From Deterministic to Stochastic Life-Cycle Investing

Towards New Forms of Target Date Funds

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Traditional retirement funds have traditionally used time-horizon allocations but research tend to prove more sophisticated models, including in particular state dependencies, could offer better performance.

Stricter accounting rules and an increased regulatory focus on risk management have led corporations to transfer some of the pension-related risks to individuals. As a consequence, the retirement system in most developed countries has experienced a substantial transformation in recent years, with a shift from defined benefits (DB) plans to defined contributions (DC) plans. According to a recent study by Watson Wyatt, DC assets now comprise 45% of global pension assets, compared with 30% in 1998, a trend that is likely to keep increasing[1].

As a result, employees must increasingly rely on their own saving and investment decisions to fund their retirement. This is a serious concern, not only because of the induced risk transfer, but also because individual investors typically lack the expertise needed to implement educated investment decisions, and often show a great deal of inertia. In response to this concern, the asset management industry has started to look into packaged investment mutual fund products providing investors with dedicated solutions to their long-term investment needs.

Target date funds to meet long-term investment needs

One key innovation in this area is the development of "life-cycle" or "target date" funds (TDF), which propose changing the stock exposure of the fund as a function of time remaining until target maturity date. Hence, the target mix evolves in time until a date called the target date or target maturity date of the fund, with a deterministic decrease of equity allocations. This is somewhat reminiscent of the rule of thumb put forward by R. Shiller (2005), advocating a percentage allocation to equity given by 100 minus investor's age in years. This approach has enjoyed a great deal of success over the past few years, with total TDF assets having been multiplied by more than 12-fold, to over $180bn, between 2002 and March 2008. The growth is accelerating, having drawn in $58bn in 2007 compared with $35bn in 2006. More striking perhaps is the fact that in the first three months of 2008, equity funds experienced outflows of more than $40bn while TDFs gathered nearly $15bn, according to a study by the firm Strategic Insight.[2]

Embedding the life-cycle allocation decisions within a one-stop decision is a valuable attempt at providing added-value to unsophisticated investors who otherwise will likely make sub-optimal decisions, and subsequently tend to stick to them. Still remains, however, the question whether existing life-cycle funds make sense in their current format, and some have wondered whether they could be rationalized within the context of modern portfolio theory (see for example Viceira (2007)). In fact there is an intuitive justification to the advocated decrease of equity allocation: the presence of mean reversion in equity returns would justify that equities are less risky for the long-term, and that the allocation to equities should decrease when approaching the horizon. Hence, the reduction in equity allocation would lead to reducing the impact of a fall in the stock market just before retirement.

Time-horizon allocations: not optimal for a long-term strategy

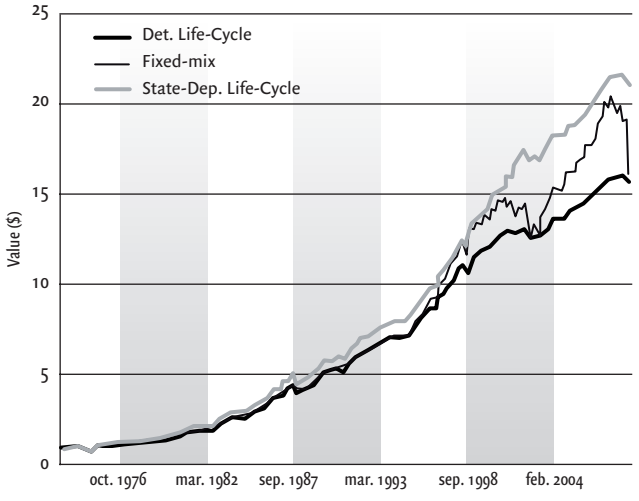
While such arguments seem to be making compelling intuitive sense, it hardly seems plausible, on the other hand, that an allocation strategy depending purely on time-horizon (time-dependence), regardless of what happens in the economy

1. See *www.watsonwyatt.com/retirementplandesign*.

2. See *www.sionline.com/research/newfunds.asp*.

Performance of the three long-term investment strategies

Over the period 1973-2008, starting with $1 on January 1973



(state-independence), should be truly optimal! To address these questions, the EDHEC Risk and Asset Management Research Center has recently launched a research chair, supported by UFG, fully dedicated to the analysis of life cycle investing. More specifically, the purpose of this research chair is to analyze the optimal dynamic asset allocation strategy that takes into account the stochastic features of the investor's investment objective as well as the stochastic features of the assets held in his portfolio. These questions can be naturally analyzed within the dynamic portfolio optimization framework of R. Merton's work (see Merton (1969, 1971)), who has opened a world of opportunities for more subtle dynamic asset allocation decisions, involving adjustments to the asset mix as time goes by.

