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Vanguard research | Portfolio perspectives

January 2023

Constructing inflation-resilient portfolios

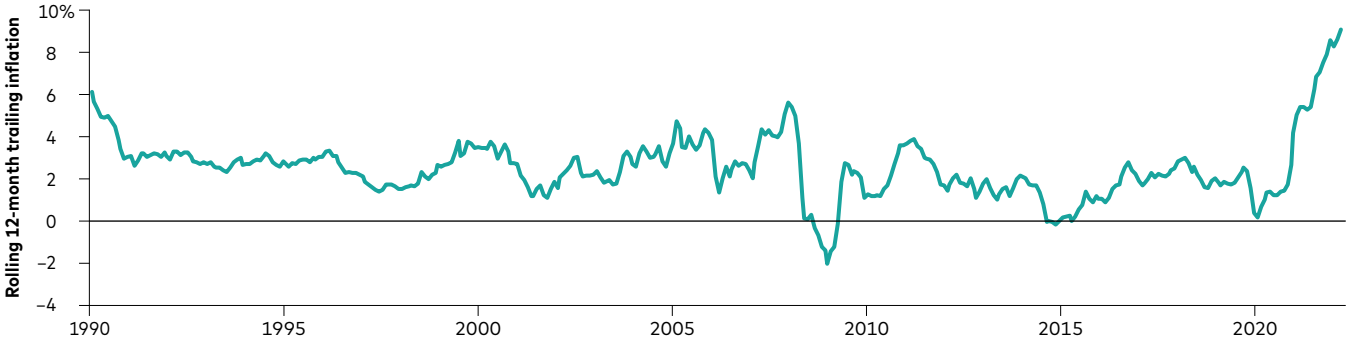
- The unexpected spike in inflation that occurred in the first half of 2022 has been unsettling for capital markets and investors alike—and it has led many investors to revisit how they think about inflation when it comes to portfolio construction.
- We distinguish between investors who seek to maximize their wealth in excess of inflation in the long run and investors who have the explicit goal of hedging inflation in the short to medium term. The latter group—usually retirees and other income-sensitive investors—may want to consider adding assets with greater inflation-hedging properties, such as commodities and, to a lesser extent, Treasury inflation-protected securities (TIPS).[1]
- We demonstrate that for inflation-conscious investors seeking a higher beta between their portfolio's total return and inflation, our approach offers an attractive and well-balanced option.

Over the past three decades, investors have become accustomed to relatively low inflation. While the specific drivers of inflation are beyond the scope of this research paper, demographic trends, globalization, and advances in technology have certainly all played a role in keeping inflation low. In fact, for the decade ended December 31, 2021, inflation averaged just 2.1% per year. This secular trend was interrupted in the first half of 2022, when inflation unexpectedly spiked to 9.0% for the trailing 12 months ended June 30, 2022—mainly because of COVID-related supply chain disruptions and the war in Ukraine (Davis et al., 2022; see **Figure 1** on page 2). Although inflation is unlikely to continue rising at that pace—and in fact fell to a year-over-year increase of 7.1% at the end of November 2022—the elevated levels of inflation over the course of 2022 have led many investors to question how they should think about inflation and portfolio construction.

1 Vanguard believes that alternative investments with greater complexity, such as commodities, are not ideally suited for a qualified default investment vehicle such as a target-date fund. Vanguard Capital Markets Model simulations do show improvements in a portfolio's risk-adjusted returns when these types of investment strategies are used, thanks to fundamental differences in their drivers of return; however, such results are before fees and do not consider the generally higher costs, lower wealth accumulation, and other implementation risks involved.

FIGURE 1.

2022 saw the most significant spike in inflation in decades



Notes: Rolling 12-month trailing inflation is represented by the U.S. CPI All Items and Cities Index. Data are for the period from January 1, 1990, to June 30, 2022.
Sources: Vanguard calculations, using data from Macrobond.

