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Savings and asset allocation decisions in 529 plans: Vanguard's view

Vanguard research

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Executive summary. 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 to a number of investment best practices—the principles of asset allocation, diversification, transparency, and maintaining 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 present considerations for investors as they determine their level of annual saving, and we examine college cost inflation, which in recent decades has far outpaced the rate of headline inflation.

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Vanguard's approach to 529 age-based investing

Vanguard offers aged-based investment options in several state 529 plans. In this paper, we draw our examples from the nationally branded Vanguard 529 College Savings Plan, which is sponsored by the state of Nevada.¹

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 farther from college, and the bond allocation becomes dominant as the college years approach.

To offer investors flexibility, the Vanguard 529 Plan offers 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" 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 25% increments over time, in an evenly stepped

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. 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.

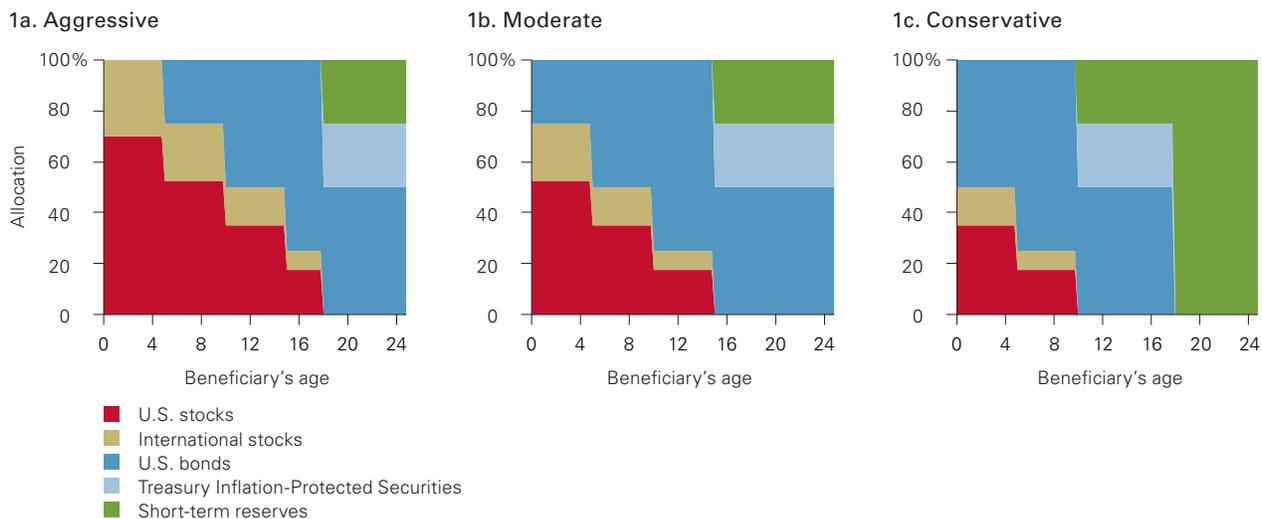
The Vanguard Income Portfolio and Vanguard Interest Accumulation Portfolio both invest in the Vanguard Short-Term Reserves Account, which, in turn, invests in Vanguard Prime Money Market Fund. The Vanguard Short-Term Reserves Account's investment in Vanguard Prime Money Market Fund is not insured or guaranteed by the Federal Deposit Insurance Corporation or any other government agency. Although the fund seeks to preserve the value of the investment at \$1 per share, it is possible that the Vanguard Short-Term Reserves Account may lose money by investing in the fund.

Notes on risk: All investing is subject to risk, including possible loss of principal. Past performance does not guarantee future results. Investments in bonds are subject to interest rate, credit, and inflation risk. While U.S. Treasury or government agency securities provide substantial protection against credit risk, they do not protect investors against price changes due to changing interest rates. Investments in stocks or bonds issued by non-U.S. companies are subject to risks including country/regional risk and currency risk.

In a diversified portfolio, gains from some investments may help offset losses from others. However, 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. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index.

¹ In reviewing any state 529 plan, investors who do not live in that state should consider whether their—or the beneficiary's—home state offers any state tax or other benefits that are available only in the home state's college-saving program. More information on college savings plans is available at Vanguard's online college center, vanguard.com/college.

Figure 1. Glide paths for age-based options in The Vanguard 529 College Savings Plan



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 sponsored by individual states. 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 too, so long as the money goes for qualified higher education expenses.² Prepaid plans, on the other hand, basically allow the investor to purchase college “credits” that may be used for in-state public college costs. They generally may be converted for use at out-of-state colleges or private colleges as well.

