Utility functions for financial calculators

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12 February 2015

Introduction

People need ***help to plan for retirement***. Some of the help must come in the form of a ***calculator*** to decide how much to ***save*** and to spend, and where to ***invest***. These are the decisions that people can ***control*** (in the cab).

Current advice and calculators are embarrassingly primitive and much ***panders to ignorance and instinct*** (some fortunately is not wrong!)

Users do not need to know the details of the workings of the calculators, but those who design them need to use ***plausible and coherent utility functions*** that represent the users' preferences. The utility functions can be as complex as necessary (because they belong under the hood).

Users ultimately have to express preferences between alternative stochastic distributions of ***random vectors*** of consumption, leisure and bequests. This is not easy but can perhaps be elicited through offering them ***graphic representations***.

Rationale: saving for retirement

Two critical social changes lead to the need for retirement funding:

- Smaller and nuclear families from urbanization and greater wealth (all cultures)
- Greater longevity, much in poor health

Political and economic ideology has privatised provision and has led to DC funds - investment and longevity risks are born by the middle classes.

It is possible that DB might make a return – once new patterns of longevity and retirement are established. Until then people need a calculator to help navigate the risks.

This paper forms part of a project aimed at designing such a calculator. Related work is Butt and Khemka (2014), showing the costs of focussing on the lump sum available at retirement, and Kayande et al (2009), on hopeople can be motivated to use “decision support systems”.

The controls and the assumptions

Controls (In the cab)

How much to earn, allowing for decline in hours with age and retirement.

How much to consume and save each year, depending on household structure – children and divorce.

How to invest over time – including liquidity and annuitization choices.

Assumptions (Under the hood)

Demographic assumptions as to longevity and perhaps divorce.

Economic assumptions as to wage levels and investment returns

Regulations and tax.

Current advice is primitive

Many are **financially illiterate** and take no interest in retirement savings. Advice can be **inconsistent, biased and counter-productive** (Gokhale and Kotlikoff; Inderst and Ottaviani; Hackethal et al). Merton (2014) suggests that we face a crisis in “financial well-being”.

- Inappropriate inflation and investment assumptions – equity risk premium too high; no momentum and mean reversion.
- No allowance for consistency between current and future consumption – by using arbitrary targets or “needs”.
- Misleading risk appetite assessments using short term portfolio volatility and life expectancy.
- Incoherent ruin probabilities (VaR), which can encourage risk taking by ignoring the size of some downside losses.

Identifying and addressing ignorance and instinct

“Bounded rationality, bounded willpower”

The difficulties with traditional logic can be explained by two systems :

- *System 1* is instinctive, responds rapidly, is low effort, often quick to make emotional judgments and works off rules of thumb
- *System 2* is slower, reasoned and requires higher effort to engage, although not always right.

The difficulty of engaging system 2 means that we all have a tendency to make snap judgements that we can regret, because we did not take the time and effort to engage our deeper thinking processes.

But the lessons of modern psychology (Mischel, 2014) and the ancient world religions tell us we can – with some effort – decide differently.

“So then with the mind I myself serve the law of God; but with the flesh I serve the law of sin.” (Romans 7:25 King James Version)

Explaining apparent irrationality

System 1 heuristics explain some apparent irrationality:

- Hyperbolic discounting, with high short term rates of discount for small amounts of money.
- Discount rates are lower when people consider probabilities (too complex for system 1). Similarly, when time preferences are framed as choosing lifetime patterns of consumption, people prefer level ones.
- People choose prior commitments (such as forced savings and “bucket” allocations) to take decisions away from system 1.

Other apparent irrationality can be explained by frictional costs:

- The Prospect Theory “kink” in the utility function can be explained by consequential financial losses (eg cannot use the car and so sell it).
- Information costs of making equity investments mean greater risk aversion.
- If my consumption falls below those of my reference group, I cannot participate as much in their activities.

(See Frederick et al (2002) and Clark et al (2000) for explorations of some of these biases but without these explanations.)