We divide individual investors into two cohorts based on their goals: (1) those who seek to grow their wealth in excess of inflation over the long term, and (2) those who aim to achieve varying degrees of beta to inflation in the short to medium term (over the next decade, for example). As described in Vanguard's portfolio construction framework (Aliaga-Díaz et al., 2022), model-based strategic asset allocation (SAA) methodologies may be used to meet various portfolio objectives by using sub-asset-class tilts aimed at improving the odds of hedging those risks. In our case, the goal is to strategically tilt the portfolio to address inflation risk.

Notes on risk

All investing is subject to risk, including the possible loss of the money you invest. 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. Investments in bonds are subject to interest rate, credit, and inflation risk. Investments in stocks or bonds issued by non-U.S. companies are subject to risks including country/regional risk and currency risk. Diversification does not ensure a profit or protect against a loss. Annuities are long-term vehicles designed for retirement purposes and contain underlying investment portfolios that are subject to investment risk, including possible loss of principal.

IMPORTANT NOTE: The projections and other information generated by the Vanguard Capital Markets Model® (VCMM) regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results, and are not guarantees of future results. VCMM results may vary with each use and over time. For more information, see Appendix 2.

We begin by examining asset return distributions from the Vanguard Capital Markets Model (VCMM) for the next 10 and 30 years. We then consider these assets' inflation-hedging properties, distinguishing between correlation with inflation and beta to inflation and favoring the latter in our portfolio optimization framework. For long-term wealth accumulators, we find that a strategic allocation to equities provides the highest likelihood of growing wealth in excess of inflation over the long run. Retirees and other income-sensitive investors who have the explicit goal of hedging inflation over the short to medium term, however, may want to consider adding assets with greater inflation-hedging properties (such as commodities and, to a lesser extent, TIPS)—either by traditional portfolio optimization or as part of a core-satellite approach where the existing portfolio remains intact while inflation-hedging assets are added as a smaller, strategic allocation. Although both methods introduce additional layers of risk to the portfolio, we conclude that for investors seeking to augment their core portfolio—and who have a tolerance for volatility—the core-satellite approach offers an attractive alternative with a more balanced trade-off between risk and reward.

Research design

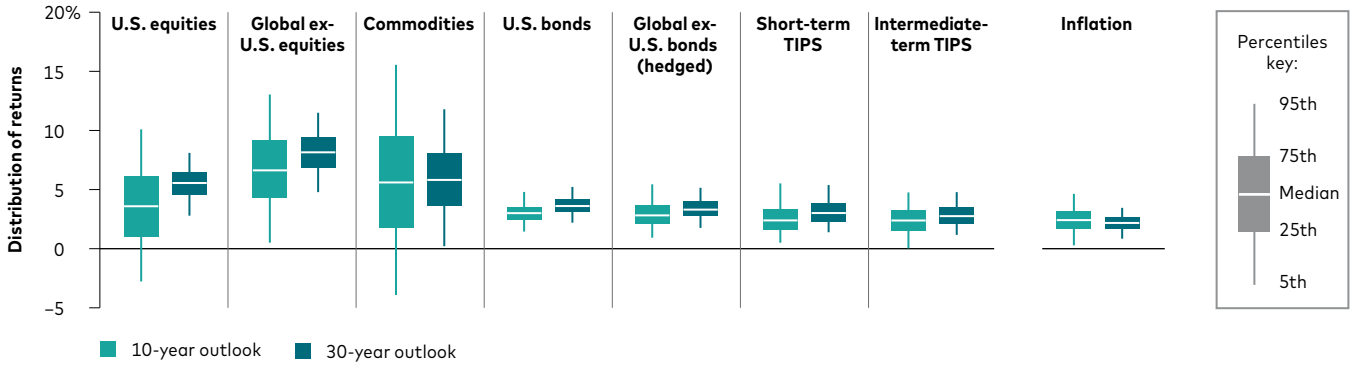
Capital market assumptions and asset return distributions

