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Vanguard's approach to target-date funds

Vanguard research

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Executive summary. Target-date funds (TDFs) are designed to address a particular challenge facing many retirement investors: constructing a professionally diversified portfolio. Many investors lack time or interest when it comes to investment or retirement planning. They can become overwhelmed by the choice of investments available in a retirement plan lineup. TDFs are designed to help long-term investors achieve their goals and overcome these challenges. Vanguard TDFs are constructed on a number of investment best practices—the principles of asset allocation, diversification, transparency, and maintaining a balance among risk, return, and cost. Vanguard TDFs offer a straightforward design coupled with a high degree of transparency, low investment costs, and broad-based exposure to major asset classes, which help maximize the usefulness of these funds for investors.

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This paper provides an overview of Vanguard’s methodology in designing its TDFs. We begin by reviewing the theoretical foundations for life-cycle investing, including the equity risk premium and the need to balance an investor’s “human” and financial capital throughout his or her life cycle. Two fundamental principles—that there are significant potential rewards for taking market risk, and that younger investors are better able to take risk than older investors—underlie our philosophy for constructing Vanguard’s TDFs. The paper outlines Vanguard’s rationale for what we view as appropriate glide-path construction, asset class diversification, and the benefits of a passively managed implementation strategy.

Notes on risk: All investments are subject to risk. Past performance is no guarantee of future results. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index. Diversification does not ensure a profit or protect against a loss in a declining market. Investments in bonds are subject to interest rate, credit, and inflation risk. Foreign investing involves additional risks, including currency fluctuations and political uncertainty. Prices of mid- and small-cap stocks often fluctuate more than those of large-company stocks.

Investments in target-date funds are subject to the risks of their underlying funds. The year in the fund name refers to the approximate year (the target date) when an investor in the fund would retire and leave the work force. The fund will gradually shift its emphasis from more aggressive investments to more conservative ones based on its target date. An investment in a target-date fund is not guaranteed at any time, including on or after the target date.

IMPORTANT: The projections or other information generated by the Vanguard Capital Markets Model® (VCMM) regarding the likelihood of various outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results.

The use of TDFs in employer-sponsored and individual retirement plans has expanded dramatically over the past ten years—and for good reason. TDFs can help investors construct well-diversified portfolios—critical to achieving retirement readiness—while simplifying the investment process. TDFs can also provide a sensible default investment option that plan sponsors can use in conjunction with plan design strategies to improve participant portfolio diversification, enrollment, and savings rates.

TDFs are designed to address a particular challenge facing many retirement investors: constructing a professionally diversified portfolio. As academic and Vanguard research indicates, many investors lack time or interest when it comes to investment or retirement planning.¹ Even a motivated retirement saver may make portfolio errors or fail to manage the portfolio’s strategy effectively over time. TDFs address these challenges by simplifying the asset allocation decision for the investor. After making the decision to invest in a TDF, subsequent decisions about portfolio construction and ongoing and life-cycle rebalancing are delegated to the fund’s portfolio manager.

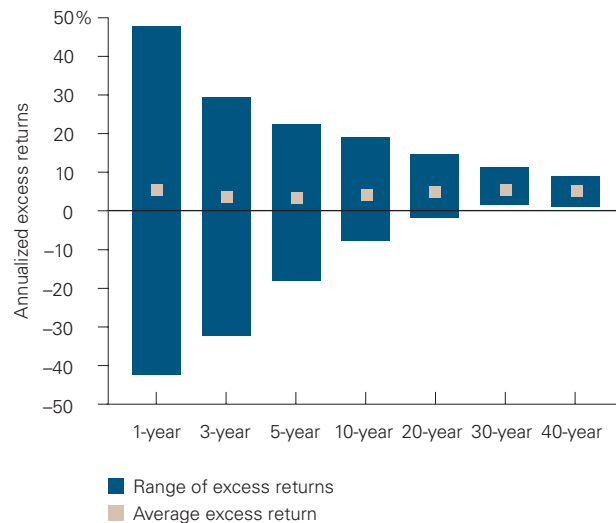
Asset allocation glide path

At its most fundamental level, the investment case for TDFs rests on two key strategic principles: that there are significant potential rewards for taking market risk, and that younger investors are better able to withstand that risk than older investors because a larger percentage of their total wealth is in human capital versus their financial holdings.

In our view, two important considerations justify an expectation of an equity risk premium. The first is the historical record: In the past, and in many countries, stock market investors have been rewarded with such a premium. **Figure 1** shows historical returns on equities in excess of returns of nominal U.S. bonds over various time periods from 1926 through 2009.²

Figure 1. Historical equity risk premium over different time periods, 1926–2009

Excess returns of stocks versus nominal bonds



Sources: For U.S. stock market returns, we use the Standard & Poor’s 90 Index from 1926 through March 3, 1957, the Standard & Poor’s 500 Index from March 4, 1957, through 1974, the Wilshire 5000 Index from 1975 through April 22, 2005, and the MSCI US Broad Market Index thereafter. For U.S. bond market returns, we use the Standard & Poor’s High Grade Corporate Index from 1926 through 1968, the Citigroup High Grade Index from 1969 through 1972, the Lehman Brothers U.S. Long Credit AA Index from 1973 through 1975, and the Barclays Capital U.S. Aggregate Bond Index thereafter.

The data in Figure 1 show that stocks have provided higher average returns than bonds at all horizons—albeit with a greater propensity to underperform by significant amounts over shorter time frames. Historically, bond returns have lagged equity returns by about 5–6 percentage points, annualized—amounting to an enormous return differential in most circumstances over longer time periods. Consequently, retirement savers investing only in “safe” assets must dramatically increase their savings rates to compensate for the lower expected returns those investments offer.

The second reason is forward-looking and theoretical: The long-term outlook for global corporate earnings, despite today’s enormous short-term challenges,

1 For a more detailed discussion of these issues, please see Utkus and Young (2004 and 2009) and Choi et al. (2006).

2 The expectation of a long-term equity risk premium is also corroborated by Dimson, Marsh, and Staunton, who show positive historical risk premiums for equities, over bonds, in 19 countries since 1900.

remains positive. The fact that some investors are questioning the outlook for equities, in light of the existence of some risks, is precisely why those who do invest in stocks should expect to earn higher *average* returns than investors who choose less volatile investments.

