

Vanguard economic and market outlook for 2023: Beating back inflation

- Generationally high inflation has led to a marked slowing in global economic activity. Rapid monetary tightening aimed at bringing down inflation will ultimately succeed, but at a cost of a global recession in 2023.
- Current and expected conditions are like those that have signalled past global recessions. Significantly deteriorated financial conditions, increased policy rates, energy concerns and declining trade volumes indicate the global economy will likely enter a recession in the coming year. Job losses should be most concentrated in the technology and real estate sectors, which were among the strongest beneficiaries of the zero-rate environment.
- Inflation continued to trend higher in 2022 across most economies as supply chains had yet to fully recover from pandemic-related distortions and as demand was buoyed by strong household and business balance sheets. Inflation has likely already peaked in most markets, but reducing price pressures tied to labour markets and wage growth will take longer. As such, central banks may reasonably achieve their 2% inflation targets only in 2024 or 2025.
- Consistent with our investment outlook for 2022 which focused on the need for higher short-term interest rates, central banks will continue their aggressive tightening cycle into early 2023 before pausing as inflation falls and job losses mount. Importantly, we see most central banks reluctant to cut rates in 2023 given the need to cool wage growth.
- Although rising interest rates have created near-term pain for investors, higher starting rates have raised our return expectations for both US and international bonds, which we now expect to return roughly 4%–5% over the next decade.
- Equity markets have yet to drop materially below their fair-value range, which they have historically done during recessions. Longer term, however, our global equity outlook is improving because of lower valuations and higher interest rates. Our return expectations are 2.25 percentage points higher than last year. From a US dollar investor's perspective, our Vanguard Capital Markets Model projects higher 10-year annualised returns for non-US developed markets (7.2%–9.2%) and emerging markets (7%–9%) than for US markets (4.7%–6.7%).

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Lead authors



Joseph Davis,
PhD



Roger A.
Aliaga-Díaz, PhD



Jumana Saleheen,
PhD



Qian Wang,
PhD



Andrew J.
Patterson, CFA



Kevin DiCiuccio,
CFA



Alexis Gray,
MSc



Asawari Sathe,
MSc



Joshua M. Hirt,
CFA



Shaan Raithatha,
CFA

Vanguard Investment Strategy Group

Global Economics Team

Joseph Davis, PhD, Global Chief Economist

Americas

Roger A. Aliaga-Díaz, PhD, Americas Chief Economist

Joshua M. Hirt, CFA, Senior Economist

Andrew J. Patterson, CFA, Senior Economist

Asawari Sathe, MSc, Senior Economist

Adam J. Schickling, CFA

Maximilian Wieland

David Diwik, MSc

Ariana Abousaeedi

Europe

Jumana Saleheen, PhD, Europe Chief Economist

Shaan Raithatha, CFA, Senior Economist

Roxane Spitznagel, MSc

Lulu Al Ghusein, MSc

Asia-Pacific

Qian Wang, PhD, Asia-Pacific Chief Economist

Alexis Gray, MSc, Senior Economist

Capital Markets Model Research Team

Qian Wang, PhD, Global Head of VCMM

Kevin DiCiuccio, CFA, Senior Investment Strategist

Daniel Wu, PhD, Senior Investment Strategist

Ian Kresnak, CFA

Vytautas Maciulis, CFA

Olga Lepigina, MBA

Ben Vavreck, CFA

Lukas Brandl-Cheng, MSc

Alex Qu

Acknowledgments: We thank Brand Design, Corporate Communications, Strategic Communications and the Asset Allocation teams for their significant contributions to this piece. Further, we would like to acknowledge the work of Vanguard's broader Investment Strategy Group, without whose tireless research efforts this piece would not be possible.

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Notes on asset-return distributions

The asset-return distributions shown here represent Vanguard's view on the potential range of risk premiums that may occur over the next 10 years; such long-term projections are not intended to be extrapolated into a short-term view. These potential outcomes for long-term investment returns are generated by the Vanguard Capital Markets Model® (VCMM) and reflect the collective perspective of our Investment Strategy Group. The expected risk premiums – and the uncertainty surrounding those expectations – are among a number of qualitative and quantitative inputs used in Vanguard's investment methodology and portfolio construction process.

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 modelled asset class. Simulations are as at 30 September 2022. Results from the model may vary with each use and over time. For more information, see the Appendix section "About the Vanguard Capital Markets Model".

