International Consultation on
The Debt Crisis, Financial Reforms and the Common Good

The Debt Crisis and the Pension Dilemma

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Cambridge Systems Associates Limited
Outline

- The debt crisis, the growing deficits of pension funds and the response from governments and corporations
- What can individuals, society and governments do to prevent a crisis?
  - Households’ dilemma – optimal consumption / saving over lifetime
  - New theory and technology for *individual* Asset Liability Management
The Demographic Challenge

- Human longevity has improved rapidly over the past century: “72 is the new 30, researchers at the Max Planck Institute for Demographic Research say”\(^1\). Older people are living longer too. It is among the most frail that life expectancy is rising fastest; between 2002 and 2012, while the over-65 population in England and Wales rose by just under 7 per cent, those aged 85 and over rose by 26 per cent

- United Nations’ forecasts are that the percentage of the world’s population that is over 65 will rise to 12 per cent from 5 per cent as of 2010. The UN predicts that by 2050, almost a third of the UK’s population will be over 65 – and that there will be only three working-age people to help support over-65s, down from four now\(^2\).
The Demographic Challenge

USA Replacement Rate [PEW Mobility Project, May 2013]

Late Baby Boomers and Gen-Xers do not have adequate resources for retirement and facing possible downward mobility.

Source: Panel Study of Income Dynamics

Note: The replacement rate calculations project how much wealth individuals and families may have upon retirement at age 65 given current income levels and wealth accumulation. A replacement rate of 100 percent means that an individual or family would have exactly the same money in retirement that they had pre-retirement. A value below 100 percent means less, and a value above 100 percent means they would have more. There is debate about what an ideal replacement rate would be, but financial planners suggest that individuals should ideally be able to replace 70 to 100 percent of their annual income.
OECD Factbook 2013

Public and private expenditure on pensions

As a percentage of GDP, 2009

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Impacts of the Crisis on Pensions

Average annual real net investment return of pension funds in selected OECD countries

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Aging Population and National Debt

Life-Cycles

- Retirement
- Earning years
- Dependent years

Varieties of Pensions
# Pensions and Risks

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<tr>
<th>Type of pensions</th>
<th>Risk</th>
<th>Risk Description</th>
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<tbody>
<tr>
<td>State pensions</td>
<td>Government</td>
<td>Reduced state social security guarantees due to high national debts</td>
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<tr>
<td>Defined Benefit</td>
<td>Corporate</td>
<td>Loss in value of institutional pension funds due to current crash in asset prices and low interest rates</td>
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<tr>
<td>Defined Contribution</td>
<td>Corporate and Individual</td>
<td>Low asset returns predicted for the next decade with the possibility of high inflation and loss in value of savings due to low saving rates</td>
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<tr>
<td>SIPP, 401K, individual savings, etc</td>
<td>Individual</td>
<td>The asset management industry has yet to respond. This is the most challenging task theoretically and computationally - too complex for an individual</td>
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Response from Governments and Corporations

- **Greece:** The country's severe crisis has made public pensions increasingly unsustainable and led to severe cuts. The government has since raised the number of years of work needed to claim a pension from 35 to 37 years and introduced penalties for early retirement.

- **France:** European Commission picked out France’s pension system as requiring an ‘urgently needed’ overhaul to help bring the country’s public accounts under control. Complex set of 35 pension regimes cost €270bn in 2011 or 13.6 % of gross national product. Public spending has reached 57 per cent of gross domestic product, pensions account for a quarter of all public outlays, two-thirds of social charges and half of welfare spending.

- **UK:** Pension schemes of FTSE 100 companies had a combined deficit of £43bn at June 30. Their liabilities totalled £0.5 trillion. Only 61 of the FTSE 100 companies continue to provide defined benefit and most are expected to close their schemes. As companies replace these expensive schemes with "defined contribution" alternatives, the retirement prospects for younger workers have dimmed. Figures from the Office for National Statistics last week showed as much, with fewer people are saving into a company pension plan that at any point for the past 60 years. The solution pushed through by government is "automatic enrolment". Here, nearly every worker in the land will, by default, be signed-up to their company's scheme by 2018. By that date an extra 11 million people will have been put into a pension scheme, the Government estimates. However, Hargreaves Lansdown's figures show automatic enrolment contribution rates, which will be 8pc once the scheme is firing on all cylinders, will barely suffice.
What can Governments do to prevent a pension crisis?