The second strategic principle underlying our glide-path construction—that younger investors are better able to withstand risk—recognizes that an individual’s total net worth consists of both their *current* financial holdings and their *future* work earnings. For younger individuals, the majority of their ultimate retirement wealth is in the form of what they will earn in the future, or their “human capital.” Therefore, a large commitment to stocks in a younger person’s portfolio may be appropriate to balance and diversify risk exposure to work-related earnings (Viceira, 2001; Cocco, Gomes, and Maenhout, 2005).³

Although the “human capital” theory doesn’t explicitly state how quickly equity exposure should diminish without the addition of a variety of assumptions and caveats, it does support the theoretical concept that equity allocations should decline with age to help manage risk through time. A topic of widespread debate remains what level of equity exposure may be appropriate to diversify investors’ human capital. There is no universally accepted optimal answer; ultimately, this is a fiduciary decision that sponsors have to make for their participants and individual investors must make for themselves.

Glide-path construction approach

A portfolio’s asset allocation—the percentage of a portfolio invested in various asset classes such as stocks, bonds, and cash investments—is the most important determinant of the return variability and long-term performance of a broadly diversified portfolio engaging in limited market-timing (Davis, Kinniry, and Sheay, 2007; Brinson and Hood, 2006). For that reason, Vanguard’s TDF portfolio glide path, illustrated in **Figure 2**, represents a strategic asset allocation to a broadly diversified set of asset classes—not a tactical asset allocation philosophy.⁴

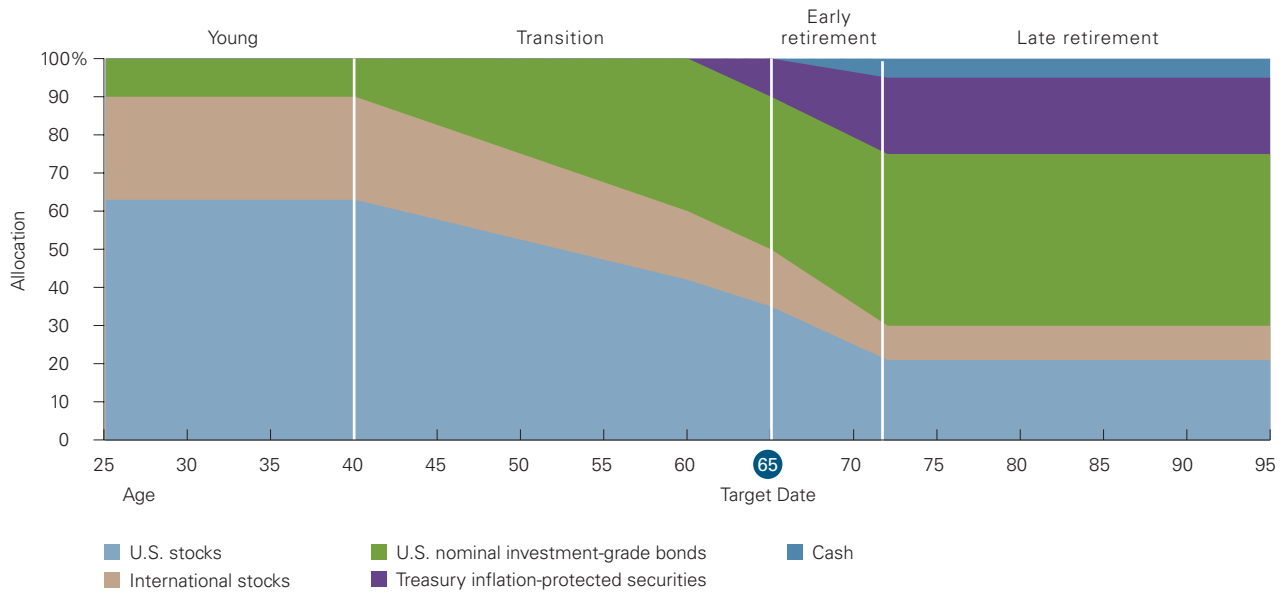
Vanguard TDFs take a long-term, strategic approach and are built to be highly diversified and low-cost, which are keys to long-term investing success. The asset allocation glide path was designed to help a typical investor who maintains a reasonable savings rate to reach his or her retirement investment goals while bearing what we believe to be an appropriate level of risk at each stage of the life cycle.

As described earlier, the human capital theory supports a significant commitment to equities for young individuals, declining to a more modest allocation as one approaches retirement and eventually leaves the workforce. Vanguard TDFs maintain a significant level of equity exposure (90%) to age 40 because one’s “human capital” remains so dominant over the small balances in financial capital during the early stages of asset accumulation. After age 40, the equity allocation continues to decline up to age 72 to compensate for the shifting balance between human and financial capital.

³ For a more detailed discussion of these issues, see Bennyhoff (2008) and Ameriks, Hess, and Donaldson (2008).

⁴ Tactical asset allocation is a type of dynamic asset allocation that actively and systematically adjusts the strategic portfolio mix of an entire TDF allocation based on relative short- to intermediate-term market conditions. Such an approach attempts to add value beyond that of a baseline strategic asset allocation by altering systematic risk factors and overweighting asset classes that are expected to outperform on a relative risk-adjusted basis in the near term. For a more detailed discussion of these issues, see Stockton and Shtekman (2010).

Figure 2. Glide path for the Vanguard target-date funds



Note: Figure assumes that a particular fund was selected based on a projected target retirement age of 65.

Source: Vanguard.

