CCFEA 10th Anniversary Conference

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Asset Liability Management for Individual Households

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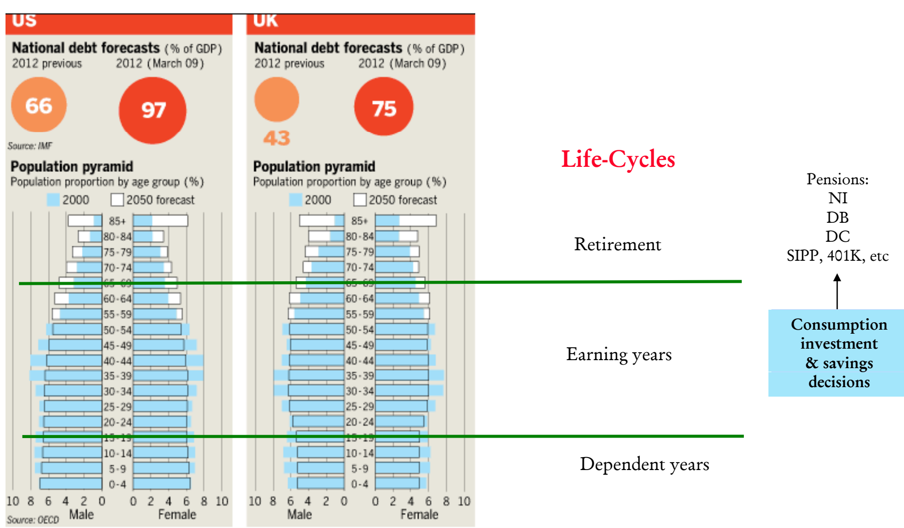
"Because we humanoid primates had to struggle with personal finance, we became human"

Joseph Schumpeter

Outline

- **Personal finance and individual financial planning**
- **Asset liability management for *individual* households**
- **Dynamic stochastic model and its implementation**
- **iALM : Decision support tool for financial planning**
- **US *i*ALM performance testing**
- **UK iALM example household plans**

Problems of Aging and Financial Planning



Pensions and Risks

State pensions	Governments	Reduced state social security guarantees due to high national debts
DB	Corporate	Loss in value of institutional pension funds due to current crash in asset prices and low interest rates
DC	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 Reduced willingness of corporates/governments to accept funding risk of pensions and the move to 3rd pillar pension plans
SIPP, 401K, individual savings, etc	Individual	Managed funds – no systematic data on their performance and risks

Should individuals rely on social security or take control of their future through individual financial planning?

Financial Planning for Individual Households

- Financial planners have traditionally resisted the academic solutions based on theoretical models
  - Asset allocation puzzle of Canner *et al* [J. Campbell, 2002]
- Common practice is based on the qualitative assessment of risk attitude by financial advisers
  - Rule of thumb: equity fraction of one's portfolio equals 100 – one's age
  - "The myth of risk attitudes" Daniel Kahneman [JPM, Fall 2009]

Kahneman's Summary

- **Classical utility theory**
  - Risk aversion is measured by the curvature of the utility function for wealth
  - Common practice is to find a portfolio that fits a single number: the investor's attitude to risk
- **Prospect theory, psychology and behavioral economics**
  - People are not consistently risk adverse and more sensitive to losses than to gains
  - People are risk seeking in their attraction to long shots and their willingness to gamble when faced with a near-certain loss, and hold separate mental accounts
- **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**
  - Utility theory and its behavioral alternatives are concerned with the moment of decision not with the moment of truth when consequences are experienced

" The theories (utility theory and its behavioral 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 the responsibilities of financial advisors should be to provide that help."

Daniel Kahneman

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Financial Planning

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

  Paul Samuelson
- Is reconciliation of theory and practice possible?
- In the search for 'good sense' we can apply a modelling methodology which comes from Operations Research – decision making in the face of uncertainty
- In financial planning the principal ideas should be brought together from behavioural and classical finance using stochastic optimization theory

Framing the Financial Planning Problem?

"We do not prosper by income or happiness alone"
Samuel Brittan

"Is wealth the long-term spending that our portfolio can sustain ? This definition is close to the truth, but it ignores purchasing power. Is wealth, then, the inflation-indexed real income that our assets could sustain over time? For most investors, this is probably the most useful definition of wealth."
Robert Arnott

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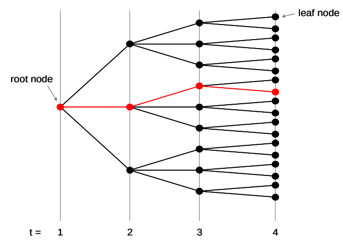
Asset Liability Management for *individual investors*: *i*ALM

- The ***i*ALM system is a decision support tool** based on the **theory of stochastic optimization**
- ***i*ALM generates life-cycle recommendations** for managing wealth and other selected (by user) critical decisions along his/her life span such as level of saving or spending at retirement, borrowing, sending children to private schools, buying real estate, and so on
- It allows **interactive re-solving** to obtain long-term financial plans with modified data inputs in order to compare the consequences of the changes in individual preference
- Principal ideas are brought together from **behavioural and classical finance** and **decision theory**

*i*ALM Implementation

- **Dynamic multi-stage optimization problem with stochastic data:** simulated cashflows (inflows and outflows) of incomes, liabilities, investment returns, etc
- What-if scenario analysis
- **Implementable decisions** correspond to the root node of the scenario tree
- **Periodic recalibration** of the model parameters to market and personal data – ability to modify inputs periodically or at times of significant changes in life
- Uses *STOCHASTICS*™ with special attention to graphics and computational speed for interactive use

Stochastic Programming Techniques for *i*ALM



I. Simulation

Generation of **stochastic data** with a discrete number of annual observations of a continuous time vector data process branching at specified times (decision times) in the future

Scenario tree is a schema for forward simulation – along each branch a multiple number of stochastic processes are simulated. Some are independent, other may be correlated.