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 broad range of investment options, and 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.

At the end of 2011, according to Financial Research Corporation, 529 savings plans held more than \$144 billion in assets within 59 direct-sold plans and 36 advisor-sold plans. 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.

² See IRS Publication 970, *Tax Benefits for Education*, for information on qualified withdrawals. The IRS also provides criteria for changing designated beneficiaries.

path. 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 on his or her birth date. This process not only moves the account to appropriate allocations in meaningful increments, but 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

Asset allocation and diversification

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, Davis, Kinniry, and Sheay, 2007; Brinson and Hood, 2006). For that reason, Vanguard's 529 age-based options, as illustrated in Figure 1, represent a strategic asset allocation to a broadly diversified set of asset classes—not a tactical asset allocation, which would shift according to market conditions.³

Once the overall asset allocation has been determined, diversification within asset classes is paramount, reducing 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 whichever areas are performing well while mitigating the impact of weaker areas. Performance leadership is quick to change, and a well-diversified portfolio would be less prone to swings in performance based on any one segment. This is why Vanguard believes that most investors are best served by maintaining significant allocations to holdings associated with broad markets such as U.S. stocks, U.S. bonds, and international stocks.

To obtain exposure to these markets, the portfolios in Vanguard's 529 age-based glide paths use market-weighted index funds.⁴

In recent years we have seen increasing interest among some investors, institutional and individual, in adding alternative asset classes to the mix. They point to various analyses that show improvement in risk/return relationships, on average, over time. While adding alternative asset classes and strategies might lend an aura of sophistication to a portfolio, the reality is that investors may not actually benefit from the diversification. Vanguard research has highlighted the challenges of implementing some of these strategies (Philips, Walker, and Kinniry, 2012). One example is the "dynamic correlations" that can occur when, during times of market stress, diversification benefits may seem to vanish among some asset classes with low long-term correlations, often during a flight to quality. In addition, over-weighting sub-asset classes, such as REITs or high-yield bonds, may concentrate risk exposures in the portfolio.

Equity allocations

One primary way to diversify the equity allocation of a U.S.-based portfolio is through adding international exposure. Vanguard research has shown that, for many investors, an international allocation of 20%–40% of the stock portfolio is appropriate, given the historical benefits of diversification (Philips, 2012a). Thus, within the age-based options of the Vanguard 529 Plan, 30% of the equity allocation is invested in international stocks.

As previously discussed, the portfolios in the age-based tracks obtain stock exposure through broad-based, market-cap-weighted index funds. The portfolios therefore do not maintain a separate allocation to REITs (real estate investment trusts); instead, they gain exposure to REITs at the market weight of these securities in the indexes.

³ A tactical asset allocation strategy attempts to outperform the markets in the near term through allocation shifts meant to capitalize on apparent market trends. For a detailed discussion of these issues, see Stockton and Shtekhman (2010).

⁴ Because current prices (and thus company valuations) are 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, 2012b).

Fixed income allocations

Vanguard follows a similar market-proportional approach toward the U.S. nominal investment-grade bond market. The portfolios hold no high-yield (“junk”) bonds, for these reasons: First, high-yield bonds make up only a small portion of the taxable U.S. bond market and, if held at market weight, would not have historically significantly altered the overall risk and return makeup of a broadly diversified portfolio. Second, Vanguard research has found that an above-market allocation to high-yield bonds would not have historically provided significant diversification benefit to a balanced portfolio, but would have added average volatility and downside risk (if replacing investment-grade bonds) or reduced average expectations for returns (if replacing equities).

As noted earlier, Vanguard’s age-based 529 tracks eliminate stocks entirely by the time the student enters college. The investor’s account moves to an income-oriented portfolio that includes a 25% allocation to Treasury Inflation-Protected Securities, or TIPS. At earlier stages, the risk of inflation is countered by the higher return potential of stocks. During the college years, however, the volatility risk associated with equities begins to outweigh their potential for offsetting inflation, so investors at that stage must balance the need to preserve capital with the need to preserve purchasing power. TIPS adjust to changes in inflation quickly and thus are considered a viable addition at this stage.

Cash reserves

As beneficiaries reach college age and begin to use the plan assets for tuition and other expenses, capital preservation becomes paramount. Thus, all of Vanguard’s age-based 529 tracks have an allocation to cash reserves at this point to preserve principal in the account.

