



When age meets risk tolerance: Best practices for 529 investing

Vanguard Research

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- 529 college savings plans are designed to assist investors who are saving for the primary goal of college funding.
- Vanguard approaches the construction of 529 portfolios with an eye toward a number of investment best practices—the principles of asset allocation, diversification, transparency, and striking a balance among risk, return, and cost.
- This paper focuses on the application of those principles in the design of age-based 529 options, which manage the asset allocation according to the prospective student's age.
- As part of our overview of this methodology, we discuss rationales for glide path design, asset allocation, and diversification.
- In addition, we review Vanguard analysis supporting our suggested glide paths and portfolios. We consider the impact of asset allocation on wealth accumulation, as well as how annual savings levels affect the likelihood of meeting college savings goals.

Acknowledgments: This paper is an update of Vanguard research first published in 2012 as *Savings and Asset Allocation Decisions in 529 Plans: Vanguard's View* by Maria A. Bruno, Roger Aliaga-Díaz, Andrew J. Patterson, and Brad Redding. The current authors thank them for their extensive contributions and original research on this topic.

Vanguard's approach to 529 age-based investing

Vanguard's approach to 529 portfolio construction is based on the application of our core principles: developing a suitable asset allocation, creating clear investment goals, maintaining discipline, and minimizing costs.

Glide path portfolio construction includes quantitative analysis for metrics relevant to college savings, such as the potential ending wealth accumulation at beneficiary age 18 and the probability of meeting college costs. In addition, to assess risk tolerance and time horizon, it is important to understand and analyze college savers' behavior. For example, draw-down patterns are important considerations in determining the time horizon and the appropriate level of risk at the end of the 529 glide path. As a result, the glide path and portfolios we suggest are based on a consideration of quantitative and qualitative factors to find the appropriate risk–return balance.

Vanguard research (Bennyhoff, 2009) has shown that a portfolio's investment strategy should differ depending on whether the goal is to grow the portfolio to meet a future liability or to preserve its ability to pay for near-term liabilities. If the value of the liability is uncertain (i.e., future college costs), a diversified total-return strategy seeking higher real returns may be preferable.

For short-term liability planning (i.e., payments during college years), the emphasis should be on preservation of principal.

This concept is the foundation for the design of Vanguard's 529 age-based option. Stocks have a larger allocation when the beneficiary is further from college age; the bond allocation becomes dominant as the college years draw closer.

To offer investors flexibility and provide a solution better matched to investor risk tolerance, Vanguard suggests three age-based savings tracks: Aggressive, Moderate, and Conservative. With each of these tracks, the investor's account moves through a set of progressively more conservative investment portfolios. **Figure 1** shows the "glide paths" Vanguard recommends for these tracks—in other words, how the asset allocation shifts over time.

As depicted, each track begins with the allocation at age "0"—birth—and reduces the equity allocation in 12.5% increments over time. Note that a range of equity reduction rates may be appropriate, depending upon the plan sponsor's desire to maintain simplicity of the glide path allocations while managing investor risk aversion regarding larger steps.

Notes on asset-return distributions and risk

IMPORTANT: 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 will vary with each use and over time. For more information, see the Appendix.

All investing is subject to risk. Past performance is no guarantee of future returns. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index. Investments in bond funds are subject to interest rate, credit, and inflation risk. Foreign investing involves additional risks, including currency fluctuations and political uncertainty. Currency hedging transactions may not perfectly offset a fund's foreign currency exposures and may eliminate any chance for a fund to benefit from favorable fluctuations in those currencies. The fund will incur expenses to hedge its currency exposures. Diversification does not ensure a profit or protect against a loss. There is no guarantee that any particular asset allocation or mix of funds will meet your investment objectives or provide you with a given level of income.

A stable value investment is neither insured nor guaranteed by the U.S. government. There is no assurance that the investment will be able to maintain a stable net asset value, and it is possible to lose money in such an investment. U.S. government backing of Treasury or agency securities applies only to the underlying securities and does not prevent share-price fluctuations.

Figure 1. Vanguard’s 529 age-based glide path options



Note: These charts assume that the beneficiary’s account is opened at birth. For a beneficiary who enters the plan later, the account would be opened at the appropriate age on the glide path.

Source: Vanguard.

An introduction to 529s

Created by Congress in 1996, these plans take their name from Section 529 of the Internal Revenue Code, which governs them. They are typically sponsored by individual states but can also be sponsored by educational institutions. There are two types of 529s—savings plans and prepaid plans.