Global outlook summary

The global economy in 2023: Beating back inflation

In our 2022 economic and market outlook, we outlined how we believed the removal of policy accommodation would shape the economic and financial market landscape. Policy has in fact driven conditions globally in 2022, one of the most rapidly evolving economic and financial market environments in history. But one fact has been made abundantly clear: so long as financial markets function as intended, policymakers are willing to accept asset price volatility and a deterioration in macroeconomic fundamentals as a consequence of fighting inflation. The normalisation of consumer behaviour, stabilisation of supply pressures and rapid monetary tightening suggest a more challenging macroeconomic environment in 2023 that, in our view, will help bring down the rate of inflation.

Global inflation: Persistently surprising

Inflation has continued to trend higher across most economies, in many cases setting multidecade highs. The action taken and likely to be taken in the months ahead, by central banks reflects a promising effort to combat elevated inflation that has proven more persistent and broad-based. Supply-demand imbalances linger in many sectors as global supply chains have yet to fully recover from the Covid-19 pandemic and as demand is supported by strong household and business balance sheets buoyed by pandemic-era stimulus. The war in Ukraine continues, threatening another surge in energy and food commodities prices. Effective monetary policy requires good decision-making, good communication and good luck. The current backdrop is missing the good-luck component, posing a challenge for policymakers whose fiscal and monetary tools are less effective at combating supply shocks.

A recession by any other name

Global macro and financial market conditions today and those anticipated in the coming months are similar to those that have signalled global recessions in the past. Energy supply-and-demand concerns, diminishing capital flows, declining trade volumes and falling output per person mean that, in all likelihood, the global economy will enter a recession in the coming year. Central banks generally seek to avoid a recession. Inflation dynamics mean that supply-side price pressures on inflation are likely to reverse in 2023. However, policymakers must tighten financial conditions to stop high inflation from becoming entrenched into the decision-making of households and businesses. That said, households, businesses and financial institutions are arguably in a better position to handle an eventual downturn, to the extent that they have stronger balance sheets. All recessions are painful and we expect the length and depth of the recession in 2023 to vary by region.

Our base case is a global recession in 2023 brought about by the efforts to return inflation to target. Whether history views the 2023 recession as mild or significant matters little for those affected by the downturn. But failing to act aggressively to combat inflation risks harming households and businesses through entrenched inflationary pressures that last longer than the pain associated with any one recession.

As the following table highlights, growth is likely to end 2023 flat or slightly negative in most major economies outside of China. Unemployment is likely to rise over the year but nowhere near as high as during the 2008 and 2020 downturns. Through job losses and slowing consumer demand, a downtrend in inflation is likely to persist throughout 2023. We don't believe that central banks will achieve their targets of 2% inflation in 2023, but they will maintain those targets and look to achieve them throughout 2024 and into 2025 – or reassess them when the time is right. That time isn't now; reassessing inflation targets in a high-inflation environment could have deleterious effects on central bank credibility and inflation expectations.

Vanguard's economic forecasts

Country/ region	GDP growth*			Unemployment rate			Headline inflation*		Monetary policy		
	2023			2023			2023		Year-end 2022	Year-end 2023	Neutral rate
	Vanguard	Consensus	Trend	Vanguard	Consensus	NAIRU	Vanguard	Consensus			
US	0.25%	0.9%	1.8%	5%	4.4%	3.5%–4%	3%	2.4%	4.25%	5%	2.5%
Euro area	0%	0.2%	1.2%	7.4%	7.1%	6.5%–7%	6.0%	5.8%	2%	2.5%	1.5%
UK	-1.1%	-0.8%	1.7%	4.7%	4.4%	3.5%–4%	6.3%	6.8%	3.5%	4.5%	2.5%
China*	4.5%	5%	4.3%	4.7%	N/A	5%	2.2%	2.3%	2.65%	2.6%	4.5%

* For the US, GDP growth is defined as the year-over-year change in fourth-quarter gross domestic product. For all other countries/regions, it is defined as the annual change in total GDP in the forecast year compared with the previous year.

* For the US, headline inflation is defined as year-over-year changes in this year's fourth-quarter Personal Consumption Expenditures (PCE) Price Index compared with last year. For all other countries/regions, it is defined as the average annual change in headline Consumer Price Index (CPI) inflation in the forecast year compared with the previous year. Consensus for the US is based on Bloomberg ECFC consensus estimates.

* China's policy rate is the one-year medium-term lending facility (MLF) rate.

Notes: Forecasts, which may have been updated from earlier outlooks, are as at 30 November 2022. NAIRU stands for non-accelerating inflation rate of unemployment. The neutral rate is the interest rate that would be neither expansionary or contractionary when the economy is at full employment and stable inflation. This table displays our median neutral rate estimates with an effective range of +/- 1 percentage point.

Source: Vanguard.

