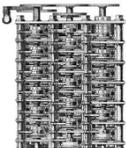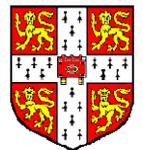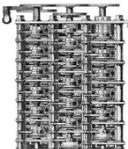**International Consultation on
The Debt Crisis, Financial Reforms and the Common Good**

# The Debt Crisis and the Pension Dilemma

Elena Medova

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
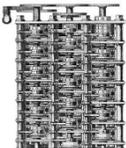
The Demographic Challenge

- 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].
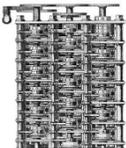
The Demographic Challenge
USA Replacement Rate [PEW Mobility Project, May 2013]

Late Baby Boomers and Gen-Xers do not have adequate resources for retirement and facing possible downward mobility.
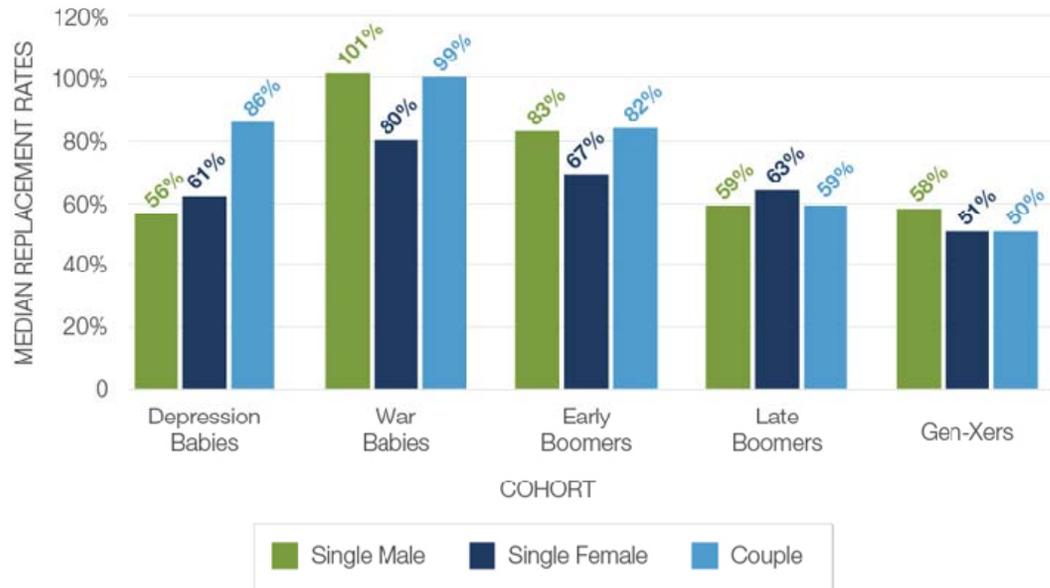
Source: Panel Study of Income Dynamics

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 preretirement, 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.

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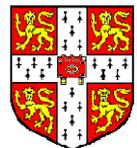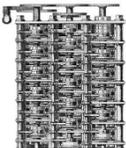
OECD Factbook 2013

Public and private expenditure on pensions

As a percentage of GDP, 2009
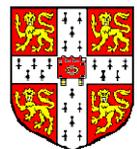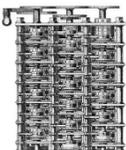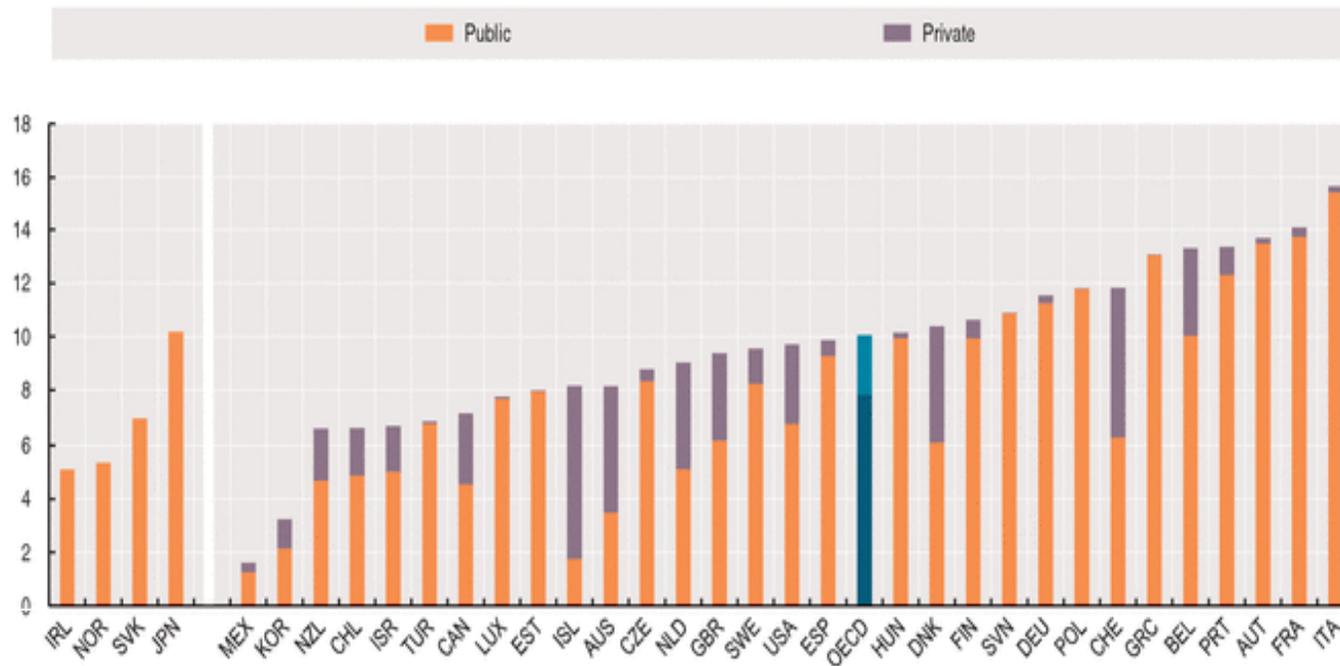
Impact of the Crisis on Pensions

