2010

Asset Allocation for Retirement: Simple Heuristics and Target-Date Funds

Steven D. Dolvin
Butler University, sdolvin@butler.edu

William K. Templeton
Butler University, wtemplet@butler.edu

William Rieber
Butler University, wrieber@butler.edu

Asset Allocation for Retirement: Simple Heuristics and Target-Date Funds

by Steven D. Dolvin, Ph.D., CFA; William K. Templeton, Ph.D.; and William J. Rieber, Ph.D.

Steven D. Dolvin, Ph.D., CFA, is an associate professor of finance at Butler University in Indianapolis, Indiana. He is a CFA charterholder and is active in both academic and practitioner circles.

William K. Templeton, Ph.D., is a professor of finance at Butler University in Indianapolis, Indiana. His research has focused on retirement investing and mortgage selection.

Willam J. Rieber, Ph.D., is a professor of economics and chair of the department of economics, law, and finance at Butler University in Indianapolis, Indiana.

Executive Summary

- We examine common asset allocation strategies for retirement investing, considering both static and dynamic approaches, as well as those allocation policies used by leading target-date fund providers.
- We studied the average performance of each strategy over historical rolling periods (that is, bootstrapping), using actual annual returns starting in 1926. Then we applied the simulation method to review potential future results, as well as to provide additional insight into the structure and characteristics of each approach.
- We find that, over time, certain static approaches are essentially equivalent to dynamic strategies that reduce equity exposure through time. Further, we find that most target-date fund providers appear to target a dynamic 120 - age equity allocation.
- We suggest that financial planners consider a 100 percent equity allocation for their clients until approximately 10 years prior to a client's retirement, at which point a more conservative allocation should be employed.
- Although the average outcome for this approach is technically "better," there is still significant risk associated with this strategy. Consider the outcome should the year prior to reallocation be like 2008, or the inherent difficulties of a large shift from 100 percent equity to 45 percent equity because of tax or other issues. A more moderate reallocation over a few years may be reasonable. This flexibility suggests that financial planners can play a valuable role by helping investors determine the optimal reallocation time and process, in addition to encouraging a larger equity exposure early on to capture the benefits thereof.

Individuals investing for retirement face the task of selecting securities or funds that will provide the return necessary to afford the chosen retirement lifestyle. Yet the eagerness to achieve larger portfolio values must be balanced against the volatility of returns. The risk-return trade-off is particularly important in the immediate years leading up to retirement. One would regret, for example, losing 25 percent (or more) of the value of an all-equity retirement portfolio in the year prior to retirement, especially if the individual planned to convert the retirement portfolio into a guaranteed annuity of some sort at that point. Avoiding this potential regret may be a primary reason for the popularity of investment heuristics that suggest decreasing the risk of portfolios as the target retirement date nears.

Although much attention is paid to the security or fund selection process, financial advisers have long recognized that the more important decision is asset allocation, which commits funds to different classes of assets according to some weighting scheme (see Ibbotson and Kaplan, 2000). Examples of asset classes include large capitalization domestic equities, international equities, real estate, and high quality fixed income securities, among others; however, the most fundamental asset allocation decision is the one that identifies overall equity versus fixed income.

Over the years, advisers and pundits have offered some basic heuristics to deal

Acknowledgments: Parts of this paper draw heavily on Meyaard and Templeton (2002). Working under Templeton, Meyaard developed a portion of the framework presented here as part of an honors thesis at Butler University. The present authors are indebted to Meyaard's earlier efforts.

with this most fundamental of retirement investing decisions. For example, one guideline suggests allocating a percentage of one's portfolio to equity that equals 100 minus one's age. This approach is so popular in the financial press that it has been the subject of a policy brief sponsored by the Office of Policy of the Social Security Administration (Kintzel, 2007). According to this rule, a 25-year-old investor should construct a portfolio consisting of 75 percent equity and 25 percent fixed income. As the investor ages, the allocation to equities should decline such that a 65-year-old investor, for example, would have reduced the equity holdings to 35 percent of the retirement portfolio. A common variation on this guideline uses 120 – age, which results in a 20 percent greater allocation to equity at every age level, compared to the 100 – age formula.

Recognizing the importance of this decision, numerous mutual fund families have developed a series of fund offerings that make investment decisions in the context of specific retirement target dates. Investors choosing a product of this sort would be relieved of managing this shifting allocation over time. The fund managers would handle that on their behalf, reallocating to a less volatile portfolio as the retirement target date neared.

In this paper, we examine these various investment strategies using two approaches: (1) we review the hypothetical performance of these asset allocation strategies using actual historical returns and (2) we simulate future performance results using characteristics derived from the historical examination. For each analysis, we first review the risk and return characteristics of portfolios constructed using either fixed allocations or dynamic heuristics such as the 100 – age rule. Second, we evaluate the risk-return efficiency of some of the well-known target-date retirement portfolio funds. We attempt to identify the underlying asset allocation guidelines for these funds over time and evaluate their risk-return performance relative to the simple heuristics and fixed allocations to determine if these particular funds are value-enhancing.

Our results suggest that most target-date funds (TDFs) employ an asset allocation strategy that follows the 120 – age approach. Further, we find that over time, this approach also mimics the outcomes from a static 70 percent equity/30 percent debt allocation. Of the other strategies we examine, only one seems to be a better choice: 100 percent equity until 10 years prior to retirement, at which point the 100 – age approach is used. This strategy captures the positive upside volatility associated with equity, while reducing the potentially negative consequence associated with a large loss immediately prior to retirement. However, we note that the 10-year cutoff is somewhat subjective, particularly considering what might happen if the year prior to reallocation were one like 2008. Thus, we suggest that much of the value added by a financial planner will be helping clients recognize the optimal time to make the switch from a pure equity portfolio to a more conservative approach, particularly in the context of such potentially extreme events.

Given these findings, we suggest that financial planners encourage their clients (provided they can emotionally tolerate market volatility) to stay fully invested in equity until approximately 10 years prior to retirement. However, for those clients who are less sophisticated and therefore likely to exhibit behavioral biases that prevent maintaining composure in down markets, we suggest that planners may want to propose a simple target-date fund or equivalent allocation.

Background

Two recent works serve as the primary motivation for the present study. First, Meyaard and Templeton (2002) compare the 100 – age heuristic to constant equity allocations of either 50 percent or 100 percent. They find, using a fairly primitive simulation approach, that the 100 – age strategy is nearly equivalent to a constant 50 percent allocation to equity in terms of ending portfolio value or risk-return characteristics. In addition, they present a reasonable argument for investors to prefer the more aggressive 100 percent equity approach, noting that much of the uncertainty in the value of the target-date portfolio reflects the upside potential that is favorable to the investor. Furthermore, the aggressive approach results in a target portfolio value being achieved more frequently at the expense of only a slightly increased possibility of extremely poor results.

Second, Schleef and Eisinger (2007) focus on an investor's ability to hit a predetermined target-date portfolio value in real (inflation-adjusted) terms. Their Monte Carlo simulation model assumes that investors annually determine the real contribution to equity and fixed income investments that is needed to reach the target portfolio value, which implies that an investor's contributions vary significantly from one year to the next. This, in reality, is not an approach most investors are likely to follow.[1] Based on their results, Schleef and Eisinger (2007) suggest that more than half of investors fail to achieve their targeted real value portfolios. Fortunately, these dire results appear to be influenced by a bias in their investment return simulation technique (a bias acknowledged by the authors), rather than a true inability of investors to properly plan for retirement.[2] Nevertheless, they conclude that investors will generally fail to achieve a target portfolio value using any of the constant allocation strategies they tested.