Savings plans, which are the focus of our paper, work much like retirement plans, in that the investor owns a tax-advantaged account whose portfolio value will fluctuate based on the underlying investments. Withdrawals are free of federal tax, and often state tax, as long as the money is used for qualified higher education expenses.¹ Prepaid plans, on the other hand, basically allow the investor to purchase college “credits” that may be used for in-state public college costs. These credits generally may be converted for use at out-of-state or private colleges.

For investors, the benefits of 529 savings plans include tax-advantaged growth, tax-free withdrawals, gift tax incentives, and, in some cases, state tax deductions

or credits. These accounts also offer flexibility in terms of high contribution limits, a range of investment options, and asset portability across plans.

The account owner retains control of the assets and can change the beneficiary to another eligible family member. Also, depending upon how the account is registered, in most cases the 529 is considered to be an asset of a parent or other account owner for determining financial-aid eligibility.

As of December 31, 2015, 529 savings plans held more than \$253 billion in direct and advisor-sold programs, according to College Savings Plans Network. Many plans offer a variety of investment types, including individual stock or bond funds, static balanced funds, and—our subject here—age-based options that set an asset allocation based on the child’s age and shift to become more conservative as the child approaches college matriculation.

¹ See IRS Publication 970, *Tax Benefits for Education*, for information on qualified withdrawals. The IRS also provides criteria for changing designated beneficiaries.

Beneficiaries who enter the plan at later ages start with the glide path allocation based on their age. Once the beneficiary reaches the end of an age band, the account shifts to the next more conservative portfolio near his or her birth date. This process not only moves the account to appropriate allocations in meaningful increments, it does so in a way that minimizes transaction costs at the portfolio level, thus helping to keep overall plan costs low.

Portfolio construction within the age-based tracks

Strategic asset allocation

Extensive research has shown that asset allocation is the most important determinant of the return variability and long-term performance of a broadly diversified portfolio engaging in limited market-timing (for example, Brinson and Hood, 1986; Scott, Balsamo, McShane, and Tasapoulos, 2016). For that reason, Vanguard's 529 age-based options, as illustrated in Figure 1, represent a strategic allocation to a broadly diversified set of asset classes—not a tactical or dynamic allocation predicated on timing systematic market and economic risk factors.

Passive vs. active strategies

Vanguard's recommended 529 glide path portfolios use passive strategies, with the exception of the cash portfolio. Indexing offers broad diversification, low costs, direct market exposure, and transparency. Although active management offers the opportunity to outperform the market, 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 viewpoint because of these risks.

Low-cost active management can play an important role in other parts of a college savings plan for investors willing to accept the risks. Investors must weigh whether to take on that added risk, as opposed to just assuming it as part of an age-based glide path.² Index investing makes sense as a starting point for many, while low-cost active management can be a good choice for some. Plan

sponsors may choose to offer active investment strategies as stand-alone portfolios outside of the age-based tracks.

Alternative assets

Vanguard does not recommend alternative assets in 529 glide path portfolios, because these assets typically add a layer of risks, often without commensurate benefit. These risks can include reduced liquidity and transparency, difficulty of effective risk attribution, wide dispersion of managers' returns, and higher fees. A common rationale for including alternatives in any portfolio is broader diversification. However, Vanguard research has found that investors may not benefit from the diversification when it is needed most—during the worst equity market environments. Because asset return correlations tend to converge during times of market stress, diversification benefits may wane for some asset classes, even those with low long-term average correlations to equity.

Equity suballocations

Vanguard believes that most investors are best served by obtaining stock exposure through broad-based, market-capitalization-weighted index funds. Diversification within asset classes is paramount because it reduces a portfolio's exposure to risks associated with a particular company, sector, or market segment. Owning a portfolio with at least some exposure to many or all of the key market components gives the investor a chance to benefit from areas that are performing well while mitigating the impact of weaker areas. Performance leadership is quick to change, and a well-diversified portfolio is less prone to swings based on any one segment.

Non-U.S. equity

With respect to non-U.S. equity, although historical analysis strongly supports the benefits of increasing global diversification, it also demonstrates that the mean variance optimal portfolio was not the market-cap-weighted portfolio.³ Our research has shown that allocations of 20% non-U.S. equities have

² Whether it is because of lack of time, interest or knowledge, glide path investors have chosen not to be actively engaged in portfolio construction decisions.

