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Time-varying asset allocation: Vanguard's approach to dynamic portfolios

- Time-varying asset allocation (TVAA) can increase an investor's chances of investment success by dynamically altering a portfolio's positioning based on medium-term forecasts, such as over the next decade. TVAA differs from tactical asset allocation (TAA), which focuses on the very near term, often relies on economic opinions or qualitative views, and assumes superior information to counterparties.
- Our methodology is designed for investors seeking to grow their wealth over time. TVAA balances risk and return to pursue higher wealth accumulation while managing the range of potential outcomes an investor may experience, which we call "risk-adjusted alpha." The methodology is outlined in a step-by-step repeatable process, built on the framework of the Vanguard Asset Allocation Model (VAAM), and is designed to provide risk management as much as return enhancement.
- The VAAM (Aliaga-Díaz et al., 2019) uses proprietary capital market forecasts from the Vanguard Capital Markets Model® (VCMM) to simulate a range of potential outcomes (including returns, volatility, correlations, and covariances) for the asset classes in our portfolio optimizations in a distributional and probabilistic manner. Therefore, because the TVAA allocations rely on the time-varying returns from the VCMM, an investor must be willing to bear model risk.

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Introduction

In this paper, we outline a step-by-step, repeatable process to create TVAA portfolios built for investors seeking to grow their wealth through risk-adjusted alpha,[1] which we define as simultaneously pursuing higher median returns while narrowing the uncertainty around potential outcomes that an investor may experience. These potential value-added returns are made possible by the fact that returns for stocks, bonds, and their sub-asset classes deviate materially from their long-term averages over the medium term, defined here as the next decade; and that there is a directional relationship between the "fair value" of these asset classes at a given point in time and their future realized returns.

Vanguard's portfolio construction framework (Aliaga-Díaz et al., 2022) establishes the use of TVAA as a suitable investment methodology for investors pursuing financial goals, such as return-target portfolios, risk-hedging strategies, or general wealth-growth goals. This TVAA methodology consists of using the VAAM in combination with medium-term, time-varying return expectations from our VCMM to recommend portfolios that change with different market conditions.

Prevailing market conditions can impact portfolios and ultimately undermine investors' success over the medium term. Examples in the past few decades include the stretched equity market valuations of the late 1990s, persistently low interest rates in the 2010s, and the more recent high-inflation regime post-COVID-19. Investors who are willing to go beyond broad equity and bond market beta exposures, and who have the risk tolerance to take on model forecast risk, may benefit from adjusting their portfolio allocations when market conditions materially change. Accordingly, TVAA is designed to provide risk management as much as return enhancement.

TVAA differs from common tactical portfolio approaches in the industry and is philosophically aligned with Vanguard's investment principles.[2] The VCMM provides a rigorous statistical framework that captures the full distribution of medium-term outcomes (returns, volatility, correlations, and "fat tails," or non-normal assumptions) for the asset classes under consideration in the portfolio construction process. The VCMM forecasts are medium-term asset return *distributions*, rather than short-term *point forecasts*, and are the key driver of our TVAA portfolios. VCMM signals have a risk interpretation, signaling potential portfolio risks over medium-term horizons in addition to opportunities. In this way, our TVAA methodology accounts for portfolio risks, including both market risk and model forecast risk.

1 See Schlanger, O'Connor, and Ahluwalia (2021) and Zhu et al. (2023) for examples of income-target or return-target TVAA portfolios.

2 Typically, TAA seeks to outperform benchmarks via the timing of asset and sub-asset class prices over the short term.

Misconceptions regarding TVAA

There are two common misconceptions regarding TVAA that can often get in the way of its successful implementation:

Misconception #1: TVAA is the same as TAA.
The first misconception is that TVAA is short-term focused, similar to TAA. While both TVAA and TAA involve making portfolio adjustments based on new information, they differ in many respects, as shown in **Figure 1**. TAA often focuses on short-term market and economic analysis, while assuming that forecasts have high accuracy and that the information is superior to counterparties.

TVAA, on the other hand, seeks to harvest time-varying risk premia over longer periods of time such as the next decade, is focused on managing a range of potential outcomes, and considers an investor's willingness to take risk in the pursuit of higher returns. TVAA is based on a repeatable process and sits on a spectrum between TAA and strategic asset allocation (SAA). The distinction between TAA and TVAA is not new. Over 30 years ago, Bogle (1994) described market-timing (another common name for TAA) portfolio strategies as either based on intuitive judgment, technical factors, and/or optimism and pessimism, while drawing a contrast with longer-term, time-varying strategies based on a quantitative assessment of the fundamental valuations of the stock and bond markets and the implications for returns over the next decade.

FIGURE 1

Time-varying asset allocation sits between tactical and strategic asset allocation

	Tactical asset allocation	Time-varying asset allocation	Strategic asset allocation
Source of portfolio value	Seeks to profit from short-term capital gains.	Seeks to harvest time-varying, medium-term risk premia based on risk-return relationships.	Seeks to harvest static risk premia based on long-term risk-return relationships.
Accuracy required	**High:** Superior accuracy based on skill is required.	**Moderate:** Market overvaluation/undervaluation signals direction of returns over the medium term (that is, mean-reversion of asset prices).	**Lower:** Only historical or forecasted average returns matter (that is, this method assumes asset prices, on average, will be in equilibrium).
Information required	**High:** Speed and accuracy of signals are crucial (that is, it's a zero-sum game).	**Moderate:** Complex but readily available information (for example, Shiller's price/earnings ratio and bond yields) is required.	**Lower:** Simple, publicly available information (that is, historical or long-term equity risk premium assumptions) is required.
Risk-mitigation approach	Diversification is secondary to return opportunity.	Asset valuations signal portfolio risks plus strategic portfolio diversification (risk-budget limits can also be implemented).	Portfolio diversification is based on historical or forecasted correlations.
Drivers of portfolio changes	Portfolio strategist(s) often make(s) discretionary changes based on technical factors or judgments.	Systematic model-based portfolio optimization based on statistical forecasts of time-varying risk premia (VCMM, for example).	**No change:** Constant risk premia lead to static portfolios (based on historical or forecasted data).
Process	Depends on skill of discretionary portfolio manager(s) or quantitative model.	Portfolio optimization and return forecast models (VAAM, for example) are built by investment strategy team—systematic and repeatable.	One-time portfolio construction until a change in objectives or risk tolerance.

Source: Vanguard.