Schleef and Eisinger (2007) also examine a dynamic allocation strategy, which is intended to represent a generic target-date mutual fund, one that shifts the allocation away from equity as the retirement date approaches. However, similar to Poterba, Rauh, Wise, and Venti (2006), these are hypothetical and are not representative of any actual TDFs. Based on the results from this analysis, they conclude, in contrast to Viceira (2007), that such funds provide no improvement in increasing the likelihood of achieving the target portfolio value by

Table 1: Summary Statistics

The following table presents basic summary statistics for the returns of equity and fixed income, as proxied by large capitalization equity and investment grade corporate bonds, respectively. Returns come from Ibbotson (2008) and cover the period 1926–2007.

	Equity	Fixed Income
Mean Return	12.23%	6.21%
Geometric Average Return	10.36%	5.92%
Standard Deviation	19.97%	8.49%
Maximum	54.00%	43.80%
Minimum	–43.30%	–8.10%
One Period Serial Correlation	0.03	0.06
Correlation (Equity, Fixed)	0.19	

retirement. This conclusion ignores the broader question of value by focusing purely on the return aspect of the (fictitious) TDFs and ignoring the potential benefits associated with a structured asset allocation plan.

The present study is an improvement relative to these two earlier efforts.[3] Specifically, we examine the efficacy of multiple investment approaches that span these existing studies, enabling us to make conclusions across approaches that have previously been examined in isolation. For example, we analyze the basic approach of static allocation (for example, constant 70 percent equity, 100 percent equity, etc.), and we also consider some common retirement investing heuristics, such as the 100 – age and 120 – age rules. Most critical to our contribution, we also examine the allocation strategies of five of the leading TDF mutual fund providers, as well as some combination static/dynamic strategies (for example, 100 percent equity until some designated year prior to retirement). We do so with a simulation method that closely matches actual investor saving behavior. We then judge results based on overall return and risk characteristics, rather than simply the probability of hitting a particular target portfolio value.

Methodology

To examine the issue of optimal retirement portfolio asset allocation over time, we employ two approaches. First, we examine the average performance of each strategy over historical rolling periods (that is, bootstrapping), using actual annual returns starting in 1926. Second, we apply the simulation method to review potential future results, as well as to provide additional insight into the structure and characteristics of each approach. Cooley, Hubbard, and Walz (2003) find that these two approaches may produce different results, which they attribute to the overweighting of mid-sample returns in the overlapping methodology. This effect may be reduced if the study period is short relative to the data period, as in our study. Nonetheless, following Chen and Estes (2008), we choose to employ both approaches to ensure our results are robust.

To keep the study manageable and to more closely follow previous literature, we concentrate on the most important decision an investor must make, while overlooking others. We do not distinguish between domestic and international equities, large cap and small cap stocks, real estate and cash, and so on. Instead we reduce the issue to the general allocation between overall equity and fixed income.

We begin by collecting annual return data on large cap equities and investment grade fixed income securities from Ibbotson (2008) for the years 1926 through 2007, which results in 82 years of return data observations. We concentrate on an investor who is planning for retirement, so we therefore assume a typical 40-year investment horizon. Thus, the data series provide us with 43 rolling periods of 40 years each for our historical analysis (that is, 1926–1965, 1927–1966, etc.). These two data series also serve as our proxies for the characteristics of equity and fixed income returns, as well as for their estimated relationship, to be used in our simulation.[4] We calculate various statistics related to these original data, including mean annual return and standard deviation of returns, and we report these in Table 1.

As would be expected, the mean return of the common stock series (12.23 percent) is substantially higher than the mean return for the bond series (6.21 percent). In line with the higher returns, the common stock series exhibits much more risk, as reflected by the larger standard deviation of returns compared to the bond series (19.97 percent and 8.49 percent, respectively). For purposes of the simulation, we also calculate the serial correlation of returns for the equity (0.03) and fixed income (0.06) series. Although the values of these correlations are quite low, which is consistent with the findings of previous studies (for example, Getmansky, Lo, and Makarov (2004)), we nonetheless control for them in our simulation. In addition, because both asset classes may be influenced by the same economic forces (for example, changes in interest rates or inflation), there is some correlation between the returns of stocks and bonds, which we estimate as 0.19.

To facilitate a test of the various investment strategies, we consider the following scenario. On her 25th birthday, an individual begins making regular contributions to equity and fixed income investments in a retirement portfolio and continues this practice through her 65th birthday.[5] This results in 41 annual contributions and an investment period of 40 years. The first contribution is $5,000, and each subsequent yearly contribution increases by 4 percent. This assumption is meant to reflect the fact that individual investors may leave contribution percentages unchanged as their incomes increase, thereby implying contributions will rise in direct proportion to wages.[6]

As an example, for the 100 – age strategy, the first year's contribution would be allocated $3,750 to equity (75 percent) and $1,250 to fixed income (25 percent). At the time of each subsequent contribution, the investor observes the previous year's return performance on equity and fixed income positions of the portfolio. Each annual contribution is allocated such that the portfolio's overall asset allocation meets the designated strategy even if the contribution to one asset class is negative. In short, the investor effects a rebalancing of the portfolio by allocating returns *and* new contributions into equity and fixed income at a percentage dictated by the strategy being simulated.

The models for all retirement investment approaches under examination were constructed in Crystal Ball®, a simulation program that integrates with Microsoft Excel. The spreadsheet approach enables us to indicate the size of the original annual contribution ($5,000 in our example), as well as the growth in the annual contributions (for example, 4 percent) over the 40-year horizon. For the historical analysis, the development is straightforward, as each approach is analyzed using actual returns over subsequent rolling periods.

For the simulation, the model is similar; however, parameters must be identified. For example, the simulation software enables the user to indicate the mean annual return and standard deviation of returns for the equity and fixed income asset classes, as well as the distribution of the series, which we assume is normal.[7] Finally, the user can indicate the serial correlation of each returns series, as well as the correlation between the returns series. The return characteristics employed in the simulation correspond to those reported in Table 1. Once the model is created, the simulation software draws each year's simulated returns for the equity and fixed income components from distributions with the indicated parameters. The primary output of the analysis is a terminal value at the end of the 40-year investment horizon and an internal rate of return (IRR) earned on the invested amounts.

As a reference, Table 2 provides a sample of a single run for the 100 – age simulation, which is very similar to the historical analysis, except simulated rather than actual returns are used.[8] The full simulation for each strategy involves 1,000 runs (conducted multiple times for robustness), from which we can construct distributions for the terminal values of the portfolio and the IRRs for each strategy.

We conduct our analysis on multiple basic static allocation strategies, in addition to dynamic allocation methods such as the 100 – age approach.[9] Specifically, we consider the strategies outlined in Table 3.

The last strategy described in Table 3 is based on a suggestion in Meyaard and Templeton (2002). They note that such a strategy would maximize the advantage of higher equity returns for a longer period leading up to retirement, while reducing the risk of significant losses in the years immediately leading up to retirement. Losses during that period cannot be easily recovered in a shorter investment horizon. While we examine the 10-year time frame, we recognize that this cutoff is somewhat subjective. Thus, making this decision (that is, determining the actual transition point) is possibly one of the most value-enhancing services that a financial planner can provide.