To help meet retirees' need for diversification and growth potential for a significant number of years in retirement to offset inflation, Vanguard TDFs offer significant equity exposure at an investor's designated retirement year—50%, which is gradually reduced over the next seven years to 30% and remains constant thereafter. This allocation to equities recognizes that most pre-retirees and recent retirees still have the ability to alter their retirement plans—though far less than younger investors—if absolutely necessary and that modest exposure to equities can diversify their portfolios and help them realize their long-term goals. In addition, most retirees have a substantial portion of their wealth

in the form of relatively safe, inflation-adjusted Social Security benefits, which should be diversified with some exposure to the equity markets.⁵

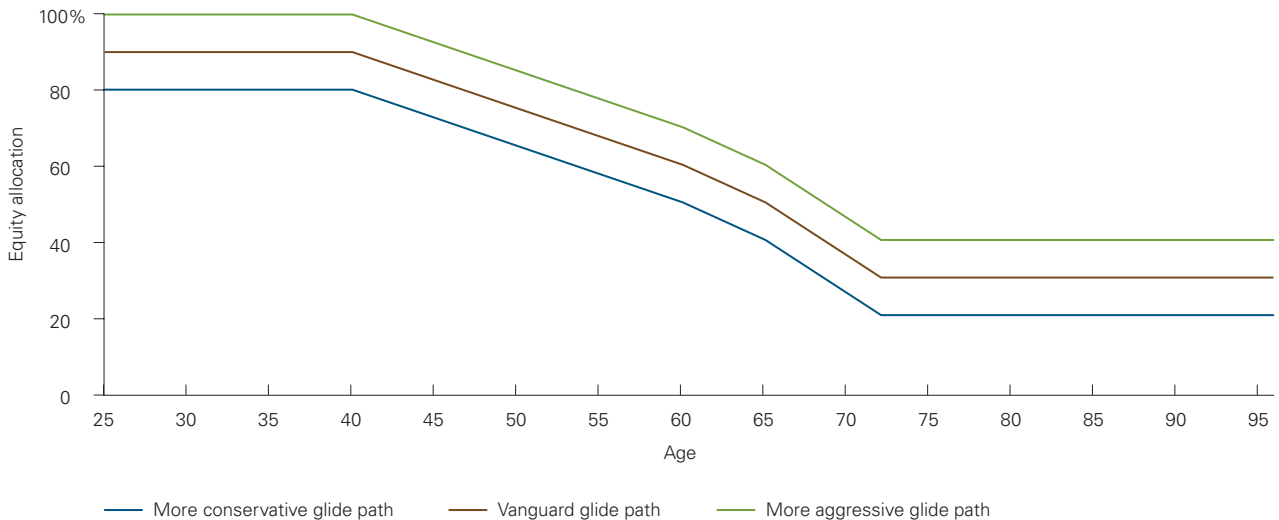
Simulated outcomes and measures of success

As part of the process of evaluating and identifying an appropriate glide path given this theoretical framework, we ran various financial simulations using the Vanguard Capital Markets Model. We examined different risk-reward scenarios and the potential implications of different glide paths and TDF approaches.

5 There have also been some academic attempts to determine an appropriate glide path based solely on the specification of investor preferences, and a variety of assumptions about capital markets and labor income patterns, using some sophisticated modeling techniques. As a part of its ongoing oversight process, Vanguard has also conducted similar exercises. See, for example, "Optimal Portfolio Choice for Long-Horizon Investors with Nontradable Labor Income," by Luis Viceira, *The Journal of Finance*, Vol. 56, No. 2: 433–470, April 2001, and "Optimal Life-Cycle Investing with Flexible Labor Supply: A Welfare Analysis of Life-Cycle Funds," Francisco J. Gomes and Laurence J. Kotlikoff, *American Economic Review: Papers and Proceedings*, 98:297–303, May 2008.

Figure 3. Vanguard glide path compared with hypothetical more aggressive and more conservative glide paths

Glide-path equity allocations



Note: The hypothetical illustration shown does not represent any particular investment. Results may vary with each use and over time. For a detailed description of the assumptions used in the scenario analysis, please see the appendix.
Source: Vanguard.

For example, **Figure 3** illustrates three different glide paths, including Vanguard’s TDF glide path, beginning with varying levels of significant equity exposure and ending at retirement with ranges of more moderate levels of equity exposure.

Figure 4 compares the glide paths under a baseline simulation yielding a predictable outcome. The more aggressive the glide path, the greater the wealth accumulation, on average.

After contributing over a 40-year period, the median hypothetical investor in the Vanguard glide path retired with 14.1 times their ending annual salary saved. Investors in the more aggressive glide path accumulated an additional 9% over the Vanguard glide path, for 15.3 times their ending salary saved; however, this required investors to assume additional risk at all stages of their life cycle, as shown by the

Figure 4. Wealth accumulation at retirement under different glide paths

	More conservative glide path	Vanguard glide path	More aggressive glide path
Median	12.8X	14.1X	15.3X
5th percentile	5.2X	4.9X	4.7X

Note: The figures above represent a multiple of an investor’s ending salary. For example, an investor in the Vanguard glide path would accumulate assets equal to 14.1 times his or her ending salary, on average, over a 40-year investment period. Please see the Appendix for additional details of the simulation.

Source: Vanguard.

5th-percentile multiple. The most aggressive glide path had the lowest ending wealth in a significant downside event. Investors in the more conservative glide path accumulated about 9% less than investors

Figure 5. Portfolio returns during historical bull and bear markets

Asset allocation	Historical average annual return 1926–2009	Real historical average annual return 1926–2009	Number of years with a loss	Bear markets					Bull market
				Cumulative return 9/30/1929–6/30/1932	Cumulative return 1973–1974	Cumulative return 9/30/1987–12/31/1987	Cumulative return 3/31/2000–12/31/2002	Cumulative return 9/30/2007–12/31/2008	Cumulative return 1/1/2003–9/30/2007
30% stocks 65% bonds 5% cash	7.18%	4.05%	14 of 84	–33.10%	–14.26%	–3.07%	4.95%	–8.00%	42.00%
50% stocks 50% bonds	8.23%	5.07%	17 of 84	–52.71%	–21.78%	–8.62%	–8.84%	–17.57%	55.69%
70% stocks 30% bonds	9.04%	5.85%	22 of 84	–67.45%	–28.11%	–14.39%	–22.13%	–26.69%	69.67%
90% stocks 10% bonds	9.67%	6.47%	23 of 84	–78.25%	–34.18%	–20.17%	–34.06%	–35.14%	84.46%

Sources: For U.S. stock market returns, we use the Standard & Poor’s 90 Index from 1926 through March 3, 1957, the Standard & Poor’s 500 Index from March 4, 1957, through 1974, the Wilshire 5000 Index from 1975 through April 22, 2005, and the MSCI US Broad Market Index thereafter. For U.S. bond market returns, we use the Standard & Poor’s High Grade Corporate Index from 1926 through 1968, the Citigroup High Grade Index from 1969 through 1972, the Lehman Brothers U.S. Long Credit AA Index from 1973 through 1975, and the Barclays Capital U.S. Aggregate Bond Index thereafter. For U.S. cash reserve returns, we use the Ibbotson 1-Month Treasury Bill Index from 1926 through 1977 and the Citigroup 3-Month Treasury Bill Index thereafter. Inflation is based on the Consumer Price Index from 1926 through the present.

in the Vanguard glide path because of the lower equity allocation, but had the highest ending wealth in the same significant downside event.