To provide an everyday example, SAA is akin to setting a route to your destination that is expected to be the most efficient over time based on long-term average traffic patterns. While there may be an alternative route that is faster on that day, it might not be relevant if the route is traveled often enough. This concept is similar to how a long-term retirement saver who is investing over multiple decades may not be concerned with their risk-return trade-off over the coming decade, but rather multiple decades.

TVAA, on the other hand, is akin to following a global positioning system (GPS) that takes traffic into account and avoids congested areas while guiding you to your destination. This means that TVAA adjusts based on traffic updates, road closures, and accidents to find the most efficient route on a particular day of travel, which is the coming decade in this analogy. Although TVAA does not assume to know the precise movement of all the cars on the road, which would enable it to weave in and out of traffic like TAA in this analogy, it is likely to provide a faster and more efficient route.

Of course, the ability of a GPS to forecast traffic patterns is based on the robustness of the service used, and it will never be completely accurate regardless of which one you choose. This is a useful way to think about model risk within the context of TVAA. We have all likely been guided by GPS down a road that was expected to be faster, only to be delayed by a detour or construction. No GPS service is infallible.

Misconception #2: SAA explains 90% of portfolio outcomes. The second misconception is that SAA, defined as a static mixture of equity and fixed income assets, explains such as large portion of portfolio returns that TVAA has little room to add value. This view is largely the result of a seminal 1986 study by Brinson, Hood, and Beebower (BHB), as well as a subsequent study by Ibbotson and Kaplan (2000), that demonstrated a portfolio's SAA explains around 90% of its return variability. This statistic is often used to make the case against TVAA, based on the logic that there is limited value to be offered through active management via security selection, factor tilts, and timing. However, this statistic is computed as the variability of monthly returns, not the variation of the terminal, end-of-period wealth (that is, compounded portfolio returns)—a distinction that is frequently misunderstood.

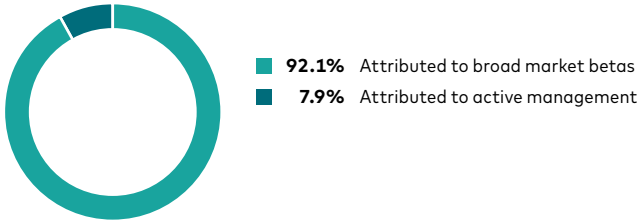
While explaining the drivers of monthly return variability may be important from a risk management point of view, the approach taken by BHB is less relevant to goal-based investors who seek to achieve a certain investment goal. Investors seeking to grow their assets over time should be more interested in the distribution of end-of-period wealth, not month-to-month variations. Jahnke (1997) conducted the first well-known study to strongly argue this point. By focusing only on explaining monthly return variability, BHB ignored the wide dispersion of actual returns among multiasset portfolios over the medium to long term. Jahnke maintained that a portfolio could have similar variability through time, but very different terminal wealth outcomes, depending on portfolio deviations from a static policy benchmark.

We conducted our own study of 1,514 multiasset funds from the Morningstar database and similarly found that 92.1% of the monthly return variance was attributed to the policy portfolio of broad market global equities and bonds (see **Figure 2a**). However, only 52.5% of the variance in the 10-year compound return was attributed to that policy portfolio, as shown in **Figure 2b**.[3] This leaves nearly half of the variation in long-term returns attributed to active portfolio management, and room to add value around the policy portfolio to increase an investor's chances of investment success.

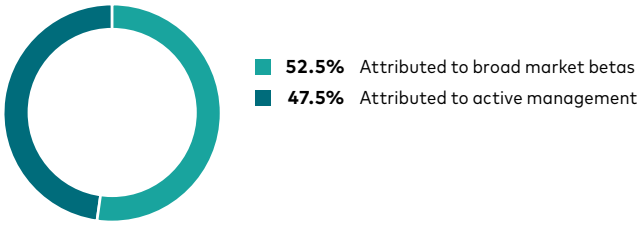
FIGURE 2

Percentage of portfolio explained by broad asset allocation

a. Monthly return variation



b. End-of-period wealth



Notes: Data run from January 2014 to December 2023. The asset allocation was determined to be the average monthly equity weight from the 10-year period for all multiasset funds.

Sources: Vanguard calculations, using data from Morningstar, Inc. and Bloomberg.

Time-varying forecasts are at the heart of our approach to TVAA

The main reason that timing allocation changes, such as the percentage of a portfolio allocated to the equity markets, is so difficult is because of the unpredictable nature of short-term, year-to-year returns. This is largely because equity prices are forward looking, and tend to move in the short term based on changing investor sentiment and expectations that are difficult to predict. As a result, it is not uncommon for a sub-asset class to go from one of the best performing to one of the worst performing over a short period of time.

An alternative approach to forecasting time-varying returns is based on longer-term statistical relationships, such as the next decade, or what we call the "medium term." The intuition is that higher (or lower) earnings yields are consistent with lower (or higher) fair market values for equities, and that tends to result in higher (or lower) expected returns over the medium term and vice versa. Current yields on a fixed income portfolio are also a reasonable predictor of 10-year-ahead returns because absent price movements, yields make up the total return.

3 Vanguard calculations, using data from Morningstar, Inc. and Bloomberg. The data are based on monthly returns from January 2014 to December 2023. The broad asset allocation is defined as the average monthly total equity weight over the 10-year period and was mapped to the MSCI ACWI IMI Index. The remainder was mapped to the Bloomberg Global Aggregate Index (hedged).