We also examine the broad asset allocation strategies for five of the most popular target-date fund offerings. Table 4 provides the series of TDFs offered by each of these firms and the associated asset allocations. In practice, TDFs are offered in increments of five years (target retirement date of 2035 or 2040, for example), each with a stated asset allocation goal. For our analysis, we assume that allocations remain stable throughout each five-year period.[10] Reviewing the allocations presented in Table 4, it appears that most target-date fund providers follow an approximate 120 – age approach, as the average difference across target-date fund equity allocations relative to the 120 – age criterion is only an absolute 2 percent. Nonetheless, there is some variation in the aggressiveness among firms, as represented by higher allocations to equities at similar retirement investment horizons.[11]

Results

Historical Periods. We commence by examining each strategy's performance over historical periods. For each 40-year period (that is, 1926–1965, 1927–1966, etc.), we calculate the ending portfolio value and IRR associated with each investment approach. From this analysis, we derive 43 sample terminal values and IRRs for each investment strategy, which we can then examine using basic statistical analysis. We present the results of this investigation in Table 5 (on page 66).

We begin by reporting the mean, median, standard deviation, minimum, and maximum for the terminal values. As would be expected, the larger the allocation to equity, the higher the average portfolio terminal value. Similarly, the standard deviation tends to increase with the allocation to equity; however, in contrast to what many investors may expect, the increase in deviation is small, relative to the effect on the terminal value. Further, the deviation seems to affect upside "risk" more, as the minimum value of the portfolio over the period increases with an allocation to equity. Thus, the added volatility does not appear to negatively affect the investor, on average, over this long time horizon.

Analyzing the dynamic strategies also reveals some interesting results. For example, the characteristics of the 100 – age approach, as previous studies report, are very similar to a static 50/50 allocation. Thus, the question arises, is the added effort associated with dynamic allocation offset by any additional value? For the 100 – age approach, the answer may be no, assuming that the labor of reallocation cannot be subcontracted for little-to-no cost. If, however, target-date fund managers were willing to conduct the reallocation for little or no incremental cost (other than the underlying fees of the mutual funds held, which an investor would be paying anyway), then there is a benefit.[12]

Table 2: Sample Output for a Single Run of the 100 – Age Simulation

Year	Age	Percent Equity	Equity Return	Beg. Equity Balance	End Equity Balance	Fixed Return	Beg. Fixed Balance	End Fixed Balance	Portfolio Before Contrib.	Contrib.	Total Ending Portfolio
0	25	0.75								$5,000	$5,000
1	26	0.74	0.39	$3,750	$5,214	0.0862	$1,250	$1,358	$6,572	$5,200	$11,772
2	27	0.73	0.50	$8,711	$13,148	0.1586	$3,061	$3,546	$16,695	$5,408	$22,103
3	28	0.72	0.29	$16,135	$20,974	0.1998	$5,968	$7,160	$28,134	$5,624	$33,759
4	29	0.71	0.13	$24,306	$27,493	0.0222	$9,452	$9,662	$37,154	$5,849	$43,004
5	30	0.70	0.24	$30,533	$37,925	0.0257	$12,471	$12,791	$50,716	$6,083	$56,799
6	31	0.69	0.39	$39,759	$55,280	0.2724	$17,040	$21,681	$76,961	$6,327	$83,288
7	32	0.68	0.05	$57,469	$60,813	0.1181	$25,819	$28,867	$89,681	$6,580	$96,260
8	33	0.67	0.06	$65,457	$69,674	0.1112	$30,803	$34,229	$103,903	$6,843	$110,746
9	34	0.66	0.36	$74,200	$101,006	0.1595	$36,546	$42,376	$143,382	$7,117	$150,499
10	35	0.65	0.46	$99,329	$145,199	0.0122	$51,170	$51,796	$196,996	$7,401	$204,397
11	36	0.64	−0.15	$132,858	$111,894	0.0771	$71,539	$77,057	$188,951	$7,697	$196,648
12	37	0.63	0.04	$125,855	$131,758	0.1834	$70,793	$83,778	$215,536	$8,005	$223,541
13	38	0.62	0.03	$140,831	$146,212	−0.0294	$82,710	$80,277	$226,489	$8,325	$234,814
14	39	0.61	0.37	$145,585	$199,574	0.1695	$89,229	$104,357	$303,931	$8,658	$312,590
15	40	0.60	0.25	$190,680	$238,854	0.3100	$121,910	$159,698	$398,553	$9,005	$407,558
16	41	0.59	0.46	$244,535	$359,205	0.1781	$163,023	$192,062	$551,268	$9,365	$560,633
17	42	0.58	0.02	$330,773	$338,415	0.0700	$229,859	$245,951	$584,366	$9,740	$594,106
18	43	0.57	0.06	$344,581	$365,399	−0.0700	$249,524	$232,053	$597,453	$10,129	$607,582
19	44	0.56	−0.46	$346,322	$186,359	−0.0009	$261,260	$261,032	$447,391	$10,534	$457,925
20	45	0.55	0.32	$256,438	$339,917	0.0364	$201,487	$208,818	$548,735	$10,956	$559,690
21	46	0.54	0.12	$307,830	$347,475	−0.0611	$251,861	$236,479	$583,955	$11,394	$595,348
22	47	0.53	0.16	$321,488	$373,965	0.0473	$273,860	$286,827	$660,792	$11,850	$672,642
23	48	0.52	−0.02	$356,500	$348,346	0.0550	$316,142	$333,545	$681,891	$12,324	$694,215
24	49	0.51	0.16	$360,992	$419,195	0.0333	$333,223	$344,333	$763,528	$12,817	$776,344
25	50	0.50	−0.07	$395,936	$366,782	0.1924	$380,409	$453,591	$820,373	$13,329	$833,702
26	51	0.49	−0.14	$416,851	$354,796	0.1323	$416,851	$472,010	$826,806	$13,862	$840,668
27	52	0.48	0.23	$411,927	$508,238	0.0845	$428,741	$464,974	$973,212	$14,417	$987,629
28	53	0.47	−0.15	$474,062	$399,487	−0.0058	$513,567	$510,590	$910,077	$14,994	$925,070
29	54	0.46	0.00	$434,783	$434,907	0.0830	$490,287	$530,981	$965,888	$15,593	$981,481
30	55	0.45	0.02	$451,481	$463,547	−0.0269	$530,000	$515,760	$979,306	$16,217	$995,523
31	56	0.44	0.27	$447,985	$573,278	0.0846	$547,538	$593,884	$1,167,162	$16,866	$1,184,028
32	57	0.43	0.26	$520,972	$656,532	0.2145	$663,056	$805,309	$1,461,841	$17,540	$1,479,381
33	58	0.42	−0.09	$636,134	$572,593	−0.0286	$843,247	$819,152	$1,391,744	$18,242	$1,409,986
34	59	0.41	0.48	$592,194	$881,623	0.2173	$817,792	$995,471	$1,877,094	$18,972	$1,896,066
35	60	0.40	0.20	$777,387	$940,533	0.0046	$1,118,679	$1,123,839	$2,064,372	$19,730	$2,084,103
36	61	0.39	0.04	$833,641	$874,098	0.0997	$1,250,462	$1,375,079	$2,249,177	$20,520	$2,269,697
37	62	0.38	0.59	$885,182	$1,410,837	0.1259	$1,384,515	$1,558,830	$2,969,667	$21,340	$2,991,008
38	63	0.37	0.10	$1,136,583	$1,252,772	−0.0258	$1,854,425	$1,806,490	$3,059,262	$22,194	$3,081,456
39	64	0.36	0.10	$1,140,139	$1,256,476	0.0896	$1,941,317	$2,115,281	$3,371,757	$23,082	$3,394,839
40	65	0.35	0.08	$1,222,142	$1,327,744	−0.0438	$2,172,697	$2,077,618	$3,405,362	$24,005	$3,429,367

