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Vanguard's approach to target-date funds

Vanguard Research

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- Research indicates that many investors lack time for or interest in retirement planning.¹ Target-date funds (TDFs) are designed to help them build a professionally diversified portfolio and achieve their retirement goals.
- Vanguard TDFs are constructed based on investment best practices, including the principles of asset allocation, diversification, transparency, and a balance among risk, return, and cost.
- This paper provides an overview of Vanguard's methodology in designing its TDFs. It outlines our view of glide-path construction, asset-class diversification, and the potential benefits of passively managed implementation.

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

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. Both Vanguard research and other studies indicate that many investors lack time for or interest in retirement planning.² Even a motivated saver may make errors or fail to manage a portfolio's strategy effectively over time. TDFs address these challenges by simplifying the asset-allocation decision. Once an investor decides to invest in a TDF, subsequent decisions about portfolio construction and ongoing and life-cycle rebalancing are delegated to the fund's portfolio manager.

Notes on risk: All investing is subject to risk, including the possible loss of the money you invest. 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. Bond funds are subject to the risk that an issuer will fail to make payments on time, and that bond prices will decline because of rising interest rates or negative perceptions of an issuer's ability to make payments. Investments in stocks or bonds issued by non-U.S. companies are subject to risks including country/regional risk and currency risk. 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 workforce. 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. Investors should periodically monitor the portfolio to ensure it is in line with their current situation.

IMPORTANT NOTE: The projections or other information generated by the Vanguard Capital Markets Model[®] 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 results may vary with each use and over time. 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.

² Source: Ibid.

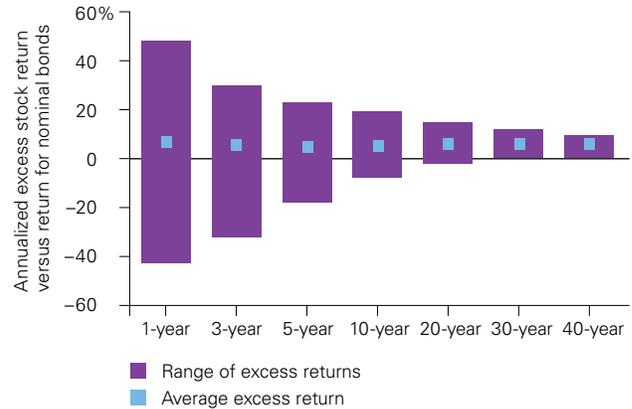
Asset-allocation glide path

Fundamentally, the investment case for Vanguard 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.

Regarding the first of these principles, two important considerations justify an expectation of an equity risk premium. The first is the historical record: In the past, stock market investors in many countries have been rewarded with such a premium. **Figure 1** shows historical returns for equities in excess of returns of nominal U.S. bonds over various time periods from 1926 through 2014.³

Figure 1 shows that stocks have provided higher average returns than bonds over all time horizons analyzed from 1926 through 2014—albeit with a greater propensity to underperform by significant amounts over shorter time frames. Historically, bond returns have lagged equity returns by about 4–5 percentage points, annualized—amounting to a sizable 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.

Figure 1. Historical equity risk premium over different time periods, 1926–2014



Notes: 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. U.S. stock market returns are represented by the Standard & Poor’s 90 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; the MSCI US Broad Market Index from April 23, 2005, through June 2, 2013; and the CRSP US Total Market Index thereafter. U.S. bond market returns are represented by the Standard & Poor’s High Grade Corporate Index from 1926 to 1968, the Citigroup High Grade Index from 1969 to 1972, the Lehman Brothers U.S. Long Credit AA Index from 1973 to 1975, the Barclays Capital U.S. Aggregate Bond Index from 1976 to 2009, and the Spliced Barclays U.S. Aggregate Float Adjusted Bond Index thereafter.

Sources: Vanguard calculations, based on data from Standard & Poor’s, Wilshire, MSCI, CRSP, Citigroup, and Barclays.

³ The expectation of a long-term equity risk premium was also corroborated by Dimson, Marsh, and Staunton (2002), who showed positive historical risk premiums for equities versus bonds in 19 countries since 1900.

The second reason for stocks' outperformance of bonds is forward-looking and theoretical: The long-term outlook for global corporate earnings remains positive. The fact that investors sometimes question this outlook because of the risks involved is precisely why stock investors should expect to earn higher *average* returns over the long run than those who choose less volatile investments.