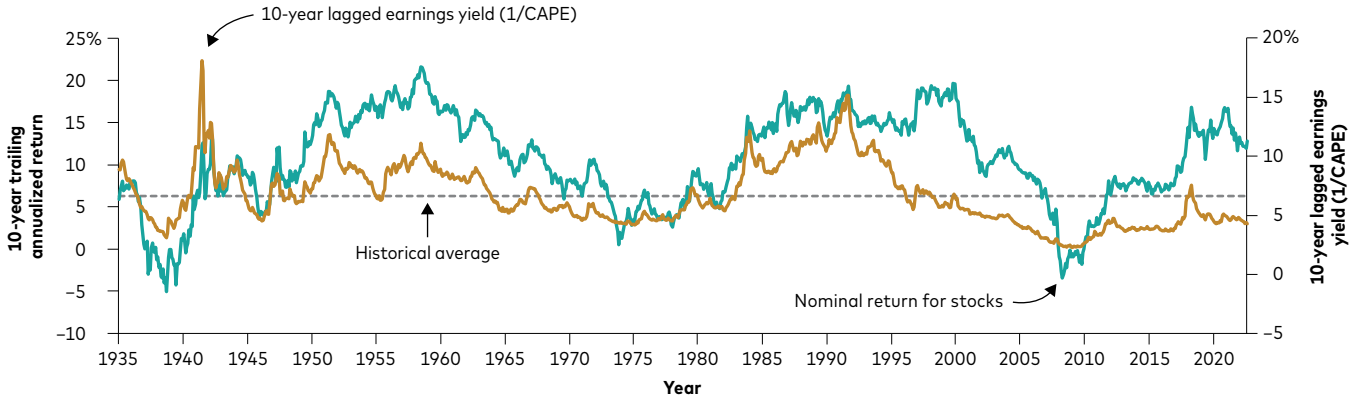
This valuation-based return forecasting approach has been well known to the industry since at least the 1990s. For instance, Bogle (1994) discussed it extensively.[4] **Figure 3a** and **Figure 3b** reproduce and update Bogle's rolling 10-year return forecasts, based on the relationship between the initial earnings yields on U.S. equities and yields on the U.S. bond market and the subsequent 10-year forward realized returns. There is a strong, albeit imperfect, relationship between these variables that creates the opportunity for TVAA to add incremental return and better manage risk. That is, as equity valuations increase, the likelihood and potential magnitude of a decline increase.

FIGURE 3

Medium-term returns are time varying based on initial conditions

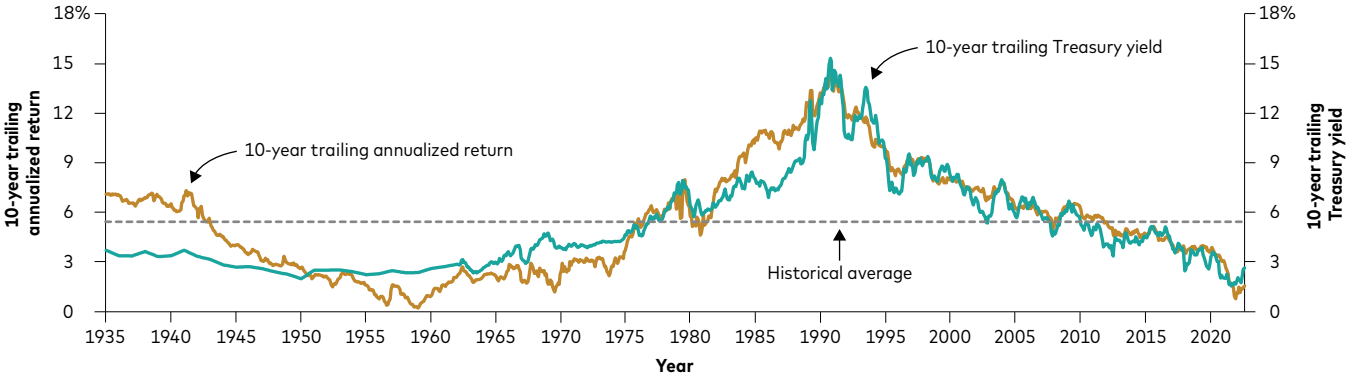
a. Relationship between cyclically adjusted price/earnings ratio (CAPE) and future 10-year equity returns

U.S. equity



b. Relationship between current yield and future 10-year equity returns

U.S. fixed income



Note: This figure replicates and updates the return forecast charts provided by Bogle (1994).

Sources: Vanguard calculations, with U.S. stock returns represented by the Standard & Poor's 500 Index from March 1957 to 2023, and by the S&P 90 prior to that time period. U.S. fixed income 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 U.S. Long Credit Aa Index from 1973 to 1975, and the Bloomberg U.S. Aggregate Bond Index thereafter. Earnings yields are represented by 1/CAPE, and 10-year Treasury yields are represented by the Long Interest Rates, both from Robert Shiller. Return data are from 1926 to 2023, with the first 10-year return period starting in 1935. Interest rates and price/earnings ratio are based on data from FactSet and Robert Shiller's website, at www.econ.yale.edu/~shiller/data.htm.

Past performance is not a 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.

4 Bogle (1994) drew a clear distinction between this systematic approach and the more common practice of market timing: For both stocks and bonds, he clarified that this approach to forecasting market returns is longer term in nature and not worth the effort over shorter periods.

Time-varying expected returns have also been an area of intense study by academics over the last three decades, giving rise to what Cochrane (1999) termed the "new facts in finance" (NFF). Cochrane compared asset return forecasting to a coin flip and to the weather. Under the traditional view, short-term return forecasts are like a coin flip—with each flip, the probabilities of a given outcome are 50/50, which means that the outcome is completely unpredictable. The weather, by contrast, changes over time, with the expected temperature in the summer quite different from that in the winter. Cochrane's NFF suggests that, just as no one knows exactly what the temperature will be tomorrow but certain ranges can be expected based on the season, there are "seasons" to stock returns, and expectations of returns will differ over time based on current conditions. As a result, time-varying expected returns do not occur over the short term and perfectly, but rather over the longer term and directionally (Aliaga-Díaz et al., 2022).

The VCMM is our proprietary forecast engine for time-varying asset returns. It builds on Bogle's idea of rigorous longer-term valuation-driven forecasts. The VCMM follows a distributional approach, as it estimates median returns, volatilities, correlations, and fat tails for the asset classes considered. The model begins with a set of very long-run return assumptions that would be the expected returns if markets were in a perfect state of equilibrium, which we will refer to as our "steady-state" expectations. The model then utilizes initial conditions such as current equity and bond yields, along with other economic variables, to establish a central tendency for the next decade of returns. The outlooks are probabilistic, with a non-normal distribution of 10,000 expected outcomes around the median based on the pattern of dispersion each asset class tends to exhibit.

