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Saving for retirement while having more nights with peaceful sleep: Comparison of lifecycle and lifestyle strategies from expected utility perspective

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Abstract

We evaluate the fit of target-date funds (TDFs) as the main retirement savings instrument for the utility-maximizing investor who becomes more risk averse as she gets older. Using bootstrapping simulations, we show that TDFs can provide higher expected utility than the alternative lifestyle strategies. With loss aversion incorporated in the model, we still find that the optimal lifecycle strategy over time leads to higher expected utility than the best lifestyle strategy. Therefore, TDFs are preferable to the utility-maximizing investor. However, lifecycle strategies are not one-size-fits-all solution and investor's risk tolerance has to be considered when selecting TDF funds. © 2014 Academy of Financial Services. All rights reserved.

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1. Introduction

Since being endorsed by the Department of Labor, target-date funds (TDFs) have grown in both size and popularity.[1] According to the Investment Company Institute (2013), at the end of 2012 the total assets of TDFs were $481 billion, which is about 9.5% of the total assets of defined contribution plans. This represents a significant increase since 2007, when TDFs only had a 4.2% share of defined contribution plans. With this growing market share, it is

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important to verify the central tenet of TDFs: investors should gradually diminish the importance of risky assets in their retirement portfolio returns over time. Moreover, it is essential to establish if the current variety of TDF offerings satisfy the risk preferences of all individual investors. If not, individual investors and financial advisors need to be aware of this, so that they can evaluate how to alter the portfolios properly to match their risk profiles and maximize their utilities.

TDFs are distinguishable by both the target retirement date and a glide path, which is defined as the specific strategy that decreases the portfolio's risky asset allocation throughout its accumulation period.[2] Instead of TDFs, an investor could alternatively invest in lifestyle funds that hold equity allocations fixed over time. The superiority of decreasing equity allocations over holding them fixed has been questioned for a long time, even before the emergence of TDFs. Many financial planners have advocated that the equity weighting in an individual investor's portfolio should be inversely related to the investor's age. The most common rule of thumb is that the percentage of wealth invested in stocks should be equal to 100 minus the investor's age (Ameriks and Zeldes, 2004). Following this rule an investor who is 45 years old should have no more than 55% of her wealth invested in stocks. Academic literature refers to this idea as the lifecycle investment hypothesis (Bakshi and Chen, 1994).

Although financial planners seem to generally agree with decreasing risky allocations over time, the academic support for this argument has been less straightforward. We do know that stocks are not as risky over a long investment horizon (Bali, Demirtas, Levy, and Wolf, 2009; Malkiel, 2011), and that stocks are essential to accumulate funds for different financial goals (Samuelson, 1989; Dynan, Skinner, and Zeldes, 2002). We also know that younger employees are endowed with future labor income that will help them recover from potential investment losses if they earn poor returns from risky investments, and likewise, that all investors have desire to attain high terminal values at the end of their investment horizon (Bodie, Merton, and Samuelson, 1992; Jagannathan and Kocherlakota, 1996). Our findings add one more reason to this list: as an investor's risk aversion increases with age, the equity allocation in her portfolio needs to decrease to remain optimal for the utility-maximizing investor.

An investor's risk aversion is directly related to her utility, which represents the satisfaction that the investor gets from her consumption of goods or services. Unlike returns on investments or the terminal wealth, utility takes into account the cost of reaching monetary goals; such as an investor's sleepless nights that are attributable to taking too much risk. Keeping too much wealth in risky assets when the investor's risk tolerance is low might lead to lower expected utility despite the potential large dollar amount that could be earned by doing so.

Experts in different fields, such as psychology, economics, finance, and management, among others, have conducted research on demographics of individual risk aversion with data from many countries. They have determined an individual's risk aversion with: analysis of actual holdings of risky assets (see, for instance, Morin and Suarez, 1983; Bakshi and Chen, 1994; Pålsson, 1996; Agnew, Balduzzi, and Sundén, 2003; and Gibson, Michayluk, and Van de Venter, 2013); experimental studies looking at the participant's choice between risky alternatives, and studies that involve monitoring brain activity during decision-making

that involves risk (Deakin, Aitken, Robbins, and Bahakian, 2004; Lee, Leung, Fox, and Gao, 2007). In general, these studies support the lifecycle risk aversion hypothesis. Specifically, they provide evidence that the Arrow-Pratt measure of relative risk aversion increases with age, and older investors hold lower proportion of risky assets in their total wealth.[3]

In this article we use expected utility over different accumulation periods to compare differences between lifecycle and lifestyle strategies whereas assuming that investors are utility maximizers.[4] We run simulations with a range of portfolio weights on stocks and bonds for both lifecycle and lifestyle strategies, with a range of representative investors with different risk aversion characteristics. Our investigation includes portfolio strategies that are more common among the funds offered by fund families and the best performing strategies. We find that for the investor whose risk aversion increases as she gets older, the lifecycle portfolio strategies lead to higher expected utility than strategies that keep equity allocation fixed over the whole accumulation period. Prior studies in the field of behavioral finance have concluded that investors have different attitude towards downside risk and are more sensitive to the negative changes to their wealth (Kahneman and Tversky, 1979). We therefore incorporate the concept of loss aversion into the expected utility model. The results find further evidence that an investment strategy that decreases the weight of risky assets in the portfolio as the target retirement date nears, leads to higher expected utility than that of the best lifestyle strategy and is, therefore, preferable to the utility-maximizing investor.

It is also important to remember that not all TDFs with the same target date are the same. Balduzzi and Reuter (2012) find increased heterogeneity among the TDFs offered in the market and conclude that this differentiation can lead to varying levels of performance and risk. Idzorek (2009) stresses that it is important to look beyond the target date and evaluate the fund strategy in terms of investors' risk preference and risk capacity. The Morningstar Industry Survey (2009) reports that in 2008 the equity allocations for 2010 TDFs range from 26% to 72%. Because of this wide difference in glide paths, we consider a variety of lifecycle strategies, including different glide path lengths, gentle and steep descent glide paths (also referred to as glide paths with kink), as well as aggressive and conservative glide paths in our analysis.