If we expect the risk-reward relationships of the past to prevail in the future, it makes sense that simulation output would conclude that higher allocations to riskier asset classes will lead to greater wealth accumulation and retirement income over an investor’s life cycle. If maximization of wealth is the primary goal, then a higher equity allocation would be an appropriate strategy. However, this does not account for the downside risk that investors would need to withstand on a short-term basis to realize the greater wealth accumulation over their entire life cycle. Conversely, if minimization of risk is the goal, simulation results would lean toward much more conservative allocations along the glide path.

Long-term investors are aware of near-term events

Our experience suggests that even some long-term investors pay attention to short-term downside risks during the holding period. **Figure 5** illustrates varying degrees of risk and return for different asset allocation strategies. It is important for the asset allocation strategy to maintain a balance between long-term growth potential and risk exposure. Focusing too much on return may subject the portfolio to significant fluctuations in value, while focusing too much on risk may result in inadequate expected returns.

Evaluating retirement income sufficiency

To evaluate the sufficiency of any TDF glide path, an adequate target for wealth accumulation needs to be made that can realistically be expected to meet a reasonable retirement spending goal. As a base case scenario, we follow standard practice in the industry, based on an “after-tax replacement rate methodology,” and assume an individual earning \$60,000 per year at age 65 will need to replace 78% of that age-65 salary, or \$46,800.⁶ An amount equal to 46% of the individual’s salary at age 65 (\$27,600) will come from Social Security, and an amount equal to 32% of that salary (\$19,200) will come from private sources. One way to perform this evaluation is to determine the probability of accumulating sufficient assets to purchase an immediate income annuity with an annual payout equal to the required income replacement needed from private sources.

The target level of wealth to purchase an appropriate annuity was identified as approximately \$298,000,⁷ or about five times the retiree’s \$60,000 ending salary. Importantly, this level of savings is roughly equivalent to the 5th-percentile outcome in all three glide paths. We note that while this exercise can be informative in terms of determining what level of guaranteed income could potentially be obtained from a pool of assets at retirement, very few individuals end up using their balances to purchase immediate annuities. If the investor chooses not to purchase an annuity, and decides to systematically draw down the portfolio in retirement, an additional evaluation can help to determine an adequate level of wealth accumulation and an appropriate asset allocation during retirement to support retirement spending goals. We again evaluate a retirement income need that will replace the same 32% of the investor’s preretirement income. Again, this translates to a spending need of \$19,200 annually, adjusted for inflation, for a person earning \$60,000 at retirement.

See the Appendix for a comparison of the material differences between an income annuity and a systematic withdrawal program.

Figure 6 shows the probability that each glide path will enable an investor to accumulate sufficient assets to purchase an annuity with the designated annual payout. The probability of meeting the retirement income objective through an annual systematic withdrawal is also shown.⁸ Under each retirement sufficiency evaluation, the Vanguard glide path provides probabilities of at least 90% of achieving the retirement income goal.

Of note, the probabilities of achieving retirement income needs are similar across different glide-path scenarios. In the annuity example, the probability of an investor accumulating sufficient assets to purchase an appropriate annuity is highest with the conservative glide path. This is because the price of the annuity is low relative to the accumulated assets of the investor, so assuming more equity risk in the more aggressive glide paths actually produces a marginally lower probability of success because of the increased likelihood that an investor will experience a downside event. However, if an investor requires a higher annual payout, or opts for an inflation-adjusted payout, the price of the annuity would be higher, and subsequently the investor would have a higher probability of success in one of the more aggressive glide paths, as a result of greater upside potential with higher equity allocations.

Similarly, an investor who decides to systematically draw down his or her portfolio has a slightly higher probability of success in the more conservative glide path through age 85. This is again the result of a conservative spending objective relative to a larger asset base. However, over a longer period, through age 95, the probability is slightly higher in the more aggressive glide paths. For this reason, an investor

6 For a further breakdown of replacement ratios at various preretirement salary levels, please see page 6 of Aon Consulting’s “2008 Replacement Ratios Study: A measurement tool for Retirement Planning.”

7 Note that in the annuity example, we do *not* assume payments are adjusted for inflation. We do this because in most private, corporate pension plans, annuity benefit payments are not typically adjusted for inflation. It has also been Vanguard’s experience that among investors who do choose to annuitize retirement assets, the vast majority do not choose inflation-adjusted payout options.

8 We also evaluate the glide-path success under a larger replacement-ratio assumption. An investor must replace 50% of ending salary from private sources (annual payout equal to \$30,000). A comparable annuity in this example would cost approximately \$465,000 or about eight times ending salary. In this scenario, a participant in the Vanguard glide path would have an 81% probability of accumulating sufficient assets to purchase an annuity.

Figure 6. Probability of achieving retirement income needs under different glide-path scenarios

	Systematic draw down		Cost of immediate annuity
	Positive balance at 85	Positive balance at 95	
More conservative glide path	96%	89%	96%
Vanguard glide path	95	90	95
More aggressive glide path	95	90	94

Source: Vanguard.

who decides to draw down his or her portfolio more aggressively would benefit from a more aggressive glide path. For example, if an investor decides he or she needs to replace 50% of ending salary from private sources, instead of 32%, he or she would have a 69% probability of positive wealth at age 95 in the more conservative glide path, and a 74% and 77% probability in the Vanguard and more aggressive glide paths, respectively. Because many investors have uncertain income requirements in retirement, Vanguard maintains a moderately higher equity exposure to counter the uncertainties of retirement spending. The upside potential of a slightly higher equity allocation is evident in the median wealth balance at retirement (see Figure 4 on page 6). This upside potential is also reflected in the terminal wealth balances (age 95) for the different glide paths, where an investor in the Vanguard glide path ended with 29.8X ending salary, compared with 20.8X and 40.7X for the more conservative and more aggressive glide paths, respectively.