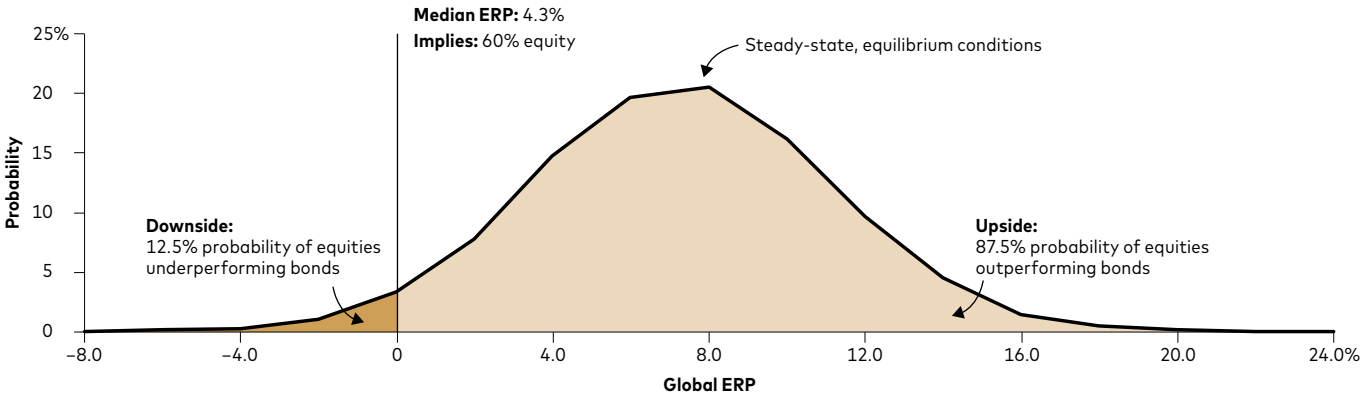
While getting both the magnitude and direction of the return forecast correct is challenging, the more important objective is to predict the direction of change, across asset and sub-asset classes and time horizons. The forward-looking forecasting techniques rely on reversion toward an estimated "fair value." The assumption is that although asset classes can exhibit momentum and overvaluation/undervaluation in the short run, they tend to converge to levels consistent with economic and financial fundamentals, or fair value, in the medium to long term. More information on the VCMM and the role of asset return expectations can be found in the **Appendix**.

We introduce the concept of TVAA with a simple example using the expected global equity risk premium (ERP) from the VCMM, defined in **Figure 4a** and **Figure 4b** as the additional expected return from investing in global equities relative to hedged global bonds. Figure 4a displays the probability of expected ERPs in steady-state market conditions. Using these assumptions, global equities would yield a positive return over bonds in 87.5% of scenarios, with a median ERP of 4.3%. This is far more attractive than the probability distribution represented in Figure 4b, which displays the projected ERPs based on the conditions present at year-end 2023, when global equites were expected to outperform in only 65.5% of scenarios, with a median ERP of just 1.5%. For the next 10 years, the downside risk to equity investing (the so-called "left tail" of the distribution) is much higher than normal (34.5% versus 12.5% probability of negative outcomes).

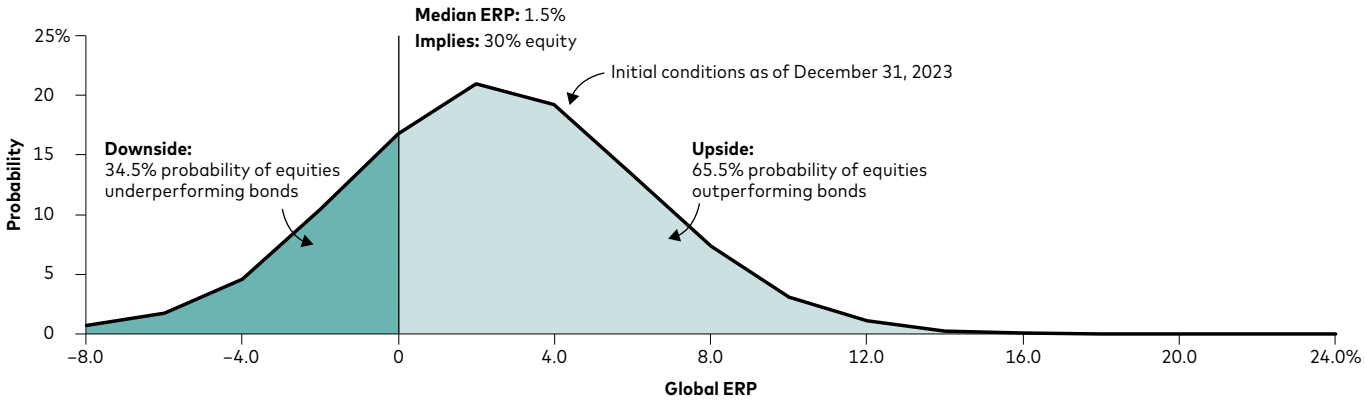
FIGURE 4

An evolving ERP implies TVAA

a. Probability of expected ERPs in steady-state market conditions



b. Projected ERPs based on the conditions present at year-end 2023



Note: Probability distributions of ERPs are calculated by subtracting the expected return of the hedged global bond market from the global equity market across 10,000 portfolio simulations from the VCMM.

Source: Vanguard.

IMPORTANT: The projections and other information generated by the VCMM regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. Distribution of return outcomes from VCMM are derived from 10,000 simulations for each modeled asset class. Simulations are as of December 31, 2023. Results from the model may vary with each use and over time. For more information, please see page 19.

The implications for TVAA are clear: Unless the investor's risk preferences have changed, it is not obvious that an investor should have the same exposure to the global equity market under both sets of assumptions, considering that the ERP is 22% more likely to be realized and the median expectation for the ERP is 2.9x higher under the steady-state assumptions. In fact, as we will explain later, a global equity/bond investor willing to take on 60% global equity risk in steady state would only be willing to accept 30% global equity risk under the conditions present as of December 2023, absent any risk constraints. Thus, time-varying returns are as much about the risks to manage as the opportunities to exploit.

Similar shifts in risk premia distributions occur across the full set of asset and sub-asset classes in the VCMM, providing additional levers to add value, which we will discuss later.

How are time-varying portfolios built?

We utilize the VAAM in combination with VCMM time-varying return distributions to solve for the optimal risk-return portfolio trade-offs through time. The VAAM is a utility-based model that assesses risk-return trade-offs from the distribution of expected returns to arrive at optimal portfolio solutions over the time horizon relative to a level of risk aversion (that is, risk tolerance).[5] The specific, six-step repeatable process for constructing TVAA strategies with the VAAM is broken down in **Figure 5**.

FIGURE 5

The steps involved in constructing TVAA strategies

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Define the asset and sub-asset class universe to be included in the portfolio.	Use prudent judgment and experience to establish risk budgets and any other portfolio constraints based on client preferences.	Gather VCMM asset return forecasts for each asset class over the forecast horizons (for example, 10 years).	Define an investor's risk profile by determining an appropriate policy portfolio (for example, a 60% stock/40% bond portfolio), and extract the implied risk aversion.	At each point in time, using the VAAM, solve for the portfolio that strikes the optimal risk-return balance relative to the investor's risk aversion.	Repeat steps 3 and 5 periodically (for example, annually, quarterly, or when major shifts occur).

