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Personalized inflation hedging: A closer look at your true consumer price index

- Personalized inflation is driven by factors specific to the individual which may not be accurately represented by the broad Consumer Price Index (CPI). More specifically, personalized inflation is impacted by the types of items and services an individual purchases, the amount spent within each category, and the change in category weights over time.
- The personalized inflation framework detailed in this paper incorporates inputs such as spending category weights to calculate an individual's personalized inflation rate. In addition, the framework solves for the optimal asset allocation mix to hedge against one's personalized inflation rate.
- This conceptual framework shows that an investor's personalized inflation can be more or less sensitive to the popular CPI measure and illustrates the effects of asset allocation when building inflation-hedged portfolios.

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Introduction

Inflation is an important concept in investing because it can erode the real value of investment returns and reduce one's real purchasing power over time. In the U.S., the CPI is used as a general benchmark of inflation and is based on a basket-weighted approach. However, the headline CPI number might not accurately measure the sensitivity to inflation of a given individual, thereby making the case for personalization. We define "personalized inflation" as an individual's custom-weighted basket of the CPI components.

In this paper, we discuss a way to measure personalized inflation and provide insights into how inflation may differ based on demographic data like age and geography. Next, we introduce our conceptual personalized inflation framework and methodology. Last, we compare the personalized inflation of two personas and their implications for optimal portfolio construction.

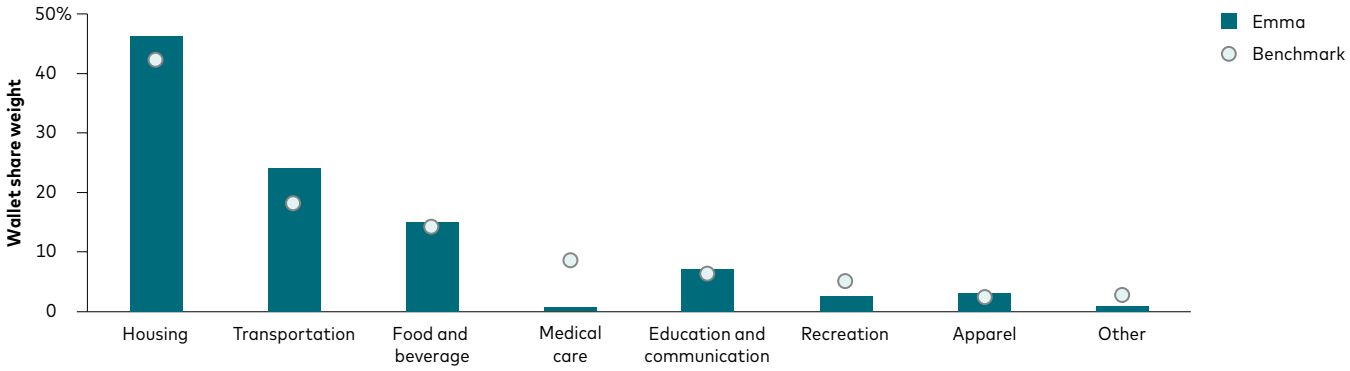
Measuring personalized inflation using Personalized Inflation Beta

To better understand why it is important to measure personalized inflation, we first need to understand how spending habits can result in different inflation rates. To illustrate this, we introduce the fictional example of Emma, who is in her late 20s, enjoys good health, lives in Los Angeles, and loves to travel. We constructed an estimated spending budget based on Emma's lifestyle and compared it with the benchmark spending budget from the Bureau of Labor Statistics (BLS), as shown in **Figure 1**.

Emma's spending basket differs from that of the CPI, most notably because she spends more on housing and transportation—reflecting the high cost of living in Los Angeles as well as travel expenses—and less on medical care and recreation, which includes things like home theater equipment, pets, and sporting goods.

In **Figures 2 and 3**, we use Consumer Expenditure Surveys from the BLS to analyze spending habits of consumers in different demographics and consider their effects on personalized inflation.

FIGURE 1.
Spending basket weight breakdown, Emma versus CPI



Sources: Vanguard calculations, using BLS subcategories of the CPI and Vanguard's assumption of Emma's spending budget.