As the popularity of TDFs increases, there is an emerging research on this topic in recent years. Studies have been both critical of the lifecycle model as well as finding support for the suitability of TDF strategy. The main focus in most of these studies has been on the accumulated wealth by the target retirement year and the appropriateness of the asset allocation (see, for instance, Bodie and Treussard, 2007; Schleef and Eisinger, 2007; Basu and Drew, 2009; Branch and Qiu, 2011). Spitzer and Singh (2008, 2011) analyze the performance of lifecycle strategies both during accumulation period and during retirement, and find that TDF strategies underperform the lifestyle strategies and are not as safe as implied. Liu, Chang, De Jong, and Robinson (2011) evaluate the performance of the two lifecycle funds with gentle and steep descent glide paths and seven lifestyle funds throughout accumulation and withdrawal phases examining the total accumulated wealth at the retirement date. They conclude that lifecycle strategies are beneficial to the investor, especially during the withdrawal phase. Pang and Warshawsky (2011) find that lifecycle strategies are less risky than comparable balanced strategies and are proper for investors who wish to protect their accumulated funds. Recent article by Lipton and Kish (2011) finds that lifecycle

strategies fail to reach the benchmarks, and there is little uniformity in allocation and timing among the TDF families. Pfau (2010, 2011) studies the utility from retirement savings by using standard constant relative risk-aversion utility function. He focuses on four different lifecycle strategies and compares them to 11 lifestyle strategies, and finds that investors with moderate risk aversion will reach higher expected utility from investing their retirement savings in TDF strategy than fixed asset allocation strategy. This article extends the existing literature by incorporating investor's increasing risk aversion and loss aversion into the expected utility framework introduced in Pfau (2010, 2011). We also include in our analysis a wider range of real-world lifecycle and lifestyle strategies and examine the lifecycle strategy with the highest expected utility in theory from bootstrapping simulations. Our results suggest that for the representative investor there always exists a TDF strategy that generates higher lifetime utility than those from the conventional lifestyle strategies. We also find that TDFs are not one-size-fits-all solution. Although many TDF strategies already exist in the market, they may not be optimal to utility-maximizing investors. Investors who are less risk tolerant need a TDF strategy that starts at lower levels of equity in the portfolio. Financial advisers and plan sponsors should take into account the risk tolerance profiles of individual investors to make sure the chosen TDF strategy is a good fit.

2. Data and methodology

2.1. Mean-variance utility model

The objective of this article is to evaluate the accumulation period utility of investors with similar, but uniquely different perceptions about risk from different portfolio strategies. Our first analysis assumes that the investor's risk aversion increases as she gets older. In the second model we also assume that the investor becomes more risk averse as she experiences losses. Based on these assumptions we look at how the change in risk aversion over the accumulation period and the portfolio composition affect the investor's expected utility. More specifically, do lifecycle strategies yield higher expected utility compared with lifestyle strategies for the utility-maximizing investor who becomes more risk averse as she gets older?

We use the expected utility in the accumulation period to compare the differences between lifecycle and lifestyle strategies for a representative investor who becomes less risk tolerant as she gets older. At any month t, we express the utility of the representative investor using the mean-variance model adopted by Friend and Blume (1975):

$$U_t = E(R_{p,t}) - \frac{1}{2} A_t \sigma_{p,t}^2 \tag{1}$$

Where $R_{p,t}, \sigma_{p,t}$ are the return and variance of the portfolio that the investor holds, and A_t is Arrow and Pratt's measure of relative risk aversion at month t.[5] This mean-variance model can be motivated by assuming quadratic utility for arbitrary distributions, or assuming that the return of the risky portfolio is normally distributed for arbitrary preferences (Huang and

Litzenberger, 1988). We calculate monthly utilities for the representative investor with different scales of risk aversion.

Many articles have studied the value of the risk aversion coefficient using theoretical models and experimental frameworks, resulting in a wide range of results. The majority of the studies conclude that the value of a relative risk aversion coefficient is somewhere between 0 and 5, and 2 to 4 for a typical investor. For example, Friend and Blume (1975) estimate that a coefficient of relative risk aversion is about 2 assuming stock returns are the only stochastic component of wealth. Grossman and Shiller (1981) find the coefficient of relative risk aversion has to be at least 4 to explain the variability in stock prices. Pålsson (1996) finds the range for the coefficient of relative risk aversion is between 2 and 4.

In our analysis we assume that for the representative investor the risk aversion level starts from zero to 2 at the beginning of the accumulation period, and ends between 4 and 6 at the target retirement year.[6] The expected utility for all these different risk aversion ranges is calculated for the finite number of portfolio strategies based on equity/bond mix. The expected utility for the whole accumulation period (e.g., 40 years from age 25 to age 65) is defined as the present value of all monthly expected utilities:

$$E(U) = \sum_{t=1}^{T} \beta^t \left[E(R_{p,t}) - \frac{1}{2} A_t \sigma_{p,t}^2 \right] \tag{2}$$

Where β is the discount factor, T is the length of accumulation period in months, and t stands for a specific month. We use a discount factor of 0.99.[7]

In this expected utility model we assume the investor's relative risk aversion increases over her lifetime. We assume that the change in risk aversion is linear, but for robustness we also examine cases where the investor's risk aversion stays constant for a certain period (e.g., first 10 years) and starts increasing closer to the target retirement year.

2.2. Mean-variance utility model with loss aversion

Behavioral finance studies have shown that investors are loss averse, meaning they are more sensitive to the negative changes to their wealth than gains (Thaler, Tversky, Kahneman, and Schwartz, 1997). In the case of loss aversion, utility function is steeper for losses than gains. In the second model we incorporate the concept of loss aversion into the original mean-variance utility model. We add to the expected utility function the loss aversion coefficient, λ, which increases the investor's risk aversion when the prior period's portfolio return was negative. The value of the loss aversion coefficient, λ, is determined based on the realized portfolio return in the previous month. Following Tversky and Kahneman (1992), we assume this parameter to be equal to 2.25 when the portfolio return was negative in the previous month.

With the loss aversion coefficient the accumulation period expected utility function is expressed as follows,

$$E(U) = \sum_{t=1}^{T} \beta^t \left[E(R_{p,t}) - \frac{1}{2} A_t \lambda_t \sigma_{p,t}^2 \right] \tag{3}$$

Where

$$\lambda_t = \begin{cases} 1 & when\ R^s_{p,t-1} \geq 0 \\ 2.25 & when\ R^s_{p,t-1} < 0 \end{cases} \quad (4)$$

$R^S_{p,t-1}$ stands for the portfolio return for the month t − 1. If during the previous month the portfolio return was negative, the investor's risk aversion will increase 2.25 times next month. In the case of a positive portfolio return, the investor's risk aversion does not deviate from the regular risk aversion that the investor normally has.