Evaluating the glide paths through simulations

In evaluating the Vanguard 529 age-based portfolio construction, we used the Vanguard Capital Markets Model® (VCMM) 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:

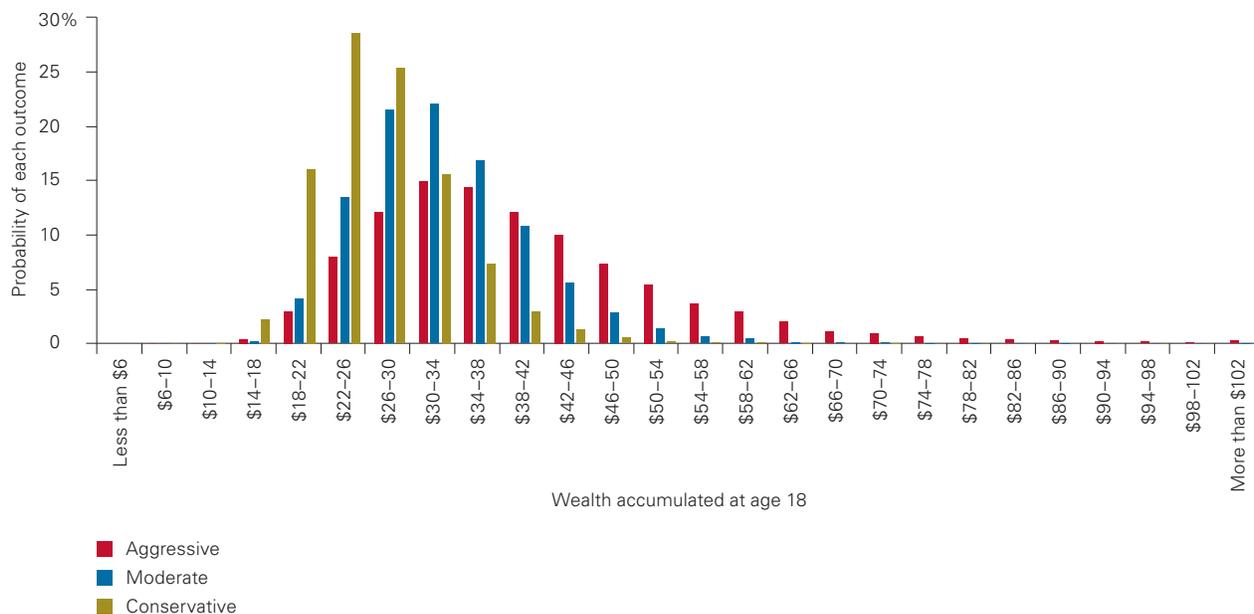
- Annual contributions begin at birth and continue up to age 18.
- Contributions are adjusted for inflation annually. (For simplicity, in the examples here we have set the contribution level at \$1 a year.)⁵
- All figures are adjusted for inflation based on the headline Consumer Price Index.
- The assumed rates of return are based on VCMM projections for the various asset classes in the glide path portfolios. See the Appendix for information about the methodology used in creating 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 \$26.40, for the Moderate track \$31.90, and for the Aggressive track \$37.20. (We provide more information about these simulations, including the best and worst results and the standard deviation for each track, in Figure 4a on page 8.)

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

Assuming a contribution of \$1 annually, adjusted for inflation



Notes: These probabilities were calculated by the Vanguard Capital Markets Model using the allocation glide paths shown in Figure 1 and applying projected asset class returns. Annual contributions are made at the beginning of each year, for a total of 18 contributions. The analysis assumes quarterly rebalancing within the asset allocations that make up each track. All figures are adjusted for inflation.

Source: Vanguard, based on VCMM calculations. (See the Appendix for details of the methodology and benchmarks used.)

As expected, the Aggressive track, which maintains a higher allocation to equities and retains exposure to them longer than the others, 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 outcomes 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. This means 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 would be in a worse position than if it had been invested in the Moderate or Conservative tracks, in which equity exposure is phased out earlier.

A look at “smoothed” versus “stepped” glide path design

Generally speaking, there are two ways to design an asset allocation glide path: a “smoothed” approach, in which reallocations occur fairly frequently (typically at least once a year), and a “stepped” approach, in which larger shifts are made less frequently, at specified ages. While each approach involves trade-offs that include business implementation considerations, we examine the investment implications below.