The second strategic principle underlying Vanguard TDFs' construction—that younger investors are better able to withstand risk—recognizes that total net worth consists of both *current* financial holdings and *future* work earnings. The majority of younger individuals' ultimate retirement wealth is in the form of what they will earn in the future, or their human capital. Therefore, it may be appropriate for a younger person's portfolio to have a large commitment to stocks to balance and diversify his or her risk exposure to work-related earnings (Viceira, 2001; Cocco, Gomes, and Maenhout, 2005).⁴

The human capital theory doesn't explicitly state how quickly or in what proportion equity exposure should diminish without the addition of a variety of assumptions and caveats. It does, however, support the theoretical concept that equity allocations should decline with age to help manage risk through time. Widespread debate remains as to 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 offering TDF funds must make for their participants and that individual investors must make for themselves.

Glide-path construction approach

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 that engages in limited market-timing (Brinson, Hood, and Beebower, 1986; Davis, Kinniry, and Sheay, 2007). For that reason, Vanguard's TDF portfolio glide path, illustrated in **Figure 2**, represents a strategic allocation to a broadly diversified set of asset classes—not a tactical asset-allocation philosophy.⁵

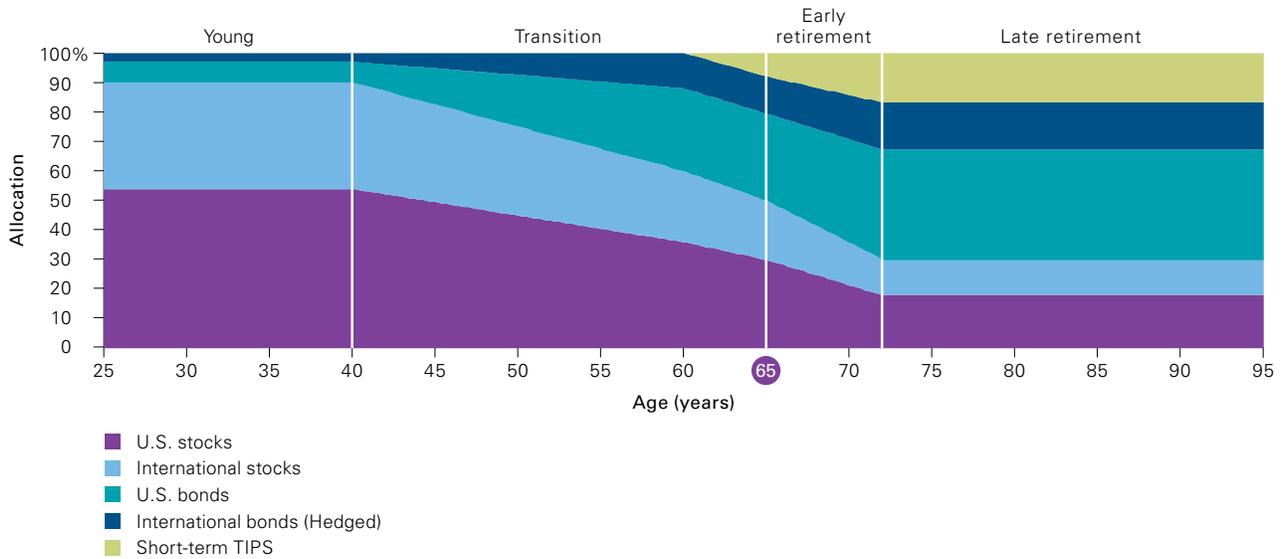
Vanguard TDFs take a long-term, strategic approach and are built to be highly diversified and low-cost—proven keys to long-term investing success. The funds' asset-allocation glide path was designed to help a typical investor who maintains a reasonable savings rate to reach his or her retirement goals 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 larger commitment to equities for young individuals, declining to a more modest allocation as the investor 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 until age 72 to compensate for the shifting balance between human and financial capital (see Figure 2).

⁴ For a more detailed discussion of these issues, see Bennyhoff (2008) and Ameriks, Hess, and Donaldson (2008).

⁵ 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 Shtekhman (2010).

Figure 2. Glide path for Vanguard target-date funds



Notes: Figure assumes that a particular fund was selected based on a projected target retirement age of 65. TIPS = Treasury Inflation Protected Securities (see discussion of TIPS later in the text).

Source: Vanguard.