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

Dec. 2001-Dec. 2010 and Dec. 2007-June 2011

Aging Population and National Debt
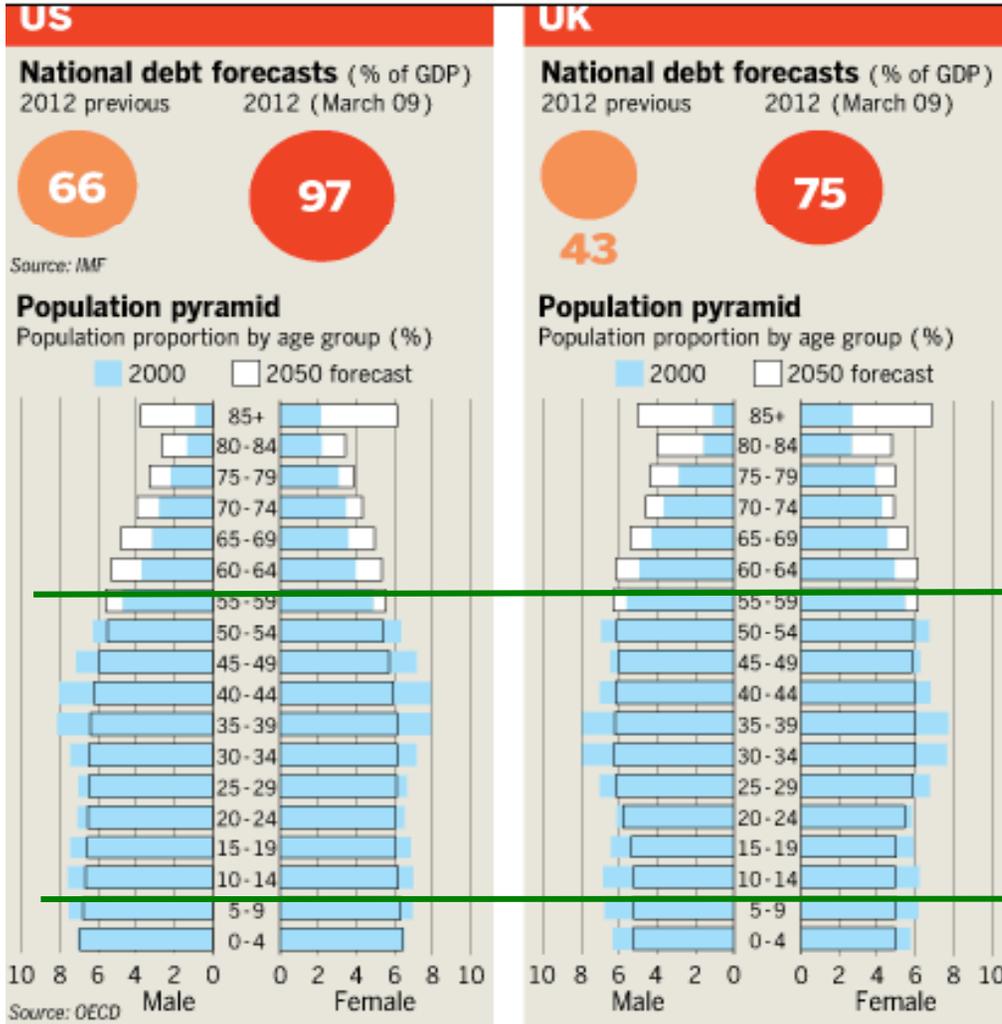
Life-Cycles

Retirement   Varieties of Pensions

Earning years
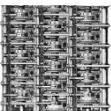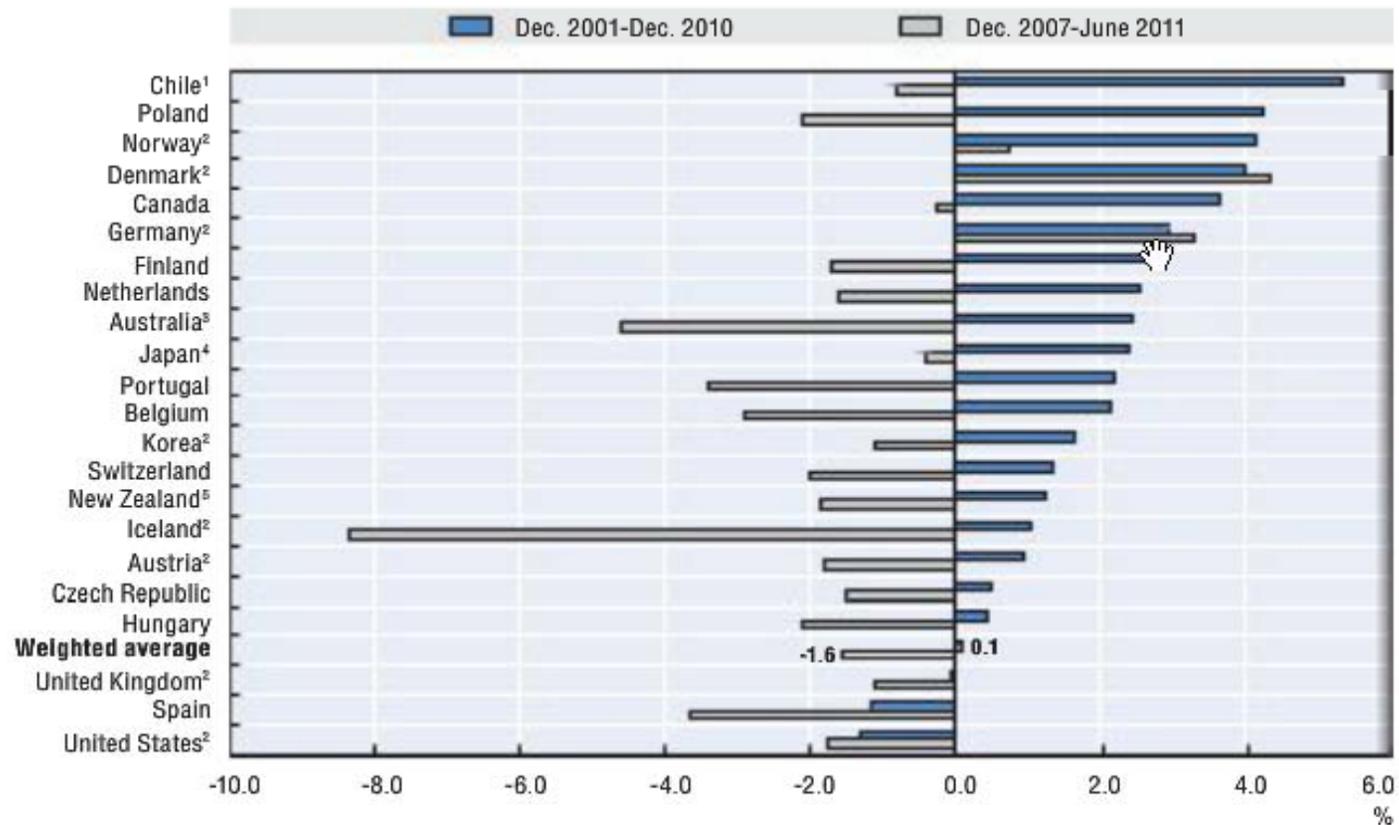
Dependent years