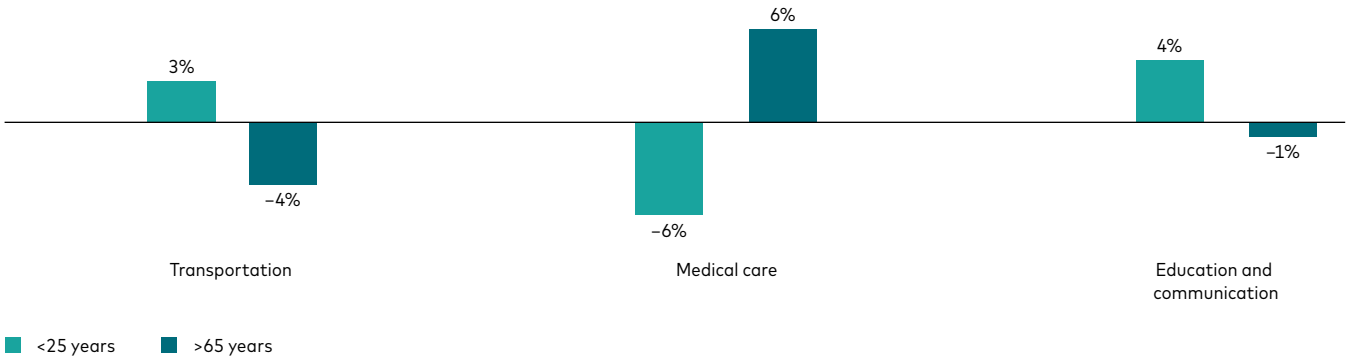
We find that personalized inflation is affected by age, social, and economic factors. For example, one's personalized inflation rate and its sensitivity to CPI, or Personalized Inflation Beta (PIB), may vary based on age and income level, among other factors.

Based on different weightings of baskets for age-based cohorts, we discover that sensitivity to CPI tends to decrease as age increases, as illustrated by the Personalized Inflation Beta for different age groups in Figure 2.

For individuals under 25, personalized inflation is about 20% more sensitive than CPI, and for those older than 75 it is about 20% less sensitive. This is partly due to differences in spending on transportation and medical care. The transportation sector, which includes gasoline prices, is historically a more volatile sector, which leads to an increased sensitivity to CPI. A spending reduction in this category would help to dampen the sensitivity of one's PIB.

FIGURE 2.

Personalized Inflation Beta by age group



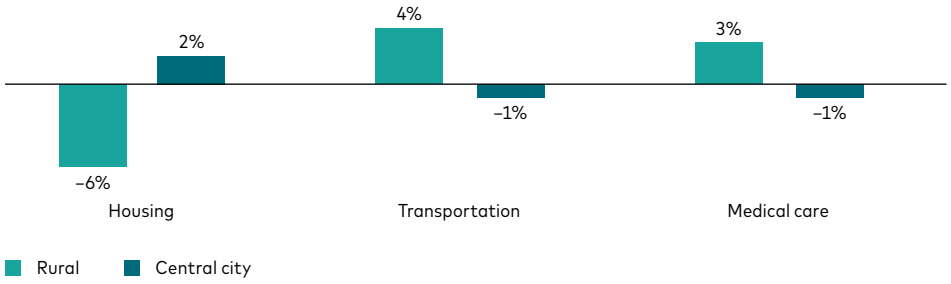
	Under 25 years	25–34 years	35–44 years	45–54 years	55–64 years	65 years and older	65–74 years	75 years and older
Personalized Inflation Beta	1.18	1.16	1.14	1.11	1.08	0.92	0.99	0.80

Notes: Personalized Inflation Beta (PIB) is derived using a least-squares regression for a time horizon of 30 years to capture sensitivity between personalized inflation and CPI. For example, a PIB of 1.18 indicates that when headline CPI increases by 1%, personalized inflation would increase by 1.18%.

Sources: Vanguard calculations, using BLS data, Consumer Expenditure Surveys, and subcategories of the CPI.

FIGURE 3.

Personalized Inflation Beta by location



	Rural	Central city
Personalized Inflation Beta	1.20	1.00

Notes: Personalized Inflation Beta (PIB) is derived using a least-squares regression for a time horizon of 30 years to capture sensitivity between personalized inflation and CPI. For example, a PIB of 1.20 indicates that when headline CPI increases by 1%, personalized inflation would increase by 1.20%.

