Robert C. Merton
2011 Princeton Lectures in Finance

Lecture 1: A Next-Generation Solution for Funding Retirement: A Case Study in Design and Implementation of Financial Innovation
## Innovation and Crisis: Behavioral Bias Between Familiar Risk and New Risk

### Corporate Pension Plan: Immunized match-funded: No risk to Corporation

<table>
<thead>
<tr>
<th>Nonfinancial Corporation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating Assets</strong></td>
</tr>
<tr>
<td>Pension Assets [100 long-maturity fixed-rate bonds]</td>
</tr>
<tr>
<td><strong>Senior Debt</strong></td>
</tr>
<tr>
<td>Pension Liabilities [100 long-maturity fixed payments]</td>
</tr>
<tr>
<td><strong>Common Stock</strong></td>
</tr>
</tbody>
</table>

### Corporate Pension Plan: Mismatch Funded: Risky to Corporation

<table>
<thead>
<tr>
<th>Nonfinancial Corporation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating Assets</strong></td>
</tr>
<tr>
<td>Pension Assets [75 Common Stock; 25 bonds]</td>
</tr>
<tr>
<td><strong>Senior Debt</strong></td>
</tr>
<tr>
<td>Pension Liabilities [100 long-maturity fixed payments]</td>
</tr>
<tr>
<td><strong>Common Stock</strong></td>
</tr>
</tbody>
</table>
Risk Comparison: Equities in Pension Fund vs. Swap

Incremental Pension risk is: receive: the total return on stocks on 75
Give up: the total return on bonds on 75

Derivative: Total-Return Equity Swap for Total-Return on Bonds on 75 notational amount

Incremental Swap risk is: Receive the total return on stocks on 75
Pay the total return on bonds on 75

Risk and Return on Equities in the pension fund is identical to Swap
Providing Core Retirement Funding for Working- and Middle-Class Households

**Goal:** Lifecycle Hypothesis – inflation-protected income for life adequate to maintain standard of living enjoyed in latter part of worklife

**Objective:** Maximize probability of achieving target income (replacement ratio) subject to a minimum income (replacement ratio) and other risk constraints

**Current Designs:**

Defined-benefit (DB) plans are unsustainable
- Accounting standards and actuarial principles vastly underestimate cost
- Plan sponsors no longer willing to accept lack of transparency, balance sheet risk and contribution cost uncertainty

Traditional defined-contribution (DC) plans were not designed to provide core retirement benefits
- Require participants to make complex financial decisions
- Not integrated with other retirement assets
- Focus on the wrong goal

DC plans organized with target-date funds are ineffective solutions
Design Requirements and Challenges for Next-Generation Retirement Solutions

- Robust, scalable low-cost investment strategies that make efficient and effective use of all dedicated retirement assets
- Integrate all sources of retirement savings into portfolio decision
- Measure the risk and return tradeoff in terms of retirement income (hedged for inflation, longevity, and real interest rates), and not in terms of portfolio value
- Mass customization based on salary, age, gender, plan accumulation, and other retirement-dedicated assets
- Be effective for participants who are completely unengaged [“default”]
- Engage the worker with an automatic alert if the likelihood of achieving his targeted level of retirement income falls below a preset threshold
- For participants who do engage provide meaningful choices to improve the likelihood of achieving his target goal, with easy implementation
- Allow plan sponsors to control their costs and eliminate balance sheet risk
Create a personal balance sheet for each participant that integrates various sources of retirement income.

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Security</td>
<td>Minimum retirement income requirement</td>
</tr>
<tr>
<td>Current DC plan balance</td>
<td></td>
</tr>
<tr>
<td>Projected future contributions (human capital)</td>
<td></td>
</tr>
<tr>
<td>DB plan rights</td>
<td>Surplus available for target income goal</td>
</tr>
<tr>
<td>Other dedicated assets</td>
<td></td>
</tr>
</tbody>
</table>
### Integrated Retirement Investment Approach and Asset Allocation Risk Measures

<table>
<thead>
<tr>
<th>Total Assets</th>
<th>FC/SS/DB</th>
<th>DC Pension</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>$1000</td>
<td>$700</td>
<td>$300</td>
</tr>
<tr>
<td>Fixed Income</td>
<td>700</td>
<td>700</td>
<td>0</td>
</tr>
<tr>
<td>Equity</td>
<td>300</td>
<td>0</td>
<td>300</td>
</tr>
</tbody>
</table>

| Total        | $1000    | $500       | $500  |       |
| Fixed Income | 700      | 500        | 200   | 33%   |
| Equity       | 300      | 0          | 300   | 67%   |

| Total        | $1000    | $100       | $900  |       |
| Fixed Income | 700      | 100        | 600   | 67%   |
| Equity       | 300      | 0          | 300   | 33%   |
Measuring Risk: Deferred Annuities Monthly Returns
High risk in value terms, low risk in income terms

Copyright © 2011 Robert C. Merton.
Measuring Risk: T-Bill Monthly Returns
Stable-value returns do not meet stable-income goals
Measuring the Risk/Return Tradeoff: Value vs. Income

USD $

MSCI World

Annuity

T-bills

Annuity Units

MSCI World

T-bills

Copyright © 2011 Robert C. Merton
Dynamic Portfolio Strategies Focused on Achieving the Retirement Income Goal

Cut off excess upside possibilities to improve the chances of achieving the desired income target.
Getting the Participant Engaged and Making Engagement Improve the Chances of Achieving the Goal

• Alert to all participants if probability of success falls below a pre-set threshold. Record of alerts kept on file
• Meaningful information on how well on track to realize retirement goals
• Only offer meaningful choices for the participant to improve the likelihood of achieving his target goal, together with easy implementation.
  – Increase contribution rate (save more)
  – Increase retirement age (work longer)
  – Increase risk of investment
    Other than death, there are no other ways
• Analogous to a medical report from annual checkup
Future Enhancements

• Integration to include other retirement-dedicated assets
• House: pre-paid consumption and retirement-funding asset
• Bequest and asset-use efficiency: reverse mortgage
• Product efficiency: long-term care and life annuity
• Age, means, and interest-rate-dependent employer contribution rates to reduce duration mismatch risk
• Standard of living risk: consumption-linked income units
• Tail-insurance on longevity: >85 life annuities
The Role of Financial Innovation in Addressing Financial Challenges in the Future

If we review what is needed in terms of innovation and financial engineering to implement this next-generation retirement solution:

- Longevity and inflation bonds/swaps
- Valuation and risk of future contributions
- Increasing duration beyond existing instruments
- Dynamic replication portfolios to match annuity units
- Reverse mortgage design requires complete revamp and efficient placement
- Behavioral finance
- Securitization better get fixed

Difference in performance between this approach and target date funds is substantial.

All of this has to be done for very low fees, on a massive scale, and must be totally reliable.