To help meet retirees’ need for diversification and growth potential for a number of years in retirement to offset inflation, Vanguard TDFs still offer 50% equity exposure at an investor’s designated retirement year (including both U.S. and international stocks—see Figure 2)—which is gradually reduced over the next seven years to 30%. This allocation recognizes that, if absolutely necessary, most preretirees and recent retirees still have the ability—though far less so than younger investors—to alter their retirement plans, 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.⁶

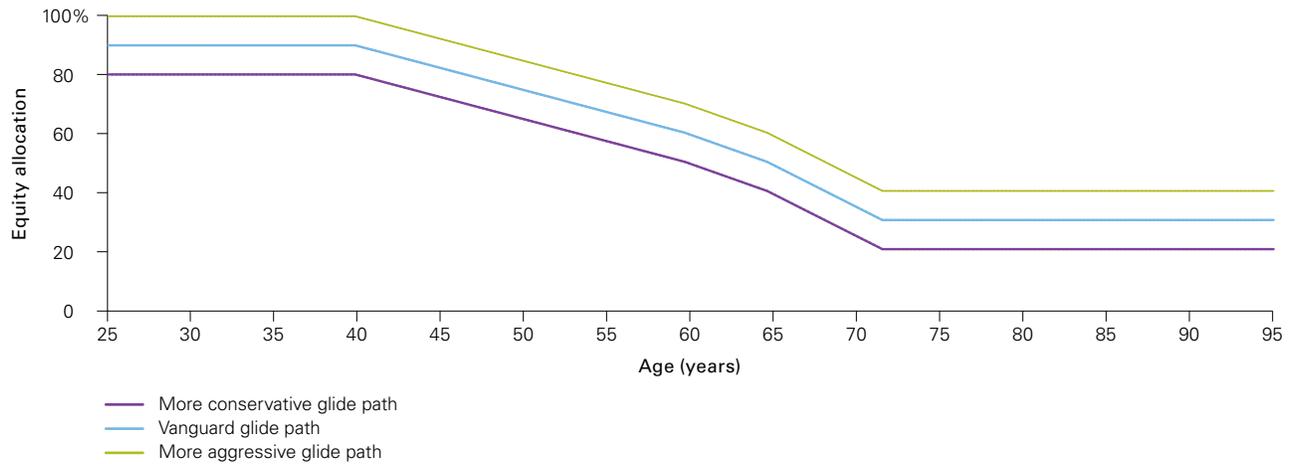
Simulated outcomes and measures of success

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 alternate risk–reward scenarios and the potential implications of different glide paths and TDF approaches.

⁶ 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 conducted similar exercises. See, for example, Viceira (2001) and Gomes and Kotlikoff (2008).

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

Glide-path equity allocations



Note: This hypothetical illustration 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, see Appendix I.

Source: Vanguard.

For example, **Figure 3** illustrates three different glide paths, including that of Vanguard TDFs. They begin with varying levels of significant equity exposure and end at retirement with ranges of more moderate levels of equity exposure.

Figure 4 compares the same glide paths under a baseline simulation yielding a predictable outcome. The more aggressive the path, the greater the wealth accumulation, on average. After contributing over a 40-year period, the median hypothetical Vanguard investor retired with 15.4 times his or her ending annual salary saved. Investors on the more aggressive glide path accumulated an additional 11% more for 17.1 times the investors’ ending salary saved. However, this required investors to assume

Figure 4. Average wealth accumulation at retirement under different 40-year TDF glide paths

	More conservative glide path	Vanguard glide path	More aggressive glide path
Median	13.8x	15.4x	17.1x
5th percentile	5.4x	5.2x	5.0x

Notes: This hypothetical illustration does not represent any particular investment. Numbers in this chart represent multiples of an investor’s ending salary at retirement. For example, an investor on the Vanguard glide path would accumulate assets equal to 15.4 times his or her ending salary, on average, over a 40-year investment period. See Appendix I for additional details on the simulation.

Source: Vanguard.

additional risk at all stages of their life cycle, as shown by the 5th-percentile multiple. The most aggressive glide path had the lowest ending wealth after a significant hypothetical downside event. Investors on the more conservative glide path accumulated about 10% less than the Vanguard investors because of the lower equity allocation but had the highest ending wealth in the same hypothetical 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 overall 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 (as just mentioned) on a short-term basis. Conversely, if minimization of risk is the goal, simulation results would lean toward much more conservative allocations.