Term.Value	**$3,429,367**
IRR	**9.68%**

Specifically, the mean, median, minimum, and maximum values are all slightly higher for the dynamic approach, while the deviation is slightly lower. So, although almost identical, 100 – age does technically dominate the 50/50 approach if there are no other indirect costs. Much of this benefit is likely driven by the decline in equity as retirement nears, at which time downside equity risk is more pronounced. The same conclusion and relationship exist for the 120 – age strategy relative to the static 70/30 allocation.

As mentioned previously, the TDFs appear to closely follow the 120 – age strategy, which is apparent in Table 5 given the proximity of the terminal value characteristics. Thus, we conclude that these providers do appear to add some value relative to the traditional static approach of 50/50 or 70/30, in that they generally mimic a common heuristic without requiring effort on the part of the investor, thereby optimizing potential return without adding indirect cost. Further, the mean values of the TDFs are all higher than the 120 – age approach, which suggests the added diversification within sector (that is, various types of equity) may be beneficial for the investor.

In Table 5, we also provide the mean IRR for each approach, as well as a ratio that measures average return relative to risk.[13] Thus, a higher reported ratio is indicative of more favorable risk-adjusted performance. Using this ratio, we rank order the strategies from highest to lowest, with one being the best performing strategy. Consistent with our previous discussion, the rankings using the return-to-risk ratio cluster around the TDFs, as these funds earn ranks 2–7. The only better performing approach is the strategy of investing 100 percent in equity until 10 years prior to retirement, at which point the 100 – age approach is followed. This result is intuitive in that the higher average return (and upside volatility) associated with equity is maximized for a longer period, while the downside risk of a severely low return immediately prior to retirement is controlled.

Even though the average outcome for the 100/0 (until 10+) approach is technically "better," there is still significant risk associated with this strategy. As an example, consider the outcome should the year prior to reallocation be something like 2008, when the equity markets were down approximately 40 percent. Taken strictly, our approach would suggest taking funds from equity and allocating into fixed income. Obviously this approach is counter

Table 3: Static Allocation Strategies Considered

Allocation Strategy	Description
0/100	Equity allocation in all years is equal to a static 0 percent
30/70	Equity allocation in all years is equal to a static 30 percent
50/50	Equity allocation in all years is equal to a static 50 percent
70/30	Equity allocation in all years is equal to a static 70 percent
100/0	Equity allocation in all years is equal to a static 100 percent
100 – age	Percentage equity allocation in any given year is equal to 100 minus the investor's age.
120 – age	Percentage equity allocation in any given year is equal to 120 minus the investor's age.
100/0 (until 10+)	Equity allocation in all years is equal to a static 100 percent until 10 years prior to retirement, at which point the investor follows the 100 – age rule.

Table 4: Target-Date Fund Providers—Percentage Equity

The following table lists five primary providers of target-date retirement funds. For each provider, the estimated asset allocation to equity is given. This allocation is based on underlying investments held in the fund as reported in each fund's prospectus. The table also provides comparable allocations to equity for the 100 – age and 120 – age strategies, as well as an average holding for all target-date funds (TDFs). The final columns list the difference in holding between the average TDF and the age-based heuristics.

Yrs. to Retire	100 – Age	120 – Age	Vanguard	T. Rowe Price	Fidelity	TIAA-CREF	American	Avg. TDF	Avg. vs. 100	Avg. vs. 120
0	35	55	55	55	50	55	55	54	–19	–1
5	40	60	65	65	55	60	60	61	–21	1
10	45	65	70	75	65	70	70	70	–25	5
15	50	70	80	80	70	75	75	76	–26	6
20	55	75	85	85	80	85	80	83	–28	8
25	60	80	90	90	85	90	85	88	–28	8
30	65	85	90	90	85	90	85	88	–23	3
35	70	90	90	90	85	90	85	88	–18	–2
40	75	95	90	90	90	90	85	89	–14	–6
								Average:	**–22**	**2**

Table 5: Summary Statistics for Historical Strategies

The following table provides summary statistics for our investment strategies applied over historical 40-year rolling periods, beginning in 1926. Specifically, we provide the following metrics for the distribution of terminal values: mean, median, standard deviation, minimum, and maximum. In addition, we report the mean internal rate of return, which provides the compounded return earned on the dollar investment over the life of the account relative to the average terminal value. We also report a return-to-risk ratio (*Ratio*), which is calculated as the mean return level relative to standard deviation of return. Finally, we rank the approaches via this ratio, with one being highest (highest return to risk ratio). Data are from Ibbotson (2008).

Strategy	Terminal Value					Mean IRR	Ratio	Rank
	Mean	Median	Std. Dev.	Minimum	Maximum			
0/100	$1,731,867	$1,670,984	$925,820	$625,826	$3,099,957	6.79%	1.87	14
30/70	$2,432,382	$2,262,558	$1,121,652	$1,094,847	$4,255,893	8.27%	2.17	13
50/50	$3,064,829	$2,795,081	$1,215,251	$1,475,314	$5,372,788	9.23%	2.52	12
70/30	$3,871,176	$3,599,646	$1,276,912	$2,009,448	$6,933,419	10.17%	3.03	10
100/0	$5,496,354	$5,420,270	$1,461,335	$3,170,043	$10,019,289	11.55%	3.76	8
100 – Age	$3,153,650	$3,074,040	$1,129,224	$1,688,211	$5,075,280	9.34%	2.79	11
120 – Age	$4,008,579	$3,874,497	$1,113,929	$2,320,336	$6,357,923	10.31%	3.60	9
100/0 (until 10+)	$4,582,119	$4,432,415	$780,721	$3,142,838	$6,323,096	10.84%	5.87	1
Vanguard	$4,446,613	$4,196,896	$1,070,774	$2,766,617	$7,090,762	10.72%	4.15	3
T. Rowe Price	$4,485,920	$4,237,658	$1,085,789	$2,810,671	$7,094,682	10.76%	4.13	4
Fidelity	$4,129,842	$3,910,248	$1,063,008	$2,588,583	$6,332,718	10.43%	3.89	6
TIAA-CREF	$4,375,371	$4,100,666	$1,043,583	$2,804,132	$6,733,905	10.66%	4.19	2
American	$4,225,476	$3,976,538	$1,096,041	$2,597,839	$6,660,760	10.52%	3.86	7
Average TDF	$4,330,692	$4,078,389	$1,070,188	$2,717,214	$6,777,796	10.62%	4.05	5

to what a rational investor would likely do.