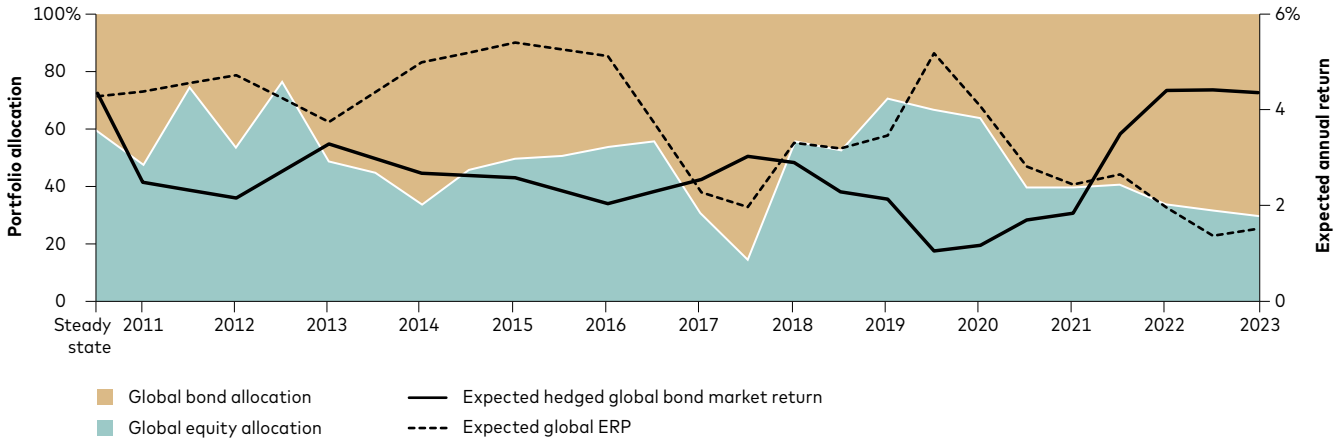
Source: Vanguard.

5 In the context of portfolio construction, utility functions are mathematical representations of an investor's attitude toward investment risk. The utility function captures the trade-off any investor faces in balancing the desire for higher portfolio returns with the increased risk that comes with it. Utility functions are widely used in finance, and have been increasingly adopted by investment professionals and practitioners.

Following the process laid out in Figure 5, we identified the risk aversion that yielded a 60/40 global equity/bond policy portfolio given our steady-state capital market expectations from the VCMM. We then allowed the VAAM to alter the equity/bond allocation quarterly around the 60/40 policy target from 2011 to 2023, with the results shown in **Figure 6**. For illustrative purposes, we also plotted the expected global ERP and expected hedged global bond market return to show the relationship. As the expected ERP increased and expected hedged global bond market return fell, exposure to the global equity market rose. The implication is clear: As the potential rewards for investing in equities increased relative to bonds, so did the portfolio's willingness to take on equity market risk, and vice versa.

FIGURE 6

A TVAA portfolio's risk posture is dependent on the expected ERP



Notes: Time-varying portfolio allocations were determined by the VAAM. The assets under consideration were global equities and hedged global fixed income based on the VCMM 10-year projections as of each quarter-end from January 2011 to December 2023.

Source: Vanguard.

IMPORTANT: The projections and other information generated by the VCMM regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. Distribution of return outcomes from the VCMM are derived from 10,000 simulations for each modeled asset class. Simulations are as of December 31, 2023. Results from the model may vary with each use and over time. For more information, please see page 19.

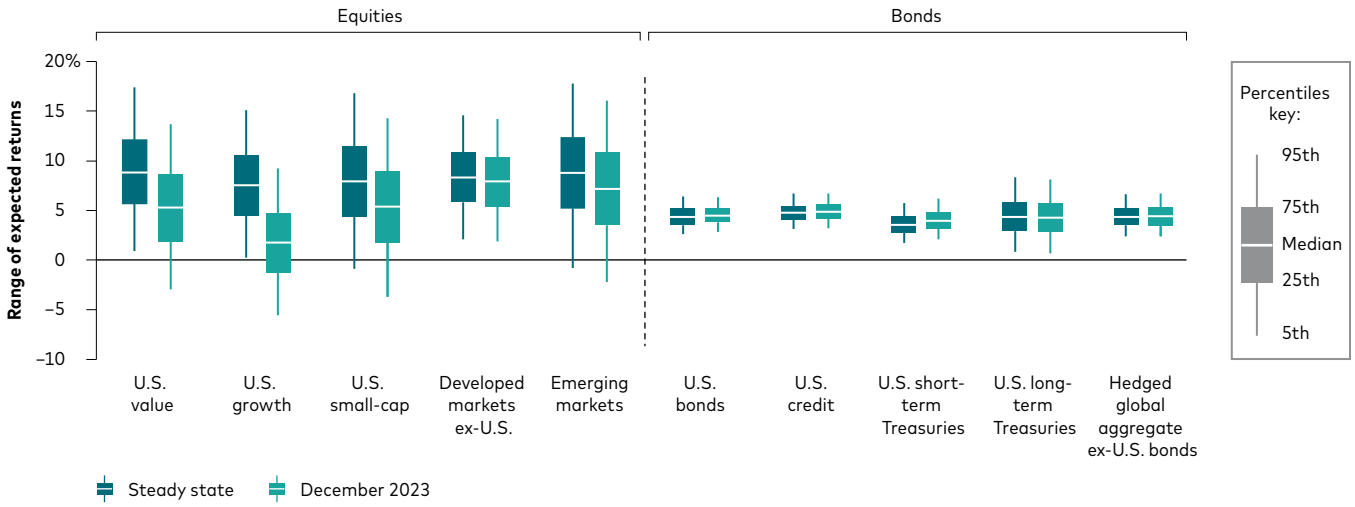
Sub-asset classes provide more levers for TVAA to improve the risk-return trade-off

Beyond broad market betas such as the global equity and bond markets, sub-asset classes are another dimension for TVAA to tilt the portfolio toward sub-asset classes that are more attractively priced at any given time relative to their steady-state expectations. This is illustrated in **Figure 7**, where we display the 10-year expected returns based on both our long-term steady state and the conditions present at year-end 2023. The outlooks are displayed in a percentile distribution to indicate not only the median, but also the potential range of returns an investor may encounter from the 5th to 95th percentiles.