The probability of success for achieving an appropriate wealth accumulation or systematic withdrawal objective, however, cannot be considered in isolation. For an investor to realize the projected outcomes, it is assumed that the investor remains invested in the glide path to retirement or, in the case of a systematic withdrawal program, beyond

retirement date, regardless of market environment.⁹ Base case simulations show that for each glide path, in the fifth-percentile observation for a systematic draw down, investors have a low probability—however a possibility—of depleting their assets before age 86.

Sub-asset allocation of the glide path: Diversifying within the major asset classes

Once the allocation among stocks, bonds, and cash across the life of the portfolio has been determined, the focus turns to sub-asset allocation—how to allocate across various types of stocks and bonds. For broadly diversified, balanced portfolios such as the Vanguard TDFs, exposure across all key sub-asset classes means the investor will always be able to participate in some of the stronger-performing sectors while also mitigating the negative impact of weaker-performing ones.

The level of equity exposure and the rate of change in that exposure as the investor ages are the most recognizable components of risk in TDFs and their most significant drivers of long-term performance. However, over shorter periods, performance differentials can stem not only from differences in the portfolio’s broad asset allocations but also from the portfolio’s relative allocation to sub-asset classes within stocks and bonds (Cole, Kinniry, and Donaldson, 2009). It is important for plan sponsors and investors to be aware of the trade-offs associated with various sub-allocations within both the more risky asset class (stocks) and the less risky asset class (bonds).

U.S. equity allocations

The U.S. equity allocation within the Vanguard TDF portfolios is weighted according to prevailing market capitalization. This means that the investor will always have exposure to all segments of the broad U.S. stock market (large-, mid-, and small-cap stocks; growth and value stocks) in the exact proportion in which they are represented in the market.

⁹ Vanguard research shows that among plan participants, pure target-date investors have been historically less likely to abandon equities in times of market volatility relative to non-target-date investors (Mottola and Utkus, 2009).

A higher savings rate increases the probability of retirement sufficiency

Given the highly uncertain nature of the capital markets, investors need to understand what can be controlled and what cannot be controlled. Stock and bond market returns cannot be controlled; however, the amount that an investor saves can be.

In **Figure 7** we examine the impact of changing an investor's contribution rate. Specifically, we assume that an investor stayed the course in the Vanguard glide path for the full 40-year accumulation horizon, all else being equal, but increased (decreased) the savings rate by 20%. For example, someone who had been saving 5% of salary is now saving 6% (4%). The additional capital accumulation for the increased savings scenarios provides a higher probability of achieving the retirement income goal than does exposure to a slightly more risky asset allocation by investing the baseline 5% of salary in the more aggressive glide path.

Therefore, to reliably increase the probability of retirement readiness, prudent portfolio construction must be accompanied by a diligent savings program.

Figure 7. Probability of achieving retirement income needs under different savings scenarios

	Systematic draw down		Cost of immediate annuity
	Positive balance at 85	Positive balance at 95	
Reduced savings rate	92%	85%	90%
Baseline savings	95	90	95
Increased savings rate	97	94	97

Note: Simulations assume Vanguard glide-path allocations.

Source: Vanguard.

A market cap-weighted index reflects the consensus estimation of each company's value at any given moment. In any efficient market, new information affects the price of one or more securities and is reflected instantaneously in an index via the change in market capitalization. Because current prices (and, hence, company values) are set based on current and expected events, market cap-weighted indexes represent the expected, theoretically mean-variance-efficient, portfolio of securities in a given asset class (Philips, 2010). Vanguard does not maintain a separate allocation to real estate investment trusts (REITs) within the TDFs. However, to the extent that REITs are part of the global equity portfolio, Vanguard includes exposure to REITs as part of the U.S. and non-U.S. equity allocations at their market weight.¹⁰

International equity allocations

Vanguard's TDFs diversify a U.S. stock portfolio with international stocks currently equal to 30% of the total equity allocation. While finance theory dictates that an upper limit should be based on the global market capitalization for international equities (currently approximately 55%), our research has shown that international allocations exceeding 40% have not historically added significant additional diversification benefits, particularly after accounting for costs. However, allocations between 20 – 40% historically have achieved most of the maximum diversification benefit. International allocations in this range offer a greater balance among the benefits of diversification, the risks of currency volatility and higher correlations, investor preferences, and costs, considering the targeted TDF audience. Within Vanguard's TDF's, non-US stocks are represented

10 For an empirical analysis of REITs, see Vanguard's publication "Commercial equity real estate: A framework for analysis" on institutional.vanguard.com.

by an index fund that seeks to track the performance of a benchmark index that measures the investment return of stocks in the developed and emerging markets, excluding the U.S.

U.S. fixed income allocations

Similar to our market-cap-weighted methodology within both U.S. equities and non-U.S. equities, we follow a market-proportional approach within the U.S. nominal investment-grade bond market to match its risk and return characteristics as an investor approaches retirement. We focus this allocation on nominal U.S. investment-grade bonds to provide diversification to the primary risk of a sizable equity exposure. High-yield bonds are not included in the allocation as they represent a small portion of the taxable U.S. bond market, and, at market weight, high-yield bonds would not significantly alter the risk and return makeup of a broadly diversified portfolio. If instead held at market overweightings, our analysis shows high-yield bonds have not historically provided meaningful diversification to a balanced portfolio, but they have increased average volatility and downside risk (if replacing investment-grade bond positions) or reduced average returns (if replacing equity positions). We conclude that adding this exposure to the TDFs would complicate the structure without providing meaningful benefits.