2.3. Return data and simulation

Expected portfolio return is calculated based on the portfolio mix for each strategy at the respective accumulation period. The lifecycle portfolios follow different glide path strategies that are characterized by the beginning equity allocation, ending equity allocation, and the time point when the equity allocation starts to decrease in the portfolio (e.g., for the first 10 years the weight of equity is kept at the maximum creating a kink in the glide path). Based on these parameters, the portfolio allocations of lifecycle strategies change each year by decreasing the equity in equal increments but stay the same within the year.[8] Lifestyle strategies keep the equity allocation constant over the entire accumulation period. The monthly mean return of the portfolio for each strategy is calculated as follows:

$$E(R_{p,t}) = w_{bond,t} \times \bar{R}_{bond} + w_{eq,t} \times \bar{R}_{eq} \quad (5)$$

Where $w_{bond,t}$ and $w_{eq,t}$ are the weights on bond and equity in the portfolio at month t, respectively. $\bar{R}_{bond}$ is the mean return of the bond and $\bar{R}_{eq}$ is the mean return of diversified equity portfolio. The portfolio variance for each strategy is calculated for each period as follows:

$$\sigma^2_t(R_{p,t}) = w^2_{bond,t}\bar{\sigma}^2_{bond} + w^2_{eq,t}\bar{\sigma}^2_{eq} + 2w_{bond,t}w_{eq,t}\bar{\sigma}_{bond}\bar{\sigma}_{eq}\rho_{bond,eq} \quad (6)$$

Where ρ is the correlation between the returns of the equity portfolio and the returns of the fixed income portfolio. In the simulations we use a diversified equity portfolio for equity allocation with 45% invested in the S&P 500 Index, 30% invested in the Russell 2000 Index, and 25% invested in the MSCI EAFE Index, following Liu, Chang, De Jong, and Robinson (2009). For the fixed income holding we use a 10-year U.S. Treasury bond. The monthly return data for equity indices and Treasury bonds is retrieved from CRSP and Datastream. The sample period is from January 1970 to December 2010. Table 1 shows the descriptive statistics for the three equity indices: the S&P 500 Index, the Russell 2000 Index, and the MSCI EAFE Index, the 10 year U.S. Treasury Bonds, and the diversified equity portfolio.

2.4. TDFs and their glide paths

The glide path of the TDF is characterized by two attributes: length of the glide path and change in the asset allocation over the fund lifetime. As Balduzzi and Reuter (2012) note, the fund families try to differentiate themselves from other TDFs there are many different glide

Table 1 Descriptive statistics for monthly returns for assets used in simulated strategies for the period from January 1970 to December 2010

	10-year T-bond	S&P 500	Russell 2000	MSCI EAFE	Diversified equity portfolio
Mean	0.00689	0.00896	0.00908	0.00755	0.00864
Median	0.00595	0.01202	0.01308	0.00978	0.01187
Standard deviation	0.02357	0.04555	0.06392	0.05018	0.04417
Sample variance	0.00056	0.00207	0.00409	0.00252	0.00195
Kurtosis	1.17384	1.97282	4.29705	1.08029	3.55604
Skewness	0.35503	−0.48217	−0.03284	−0.34430	−0.60492
Minimum	−0.06682	−0.21580	−0.30615	−0.20239	−0.22394
Maximum	0.09999	0.16811	0.39515	0.17874	0.21885

paths and asset allocation strategies in the market. Table 2 summarizes the characteristics of glide paths offered by fund families collected from the prospectus of individual TDFs as of September 2012.

As of September 2012, there were 230 TDFs with 45 fund families sponsoring these funds. Most TDFs are founded 40 years before the target year with five year increments. The most common beginning equity level among the TDFs offered currently in the market is 90% equity. The highest level of beginning equity in the glide path is 100%. On average the TDFs reach the level of 40% to 45% equity by the target year. The minimum level of equity at the target year is 20%. The most common combination is the glide path from 90% equity allocation 40 years before the target year and 50% equity at target year. Five fund families follow this glide path strategy with their TDFs. The next most common combinations are 90% to 40%, 90% to 30%, and 90% to 20% equity. Among the more conservative strategies

Table 2 Summary statistics for the glide paths of TDFs offered by the mutual fund families

	Percentage of equity		Year of the kink before target year	Length of the glide path in years	
	40 years before target year	At target year		Before target year	After target year
Mean	91	42	30	43	19
Median	90	45	30	40	20
Mode	90	45	25	40	10
Min	80	20	10	40	0
Max	100	60	35	50	40
Market leaders					
Fidelity	90	20	N/A	45	0
Vanguard	90	50	25	50	5
T. Rowe Price	90	45	25	45	40
Percentage of TDFs with					
Kink in the glide path		57%			
Continue past target year		66%			
Glide path longer than 40 years before target year		41%			
Number of fund families	45				
Number of funds	230				

the common combination is from 80% to 40%, 80% to 30%, and 80% to 20% equity. Among the TDF families, 57% have a kink in their glide path, meaning that they keep the equity at the maximum level for the first five to 30 years. Most commonly the glide path is flat for the first 10 years and starts decreasing after 10 years. TDFs that continue the glide path after the target year are called "through" TDFs. On average the glide path continues 19 years past the target year and 66% of TDFs are "through" TDFs.

Given there is a wide range of glide path strategies used by actual TDFs in the marketplace, we calculate the expected utility over the accumulation period for different glide paths. Each glide path can be characterized by its beginning equity level, ending equity level, and the steepness of the glide path or the presence of the kink in the glide path. We analyze glide paths that begin with equity allocation from 100% to 50% and end with the equity allocation from 70% to 0%. In addition we assume the glide path can be flat in the beginning of the accumulation period for 10, 20, or even 30 years, creating a kink into the glide path. Given the different combinations between the beginning and ending equity and the kink in the glide path, we analyze well over 900 different portfolio strategies. We simulate 1,000 bootstrap samples for each portfolio strategy. In this article, we present the results for the more common strategies used by the fund families as well as the best performing strategy. For the base case we examine the representative investor who starts saving for retirement in the beginning of her professional career and has at least 40 years to accumulate funds to support her retirement years. In our results we present the expected utility for the following seven common lifecycle strategies: 90% to 50%, 90% to 40%, 90% to 30%, 90% to 20%, 80% to 40%, 80% to 30%, and 80% to 20%. For comparison we also present results from the best performing lifecycle and lifestyle strategies.

3. Empirical results

3.1. Expected utility for the representative investor with different accumulation periods

We first consider the case of a young investor who has at least 40 years to save up for her retirement and calculate the total accumulation period expected utility following Eq. (1) for a wide range of different portfolio strategies; both lifestyle and lifecycle. Table 3 summarizes the results for the common strategies offered by the fund families as specified in Section 2.4. The results are generated from 1,000 simulations in each scenario, with equity allocation 5% increments ranging from 0% to 100% (e.g., 20 times).