Simulation **discrete time steps** correspond to the data sampling frequency of the process of interest

***i*ALM involves simulation of asset returns and liabilities punctuated by life events**

II. Optimization

Discrete time and state optimization giving a **different optimization problem** (given by its objective and constraints) **at each node of the scenario tree** dependent on both its predecessors and successors

Major decision time points are stages of the tree

Implementable decisions are at the **root node** which are the most constrained decisions **robust against all alternative scenarios** generated while the **remainder** allow **what-if prospective** analysis

***i*ALM solves a large scale linear optimization problem**

- **Consumption (goal) maximization at each decision time subject to constraints such as risk, budget, cash flow balance and so on annually**
- **Sustainable wealth maximization across all years and generated scenarios simultaneously**

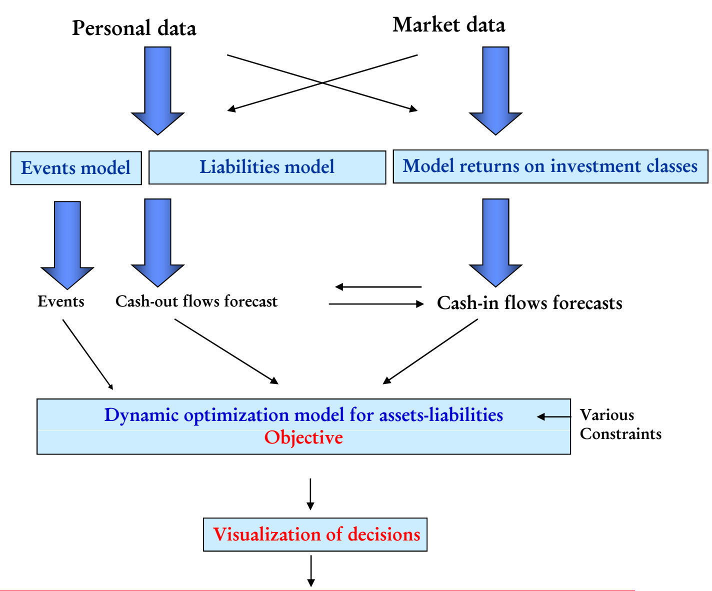
Overview of *individual* ALM

Gather Individual and Market Data

Econometric and Actuarial Modelling

Scenario Tree Simulation

Optimization Model:
Tailored Portfolios, Goals Spending, Cashflow balances, etc



Modelling Changing US Markets

Investment securities

- Domestic and International Equities
- Government Bonds
- Corporate Bonds
- Alternatives
- T-bills and all bond coupons
- Treasury Inflation Protected Securities (TIPS)
- Cash
- CPI
- Other fixed assets

Fundamental financial models

Multi-dimensional GBM process

$$d \ln X_{i,t} = \mu_i dt + \sigma_i dW_{i,t}$$

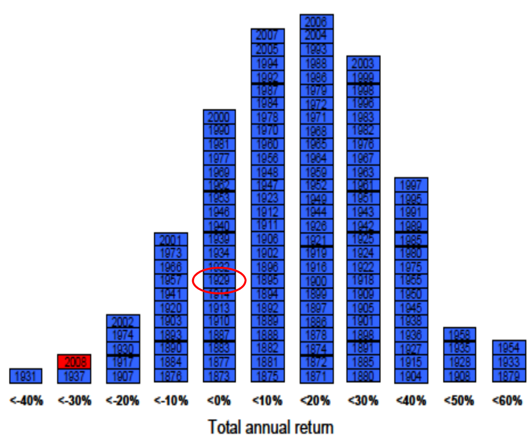
Geometric Ornstein Uhlenbeck (OU) process

$$d \ln r_t = (\alpha - \beta \ln r_t)dt + \sigma dW_t$$

OU process

$$dr_t = (\alpha - \beta r_t)dt + \sigma dW_t$$

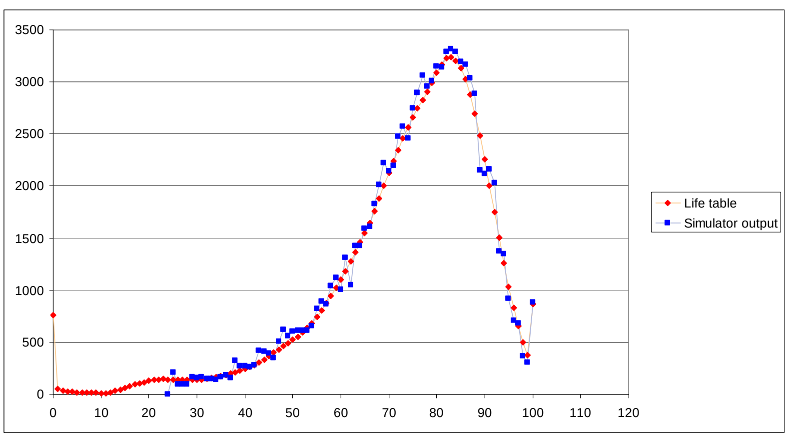
Annual Returns of the S&P 500 Index



Modelling Events

- Random events
  - *death* (D) with probability of dying at age t
    - Simulation of *length of life* scenarios
  - *long-term care* (LTC): a single event drawn from an historical frequency distribution in an interval beginning at age 65 and ending at the realization of the last of two independent deaths at **T**
  - *Terminal healthcare* is currently incurred for *exactly* two years prior to death by all persons with the out-of-pocket costs paid by the terminally ill of age 63 and older having a rate of increase above inflation
- Maximum horizon T equals 115 years minus the starting age of the youngest head of household