Evaluating retirement-income sufficiency

To evaluate the sufficiency of any TDF glide path, we need to identify a target for wealth accumulation that can realistically be expected to meet a reasonable retirement-spending goal. As a base-case scenario, Vanguard follows standard industry practice based on an “after-tax replacement-rate methodology.” This assumes an individual earning \$60,000

per year at age 65 will need to replace 78% of that age-65 salary, or \$46,800, as an annual spending goal.⁷ 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 the investor accumulating assets sufficient 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 has been identified as approximately \$338,000,⁸ or about 5.5 times the retiree’s \$60,000 ending salary. Note that this level of savings is roughly equivalent to the 5th-percentile outcome of 5.2x in the Vanguard glide path. However, very few individuals end up using their balances to purchase immediate annuities.

If the investor chooses instead to systematically draw down the portfolio in retirement, an additional evaluation is needed to help determine an adequate level of wealth accumulation and an appropriate asset allocation during retirement. We thus again assumed a spending need of \$19,200 annually (32% of the investor’s preretirement income), adjusted for inflation, for a person earning \$60,000 at retirement. (See Appendix II for a comparison of the material differences between an income annuity and a systematic withdrawal program.)

⁷ For a further breakdown of replacement ratios at various preretirement salary levels, see Aon Consulting and Georgia State University’s *2008 Replacement Ratios Study: A Measurement Tool for Retirement Planning*.

⁸ Note that in the annuity example, we do not assume payments are adjusted for inflation. This is 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.

Figure 5. Probability of achieving retirement-income needs under different TDF glide-path scenarios

	Systematic drawdown		Cost of immediate annuity
	Positive balance at age 85	Positive balance at age 95	
More conservative glide path	97%	91%	95%
Vanguard glide path	96	92	94
More aggressive glide path	96	92	93

Source: Vanguard.

The far-right column of **Figure 5** compares the probability that each glide path will enable an investor to accumulate sufficient assets to purchase an annuity with the designated annual payout at age 65. The probability of meeting the retirement-income objective through an annual systematic withdrawal is shown in the other two columns.⁹ Here we have defined the objective as having a positive balance at the ages of 85 and 95, essentially enough to last through the retirement years. In each evaluation, the Vanguard glide path provides probabilities of at least 92% of reaching the goal.

Note that **Figure 5** shows that the probabilities of achieving retirement income needs are similar across scenarios. In the annuity example, the probability of success is comparable (though slightly lower) even along the aggressive glide path. This is because although the annuity’s price is low relative to the investor’s accumulated assets, the aggressive path assumes an increased likelihood of a downside event. At the same time, if an investor opts for a higher annual or inflation-adjusted payout, the price of the annuity would be higher. Subsequently, the investor would have a higher probability of success on one of the more aggressive glide paths as a result of the greater upside potential of higher equity allocations.

Over a longer period—through age 95—the investor’s probability of success is slightly higher on the more aggressive glide paths. For this reason, someone who decides to draw down his or her portfolio more heavily

Higher savings rate increases probability of retirement sufficiency

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

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

	Systematic drawdown		Cost of immediate annuity
	Positive balance at age 85	Positive balance at age 95	
Reduced savings rate	93%	86%	89%
Baseline savings	96	92	94
Increased savings rate	98	95	96

Source: Vanguard.

Figure 6 examines the impact of changing an investor’s contribution rate. Specifically, we assume that an investor stayed the course on the Vanguard TDF glide path for the full 40-year accumulation horizon, all else being equal, but increased (or decreased) the savings rate by 20%. For example, someone who had been saving 5% of salary is now saving 6% (or 4%). At both ages 85 and 95, the additional capital accumulation for the increased savings scenarios provides a higher probability of achieving the retirement-income goal (in **Figure 6**, 98% and 95%, respectively) than does exposure to a slightly more risky asset allocation by investing the baseline percentage of salary in the more aggressive glide path (in **Figure 5**, 96% and 92%, respectively).

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

⁹ We also evaluated glide-path success using a significantly more conservative assumption that an investor must replace 50% of ending salary from private sources (annual payout equals \$30,000). A comparable annuity in this example would cost approximately \$528,000, or about nine times ending salary. In this scenario, a participant on the Vanguard glide path would have a 77% probability of accumulating sufficient assets to purchase an annuity.

would benefit from such a path. For example, an investor who needs to replace 50% (instead of 32%) of his or her ending salary from private sources would have a 74% probability of sufficient wealth at age 95 on the more conservative path and a 78% and 81% probability on the Vanguard and more aggressive paths, respectively (not detailed in Figure 5).

