Original Article

Using hedge funds to enhance asset allocation in life cycle pension funds

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ABSTRACT Life cycle investment funds are one of the fastest growing segments in the defined contribution pension industry. Despite concerns over long-term investment performance, many life cycle products continue to remain focused on traditional core allocations to US stocks and US bonds, with very little exposure to alternative asset classes such as commodities or global real estate. This paper outlines a methodology for assessing the potential enhancement to long-term performance that may arise from the inclusion of hedge funds into life cycle investment products. The results indicate a potential role for hedge funds. It is argued that exposure can be most efficiently gained via investable hedge fund of fund indices or by using widely available technology to replicate hedge fund returns via common risk factors. Because the approach developed in this paper can be easily modified, it could prove useful to financial planners, investors, portfolio managers and policy makers in assessing the risk and return characteristics of various life cycle asset allocation strategies.

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INTRODUCTION

The hedge fund industry has experienced rapid growth over the past decade. It is estimated that there are over 9000 hedge funds worldwide in excess of US\$1.8 trillion under management.¹ Institutional investors are increasingly investing in hedge funds. The hedge fund industry is known for its high attrition rate, however. Selecting a successful fund can be challenging. As a result, hedge fund of funds, which seek to diversify the risk of investing in individual hedge funds, have emerged as popular investment vehicles.

Investable hedge fund indices and technology to replicate hedge fund returns using common risk factors provide other routes by which hedge fund exposure can now be obtained.^{2,3} This paper develops a framework to assess the potential benefit of using hedge fund of funds to replace some or all of the equity allocation in life cycle investment funds.

Over the past 25 years, the US retirement system has experienced a substantial transformation whereby US workers have taken on more responsibility for the management of their own retirement portfolios. Employees in 401(k) plans, for example, are increasingly expected to decide on investment allocations and manage their portfolio asset mix over time. In response to concern that many participants in self-directed retirement plans may not know

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Table 1: Proportion invested in equities of four leading life cycle investment providers for various target (retirement) dates as of October 2007

Target date	Barclays (%)	Fidelity (%)	Principal (%)	Russell (%)	Average (%)
2010	45.0	52.6	50.4	25.5	43.4
2020	64.6	69.3	63.6	44.7	60.5
2030	78.9	81.7	74.1	78.8	78.4
2040	90.8	84.4	82.1	86.3	85.9

enough to choose rationally among alternative investments, mutual fund companies have launched life cycle investment funds, also known as target-date funds.^{4,5}

Unlike balanced funds, which keep the mix between equities and bonds constant over time, life cycle investment funds deterministically vary the proportion that is held in stocks and in bonds. Asset allocation is changed according to a predefined 'glide path', which gradually tilts the asset mix away from equities towards bonds as the investor in the fund gets closer to retirement. Table 1 shows the equity glide path of four major US life cycle investment fund providers. Although there is no agreed upon approach to the calculation of the equity glide path, the majority of funds place a large allocation to equities when the investor is young. This allocation is gradually reduced as the participant draws closer to retirement. The rule used by life cycle investment funds is a variant of the traditional rule of thumb that the percentage allocation to equities should be set to 100 minus the investor's age in years.⁶ The relationship between years to retirement and asset allocation using this rule is a straight line with a slope of one.

Life cycle investment funds are one of the fastest growing segments in the mutual fund industry. Assets under management grew from around \$1 billion in 1996 to over \$391 billion by the third quarter of 2007.^{7,8} Growth is expected to continue, as the enactment of the Pension Protection Act of 2006 gave plan sponsors the opportunity to include life cycle investments funds. In addition, in 2007 the US Department of Labor included life cycle investment funds alongside managed accounts and balanced funds as default investments in participant-directed defined contribution plans. It is expected that

many plan sponsors will adopt life cycle investment funds as their default option.⁹

Life cycle investment funds have gained rapid popularity because they simplify the investing process. New participants can sign up without significant knowledge of investing by answering the question 'when do I retire?' and choosing a fund with the closet retirement date. For example, Vanguard offers life cycle investment funds with target dates increasing in 5-year increments: 2010, 2015, 2020, 2045 and so on. A new participant expecting to retire in 2028 might select the 2030 fund.