- Changes in general to existing pensions include:
  - raising the minimum retirement age
  - longer contribution period to earn full pension
  - increase in contributions by employees and employers which leads to net increase in labour costs for employers

- Any previous attempts led to massive demonstrations and protests from the public
Governments are anxious to avoid the outbreaks of social conflict that accompanied previous reform efforts.

Greece's elderly are seeing the value of their pensions plummet amid austerity cuts.

Few in Greek society have escaped the effects of the country's austerity programme. But it is Greece's elderly who may be suffering the most. Falling pensions, rising taxes and pressure on family support networks are causing stress for many.

SOLIDARITY WITH ITALIAN UNIONS OVER PENSIONS

Esodati – older people out work and now trapped by pensions changes – take part in an earlier union protest in Italy. Photo: CGIL.
Households’ Dilemma – optimal consumption/ saving decisions?

“Is Personal Finance an exact science? An immediate flat no. ... It is a domain full of ordinary common sense. Common sense is not the same thing as good sense. Good sense in these esoteric puzzles is hard to come by.”  

Paul Samuelson

What is Wealth?

• What is the risk in matching cash inflows from assets and outflows from liabilities?
• Is wealth the inflation-indexed real income that our assets can sustain over time?
• Is wealth the long-term spending that our portfolio can sustain?
• When does a person consider himself wealthy?
  – Identification of individual’ risk/reward attitude which is not constant over lifetime
‘The myth of risk attitudes’
Daniel Kahneman JPM Fall 2009

“To understand an individual’s complex attitudes towards risk we must know both the size of the loss that may destabilize them, as well as the amount they are willing to put in play for a chance to achieve large gains. Temporary perspectives may be too narrow for the purpose of wealth management. The theories - utility theory and its behavioural alternatives - assume that individuals correctly anticipate their reaction to possible outcomes and incorporate valid emotional prediction into their investment decisions. In fact, people are poor forecasters of their future emotions and future tastes – they need help in this task – and I believe that one of responsibilities of financial advisors should be to provide that help.”

New theory and innovative technology – HPC Finance Project
New Meta-Model for Individual Financial Planning - iALM

- The iALM system is a decision support tool based on the theory of stochastic optimization.

- Principal ideas are brought together from behavioural and classical finance and from decision theory.

- It allows interactive re-solve of an instance of the problem to obtain long-term financial plans with different data inputs in order to compare the consequences of changes in individual preferences (HPC Finance project) – ‘gaming’ aspect of solution process.
Key Features of iALM

- Optimal portfolio decisions correspond to the best possible desirable consumption subject to existing and future liabilities

- Portfolio risks are managed by
  - constraining portfolio drawdown in each scenario
  - imposing limits on portfolio asset holdings in each scenario

- Interactive use of the system allows looking at the possible outcomes for a number of the household’s alternative preferences in order to choose a most suitable financial plan over the long-term horizon

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Overview of individual ALM

Gather Individual and Market Data

Econometric and Actuarial Modelling

Scenario Tree Simulation

Optimization Model: Tailored Portfolios, Goal Spending, Cashflow Balances, etc

Personal data

Market data

Events model

Liabilities model

Model returns on investment classes

Events

Cash-out flows forecast

Cash-in flows forecasts

Dynamic optimization model for assets-liabilities

Objective: maximize spending on risk managed goal

Visualization of decisions

Various Constraints

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Framing of the Problem

- **Broad Framing**: overall objective is to provide ‘sustainable spending’ over a household’s lifetime in terms of desired consumption on multiple life goals specified by preferences and their priorities

- **Narrow Framing**: maximization of goal consumption at given times (annually)
  - Each single goal utility function is defined with respect to reference points chosen by the household in terms of spending on the goal
Value Function of the Prospect Theory

- Recall Value Function of the Prospect Theory

\[ v(x) = x^\alpha \text{ if } x > 0 \]
\[ v(x) = -\lambda (-x^\alpha) \text{ if } x > 0 \]
with a typical \( \alpha = 0.88 \) and \( \lambda = 2.25 \)
Individual Goal Utility – Narrow Framing

- Utility function for an individual goal is given by three reference points.
- For each single goal the level of spending $y$ is in the range between acceptable (s) and desirable (g) and minimum (h) spending subject to existing and foreseen liabilities. Together with goal priorities these values specify the piecewise linear shape of the utility function for each goal.
- The objective is to maximize goal spending with a piecewise linear utility function for the year.
Overall Objective – Broad Framing