To formulate a forecast for the total returns of various asset classes and determine their relationship with inflation, we used data from the VCMM (Davis et al., 2014, and Davis et al., 2022). The VCMM is a regression-based Monte Carlo simulation engine that incorporates non-normal return distributions (i.e., distributions with fat tails) and accounts for autocorrelations within an asset class and for cross-asset return correlation. The VCMM's asset-return simulation model blends quantitative statistical analysis and forward-looking assumptions to determine very-long-term market equilibrium conditions and generates 10,000 potential outcomes for each asset class across a distribution of global asset returns, cross-correlations, and volatility.

The VCMM can also incorporate current market conditions (for example, interest rates, spreads, price/earnings ratios, and other fundamental drivers of asset return) to generate medium- to long-term return expectations of 10 to 30 years. Its probabilistic and distributional forecast makes the VCMM a powerful tool for setting reasonable return expectations for a variety of asset classes and evaluating the risk-and-return trade-offs inherent in portfolio decisions—such as the potential range of portfolio return outcomes and the probabilities of achieving return objectives or realizing downside-risk events. In **Figure 2**, we show the 10- and 30-year return distributions for four core asset classes (U.S. equities, global ex-U.S. equities, U.S. bonds, and hedged global ex-U.S. bonds) and three asset classes typically associated with hedging inflation (commodities, short-term TIPS, and intermediate-term TIPS). We also present the 10- and 30-year outlooks for headline inflation.

FIGURE 2.

VCMM's 10- and 30-year outlooks for selected asset classes



Notes: Data are as of June 30, 2022. For more information, please see Davis et al. (2014) and Davis et al. (2022). For more information about the VCMM, see **Appendix 2**. See **Appendix 3** for further details on asset classes.

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 as of June 30, 2022. Results from the model may vary with each use and over time.

As of June 2022, over the next 30 years, global ex-U.S. equities are expected to produce the highest returns in excess of inflation, with a median expected return of 8.1%. Commodities—an asset class that carries with it greater volatility and potential drawdown risk—are next, with a median expected return of 5.8%, followed by U.S. equities (5.5%). Over the next 10 years, equities outside the U.S., with a median expected return of 6.7%, are most likely to outperform inflation, followed by commodities (5.8%) and U.S. equities (3.6%). Over both time periods, the traditional portfolio diversifiers, broad market bonds (U.S. and global ex-U.S. hedged), have lower expected median returns—though again, they also come with much less volatility. Finally, short- and intermediate-term TIPS both have slightly lower median expected returns than their broad market counterparts.

Inflation-hedging properties

We can use the VCMM to better understand the inflation-hedging properties of various asset classes under consideration (and also, therefore, of portfolio that includes those classes). Asset classes with a strong positive correlation to inflation are often thought to be good inflation hedges. **Figure 3** shows how the median return from our VCMM distribution for each of our asset classes correlates with inflation. Short-term TIPS have the highest correlation with inflation—unsurprisingly, given that they receive the same inflation adjustment as do longer-dated TIPS—but have a lower duration and corresponding volatility. Commodities come in a close second, thanks to the relationship between their prices and inflation, followed by intermediate-term TIPS. Equities have virtually no correlation with inflation, and broad market bonds (U.S. and global ex-U.S. hedged) generally have negative correlations because of the inverse relationship between nominal yields and bond prices.

FIGURE 3.

Inflation-hedging properties of selected asset classes

Notes: Correlation with inflation was calculated across the median return from the VCMM distribution of each asset class and inflation within equilibrium market conditions. Inflation beta was calculated as the slope of each asset class and inflation across all 10,000 paths cross-sectionally to year 30 to best represent equilibrium market conditions. For more information about the VCMM, see Appendix 2. See Appendix 3 for further details on asset classes.

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 as of June 30, 2022. Results from the model may vary with each use and over time.