A question sometimes arises as to whether a stepped approach would leave investors more vulnerable to market fluctuations. For example, what if the predetermined timing of shifts meant that an allocation to equities would be shifted right at a stock market low point and potentially miss out on a subsequent equity rally?

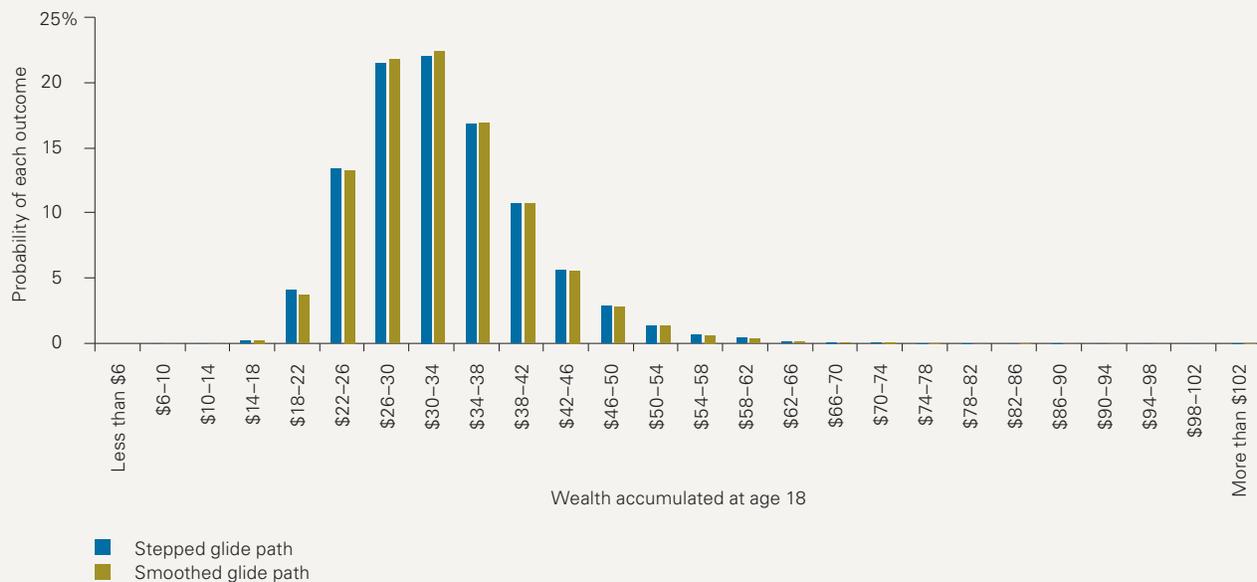
To examine possible outcomes, we used the same simulation analysis employed elsewhere in this paper to compare outcomes for stepped and smoothed

glide paths. The stepped paths are the three shown in Figure 1. We modeled smoothed glide paths that maintained the same average equity exposure as the stepped paths over the same time period, 18 years. We found that the differences in overall risk and return scenarios were mostly indiscernible.

Figure 3 shows the wealth accumulation outcomes for the Moderate track under both stepped and smoothed glide path assumptions, and Figures 4a and 4b, on page 8, show the tabular results for all three tracks. The median outcomes for the smoothed and stepped glide paths were very similar under extreme negative market outcomes (5th percentiles), with a difference of approximately \$0.20 in the Moderate track (\$22.50 versus \$22.30, respectively). As shown in Figure 4, the differences in volatility among the Conservative, Moderate, and Aggressive tracks are much greater than the differences between the stepped and smoothed glide paths.

Figure 3. Probability distribution for wealth accumulation at age 18 using stepped and smoothed glide paths

Based on simulation results for the Moderate age-based track, assuming a contribution of \$1 annually, adjusted for inflation



Note: Calculations assume that contributions begin at birth and continue up to age 18. Contributions begin at \$1 and are adjusted annually for inflation.

Source: Vanguard, based on VCMM calculations. (See the Appendix for details of the methodology and benchmarks used.)

Continued on page 8.

Figure 4. Statistics for wealth accumulation based on stepped and smoothed glide paths

Assuming contributions of \$1 annually, adjusted for inflation, over 18 years

4a. Stepped glide paths

	Conservative	Moderate	Aggressive
Mean	\$27.3	\$32.9	\$39.8
Median	26.4	31.9	37.2
Standard deviation	5.9	7.7	13.5
Worst (5th percentile)	19.1	22.3	23.1
Best (95th percentile)	38.0	46.6	64.3

4b. Smoothed glide paths

	Conservative	Moderate	Aggressive
Mean	\$27.3	\$32.9	\$39.8
Median	26.5	31.9	37.3
Standard deviation	5.8	7.6	13.4
Worst (5th percentile)	19.3	22.5	23.3
Best (95th percentile)	37.9	46.7	64.0

Note: Calculations assume that contributions begin at birth and continue up 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 details of the calculations and benchmarks used.