³ Non-U.S. market-cap weight has ranged from 31% to 71% of the total equity market since 1970. As of December 31, 2015, non-U.S. market-cap weight is approximately 50% of the total equity market.

provided about 85% of the maximum diversification benefit. Higher amounts, such as 30% and 40%, have provided more than 95% of this benefit. Therefore, in addition to market-cap weight, we also consider 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, non-U.S. equity allocations of between 20% and full market cap can be appropriate. We currently recommend 40% of equity be allocated to non-U.S. equities.

The portfolios in the age-based tracks obtain stock exposure through broad-based market-cap-weighted index funds. Therefore, the portfolios gain exposure to equity sub-asset classes such as REITs (real estate investment trusts) and emerging markets at the market weight of these securities in the indexes.

Fixed income suballocations

U.S. nominal bonds

Vanguard follows a similar market-proportional approach toward the U.S. nominal investment-grade bond market. As a result, we recommend that the portfolios match the U.S. nominal investment-grade bond market's risk–return characteristics, such as in credit quality, issuer type, and maturity.

The portfolios hold no high-yield (“junk”) bonds, for two reasons. First, high-yield bonds make up only a small portion of the taxable U.S. bond market and, if held at market weight, historically would not have significantly altered the overall risk–return makeup of a broadly diversified portfolio. Second, Vanguard

research has found that, historically, an above-market allocation to high-yield bonds would not have provided significant diversification benefit to a balanced portfolio but would have added volatility and downside risk (if replacing investment-grade bonds) or reduced average expectations for returns (if replacing equities).

Non-U.S. bonds

As with non-U.S. equity, we consider diversification benefits, market efficiency, costs, and home bias in determining the non-U.S. fixed income allocation. We currently recommend 30% of fixed income be allocated to hedged non-U.S. fixed income. As with non-U.S. equity, we believe further movement to market-capitalization weights can be prudent. However, because of the differing risk–return characteristics of non-U.S. fixed income and equities, appropriate allocations to these assets may differ.

Non-U.S. fixed income is the largest asset class in the investable universe, representing about one-third of the global liquid market. Risk factors such as interest rate fluctuations, inflation, economic cycles, and issues associated with changing or unstable global political regimes should be viewed in the appropriate context. 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 moderate risk in a diversified portfolio.

Inflation protection

Vanguard believes that in earlier stages of saving for college, the risk of inflation should be countered by the higher return potential of stocks. During the near-college/college years, however, the volatility risk associated with equities may begin to outweigh their potential for offsetting inflation. Investors at that stage must balance the need to preserve capital with the need to preserve purchasing power. For investors on the Conservative or Moderate tracks, Vanguard suggests inflation protection in this period be obtained from assets that are less volatile and quickly adjust to changes in inflation, such as short-term Treasury Inflation-Protected Securities (TIPS).⁴

Cash reserves

As beneficiaries reach college age and begin to use the plan assets for tuition and other expenses, capital preservation becomes a primary objective. Thus, Vanguard's suggested Conservative and Moderate age-based 529 tracks have an allocation to cash reserves at this point to preserve principal in the account.

Stable value products are a viable cash vehicle for 529 plans. Vanguard stable value funds seek to provide principal preservation by maintaining \$1 net asset values, while attempting to provide returns similar to those of short- or intermediate-term bond funds. The funds invest primarily in a combination of synthetic investment contracts (backed by high-credit-quality commingled trusts and mutual funds), traditional investment contracts, and cash.

If stable value products are not available to the plan sponsor, money market portfolios are also a viable cash option.

Evaluating the glide paths through simulations

In evaluating the Vanguard 529 age-based portfolio construction, we used the Vanguard Capital Markets Model to run 10,000 simulations representing various financial scenarios for each of the three glide paths. The simulation outcomes indicate the probabilities of given levels of return and wealth accumulation. The key assumptions of the simulations are:

- Annual contributions begin at birth and continue to age 18.
- Contributions are adjusted for inflation annually. (For simplicity, we have set the contribution level at \$1 a year in the examples here.)⁵
- All figures are adjusted for inflation based on the headline Consumer Price Index.
- Asset risk–return statistics are from VCMM projections. See the Appendix for information about the methodology used to create these projections.