Length of Life



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Modelling Life Style

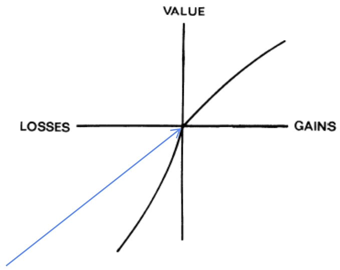
- Construction of a problem suitable for a general household from different age and wealth groups which must reflect individual circumstances
  - – Planning horizon for each problem depends on the age of individuals
  - – Major impacts of uncertain events: Long Term Care and Death
  - – Medical expenses depend on the state of health and insurance
- Forecasting of earned income
- Client's defined specific goals and spending on these within a range of desirable, acceptable and minimum levels

Framing of the Problem

- **Broad Framing:** overall objective is to provide **'sustainable spending'** over a household's lifetime in terms of desired multiple life goals specified by preferences on goal choice and their priorities
- **Narrow Framing:** maximization of goal consumption
  - – each single **goal utility function** is defined with respect to **reference points** chosen by household specifying its individual consumption preferences
  - – example of a goal with high preference – private education of a child

The Value Function

- Recall the value function of prospect theory

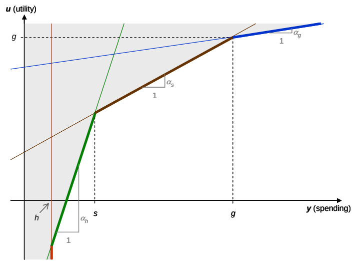


$v(x) = x^{\alpha}$ if $x > 0$
$v(x) = -\lambda(-x^{\alpha})$ if $x > 0$
(with a typical $\alpha = 0.88$ and $\lambda = 2.25$)

Reference point

Individual Goal Utility

- Individual goal utility function 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) subject to existing and foreseen liabilities, i.e. minimum (h) spending. These values specify the shape of the utility function for **each** goal
- Objective to maximize goal spending with piecewise linear utility functions for goal spending with priorities



Overall Objective

- The objective is to **maximize the expected present value** (over all scenarios) **of life time consumption,** i.e. spending on all selected goals

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

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

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

Key Modelling Features

- **Portfolio return and risk** are driven by desirable consumption subject to existing and future liabilities

- Risk management of portfolio by
  - Constraining the **portfolio drawdown in each scenario**
  - Constraining the proportion of assets in the portfolio

- Length of each individual scenario represents a possible duration of life, i.e. we solve a problem with a **random time horizon**

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Wealth Generation Through Optimum Resource Allocation

- *i*ALM objectives are achieved through **optimum resource allocation** over a network of cashflows
  - cash flows of liabilities
  - cash flows of different incomes and portfolio returns
  - income from portfolio returns provides optimal consumption

Portfolio Allocation Sub-problem

- Fundamental constraints of **portfolio allocation sub- problem**
  - Initial holding
  - **Portfolio cash flow**
  - Asset inventory balance
  - Investment limits, position limits
  - Portfolio drawdown
  - etc
- Optimal allocation between **different types of account**
  - taxable and savings portfolios such as 401K (USA) or SIPP and ISA (UK)

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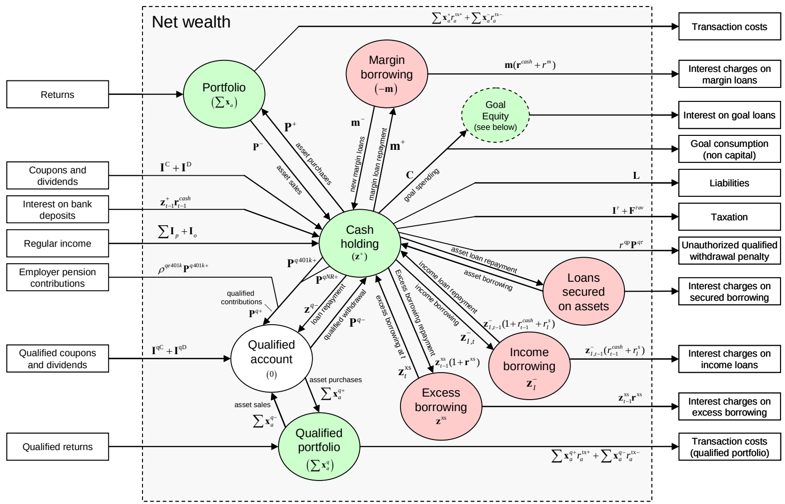
Cashflow Constraints



Challenges Overcome in the *i*ALM Solution

- Up to 90 annual decision periods using 4 major portfolio rebalancing (tree branching) points using novel information constraints on most decisions in between these points
- Automatic placement of major rebalancing points based on problem instance data
- Random scenario lengths due to deaths of household heads
- Occurrence of non-terminal random events such as entry and exit from long term care
- Indexing of future incomes and expenditures at appropriate rates relative to inflation
- Second order moment matching in market return scenario tree
- No solver tuning for first time solution of arbitrary client instances

*i*ALM Financial Plan

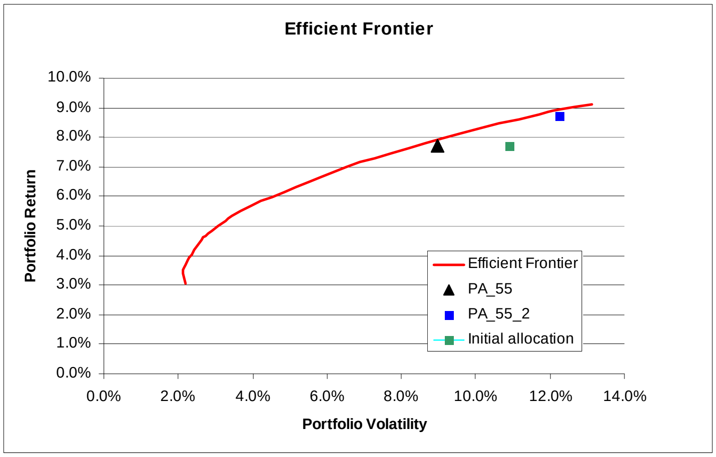
- *i*ALM provides optimum values for many decision variables – spending, amount of savings, tax-efficient allocation between multiple portfolios, etc – across time simultaneously for multiple scenarios of random processes representing market returns, foreseen liabilities and life events
- Current *i*ALM model includes 20 random processes that vary over the client's lifetime and around 200 mathematically formulated conditions (constraints) per node of the scenario tree
- Average desktop computer solving times are 1-10 minutes (Problem size over 3mln non-zero entries)