The standard utility function

$$U_0 = \sum_1^T \beta^{t-1} \left(\prod_{j=0}^{t-2} p_t\right)\{p_{t-1} \frac{1}{1-\gamma}\left(\frac{C_t}{\emptyset_t} l^{\alpha}\right)^{1-\gamma} + b(1-p_{t-1})\frac{1}{1-\gamma}(D_t)^{1-\gamma}\}$$

Where β represents the net time preference rate;

C_t consumption in period t;

φ_t represents an allowance for the family state (which in Hubener et al (2013) is contingently modelled using empirical transition rates for divorce and widowhood;

l^{α} represents the utility of the hours of leisure;

p_t the probability of survival in the year t to t+1;

γ>0 is the coefficient of risk aversion;

b the intensity of the bequest motive, and

D_t the bequest.

Random vectors

One can attempt to elicit utility preferences by asking questions about each of the elements of the formula separately. (Rob Thomson and his collaborators) This does not however check the formula as a whole.

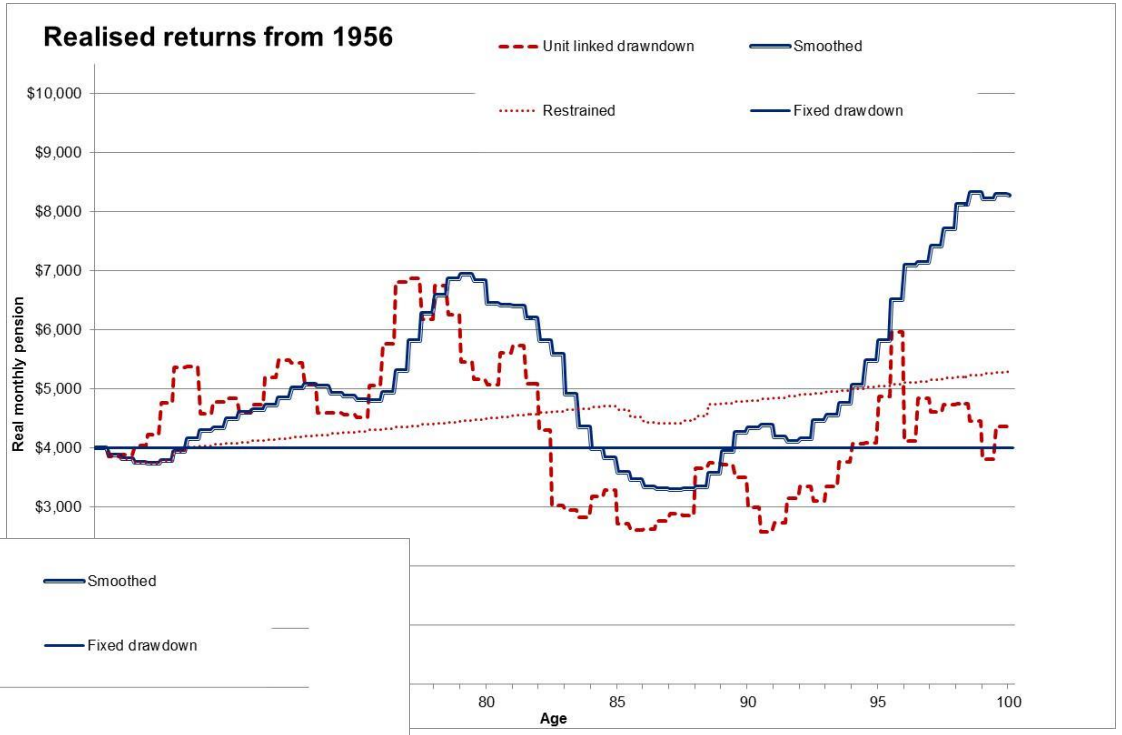
Alternatively one can attempt to determine values from the preferences revealed by average behaviour (Hubener et al). But if individuals are behaving inconsistently, the average may also be inconsistent.