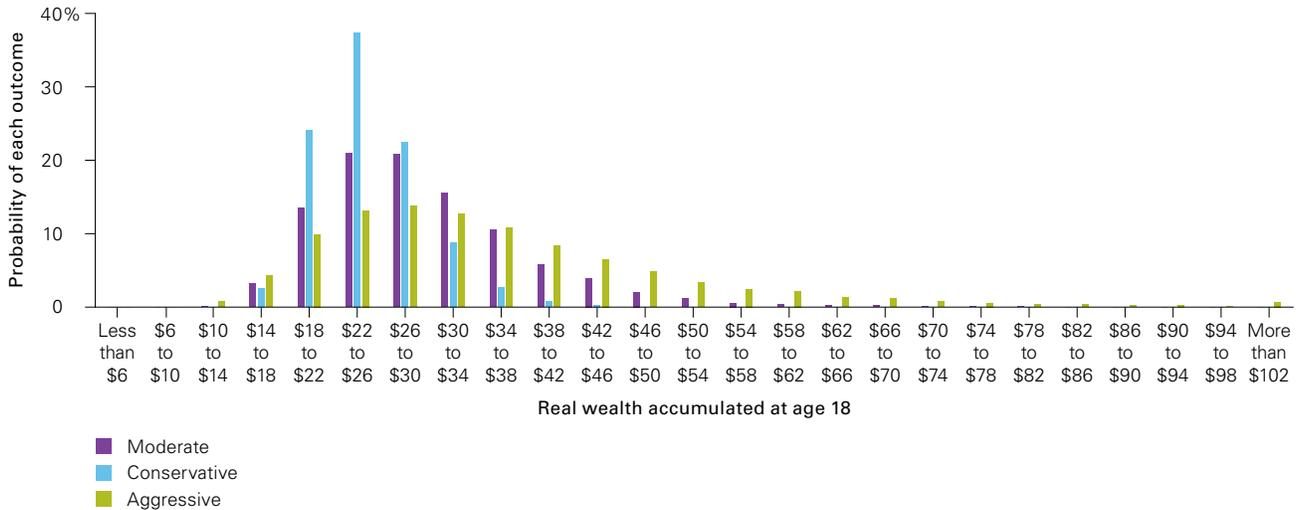
Figure 2 shows the results of the simulations in probabilistic terms. The horizontal distribution of the bars reflects the range of potential wealth accumulation outcomes for each track (Conservative, Moderate, and Aggressive), and the height of each bar indicates the likelihood of that outcome according to the VCMM. The results vary in predictable ways according to the allocations in each portfolio. Given the assumed total of \$18 in inflation-adjusted contributions, the median ending balance for the Conservative track was \$24.40, for the Moderate track, \$28.20, and for the Aggressive track, \$32.40.

⁴ TIPS are indexed to the Consumer Price Index: Urban Consumer (CPI-U) and are positively correlated with inflation. Short-term TIPS feature the same inflation protection mechanism as longer-maturity TIPS but are less volatile given their shorter duration. Although there is no “perfect hedge” for college inflation, allocating to short-term TIPS balances the desire for college inflation protection against the volatility risk from remaining too aggressive in equities and bonds in the years leading up to college.

⁵ Contributions in each simulation are adjusted each year based on the inflation rate projected for the preceding year. For example, if inflation is projected to be 3% in the first year, the contribution in the second year will be \$1.03. If inflation during the second year is then projected to be 2%, the contribution for the third year will be $1.03 \times (1 + 0.02)$, or approximately \$1.05, and so on.

Figure 2. When choosing a glide path, consider downside risk as well as upside potential

Simulation results: Wealth accumulation at age 18, per dollar of contribution



	Conservative	Moderate	Aggressive
Median	\$24.40	\$28.20	\$32.40
Mean	25	29.8	35.6
Standard deviation	4.5	8.8	15.7
Worst (5th percentile)	18.8	18.8	17.9
Best (95th percentile)	33.1	46.0	64.3
Probability of 5% decline in any year	9.4	14.2	18.4

Note: Calculations assume that contributions begin at birth and continue to age 18. Contributions start at \$1 and are adjusted annually for inflation. Standard deviation is a measure of the dispersion of the returns; specifically, the degree of variation of returns around the average.

Source: Vanguard, based on VCMM simulations. See the Appendix for more information on the VCMM.

As expected, the Aggressive track, which maintains a higher allocation to equities and retains exposure to them longer than the other tracks, has a much wider distribution of potential outcomes. On the other hand, the Conservative track has a much tighter distribution of outcomes but with the central tendency resulting in lower wealth accumulation at age 18.