Sources: Vanguard calculations, using BLS data, Consumer Expenditure Surveys, and subcategories of the CPI.

When comparing against the general BLS inflation reading by location, we observe an increase in PIB for individuals living in rural areas, as shown in Figure 3. The different sensitivity is explained by increased allocations to transportation and medical care for rural living, which more than offset lower housing expenses. We can observe the inflation sensitivity difference not only in age and location, but also characteristics such as income (see **Appendix**).

Although CPI is broadly representative of inflation in the U.S., Figures 2 and 3 show that, when accounting for individual situations, the sensitivity changes to CPI can be very noticeable. (Remember also that CPI excludes financing-related expenses like mortgages and car loans.) Therefore, when we construct a portfolio to hedge against inflation using only the general CPI and not one's personalized inflation rate, we might over- or under-hedge the portfolio.

Personalized inflation framework

PCPI methodology

In order to capture the uniqueness that comes with personalized inflation, we used the following four-step approach: Prepare, Collect, Process, and Invest (PCPI).

Prepare

Understanding where money is spent is an important step in managing one's sensitivity to inflation. It starts by making a list of all expected expenses, such as rent or mortgage payments, car payments, utilities, groceries, and entertainment. Then the totals for each category are added up to get an estimate of one's monthly or yearly expenses. This gives an individual an idea of how much money is available to spend each month or year.

Collect

Collecting an individual's unique expected spending budget is necessary to estimate personalized inflation beta and alpha. Those outputs can then be used to create personalized inflation-hedged portfolios. Inputting an expected budget using the BLS's 15 predefined spending categories allows us to calculate a personalized spending basket weight.

For financing-related expenses like housing, we also included the option to keep the historical BLS price fluctuation of the shelter spending category the same while keeping their relative spending weight. For example, for someone who has a 30-year fixed mortgage where the monthly payment accounts for 40% of their current spending basket, we would hold that 40% constant through the entire historical period. We then assume that weight stays constant for the past 30 years to extract the relationship between the personalized inflation and CPI via regression analysis. This process not only captures the personalized inflation relationship but also informs the individual of the possibility to change their inflation sensitivity through future spending decisions.

Process

The Vanguard Capital Markets Model® (VCMM) is a financial simulation engine that forecasts a non-normal return distribution of asset returns, volatilities, and cross-asset return correlations for passive assets and factors (see Davis et al., 2014 and 2022). The VCMM model can also incorporate current market conditions, such as level of interest rates, spreads, price-earnings ratios, and other fundamental drivers of asset return, to generate return expectations for the next 10 to 30 years.

Using VCMM-based inflation simulations, we can create personalized inflation simulations with the appropriate sensitivity to CPI. The process starts by incorporating the relationship extracted from one's personalized inflation and general inflation, as measured by the BLS, then uses Monte Carlo methods to simulate a non-normal distribution (t-distribution) of personalized inflation-adjusted projection similar to VCMM.

Invest

By leveraging the inflation-hedging capability of the Vanguard Asset Allocation Model (VAAM), we can construct an optimized portfolio that is personally tailored to an individual (see Schlanger et al., 2022). VAAM is a utility-based model that evaluates the risk and return trade-offs of selected asset classes to reach optimal allocations relative to a level of risk tolerance based on VCMM asset return projections. The inflation-hedging feature was created by targeting an expected inflation beta range (i.e., a minimum and maximum threshold for inflation beta).

The PCPI methodology concept advances our thinking regarding the optimal asset allocations to hedge against one's personalized inflation goal.

Personas and portfolio construction

This new personalized inflation methodology has multiple applications. In **Figures 4 and 5**, we provide two personas to better illustrate it.