Investors cannot manage inflation risk—the risk that the returns earned across the investor’s time horizon will fall short of actual inflation—with certainty in a portfolio of traditional fixed income securities. That is because a bond portfolio’s “real” (inflation-adjusted) value falls when actual inflation exceeds the “expected rate” of inflation that was built into market interest rates at the time the investor purchased the bond. But with the advent of Treasury Inflation Protected Securities (TIPS), which provide for inflation-adjusted increases in both principal value and interest payments, investors can manage the extent to which their fixed income portfolios are subject to general inflation risk.¹¹

While the risk of inflation is prevalent throughout an investor’s life cycle, it’s primarily in the later stages that investors must focus on investment tools to provide some protection. This is because for investors in the accumulation stage, inflation protection can be effectively provided from salaries and higher real returning assets, such as equities. But once in retirement, it is much more difficult to add to a portfolio through additional earnings. As a result, investors must balance the need for preservation of their capital through bonds and cash, as well as preservation of their purchasing power. Given that inflation-protected securities adjust to changes in inflation quickly, TIPS are an appropriate substitute for a portion of the portfolio’s equity allocation during retirement.

Vanguard dedicates a portion of each TDF’s total fixed income allocation to U.S. Treasury Inflation Protected Securities as a diversifier in the more conservative portfolios, beginning five years prior to retirement and reaching a maximum allocation of 20% of the portfolio at age 72. As a result, for later-stage portfolios, the fixed income allocation combines a market-proportional allocation to nominal U.S. investment-grade bonds and a meaningful allocation to TIPS.

Since TDF portfolios use bonds as the primary diversifier vis-à-vis equities, it is important to recognize that the components of the bond allocation can contribute to the portfolio’s overall level of risk and to its return variability, particularly over shorter periods. Historically, the correlation between stock and bond returns has been low; however, in extreme market conditions, the correlation between equities and higher-risk, more aggressive bonds (i.e., corporate bonds) is much higher, which can diminish the diversification benefit of holding bonds as a general asset class. In an extreme down market, an explicit allocation to TIPS in the more conservative portfolios also provides a relative overweight to high-quality government bonds at a time when the investor can least afford the possibility that the bond allocation might react similarly to a portfolio’s equity allocation.

11 For a detailed discussion on Treasury Inflation Protected Securities, see The Vanguard Group (2006) and Wallick and Marshall (2009).

Cash reserves

As investors reach retirement age, an allocation to cash reserves provides further diversification and downside protection from short-term equity losses, then acts as a short-term inflation hedge for investors in their retirement years. The small allocation to cash reserves, beginning at age 65, reaches its maximum of 5% of portfolio at age 72. This additional level of diversification during one's retirement years reflects our belief that modest capital risk, income, and inflation protection are the primary goals of retirees.

Role of nontraditional asset classes

Nontraditional and alternative asset classes and investment strategies are also being used or considered for use in shaping the risk/return profiles of some TDFs. These nontraditional asset classes include REITs, commodities, private equity, emerging market bonds, and currency. Among the alternative investment strategies are long/short and market-neutral approaches. These asset classes and strategies can offer potential advantages compared with investing in traditional stocks, bonds, and cash, including:

- Potentially higher expected returns.
- Lower expected correlation and volatility vis-à-vis traditional market forces.
- The opportunity to benefit from market inefficiencies through skill-based strategies.

Although these potential advantages are often debated, it can be difficult to assess the degree to which they can be relied upon. This is even more evident for those strategies where investable beta is not available. Strategies such as long/short, market-neutral, and private equity largely depend on manager skill. Investors will therefore be subject to the distribution of manager skill, where success depends on consistently selecting top managers.¹²

An allocation to commodities provides another example of the complexity introduced with allocations to alternative assets. While recognizing

the historical portfolio diversification benefit of an allocation to commodities (specifically, commodities futures), we caution against making such an allocation solely on the basis of an extrapolation of historical commodity returns. The long-term economic justification for expecting significant, positive returns from a static, long-only commodities futures exposure is subject to ongoing debate. Other issues for consideration include the choice of indexing methodology and tax and regulatory issues surrounding the nature of the "income" generated by commodities futures positions within a mutual fund. An explicit allocation to commodities futures is not included in the Vanguard TDF portfolios given our current assessment of the risks, costs, and additional complexities involved.

Key implementation considerations

Active versus indexing

This is an age-old decision for investment professionals. Indexing offers broad diversification, low costs, market-like returns, and transparency. Indexing has been instrumental in reducing surprises and controlling risk. Costs are one of the few variables investors can control, and that cost advantage is especially important for TDFs (especially those that function as a plan qualified default investment alternative (QDIA)). Compared with index funds, actively managed mutual funds typically have higher management fees coupled with higher transaction costs. The higher fees often result from a portion of the management fee that must cover the research process. Higher transaction costs are attributable to the generally higher turnover associated with active management's attempt to outperform the market.

On the other hand, active management offers the opportunity to outperform the market, but it may involve higher costs and additional risks, including manager risk, security selection, and underperformance. Ongoing oversight of active managers may also be a more complex task from a fiduciary point of view because of these risks.

¹² For more detailed discussion on the use of alternatives, see Philips and Kinniry (2007) and for additional detail and empirical analysis of commodities as investments, see the Vanguard publication "Understanding Alternative Investments: The Role of Commodities in a Portfolio" on institutional.vanguard.com.

Active management may play an important role in other parts of a retirement plan for investors willing to accept the risks of active management in exchange for potential outperformance. Because, in aggregate, active managers can't all add value, whether to take active manager risk is a decision that we believe investors should make on their own. Indexed investing makes sense as a starting point for many investors, while low-cost active management can be a good choice for some.

In constructing the Vanguard TDFs, we strongly believe that any risks investors bear should be expected to produce a compensating return through time. Modern financial theory and years of financial practice lead us to conclude that diversified, broad-based index exposures are precisely this kind of compensated risk. While some active managers can add value at least some of the time, outperformance cannot be guaranteed.