Global fixed income: Brighter days ahead

The market, which was initially slow to price higher interest rates to fight elevated and persistent inflation, now believes that most central banks will have to go well past their neutral policy rates – the rate at which policy would be considered neither accommodative nor restrictive – to quell inflation. The eventual peak and persistence of policy rates, which will depend heavily on the path of inflation, will determine how high bond yields rise. Rising interest rates and higher interest rate expectations have lowered bond returns in 2022, creating near-term pain for investors. However the bright side of higher rates is higher interest payments. These have led our return expectations for US and international bonds to increase by more than twofold. We now expect US bonds to return 4.1%–5.1% per year over the next decade, compared with the 1.4%–2.4% annual returns we forecast a year ago. For international bonds, we expect returns of 4%–5% per year over the next decade, compared with our year-ago forecast of 1.3%–2.3% per year. This means that for investors with an adequately long investment horizon, we expect their wealth to be higher by the end of the decade than our year-ago forecast would have suggested. In credit, valuations are

fair, but the growing likelihood of recession and declining profit margins skew the risks towards higher spreads. Although credit exposure can add volatility, its higher expected return than that of US Treasuries and low correlation with equities validate its inclusion in portfolios.

Global equities: Resetting expectations

Rising interest rates, inflation and geopolitical risks have forced investors to reassess their rosy expectations for the future. The silver lining is that this year's bear market has improved our outlook for global equities, though our Vanguard Capital Markets Model (VCMM) projections suggest there are greater opportunities outside the US.

Stretched valuations in the US equity market in 2021 were unsustainable and our fair-value framework suggests they still don't reflect current economic realities. We also see a high bar for continued above-average earnings growth, especially in the US. Although US equities have continued to outperform their international peers, the primary driver of that outperformance has shifted from earnings to currency over the last year. The 30% decline in emerging markets

over the past 12 months has made valuations in those regions more attractive. We now expect similar returns to those of non-US developed markets and view emerging markets as an important diversifier in equity portfolios.

From a US dollar investor's perspective, the VCMM projects higher 10-year annualised returns for non-US developed markets (7.2%–9.2%) and emerging markets (7%–9%) than for US markets (4.7%–6.7%). Globally, our equity return

expectations are 2.25 percentage points higher than they were at this time last year. Within the US market, value stocks are fairly valued relative to growth and small-capitalisation stocks are attractive despite our expectations for weaker near-term growth. Our outlook for the global equity risk premium is still positive at 1 to 3 percentage points, but lower than last year because of a faster increase in expected bond returns.

Indices used in our historical calculations

The long-term returns for our hypothetical portfolios are based on data for the appropriate market indices throughout 30 September 2022. We chose these benchmarks to provide the best history possible and we split the global allocations to align with Vanguard's guidance in constructing diversified portfolios.

US bonds: Standard & Poor's High Grade Corporate Index from 1926 to 1968; Citigroup High Grade Index from 1969 to 1972; Lehman Brothers US Long Credit AA Index from 1973 to 1975; and Bloomberg US Aggregate Bond Index thereafter.

Ex-US bonds: Citigroup World Government Bond Ex-US Index from 1985 to January 1989 and Bloomberg Global Aggregate ex-USD Index thereafter.

Global bonds: Before January 1990, 100% US bonds, as defined above. From January 1990 onward, 70% US bonds and 30% ex-US bonds rebalanced monthly.

US equities: S&P 90 Index from January 1926 to March 1957; S&P 500 Index from March 1957 to 1974; Dow Jones Wilshire 5000 Index from the beginning of 1975 to April 2005; and MSCI US Broad Market Index thereafter.

Ex-US equities: MSCI World ex-USA Index from January 1970 to 1987 and MSCI All Country World ex-USA Index thereafter.

Global equities: Before January 1970, 100% US equities, as defined above. From January 1970 onward, 60% US equities and 40% ex-US equities rebalanced monthly.

Notes on risk

All investing is subject to risk, including the possible loss of the money you invest. Past performance is no guarantee of future returns. Diversification does not ensure a profit or protect against a loss in a declining market. There is no guarantee that any particular asset allocation or mix of funds will meet your investment objectives or provide you with a given level of income. The performance of an index is not an exact representation of any particular investment as you cannot invest directly in an index.

Stocks and bonds of companies in emerging markets are generally more risky than stocks of companies in developed countries. US government backing of Treasury or agency securities applies only to the underlying securities and does not prevent price fluctuations. Investments that concentrate on a relatively narrow market sector face the risk of higher price volatility. Investments in stocks issued by non-US companies are subject to risks including country/regional risk and currency risk.