➢ **An interactive process for analysing retirement and saving alternatives**

Performance of *i*ALM

- Testing on real profiles of UK and US investors and comparison with recommendations of financial advisors
- Comparison with MVO based methodology
- Backtesting performance over 10 years: 1995-2005 for US model
- Behavioural aspects tested using ability to analyse relationship between current wealth, earnings, savings and desirable consumption

Comparison with MVO



Historical Backtest

1995-1999

Asset Return / Volatility

	Return	Volatility
muni	6.0%	2.8%
domeq	15.5%	17.5%
inteq	17.9%	18.6%
corp	7.8%	3.6%
long	9.7%	7.2%
tips	6.9%	3.2%
alt	10.5%	8.7%
Tbill	3.5%	0.5%

2000-2002

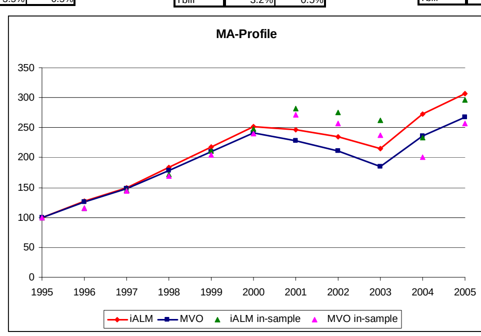
Asset Return / Volatility

	Return	Volatility
muni	4.9%	2.8%
domeq	13.5%	17.5%
inteq	15.4%	18.6%
corp	6.4%	3.6%
long	8.0%	7.2%
tips	5.9%	3.2%
alt	10.0%	8.7%
Tbill	3.2%	0.5%

2003-2004

Asset Return / Volatility

	Return	Volatility
muni	3.2%	2.8%
domeq	9.7%	17.5%
inteq	10.1%	18.6%
corp	4.1%	3.6%
long	5.2%	7.2%
tips	4.7%	3.2%
alt	7.8%	8.7%
Tbill	1.9%	0.5%



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Technical Summary

- Average desktop computer solving times are **1-10 minutes**
  - **Pimlott profile: 102sec** (Dell i5)
- *i*ALM provides **optimum values for multiple decision variables**
  - Recommended allocation for current year is robust with respect to the most unfavourable scenarios
- Probabilities of goals and shape of the corresponding distributions are a good **indication of uncertainty** inherited in the plan
- Many **other aspects of financial plans** are available, e.g. cash flow statements, graphs of individual cash flows for liabilities, goal spending, taxes, borrowing through life, and so on

UK Household Data

- FT weekly 'Money' supplement 2005-2007
- Family member describes the household's financial position and goals and asks expert financial advisers for recommendations on investment, savings and appropriate spending
- Quantity and quality of data provided by household may vary significantly
- Adviser's opinions may differ significantly
- Example – Pimlott household profile

FINANCIAL TIMES JULY 1/JULY 2 2006 ★ MONEY

Gnawing doubts on use of cash pile

A management consultant couple may be risk-averse but experts say they could make their substantial assets work much harder for them

JOSEPHINE CUMBO
MONEY MAKEOVER

Carolyn and Jim Pimlott are self-employed management consultants who want to make their substantial cash assets work harder.

The couple, who have two children aged 11 and 10, have assets of more than £880,000, including the £550,000 family home, which they own outright, and about £250,000 held in cash or near-cash savings such as Premium Bonds.

Jim, 43, who earns £85,000 a year gross, says the cash pile built up because money set aside for private school fees and a new, bigger home was not needed. "The issue with us is that we are very good at earning money, and saving it, but not at making the most of it," he says. "We now have a cash pot which could be doing better than chugging along in a high interest account."

Financial freedom and security is another key objective for the couple, who have no debts and say they live in the "slow lane". But being "inherently cautious", they don't want to take many risks with their money.

While the couple are focused on their cash pot, the advisers say they need to think about the short-term threats to their financial security.

Jim and Carolyn, 45, who earns £30,000 a year, have individual life cover of £50,000 each but this was seen as "wholly inadequate" by one adviser. "You should consider putting in place substantial additional cover on each of you to ensure that the survivor of you and the children would be able to maintain their desired lifestyle," says Nigel Bourke of Bourke & Co. He suggests the couple also consider critical illness and/or income protection policies.

Another weak spot in their planning, which needs urgent attention, is their wills, which were drafted 10 years ago without professional advice. "It is very important these are appropriately drafted, particularly now that you have significant net assets and Jim is anticipating a sizeable inheritance [from his parents]," says Stuart Davies of Deloitte.

He says the couple may wish to wait until proposed changes to laws governing inheritance tax and trusts are enacted before revising their wills. He says they should bear in mind that setting up a nil rate band trust in their wills may help reduce their IHT liability, likely to be about £214,000, based on the current nil rate band of £285,000. "The use of a nil rate band trust in your wills could reduce this to less than £100,000," he says.

Turning to the £140,000 the couple have identified as available for investment, Davies says the couple "seem to be prepared to accept more investment risk than they are currently taking". He suggests collective investment products, such as unit trusts, as these give exposure to diverse assets that provide the opportunity for growth but reduce risk. "Broad ranging funds with exposure across a range of assets will be a sensible starting point," he says. "It is important to develop an investment strategy that meets your risk tolerance and is cost effective."