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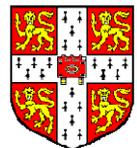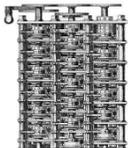
Pensions and Risks

Type of pensions	Risk	
State pensions	Government	Reduced state social security guarantees due to high national debts
Defined Benefit	Corporate	Loss in value of institutional pension funds due to current crash in asset prices and low interest rates
Defined Contribution	Corporate and Individual	Low asset returns predicted for the next decade with the possibility of high inflation Loss in value of savings due to low saving rates **Institutional ALM techniques for financial planning** [3,4]
SIPP, 401K, individual savings, etc	Individual	The asset management industry has yet to respond. **This is the most challenging task theoretically and computationally - too complex for an individual**
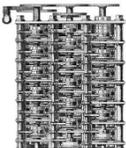
Response from Governments and Corporations

- **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 goverment 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.
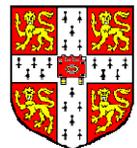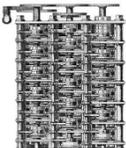
What can Goverments do to prevent a pension crisis?

- 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
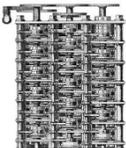
Governments are anxious to avoid the outbreaks of social conflict that accompanied previous reform efforts

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
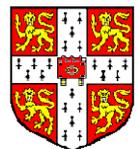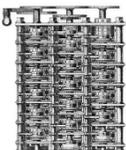
Households' Dilemma – optimal consumption/ saving decisions?

"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
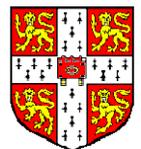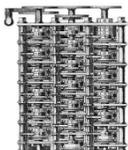
'The myth of risk attitudes'
Daniel Kahneman JPM Fall 2009

"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
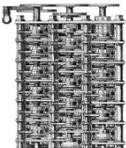
New Meta-Model for Individual Financial Planning - *i*ALM

- The *i*ALM 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
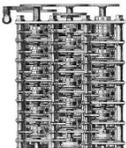
Key Features of *i*ALM

- **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
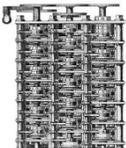
Overview of *individual* ALM

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   **Various Constraints**

Visualization of decisions
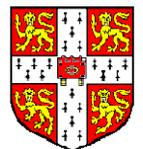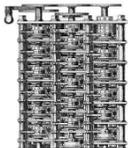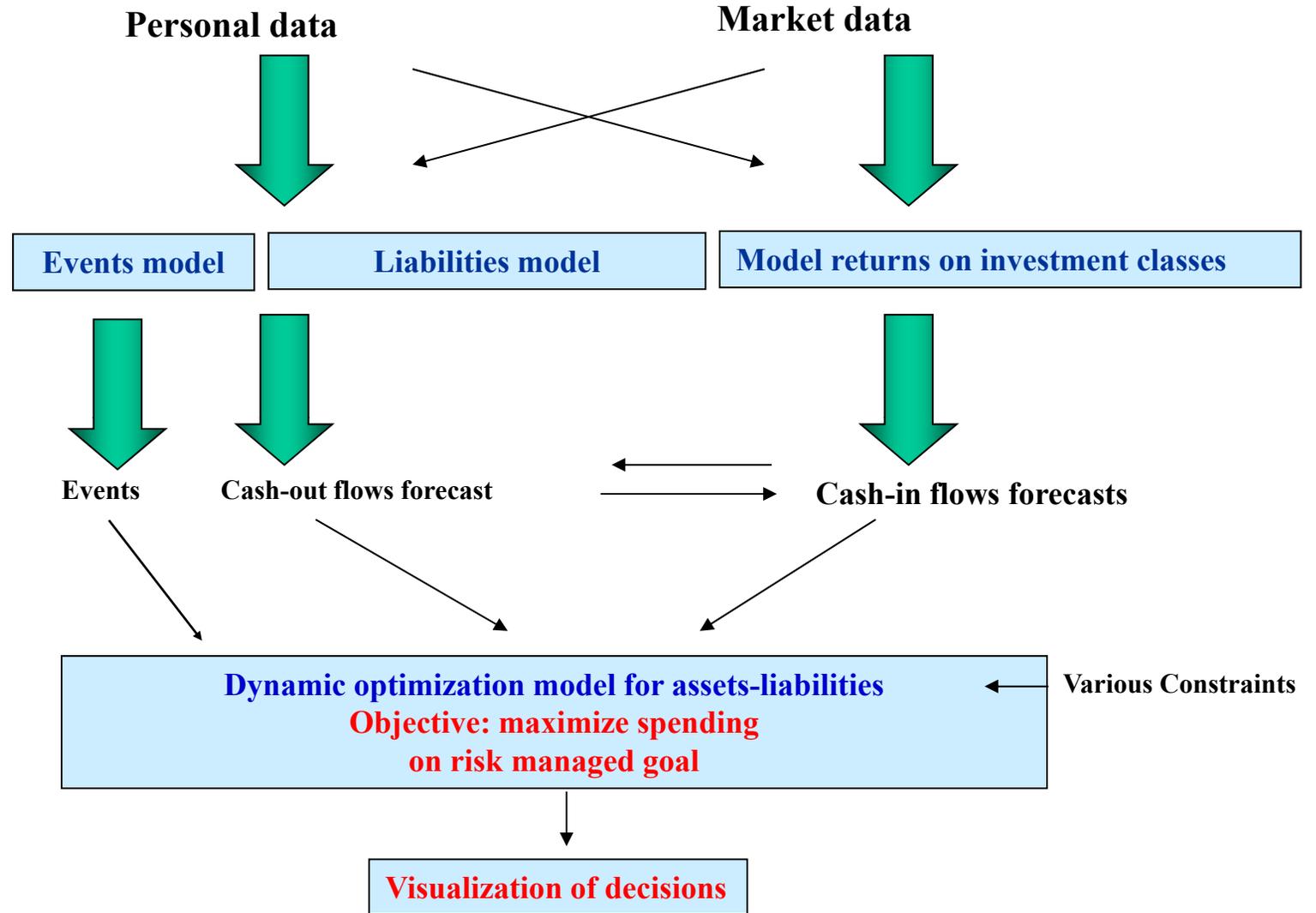
Framing of the Problem