Table 3 reports four levels of beginning-ending risk aversion: {0–4; 0–6; 2–4; 2–6} in the first column. We report the expected utility for the best lifestyle strategy and its corresponding glide path in the second to third columns. For ease of comparison, we use the expected utility for the best lifestyle strategy as a benchmark, and report the expected utilities for the seven lifecycle strategies as a percentage difference relative to the benchmark. In addition, the last three columns in Table 3 compare the best lifecycle strategy with the best lifestyle strategy by reporting the percentage difference, the glide path, and the t-statistics. Panel A reports an investor with 40 years of investment horizon followed by Panels B, C, and D with 30-years, 20-years, 10-years of investment horizons respectively. From Table 3, we

Table 3 Total accumulation period expected utility for the investor who becomes more risk averse as she gets older

Risk aversion	Best lifestyle strategy		Lifecycle strategies							Best theoretical lifecycle strategy		
	E(U)	Equity	90 to 50	90 to 40	90 to 30	90 to 20	80 to 40	80 to 30	80 to 20		Glide path	*t*-stat
Panel A: 40 year investment horizon												
0 to 4	3.284	55%	2.7%	3.5%	3.8%	3.7%	2.8%	3.0%	2.7%	4.5%	100 to 25	57.45**
0 to 6	3.075	40%	−1.0%	1.4%	3.1%	4.0%	1.7%	3.1%	3.7%	4.4%	100 to 10	28.66**
2 to 4	3.051	40%	−6.8%	−4.9%	−3.6%	−2.8%	−2.9%	−1.8%	−1.4%	0.3%	50 to 30	5.25**
2 to 6	2.903	35%	−13.3%	−9.7%	−6.9%	−5.0%	−6.6%	−4.2%	−2.7%	0.6%	45 to 20	3.89**
Panel B: 30 year investment horizon												
			80%	80%	75%	70%	70%	70%	65%			
0 to 4	2.575	55%	2.2%	2.9%	2.6%	1.7%	2.1%	2.1%	1.1%	4.5%	100 to 25	84.55**
0 to 6	2.411	40%	−0.6%	1.6%	2.9%	3.2%	1.6%	2.8%	2.9%	4.3%	100 to 10	29.72**
2 to 4	2.397	40%	−4.5%	−2.9%	−1.1%	−0.4%	−1.4%	−0.6%	−0.1%	0.3%	50 to 30	3.54**
2 to 6	2.279	35%	−9.9%	−6.6%	−3.0%	−0.9%	−4.2%	−2.1%	−0.3%	0.6%	45 to 20	5.31**
Panel C: 20 year investment horizon												
			70%	65%	60%	55%	60%	60%	50%			
0 to 4	1.796	55%	1.6%	1.7%	1.1%	−0.2%	1.2%	1.1%	−0.9%	4.6%	100 to 25	31.46**
0 to 6	1.682	40%	−0.5%	1.5%	2.3%	2.0%	1.3%	2.3%	1.4%	4.4%	100 to 10	17.48**
2 to 4	1.675	40%	−2.8%	−0.8%	0.1%	0.0%	−0.4%	0.1%	0.0%	0.3%	50 to 30	6.94**
2 to 6	1.591	35%	−7.1%	−3.1%	−0.6%	0.5%	−2.3%	−0.6%	0.6%	0.6%	50 to 20	8.98**
Panel D: 10 year investment horizon												
			60%	55%	45%	40%	50%	50%	35%			
0 to 4	0.941	55%	0.9%	0.7%	0.2%	−2.4%	0.2%	0.0%	−3.3%	5.0%	100 to 25	35.41**
0 to 6	0.881	40%	−0.5%	1.1%	1.1%	0.2%	0.8%	1.7%	−0.6%	4.9%	100 to 10	49.28**
2 to 4	0.879	40%	−1.6%	−0.1%	0.3%	−0.6%	0.0%	0.3%	−1.0%	0.3%	50 to 30	5.10**
2 to 6	0.835	30%	−5.1%	−1.7%	0.4%	0.5%	−1.2%	0.2%	0.1%	0.6%	45 to 25	8.42**

Notes. The table reports the best lifestyle strategy as a benchmark for the expected utility (E(U)) of the lifecycle strategies. The results for the lifecycle strategies are reported as a percentage difference from that benchmark. The last three columns compare the best lifecycle strategy with the best lifestyle strategy by reporting the percentage difference, the original 40 year glide path (beginning and ending level of equity), and the *t*-statistics.

**Denotes significance at the 1% level. Results for each accumulation period are reported in separate panels. First row of Panels B through D give the approximate level of equity for each lifecycle strategy at the beginning of accumulation period (e.g., 30 years before target date).

can see that as risk aversion levels increase, the total expected utilities decrease. Even though, theoretically, one can always find a lifecycle strategy which has higher expected utility than lifestyle strategy, but for investors with high levels of risk aversion, the current common market lifecycle strategies do not consistently generate higher total expected utilities than lifestyle strategies.

In our base case the representative investor is a young person who has just entered the work force and is risk neutral (A=0) when she starts saving up for retirement, and becomes less risk tolerant as she gets older, with risk aversion level increasing in equal increments every year and reaching the level of 4 at target retirement year. On average this implies risk aversion of 2. Even though our investor is risk neutral when she starts investing, we find that 100% portfolio does not yield him the highest expected utility among the lifestyle strategies and she should invest in the 55% equity portfolio instead. Panel A of Table 3 shows that all

the more common lifecycle strategies included in our investigation yield higher expected utility during accumulation period than the best lifestyle strategy. The highest utility would be reached with a theoretical lifecycle portfolio that starts out at 100% but then smoothly decreases the equity allocation to 25% by the target date. Such a strategy would yield to our representative investor 4.5% higher utility and it is significantly higher than the 55% lifestyle strategy at the 1% level. Among the more common TDF strategies her best choice would be to start investing to the TDF with the glide path from 90% to 30% equity, which generates a 3.8% higher utility than that of the best lifestyle strategy.

If the young investor becomes more risk averse as she gets older, reaching the risk aversion of 6 at the target date, the best lifestyle strategy is 40% equity portfolio; more conservative than above. For this investor all except the 90% to 50% lifecycle strategy outperform the best fixed equity portfolio. Among the lifecycle strategies the highest expected utility is reached with the theoretical glide path from 100% equity to 10%, with utility 4.4% higher and is also significantly higher than that of the best lifestyle strategy at the 1% level.

Our results show that for the investor with higher risk aversion the appeal of more common lifecycle strategies starts to diminish. In fact none of the more common lifecycle strategies reported in Table 3 manage to outperform the best lifestyle strategy when the investor's beginning risk aversion is as large as 2. However, it is still possible to construct a lifecycle strategy that generates higher utility. For example, for the investor with risk aversion from 2 to 4, the theoretical lifecycle strategy with a conservative glide path from 50% equity to 30% equity would outperform the best lifestyle strategy with 40% equity fixed. The percentage difference in expected utility is though only 0.3%, but is still significant at the 1% level.[9] The higher the investor's beginning risk aversion the lower should be the equity allocation in the beginning of the accumulation period. High risk aversion at the target retirement year shifts the preference towards a more conservative glide path with lower beginning and ending equity level.