Concern over the long-term performance of life cycle investment funds has begun to emerge in the literature. Hickman *et al.*,¹⁰ using a simulation approach and a 30-year holding period, found that life cycle investment funds yielded approximately half the median wealth associated with an index fund. Shiller,⁶ using historical data for the S&P 500 and bond market returns, found that life cycle investment funds failed to outperform a 3 per cent real return 32 per cent of the time. Poor long-term performance of life cycle funds is of particular concern because in countries such as the United States, the United Kingdom and Japan, the overall population is aging, life expectancy is increasing and workers are exiting the labour force at much earlier ages than previous generations. The consequence is a working age population that is shrinking and in turn threatening the long-term financial viability of public pension systems.

Despite emerging concerns over long-term investment performance, many life cycle products continue to remain focused on traditional core allocations to US stocks and US bonds, with very little exposure to international equities, commodities or global real estate. To date, very

few studies have addressed this issue. Lewis *et al*¹¹ and Lewis¹² propose the use of Value At Risk to actively manage tail risk and enhance long-term investment performance. This paper explores the potential enhancement of long-term performance that may arise from the inclusion of hedge fund of funds in life cycle investment funds.

A FRAMEWORK FOR ANALYSIS

A key issue in formulating investment strategies for managers of life cycle funds is how aggressive or conservative they should be to maximise the long-term wealth of fund participants. As shown in Table 1, equity glide paths vary between fund providers. To capture the dispersion in potential returns of different life cycle investment funds, three representative equity glide paths, shown in Figure 1, are used. The aggressive glide path allocates 100 per cent to equities with 35 years to retirement. Each year the equity allocation is adjusted downward until it reaches 50 per cent by retirement. The moderate glide path initially allocates 90 per cent to equities and gradually adjusts down to 40 per cent by retirement. The conservative glide path allocates 80 per cent to equities, declining to 30 per cent by retirement.

An increasing number of individuals are relying on life cycle investment funds to provide future retirement income, the ultimate goal being to save enough over the working years to support a satisfactory standard of living during retirement. Roy¹³ argues that investors think in terms of minimum acceptable outcomes. A typical goal is to save enough to be able to provide 75 per cent of pre-retirement income at age 65.¹⁴ We define *target-date extreme shortfall risk* as the probability that accumulated savings at retirement fail to be

sufficient to generate more than 35 per cent of pre-retirement income.

The evolution of a household's retirement savings over time depends on a large number of socioeconomic factors as well as asset returns. Our baseline case considers a male participant who has 35 years to retirement, with a salary of \$40 000 and initial retirement savings of \$5000. In addition, it is assumed that nominal wage grows at a rate of 5.5 per cent per annum, with a 15 per cent contribution of gross salary per year to the life cycle investment fund. The fund invests in the S&P 500 and US government long-term bonds. Inflation, denoted by q_t , is assumed to follow the Ornstein – Ulenbeck process:

$$dq_t = \kappa(\mu - q_t)dt + \sigma\varepsilon_t\sqrt{dt}$$

where ε_t is a standard normally distributed random shock, κ a mean reversion parameter, μ the equilibrium level of long-run inflation and σ long-run volatility. Reflecting the historical US inflation estimates of Ahlgrim *et al*,¹⁵ the mean reversion parameter κ is equal to 0.4, long-run inflation μ to 4 per cent and σ to 3 per cent.

A combination of bootstrapped historical data and Monte Carlo simulation is used to estimate accumulated real savings for each of the glide paths. Table 2 presents the performance results from 10 000 simulations.¹⁶ The first row presents the median annual return for each of the glide paths. The median return ranges from 8.13 per cent for the aggressive glide path to 7.86 per cent for the conservative glide path. The reason for the outperformance of the aggressive glide path is its larger average allocation to equity over the life cycle. The aggressive glide path has an average equity allocation of 75 per cent, compared to

Figure 1: Representative glide paths used in the analysis.

Table 2: Performance metrics of each of the glide paths for the portfolio of US stocks and US bonds

	Aggressive (%)	Moderate (%)	Conservative (%)
Median	8.13	8.01	7.86
Average	8.12	8.00	7.85
SD	1.86	1.62	1.40
Maximum	15.42	14.37	13.31
Minimum	1.20	1.84	2.45

65 and 55 per cent for the moderate and conservative glide paths, respectively.