Building on the intuition from Figure 4, there are many other relationships and potential sources for TVAA to optimize the risk-return trade-off. For example, the distributions of bond returns across the credit and duration spectrum are very close to the equilibriums of steady state. This indicates that the lower expected global ERP is attributed to lower expected returns for equities, especially large-cap and growth equities, while developed markets outside the U.S. are priced close to their steady-state assumptions.

FIGURE 7

Opportunities exist within sub-asset classes to pursue a better risk-return trade-off



Note: The 10-year annualized returns are based on 10,000 VCMM simulations in steady state and under the conditions present on December 31, 2023.

Source: Vanguard.

IMPORTANT: The projections and other information generated by the VCMM regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. Distribution of return outcomes from the VCMM are derived from 10,000 simulations for each modeled asset class. Simulations are as of December 31, 2023. Results from the model may vary with each use and over time. For more information, please see page 19.

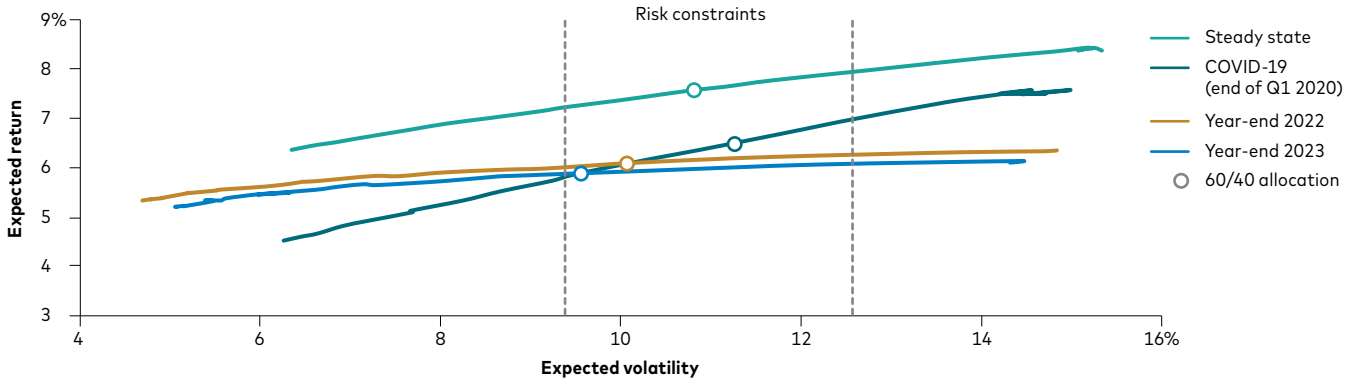
We now turn our attention to **Figure 8**, creating optimized portfolios with all of the sub-asset classes from Figure 7 across various time periods, by allowing the VAAM to assess the attractiveness of the risk-return trade-off, take on 5% more or less equity risk, and allocate within a range of sub-asset class constraints (as detailed in the Appendix). This is a way we can manage the active risk budget for TVAA within a predetermined range of acceptable allocations. We plot the intersection of risk and return, which produces an efficient frontier of portfolio combinations. For reference, we also highlight the risk aversion corresponding to a hypothetical investor who is willing to take on the risk of a 60/40 allocation in steady state. By plotting the efficient frontier through time, we can see how the level of bond returns and shape of the efficient frontier impact the portfolio's risk posture.

When the frontier steepens relative to steady state, such as during the first quarter of 2020 when the COVID-19 outbreak caused central banks to reduce interest rates to historically low levels, the portfolios take on risk and expected returns increase for more aggressive portfolios. Alternatively, as the efficient frontier becomes progressively flatter and risk is less likely to be rewarded due to higher equity valuations and/or bond yields, such as at year-end 2022 and year-end 2023, the portfolios de-risk. Therefore, TVAA is just as much about risk management as trying to achieve a higher return. For this reason, in markets with strong momentum, de-risking can lead to periods of short-term underperformance.

FIGURE 8

TVAA allocates risk based on the shape of the efficient frontier

Time-varying portfolio frontier



Note: The 10-year median annualized returns and volatilities are shown for a range of risk aversions from high to low in steady state and under the conditions present at the end of the first quarter in 2020, and at year-end 2022 and year-end 2023.

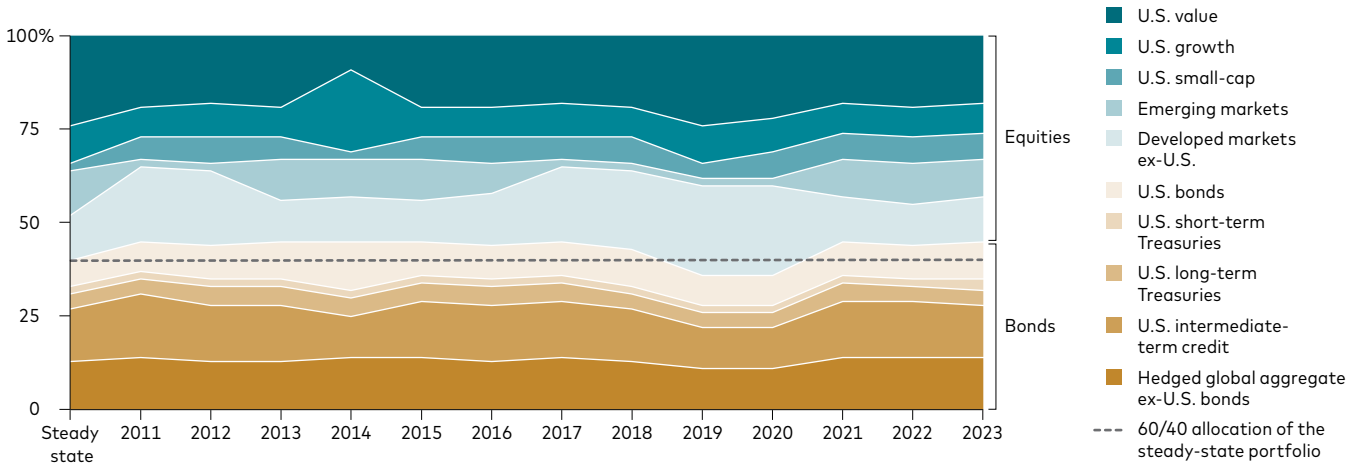
Source: Vanguard.