> *"Given that individual investors will have to be increasingly responsible for investment decisions related to retirement risk, it is more than appropriate for the asset management industry to work towards the design of life-cycle funds."*

Following Kim and Omberg (2006), we propose to model a stochastic equity risk premium with a mean-reverting component. In the context of this model, we are able to show on the one hand that the optimal allocation involves not only a deterministic decrease of the allocation to equity as the investor gets closer to the time-horizon, which is consistent with standard target date fund practice. We also show, on the other hand, that the optimal strategy displays a state-dependent component, suggesting that the allocation to equity should be increased (respectively, decreased) when equity has become cheap (respectively, expensive), as measured through a proxy like dividend yield or price-earning ratios.

Our preliminary results suggest that omitting the state-dependent element in life-cycle investing, as done by available target date funds, leads to a severe efficiency cost (see Cairns, Blake and Dowd (2006) for similar findings). To gain more intuition behind these results, we have developed a simple illustration, based on the following 3 heuristic long-term investment strategies over the period ranging from January 1973 to December 2008: i) a fixed-mix allocation strategy with 50% stocks and 50% bonds; ii) a deterministic life cycle strategy that starts at 90% stock allocation, and decreases by 10% every three years; iii) stochastic life cycle, where we add a stylized state-dependent element addition to the deterministic scheme[3].

Overall, as can be seen in the figure showing the performance of the three strategies, the stochastic life-cycle strategy is similar to the deterministic life-cycle strategy in that the returns of both strategies become smoother

3. The state-dependent element is as follows: when the log dividend yield is above (respectively, below) one standard-deviation away from the historical mean, we add (respectively, subtract) 40% to the equity allocation given by the deterministic life-cycle allocation scheme. Stock returns are represented by the CRSP value-weighted stock index, and bond returns (based on a 20 year constant maturity bond) are also obtained from CRSP. Even more spectacular would be obtained by following the exact prescription of the Kim and Omberg (1006) model, but the underlying strategy would involve a significant amount of leverage in some occasions.

when getting closer to consumption/retirement horizon; however, the state-dependent version strongly dominates the deterministic standard approach by avoiding buying too high and selling too low.

A state-dependant allocation induces better performance

More generally, relaxing the assumption of a self-financed portfolio to account for the presence of contribution and liability streams only re-enforces the need to incorporate state dependencies. In this more general setting, the optimal asset allocation strategy involves a state-dependent allocation to three building-blocks, a performance-seeking portfolio, heavily invested in equities, but also in bonds and alternative classes such as real estate, an income-hedging portfolio, heavily invested in cash but also invested in equities, which exhibit appealing wage inflation hedging properties, especially over long-horizons, and a pension-hedging portfolio, heavily invested in bonds for interest rate hedging motives, and also in real estate for inflation hedging motives. In the early stages, the income hedging fund is the dominant low-risk component of the investment strategy, but as the retirement date approaches, there is a gradual, albeit non deterministic, switch from the income hedging building block into the pension hedging building block. Again, this switching only superficially resembles deterministic life cycle investing; instead of switching from high-risk assets to low-risk assets, as in the case of deterministic life cycle investing, the optimal stochastic lifestyle strategy involves a switch between different types of hedging demands; moreover this switch takes place in a stochastic state-dependent, as opposed to deterministic, manner, as a function of the current level of various variables of interests.

More financial innovation is needed to design better target date funds

Given that individual investors will have to be increasingly responsible for investment decisions related to retirement risk, it is more than appropriate for the asset management industry to work towards the design of life-cycle funds. We argue, however, that available products, based on a deterministic decrease in equity allocation, are too limited in scope. Financial innovation is needed to design better target date funds based on stochastic life cycle investing, taking into account the stochastic nature of the opportunity set, as well as risk factors impacting contributions and liability streams.

Implementing such optimal strategies in a delegated money management context is a serious challenge, which requires a finer classification of plan participants based on factors other than the age of the participant. The challenge is in fact to design a parsimonious partition of the investors/states-of-nature that will allow for different allocation strategies. Broadly speaking, there are two set of attributes that should be used to define the various categories of asset allocation decisions, namely the subjective attributes and the objectives attributes. The subjective attributes are related to each particular investor, and include, in addition to age, which is currently the sole determinant in current TDF products, risk aversion as well as funding status, defined as assets (financial assets, to which is added the present value of future contributions) in excess of required pension benefits. In both case (risk aversion and funding status), one can partition the universe in a limited number of categories such as high, median and low. The objective attributes, on the other hand, apply for all investors, and relate instead to market conditions, with a proposed asset allocation decision that will be a function of the following three state variables, the current (estimated) level of risk premium (typically proxied by a function of dividend yield or price-earning ratios), the current level of interest rates and the current volatility level (see for example Levis and Okunev (2009)) for a proposition of extending TDF products to take into account current volatility levels). Again, a discrete partition of the states of the world can be used for these three variables, with suitably defined high, median and low values for risk premium, interest rate and volatility levels.

Overall, our research has significant potential implications for the design of stochastic, state-dependent, asset allocation policies, which stand in contrast to the deterministically time-dependent allocation strategies currently implemented in the context of target date funds. We strongly believe that there certainly is ample room for added value between one-(allocation)-size-fits-all (investors with same age) solutions and do-it-yourself approaches to long-term investment decisions. ■

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