Given the closeness of the mean and median returns, the return distribution for all of the glide paths are symmetric. The larger allocation of the aggressive glide path to equities comes with a higher short-term downside risk; this is captured by its higher volatility and lower minimum return. The extent of short-term risk in life cycle funds is important because investors typically choose portfolios as if they are more concerned about losses than gains.¹⁷

One way to measure the long-term risk of the various glide paths is by the standard deviation of terminal real wealth. As shown in Table 3, the aggressive glide path has similar downside risk characteristics to the moderate and conservative paths but with significantly higher upside potential. The additional equity risk associated with the aggressive glide path is picked up by a standard deviation of terminal wealth 12 and 23 per cent higher than the moderate and conservative glide paths, respectively.

Total accumulated savings at retirement can be used to purchase a single-premium life-time annuity with monthly payments. Using the simulated terminal real wealth from each glide path, the probability distribution of real retirement income from given present day annuity prices can be determined.¹⁸ The target-date extreme shortfall risk probability is then calculated from this probability distribution. Table 4 shows the probability that terminal wealth will be sufficient to provide 75 per cent of final salary and the target-date extreme shortfall risk probability. For all glide paths, the target-date shortfall risk is in excess of 20 per cent. Furthermore, the 'gold standard' of providing 75 per cent of pre-

Table 4: Retirement income as a percentage of final salary

<i>Terminal wealth</i>	<i>Aggressive probability (%)</i>	<i>Moderate probability (%)</i>	<i>Conservative probability (%)</i>
$\geq 75\%$ final salary	50.0	48.3	46.1
$\leq 35\%$ final salary	20.6	21.4	22.1

retirement income at age 65 is only attained 50 per cent of the time for the aggressive glide path and 46 per cent of the time for the conservative glide path. These results suggest that traditional life cycle products, with large core allocations to US stocks and US bonds, may carry with them significant shortfall risk.

We next investigate how target-date extreme shortfall risk changes with increased allocation of the equity portion to hedge fund of funds. The HFRI Fund of Funds Composite Index (FOF) is used in this analysis. Over the period from January 1990 to December 2007, the correlation between the S&P 500 and FOF was around 0.44. This suggests around 19 per cent joint variability between the two return series and indicates potential diversification benefits of inclusion of FOF. We maintain the aggressive, moderate and conservative glide paths but consider four alternative funds of funds allocations to the equity proportion: 25, 50, 75 and 100 per cent.

Table 5 shows the excess return of the various FOF allocations over the stock-and-bond-only portfolio of Table 2. Even at relatively low levels of allocation, there is statistically significant improvement in performance generated by the inclusion of FOF. The conservative glide path, with a 25 per cent allocation to FOF, generates an additional 23 basis points in return per year; this rises to 72 basis points for a 100 per cent allocation to FOF. Volatility of annual returns, as shown in Figure 2, declines steeply as the allocation to FOF increases. This reduction occurs across all three glide paths and indicates that the inclusion of FOF may significantly dampen short-term market risk.

From Table 6, it is clear that, on average, modest gains in excess terminal wealth occur across the glide paths for a 25 per cent allocation

Table 3: Terminal real wealth of each of the glide paths for the portfolio of US stocks and US bonds

	<i>Aggressive (\$)</i>	<i>Moderate (\$)</i>	<i>Conservative (\$)</i>
Median	808,991	784,873	754,711
Average	969,522	922,517	878,228
SD	641,886	575,340	521,458
Maximum	7,814,658	7,191,261	6,692,054
Minimum	103,606	109,745	115,849

Table 5: Excess return of various FOF allocations

Allocation	Aggressive (%)	Moderate (%)	Conservative (%)
25% FOF	0.36*	0.29*	0.23*
50% FOF	0.66*	0.53*	0.42*
75% FOF	0.91*	0.74*	0.59*
100% FOF	1.10*	0.90*	0.72*

*Significant at the 1 per cent level.

