Age-dependent or target-driven investing?

New research identifies the best funding and investment strategies in defined contribution pension plans for rational 'econs' and for 'human' investors

When designing defined contribution (DC) pension plans, financial economists usually assume the plan member is a rational life cycle financial planner, an 'econ' to use the terminology of Richard Thaler and Cass Sunstein in their book *Nudge: Improving Decisions about Health, Wealth, and Happiness*. To this end they choose the investment strategy which maximises the expected utility of the pension fund value at retirement. However, growing evidence suggests real world investors (called 'humans' in *Nudge*) do not behave in accordance with expected utility theory.

Two major new studies by the Pensions Institute at Cass Business School, part of City University London, investigate the optimal investment strategies in DC pension plans, first for 'econs', and then for 'human' investors. The research was led by Professor David Blake, Director of the Institute, alongside Dr Douglas Wright, Senior Lecturer at Cass.

When age-dependent investing is best

The first study, which works to the assumption that the plan members are 'econs', found that an age-dependent investment strategy 'stochastic lifestyling' – which takes into account an individual's human capital as well as their financial wealth – is a better investment strategy in DC pension plans than the more conventional 'deterministic lifestyling' (with its mechanical switch from equities to bonds over a pre-set period prior to retirement).

Despite plan members' well-known aversion to annuities, the study also identifies 'phased annuitisation' as a critically important component of a well-designed plan.

The research identified three factors which people should take into account when designing their DC pension plans. These are: their human capital as represented by their salary profile over their career (in particular, the age at which they reach their peak salary), their attitude to risk, and their preference for current versus future consumption (measured by their personal discount rate).

This has implications for the popular model of single 'one size fits all' default investment strategies which do not have the flexibility to accommodate these personal factors.

Professor David Blake comments: "this study highlights the inherent problems with default funds. When it comes to the optimal investment strategy for a DC pension plan, three factors – salary profile, attitude to risk and personal discount rate – need to be taken into consideration. These factors vary too much from person to person for one default fund to fit all circumstances. But we don't need hundreds of different funds either – people shouldn't be overwhelmed by choice – a very small number of well-defined choices will suffice."

The research has important implications for the optimal design of DC pension plans:

- There is a role for age-related contribution rates. Greater contribution rate flexibility would allow for the preferences of individual members to be more precisely recognised
- An annuity is a critically important component of a well-designed pension plan. As a result of the mortality premium inherent in the return on a life annuity, the full amount of the pension fund should eventually be annuitised in old age (assuming no bequest motive). This is true despite the well-known aversion to annuitisation of plan members who tend to underplay the longevity protection annuities provide and overemphasise the typically very low probability of dying soon after retirement and thereby 'losing' control of their pension fund
- It is important to get reliable measures of a member's risk aversion and personal discount factor. This can be achieved using appropriately designed questionnaires
- It is very important to incorporate the career salary profile in the plan design
- An investment strategy involving a switch from equities to bonds as members approach retirement, whilst appropriate, will be dependent on past investment and salary growth experience, unlike traditional lifestyle investment strategies
- The optimal equity weight in the portfolio immediately prior to retirement is not reduced to zero – rather it depends on the risk attitude and personal discount rate of the plan member.

So what does the optimal DC pension funding and investment strategy look like? According to the research:
- Rather than remaining constant over time, it involves an age-dependent annual contribution rate. To maximise their standard of living over their life cycle, individuals should wait until they are several years into their career before starting to contribute to a pension plan. Workers are better off consuming their initial low incomes, rather than saving them. As an individual's income grows a worker can save more comfortably for his or her retirement. For a male worker with a typical career salary profile, the optimal contribution rate increases steadily from zero before the age of 35 to around 30-35% after age of 55.
- The optimal investment strategy is also age-dependent. Pre-retirement, the optimal strategy is 'stochastic lifestyling'. It is optimal to begin with to invest 100% of the contributions into the pension fund in equities (or a diversified growth fund). As the retirement date approaches, the weight in equities is reduced and the pension fund is switched increasingly into bonds. So far, this looks similar to deterministic lifestyling. However, the switch away from equities is not predetermined, rather the optimal equity weighting depends on what has been happening to equity returns and labour income. Stochastic lifestyling is justified by recognising the importance of human capital (defined as the present value of lifetime labour income) and treating it as a bond-like asset (since it generates a fairly predictable labour income stream) which depreciates over the working life of the plan member. The initial high weighting in equities in the pension fund is intended to counterbalance the high initial weight of human capital in the combined 'portfolio' of human capital and financial wealth. A young person will typically be human capital rich and financial asset poor. As the share of the pension fund in the combined portfolio rises stochastically, the weighting in equities falls stochastically, while that in bonds rises to counterbalance to stochastic decay of human capital over time

- Depending on the member's risk aversion, there could still be significant equity holdings in the pension fund on the retirement date. For those with reasonable ranges of risk aversion, equity weighting at retirement varies between 20% and 50%
- At retirement, the optimal strategy is 'phased annuitisation'. On retirement, the bonds in the pension fund are sold to buy a life annuity, thereby securing lifelong income protection for the member as well as benefiting from the 'mortality premium' in the annuity return
- Each year that the member survives, the return from buying additional annuities increases (as a result of the mortality premium increasing exponentially with age) and some of the equities are sold to buy more annuities. There comes a point when the mortality premium exceeds the equity risk premium. At this point, when the member is around age 75, the entire residual pension fund is switched to annuities whatever the member's attitude to risk (assuming no bequest motive)
- For a member with lower risk aversion and a higher personal discount rate, the length of time over which the pension fund is fully invested in equities is increased and the length of the switchover period into bonds prior to retirement is reduced.