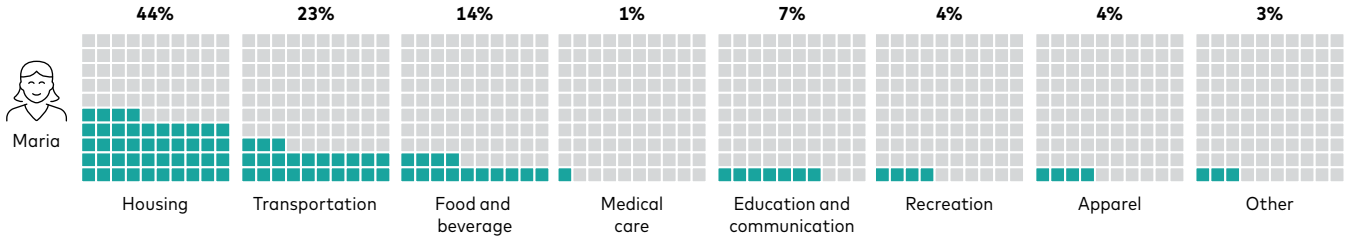
A practical application of personalized inflation: Young adult

Maria is in her late 20s, and she lives and works in New York City. She rents an apartment, loves to travel, and has few medical expenses, as shown in her spending basket breakdown in Figure 4a. Her estimated PIB is 1.24, as shown in Figure 4b.

FIGURE 4.

Maria's spending and personalized inflation

a. Maria's spending basket



Source: Vanguard's assumption of Maria's spending budget.

b. Maria's historical personalized inflation rate and Personalized Inflation Beta

PIB	Alpha	R-squared
1.24***	−0.004	0.97

Notes: Personalized Inflation Beta (PIB) is derived using a least-squares regression for a time horizon of 30 years to capture sensitivity between personalized inflation and CPI. For example, a PIB of 1.24 indicates that when headline CPI increases by 1%, personalized inflation would increase by 1.24%. The *** indicates a very statistically significant PIB ($p < 0.001$), and the high R-squared shows high fit or accuracy of the regression.

Sources: Vanguard calculations, using BLS subcategories of the CPI and Vanguard's assumption of Maria's spending budget.

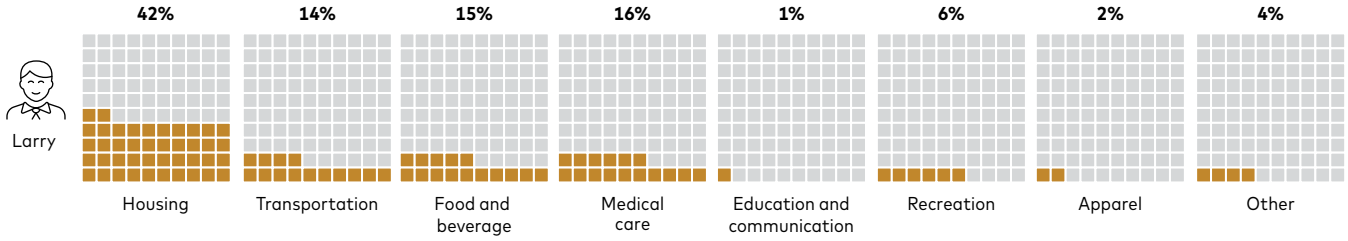
A practical application of personalized inflation: Nearing retirement

Larry is in his late 50s. He lives in suburban Texas, and he is a corporate manager approaching retirement. He owns a house with a 30-year fixed mortgage, loves to cook and garden, and has significant health care expenses, as shown in his spending basket breakdown in Figure 5a. His estimated PIB is 0.67, as shown in Figure 5b.

FIGURE 5.

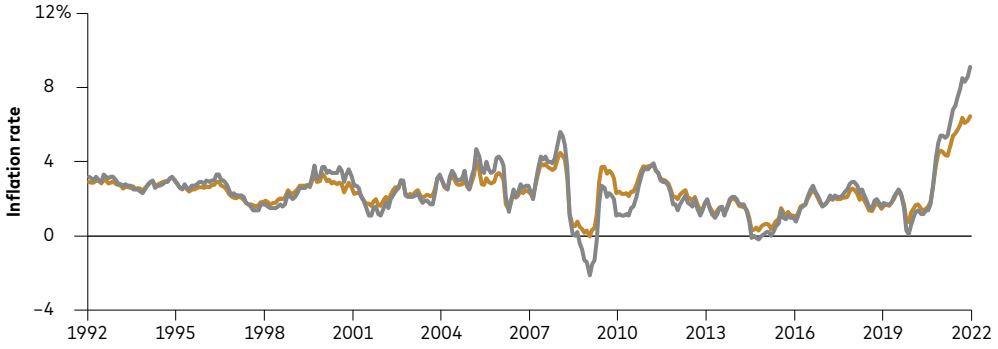
Larry's spending and personalized inflation

a. Larry's spending basket



Source: Vanguard's assumption of Larry's spending budget.