A word of caution about the results in Figure 2 and subsequent analysis: It’s important not to be misled by the attractive-looking median, mean, and 95th percentile (upside potential) return estimates for the Aggressive track. Over an 18-year period, the higher stock allocations in this track expose the investor to considerably higher year-to-year variability, both positive and negative. As a result, both upside potential and downside risk are higher on the Aggressive path.

Note that the downside risk of this track, as measured by 5th percentile results, is higher (the wealth accumulation estimate is lower) than for the Conservative or Moderate track. The higher risk of the Aggressive track is also reflected in its higher standard deviation of return: 15.7% for the Aggressive track and 4.5% for the Conservative track. Note also that the probability of a 5% decline in assets is nearly double for the Aggressive track relative to the Conservative track.

The higher risk and larger equity allocations in the Aggressive track mean that—particularly for investors at later stages of the glide path—a large drop in the market in any one year could have negative implications for reaching college savings goals. If, for instance, an investor were to experience the kind of stock market plunge seen in 2008 with only two years until college matriculation, the account could be in a worse position than if it had been invested in the Moderate or Conservative tracks.

Savings considerations

Impact of contribution amounts

For 529 savers, outcomes depend largely on decisions about risk tolerance and contribution amounts. The Vanguard 529 College Savings Plan provides the three

age-based tracks based on risk tolerance (Conservative, Moderate, and Aggressive) as well as a range of individual portfolios at various risk levels for those who prefer a more hands-on approach.

In building 529 glide path portfolios, Vanguard also considers the major role that the level of account owner contributions plays. **Figure 3** shows the probabilities of meeting typical four-year college costs based on contribution scenarios using the age-based tracks.⁶

Figure 3 shows that, based on VCMM simulations, if investors in the Moderate track were to contribute an inflation-adjusted \$1,000 each year for 18 years, they would have a 0% probability of ending with enough savings to pay for tuition, fees, and room and board at a four-year, public in-state college—currently \$78,192 on average, according to the College Board. If those same investors instead contributed an inflation-adjusted \$4,000 annually for 18 years, they would have over a 92% probability of ending with a balance large enough to cover the average cost of such a college. This pattern is repeated for the other average cost levels shown; the larger the contribution, the greater the probability of ending with a balance large enough to cover the desired college cost.

⁶ These projections are based on the central tendencies of VCMM simulations and their potential risks. All investing involves risk, and as mentioned earlier, success in college savings also depends heavily upon the time horizon over which you are saving. If you are accumulating assets during a bear market, it will be more difficult to reach your goals than had you been investing during market upswings that provided strongly positive returns.

Figure 3. Increasing contributions provides greater benefits than assuming higher risk

Probability of accumulating at least the average college cost over 18 years

Average cost of tuition plus room and board in 2015–2016

	Annual contribution at start	Public		Private	
		In-state (\$78,192)	Out-of-state (\$136,124)	Average school (\$175,684)	Expensive school (\$217,212)
Conservative age-based track	\$1,000	0%	0%	0%	0%
	\$4,000	92%	4%	0%	0%
	\$7,000	100%	92%	43%	9%
Moderate age-based track	\$1,000	0%	0%	0%	0%
	\$4,000	92%	25%	7%	2%
	\$7,000	100%	92%	67%	36%
Aggressive age-based track	\$1,000	2%	0%	0%	0%
	\$4,000	92%	45%	22%	10%
	\$7,000	100%	92%	74%	54%

Note: These probabilities were calculated by the VCMM using the allocation glide paths shown in Figure 1 and applying projected asset class returns. Contributions are assumed to be made at the beginning of each year. In the probability calculations, all figures are adjusted for annual (forecasted) headline inflation. The average college costs are based on 2015–2016 data from the College Board and represent four years of tuition, room, and board.

Source: Vanguard, based on VCMM calculations. See the Appendix for more information on the VCMM.

Figure 3 clearly shows that the benefits of increasing contribution amounts outweigh those associated with moving into a more aggressive allocation track. For instance, changing the level of contributions from \$1,000 to \$4,000 within the Conservative track increases the probability of having a balance large enough to cover the

costs of a public in-state institution from 0% to 92%, but moving from a Conservative track to an Aggressive track while maintaining a \$1,000 contribution level increases the probability only from 0% to 2%.⁷

⁷ Note that for some contribution levels, the Aggressive track shows probabilities of success similar to the Conservative or Moderate tracks. This is because although the asset allocations in the Aggressive track have a higher expected return, they also carry a higher degree of risk, as discussed earlier. In some cases, the higher downside risk in the Aggressive track offsets the higher upside potential, resulting in similar probabilities of meeting costs for the Aggressive, Moderate, and Conservative tracks.