In **Figure 9**, we display the asset allocations corresponding to Figure 8 for our hypothetical TVAA investor beginning with the 60/40 steady-state policy portfolio. The efficient frontier was relatively steep for most of the time periods in our study, but slightly less so than under the steady-state assumptions, due to higher-than-normal equity valuations over the last decade. This resulted in an average 3% underweight to equities relative to our policy portfolio from 2011 to 2023. However, when the efficient frontier steepened with the COVID-19 outbreak following historically low interest rates, the portfolio took on more risk, averaging a 4% overweight from 2019 to 2020. In recent periods, as interest rates rose and the efficient frontier flattened, the portfolio became progressively more conservative again, hitting the lower bound of equity at a 5% underweight.

Intuitive patterns can also be seen within sub-asset classes, with a few worth exploring. As valuations continued to rise for large-cap growth stocks given the very strong performance of the technology sector, they became an increasingly smaller percentage of the U.S. equity allocation, while the allocation to U.S. small-caps increased from a low of close to zero in 2014 to near the top of the band from 2021 to 2023. Similarly, as emerging markets equities went through periods of volatility, there were two periods of underweights in favor of developed markets—from 2011 to 2012 and again from 2017 to 2020. Within fixed income, the portfolio stayed close to its policy portfolio that overweighted investment-grade credit, aside from 2014 when spreads contracted and the portfolio favored broad market U.S. bonds.

FIGURE 9

TVAA relative to the 60/40 policy portfolio (2011–2023)



Notes: Time-varying portfolio allocations were determined by the VAAM. The equity assets under consideration were U.S. value, U.S. growth, U.S. small-cap, emerging markets, and developed markets ex-U.S. The fixed income assets under consideration were U.S. bonds, U.S. short- and long-term Treasuries, U.S. intermediate-term credit, and hedged global aggregate ex-U.S. bonds. Projections are based on the VCMM 10-year simulations as of each year-end through time.

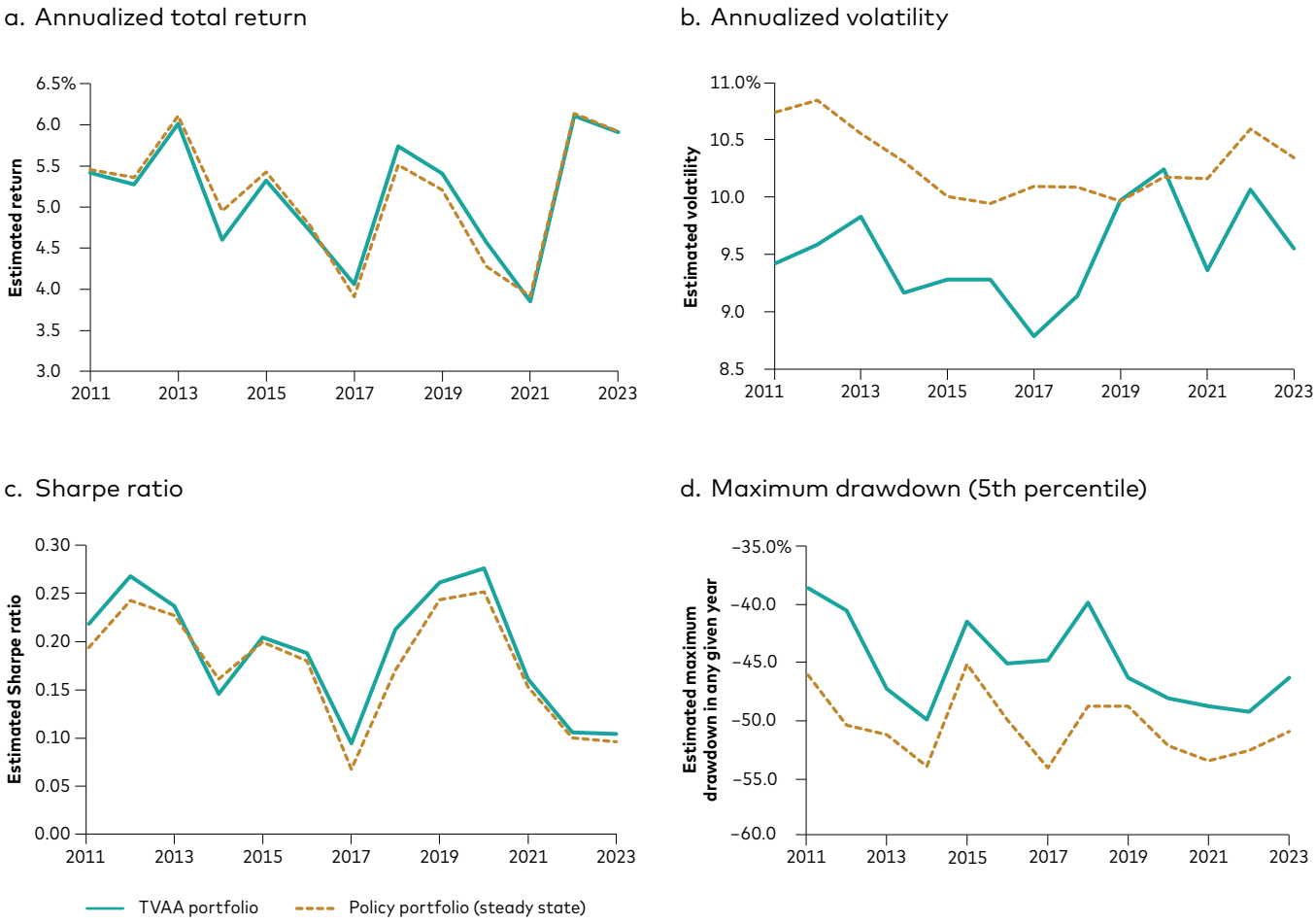
Source: Vanguard.

Figures 10a, **10b**, **10c**, and **10d** display the expected median (that is, most likely) path for annualized total returns, volatilities, Sharpe ratios, and maximum drawdowns (5th-percentile returns) for the TVAA portfolio and the policy portfolio derived from steady state. The expected value-add from TVAA through time can be measured by comparing it to the SAA of the policy portfolio.

Over most of the periods shown, when the efficient frontier was sufficiently attractive, the TVAA strategy was expected to deliver median returns similar to or higher than those of the SAA portfolio, with lower volatility. It also tended to have a higher expected return per unit of risk, represented by the Sharpe ratios.