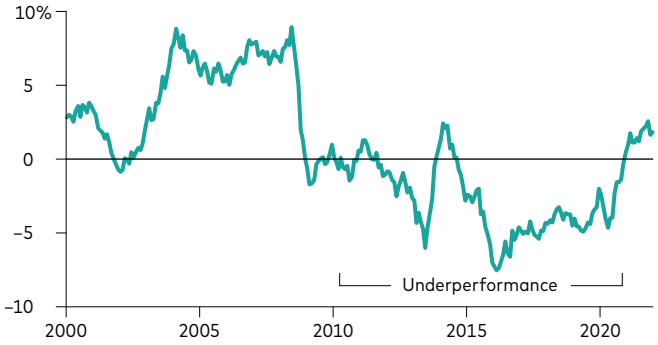
Inflation beta, also shown in Figure 3, is defined as how much an asset's return increases when inflation goes up by 1 percentage point (or 100 basis points), and it represents the true inflation-hedging properties of an asset class. The key difference between an asset class's correlation with inflation and its inflation beta is that the former captures only the *direction* of co-movement of the asset class and inflation, while the latter also captures the *magnitude*. Asset classes with high inflation correlation *and* an inflation beta close to 1, such as short-term TIPS, do a good job of hedging themselves, but they do not have enough volatility to adequately hedge the other assets or the broader portfolio.

Another important point is that inflation hedging comes with its own unique trade-offs: Assets that have higher inflation beta tend to have higher volatility. For example, if inflation were to rise by 3%, TIPS would be expected to rise 2.6%, whereas commodities would be expected to rise by 22.8%. Thus, an allocation tilting toward assets with higher inflation beta would help protect other asset classes in the portfolio. By adding inflation hedges such as commodities to the portfolio, however, investors may have to absorb higher portfolio volatility and drawdown risk (Aliaga-Díaz et al., 2018, and Bosse, 2019), and they may have to weather prolonged periods of underperformance. As a case in point, **Figure 4** shows that commodities have underperformed for most of the last decade.

FIGURE 4.

Historical commodity returns since 2000

10-year rolling annualized returns



Notes: Ten-year rolling annualized returns for commodities are represented by the Bloomberg Commodity Index Total Return. Data are for the period from January 1, 1990, to December 31, 2021.

Sources: Vanguard calculations, using data from Bloomberg.

Portfolio construction considerations

For long-term wealth accumulators, the goal is generally to accumulate as much wealth as possible relative to their risk tolerance and in excess of inflation, as inflation can erode an investor's purchasing power over the long term. This makes inflation hedging secondary to their total return efficiency objective (although a higher real return does better protect an investor's portfolio from the long-term impact of inflation).

Most of these investors use strategic asset allocation to attain this goal of growing wealth, investing in equities and other risky assets combined with fixed income to dampen portfolio volatility. However, some investors aim to achieve an explicit beta to inflation in the short to medium term to smooth the relationship between portfolio returns and consumption. For investors with the goal of hedging inflation in the short to intermediate term, adding a strategic allocation to commodities and (to a lesser extent) short- and intermediate-term TIPS may be an attractive option, given these assets' greater inflation-hedging properties.

Optimizing portfolios with a high expected inflation beta

We used the Vanguard Asset Allocation Model (VAAM) (Aliaga-Díaz et al., 2019) as the foundation for developing our inflation-optimized portfolios. VAAM is a utility-based model that evaluates the risk and return trade-offs of selected asset classes to reach optimal solutions relative to a level of risk aversion (i.e., risk tolerance) based on VCMM asset return projections. The model is able to incorporate multidimensional variables such as risk and return of passive market exposures, correlations, covariances, and inflation betas across a set of asset classes. It can even optimize among factors and active combinations, although that is beyond the scope of this analysis.