Figure 8 provides a sense of how active management has performed on average—whether delivering positive or negative excess returns versus a benchmark. The data represents the median excess returns for active managers in the equity and fixed income segments, as well as the percentage of actively managed funds that underperformed their benchmarks for the 15 years ended December 31, 2009. For example, it shows that the median excess return for the active mid-cap growth category underperformed the benchmark by 375 basis points, whereas the large-cap value category outperformed by 8 basis points.¹³

If we look at the issue from a structural standpoint, index funds provide transparent investment options that result in high efficiency and broad diversification. Index funds can also offer plan sponsors and investors investments that can work over the long term, without the need to continually monitor performance and make changes because of capacity constraints, manager turnover, or loss of confidence in a manager.

Figure 8. Percentage of managers underperforming benchmark and equal-weighted excess returns of active managers: 15 years ended 12/31/2009

<i>Stock funds</i>			
Style	Value	Blend	Growth
Large	56%	83%	73%
	0.08%	(1.38%)	(1.04%)
Medium	99%	96%	98%
	(2.63%)	(2.51%)	(3.75%)
Small	84%	93%	76%
	(1.34%)	(3.11%)	(0.66%)

<i>Bond funds</i>				
Bond sector	Government	Corporate	GNMA	High-yield
Short	94%	99%	100%	93%
	(0.79%)	(1.61%)	(0.72%)	(1.02%)
Intermediate	80%	91%		
	(0.27%)	(0.83%)		

■ % underperforming adjusted for survivorship bias
■ Median fund excess return

Notes: Equity benchmarks are represented by the following indexes: Large-Cap Blend: S&P 500 from 1995 through November 2002, MSCI Prime Market 750 thereafter; Large-Cap Value: S&P 500 Value from 1995 through November 2002, MSCI Prime Market 750 Value thereafter; Large-Cap Growth: S&P 500 Growth 1995 through November 2002, MSCI Prime Market 750 Growth thereafter; Mid-Cap Blend: S&P Midcap 400 from 1995 through November 2002, MSCI Mid Cap 450 thereafter; Mid-Cap Value: S&P Midcap 400 Value from 1995 through November 2002, MSCI Mid Cap 450 Value thereafter; Mid-Cap Growth: S&P Midcap 400 Growth from 1995 through November 2002, MSCI Mid Cap 450 Growth thereafter; Small-Cap Blend: S&P Small Cap 600 from 1995 through November 2002, MSCI Mid Cap 1750 thereafter; Small-Cap Value: S&P Smallcap 600 Value from 1995 through November 2002, MSCI Small Cap 1750 Value thereafter; Small-Cap Growth: S&P Small Cap 600 Growth from 1995 through November 2002, MSCI Small Cap 1750 Growth thereafter.

Bond benchmarks are represented by the following Barclays Capital indexes: U.S. 1–5 Year Government Bond Index, U.S. 1–5 Year Credit Bond Index; U.S. Intermediate Government Bond Index, U.S. Intermediate Credit Bond Index; U.S. GNMA Index; U.S. Corporate High Yield Bond Index. Please note that long government and long corporate funds were excluded because of the small sample size and a duration mismatch with available long-term bond benchmarks. Because duration is the dominant return factor, small differences in duration between a fund (or group of funds) and an index can lead to significant out- or underperformance, independent of cost differentials.

Sources: Vanguard calculations using data from Morningstar, MSCI, S&P, and Barclays Capital. All figures are for 15 years as of December 31, 2009.

13 For a more detailed discussion of the relative performance of indexing versus active management, please reference Philips, 2010.

Packaged versus customized TDFs

One of the most important issues when it comes to custom versus packaged TDFs is deciding exactly what problem the TDFs are intended to solve. Posing it as a question: Are the TDFs trying to deliver an optimal investment option or a better default? In Vanguard's view, the primary value of TDFs is as a default investment. For plan sponsors interested in providing a truly customized suite of investment options for individual participants, a managed account program can be more effective than a limited set of "customized" TDFs. In contrast to a custom TDF program that makes assumptions about the participant base as a whole, managed accounts have the flexibility to consider the many factors that make every participant unique: income, spousal income, assets outside of the plan, risk tolerance, time horizon, etc.

Given that participant characteristics vary considerably from household to household, it is extremely difficult to add value by customizing a TDF to broad plan averages. With a packaged TDF, a TDF is constructed for the "typical" participant with a moderate risk tolerance. The funds are built this way because of the need to provide a single

investment option for all investors with a common retirement date. Packaged TDFs can be a cost-efficient approach to target-date investing because economies of scale allow fund companies to offer TDFs with relatively low expenses. Packaged investment plans also offer a measure of portability should a participant switch jobs or leave the workforce. Few employees remain with the same company for 40 years, so the ability to transfer the TDF into an IRA (or a new employer's plan, if the new employer offers the same funds) is a benefit.

Customization can involve higher expenses for custody, daily valuation, and participant education, given the absence of economies of scale for most plans. Sponsors should also keep in mind the limits of customization when trying to create the "optimal" single-fund investment option. For instance, plan sponsors and fund providers often assume that TDFs are being used as a one-stop investment plan, and they try to engineer the construction of the funds based on this assumption. Research has shown, however, that the majority of TDF adopters are contributing to both TDFs and other investment options.¹⁴

Conclusion

Target-date funds offer a portfolio created specifically for retirement investors. Vanguard TDFs have been designed by combining capital markets and portfolio construction research with our vast practical experience with investors to offer a diversified portfolio, professional portfolio management, and automatic

rebalancing at a low cost. Straightforward design and transparency, emphasizing an index-focused approach that keeps investment costs low, coupled with broad-based exposure to major asset classes, maximizes the usefulness of these funds for investors.

¹⁴ For a more thorough discussion, please see Utkus and Young (2009).

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Appendix

The simulation results displayed in this paper are based on the Vanguard Capital Markets Model (VCMM),¹⁵ and they use various standard assumptions about contributions, replacement ratios, and life-cycle allocations. This Appendix describes the basic assumptions involved and the main limitations of the asset returns simulation model.