When target-driven investing is best

The second study, by contrast, assumes that 'human' investors have so-called behavioural biases that restrict them from investing in a fully rational way. It examines how they would optimally invest if they suffer from the most significant behavioural bias, namely loss aversion.

Professor Blake says: "Real world investors suffer from behavioural biases and are prone, among other things, to overconfidence in their investment abilities, regret and, especially, loss aversion. They also tend to monitor the performance of their portfolios (particularly their long-term portfolios) too frequently. As a result, they tend to become risk averse when winning and sell winning investments too quickly, and avoid cutting losses and even take extra risks when they have made losses."

The researchers recommend a new target-driven approach to deriving the dynamic optimal asset allocation, to counter this loss aversion. They identify the 'threshold' strategy as the optimal investment strategy under loss aversion. With this strategy, the weight in equities is increased if the accumulating fund is below a set interim target (since plan members are risk seeking in the domain of losses) and is decreased if the fund is above target (since plan members are risk averse in the domain of gains). When close to each target (whether above or below), the plan member has the lowest equity weighting (for that target) in order to minimise the risk of a significant loss relative to the target.

If, however, the fund is sufficiently above the target, there is a discrete change in the investment strategy and the equity weighting is increased (subject to the member's degree of risk aversion in the domain of gains), since the risk of the fund falling below the target is now considered to be acceptably low. This strategy of increasing the equity weight as the fund value continues to rise above the target is consistent with the investment strategy known as 'portfolio insurance'.

As the retirement date approaches and assuming the fund is on target, the overall equity weighting begins to fall and the value of the fund is 'banked' by switching to lower risk investments, such as bonds. The strategy is highly focused on achieving a target replacement ratio at retirement.

The switch to a more conservative asset allocation strategy is implemented at lower current fund values (relative to target) and at a lower age the higher is the member's loss aversion ratio. For example, if the loss aversion ratio is 4.5, then a loss of £1 makes the plan member feel 4.5 times worse off than a gain of £1 makes the member feel better off. Although the mean replacement ratio falls as a consequence, the expected shortfall from the target decreases.

The effect of higher risk aversion in the domain of gains leads, unsurprisingly, to an earlier switch out of equities and a lower mean replacement ratio, but also to a lower expected shortfall. The effect of greater risk seeking behaviour in the domain of losses leads to a later switch out of equities, a higher mean replacement ratio, a higher probability of achieving the target, but also a higher expected shortfall.

The greater the weight attached to the interim targets (relative to the final target), the less aggressive is the investment strategy adopted, although the overall impact is fairly marginal. In practice, the key factors influencing the relative significance of the interim targets are likely to be the frequency and quality of the fund performance information given to the members.

A discount rate is needed to find the value of the interim targets. Despite the controversy surrounding the choice of discount rate in valuing pension liabilities, the study found that the level of the discount rate appears to have very little impact on the optimal asset allocation in a loss aversion framework.

Compared with the 'econ', the 'human' loss-averse plan member is committed to achieving interim and final target fund levels and, accordingly, adopts a more conservative asset allocation strategy. Although this leads to a lower mean replacement ratio at retirement, there is a greater likelihood of achieving the desired target replacement ratio and a lower expected shortfall.

If the threshold strategy is successful in meeting the series of interim targets, the overall equity weight will tend to fall with age, since the fund is in line to meet the final target fund level at retirement. Although this is similar to what happens in conventional (deterministic) 'lifestyle' strategies, the target-driven strategy is very different. In particular, whilst conventional lifestyle strategies typically involve switching mechanically from 100% equities only in the last 5 to 10 years before retirement and often end up holding 100% of the fund in bond-type assets at retirement, the optimal strategy under loss aversion involves a much more gradual reduction in the equity holding if the fund remains close to the sequence of targets. If, however, the fund is either well below or well above a particular target, even one near to the retirement date, the optimal equity holding will be high. Compared with a traditional deterministic lifestyle investment approach, the optimal target-driven investment strategy significantly increases the likelihood of achieving the chosen target, thereby providing a much greater degree of certainty in retirement planning.

Professor David Blake comments: "The risks inherent in the traditional deterministic lifestyle strategy appear to be much higher than generally understood. Thus, for DC plan members who seek greater certainty in retirement planning, the investment strategy adopted over time needs to be far more focused on achieving the specified target replacement ratio. Setting the investment strategy in a defined contribution pension plan within the framework of loss aversion therefore has much to recommend it. However, the framework is not easy to implement since it requires the solution of a nonlinear dynamic programming problem whenever there is new information about key state variables (interim fund level and current labour income). Nevertheless, in practice, it should be possible to tabulate the optimal asset allocation in terms of member profile characteristics (such as age and occupation) and values of the key state variables. Financial advisers would then be able to advise on the appropriate investment strategy for the coming year."

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Notes to editors
'Age-Dependent Investing: Optimal Funding and Investment Strategies in Defined Contribution Pension Plans when Members are Rational Life Cycle Financial Planners' by David Blake, Douglas Wright and Yumeng Zhang (pensions-institute.org/workingpapers/wp1111.pdf).

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