The VAAM optimization process evaluates thousands of unique portfolio combinations and proposes the portfolio with the highest expected utility score based on the portfolio's distribution of terminal wealth. To address the goal of optimizing for portfolios with specific inflation betas, we enhanced the model by creating the ability to target portfolios that fall within an expected inflation beta band (i.e., a minimum and a maximum threshold for inflation beta).

Because portfolio construction best practices imply that rational investors aim to maximize risk-return efficiency, we calibrated the model to optimize for the portfolio with the highest expected utility of wealth based on our long-run equilibrium assumptions for each asset class under consideration, then applied a constraint that accounts for the inflation beta to return only portfolios with an inflation beta of 1 or higher. We used the long-term equilibrium VCMM simulations because the relationship between inflation and asset classes is more or less consistent over time. We had VAAM consider the four core asset classes (U.S. equity, global ex-U.S. equity, U.S. bonds, and global ex-U.S. bonds hedged) and a range of inflation-sensitive asset classes such as commodities and short- and intermediate-term TIPS. The portfolio's inflation beta is computed cross-sectionally between the portfolio's total return (TR) and the inflation rate (CPI) across year 30 of the VCMM forecasts, as shown:

Inflation beta:

$$\beta = \frac{Covariance(R_{CPI_{30}}, R_{TR_{30}})}{Variance(R_{CPI_{30}})}$$

This gives us an idea of the relationship between various portfolio combinations and inflation.

We begin our analysis by establishing a core portfolio of 60% equity/40% fixed income with a home bias of 60% U.S. equities and 70% U.S. fixed income (shown in **Figure 5a** as "core 60/40 portfolio"). We then use the VAAM optimization process to adjust for an alternative inflation-hedging portfolio with an explicit expected inflation beta. The core-satellite portfolio is generated with the same risk aversion as the core portfolio and optimizes for the satellite allocation that will produce the highest utility score and inflation beta of at least 1. As one might expect, the core-satellite portfolio gives the largest satellite allocation to commodities (12%), with smaller satellite allocations to short and intermediate TIPS of 1% each.[2] (Additional portfolio allocations for 40% and 50% equity portfolios can be found in **Appendix 1**.)

Figure 5b shows the expected portfolio metrics for the next decade for the core 60/40 and the core-satellite portfolios. The inflation-hedging strategies used in the core-satellite portfolio are expected to achieve higher median returns than the core portfolio—though not without tracking error and periods of underperformance.

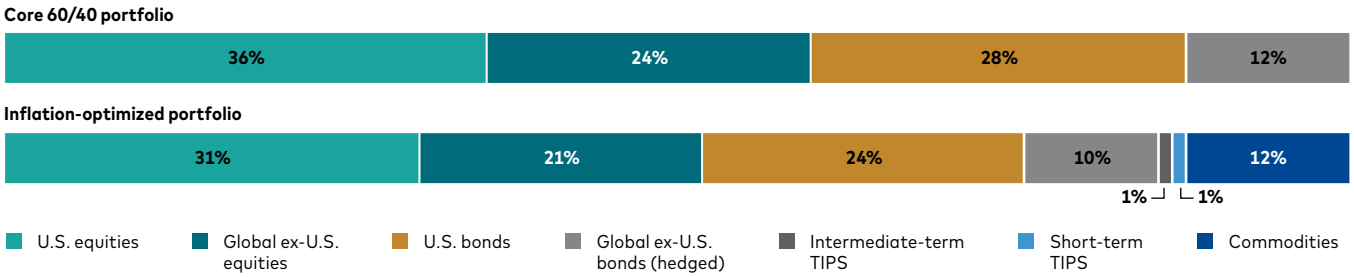
We find that the core-satellite portfolio is relatively risk-controlled and contains only a 4% increase in total risky assets. As a result, the expected volatility of the core-satellite portfolio is even lower than that of the core portfolio, thanks to the diversification benefits of including commodities exposure without increasing total equity. Although the core-satellite portfolio seemingly has a better return with lower risk, it also has a nearly 50% probability of underperforming the traditional 60/40 portfolio. Therefore, for investors seeking to augment their core portfolio with a specialized satellite allocation to increase their portfolio's inflation beta without the expectation of higher portfolio volatility—and who are willing to go through potential periods of underperformance—this approach may be an attractive option.