- To provide ‘sustainable spending’
- Optimization problem objective is to maximize the expected present value (over all scenarios) of life time consumption, i.e. spending on goals

\[ \mathbb{E} \left[ \sum_{t=1}^{T} 1_{\{\text{any alive, } t\}} u_t(C) \right] \]

where \( u_t(C) = \sum_{g \in G} u_{g,t} - \frac{1}{\phi_t} \left( \pi^{xs} z^{xs}_t + \pi^{zi} I^*_t \right) \)

Here \( z^{xs}_t \) is excess borrowing, \( I^*_t \) is total tax payment and \( \phi_t \) is the inflation index at \( t \)

- Consumption refers to all “elective” spending on chosen goals

\[ C_t = \sum_{g \in G_m} \alpha_{g,t}^{\text{alive}} \phi_{g,t} \left( F_{g,t}^d + F_{g,t}^m \right) + \sum_{g \in G \setminus G_m} \alpha_{g,t}^{\text{alive}} \phi_{g,t} \gamma_{g,t} \]
Goal Spending Cash Flow Diagram

Net wealth

Goal Equity boxes like this exist for each goal $g$ where $g$ is a mortgaged goal (e.g. home purchase with mortgage).

Goal Spending Cash Flow Diagram

1. **Cash holding**
   - Consumption
   - Mortgaged goal spending

2. **Capital goal asset**
   - Downpayment
   - Loan repayments
   - Capital goal spending $\phi_{g,t} F^d_g$

3. **Capital goal asset value**
   - Changes in goal value

4. **Goal mortgage**
   - Interest charges $\phi_{g,t} Z^g$
   - Loan repayments $\phi_{g,t} F^m_g$

5. **Goal Equity**
   - Interest charges on goal loans
   - Changes in goal value

6. **Non-capital goal spending**
   - If $g$ is a capital goal with no mortgage
   - If $g$ is a non-capital goal (e.g. education, living expenses)

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Creating Individual Financial Plan

- iALM is a meta-model for \textit{optimum resource allocation over networks of cashflows}
- The income from portfolio together with the streams of labour and other income provides the \textit{best desirable consumption}
- Optimal management of \textit{various portfolios}
  - Two types of portfolio: taxable and savings portfolios such as 401K (USA) or SIPP and ISA (UK)
- \textit{Portfolio allocation sub-problem}
Wealth Generation

- Together with stream of income the solution to the portfolio allocations subproblem provide optimal projected spending on goals.

- Fundamental constraints of portfolio allocation subproblem:
  - Initial holding
  - Portfolio value
  - Portfolio cashflow
  - Asset inventory balance
  - Investment limits, position limits
  - Portfolio drawdown
  - etc

- Current (root node) portfolio allocation decisions must be implemented:
  - Two types of portfolio: taxable and saving portfolios such as 401K (USA) or SIPP and ISA (UK)

- “What if” scenarios and projected optimal expected dynamic investment policy over a life-time.
Cashflow Constraints
iALM Solutions

- iALM provides optimum values for many decision variables – spending, borrowing, saving, etc -- across time simultaneously for multiple scenarios of random processes representing uncertain markets and life circumstances.

- Current iALM model includes 20 random processes that vary over the client’s lifetime and around 200 mathematically formulated conditions (constraints) per node.

- Average desktop computer solving times are 1-5 minutes (Problem size over 3mln non-zero entries).

- An interactive process for analysing retirement and saving alternatives.
Visual Summary of Profile

Getting an Overview

Goals

Portfolio

Cash Flows

Wealth
Dynamic Asset Allocation: Expected

Account:
- Blended
- Non-Qualified
- ISA
- SIPP

Normalise:
Scenario:
Expected

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<td>£23,224</td>
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- Open Cashflow Statement for year displayed
- What were the portfolio returns?
Better Lifestyle by Working Longer

Retirement Age Tradeoff for a Specific Consumption Pattern (135k-150k) Throughout Life
Required Lifetime Annual Saving and Retirement Age

Average % of Pre-Tax Income Saved

Retirement Age

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Summary

Financial planning decision support systems such as iALM provide comprehensive, long-term solutions to financial planning tailored to individual household needs

- Time dimension is modelled explicitly ("dynamic"; adaptive)
- Asset allocation protects the funding of intermediate goals
- Allows for uncertain future events ("stochastic")
- Penalises investment strategies that miss minimum goal spend
- Reflects client priorities for additional goal spending
- Defines risk in terms of the likelihood of meeting goals

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Could individuals prevent a pension crisis?
References

1. ‘Scientists claim 72 is the new 30’ FT February 25, 2013.
2. ‘The population conundrum’ FT November 23, 2012
3. ‘No way out of pension crisis for young workers’ The Telegraph, September 24, 2013