Because many investors have uncertain income requirements in retirement, the Vanguard glide path maintains a moderately higher equity exposure. The upside potential of this is evident in the median wealth balance at retirement (see Figure 4). This potential is also reflected in the terminal wealth balances (at age 95) for the different glide paths in the base-case scenario. The Vanguard investor ends with 38x his or her salary, compared with 25.4x and 53.8x for the more conservative and more aggressive glide paths, respectively (not detailed in Figure 4).

The probability of successfully achieving an appropriate wealth accumulation or systematic withdrawal objective, however, cannot be considered in isolation. To realize the projected outcomes, it is assumed that the investor remains on the glide path until or, in the case of a systematic withdrawal program, beyond the retirement date, regardless of market environment.¹⁰ Base-case simulations show that for each glide path, in the 5th percentile observation for a systematic drawdown, investors have a low probability—but a possibility, nonetheless—of depleting their assets before age 89.

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

Once the broad allocation among stocks, bonds, and cash across the life of the portfolio has been determined, the focus turns to sub-asset allocation among various types of stocks and bonds. For broadly diversified, balanced

portfolios such as the Vanguard TDFs, exposure to all key sub-asset classes allows the investor to participate in some of the stronger-performing sectors while also mitigating the negative impact of weaker-performing ones.

The level and rate of change of equity 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 also stem 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 in both the more risky (stocks) and less risky (bonds) asset classes.

U.S. equity allocations

The U.S. equity allocation in 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.

A market-cap-weighted index reflects the consensus estimate 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 et al., 2015). Note that Vanguard does not maintain a separate allocation to real estate investment trusts (REITs) within the TDFs. However, we do include exposure to REITs as part of the U.S. and non-U.S. equity allocations at their market weights.¹¹

¹⁰ 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).

¹¹ For an empirical analysis of REITs, see Philips, Walker, and Zilbering (2011).

International equity allocations

After the decision is made to invest globally, the next step is to determine an appropriate allocation. The standard financial-theory approach is to invest proportionally—whether globally or within a specific country or market—according to market capitalization. This method assumes that markets are reasonably efficient and that stock prices reflect all the available information, investment positions, and expectations of the investing community. However, the benefits of diversification are front-loaded (i.e., adding 100 stocks to a 1,000-stock portfolio has more impact than adding 100 stocks to a 1,100-stock portfolio).

Our research has shown that allocations of 20% non-U.S. equities have provided about 85% of the maximum diversification benefit. Higher amounts such as 30% and 40% have provided more than 95% of this benefit. Allocations exceeding 40% would not have historically added significant additional diversification benefits, particularly when costs are taken into account. We believe non-U.S. equity allocations between 20% and full market-cap can be appropriate.

Although historical analysis strongly supports the benefits of increasing global diversification, it also demonstrates that the theoretically optimal portfolio often was NOT the actual optimal portfolio over a given period. Therefore, we also take into consideration other factors such as investors' home-country preference, costs, liquidity, concentration, and regulatory constraints. We believe that if these factors are reasonably balanced against the incremental diversification benefit achieved, further movement to market-capitalization weights—a forward-looking efficient-market portfolio—is prudent.

Vanguard TDFs currently diversify a U.S. stock portfolio with international stocks equal to 40% of the total equity allocation. Within the TDFs, non-U.S. stocks are represented by a market-cap-weighted index fund. This fund seeks to track the performance of a benchmark index that measures the investment return of stocks in the developed and emerging markets, excluding the United States.

U.S. fixed income allocations

Similar to our market-cap-weighted methodology for both U.S. and non-U.S. equities, Vanguard follows a market-proportional approach in the U.S. nominal investment-grade bond market to match the market's risk-and-return characteristics as an investor approaches retirement. We focus 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 because they represent a small portion of the taxable U.S. bond market and, at market weight, would not significantly alter the risk-and-return makeup of a broadly diversified portfolio.

Furthermore, Vanguard research has shown that overweighting these bonds compared to the market has increased average volatility and downside risk (if replacing investment-grade bond positions) or reduced average returns (if replacing equity positions) (Philips, 2013). Vanguard has thus concluded that adding this exposure to the TDFs would complicate the structure without providing meaningful benefits.