Thus, while the 100/0 (until 10+) approach is likely to provide the best outcome, it is not a purely objective method. For example, if an investor has experienced a large equity return, but has 11 years (rather than 10) prior to retirement, she may still consider a reallocation at that point to further minimize risk. Further, a large shift from 100 percent equity to 45 percent equity may be difficult for some investors because of tax or other issues, so a more moderate reallocation over a few years may be reasonable. This flexibility suggests that financial planners can play a valuable role by helping investors determine the optimal reallocation time and process, in addition to encouraging a larger equity exposure early on to capture the benefits we have discussed.

While it appears the TDFs are value enhancing, the optimal approach (that is, the 100/0 until 10+ strategy) may be one that target-date fund providers are unlikely to take. From a legal and fiduciary standpoint, it is doubtful that such a provider would invest assets 100 percent into equity at any point in the lifecycle. Further, since these funds may be best suited for less sophisticated investors (or those without the benefit of advice from financial planners), there may also be practical reasons to avoid such an approach. For example, previous studies (for example, Sapp and Tiwari (2006)) suggest that individuals may "chase" returns, which implies investors might be prone to liquidate an investment subsequent to a poorly performing year. For retirement portfolios, this would imply that the benefit of having 100 percent equity would be lost, as investors do not capture the higher potential returns associated with the volatility if they liquidate in down markets. Thus, the practical implication is that financial planners should consider a strategy of 100 percent equity until their clients are close to retirement, while investors with less discipline or knowledge (such as a financial planner would provide) should undertake a basic, hands-off approach using TDFs.

Simulated Results. Although the historical analysis provides a rather concrete picture of the relative benefits and disadvantages of the investment strategies, 43 observations is a comparatively small sample from which to draw conclusions. Thus, we extend our analysis by conducting a simulation study of all the investment strategies using the characteristics from our historical analysis as defined above. We begin by examining the terminal values for each approach.

Figures 1–5 provide the distributions for terminal portfolio values for some of our basic investor scenarios as defined above. The first three strategies employ a constant allocation for the entire 40-year period, ranging from zero to 100 percent equities. The next two reflect the strategies of 100 – age and a combination strategy that employs a 100 percent equity strategy for the first 30 years and then switches to the 100 – age approach for the last 10 years leading up to the target retirement date. Figure 6 provides similar information for the average of all target retirement funds offered by leading investment firms (for example, Vanguard, Fidelity, etc.). For comparability, we standardize all figures to a center value of $3 million, which is the value an investor would earn in the 100 – age approach should the equity and debt allocations earn their average returns (12.23 percent and 6.21 percent, respectively) over the investment period. We note that some figures do not capture portfolios with extreme upside potential. For example, as stated in the figure, the 100/0 strategy reports only 920 of the 1,000 simulated portfolio values, indicating that 80 ending portfolio values are above $15 million.

A review of the figures suggests that some approaches clearly outperform others with respect to the likelihood of achieving a higher ending portfolio value; however, with this benefit comes a wider range of possible outcomes. Fortunately for an equity investor, this volatility, as suggested previously, seems to affect the upside of the distribution to a larger degree (that is, positive skewness). We also note, similar to our earlier conclusions, the frequency distribution for the 100 – age approach is virtually identical to a static 50/50 allocation to debt and equity.

Considering only the mean and the standard deviation of the terminal portfolio value over the 1,000 run simulations, there are few instances of clear domination of one strategy over another. Most results suggest a necessary weighing by the investor of additional potential return compared to increased risk. In a straight mean-variance comparison, the 100 – age strategy does dominate the constant 50 percent equity strategy, achieving both a higher mean terminal portfolio value and a lower standard deviation of results. Among the TDFs, Vanguard dominates American, and TIAA-CREF dominates Fidelity by the same standard. However, whether this domination would hold in practice is dependent on many factors beyond the control of the simulation. For example, the performance of underlying funds and the particular within-sector allocation of the general equity and debt pieces would affect the overall result. Thus, the results suggest, more than anything else, that the majority of TDFs seem to follow a similar broad allocation approach, implying that choice of such funds should primarily be based on fee structure and the nature of the underlying investments used in the fund.

Figure 1: Distribution of Simulated Terminal Values Across Investment Strategies: 0/100

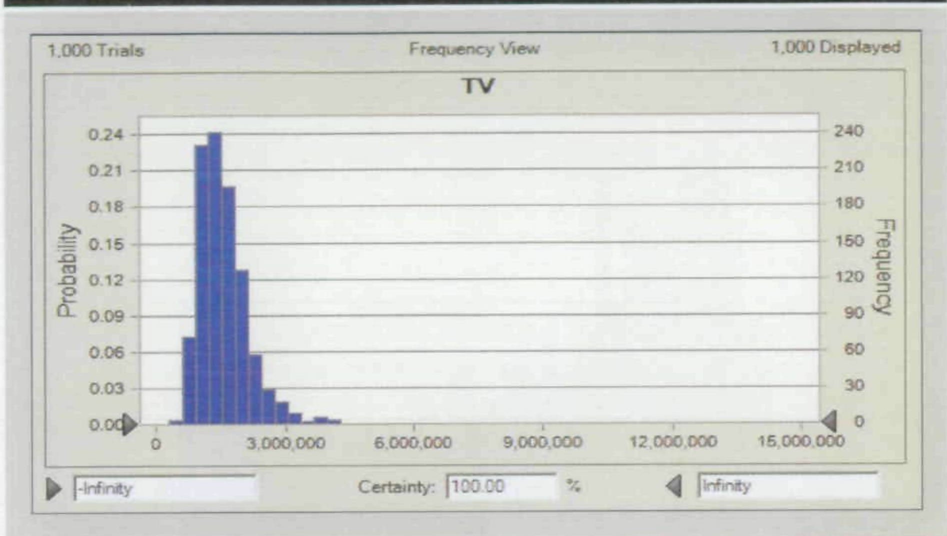
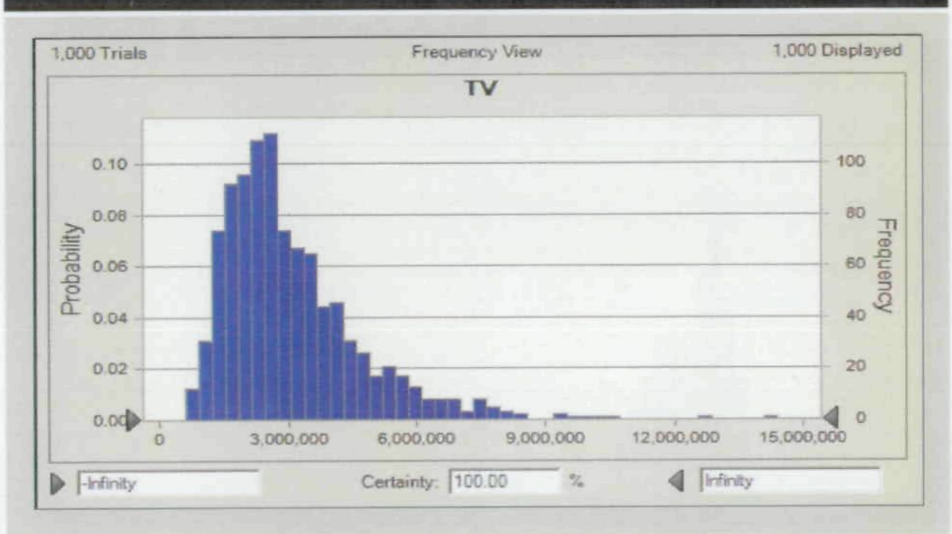


Figure 2: Distribution of Simulated Terminal Values Across Investment Strategies: 50/50



A mean-variance comparison would be sufficient evidence if the resulting terminal portfolio values were normally distributed; however, that is not the case. Because there is significant skewness to the simulation results, it may be important to consider the results from another perspective. For example, much of the standard deviation value for the 100 percent equity strategy comes from a few extreme values, both low and high. The upside volatility is of little concern to the investor. It is only the downside risk that is problematic.