- **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
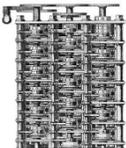
Value Function of the Prospect Theory

- Recall Value Function of the Prospect Theory

VALUE

LOSSES ——————————————— GAINS

$v(x) = x^{\alpha}$ if $x > 0$
$v(x) = -\lambda(-x^{\alpha})$ if $x > 0$
  with a typical $\alpha = 0.88$ and $\lambda = 2.25$
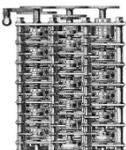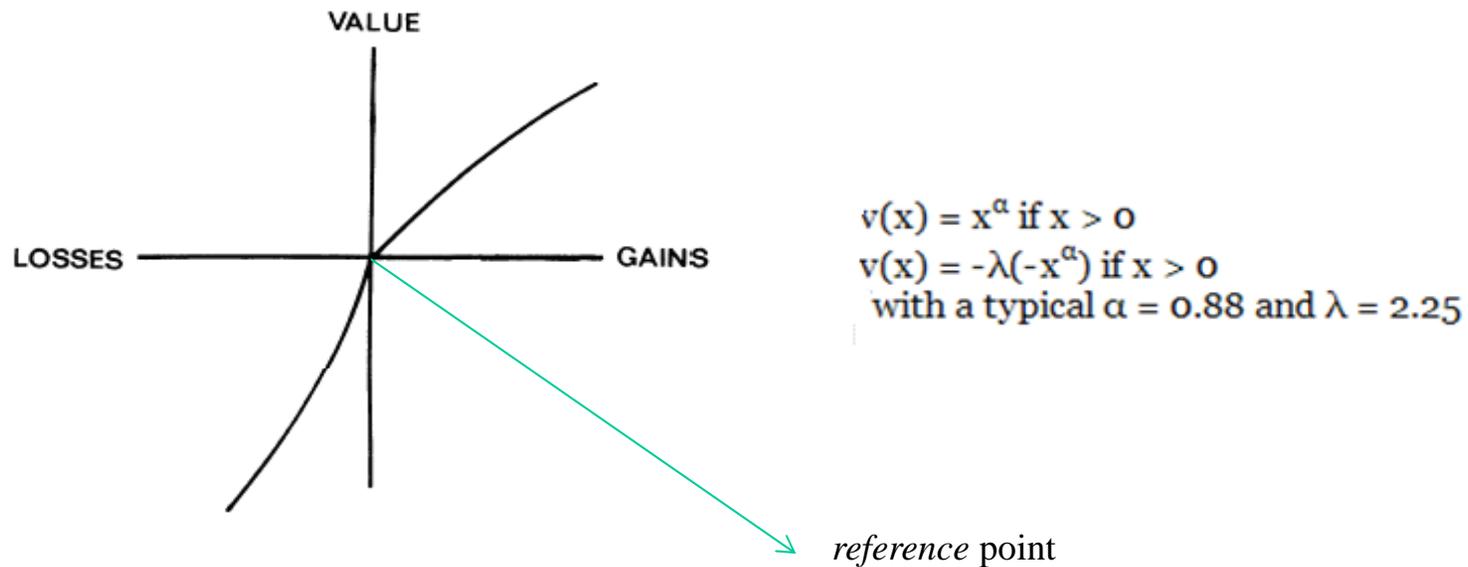
reference point

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
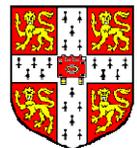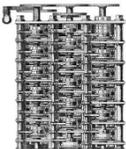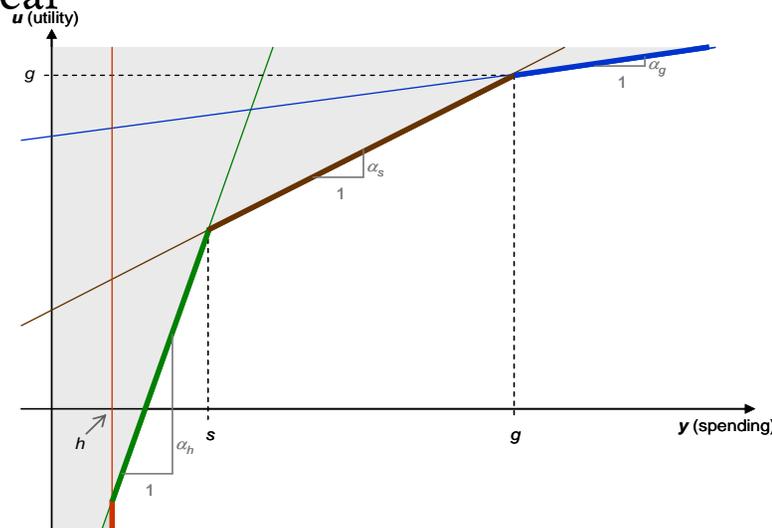
Overall Objective – Broad Framing

- 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

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

where $\mathbf{u}_t(C) = \sum_{g \in G}\mathbf{u}_{g,t} - \dfrac{1}{\boldsymbol{\varphi}_t}\left(\pi^{xs}\mathbf{z}_t^{xs} + \pi^{\tau i}\mathbf{I}_t^{\tau}\right)$

Here $\mathbf{z}_t^{xs}$ is excess borrowing, $\mathbf{I}_t^{\tau}$ is total tax payment and $\boldsymbol{\varphi}_t$ is the inflation index at t

- Consumption refers to all "elective" spending on chosen goals

$$C_t = \sum_{g \in G_m}\alpha_{g,t}^{\text{alive}}\boldsymbol{\varphi}_{g,t_g^s}\left(\mathbf{F}_{g,t}^{d} + \mathbf{F}_{g,t}^{m}\right) + \sum_{g \in G \setminus G_m}\alpha_{g,t}^{\text{alive}}\boldsymbol{\varphi}_{g,t}\hat{\mathbf{y}}_{g,t}$$
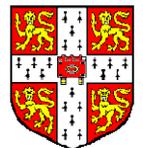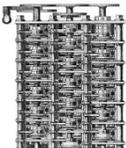
Goal Spending Cash Flow Diagram