Why are the results so similar, given the swings that markets often experience? The answer is that market volatility is two-sided. While risk-averse investors are naturally focused on the downside, a portfolio following a stepped path is just as likely to shift out of equities at the peak of a bull market as at the bottom of a bear market.

In short, although investors may prefer a smoothed glide path over a stepped one, our analysis demonstrates that there is little in the investment merits of these alternatives that makes one materially better than the other. Figure 3 shows that differences in

mean, median, and volatility outcomes, as well as in the worst and best results for wealth accumulation, are statistically insignificant.

Moreover, if risk-aversion is the investor’s primary consideration, then choosing a more conservative glide path constitutes a better risk mitigation strategy than moving from a stepped to a smoothed option. The reduction in standard deviation when going from an Aggressive track to a Moderate or a Conservative track (in Figures 4a and b) is multiple times larger than the small change in standard deviation when looking at a stepped versus a smoothed glide path.

Figure 5. Probability of accumulating at least the average college cost over 18 years

Calculations assume adjustments for headline inflation in both annual contribution amounts and college costs

Annual contribution at start	Average cost of tuition plus room and board in 2011–2012			
	Public in-state (\$68,000)	Public out-of-state (\$119,000)	Private—average school (\$154,000)	Private—expensive school (\$183,000)
Conservative age-based track				
\$1,000	0%	0%	0%	0%
\$3,000	76%	3%	0%	0%
\$6,000	99%+	92%	53%	23%
Aggressive age-based track				
\$1,000	4%	0%	0%	0%
\$3,000	95%	41%	17%	7%
\$6,000	99%+	99%	89%	73%

Note: These probabilities were calculated by the Vanguard Capital Markets Model using the allocation glide paths shown in Figure 1 and applying projected asset class returns. The average college costs are based on 2011–2012 data from the College Board. Contributions are assumed to be made at the beginning of each year. In the probability calculations, all figures are adjusted for annual headline inflation.

Source: Vanguard, based on VCMM calculations. (See the Appendix for details of the methodology and benchmarks used.)

Considerations for implementation

Understanding the importance 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.

But in weighing investment options, 529 owners should not overlook the major role that their level of contributions plays. Certainly it is intuitive that if you save more, you improve your chance of ending with a bigger balance. But many investors may not realize just how big a difference it can make.

Figure 5 shows the probabilities of meeting typical four-year college costs based on contribution scenarios using two of the Vanguard age-based tracks.⁶ It's important to note that, in calculating these results, both the contribution amounts and the college costs were adjusted for headline inflation over 18 years.

Figure 5 shows that—based on the VCMM simulations—if investors in the Conservative track were to contribute an inflation-adjusted \$3,000 each year for 18 years, they would have a 76% probability of ending with at least enough savings to pay for tuition, fees, and room and board at a four-year public in-state college—currently \$68,000 on average, according to the College Board. If those same investors instead contributed an inflation-adjusted \$6,000 annually for 18 years, they would have over a 99% probability of ending with a balance large enough to cover the average cost of such a

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.

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.

Figure 5 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 \$3,000 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 76%, but moving from a Conservative track to an Aggressive track while maintaining a \$1,000 contribution level only increases the probability from 0% to 4%.⁷

When comparing these two tables, one must balance the trade-off between higher contributions and risk tolerance. If faced with a low probability of reaching one's college goal, we always recommend considering an increase in contribution amounts before considering an increase in risk exposure.

College costs have increased at a higher rate than general inflation

Figure 6 shows the 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 in these periods, but it has also varied across types of institution. Interestingly, over the past decade, the average total cost of a public four-year college has risen faster than that

of a private four-year college (4.1% plus headline inflation versus 2.4% plus headline inflation). This reversal from the prior pattern may be attributable to decreases in funding for public institutions or to differences in spending from endowments.⁸

Figure 7 provides a more holistic view of the escalation in total college costs, showing how their growth has compared to headline inflation from 1977 to 2011. Notice that starting in 1983, college costs begin to increase exponentially faster than the costs of other goods and services. Overall, college costs rose by an average of 7.60% a year from 1977 through 2011. 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.