As suggested above, an investor might reasonably attempt to target a nominal terminal portfolio value of $3 million. The figures give some idea of the probability of achieving or exceeding that goal, with the various investment strategies or TDFs; however, to further the analysis, we have assembled some of that information in a table of values for numerical comparison from this perspective. Table 6 (on page 70)

Figure 3: Distribution of Simulated Terminal Values Across Investment Strategies: 100/0

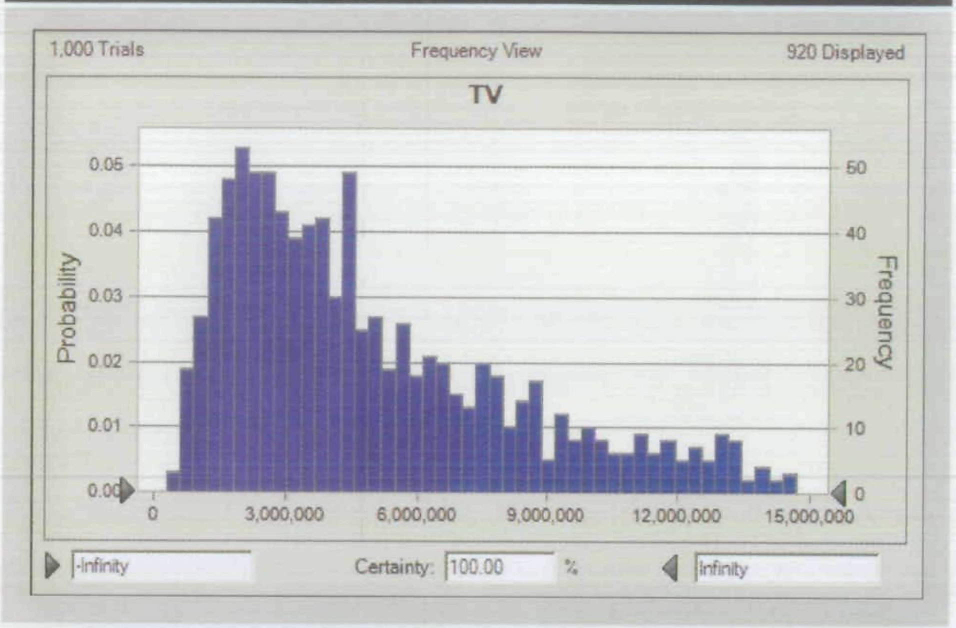
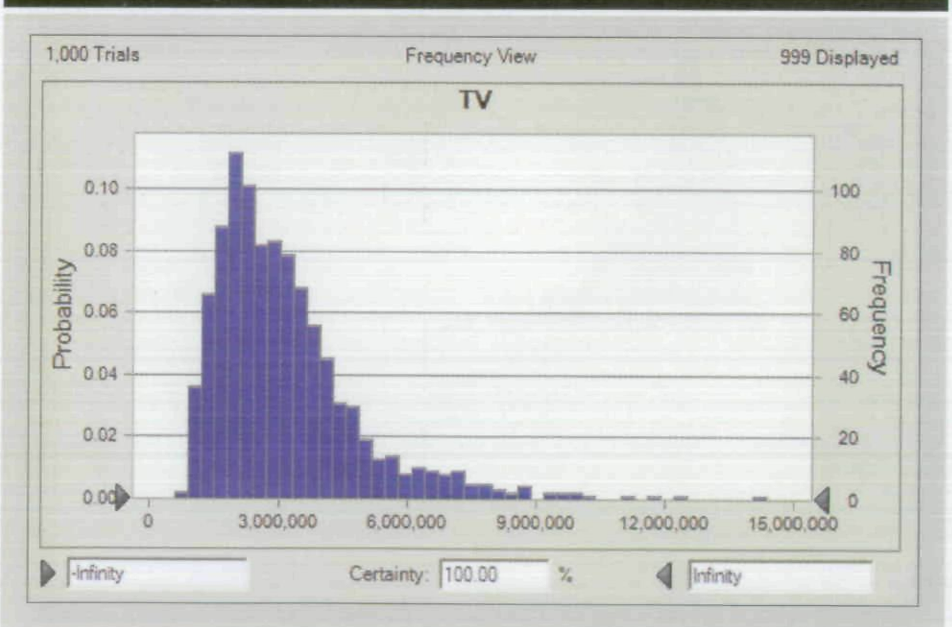


Figure 4: Distribution of Simulated Terminal Values Across Investment Strategies: 100 – Age



provides the percentage of the times (that is, cumulative probability) in the 1,000 run simulations that each strategy achieves or exceeds some minimum portfolio value. To interpret the table, consider the column headed by the portfolio value of $3 million. The column then shows the portion of the simulated runs that each of the individual strategies achieved that result or better.

This perspective places less importance on overall return and more on achieving a targeted retirement standard of living. With this perspective, the strategies that seemed aggressive now appear more attractive, and the results appear to be more in line with the conclusions from our historical analysis in the prior section. For example, whereas a pure debt approach (0 percent equity) reduces volatility and may appear to represent a good risk-return tradeoff using the simulated returns, the potential probability of all stated investment targets (beginning at $1 million) is lower than all other approaches. So, whereas there is less volatility in returns, the risk of shortfall is higher.

Examining the other approaches reveals that all strategies have comparable probabilities of achieving at least $1 million. However, a higher allocation to equity, as one might expect, significantly increases upside potential, while only slightly increasing the likelihood of an extremely low ending value. So, from a risk-return trade-off perspective, it appears that equity is "less risky" in the long term, which is consistent even with many investment textbook examples.[14] Further, consistent with all prior results, we again find that the 100 – age and 120 – age approaches are very similar to static 50/50 and 70/30 allocations, respectively.

The major difference we find using the simulation method is with respect to the attractiveness of the average target-date fund relative to the approach we suggested of employing 100 percent equity until close to retirement, which we identified as a better strategy for financial planners to recommend to their clients. With simulation, our results suggest that the TDFs may be just as attractive. So, in both historical and simulated results, it appears that TDFs do add significant value in that they provide returns that are similar to alternative approaches, while reducing the effort associated with such strategies. All this assumes, however, that the funds are not reducing the net return by adding an additional layer of management fees, which most in our sample do not. However, this would definitely be a criterion to use in determining the preferred target-date fund provider.

Conclusion

When planning for their clients' retirements, financial planners must pay particular attention to determining target asset allocations and especially to the split between overall equity and debt. While many financial planners may choose a static allocation, such as 50 percent equity/50 percent debt, other planners may decide to employ commonly accepted heuristics such as the 100 – age approach, which suggests a declining allocation to equity as their clients age. We examine various allocation approaches, including ones commonly employed by major providers of so-called target-date, or lifecycle, retirement funds. The results of our analysis of these varying approaches provide some interesting comparisons, as well as some applications for different categories of individual investors.