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 Equity

Cash holding — consumption C

Goal mortgage $-\varphi_{g,t_g^s}\mathbf{z}_g^-$

interest charges — $\varphi_{g,t_g^s}\mathbf{z}_g^-\mathbf{r}_g^m$ → Interest charges on goal loans

loan repayments $\varphi_{g,t_g^s}\mathbf{F}_g^m$

goal purchase $\varphi_{g,t_g^s}\left(\mathbf{y}_{g,t_g^s}^d - \mathbf{F}_g^d\right)$

mortgaged goal spending — downpayment $\varphi_{g,t_g^s}\mathbf{F}_g^d$ → Capital goal asset $\varphi_{g,t_g^s}\mathbf{y}_{g,t_g^s}$ ← Changes in goal value

Non-mortgaged goal spending $\varphi_{g,t}\mathbf{y}_{g,t}$

Goal Equity

If g is a capital goal with no mortgage → Capital goal asset $\varphi_{g,t_g^s}\mathbf{y}_{g,t_g^s}$ ← Changes in goal value

If g is a non-capital goal (e.g. education, living expenses) → Non-capital goal spending

Creating Individual Financial Plan

- *i*ALM is a meta-model for **optimum resource allocation over networks of cashflows**

- The income from portfolio together with the streams of labour and other income provides the *best* desirable consumption

- Optimal management of *various portfolios*
  - Two types of portfolio: taxable and savings portfolios such as 401K (USA) or SIPP and ISA (UK)

- *Portfolio allocation sub-problem*
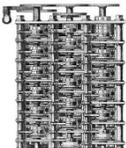
Wealth Generation

- 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

Net wealth

Returns

$\sum \mathbf{x}_a^+ r_a^{\text{tx}+} + \sum \mathbf{x}_a^- r_a^{\text{tx}-}$ → Transaction costs

Portfolio $(\sum \mathbf{x}_a)$

Margin borrowing $(-\mathbf{m})$

$\mathbf{m}(\mathbf{r}^{cash} + r^m)$ → Interest charges on margin loans

Goal Equity (see below) → Interest on goal loans

$\mathbf{P}^+$ $\mathbf{P}^-$

asset purchases / asset sales

$\mathbf{m}^-$ $\mathbf{m}^+$

new margin loans / margin loan repayment

$\mathbf{C}$ goal spending → Goal consumption (non capital)

Coupons and dividends $\mathbf{I}^C + \mathbf{I}^D$

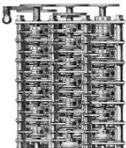Interest on bank deposits $\mathbf{z}_{t-1}^+ \mathbf{r}_{t-1}^{cash}$

Regular income $\sum \mathbf{I}_p + \mathbf{I}_o$

$\mathbf{L}$ → Liabilities

$\mathbf{I}^\tau + \mathbf{F}^{\tau av}$ → Taxation

Cash holding $(\mathbf{z}^+)$

Employer pension contributions $\rho^{qe401k} \mathbf{P}^{q401k+}$

$r^{qp} \mathbf{P}^{q\tau}$ → Unauthorized qualified withdrawal penalty

$\mathbf{P}^{q401k+}$

$\mathbf{P}^{qNR+}$

qualified contributions $\mathbf{P}^{q+}$

$\mathbf{z}^{q-}$ loan repayment

asset loan repayment / asset borrowing

income loan repayment

Loans secured on assets → Interest charges on secured borrowing

$\mathbf{P}^{q-}$ qualified withdrawal

Excess borrowing repayment / income borrowing

$\mathbf{z}_{I,t-1}^-(1 + r_{t-1}^{cash} + r_I^s)$

$\mathbf{z}_{I,t}^-$

Qualified coupons and dividends $\mathbf{I}^{qC} + \mathbf{I}^{qD}$

Qualified account (0)

excess borrowing at t

$\mathbf{z}_t^{xs}$ $\mathbf{z}_{t-1}^{xs}(1 + \mathbf{r}^{xs})$

Income borrowing $\mathbf{z}_I^-$

$\mathbf{z}_{I,t-1}^-(r_{t-1}^{cash} + r_I^s)$ → Interest charges on income loans

asset purchases $\sum \mathbf{x}_a^{q+}$

asset sales $\sum \mathbf{x}_a^{q-}$

Excess borrowing $\mathbf{z}^{xs}$

$\mathbf{z}_{t-1}^{xs} \mathbf{r}^{xs}$ → Interest charges on excess borrowing

Qualified returns

Qualified portfolio $(\sum \mathbf{x}_a^q)$

$\sum \mathbf{x}_a^{q+} r_a^{\text{tx}+} + \sum \mathbf{x}_a^{q-} r_a^{\text{tx}-}$ → Transaction costs (qualified portfolio)

