# Securitization of Longevity Risk and its implications for retirement security

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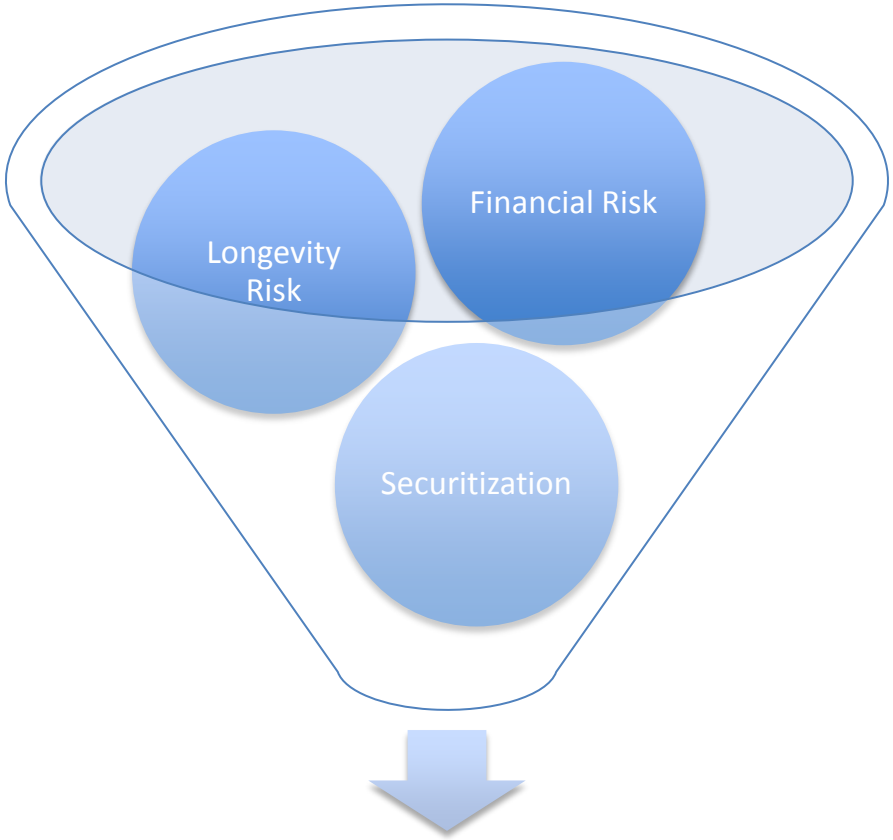
# Agenda




DB and DC Scenarios

# Longevity Risk

- Longevity risk is the risk that the funds allocated for retirement do not sustain the indefinite length of retirement
- In the case of a defined contribution plan, the individual bears the longevity risk and it is the risk of outliving the accumulated wealth.
- In the case of a defined benefits plan, the pension fund bears the longevity risk and it is the risk that the pool of retirees outlives the funds assets.
- Longevity risk has two components.
  - Idiosyncratic risk that can be diversified
  - Trend or systematic risk that cannot be diversified
- Longevity risk of U.S. defined benefit plans has been estimated to be approximately 2.2 trillion dollars in 2007 and to cover 42 million participants. Swiss Re estimates the total global exposure to be around $21 trillion.