Bourke suggests a portfolio of low-cost index-tracking funds for global equity exposure, fixed interest securities and commercial property funds "may prove appropriate" for the couple, who want to achieve good dividends and growth.

Tom Hyslop and Andy Bain of The Acumen Group say that having a plump emergency fund – of at least six months' expenditure – could ease the couple's fears of stepping outside the security of a bank account.

"By setting an appropriate amount aside for emergencies, you will find the volatility of the investment world will cease to be as scary – as you will be able to control the timing of access to your funds," they say.

The couple was advised to make their affairs more tax efficient.

"The majority of any cash held on deposit should be in Carolyn's name to take advantage of her status as a basic rate taxpayer and avoid tax at the higher rate which would be charged on any taxable interest received in Jim's name," says Bourke.

The couple was also advised to consider setting up their business as a limited liability company, rather than the present partnership structure. "There are tax benefits available to you on incorporating to a limited company," say Hyslop and Bain. "These benefits will assist you both in controlling and minimising your combined tax leakage."

While the couple did not identify retirement planning as a key issue, they were urged to review their pension funding to see if they could make use of spare capital.

"Since you have substantial funds on deposit, which are not earmarked for short-term expenditure, funding your pension arrangements to the maximum would be an ideal way of using some of the surplus capital held on deposit to reclaim some of the income tax you would otherwise lose," says Bourke.

Names have been changed to protect privacy

www.ft.com/moneymakeover

FINANCIAL GOALS

- To achieve financial security and freedom
- Make our money work harder
- To get the best from our business arrangements

FINANCIAL OVERVIEW

Carolyn and Jim Pimlott are married and live in southern England with their two children aged 11 and 10. They are both management consultants and UK resident and domiciled.

Income
Carolyn – £30,000
Jim – £85,000
Interest/share dividends – £10,000
Total – £125,000 (pre tax)

Monthly expenditure
Credit cards – £2,000
Children's tuition – £300
Utilities – £90
Dispensables – £600
Total – £2,990

Insurance
Carolyn life assurance
Jim death benefits policy

Pensions
Carolyn's with-profits – £65 per month
Jim previous employer – £20,000 (current value)
Jim personal pension – £15,000 (current value)

Property, savings and investments
Family home – £550,000
Carolyn's cash acount – £36,000
Joint account – £5,000
HSBC – £110,000
Premium bonds – £56,000
Isas – £35,000
Children's accounts – £60,000
National savings – £5,000
Equities – £25,000
Total – £882,000

Debts
Nil

What should Carolyn and Jim do to achieve their objectives?

Tom Hyslop and Andy Bain, the Acumen Group
- Set up business as a limited liability company
- Re-assess protection cover to check if adequate
- Set aside at least six months' expenditure for "emergency fund"

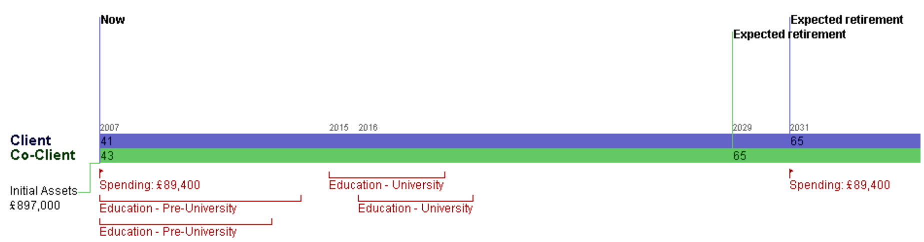
Stuart Davies, wealth director, Deloitte
- Rewrite wills as a priority
- Review current level of pension funding
- Consider income protection or critical illness policy

Nigel Bourke, certified financial planner, Nigel Bourke & Co
- Equalise earnings to allow Carolyn to benefit from higher rate relief on pension contributions
- Favour tax-free wrappers for savings/investments
- Establish nil rate band trusts on wills

GET A MAKEOVER

If you would like independent advice worth thousands of pounds, send us brief details of your financial position. If we choose you, you will be featured in the FT and receive full financial reports from up to three separate financial advisers. Send an e-mail to makeovers@ft.com

Model Illustration: Pimlott Household



iALM *Individual* Asset Liability Management

Cambridge Sy
Associates Li

Personal Data | Starting Assets | Position Limits | Consumption | Cash Inflows | Cash Outflows | Assumptions

Profile
Name:
CopyOfPimlott_07_unconst
ID: 539 *(SC)*

Close Profile
Solve
Launch help window

Reality Check
Inflation rate (%): 3.0
Savings return (%): 3.3
Run Reality Check

Cash Outflows

Print | Save

Goals

▸ From Consumption Worksheet

▾ Household Consumption

	Priority	Name	Minimum	Acceptable	Desirable	GrowthRate
☐	10	Pre-Retirement	13,800	84,400	89,400	CPI: cpi-all Adjustment%: 0.0
☐	10	Post-Retirement	13,800	66,800	76,900	CPI: cpi-all Adjustment%: 0.0

▾ Education

Add | Delete Selected

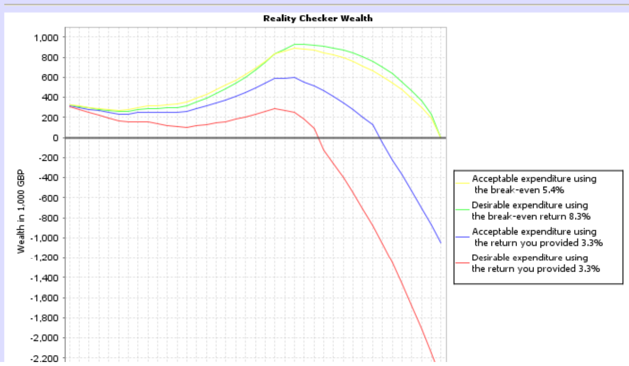
	Priority	Beneficiary	StartDate	Years	Minimum	Acceptable	Desirable	Type
☐	5	John	2007-01-01	7	8,800	10,400	12,600	School
☐	5	Jess	2007-01-01	6	8,800	10,400	12,600	School
☐	5	John	2016-01-01	4	6,000	7,200	8,800	Uni
☐	5	Jess	2015-01-01	4	6,000	7,200	8,800	Uni