Bond funds are subject to the risk that an issuer will fail to make payments on time and that bond prices will decline because of rising interest rates or negative perceptions of an issuer's ability to make payments. High-yield bonds generally have medium- and lower-range credit-quality ratings and are therefore subject to a higher level of credit risk than bonds with higher credit-quality ratings. Although the income from US Treasury obligations held in the fund is subject to federal income tax, some or all of that income may be exempt from state and local taxes.

I. Global economic perspectives

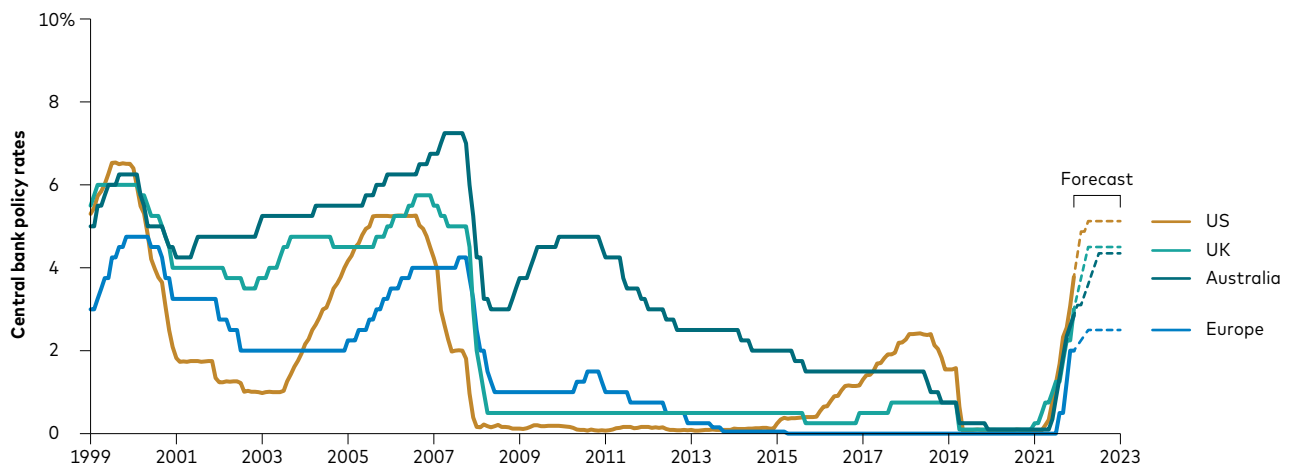
Global economic outlook: Beating back inflation

In our 2022 economic and market outlook, we outlined the reasons why we believed that the removal of policy accommodation would shape the economic and financial market landscape in the year ahead. Policy has in fact been a key driver of conditions globally, as 2022 has proven to be one of the most rapidly evolving economic and financial market environments in recent history. **Figure I-1** shows that the current and expected pace of change in monetary policy is unlike anything we've seen in the last 30 years, particularly on a globally coordinated scale.

The action taken and likely to be taken in the months ahead by central banks reflects an effort to combat multidecade high inflation that has

proven more persistent and broad-based. Supply-demand imbalances linger in many sectors as global supply chains have yet to fully recover from the Covid-19 pandemic and as demand is supported by strong household and business balance sheets buoyed by pandemic-era stimulus. The war in Ukraine continues, threatening another surge in energy and food commodities prices. Effective monetary policy requires good decision-making, good communication and good luck. The US Federal Reserve (Fed) has been behind the curve in hiking rates this year, reflecting imprecise decision-making, but more importantly it is missing the good-luck component, posing a challenge for policymakers whose fiscal and monetary tools are less effective at combating supply shocks.

FIGURE I-1
Globally coordinated monetary tightening

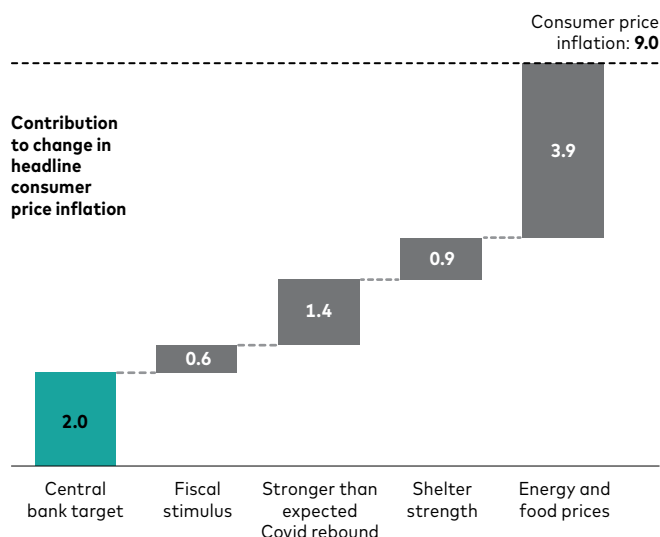


Note: Dotted lines represent Vanguard's forecast for policy rates as at 31 October 2022.