The acceleration of college costs depicted in Figures 6 and 7 can be addressed in two ways: Investors can take on more risk in hope of obtaining higher returns to help pay for college, or they can increase the level of contributions to their accounts.

As the two charts clearly show, an investor trying to gauge how much money will be needed should think in terms of the rate of college inflation rather than headline inflation. If an investor chose to increase contributions at the rate of headline inflation (roughly 2%–3%), while tuition costs actually rose at a rate closer to the historical average of 7.60%, the investor could face a shortfall in meeting actual college costs. We've illustrated this scenario in Figures 8a and 8b, on page 12.

⁷ Note that, for each contribution level, the Aggressive track shows higher probabilities of success than the Conservative track. This is because the asset allocations in the Aggressive track have a higher expected return based on historical averages—but, of course, they also carry a higher degree of risk, as discussed earlier.

⁸ *Trends in College Pricing 2011* notes that for the fifth consecutive year, the percentage increase in average tuition and fees at public four-year institutions was higher than the percentage increase at private nonprofit institutions. The report also notes that substantial variations across states in pricing patterns make national averages particularly difficult to interpret.

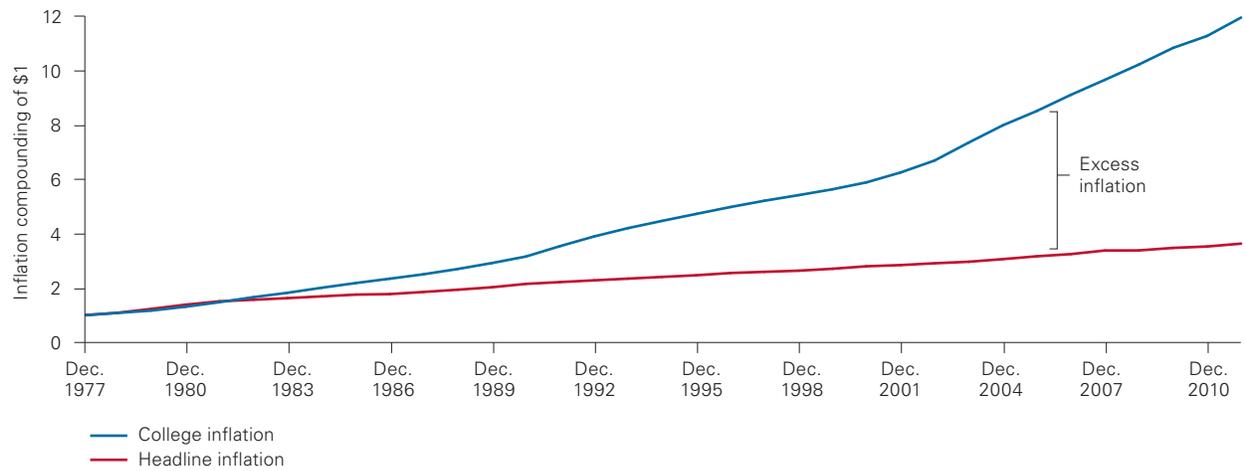
Figure 6. The average yearly increases in college costs above inflation over ten-year periods

Average annual percentage increases in inflation-adjusted published college prices

	Tuition 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
1981–82 to 1991–92	4.8%	4.5%	6.1%	4.2%	2.5%
1991–92 to 2001–02	3.1	3.2	0.5	2.6	2.4
2001–02 to 2011–12	2.6	5.6	3.8	2.4	4.1

Source: Data from College Board Advocacy and Policy Center, *Trends in College Pricing 2011*.