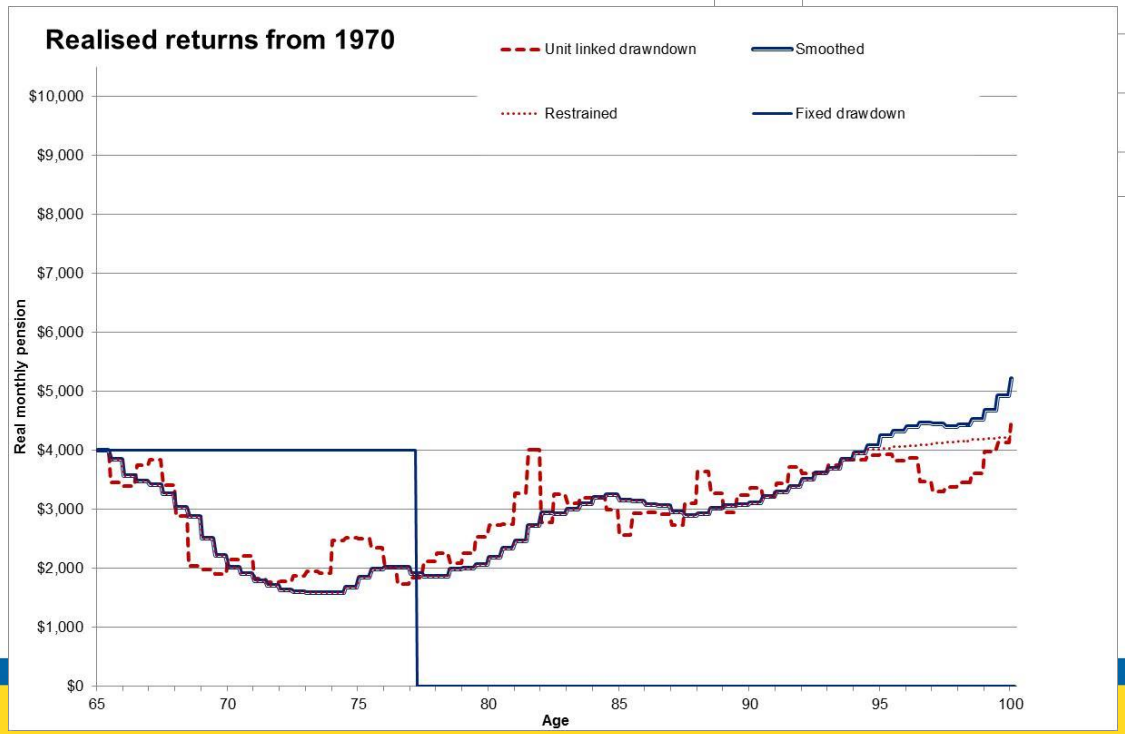
One can generate consumption paths over the remaining lifetime under alternative consumption and investment choices, and using different investment scenarios. People can then choose directly.

There are however an infinite array of possible paths, so those presented should be plausible and coherent.

The paths overleaf provide two possible paths in retirement, and offer a choice between a standard annuity ($3,000 per month) a variable allocated annuity (no life cover) with a fixed drawdown of $4,000) and two variable life annuities – with and without some smoothing.

Eliciting preferences





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Plausible values?

$$U_0 = \sum_1^T \beta^{t-1} \left(\prod_{j=0}^{t-2} p_t\right)\{p_{t-1} \frac{1}{1-\gamma}\left(\frac{C_t}{\emptyset_t} l^{\alpha}\right)^{1-\gamma} + b(1-p_{t-1})\frac{1}{1-\gamma}(D_t)^{1-\gamma}\}$$

β – should perhaps be contingent on actual earnings because of reference group, and perhaps be set to an expected value of 1 to represent level consumption throughout life.

Φ_t perhaps needs emphasis because of its size and that it can be partly controlled.

l^{α} could include a constraint related to age and health in order to generate a retirement date, or could be an input variable.

p_t could also be set to 1 as any coherent plan that has zero utility for the state of death would use a life annuity, and there would otherwise be double counting.

γ>0 can perhaps be replaced by a penalty whenever consumption drops

b and D_t can be removed, and an amount set aside separately for precautionary and bequest purposes.