When constructing glide path portfolios, Vanguard considers varying contribution amounts and the trade-off between higher contributions and risk tolerance. We also suggest that account owners faced with a low probability of reaching college savings goals consider increasing their contribution amounts before increasing risk exposure.

College costs have increased at a higher rate than general inflation

Another important consideration with respect to college savings is the rate of college inflation relative to headline inflation. **Figure 4** shows the average annual increases in college costs in excess of headline inflation over

various ten-year periods in recent history. Not only has the escalation of college costs varied during these periods, but it has also varied across types of institution. Interestingly, over the past decade, the average cost of tuition and fees for a public four-year college has risen faster than that of a private four-year college (3.4% plus headline inflation versus 2.4% plus headline inflation). This may be attributable to decreases in funding for public institutions or to differences in spending from endowments.⁸

Figure 5 provides a more holistic view of the escalation in total college costs, showing how its growth has compared with headline inflation from 1977 to 2015.

Figure 4. College costs have risen faster than headline inflation

Average yearly increases in college costs above inflation over ten-year periods

	Tuition and fees			Tuition and fees plus room and board	
	Private nonprofit four-year	Public four-year	Public two-year	Private nonprofit four-year	Public four-year
1985–86 to 1995–96	3.5%	4.2%	3.9%	3.3%	2.1%
1995–96 to 2005–06	3.0	4.3	2.5	2.6	3.4
2005–06 to 2015–16	2.4	3.4	2.6	2.3	2.8

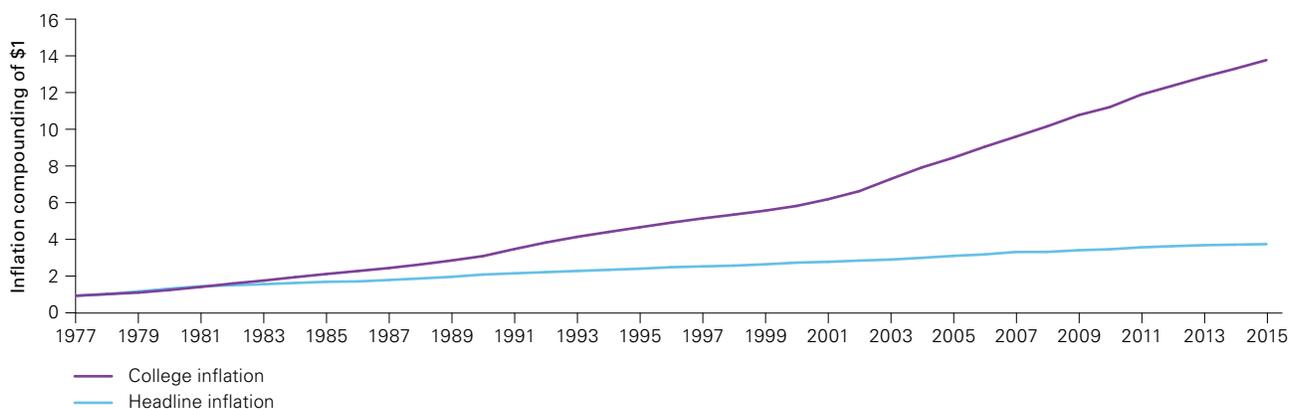
Source: The College Board, *Trends in College Pricing 2015*.

⁸ *Trends in College Pricing 2015* notes that substantial variations across states in pricing patterns make national averages particularly difficult to interpret.

Notice that starting in 1977, college costs begin to increase exponentially faster than the costs of other goods and services. Overall, college costs rose by an average of 7.1% a year from 1977 through 2015. This is an important point to consider when assessing how much college may cost in the future and, thus, how much one may need to accumulate in savings.

With respect to 529 glide path portfolios, the acceleration of college costs depicted in Figures 4 and 5 can be addressed in two ways: Portfolios can be higher risk with the objective of obtaining higher returns to help pay for college or lower risk with an assumption that some account owners will increase their level of contributions. These results highlight the benefit of having multiple risk-based glide path tracks in the 529 plan.