Because we run our analysis for a wide range of strategies we find that even with higher levels of risk aversion, there exist lifecycle strategies that outperform lifestyle strategies although none of the currently offered TDFs have sufficiently conservative glide path. To the investor who has above average risk aversion when she is young, we recommend a more conservative TDF that has a target year shorter than the investor's planned retirement. The TDF with the shorter target date has already decreased the equity allocation to the desired lower level. By picking the TDF with the target date that does not match her desired target retirement year, the investor may find a fund with the glide path that matches her risk aversion and will maximize her expected utility.

One of the main selling points of TDFs is that the target year stated in the fund name is an easy way for the investor to find the suitable fund. In addition quite often it is the plan sponsor who picks the fund for the investor as the investor herself has failed to make her choice. Therefore, the suggestion to deviate from the TDF with the matching target year may not be very helpful. Therefore, we recommend that fund families should include in their menu TDFs with more conservative glide paths that may be more suitable for more risk averse investors.

So far, we have assumed that a young person enters the work force, for example, after

finishing her undergraduate education at around age 25 and immediately starts making contributions to the retirement savings plan. Unfortunately, this is quite often not the case as young people do not take advantage of time as their ally in investing for retirement. We analyze whether TDFs would also be a good choice for the person who joins the defined contribution plan later in life, for example 30, 20, or even only 10 years before the desired target retirement date in the remaining panels in Table 3.

Panel B of Table 3 assumes that our young investor postpones saving for retirement by 10 years. We assume that our investor picks a TDF that has a target year similar to her planned year of retirement. In such a case the TDF that our investor starts making contributions to has already decreased the equity allocation for the first 10 years, assuming the smooth glide path. For example for the investor who picks a TDF with the matching target date and glide path from 90% equity to 40% equity, the level of equity in the portfolio is at about 80% when she starts making investments into this fund. In our analysis we assume our investor's risk aversion is at its minimum when she starts making contributions into the retirement fund.

If risk aversion of the risk-neutral investor increases from 0 to the level of 4 over her 30-year accumulation period, the lifestyle strategy that yields the highest utility should have 55% equity. From the more common lifecycle strategies listed in Panel B in Table 3, all of them outperform the best lifestyle strategy in the context of total expected utility. The highest utility is reached with the strategy with the original glide path from 100% equity to 25% equity at the target date. This TDF would have decreased the equity allocation to about 81% when the investor starts to make contributions to her retirement plan, and it yields a utility 4.5% higher than that from the best lifestyle strategy, which is significant at the 1% level.

If the investor is more risk averse and her risk aversion increases from 2 at 30 years before the target year to 4 at the target year, her best choice would be a portfolio strategy with original glide path from 50% equity to 30% equity. The increase in expected utility is only 0.3% still significantly higher than the utility from the best lifestyle (40% equity) strategy. If the investor is very risk averse with risk aversion increasing from 2 to 6, we still find that a conservative lifecycle strategy with the glide path from 45% equity to 20% over 30 years yields investor higher utility. However, none of the TDFs in the market have decreased the equity to such a low level 30 years before the target date. Therefore, the conservative investor needs a TDF with a far more conservative glide path than any of the fund families currently offer.

If the investor postpones making contributions into a retirement account even longer and leaves only 20 years for contributing towards her retirement nest egg, the glide path of lifecycle strategies has brought the equity level in the portfolio even lower. The summary of expected utilities under the same assumptions is brought in Panel C of Table 3. If our investor is still neutral towards risk when she starts saving for retirement and her risk aversion reaches the level of 4 when she retires, she is still better off with the lifecycle portfolio strategy. Among the more common lifecycle strategies the highest expected utility is reached with the original glide path strategy from 90% equity to 40% equity. This strategy would yield our investor a total accumulation period expected utility that is 1.7% higher than the utility from the best lifestyle strategy, which has 55% on equity. For the investor who has high risk tolerance 20 years before the target retirement, the TDFs that have decreased the level of equity to 55% or less may be too conservative. Starting out with relatively high equity level

at 20 years before target retirement might help the investor to catch up a little with the lost years of capital accumulation. However, it is important to keep in mind that in case of periods of bear markets investors have less time left to recover the losses.

Less risk tolerant investors may now find that for a suitable TDF at 20 years before the target year the level of equity has to decrease sufficiently. For example, less risk tolerant investor with risk aversion changing from 2 to 6 over her 20-year accumulation period will benefit from the conservative lifecycle strategy with the glide path from 50% equity to 20% equity. It provides significantly higher expected utility than that of the best performing lifestyle strategy (with 35% equity). This lifecycle strategy starts out at 70% equity 40 years from the target date and reaches around 50% level 20 years before the target date.

When the investor postpones making contributions to her retirement account even more and the accumulation period is only 10 years, the glide paths of lifecycle strategies have brought the equity level down very close to the level at the target date. We find, though, from Panel D of Table 3 that for our representative investor who is risk-neutral when she starts investing towards retirement and reaches a risk aversion level of 4 at the retirement date, the lifecycle strategy with the original glide path from 100% equity to 25% equity yield the highest expected utility that is 5.0% higher than utility from 55% equity lifestyle strategy that yields utility of 0.941 and the difference is significant at the 1% level. It is interesting to note that even the more risk averse investors with risk aversion increasing from 2 to 6 by the target year may now reach higher utility with some of the common TDFs as they have decreased the level of equity sufficiently. For example the TDF with the original glide path from 90% equity to 20% has reached an approximate equity level of 40% 10 years before the target date. Over the 10 year accumulation period this strategy would yield our investor 0.5% higher utility than the fixed 30% equity portfolio, which is the best lifestyle strategy.

3.2. Expected utility of the loss averse investor with different accumulation periods

Prior research has concluded that investors have different attitude towards downside risk, thus, they are more sensitive to the negative changes to their wealth. Table 4 summarizes the results for the analysis that uses Eq. (5) that incorporates the representative investor's loss aversion in our model. Similar to Table 3, in Table 4 we assume an accumulation period of 40, 30, 20, or 10 years and the total expected utility is calculated as the sum of the present value of monthly utilities over the different accumulation periods. In case the representative investor's portfolio strategy yields a loss during the given month, the investor is assumed to be more risk averse the next month. We use the loss aversion of 2.25 as suggested by Tversky and Kahneman (1992).