Hedged international fixed income allocation

The Vanguard TDF fixed income allocation also includes a hedged exposure to international fixed income, which is the largest asset class in the investable universe, representing about one-third of the global liquid market. As with other asset classes, we follow a market-proportional approach in the investment-grade international bond market.

Although risk factors such as interest rate fluctuations, inflation, economic cycles, and issues associated with changing or unstable political regimes may seem worrisome to U.S. investors, these should be viewed in the appropriate context. For example, although the bonds of any one country may be more volatile than comparable U.S. bonds, a portfolio that includes the bonds of many countries and issuers would benefit from imperfect correlations across those issuers.

It's also important to note that currency fluctuations account for a significant portion of the volatility in international bonds—volatility that is mitigated by Vanguard's decision to hedge this exposure. Vanguard research suggests that a strategic allocation to hedged international bonds can further moderate risk in a diversified portfolio (Philips et al., 2014). Accordingly, this asset class represents 30% of Vanguard TDFs' fixed income exposure.¹²

As it does when evaluating non-U.S. equities, Vanguard weighs factors including home-country preference, costs, liquidity, concentration, and regulatory constraints when assessing the appropriate allocation to non-U.S. fixed income. As with global stocks, we believe further movement to market-capitalization weights can be prudent. However, because of the differing risk-and-return characteristics of non-U.S. fixed income and equities, appropriate allocations to these assets may differ.

Short-term TIPS

In a portfolio of traditional fixed income securities, investors cannot, with certainty, manage inflation risk—the risk that the returns earned over time will fall short of actual inflation. 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. The availability of Treasury Inflation Protected Securities (TIPS) over the past two decades—providing inflation-adjusted increases in both principal value and interest payments—has given investors the opportunity to manage the extent to which their fixed income portfolios are subject to general inflation risk.¹³

Although the risk of inflation is always present, it's primarily in the later stages that investors must focus on tools to provide some protection. This is because 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. Therefore, investors must balance the need to preserve capital through bonds and cash with the need to preserve their purchasing power.

Because 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 research shows that shorter-term TIPS have historically displayed a higher correlation to realized inflation with less duration risk than longer-term TIPS. This can provide investors with a stronger inflation hedge and less duration risk—albeit at the cost of somewhat lower total expected returns (Davis et al., 2012). The primary purpose of TIPS in the near-dated funds is to provide inflation protection, not to boost returns.

Vanguard thus dedicates a portion of each TDF's total fixed income allocation to short-term U.S. TIPS as a diversifier, beginning five years before retirement and reaching a maximum allocation of approximately 17% of the total portfolio at age 72. In later-stage portfolios, the fixed income portion combines a market-proportional allocation within nominal U.S. and international hedged investment-grade bonds and a meaningful allocation to TIPS.

Because TDF portfolios use bonds as the primary diversifier for equities, it is important to recognize that the components of the bond allocation can contribute to the portfolio's overall risk level and 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 potentially beneficial 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 the equity allocation.

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 include an overweight to REITs, commodities,

¹² For a discussion of the role of hedged international fixed income in a diversified portfolio, see Philips et al. (2012)

¹³ For a detailed discussion of TIPS, see The Vanguard Group (2006), Wallick and Marshall (2009), and Davis et al. (2012).

private equity, emerging-market bonds, and currency. Among the alternative strategies sometimes included are long/short and market-neutral approaches. Each of these can offer 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.

These potential advantages are often debated, and it can be difficult to assess the degree to which they can be relied upon. This is even more evident for those strategies in which investable beta is not available.¹⁴ Strategies such as long/short, market-neutral, and private equity largely depend on manager skill; success will therefore be dependent upon consistently selecting top managers.¹⁵

Commodities provide another example of the complexity introduced with alternative assets. While recognizing the historical portfolio diversification benefit of including commodities (specifically, commodities futures), we caution against doing so solely on the basis of an extrapolation of historical 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 aspects to consider include the choice of indexing methodology and tax and regulatory issues surrounding the nature of the “income” generated by commodities futures positions in a mutual fund. Vanguard TDF portfolios do not explicitly include an allocation to commodities futures because of our current assessment of the risks, costs, and additional complexities involved.