Reality Check Result 539 - Windows Internet Explorer

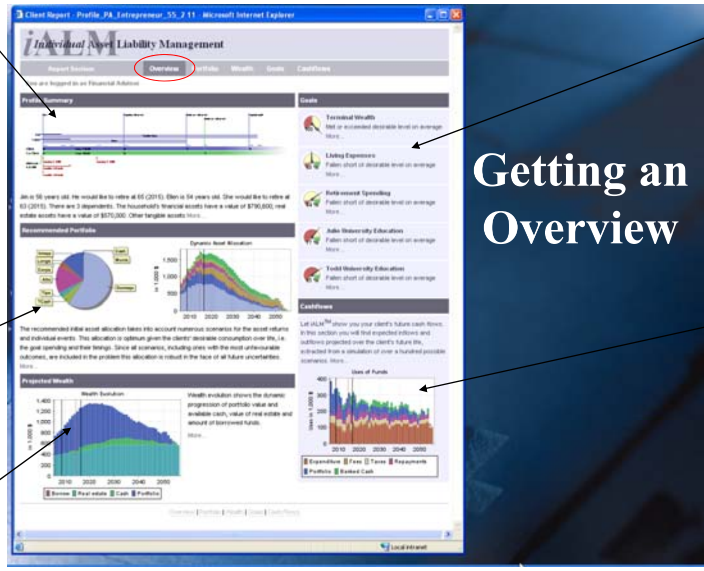
Profile ID = [539]

Reality Check details:

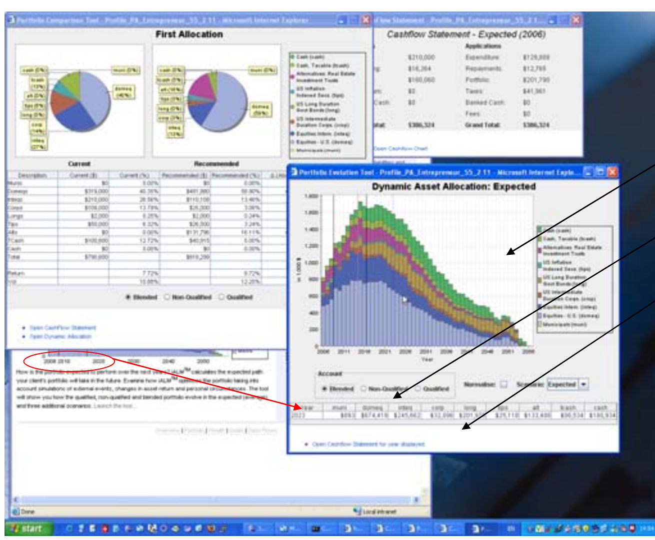
Inflation rate = 3.0%
Terminal wealth based upon savings return of 3.3% = -GBP 2,396,900 (with Desirable expenditure)
Terminal wealth based upon savings return of 3.3% = -GBP 1,047,077 (with Acceptable expenditure)
Required portfolio return to remain solvent throughout life = 8.3% (with Desirable expenditure)
Required portfolio return to remain solvent throughout life = 5.4% (with Acceptable expenditure)
Difficult



Getting an Overview

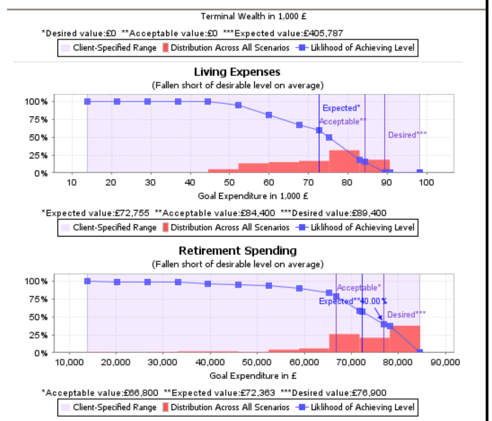


Getting Related Graphs



2007

2009



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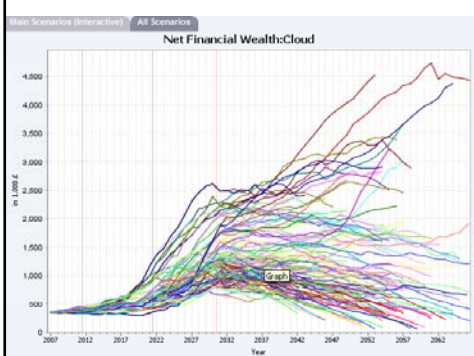
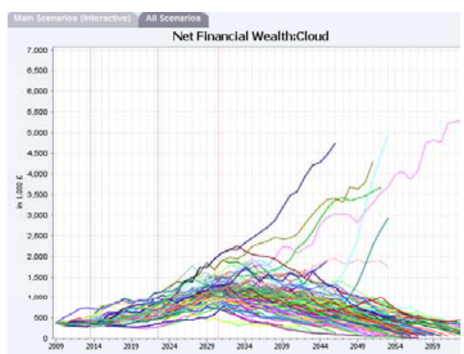
2007