Panel A in Table 4 shows that for the loss averse investor who is risk-neutral when she starts contributing towards the retirement portfolio and has a 40 year accumulation period, moderate lifecycle strategies yield higher expected lifetime utility than the lifestyle strategies. Specifically for the risk-neutral investor who reaches a risk aversion of 4 by the target year, the best portfolio strategy is the lifecycle portfolio with the glide path from 90% equity to 20% equity. Such a portfolio strategy will yield her a total accumulation period expected utility that is 1.6% higher than that from the 45% equity lifestyle portfolio, and the difference is statistically significant at the 1% level. The more common TDF strategies, except the

Table 4 Total accumulation period expected utility for the loss averse investor

Risk aversion	Best lifestyle strategy		Lifecycle strategies							Best theoretical lifecycle strategy		
	E(U)	Equity	90 to 50	90 to 40	90 to 30	90 to 20	80 to 40	80 to 30	80 to 20	Glide path		*t*-stat
Panel A: 40 year investment horizon												
0 to 4	2.679	45%	−1.1%	0.2%	1.2%	1.6%	0.5%	1.4%	1.6%	1.6%	90 to 20	7.20**
0 to 6	2.540	35%	−6.0%	−3.3%	−1.1%	0.2%	−2.2%	−0.2%	0.9%	1.2%	60 to 20	10.77**
2 to 4	2.523	35%	−11.6%	−9.2%	−7.4%	−6.1%	−6.6%	−4.8%	−3.9%	0.2%	50 to 25	1.01
2 to 6	2.395	30%	−17.9%	−13.9%	−10.8%	−8.5%	−10.3%	−7.3%	−5.4%	0.1%	45 to 25	0.25
Panel B: 30 year investment horizon												
			80%	80%	75%	70%	70%	70%	65%			
0 to 4	1.703	40%	−1.0%	0.3%	1.1%	1.3%	0.4%	1.2%	1.1%	1.3%	90 to 20	4.59**
0 to 6	1.611	35%	−5.3%	−2.4%	−0.3%	0.8%	−1.7%	0.3%	1.0%	1.0%	70 to 20	3.36**
2 to 4	1.610	35%	−8.3%	−5.6%	−3.6%	−2.3%	−4.0%	−2.1%	−1.2%	0.2%	50 to 25	1.10
2 to 6	1.525	30%	−13.7%	−9.3%	−5.8%	−3.5%	−7.0%	−3.7%	−1.9%	0.2%	45 to 25	0.37
Panel C: 20 year investment horizon												
			70%	65%	60%	55%	60%	60%	50%			
0 to 4	1.072	40%	−0.9%	0.3%	1.0%	0.7%	0.4%	0.9%	0.4%	1.1%	80 to 35	2.31*
0 to 6	1.011	35%	−4.4%	−1.5%	0.6%	1.1%	−1.0%	0.8%	1.0%	1.2%	75 to 35	2.81**
2 to 4	1.014	35%	−5.6%	−2.9%	−0.9%	−0.1%	−2.2%	−0.3%	0.1%	0.2%	50 to 30	2.33*
2 to 6	0.958	30%	−10.1%	−5.5%	−1.9%	−0.2%	−4.3%	−1.1%	0.2%	0.3%	45 to 25	0.37
Panel D: 10 year investment horizon												
			60%	55%	45%	40%	50%	50%	35%			
0 to 4	0.559	40%	−0.8%	0.3%	0.4%	−0.4%	0.3%	0.4%	−0.6%	0.5%	80 to 35	2.68**
0 to 6	0.525	35%	−3.8%	−0.9%	0.7%	0.4%	−0.8%	0.6%	0.2%	0.8%	75 to 30	3.09**
2 to 4	0.531	35%	−4.1%	−1.2%	0.3%	0.0%	−1.0%	0.3%	−0.1%	0.4%	50 to 30	3.80**
2 to 6	0.500	30%	−8.2%	−3.2%	−0.2%	0.1%	−2.8%	0.0%	0.2%	0.2%	45 to 25	0.45

Notes. The table reports the best lifestyle strategy as a benchmark for the expected utility (E(U)) of the lifecycle strategies. The results for the lifecycle strategies are reported as a percentage difference from that benchmark. The last three columns compare the best lifecycle strategy with the best lifestyle strategy by reporting the percentage difference, the original 40 year glide path (beginning and ending level of equity), and the *t*-statistics.

** and *denote significance at the 1% and 5% levels, respectively. Results for each accumulation period are reported in separate panels. First row of Panels B through D give the approximate level of equity for each lifecycle strategy at the beginning of accumulation period (e.g., 30 years before target date).

aggressive glide path from 90% to 50% all outperform the lifestyle strategies in terms of expected utility.

For the investor who is more risk-averse when she is young and has a risk aversion of at least 2 when she starts investing towards retirement and reached risk aversion level of 4 by retirement the lifecycle strategy with equity decreasing from 50% to 25% over the accumulation period, yields the highest expected utility. The more common lifecycle strategies fail to outperform the 35% equity lifestyle strategy. The investor needs a more conservative glide path. As suggested before, this can be accomplished if our investor picks a TDF with the target date closer to today than her desired retirement year. As the main target investor of TDFs is the investor who fails to pick the fund herself, it would be more important that fund families should start to offer TDFs with more conservative glide paths.

We find that even when the loss averse investor postpones making contributions into the retirement account, conservative lifecycle strategies yield higher expected utility but the

utility difference between the best lifestyle and best lifecycle strategies is smaller than in case of the investor who is not loss averse.[10] If the investor postpones making contributions into a retirement account and leaves 30 years for contributing towards her retirement nest egg, the glide path of lifecycle strategies has brought the equity level in the portfolio lower. The summary of expected utilities under the same assumptions is brought in Panel B of Table 4. If our risk-neutral investor is still risk neutral towards risk when she starts saving for retirement and her risk aversion reaches the level of 4 when she retires, she reaches higher expected utility with most of lifecycle portfolio strategies. Among the more common five lifecycle strategies the highest expected utility is reached with the original glide path strategy from 90% equity to 20% equity. This strategy would yield our investor a total accumulation period expected utility that is 1.3% higher than the utility from the 40% equity lifestyle portfolio (E(U)=1.703) and the difference is significant at the 1% level. Less risk tolerant investor with risk aversion changing from 2 to 6 over her 30-year accumulation period will benefit from more conservative lifecycle strategy with equity changing from 45% to 25%, which is only 0.2% higher than that of the best lifestyle strategy (30% equity fixed).

In case our investor's accumulation period is only 20 years, the glide paths of lifecycle strategies have brought the equity level closer to the level at the target date. We find, though, from Panel C of Table 4, that for our representative investor who is risk neutral when she starts investing towards retirement and reaches a risk aversion level of 4 at the retirement date, the lifecycle strategy with the original glide path from 80% equity to 35% equity yields the highest expected utility. For the investor whose risk aversion is 2 when she starts investing and reaches 6 by the target year, a more conservative strategy with original glide path from 45% equity to 25% equity provides the highest utility.

For the loss averse investor with the 10 year accumulation period, the glide paths of many common TDFs have reached low enough levels of equity that a conservative investor may reach higher utility with lifecycle strategies compared with best lifestyle strategy. However, the percentage difference in expected utilities is very small.