Active versus indexing

Discussions regarding the active/passive decision have recently become more commonplace among investors and investment professionals. Indexing offers broad diversification, low costs, marketlike returns, and transparency. It has been instrumental in reducing surprises in investment performance and controlling risk. Costs are one of the few variables investors can control, and that cost advantage is particularly 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 attempting to outperform the market.

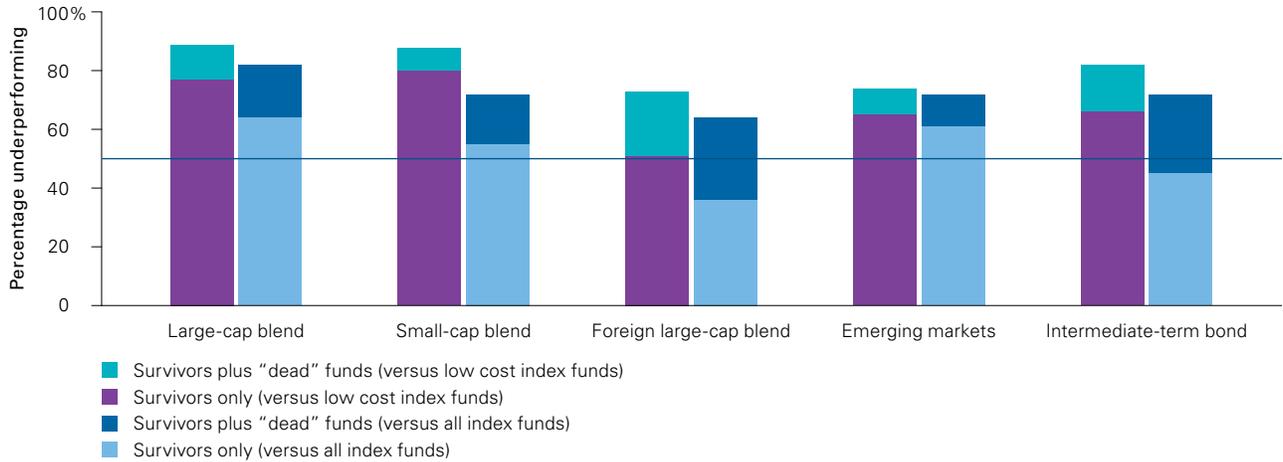
While active management does offer the opportunity to outperform, it may involve additional risks, including manager risk, security selection, and underperformance. Ongoing oversight of active managers may also be a more complex task from a fiduciary viewpoint because of these risks.

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

¹⁴ Beta refers to a measure of the volatility of a security or a portfolio relative to a benchmark.

¹⁵ For a more detailed discussion of the use of alternatives, see Philips and Kinniry (2007), and for additional details and empirical analysis of commodities as investments, see the Vanguard publication *Investment Case for Commodities? Myths and Reality* at <https://advisors.vanguard.com/iam/pdf/ICRMR.pdf>.

Figure 7. Percentage of active funds underperforming average return of index funds



Notes: Data are for the ten years ended December 31, 2014. The actively managed funds are those listed in the respective Morningstar categories. Low-cost index funds are represented by funds with expense ratios of 20 basis points or less as of December 31, 2014. Dead funds are funds that were closed or merged over the analysis period.

Sources: Vanguard calculations, based on data from Morningstar.

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 offer precisely this kind of compensated risk. While some active managers can add value at least some of the time, outperformance cannot be guaranteed.

Figure 7 demonstrates the relative success of indexed strategies when compared with their higher-cost actively managed counterparts. For this analysis, we look at the performance of active funds versus both the average return for all index funds and the average return for just low-cost index funds. Low-cost funds are defined as funds with an expense ratio of 20 basis points or less. We were limited in our evaluations by the existence of both indexed and active funds in each market. Therefore, we focused on large-cap blend stocks, small-cap blend stocks, foreign developed markets stocks, emerging markets stocks, and U.S. diversified bonds. The chart shows how difficult it can be for active managers to outperform their indexed peers, especially when accounting for funds that were closed or merged during the ten years ended December 31, 2014.

From a structural standpoint, index funds provide transparent investment options that result in high efficiency and broad diversification. They can also offer investments that can succeed over the long term without the need of a fund manager to continually monitor performance and make changes because of capacity constraints, manager turnover, or loss of confidence in a manager.