2 We recognize that in practice investors may choose not to include an asset class with an allocation of only 1%.

FIGURE 5.

Core 60/40 portfolio versus inflation-optimized portfolio

a. Asset allocation



b. 10-year expectations

	Core 60/40 portfolio	Inflation-optimized portfolio
Annualized total return	4.6%	4.8%
Annualized volatility	9.5%	8.8%
Excess return relative to core	—	0.2%
Probability of underperforming core (annualized)	—	47.4%
Tracking error relative to core	—	2.2%
Maximum drawdown	–49.1%	–43.8%
Sharpe ratio	0.20	0.24
Inflation beta	0.07	1.00
Satellite weight	—	14%
Allocation to risky assets (equity + commodities)	60.0%	64.0%

Notes: Portfolio expectations are based on the 10-year VCMM asset class forecasts as of June 30, 2022. The Sharpe ratio is a measure of return above the risk-free rate that adjusts for volatility. A higher Sharpe ratio indicates a higher expected risk-adjusted return. For more information about the VCMM, see Appendix 2. See Appendix 3 for further details on asset classes.

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 as of June 30, 2022. Results from the model may vary with each use and over time.

Conclusion

Over the course of 2022, inflation and its implications for portfolio construction emerged as a top concern for investors. For many long-term investors, the objective is to produce a total return in excess of inflation—not necessarily an explicit beta to it. Other long-term investors, however, may seek greater inflation protection in their portfolios over short- to intermediate-term investment horizons. The VAAM portfolio construction framework, as we have shown here, can be tailored to their inflation-beta preferences to construct portfolios that hedge inflation; relative to a market-cap-weighted core portfolio, these strategies will likely achieve higher median returns over the next decade, albeit with tracking error and periods of underperformance. For investors seeking to augment their core portfolio with a specialized satellite allocation to increase their portfolio's inflation beta, our approach offers an attractive option.

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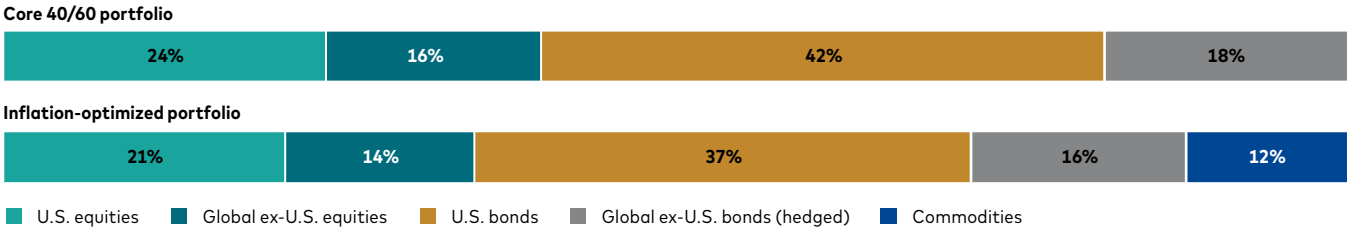
Appendix 1.

Alternative inflation-optimized portfolios and associated analytics

FIGURE A-1.

Core 40/60 portfolio versus inflation-optimized portfolio

a. Asset allocation



b. 10-year expectations

	Core 40/60 portfolio	Inflation-optimized portfolio
Annualized total return	4.1%	4.4%
Annualized volatility	6.4%	6.3%
Excess return relative to core	—	0.3%
Probability of underperforming core (annualized)	—	54.0%
Tracking error relative to core	—	2.0%
Maximum drawdown	–34.1%	–31.3%
Sharpe ratio	0.23	0.28
Inflation beta	0.07	1
Satellite weight	—	12.0%
Allocation to risky assets (equity + commodities)	40.0%	47.0%

Notes: Portfolio expectations are based on the 10-year VCMM asset class forecasts as of June 30, 2022. The Sharpe ratio is a measure of return above the risk-free rate that adjusts for volatility. A higher Sharpe ratio indicates a higher expected risk-adjusted return. For more information about the VCMM, see Appendix 2. See Appendix 3 for further details on asset classes.