For example, we find that the dynamic approaches of 100 – age and 120 – age are virtually equivalent to the static approaches of 50 percent equity/50 percent debt and 70 percent equity/30 percent debt, respectively. This result would suggest that the added effort involved in reducing equity exposure over time may not be worthwhile, unless there is a financial intermediary willing to provide this service at little incremental cost—that is, a lifecycle fund provider.

Beyond reducing the effort of investors, these lifecycle funds may further enhance value, particularly if one considers the potential behavioral biases that many unsophisticated investors are prone to exhibit. For example, Benartzi and Thaler (2007) document that participants in sponsored retirement plans, consistent with the case we examine, often employ a naïve "1/*n*" strategy, allocating equally to all available choices. The resulting allocation is therefore dependent on the underlying nature of the funds offered. Further, Sapp and Tiwari (2006) find that investors often chase returns, which implies that asset allocation may not necessarily follow a planned strategy, but rather, may be an outcome of underlying security choice. In either case, using a simple lifecycle fund would reduce the possibility of these behavioral biases negatively affecting portfolio value, particularly for investors who do not have the benefit of a financial planner to guide such decisions.

Two final points are worth noting. First, we find that most TDFs seem to employ very similar allocation strategies, closely resembling a 120 – age approach. Thus, it seems that the most logical basis for choosing a provider is the fee structure and underlying fund choice, as these would be the critical differences among most funds in this category. Second, we note that only one approach seems to dominate the TDFs, primarily in historical analysis: 100 percent equity until a few years (10 in our case) before retirement, at which point a more conservative allocation is used. However, this strategy has potential risks associated

Figure 5: Distribution of Simulated Terminal Values Across Investment Strategies: 100/0 (until 10+)

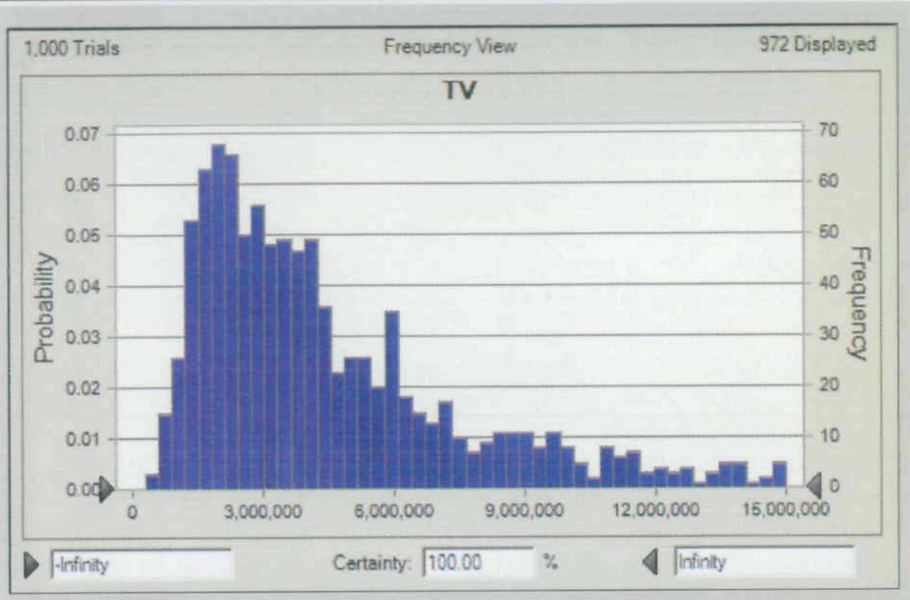


Figure 6: Distribution of Simulated Terminal Values Across Investment Strategies: Average TDF

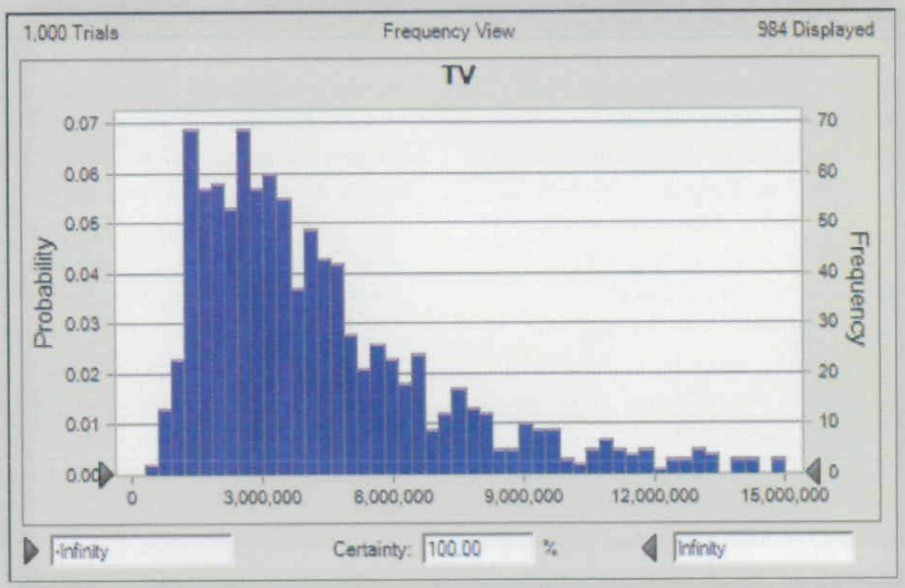


Table 6: Cumulative Probability of Achieving Stated Terminal Value

The following table provides the likelihood (in percent) of achieving a stated ending portfolio value.

Strategy	$1M	$2M	$3M	$4M	$5M
0/100	89.7	19.8	7.0	2.7	<0.1
30/70	95.0	59.6	20.1	8.9	6.2
50/50	94.2	78.8	49.0	28.8	18.1
70/30	94.6	87.3	59.9	40.0	29.2
100/0	96.3	85.8	68.8	58.8	49.1
100 – Age	93.8	79.3	49.5	29.6	18.9
120 – Age	94.1	87.6	68.1	48.6	29.7
100/0 (until 10+)	95.3	80.0	68.0	49.2	38.8
Average TDF	94.1	87.0	68.3	49.0	38.4

with significant down years just prior to reallocation. Thus, financial planners can add significant value by helping to determine the exact time (for example, year 9 vs. year 10, etc.) and reallocation process.

Unfortunately, target-date fund providers are unlikely to implement such an approach (that is, an initial period of 100 percent equity) because of legal and behavioral issues, so we view this as a cost of being less financially sophisticated. Thus, our final suggestion is for more sophisticated, patient investors (or for financial planners working with such clients)[15] to stay fully invested in equity until a few years prior to retirement, while we suggest impatient, less sophisticated investors simply use TDFs.

While we believe our findings contribute to the discussion on retirement planning, we recognize that future extensions may shed further light on this issue. For example, addressing underlying equity exposure (large cap, small cap, etc.) will highlight the most significant differences in the risk-return profile across target-date fund providers.