Figure 2: Volatility of annual returns for various allocations to FOF for each of the glide paths.**Table 6:** Excess terminal wealth of various allocations to FOF for each of the glide paths

Allocation	Aggressive (\$)	Moderate (\$)	Conservative (\$)
25% FOF	25,327	15,963	12,987
50% FOF	82,122	60,784	45,354
75% FOF	111,761	81,893	61,538
100% FOF	138,387	100,575	75,365

to FOF. The excess terminal wealth more than doubles, however, for a 50 per cent allocation, and is approximately six times larger for a 100 per cent allocation to FOF. The probability that terminal wealth is greater than 75 per cent of final salary is given in Table 7. It shows quite clearly that as the allocation to FOF increases, so does the probability of achieving 75 per cent of final salary. For a fund manager who pursues a conservative glide, the allocation to FOF would need to be around 50 per cent to have a 50–50 probability of generating terminal wealth sufficient to support a retirement at 75 per cent or more of final salary. The allocation is somewhat

Table 7: Probability terminal wealth is greater than or equal to 75 per cent of final salary

Allocation	Aggressive (%)	Moderate (%)	Conservative (%)
0% FOF	50.0	48.3	46.1
25% FOF	51.5	49.0	46.7
50% FOF	56.2	53.3	50.3
75% FOF	58.2	54.9	51.5
100% FOF	60.7	56.8	53.2

Table 8: Probability terminal wealth is less than or equal to 35 per cent of final salary

Allocation	Aggressive (%)	Moderate (%)	Conservative (%)
0% FOF	20.6	21.4	22.1
25% FOF	18.6	19.8	21.3
50% FOF	15.3	16.7	18.5
75% FOF	13.7	15.5	17.7
100% FOF	12.3	14.4	16.3

lower, at 25 per cent for the moderate glide path and between 0 and 25 per cent for the aggressive glide path.

A larger allocation to FOF reduces the extreme target-date shortfall risk probability, as shown in Table 8. For an allocation to 100 per cent FOF, it is 12, 14 and 16 per cent for the aggressive, moderate and conservative glide paths, respectively. This represents a significant reduction of around 40, 33 and 26 per cent for the aggressive, moderate and conservative glide paths, respectively. Although this is a significant improvement, these levels should be a source of concern to plan sponsors and life cycle fund managers.

DISCUSSION

Life cycle investment strategies are intuitively appealing because they have an age-dependent component in their optimal asset allocation rule. A plan sponsor's obligation to select an appropriate fund remains an important fiduciary duty. Selection of a life cycle investment product that will maximise long-term wealth is not, however, as straightforward as one might hope. This is because the target date itself does not convey any meaningful information on the suitability of a life cycle strategy for the individual

investor. Our results indicate that the use of hedge fund of funds can offer additional performance enhancement and reduce the long-term risk profile of a life cycle fund. Fees for hedge funds are based on performance and assets under management. A typical fee structure might be a 2 per cent management fee and 20 per cent outperformance fee, commonly referred to as '2 and 20'. Hedge fund of funds, which are essentially pools of hedge funds, add another layer of fees on top of this. Given the relatively high level of fees associated with hedge funds of funds and the modest performance gains associated with their inclusion in life cycle products, especially at low allocations, replication or direct investment via investable indices might be a more efficacious route to gain exposure.

Life cycle fund participants need to accumulate capital during their working years in order to generate sufficient income through retirement. A target-date fund's success will in large part be dependent on the choice of asset classes and allocation of funds between those asset classes over time. Our findings indicate that an investor seeking to minimise shortfall risk should not necessarily choose a life cycle investment strategy with the lowest allocation to risky assets such as equities or hedge funds. Although it is true that holding these assets may increase the short-term market risk, their inclusion minimises the long-term risk of a shortfall in terminal wealth. This is because short-term market risk tends to be overwhelmed by long-term growth over time. More aggressive allocations over the entire life cycle actually reduce the risk of a shortfall in terminal wealth. Our results suggest that fund participants with many years to retirement should choose life cycle funds that invest aggressively in a diverse variety of asset classes in order to maximise the upside potential of their retirement savings. Because the approach developed in this paper can be easily modified, it could prove useful to financial planners, investors, portfolio managers and policy makers in assessing the risk and return

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