Figure 7. Headline inflation versus college inflation: Two very different paths

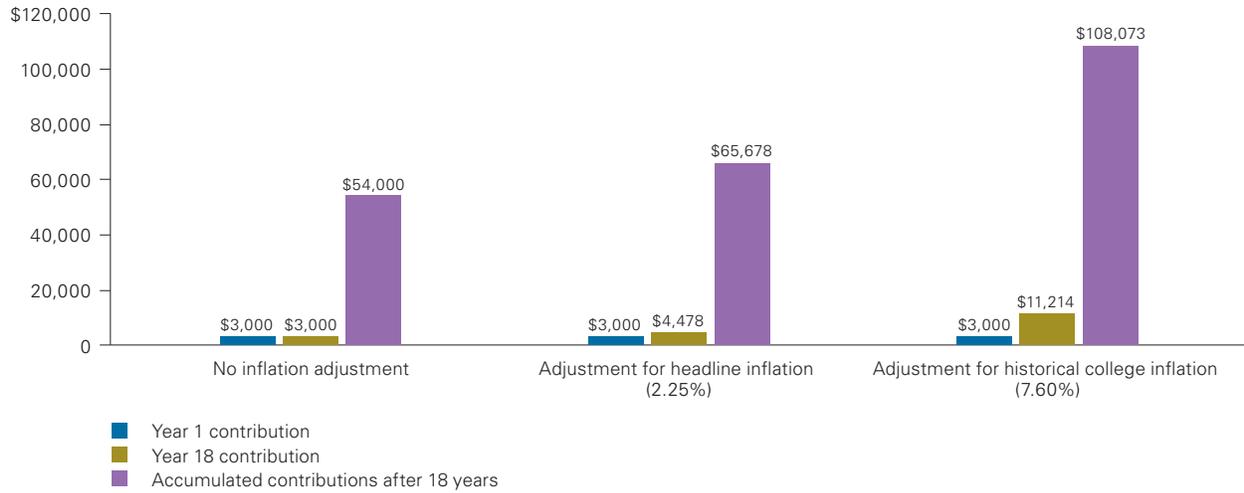


Note: Price index is re-based to 1 as of December 1977. Headline inflation is based on the Consumer Price Index (CPI). College inflation is based on the CPI: College Tuition and Fees.

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

Figure 8. The impact of inflation adjustments on savings: Headline inflation versus college inflation

8a. Differences in accumulated savings



Source: Vanguard.

8b. Probability of meeting college costs using the Aggressive age-based track if contributions are adjusted for headline inflation while costs rise at the college inflation rate

Contribution amount to start	Public in-state	Public out-of-state	Private—average school	Private—expensive school
\$1,000	0%	0%	0%	0%
\$3,000	10	0	0	0
\$6,000	83	18	5	2

Note: These probabilities were calculated by the Vanguard Capital Markets Model using the allocation glide paths shown in Figure 1 and applying projected asset class returns. Headline inflation is assumed to be 2.25% a year, which represents the approximate long-term average of the break-even inflation rate (the difference in yield between nominal and inflation-adjusted bonds). College costs are assumed to rise at 7.60% a year. Starting college costs are those shown in Figure 5.

Source: Vanguard, based on VCMM calculations and data from the College Board. (See the Appendix for details of the VCMM methodology and benchmarks used.)

The chart in Figure 8a ignores potential investment returns—it shows only how contribution levels and total savings would change given varying inflation adjustments. The first set of bars assumes that the investor makes no inflation adjustments; the second set assumes that the investor adjusts each year’s contribution for headline inflation of 2.25%; and the third set assumes annual adjustments of 7.60%, the historical rate of college inflation. Focusing on the contributions adjusted only for headline inflation, we see a savings shortfall of approximately \$42,000 when compared to the outcome for contributions adjusted for college inflation. In this case, the investor would need to hope for investment returns sufficient to make up the difference.

Figure 8b takes a different look at the implications of considering only headline inflation. Here we recalculate the probabilities of achieving various college costs through the Aggressive age-based path. The contribution levels are adjusted for headline inflation, as was done in the previous tables, but we adjust the college costs by the historical rate of 7.60%. If you compare these probabilities to those for the Aggressive track in Figure 5, where both contributions and college costs were adjusted for the same level of inflation, you will see a significant drop in the likelihood of achieving the goal amounts.

This discrepancy in results highlights the need to adjust annual savings rates with the likely rate of college inflation in mind.⁹ Rather than basing adjustments on the headline inflation rate of 2.25%, we suggest using a figure closer to the historical college inflation average of 7.60%. This will reduce the risk that the growth of a savings account will fall behind the rising costs of college. Increasing the level of saving is a much more dependable way to improve outcomes than relying solely on the markets for account growth.

A word on college costs

There are two ways to think about the price of college tuition—sticker price and net price. *Sticker price* is the full price that colleges report on their websites, for example. *Net price* represents the amount that students actually pay after accounting for grants and scholarships, and it can be much lower than the sticker price. When we discuss college costs in this paper, we are referring to the sticker price, based on national averages. We do this because the amount of grants and scholarships can vary widely by institution and prospective student. The College Board’s *Trends in College Pricing 2011* serves as a broad resource for national college costs.