JFP

Endnotes

1. For example, the personal saving (and consumption) models of Friedman (1957) and Modigliani (1986) suggest that investors take a long-term view when saving. According to these models, investors determine the amount they save in a given year not so much on their income for that particular year, but more on their expected average annual income over their lifetime. Accordingly, a given change in their portfolio's return for a particular year, to the extent it does not change the investor's perception of his or her expected lifetime income, should not have a significant effect on saving during that year.
2. Schleef and Eisinger (2007, p. 233) calculate the required contribution each year based on the historical mean returns on equity and fixed income assets over an 80-year period. In simulating returns, they draw from a distribution in which the expected value is less than this historical mean. Thus, the investor contributions are insufficient to achieve the desired portfolio value more often than not.
3. Spitzer and Singh (2008) also examine the efficacy of TDFs; however, they do so with respect to the post-retirement years. Other studies that focus on the post-retirement years (that is, the spending or distribution phase of the investment lifecycle) are Fullmer (2007), Weigand and Irons (2008), and Pye (2009). Our study complements these works by examining the use of such funds in the pre-retirement period, or accumulation phase, of the investment lifecycle.
4. Shiller (2005) chooses to simulate returns using a lower mean return than the historical average; however, this approach requires subjective assumptions of future return expectations, which we feel incapable of making due to the inherent volatility of returns. Further, since we consolidate all equity into a single category, the historically larger returns of smaller stocks are not captured, which may otherwise offset a smaller risk premium going forward. The same might be said for the international equity component as well.
5. Given that Social Security begins around the 66th birthday, we could "skew" the analysis one year, but the same results would occur, assuming the 40-year period remained constant.
6. According to data in the *Economic Report of the President 2009*, Table B-47, the average annual increase in weekly earnings in private nonagricultural industries from 1964 to 2007 was 4.3 percent.
7. The distribution of returns is approximately normal; nonetheless, we conduct a robustness test using the student's t-distribution, which has properties that may be more representative of empirical financial data (for example, larger occurrence around the mean value, with potentially more extreme observations in either end of the distribution). Our results from this analysis are qualitatively similar to those reported.
8. There are some very large returns in Table 2, which may seem unreasonable. However, the values are within reason of the stated distribution characteristics. Further, the average return over each simulated run remains consistent with the historical analysis, so the increased volatility will actually result in a lower ending value for the portfolio because increased volatility reduces the compounded return. Thus, the larger return values may actually make our estimates more (rather than less) conservative.

9. Merton (2006) examines Paul Samuelson's numerous contributions to lifecycle investing, including the possibility that, from an economic standpoint, the optimal approach may actually be to increase exposure to equity over time. Thus, in unreported results, we consider two additional approaches where we assume the equity allocation each year is equal to either the investor's age or age plus 20. Both of these approaches are dominated by all but two of those strategies presented in our primary analysis, suggesting they are less than optimal.
10. For robustness, we also examine allocations that adjust linearly between each five-year breakpoint; however, our results are generally unchanged.
11. Many funds use multiple investment categories (for example, international, small cap, etc.). For our purposes, we review the listing of investments held in each fund and designate any stock position as equity. Some positions are difficult to classify due to the underlying nature of investments. For example, we classify real estate as equity, even though it is often considered debt-like. For most funds, however, allocations to these investments are small (or nonexistent). Thus, our primary conclusions are generally robust to reasonable modifications in our treatment of fund structure.
12. At creation, most TDFs charged a fee to manage the structure, plus the fees of the underlying funds. This has changed, however, for most providers, as public outcry led to the elimination of the second layer of fees. For example, Vanguard's 2045 target-date fund charges a comprehensive fee of 0.18 percent, which is actually lower than the average of the underlying funds held. So, the assumption of no other fees seems valid in the current environment, but it does create an added criterion for selecting a fund provider.
13. We note that the average return for equity in Table 1 is 12.23 percent, whereas the mean IRR for the all-equity portfolio in Table 4 is 11.55 percent. This is a reflection of a geometrically compounded return, which is always less than an arithmetic average when volatility exists.
14. For example, Smart, Megginson, and Gitman (2004) illustrate that the deviation of returns over 30-year rolling periods is actually lower for equity than it is for debt.
15. Given the potential risks of volatility, it is a good idea to have the standard malpractice insurance or have clients sign a litigation-proof waiver. We thank an anonymous reviewer for making this point.

References

Benartzi, S., and R. Thaler. 2007. "Heuristics and Biases in Retirement Savings Behavior." *Journal of Economic Perspectives* 21: 81–104.

Chen, H., and J. Estes. 2008. "Diversification, Expenses, and Performance for 401(k) Plans: A Monte Carlo Study of the Blended Six Index Funds Approach." *Journal of Financial and Economic Practice* (Fall).

Cooley, P., C. Hubbard, and D. Walz. 2003. "A Comparative Analysis of Retirement Portfolio Success Rates: Simulation Versus Overlapping Periods." *Financial Services Review* 12: 115–128.

Economic Report of the President 2009. Table B-47. Washington, D.C.: U.S. Government Office.

Friedman, M. 1957. *A Theory of the Consumption Function.* Princeton, New Jersey: Princeton University Press.

Fullmer, R. 2007. "Modern Portfolio Decumulation: A New Strategy for Managing Retirement Income." *Journal of Financial Planning* 20: 40–51.

Getmansky, M., A. Lo, and I. Makarov. 2004. "An Econometric Model of Serial Correlation and Illiquidity in Hedge Fund Returns." *Journal of Financial Economics* 74: 529–609.

Ibbotson, R. 2008. *Stocks, Bonds, Bills and Inflation: 2008 Yearbook.* Ibbotson Associates.

Ibbotson, R., and P. Kaplan. 2000. "Does Asset Allocation Policy Explain 40, 90, 100 Percent of Performance." *Financial Analysts Journal* 56: 26–33.

Kintzel, D. 2007. "Portfolio Theory, Life-Cycle Investing, and Retirement Income." Policy Brief No. 2007-02 (U.S. Social Security Administration).

Merton, R. 2006. "Paul Samuelson and Financial Economics." *The American Economist* 50: 9–31.

Meyaard, B., and W. Templeton. 2002. "The Effectiveness of the 100-Age Asset Allocation Strategy." Proceedings of the Academy of Financial Services.

Modigliani, F. 1986. "Life Cycle, Individual Thrift and the Wealth of Nations." *American Economic Review* 76: 297–313.

Poterba, J., *et al.* 2006. "Lifecycle Asset Allocation Strategies and the Distribution of 401(k) Retirement Wealth." NBER Working Paper.

Pye, G. 2009. "When Should Retirees Retrench? Reducing the Need with Part-Time Work and Annuitization." *Journal of Financial Planning* 22: 48–55.

Sapp, T., and A. Tiwari. 2006. "Stock Return Momentum and Investor Fund Choices." *Journal of Investment Management* 4: 73–85.

Schleef, H., and R. Eisinger. 2007. "Hitting or Missing the Retirement Target: Comparing Contribution and Asset Allocation Schemes of Simulated Portfolios." *Financial Services Review* 16: 229–243.

Shiller, R. 2005. "The Life-Cycle Personal Accounts Proposal for Social Security: An Evaluation." Yale ICF Working Paper.

Smart, S., W. Megginson, and L. Gitman. 2004. *Corporate Finance.* New York: Southwestern.

Spitzer, J., and S. Singh. 2008. "Shortfall Risk of Target-Date Funds During Retirement." *Financial Services Review* 17: 143–153.

Viceira, L. 2007. "Life-Cycle Funds." Accessed online: www.ssrn.com (#988362).

Weigand, R., and R. Irons. 2008. "When Does a Bonds-First Withdrawal Sequence Extend Portfolio Longevity?" *Journal of Financial Planning* 21: 66–77.