2009





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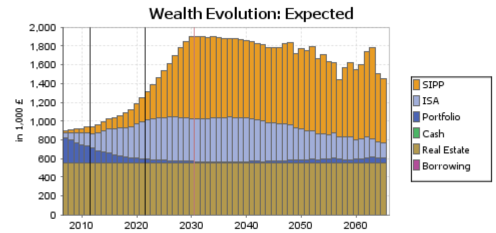
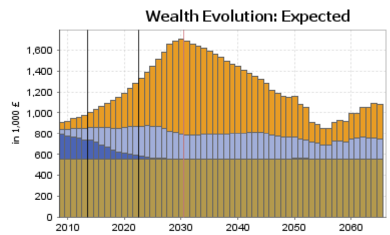
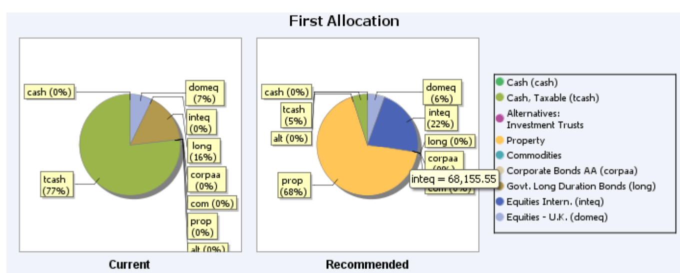
2007



2009



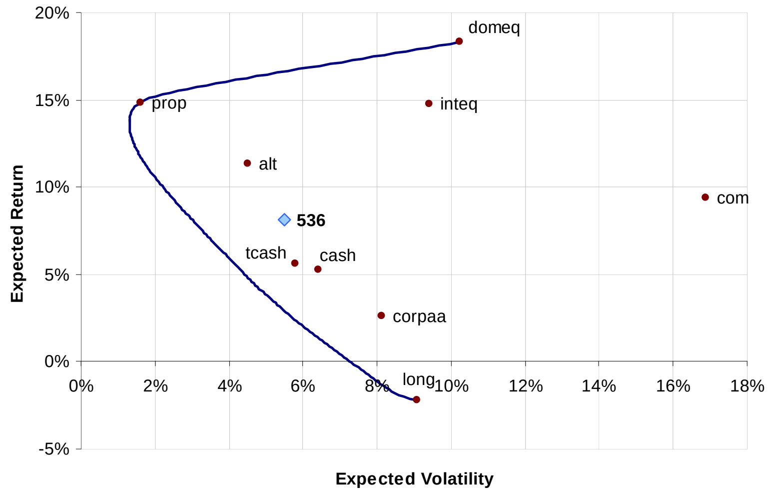
2007



Description	Current (£)	Current (%)	Recommended (£)	Recommended (%)	Δ (Absolute)	Δ (Fractional)
Domeqs	£25,000	7.20%	£17,142	5.52%	-£7,858	-1.68%
Inteqs	£0	0.00%	£68,156	21.95%	+£68,156	+21.95%
Longs	£56,000	16.14%	£0	0.00%	-£56,000	-16.14%
Corps(AA)	£0	0.00%	£0	0.00%	+/-£0	+/-0.00%
Commod.	£0	0.00%	£0	0.00%	+/-£0	+/-0.00%
Property	£0	0.00%	£209,644	67.53%	+£209,644	+67.53%
Alts	£0	0.00%	£0	0.00%	+/-£0	+/-0.00%
TCash	£266,000	76.66%	£15,523	5.00%	-£250,477	-71.66%
Cash	£0	0.00%	£0	0.00%	+/-£0	+/-0.00%
Total	£347,000		£310,466		-£36,534	
Return		5.27%		8.15%		+2.87%
Vol		1.33%		5.51%		+4.17%