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. 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.

In other words, to increase the probability of meeting college costs, Vanguard believes that a prudent choice of investment options must be accompanied by a diligent savings program.

⁹ Unless otherwise stated (as in Figures 8a and 8b), all of our results and explanations assume that inflationary growth in contributions is equal to inflationary growth in costs. If one assumes that contributions grow at 7.60% and costs grow at 7.60%, the resulting probabilities would be the same as if both contributions and costs were assumed to grow at 2.25%. For example, the probabilities in Figure 5 would be identical under either assumption—or any other, so long as the same rate of inflation is assumed for contributions and costs. In Figures 8a and 8b, we assume a difference in rates to highlight the issues associated with cost inflation being different from the rate used to determine the increase in contribution amounts.

References:

- Bennyhoff, Donald G., 2009. *Preserving a Portfolio's Real Value: Is There an Optimal Strategy?* Valley Forge, Pa.: The Vanguard Group.
- Brinson, Gary P., L. Randolph Hood, and Gilbert L. Beebower, 1986. Determinants of Portfolio Performance. *Financial Analysts Journal* 42(4): 39–48. Reprinted in *Financial Analysts Journal* (50th Anniversary Issue) 51(1): 133–38.
- College Board Advocacy and Policy Center, 2011. *Trends in College Pricing 2011*. Available online at trends.collegeboard.org/college_pricing.
- Donaldson, Scott J., and Maria A. Bruno, 2011. *Single-Fund Investment Options: Portfolio Construction Simplified for Investors*. Valley Forge, Pa.: The Vanguard Group.
- Davis, Joseph, Francis M. Kinniry Jr., and Glenn Sheay, 2007. *The Asset Allocation Debate: Provocative Questions, Enduring Realities*. Valley Forge, Pa.: The Vanguard Group.
- Philips, Christopher B., 2012a. *Considerations for Investing in Non-U.S. Equities*. Valley Forge, Pa.: The Vanguard Group.
- Philips, Christopher B., 2012b. *The Case for Indexing*. Valley Forge, Pa.: The Vanguard Group.
- Philips, Christopher B., David J. Walker, and Francis M. Kinniry Jr., 2012. *Dynamic Correlations: The Implications for Portfolio Construction*. Valley Forge, Pa.: The Vanguard Group.
- Stockton, Kimberly A., and Anatoly Shtekhman, 2010. *A Primer on Tactical Asset Allocation Strategy Evaluation*. Valley Forge, Pa.: The Vanguard Group.
- Wallick, Daniel W., Roger Aliaga-Díaz, and Joseph Davis, 2009. *Vanguard Capital Markets Model*. Valley Forge, Pa.: The Vanguard Group.

Appendix

The Vanguard Capital Markets Model

The Vanguard Capital Markets Model (VCMM) is a proprietary, state-of-the-art financial simulation tool developed and maintained by Vanguard's Investment Counseling & Research and Investment Strategy Groups. 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, 2011.

The VCMM is grounded on 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. The reader is directed to the research paper *Vanguard Capital Markets Model* (Wallick et al., 2009) for further details.

Asset allocation and return assumptions:

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 2011 and simulated going forward.

Benchmarks used in the calculations: The returns used in the simulations are based on data for appropriate market indexes.

For U.S. bond market returns, we use the Standard & Poor's High Grade Corporate Index from 1960 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 U.S. Aggregate Bond Index thereafter. For high-yield bond returns, we use the Barclays U.S. Corporate High Yield Bond Index from 1983 to the present. We calculate TIPS returns using constant-maturity yields provided by the U.S. Federal Reserve in its statistical release H.15 and core PCE (personal consumption expenditures) inflation. We calculate cash returns on the basis of 3-month constant-maturity yields dating back to 1960, also provided by the Fed in release H.15.

For U.S. stock market returns, we use the S&P 90 from 1926 through March 3, 1957; the S&P 500 Index from March 4, 1957, through 1974; the Dow Jones Wilshire 5000 Index from 1975 through April 22, 2005; and the MSCI US Broad Market Index thereafter. For international stock market returns, we use the MSCI EAFE Index from 1970 through 1988, and a blend of 75% MSCI EAFE Index/25% MSCI Emerging Markets Index thereafter. For REIT returns, we use the FTSE NAREIT US Real Estate Index from 1972 to the present. For commodity returns, we use the Dow Jones-UBS Commodity Index from 1991 to the present.



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