# Financial Risks

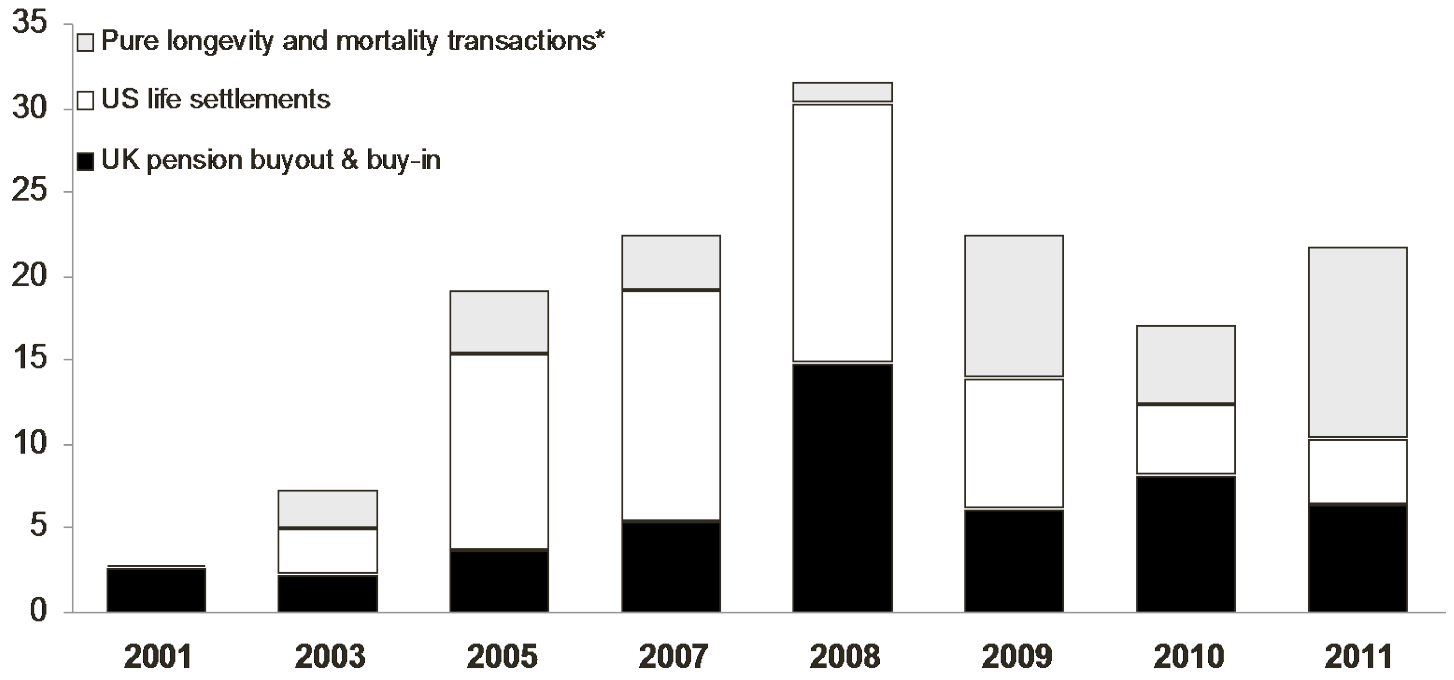
- Funds transferred forward for retirement are also exposed to financial risks. The financial risks are captured here with three asset types.
- The financial market is composed of the S&P500 index, Merrill Lynch corporate bond index and 3-month T-bill.
- The return dynamics of the first two assets at each time t is described by a combination of Brownian motion and a compound Poisson process while the return dynamics of the 3-month T-bill is described by Brownian motion.
  - The parameters of these processes are first estimated from historical data for the base case. See table 1.
  - The parameters are doubled for the baseX2 case to reflect and increase in the trend but also the volatility of the assets and also the number and size of the jumps of the equity and bond indices.

# Securitization

- Mortality securitization involves the transformation of a pure risk into a speculative risk.
- The transformed risk may then be traded in capital markets.
  - In 2003 Swiss Re issue a bond via Vita Capital I that transferred mortality risk to the capital markets
  - In 2010 Swiss Re issue a bond via Kortis that transferred longevity risk to the capital markets.
- Other instruments include:
  - Buy-outs, buy-ins, longevity options, and q-forward

# Longevity Risk Transfer

**Value of announced transactions in selected segments of the life market (US $ billions)**




* Includes longevity swaps (insurance and capital markets format) and mortality catastrophe transactions

Source: Sanford Bernstein, ABI, Mercer OliverWyman, J.P. Morgan, Life Settlement Solutions, Inc., Fasano Associates, Swiss Re Capital Markets, Aite Group, Hymans Robertson, Artimis, J.P. Morgan

# Scenarios

- The parameters of the asset return processes are first estimated from historical data for the base case. See table 1.
- The asset returns are simulated by generating 1,000 yield paths; each path is 123 – 65 = 58 years long.
- The parameters are doubled for the baseX2 case to reflect and increase in the trend but also the volatility of the assets and also the number and size of the jumps of the equity and bond indices.
- The base and baseX2 cases are considered for DC and DB plans.