It is important to note that we compared actively managed funds to low-cost index funds because when it comes to passive fund management, it's not about picking just any index fund. To track the returns of a specific market or market segment, indexing strategies use quantitative risk-control techniques that seek to replicate the benchmark's return with minimal expected deviations (and, by extension, with no expected alpha). However, the target benchmark incurs no expenses, inefficiencies, or implementation costs. The return an investor receives on an index fund will reflect those implementation costs (transaction costs and other operational or trading frictions) and, therefore, should provide investors with the best proxy for the achievable or investable index return. Any investor seeking to capture the performance of a specific benchmark must acknowledge that not all indexed investment strategies are created equal before identifying and then investing in an appropriate product that seeks to track that index.

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 Vanguard's 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 can maximize the usefulness of these funds.

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Appendix I. About the Vanguard Capital Markets Model and study assumptions

Vanguard Capital Markets Model

The Vanguard Capital Markets Model (VCMM) is a proprietary financial simulation tool developed and maintained by Vanguard's Investment Strategy Group. The VCMM uses a statistical analysis of historical data for interest rates, inflation, and other risk factors for global equities, fixed income, and commodity markets to generate forward-looking distributions of expected long-term returns. The asset-return distributions shown in this paper are drawn from 10,000 VCMM simulations based on market data and other information available as of December 31, 2014.

The VCMM is grounded in the empirical view that the returns of various asset classes reflect the compensation investors receive for bearing different types of systematic risk (or beta). Using a long span of historical monthly data, the VCMM estimates a dynamic statistical relationship among global risk factors and asset returns. Based on these calculations, the model uses regression-based Monte Carlo simulation methods to project relationships in the future. By explicitly accounting for important initial market conditions when generating its return distributions, the VCMM framework departs fundamentally from more basic Monte Carlo simulation techniques found in certain financial software. Readers are directed to the research paper titled *Vanguard Capital Markets Model* (Davis et al., 2014) for further details.

Wage scale

Investor salary growth is modeled after the U.S. 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.

Glide-path allocations

The simulations use three different TDF 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.

Contribution rates

Age-specific contribution rates are derived from *How America Saves 2014* (The Vanguard Group, 2014), 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 per dollar up to 3% of salary, which is consistent with industry averages.

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.

Annuity examples

Annuity prices are for an immediate joint annuity for a 65-year-old male and female couple with an annual payout equal to the required replacement ratio and a 50% benefit to the survivor. These prices were estimated by Vanguard using a 3% discount rate and the "Annuity 2000" (as published by the Society of Actuaries) male/female mortality tables projected generationally with 100% of Scale G (as published by the Society of Actuaries) for males and 50% of Scale G for females. To estimate future annuity prices, these prices were then adjusted upward by 10% to account for longer life expectancies 40 years in the future, estimated from the same mortality tables previously mentioned. (See Appendix II, which compares an annuity with a systematic withdrawal plan.)

Asset returns

The asset-return distributions are based on 10,000 simulations from the 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 and simulated going forward with the median and volatility displayed in **Figure A-1**. U.S. stocks are represented by the Wilshire 5000 Composite Index; U.S. bonds are represented by the Barclays 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 A-1. Annualized 75-year asset-return distributions

	Median return	Standard deviation
Domestic equity	9.3%	19.6%
U.S. nominal bonds	4.6	6.1
Inflation	2.1	3.0
International equity	9.8	20.5
International bonds	4.6	5.1
Short-term TIPS	3.5	4.4

Note: TIPS = Treasury Inflation Protected Securities.

Source: Vanguard.

Figure A-2. Asset-class correlations

	Domestic equity	U.S. nominal bonds	Inflation	International equity	International bonds	Short-term TIPS
Domestic equity	1.0					
U.S. nominal bonds	-0.1	1.0				
Inflation	-0.2	0.2	1.0			
International equity	0.7	0.0	0.2	1.0		
International bonds	-0.1	0.6	0.0	-0.1	1.0	
Short-term TIPS	-0.2	0.7	0.7	0.0	0.5	1.0

Note: TIPS = Treasury Inflation Protected Securities.

Source: Vanguard.

Appendix II. Comparing an annuity and a systematic withdrawal plan

	Immediate-income annuity: Vanguard Annuity Access™ in collaboration with the Income Solutions® platform	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	Fixed payments are made monthly, unless the annuitant chooses annual adjustments according to an inflation-based index or 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	There are 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 consist of any combination of income, capital gains, and return of capital.

Note: There may be other material differences to consider.

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