In summary, our results show that for the loss averse investor the portfolio strategies have to be more conservative to yield higher utility. Both the best lifestyle and best lifecycle strategies need to have a lower level of equity. We also find that the difference between the utility from reported lifestyle and lifecycle strategies has become smaller. For the more risk tolerant investor the utility from the common lifecycle strategies is less than 1.6% higher than the utility from the best lifestyle strategy and the most aggressive glide path (90% to 50%) does not outperform the best lifestyle strategy. For the more risk averse and loss averse investor the utility from the common lifecycle strategies is even less beneficial compared with the best lifestyle strategy. Such investor needs more conservative TDFs than currently offered on the market.

3.3. Expected utility from a kinked TDF glide path or a kinked risk aversion

So far we have examined so-called smooth glide path strategies in comparison to constant equity strategies. Poterba and Samwick (1997) study the age and cohort effects on investor portfolio allocation and find that households start decreasing equity in their overall portfolio after age 43. In addition, as shown in Table 2, among the TDFs offered in the market, 57%

Table 5 Expected utility with kinked glide path and/or risk aversion

Risk aversion	Best lifestyle strategy		Lifecycle strategies							Best theoretical lifecycle strategy		*t*-stat
	E(U)	Equity	90 to 50	90 to 40	90 to 30	90 to 20	80 to 40	80 to 30	80 to 20		Glide path	
Panel A: Glide path kinked at 30 years before target year, risk aversion linear												
0 to 4	3.284	55%	2.4%	3.3%	3.9%	4.1%	3.0%	3.4%	3.4%	4.5%	100 to 15	37.59**
0 to 6	3.075	40%	−8.9%	−0.2%	1.6%	2.7%	0.7%	2.2%	3.1%	3.4%	80 to 10	26.12**
2 to 4	3.051	40%	−9.2%	−7.6%	−6.5%	−5.8%	−4.6%	−3.7%	−3.2%	0.3%	45 to 30	28.20**
2 to 6	2.903	35%	−17.2%	−14.1%	−11.7%	−10.0%	−9.5%	−7.4%	−6.1%	0.6%	40 to 20	29.76**
Panel B: Glide path linear, risk aversion kinked at 30 years before target retirement												
0 to 4	3.445	75%	4.0%	4.2%	4.1%	3.6%	2.8%	2.6%	1.9%	5.6%	100 to 35	125.9**
0 to 6	3.222	50%	4.3%	5.7%	6.6%	6.8%	4.7%	5.3%	5.4%	8.1%	100 to 20	101.9**
2 to 4	3.092	40%	−4.6%	−3.0%	−2.0%	−1.5%	−1.5%	−0.7%	−0.5%	0.5%	55 to 30	17.07**
2 to 6	2.974	35%	−8.3%	−5.3%	−3.2%	−1.8%	−3.3%	−1.5%	−0.4%	1.0%	55 to 20	30.34**
Panel C: Both glide path and risk aversion kinked at 30 years before target retirement												
0 to 4	3.445	75%	4.7%	5.3%	5.5%	5.5%	3.7%	3.9%	3.7%	7.1%	100 to 25	169.8**
0 to 6	3.222	50%	4.4%	6.1%	7.3%	8.0%	5.1%	6.1%	6.6%	9.4%	100 to 10	78.17**
2 to 4	3.092	40%	−6.5%	−5.1%	−4.1%	−3.6%	−2.8%	−2.0%	−1.7%	0.5%	55 to 30	8.68**
2 to 6	2.974	35%	−11.0%	−8.3%	−6.3%	−3.4%	−5.2%	−3.5%	−2.4%	0.9%	50 to 20	17.18**

Notes. The table reports the best lifestyle strategy as a benchmark for the expected utility (E(U)) of the lifecycle strategies. The results for the lifecycle strategies are reported as a percentage difference from that benchmark. The last three columns compare the best lifecycle strategy with the best lifestyle strategy by reporting the percentage difference, the original 40 year glide path (beginning and ending level of equity), and the *t*-statistics.

**Denotes significance at the 1% level. Panel A of the table reports the results for different lifecycle strategies that keep the level of equity at the maximum for the first 10 years of the accumulation period. Investor's risk aversion is assumed to increase smoothly over the accumulation period. Panel B reports the results for lifecycle strategies with smooth (linear) glide path, but assumes that the investor's risk aversion is constant for the first 10 years and starts increasing only 30 years before target date. Panel C reports the results for the lifecycle strategies with the kink in the glide path at 30 years before the target year and also assumes that the investor's risk aversion starts increasing only at 30 years before the target retirement. The full accumulation period is assumed to be 40 years.

have a kink in their glide paths. Many TDFs keep the equity allocation at maximum in the beginning of the accumulation period for five to 15 years thus creating a kink into the glide path. Most TDFs in the market do not keep equity at the maximum level for that long, but have a kink in the glide path at 35 to 30 years before the target year. To investigate the impact of a kink, we study the expected utility for glide path strategies with the kink at 30 years before the target year and report the results in Table 5.[11]

We examine the lifecycle strategies with the kink at 30 years before the target year in comparison to the best lifestyle strategy as in Table 3. In Panel A of Table 5 we still assume that the investor's risk aversion changes linearly and starts increasing right after she starts making contributions to her retirement account. This investor, however, has a kinked glide path 30 years before the target year. When the investor's beginning risk aversion is neutral she can easily select a TDF among the most common lifecycle strategies that outperform the best lifestyle strategy. The higher her ending risk aversion, the more conservative should be her strategy, keeping both the beginning and ending equity allocation at lower levels. For the investor whose risk aversion in the beginning of the accumulation period is 2, although the

more common lifecycle strategies do not yield higher expected utility in comparison with the best lifestyle strategy, a very conservative lifecycle strategy is still able to outperform this constant equity strategy. For example, to the investor with risk aversion increasing from 2 to 6, the best strategy is to invest in the 40% to 20% glide path fund, which has a utility significantly higher than that of the best lifestyle strategy at the 1% level.

We next examine the expected utility for the investor whose risk aversion starts increasing many years after she enters the work force and begins making contributions to the chosen retirement plan; a scenario reported by Poterba and Samwick (1997). In the beginning of the accumulation period the accumulated capital is still small and worries about potential losses are low. Certain changes in life can change the investor's risk tolerance; like for example starting a family. Agnew, Balduzzi, and Sundén (2003) find that investor's risk aversion is low even up to age 45 to 54 and starts increasing after that. Panel B of Table 5 shows the expected utilities for the investor whose risk aversion starts increasing 30 years before the target retirement year. The strategies listed in this panel have a smooth glide path or in other words start decreasing the equity allocation in the portfolio right away.