# Defined Contribution Plans

- Investors with DC plans are exposed to longevity risk as well as financial market risks
- We consider an investor who selects a portfolio of equity, bonds and T-bills
- Given our interest in longevity risk we consider the sustainable length of the retirement under two assumptions:
  - The individual invests in a TIAA-CREF lifecycle fund
  - The individual selects a portfolio
- The portfolio returns are generated with the financial market model.
- The sustainable lengths of retirement are generated from the portfolio returns and form a distribution. We consider the mean, VaR and CVaR of the sustainable lengths of retirement for the portfolios.

# TIAA-CREF lifecycle funds

- The TIAA-CREF lifecycle fund portfolio
  - The composition of the portfolio changes from more equity to more fixed income, short term and inflation protected assets as the client base ages.
  - That composition is approximated here with fewer asset types.
- The portfolio determines the distribution of sustainable lengths of retirement
- We report the mean, VaR and CVaR for this distribution at the 1% level
- We also report the failure rate for the portfolio.

| TIAA-CREF Retirement Fund | | |
|---|---|---|
| | With No Inflation | With 2% Inflation |
| Base case | 7.10% | 32.40% |
| BaseX2 case | 97.40% | 99.90% |

# Other DC portfolios

- Suppose the investor selects the portfolio of assets
- The structure of the portfolio is considered here
- The portfolio selection determines the distribution of sustainable lengths of retirement
- We consider two scenarios: the base and baseX2 cases
  - In the base case we suppose financial markets maintain the same trends and volatility demonstrated in the last 20 years.
  - In the baseX2 case we suppose the trend and volatility are amplified.
- For the base case and a $75,000 withdrawal rate we see mean, VaR and CVaR.
- For the base case and $40,000, we report the mean sustainable length of retirement, the VaR and CVaR at the 1% level for each portfolio combination. With inflation mean, VaR and CVaR

| DC Portfolio (40% equity, 60% bonds) | | |
|---|---|---|
| | With No Inflation | With 2% Inflation |
| Base case | 4.1% | 24.5% |
| BaseX2 case | 97.3% | 99.9% |

# Other DC portfolios

- Again suppose the investor selects the portfolio of assets but anticipates a more volatile financial market.  Call this case baseX2
- The structure of the portfolio is considered here
- The portfolio selection determines the distribution of sustainable lengths of retirement
- For the baseX2 case, we report the mean sustainable length of retirement, the VaR and CVaR at the 1% level for each portfolio combination. With inflation mean, VaR and CVaR

# Defined Benefit Plans

- Pension funds are exposed to longevity risk as well as financial market risks
- The pension fund has a fiduciary responsibility to its members. To meet that objective, the manager minimizes the variance of the underfunding distribution subject to constraints on the expected underfunding, short selling and the size of the tail of the underfunding distribution.
- The constrained minimization problem is run for the base case
  - Longevity risk is incorporated into this by considering three different trends in mortality improvement
  - The base case solution is shown in table 5
  - The baseX2 case solution is shown in table 6

# DB Hedging

- A partial buy-out transfers a fraction of the pension fund assets and liabilities to the capital market.
- Suppose the asset portfolio and normal pension fund contributions from the base case are maintained then table 7 shows how the partial buy-out hedge mitigates the underfunding risk due to the financial market and longevity risks for different hedge ratios.

# DB Hedging

- A longevity option transfers a portion of the pension liability risk to the capital markets.
- Suppose the asset portfolio and normal pension fund contributions from the base case are maintained then table 13 shows how the option mitigates the underfunding risk due to the longevity risks for different hedge ratios.

# Concluding remarks

- Buy-outs, options, q-forwards and other instruments exist to hedge longevity risk and these hedging instruments are increasingly being used.
- For defined contribution plans where the individual bears the longevity and capital market risks, current and potential capital market volatilities show that there is a need for more hedging instruments to extend the sustainable length of the retirement portfolio.
- For defined benefit plans where the pension fund bears the longevity and capital market risks, the analysis shows that the underfunding risk can be cut by hedging with partial buy-outs or with options.