*i*ALM Solutions

- *i*ALM 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 *i*ALM 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
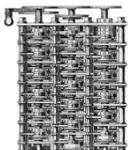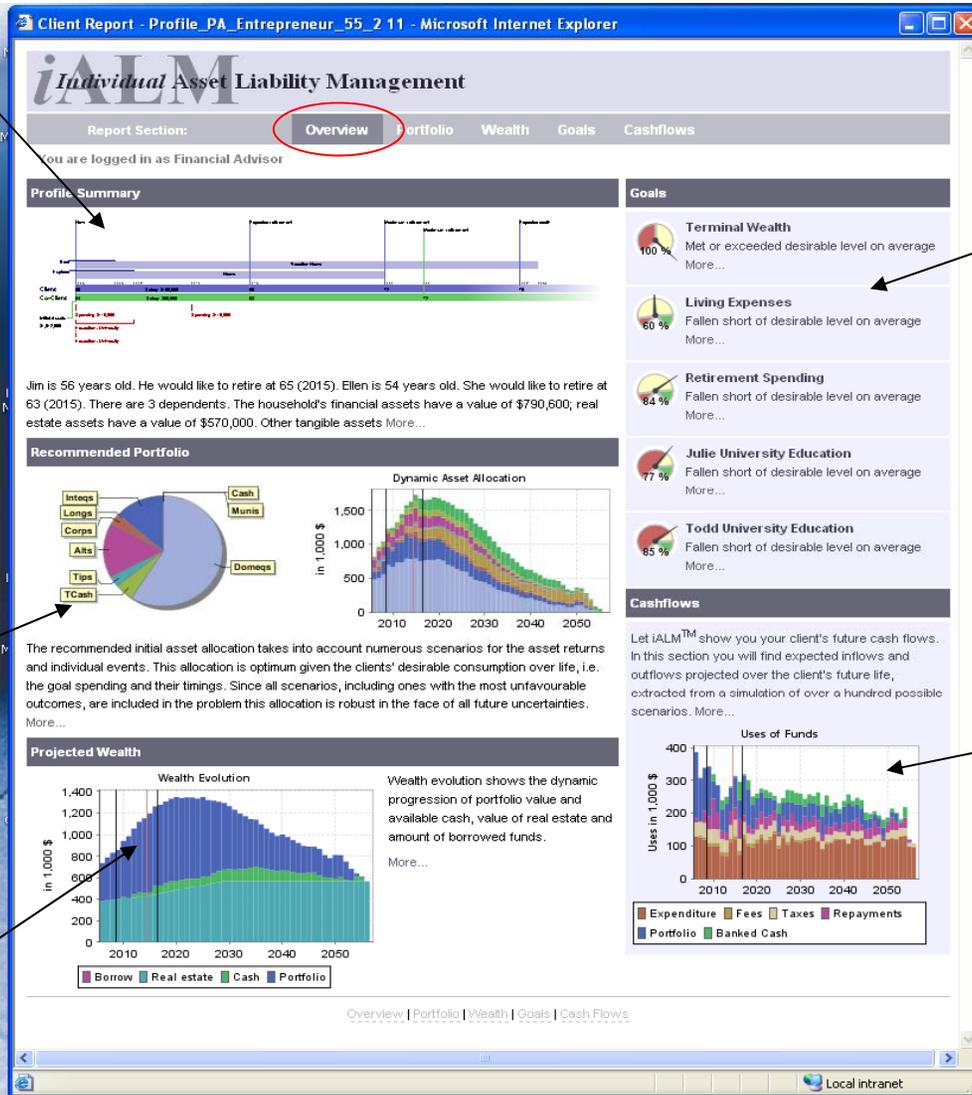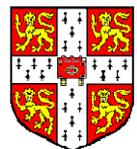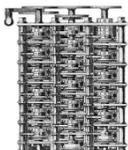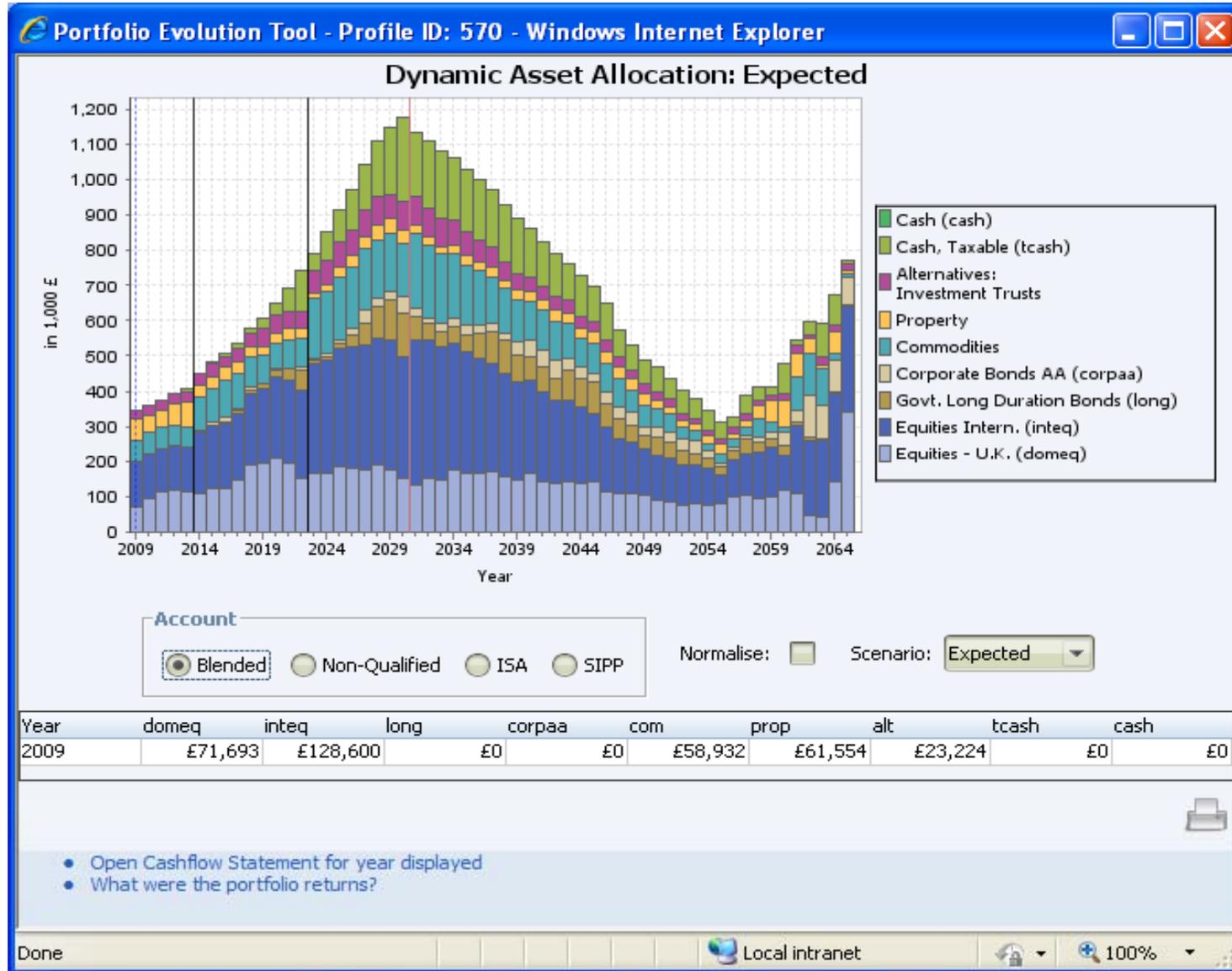
Visual Summary of Profile

Goals

Getting an Overview

Portfolio

Cash Flows

Wealth

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Portfolio Evolution Tool - Profile ID: 570 - Windows Internet Explorer

Dynamic Asset Allocation: Expected

Legend:
- Cash (cash)
- Cash, Taxable (tcash)
- Alternatives: Investment Trusts
- Property
- Commodities
- Corporate Bonds AA (corpaa)
- Govt. Long Duration Bonds (long)
- Equities Intern. (inteq)
- Equities - U.K. (domeq)

Account
- ( ) Blended
- ( ) Non-Qualified
- ( ) ISA
- ( ) SIPP

Normalise: [ ]   Scenario: Expected ▼

Year	domeq	inteq	long	corpaa	com	prop	alt	tcash	cash
2009	£71,693	£128,600	£0	£0	£58,932	£61,554	£23,224	£0	£0

- Open Cashflow Statement for year displayed
- What were the portfolio returns?