I. Wage scale

Investor salary growth is modeled after the Social Security Administration's wage index. The SSA wage index is based on reported wages across workers' age spectrum 25–65 for low, medium, and high income earners. This wage scale allows us to trace the earnings progression of an average earner over a 40-year working career, accounting for factors such as career development. Therefore, as modeled, the average participant reaches a peak salary at age 55 (in real terms) and experiences a decline in real salary through the age of 65. In our life-cycle simulations, we also allow for 1.1% annual salary growth, on a real basis, in addition to the cross-sectional increase in the wage scale, which reflects the historical average productivity growth of the U.S. economy.

II. Glide-path allocations

The simulations use three different glide-path allocations, the Vanguard glide path, the more conservative glide path, and the more aggressive glide path. The Vanguard glide path reflects Vanguard's current allocations; the more conservative glide path reallocates 10% of the Vanguard glide path's equity exposure proportionately across all other asset classes; and the more aggressive glide path increases Vanguard's glide path's equity allocation by 10%, which is taken proportionately from the other asset classes.

III. Contribution rates

Age-specific contribution rates are derived from "How America Saves 2009," a report surveying the 3 million participants served by Vanguard's recordkeeping business. Contribution patterns account for the likelihood that investors will start with a lower savings rate in their early working years and increase their contributions as retirement approaches. Contributions start at approximately 5% at age 25 and increase to approximately 10% at age 65. In addition, the simulations include a company match of \$0.50 on the dollar up to 3% of salary, which is consistent with industry averages.

IV. Replacement ratios and drawdown scenarios

We follow industry convention in assuming that retirees will spend a percentage of their age-65 salary every year in retirement from a combination of Social Security benefits and investment income from private sources. The replacement ratio assumption (as a percentage of age-65 salary) is consistent with retirees maintaining the same standard of living enjoyed during their final working years. Replacement ratios vary by income level as Social Security makes up a smaller percentage at larger salaries. Vanguard draws on the work of Aon Consulting (with data taken from the U.S. Department of Labor's Bureau of Labor Statistics' Consumer Expenditure Survey) to assign appropriate replacement ratios based on retirees' age-65 income.

¹⁵ For a detailed explanation of the Vanguard Capital Markets Model, please see Wallick, Aliaga-Díaz, and Davis (2009).

V. Annuity examples

Annuity prices are quotes taken from Vanguard's Annuity & Insurance Services and represent the price of an immediate annuity with 50% survivor benefits and an annual payout equal to the required replacement ratio. These quotes were then adjusted upward by a longevity premium of 13% to account for longer life expectancies in future years, as cited by the Social Security Administration.

Asset returns

The asset return distributions are based on 10,000 simulations from VCMM. VCMM uses a statistical analysis of historical data to create forward-looking expectations for the U.S. and international capital markets.

The model uses index returns, without any fees or expenses, to represent asset classes. Taxes are not factored into the analysis. Inflation is modeled based on historical data from 1962 through 2009 and simulated going forward with the median and volatility displayed in **Figure A1**. U.S. stocks are represented by the Wilshire 5000 Composite Index; U.S. bonds are represented by the Barclays Capital U.S. Aggregate Bond Index (a former Lehman Brothers index); international stocks are represented by the Morgan Stanley Capital International Europe, Australasia & Far East (MSCI EAFE) plus Emerging Markets Index; inflation is calculated from the Consumer Price Index; and intermediate TIPS and cash are derived from underlying U.S. Treasury yield data from the Federal Reserve Board.

Figure A1. Annualized 75-year asset return distributions

	Median return	Standard deviation	Volatility in a given year	
			5th percentile	95th percentile
Domestic equity	9.6%	23.0%	-24.8%	51.3%
U.S. nominal bonds	5.5	5.8	-3.4	15.7
Inflation	3.0	2.7	-1.8	7.9
Cash (3-month T-bill)	3.8	1.5	1.3	6.6
International equity	9.6	23.0	-23.1	52.7
TIPS	4.7	5.0	-3.0	13.6

Figure A2. Asset class correlations

	Domestic equity	U.S. nominal bonds	Inflation	Cash (3-month T-bill)	International equity
Domestic equity	1				
U.S. nominal bonds	0.1	1			
Inflation	0	0.1	1		
Cash (3-month T-bill)	0	0.2	0.6	1	
International equity	0.7	0	0	0	1
TIPS	0	0.6	0.3	0.3	0

Disclaimers:

IMPORTANT: The projections or other information generated by Vanguard Capital Markets Model (VCMM) regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. VCMM simulation may vary over time with each use of the model.

The VCMM projections are based on a statistical analysis of historical data. Future returns may behave differently from the historical patterns captured in the VCMM. More important, the VCMM may be underestimating extreme negative scenarios unobserved in the historical period on which the model estimation is based.

Comparing an annuity and a systematic withdrawal plan

	Immediate-income annuity: Vanguard Lifetime Income Program Life-Only Fixed Annuity	Systematic Withdrawal Plan
Objective	To provide a fixed, guaranteed monthly payment for the life of the annuitant.	To gradually spend down a diversified portfolio that is managed for total return, rather than income. The goal is to provide some reasonable level of income over time.
Payments	Monthly; fixed, unless the annuitant chooses annual adjustments according to an inflation-based index or by a fixed percentage rate selected at the time of purchase.	Payments are normally made monthly. Strategies vary from simple percentage spending rules to more complicated Monte Carlo and tax-sensitive withdrawals. Investors' spendable income is not limited to portfolio yield, but can be based on initial capital and a portfolio's total return.
Costs and expenses	No initial sales loads, charges, or surrender fees. Fees are incorporated into the rate quoted at the time of purchase. Also, see "Taxes" below.	Expenses vary depending on the underlying assets involved.
Liquidity	None. The annuitant surrenders any claim to principal in exchange for the annuity.	Depends on the assets involved. In most cases, shares can be redeemed at any time.
Guarantees and safety	Payments are guaranteed based on the claims-paying ability of the insurance company that issues the annuity.	The investor receives no guarantees; payments and principal can go up or down significantly.
Fluctuation of principal	Not applicable, because the annuitant surrenders the principal.	Share prices can fluctuate significantly.
Taxes	Payments are generally treated as ordinary income. Annuities purchased with after-tax dollars will receive a partial return of capital in each payment. Some states may assess a one-time premium tax on annuity purchases.	Distributions may comprise any combination of income, capital gains, and return of capital.



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