b. Larry's historical personalized inflation rate and Personalized Inflation Beta



PIB	Alpha	R-squared
0.67***	0.008	0.92

Notes: Personalized Inflation Beta (PIB) is derived using a least-squares regression for a time horizon of 30 years to capture sensitivity between personalized inflation and CPI. For example, a PIB of 0.67 indicates that when headline CPI increases by 1%, personalized inflation would increase by 0.67%. The *** indicates a very statistically significant PIB ($p < 0.001$), and the high R-squared shows high fit or accuracy of the regression.

Sources: Vanguard calculations, using BLS subcategories of the CPI and Vanguard's assumption of Larry's spending budget.

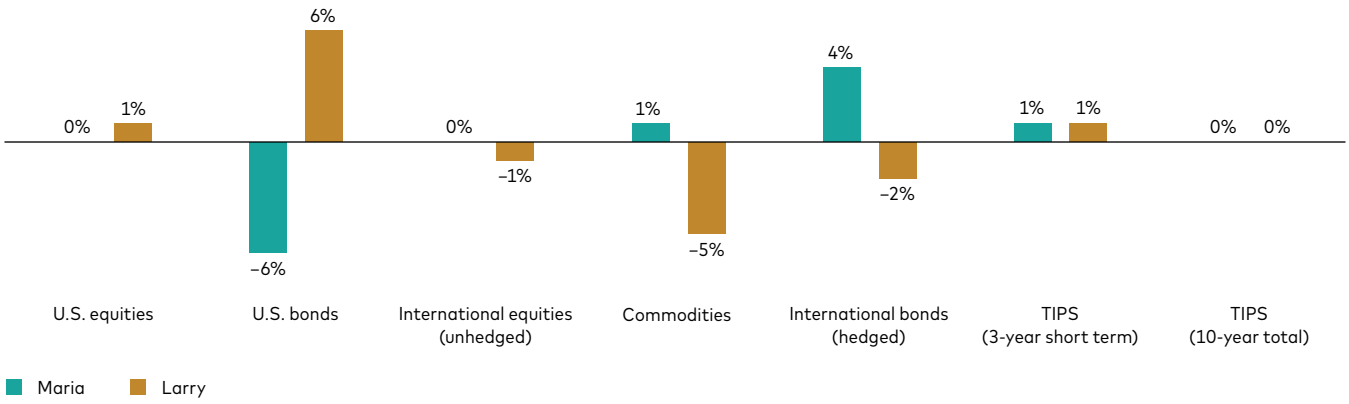
Figures 4a and 5a illustrate the differences between Maria and Larry's spending patterns. Maria spends more on housing, apparel, and transportation compared with both Larry and the average American. As a result of her increased spending on more inflation-sensitive sectors, Maria's estimated PIB is 1.24. Larry has similar spending on housing, but his fixed mortgage helps dampen his sensitivity to CPI. That, along with his lower spending on transportation, has led to an estimated PIB of 0.67.

Based on different personalized inflation relationships, we used our new simulation engine and VCMM to project 10,000 possible future personalized inflation scenarios. We then leveraged our inflation-hedging feature in VAAM to evaluate the risk and return trade-offs of selected asset classes to find optimal solutions relative to the same level of risk aversion for both profiles. We see much different portfolio allocations for Maria and Larry, especially when compared to the general CPI.

For Maria's portfolio (see **Figure 6**), an increased allocation toward international bonds and commodities would help hedge against her personalized inflation while marginally increasing the risk compared with a portfolio based solely on the CPI. **Figure 7** shows a 0.3% increase in volatility Maria would expect to have a 6.6% annualized return compared with 5.6% using only a traditional 60/40 portfolio (60% equity, 40% fixed income, 60% equity home bias and 70% fixed income home bias). Plus, this aligns the portfolio objective to hedge against her own PIB of 1.24.

Larry's portfolio (see **Figure 8**) could accomplish the same goal—hedging against personalized inflation—with a much lower drawdown risk of –40.1% compared with –47.9% for the traditional 60/40 portfolio. Indeed, in Figure 6 we see a much higher allocation toward U.S. bonds for Larry, and we were able to reduce the need for allocation toward commodities. Given his lower sensitivity to inflation, Larry gets a portfolio with similar risk while keeping the same personalized inflation hedge objective.

