0%</i>	<i>10.0%</i>	<i>11.0%</i>	<i>13.0%</i>	<i>10.40%</i>				
 <i><u>REALIZED RETURNS:</u></i>								<i>DD</i>	<i>TD</i>	<i>SD</i>
<i>PORTFOLIO C</i>	<i>9.0%</i>	<i>9.5%</i>	<i>10.0%</i>	<i>11.5%</i>	<u><i>12.0%</i></u>	<i>10.50%</i>	<i>0.2</i>	<i>0.4</i>	<i>1.2</i>	
<i>PORTFOLIO D</i>	<i>8.0%</i>	<u><i>8.0%</i></u>	<i>12.0%</i>	<i>12.0%</i>	<i>14.0%</i>	<i>11.20%</i>	<i>0.2</i>	<i>1.8</i>	<i>5.0</i>	

DD = DOWNSIDE DEVIATION FROM REQUIRED RETURNS
TD = TOTAL DEVIATION FROM REQUIRED RETURNS
SD = DEVIATION FROM PORTFOLIO AVERAGE RETURN

TOTAL RETURN

RRO
RISK VS. RETURN

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Asset (SD)
Liability
Asset (DD)
Asset (TD)

RISK-RETURN TRADE-OFF

For Each Portfolio, Evaluate :

RETURN = Probability Weighted Realized Return

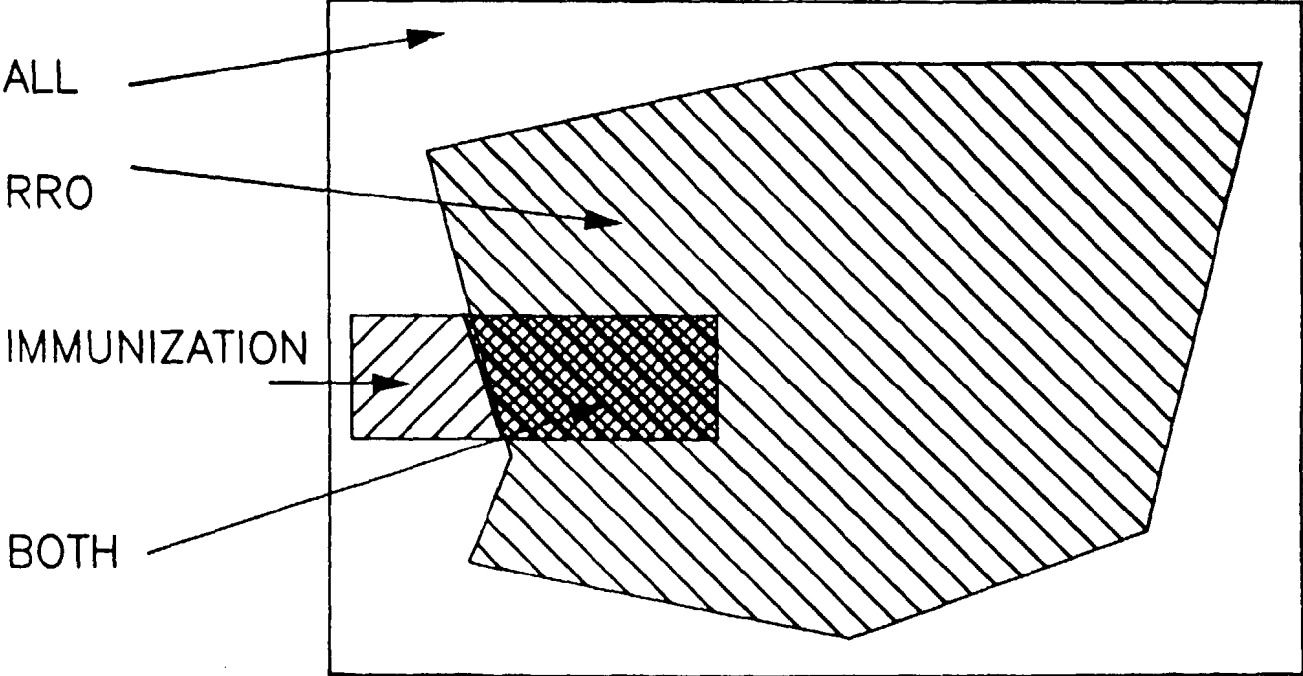
RISK = Downside Deviation From Required Return

RANK Portfolios By RETURN For Each Level Of RISK

RISK-RETURN FRONTIER :

- Maximum Return For Each Level Of Risk***
- Quantifies Risk-Return Trade-off***

FEASIBLE PORTFOLIOS



SOME APPLICATIONS OF RRO

- *Enabling Trading Across Markets*
- *Funding Life Insurance Liabilities*
- *Funding Pension Liabilities*
- *Maximizing Total Return*
- *Achieving Minimum Total Return In All Scenarios*
- *Enabling Active Management Of Interest Rate Risk*

GENERAL ADVANTAGES OF RRO

- ***Flexible With Respect To Objectives And Targets***
 - ***Allows For Multiple Investment Horizons***
 - ***Accounts For Diverse Shifts In Interest Rates***
- ***Handles Cash Flow Uncertainty Caused By Asset Options***
- ***Identifies Untenable Positions Well In Advance***
- ***Determines Risk-Return Frontier Based On Investor's Targets***
- ***Can Incorporate Margins For Profit And Error***

ADVANTAGES OF RRO FOR LIABILITY FUNDING

- *Ensures Ability To Meet Cash Outflows*
- *Matches Present Values Of Assets And Liabilities*
- *Handles Cash Flow Uncertainty Caused By Liability Options*