FIGURE 10

Median expectations for the TVAA portfolio relative to the policy portfolio



Notes: The 10-year expected median annualized returns, volatilities, Sharpe ratios, and 5th-percentile drawdowns are shown for a globally diversified 60/40 market-cap portfolio containing 60% U.S. equities and 40% international equities within the equity portion, and 70% U.S. bonds and 30% hedged global ex-U.S. bonds within the bond portion. The policy portfolio corresponds to a 60/40 portfolio under steady-state assumptions, and the TVAA portfolio represents the TVAAs at each year-end period from Figure 9.

Source: Vanguard.

In addition to Figure 10b displaying the median standard deviation of returns, Figure 10d displays the expected 5th-percentile return in any given year over the 10-year optimization period as a measure of potential drawdown. This additional measure of risk is important to keep in mind. While investment risk is often considered to be the volatility of returns, defining risk solely as volatility is problematic because an investment that falls rapidly and then recovers is said to be risky, while another investment on a steady secular decline is considered safe. After all, the risk that necessitates the need to invest is the loss of purchasing power due to inflation over time, and exposure to equities and other risky assets is generally the best way to grow a portfolio's wealth in excess of inflation over the long term (Schlanger et al., 2023).

There are many ways to think about risk, but perhaps the ultimate form of risk that investors bear is the risk of permanent loss, which would require selling out of an asset either while it is temporarily depressed in value or fundamentally impaired (Marks, 2014). A successful investor should allocate capital to grow their wealth over the long term, while managing the risks they are taking in pursuit of those returns—where risk can be measured by the potential drawdown, which was expected to be lower across all periods for the TVAA portfolio in Figure 10d.

Because risk and return are fundamentally linked, managing risk can sometimes mean narrowing the potential range of positive returns that an investor may experience. Referring back to Figure 10, this explains why in periods such as 2014, the TVAA portfolio was expected to deliver a lower return per unit of risk via the Sharpe ratio. It is because, rather than defining risk as the standard deviation of returns, risk within our framework is defined as the potential for drawdown over the 10-year optimization period from the distribution of expected returns, and was consistently lower for the TVAA portfolio.

Conclusion

When combined with prudent judgment and experience, TVAA can increase an investor's chances of investment success by dynamically altering a portfolio's positioning based on medium-term forecasts—such as for the next decade—in order to enhance returns, manage risks, or both, depending on the environment. This differs from TAA in that it is longer term in nature and based on a quantitative and repeatable process. For investors willing to bear model risk, there is potential to add incremental return while managing the range of outcomes an investor may experience, or risk-adjusted alpha. Recognizing that TVAA is inherently contrarian and there will be periods of underperformance, discipline in the execution of this strategy is paramount to its success.

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Appendix

Vanguard's proprietary portfolio construction models are the quantitative foundation of Vanguard's portfolio construction framework. Two models used in tandem are the Vanguard Capital Markets Model® (VCMM), our simulation engine for asset return and risk forecasts, and the Vanguard Asset Allocation Model (VAAM), our portfolio optimization engine.

VCMM and the role of asset return expectations in portfolio construction

Asset return forecasts (or capital market assumptions) can play a critical role in portfolio construction, either implicitly or explicitly. For VAAM-based portfolios, the asset return forecasts are an explicit input in the asset allocation process. The VCMM is our proprietary statistical engine for estimating asset class expected returns, volatilities, correlations, and other statistical distributional properties of asset returns.[6]

Asset return distributions, not just asset return point forecasts, are the main output from the VCMM and the key input in portfolio construction. Since portfolio construction can be defined as the practice of investing amid uncertainty, it's necessary to go beyond asset return point forecasts in order to properly capture the role of uncertainty and the benefits of portfolio diversification. Thus, the VAAM uses the full range of VCMM statistical return distributions, including return volatility and correlations, in addition to the median (or expected) returns.

Important features of the VCMM return forecast include:

- A probabilistic or distributional framework.
- Reliance on key economic and market valuation forecasting signals proven to work better at medium- to long-term horizons. Short-term forecasting is extremely difficult.
- The context that medium-term return projections are sensitive to initial conditions. Over the medium term, expected returns depend on initial valuations such as price/earnings ratios and interest rate levels.
- Reliance on forward-looking equilibrium assumptions for certain economic or market drivers, such as long-run inflation, productivity growth, currency trends, and central bank neutral policy rates. The VCMM incorporates forward-looking equilibrium views based on inputs from Vanguard's global economics team.
- Allowance for non-normal distribution, featuring a higher probability of tail events than a normal distribution would suggest.

For a detailed overview of the VCMM, refer to Davis et al. (2014).

Time-varying portfolio optimization constraints

The following asset class constraints were implemented within our methodology according to prudent judgment and experience, based on the types of preferences displayed by U.S. intermediary clients when constructing portfolios for clients.

- **Equity:** 60% (+/–5%).
- **U.S. equity:** 60%–70% of total equity.
- **Small-cap equity:** no more than 20% of U.S. equity.
- **Growth equity:** 30%–70% relative to value.
- **Value equity:** 30%–70% relative to growth.
- **Emerging markets equity:** no more than 20% of total equity.
- **U.S. credit:** no more than 50% of total bonds.
- **Long-term Treasury:** no more than 15% of total U.S. bonds.
- **Credit and short-term/long-term Treasury:** no more than 50% of total bonds.
- **Global aggregate ex-U.S.:** no less than 30% of total bonds.

6 The VCMM also estimates higher-order moments for the return distributions of all asset classes, such as kurtosis or fat tails, as it allows for departures from the standard normal distribution assumptions.

Vanguard Capital Markets Model

IMPORTANT: The projections and other information generated by the VCMM regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. VCMM 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 VCMM is a proprietary financial simulation tool developed and maintained by Vanguard's primary investment research and advice teams. The model forecasts distributions of future returns for a wide array of broad asset classes. Those asset classes include U.S. and international equity markets, several maturities of the U.S. Treasury and corporate fixed income markets, international fixed income markets, U.S. money markets, commodities, and certain alternative investment strategies. The theoretical and empirical foundation for the VCMM is that the returns of various asset classes reflect the compensation investors require for bearing different types of systematic risk (beta). At the core of the model are estimates of the dynamic statistical relationship between risk factors and asset returns, obtained from statistical analysis based on available monthly financial and economic data from as early as 1960. Using a system of estimated equations, the model then applies a Monte Carlo simulation method to project the estimated interrelationships among risk factors and asset classes as well as uncertainty and randomness over time. The model generates a large set of simulated outcomes for each asset class over several time horizons. Forecasts are obtained by computing measures of central tendency in these simulations. Results produced by the tool will vary with each use and over time.

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