FIGURE 6.
Personalized Inflation Beta portfolios



Source: Vanguard, using June 2022 VCMM forecast.

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. For more information, please see page 12 of the Appendix.

FIGURE 7.

Maria's personalized portfolio versus the traditional 60/40

	Traditional 60/40 portfolio	Maria's portfolio	Difference
Annualized total return	5.6%	6.6%	1.0%
Annualized volatility	9.8%	10.1%	0.3%
Excess return	—	1.0%	—
Probability of underperforming (annually)	—	43.4%	—
Tracking error	—	5.3%	—
Drawdown risk	−47.9%	−41.4%	6.5%
Sharpe ratio	0.2	0.3	0.1
Personalized Inflation Beta	1.24	1.24	—
Risk allocation	60%	72%	12%

Notes: Personalized Inflation Beta is calculated based on Maria's spending basket. Risk allocation refers to the percentage of the portfolio invested in equities and commodities.

Source: Vanguard.

FIGURE 8.

Larry's personalized portfolio versus the traditional 60/40

	Traditional 60/40 portfolio	Larry's portfolio	Difference
Annualized total return	5.6%	6.4%	0.8%
Annualized volatility	9.8%	9.7%	−0.1%
Excess return	—	0.8%	—
Probability of underperforming (annually)	—	42.7%	—
Tracking error	—	4.0%	—
Drawdown risk	−47.9%	−40.1%	7.8%
Sharpe ratio	0.2	0.3	0.1
Personalized Inflation Beta	0.67	0.67	—
Risk allocation	60%	66%	6%

Notes: Personalized Inflation Beta is calculated based on Larry's spending basket. Risk allocation refers to the percentage of the portfolio invested in equities and commodities.

Source: Vanguard.

Conclusion

The CPI, which measures the average change over time in the prices paid by consumers for a representative basket of goods and services, is a popular metric for evaluating inflation. However, the CPI is not customized on an individual basis. This new personalized inflation methodology brings greater in-depth insights and understanding of individuals' sensitivity to CPI and enables them to create portfolios that hedge against personalized inflation, if desired.

References

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U.S. Bureau of Labor Statistics. *Consumer Expenditure Surveys Tables*; available at www.bls.gov/cex/tables.htm.

U.S. Bureau of Labor Statistics. *Table 1. Consumer Price Index for All Urban Consumers (CPI-U): U.S. City Average, by Expenditure Category - 2022 M09 Results*; available at www.bls.gov/news.release/cpi.t01.htm.

Appendix: Personalized Inflation Beta by income level

Income is another insightful measurement for assessing Personalized Inflation Beta. As an individual's income increases, one might expect a higher discretionary spending allocation in more inflation-sensitive sectors and items, including recreation, travel, and luxury goods. However, the relationship between income and sensitivity to inflation isn't linear, as shown below. As income level rises, we see a steady increase in sensitivity to inflation as spending shifts toward transportation and recreation. It's not until annual income exceeds $150,000 that we see a drop-off in Personalized Inflation Beta as spending shifts toward education and communication and housing. Thus, an increase in disposable income might not directly increase one's inflation sensitivity as the spending might be distributed evenly into different sectors.

FIGURE A-1.

Personalized Inflation Beta by income level

	Less than $15,000	$15,000 to $29,999	$30,000 to $39,999	$40,000 to $49,999	$50,000 to $69,999	$70,000 to $99,999	$100,000 to $149,999	$150,000 to $199,999	$200,000 and more
Personalized Inflation Beta	0.92	0.89	0.96	0.99	1.05	1.06	1.09	0.96	0.94

Notes: Personalized Inflation Beta (PIB) is derived using a least-squares regression for a time horizon of 30 years to capture sensitivity between personalized inflation and CPI. For example, a PIB of 0.92 indicates that when headline CPI increases by 1%, personalized inflation would increase by 0.92%.

Sources: Vanguard calculations, using BLS data, Consumer Expenditure Surveys, and subcategories of the CPI.

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IMPORTANT: 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 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 importantly, 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 inter-relationships 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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