Figure 5. Headline inflation versus college inflation: Two very different paths



Note: Price index is re-based to 1 as of December 1977. Headline inflation is based on the Consumer Price Index (CPI). College inflation is based on the CPI: College Tuition and Fees.

Sources: Vanguard calculations, based on data from U.S. Bureau of Labor Statistics.

Net college costs

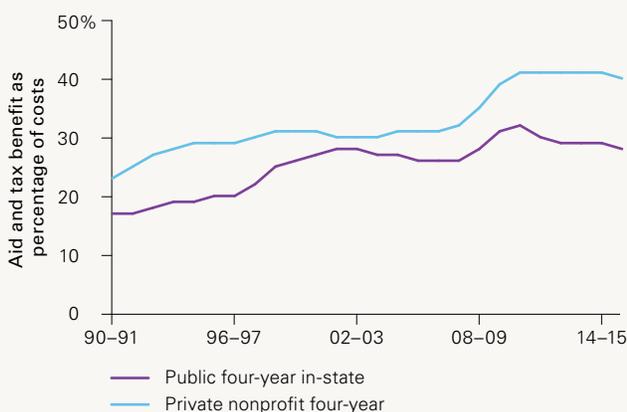
Although college tuition, fees, and room and board (TFRB) have increased fairly dramatically in the past 25 years, so has the percentage of college expenses subsidized by grant aid and tax benefits. As shown in **Figure 6a**, the percentage of total college costs covered by grant aid and tax benefits has risen since 1990, with current average levels of 28% for public colleges and 40% for private colleges.

As a result, after adjusting for aid and tax benefits, net TFRB rose at a much slower rate than gross college costs, particularly in the case of a private four-year education, as shown in **Figure 6b**.

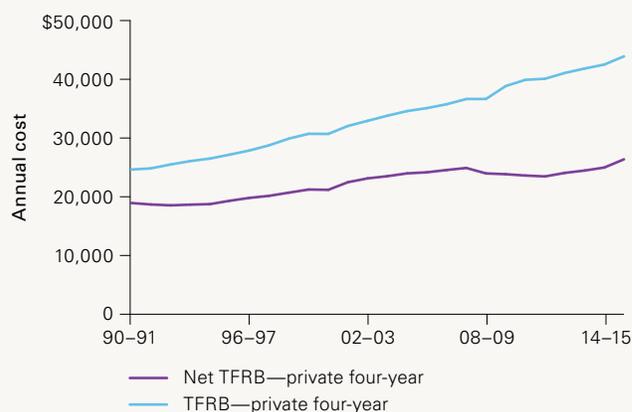
Because aid and tax benefits are uncertain, difficult to predict, and vary greatly based on individual circumstances, we do not suggest using average net TFRB for college savings planning, and we do not use it in our analysis for the glide path portfolios. We acknowledge, however, that what investors pay for college expenses could be considerably less than published gross tuition and other costs.

Figure 6. Grant aid, tax benefits help offset net college costs

a. Grant aid and tax benefits/college costs



b. TFRB net and gross



Note: College costs are based on 2015–2016 data from the College Board and represent the average for one year of tuition, fees, and room and board.
Source: Vanguard.

Conclusion

On the basis of Vanguard’s market and economic research applied to extensive 529-specific simulation modeling, we conclude that age-based investment tracks using portfolios grounded in traditional broad-based, market-proportional asset classes can serve as a prudent foundation for a college savings program. In forming our recommended glide paths, we consider not only quantitative historical and forward-looking analysis of key metrics but also

qualitative factors, such as investor behavior. The glide paths we suggest combine both to find the appropriate risk-and-reward balance.

Regardless of whether an investor selects an age-based 529 track or a static balanced investment option, our analysis also underscores the importance of balancing risk tolerance with a college savings plan that is based on realistic assumptions about college costs and college inflation.

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Appendix

The Vanguard Capital Markets Model 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 March 30, 2016.

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 *Vanguard Global Capital Markets Model* (Davis et al., 2014) for further details.

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For more information about any 529 college savings plan, contact the plan provider to obtain a Program Description, which includes investment objectives, risks, charges, expenses, and other information; read and consider it carefully before investing. If you are not a taxpayer of the state offering the plan, consider before investing whether your or the designated beneficiary's home state offers any state tax or other benefits that are only available for investments in such state's qualified tuition program. Vanguard Marketing Corporation serves as distributor and underwriter for some 529 plans.

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