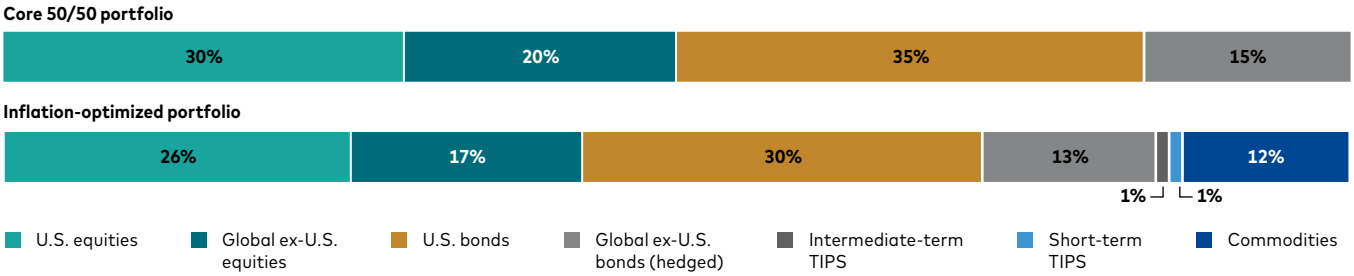
Source: Vanguard.

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 as of June 30, 2022. Results from the model may vary with each use and over time.

FIGURE A-2.

Core 50/50 portfolio versus inflation-optimized portfolio

a. Asset allocation



b. 10-year expectations

	Core 50/50 portfolio	Inflation-optimized portfolio
Annualized total return	4.4%	4.6%
Annualized volatility	7.9%	7.40%
Excess return relative to core	—	0.20%
Probability of underperforming core (annualized)	—	52.7%
Tracking error relative to core	—	2.10%
Maximum drawdown	–41.9%	–37.4%
Sharpe ratio	0.21	0.26
Inflation beta	0.07	1
Satellite weight	—	14.0%
Allocation to risky assets (equity + commodities)	50.0%	55.0%

Notes: Portfolio expectations are based on the 10-year VCMM asset class forecasts as of June 30, 2022. The Sharpe ratio is a measure of return above the risk-free rate that adjusts for volatility. A higher Sharpe ratio indicates a higher expected risk-adjusted return. For more information about the VCMM, see Appendix 2. See Appendix 3 for further details on asset classes.

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 as of June 30, 2022. Results from the model may vary with each use and over time.

Appendix 2.

Vanguard Capital Markets Model

IMPORTANT: The projections and 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. VCMM results presented are as of June 30, 2022.

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 Investment Strategy Group. 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. 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 simulation 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.

Appendix 3.

Indexes for VCMM simulations

The long-term returns of our hypothetical portfolios are based on data for the appropriate market indexes through June 30, 2022. We chose these benchmarks to provide the most complete history possible, and we apportioned the global allocations to align with Vanguard's guidance in constructing diversified portfolios. Asset classes and their representative forecast indexes are as follows:

- U.S. equities—MSCI US Broad Market Index.
- Global ex-U.S. equities—MSCI All Country World ex USA Index.
- U.S. bonds—Bloomberg U.S. Aggregate Bond Index.
- Global ex-U.S. bonds—Bloomberg Global Aggregate ex-USD Index (hedged).
- U.S. TIPS—Bloomberg U.S. Treasury Inflation Protected Securities Index.
- U.S. short-term TIPS—Bloomberg U.S. 1–5 Year Treasury Inflation Protected Securities Index.

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