As our representative investor's risk aversion starts increasing only later in life, her average risk aversion over the accumulation period is relatively lower. Therefore, in general this investor reaches higher utility with more aggressive strategies compared with the investor whose risk aversion starts increasing right away. More specifically our investor who is risk neutral when she is young and whose risk aversion starts increasing 30 years before retirement reaching the level of 4 by the target date, would reach the highest total expected utility when investing in the TDF that has 100% equity in the beginning and decreases it to the level of 35% equity by the target date. The more risk averse investor whose risk aversion changes from 2 to 6, would benefit from choosing a lifecycle strategy with the glide path from 55% equity to 20% equity. In both cases, the improvements are significant at the 1% level. Panel B shows that if investor's risk aversion is constant for a period and starts increasing later in life, the lifecycle strategies still provide higher expected utility than lifestyle strategies.

In Panel C of Table 5, we present the results for the case where the glide path has a kink 30 years before target date and investor's risk aversion starts increasing 30 years before the target retirement. The more risk tolerant investor (risk aversion increasing from 0 to 4 and from 0 to 6) will reach higher expected utility from investing in the common lifecycle strategies than from lifestyle strategies. Given the flexibility in the kinked glide path, the percentage increase in the expected utilities is higher among the lifecycle strategies. For example the investor with risk aversion from 0 to 4 (with the kink in 30 years before the target year) will reach the highest utility with the lifecycle strategy that has a steep glide path that holds equity at 100% for the first 10 years and decreases it to 25% over the remaining 30 years. Such strategy will yield him 7.1% higher expected utility (significant at the 1% level) than the best lifestyle strategy with 75% equity fixed over the 40 years of investment.[12]

In summary, when the investor has a kinked glide path and/or kinked risk aversion before the target retirement year, our results show that the best lifecycle strategy still outperforms all lifestyle strategies which have the fixed equity allocation. As in the previous analyses, for the more risk averse investor the utility from the more common lifecycle strategies is

typically less than the best lifestyle strategy, thus needs more conservative TDFs than currently offered on the market.

4. Conclusions

Prior literature has examined several reasons why investors should follow the conventional wisdom of switching their investment portfolio gradually into safer assets when they get older. This article adds investors' increasing risk aversion to this list and shows that for the investors who become less risk tolerant over their lifetime, the lifecycle strategy used by TDFs is a choice that would yield higher expected utility than a constant allocation strategy.

For investors who start saving for retirement early and have 40 years to accumulate wealth to support their golden years, the best choice for the retirement plan depends on their risk aversion. To the investors who are less risk averse when young and become moderately risk averse by the time they plan to finish working, the best fit would be a plan that is relatively aggressive and starts the portfolio glide path at a high level of equity (close to 100%), decreasing it over the accumulation period to a low level (about 25%) at the target date. Investors, who are more risk averse and become even less risk tolerant throughout their life, may not find a beneficial lifecycle strategy among the TDFs offered currently by the fund families and would need a lifecycle strategy with a more conservative beginning and ending level of equity.

Procrastinators who leave saving for retirement until later in life are also better off with investment strategies that have a glide path with decreasing stock allocation over time. In most cases they would still be better off picking the TDF that matches their planned retirement year. If the investor's risk tolerance starts decreasing later in life, for example 30 years before their planned retirement, lifecycle strategies will still provide a higher expected utility over the accumulation period than the constant allocation strategy. Compared to the lifestyle strategies, the investor also enjoys higher utility from a kinked TDF strategy that keeps the equity allocation at the maximum in the beginning years.

After incorporating the investor's loss aversion into the conventional expected utility framework, our results show that conservative lifecycle investment strategies provide higher expected utility than strategies with constant equity allocation, though the TDFs currently offered by fund families are not conservative enough for the loss averse and extremely risk averse investor.

We find it important to remember that TDFs are not a one-size-fits-all solution. Investors should look at the TDFs strategy a bit closer than just the target date. Financial advisors should determine individual investors' risk aversion characteristics before suggesting the appropriate TDF. Though it is hard to predict an investor's future risk tolerance, her beginning risk aversion can give at least some indication for the starting point of the glide path of the portfolio strategy.

As one of the QDIA options, lifecycle funds are targeted at individuals who have failed to pick the fund for their retirement contributions. Our analyses suggest that the plan sponsors who make the choice for them should become more familiar with the plan

participants' risk aversion. In particular, fund families should consider offering some TDFs with more conservative glide paths for those investors who are more risk averse.

Notes

1 With the enactment of the Pension Protection Act (PPA) of 2006, the U.S. Department of Labor defines qualified default investment alternatives (QDIAs) for retirement plan participants who fail to choose an allocation for their retirement contributions. One of the four mechanisms described in the PPA says that the qualified default instrument should have a portfolio mix that considers an investor's age or retirement date (Employee Benefits Security Administration, 2009). TDFs, also known as lifecycle funds, change asset allocation on a pre-stated schedule, depending upon an investor's age relative to retirement, can therefore be used by plan sponsors as a default option for those participants who fail to choose an investment allocation for themselves.

2 In this article we use terms "lifecycle fund" and "target-date fund (TDF)" interchangeably.

3 When wealth is taken into account, some studies have shown that as investors get older and their wealth increases, their (absolute) risk aversion may not increase. However, Siegel and Hoban (1982) show that there is an increasing relative risk aversion with wealth if a broader based sample and a more comprehensive measurement of wealth are used.

4 In this article we focus on a representative investor who has failed to choose a fund for his contributions towards retirement, or who wants to make his contributions with minimal or no interference during the full investment period. This is an investor who is kept in mind in the PPA 2006 that defined QDIAs. This is also the investor who without this default choice would have made no or very small contributions toward his retirement welfare. Therefore, it is important to remember that an investor who actively manages his retirement portfolio may find other strategies more suitable.

5 Hereafter, all risk aversions included in this article mean relative risk aversion.

6 We assume that the relative risk aversion changes annually. Within each month during a year the investor's risk aversion is assumed to stay the same.

7 For robustness, we also test with β of 0.95 and 0.90. The results are available upon request.

8 As in Liu, Chang, De Jong, and Robinson (2011), we rebalance the portfolio annually in the beginning of each year. Therefore, within the year the level of equity in the portfolio is kept constant.

9 In Eq. (2), the lifetime expected utility is based on the mean and variance of the portfolio, which are the same in the 1,000 simulations. This leads to a small standard deviation of the utility difference series and very large t-statistic correspondingly.

10 Unlike Table 3, the utility difference between the best lifecycle and lifestyle strategies is not statistically significant at any conventional level for many highly risk averse investors. This is because of the much higher standard deviation of the utility differ-

ence series in the 1,000 simulations, generated from a path-dependent utility model specified in Eq. (3).

11 We also calculate the expected utility for glide path strategies with the kink at 20 and 10 years before the target year and our results are qualitatively similar as in the 30 year case. These results are unreported to save place, and are available upon request.

12 The results are similar when we assume the investor's risk aversion starts to increase 20 years before the target retirement. They are available upon request.

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