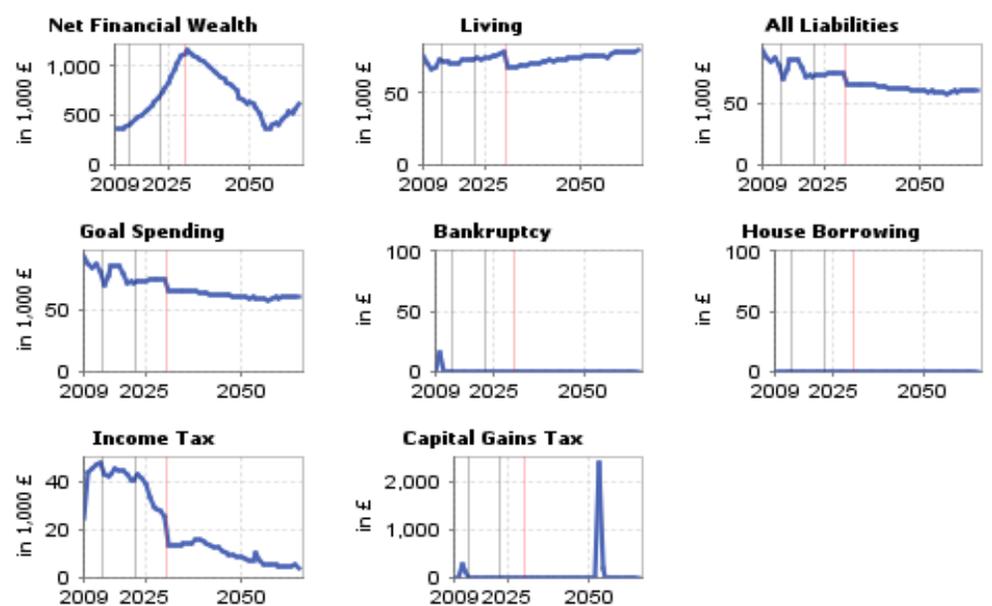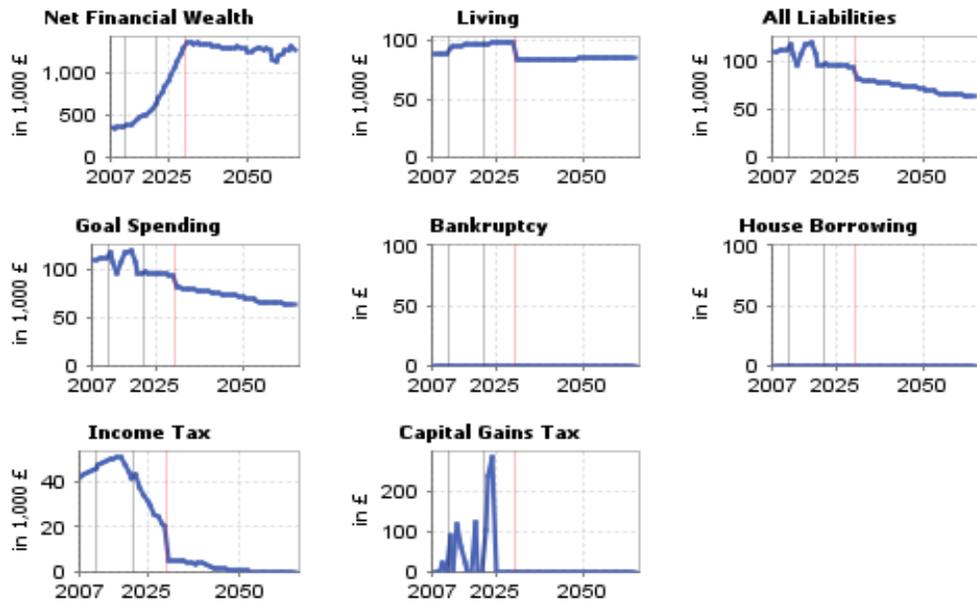Done   Local intranet   100%

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2007

2009

Individual Cashflows (2007): Net Financial Wealth, Living, All Liabilities, Goal Spending, Bankruptcy, House Borrowing, Income Tax, Capital Gains Tax

Individual Cashflows (2009): Net Financial Wealth, Living, All Liabilities, Goal Spending, Bankruptcy, House Borrowing, Income Tax, Capital Gains Tax
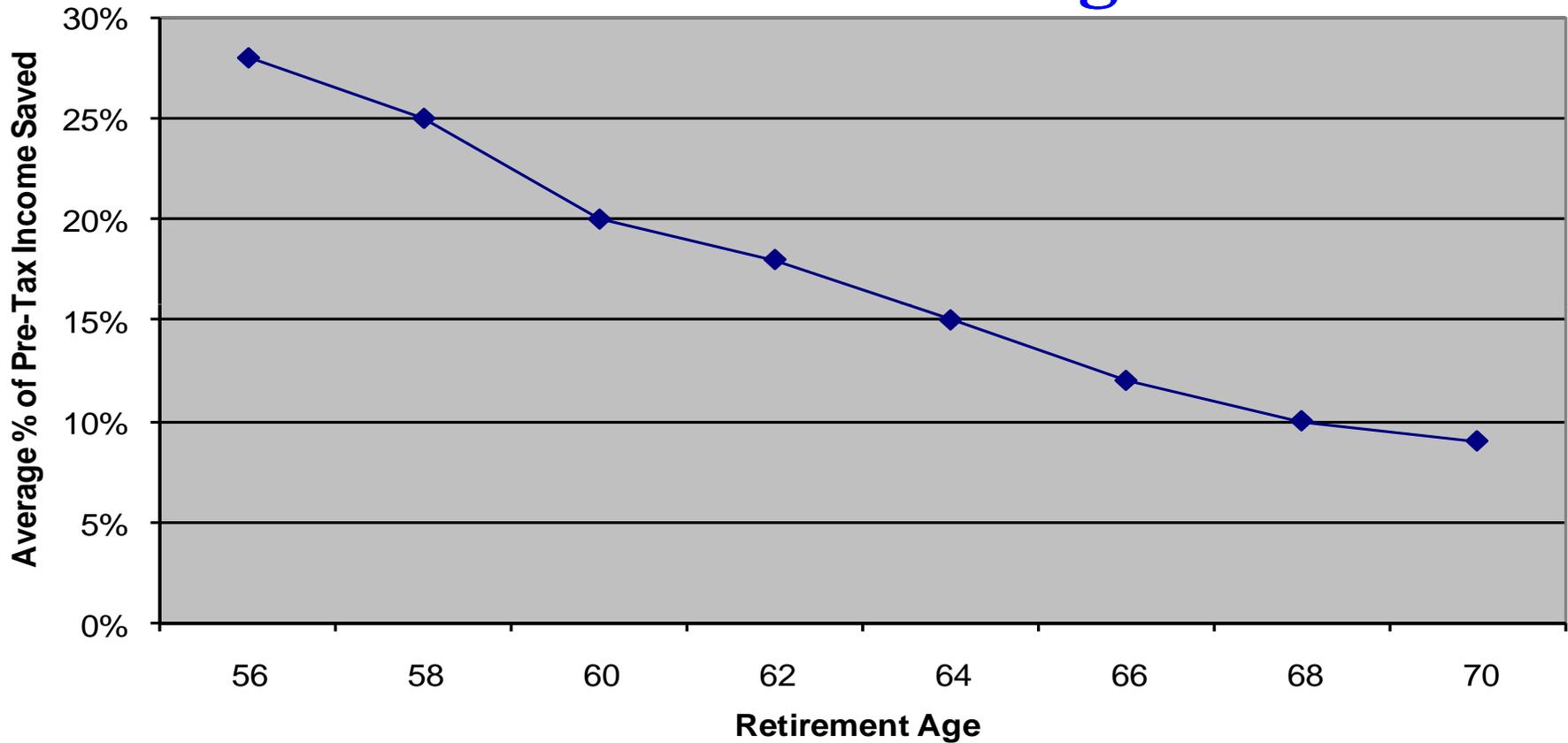
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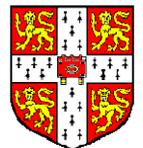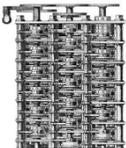
Better Lifestyle by Working Longer