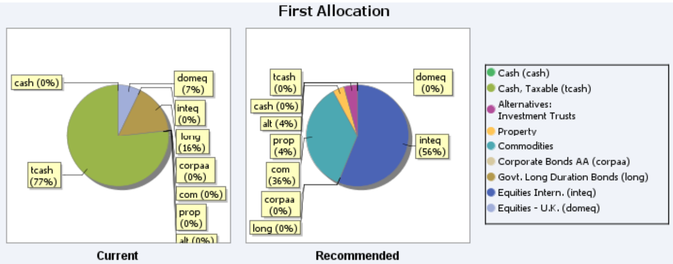
Blended   Non-Qualified   ISA   SIPP

Efficient Frontier 2007



2009

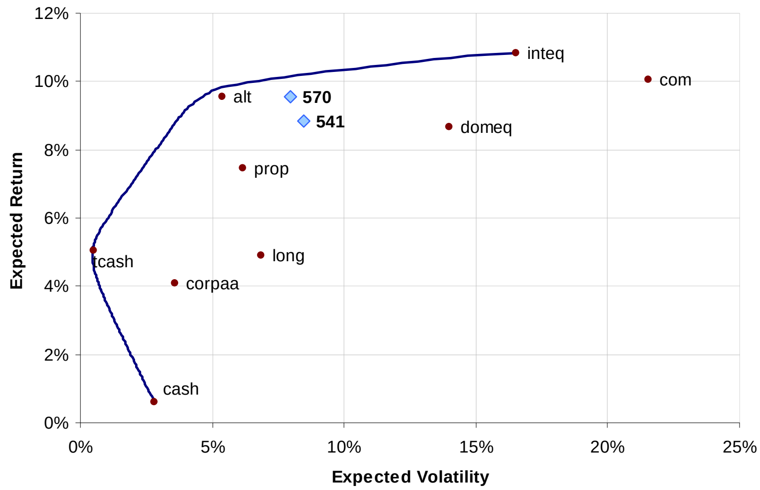
First Allocation



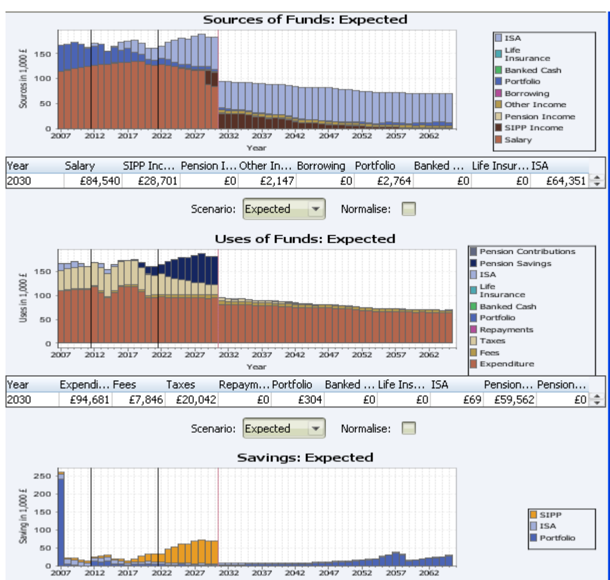
Description	Current (£)	Current (%)	Recommended (£)	Recommended (%)	Δ (Absolute)	Δ (Fractional)
Domeqs	£25,000	7.20%	£0	0.00%	-£25,000	-7.20%
Inteqs	£0	0.00%	£192,979	56.21%	+£192,979	+56.21%
Longs	£56,000	16.14%	£0	0.00%	-£56,000	-16.14%
Corps(AA)	£0	0.00%	£0	0.00%	+/-£0	+/-0.00%
Commod.	£0	0.00%	£123,146	35.87%	+£123,146	+35.87%
Property	£0	0.00%	£12,779	3.72%	+£12,779	+3.72%
Alts	£0	0.00%	£14,392	4.19%	+£14,392	+4.19%
TCash	£266,000	76.66%	£0	0.00%	-£266,000	-76.66%
Cash	£0	0.00%	£0	0.00%	+/-£0	+/-0.00%
Total	£347,000		£343,296		-£3,704	
Return		5.27%		10.38%		+5.11%
Vol		1.33%		12.18%		+10.84%

Blended   Non-Qualified   ISA   SIPP

Efficient Frontier 2009



2007



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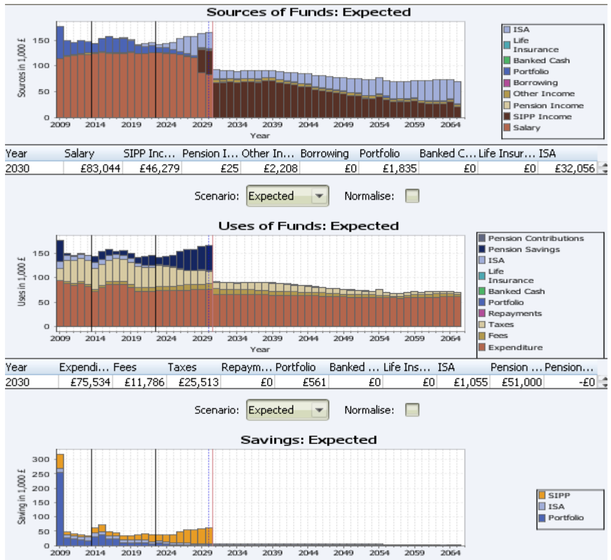
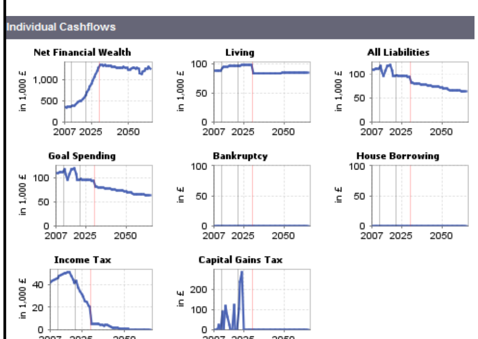
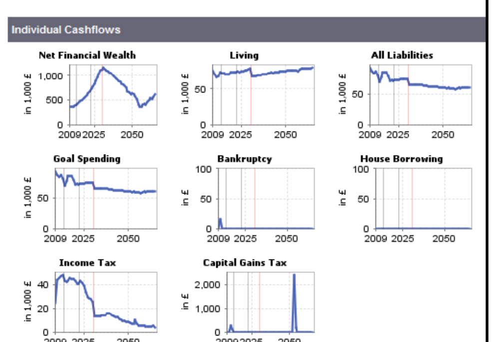
2009



2007	2009





Linking Strategic and Tactical Decisions

- **Strategic** allocation in market indices of *i*ALM takes long term view of individual circumstances
  - Implements dynamic allocation
- **Tactical** allocation exploits financial advisors' knowledge at the level of individual fund characteristics
  - adding alpha without increasing beta
- **Both levels** must consider legal and institutional framework
  - Taxation
  - Pension regulations

Helping households become involved in managing their investments

Strategic (*i*ALM)

- Constructs the optimum consumption and investment policy for life-long investment
- Defines risk attitude by life-style goals
- Helps clients identify affordable goals and manage their liabilities
- Allows investigation of the benefits of insurance products relative to identified risks
- Generates client profiles useful for new product design

Tactical (MVO)

- Chooses efficient frontier point consistent with risk and returns of strategic portfolio recommendation
- Selects quality instruments in the market by strategic asset class
- Allows benchmarking of client portfolio performance versus indices
- Allows optimization of post tax return by separating instrument portfolio into taxable and non-taxable components consistent with strategic asset classes

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Benefits Offered by *i*ALM

- **Comprehensive, long-term solution to wealth management tailored to individual needs**
  - Free format of specification of life goals and their values
  - Construction of the utility function based on distinct client needs
  - Hedging against longevity risks by solving random horizon optimization problem
  - Combination of life insurance with retirement saving plan
  - Consideration of different options for borrowing
  - Optimum use of tax-shielded accounts
- **Interactive process** for analysing investment and savings alternatives for long term financial planning
- **New paradigm in wealth management**

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