Retirement Age Tradeoff for a Specific Consumption Pattern (135k-150k) Throughout Life

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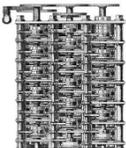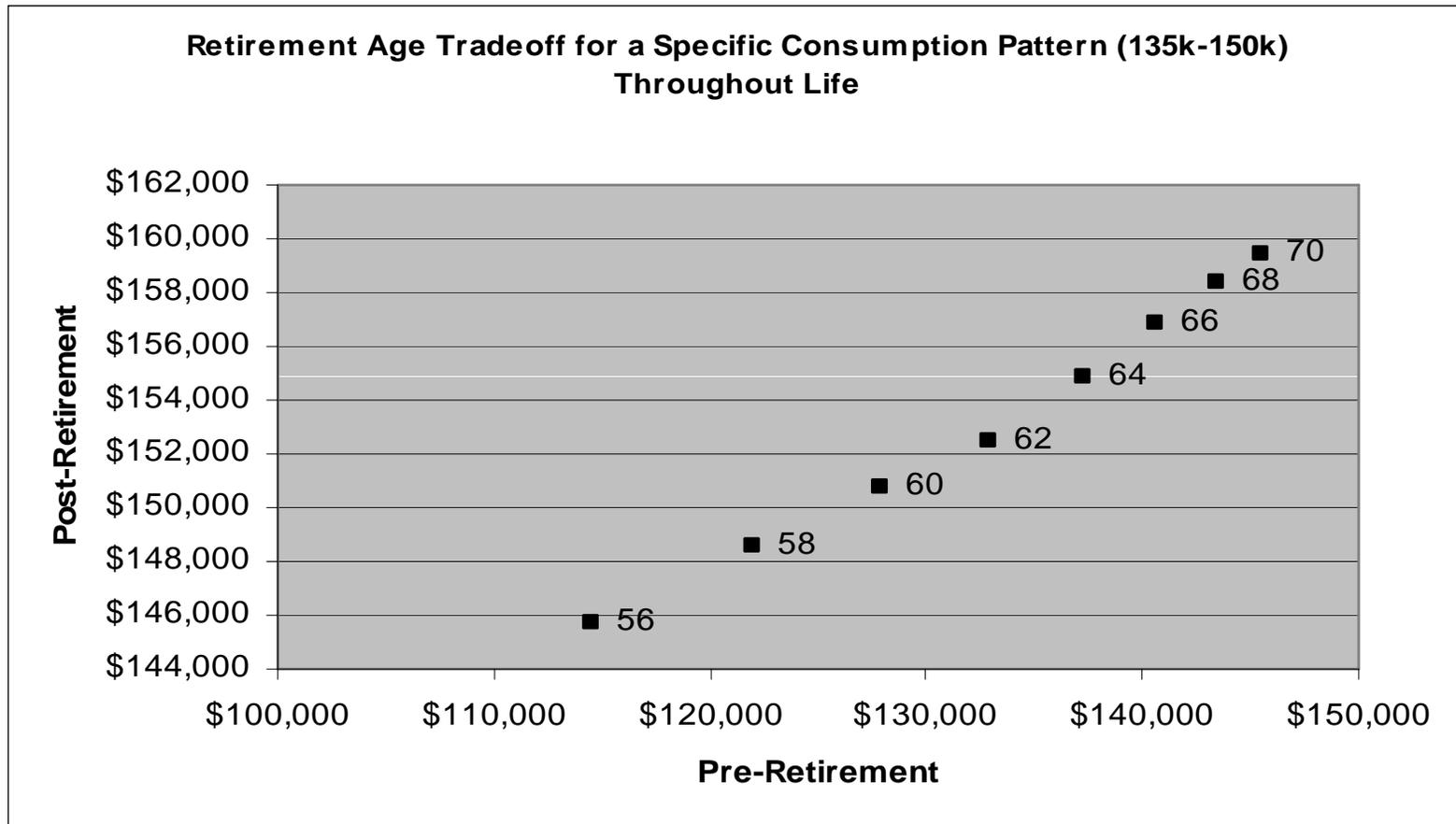
Required Lifetime Annual Saving and Retirement Age
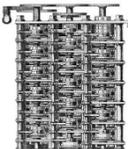
Summary

 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
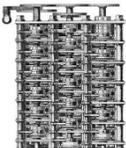
Could individuals prevent a pension crisis?
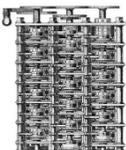
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