Sources: Vanguard calculations based on data from Thomson Reuters Datastream and Bloomberg.

Because central banks' tools are most effective in bringing down inflation by tamping down demand, the decomposition of the drivers of inflation is crucial. By our estimates (**Figure I-2**), supply and demand factors are evenly contributing to inflationary pressures. If central banks are to rein in inflation, they will probably have to depress demand to the extent that a recession becomes very likely. **Figure I-3** outlines our projected probabilities of recession along with the likely forces that tip the economy into recession.

FIGURE I-2
Global inflation has been driven by a multitude of factors



Notes: This decomposition of inflation into each of the subcategories is based on subjective analysis of our latest inflation forecast for year-end 2022 compared with expectations at the start of 2021. Shelter inflation is the component that captures the effect of shelter costs in the overall CPI. Shelter includes prices for both renters and homeowners. For renters, shelter inflation measures rent, temporary lodging away from home and utility payments. For homeowners, the U.S. Bureau of Labor Statistics calculates what it would cost to rent a similar house. Values in the figure reflect rounding.

Sources: Vanguard calculations based on data from Moody's, Refinitiv and Bloomberg, as at 31 October 2022.

FIGURE I-3
Near-term recession risk is elevated across major developed markets

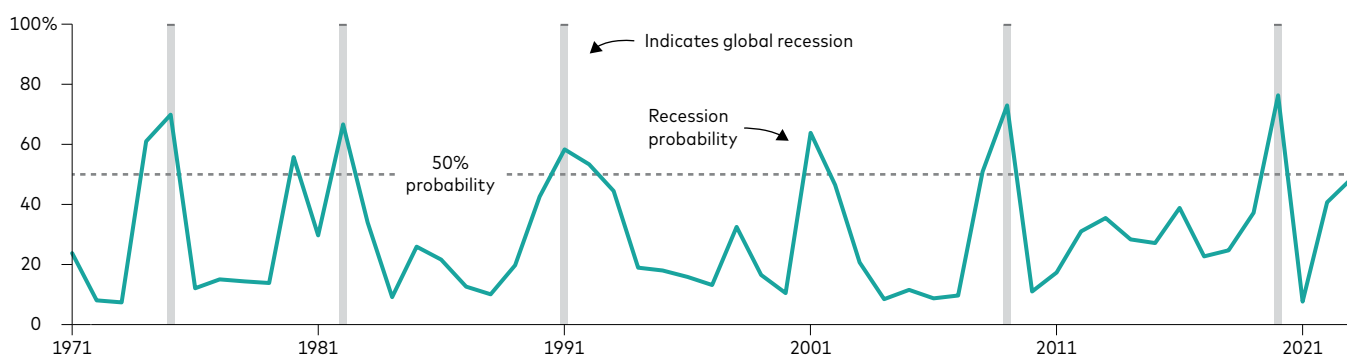
	Probability of recession by end of 2023	Drivers/key risks
US	90%	<ul style="list-style-type: none"> Fed tightening path Inflation eroding consumer purchasing power
Euro area	90%	<ul style="list-style-type: none"> Ukraine war impact including energy crisis Inflation eroding consumer purchasing power European Central Bank (ECB) tightening path
UK	90%	<ul style="list-style-type: none"> Bank of England (BoE) tightening path Inflation eroding consumer purchasing power

Source: Vanguard, as at 30 September 2022.

Global conditions today and those that are expected to materialise in the coming months are similar to conditions that have signalled global recessions in the past. Energy supply-and-demand concerns, decreasing capital flows, declining trade volumes and falling output per person mean that, in all likelihood, the global economy will enter a recession in the coming year¹. Borrowing from the World Bank's

definition of a global recession, **Figure I-4** assigns a probability that the world is in a state of recession at any given point in time². Only in 2001 was the probability of global recession as high as it is today without an actual recession taking place within the subsequent 12 months³. From this we infer that the chances of a global recession in 2023 are very high.

FIGURE I-4
Global recession indicator is at dangerous levels



Note: Probabilities derived from vector similarity matrixes for global unemployment, real per capita GDP, industrial production, foreign direct investment, trade and global energy demand were used to identify similarities between the period under consideration and other recessionary periods.

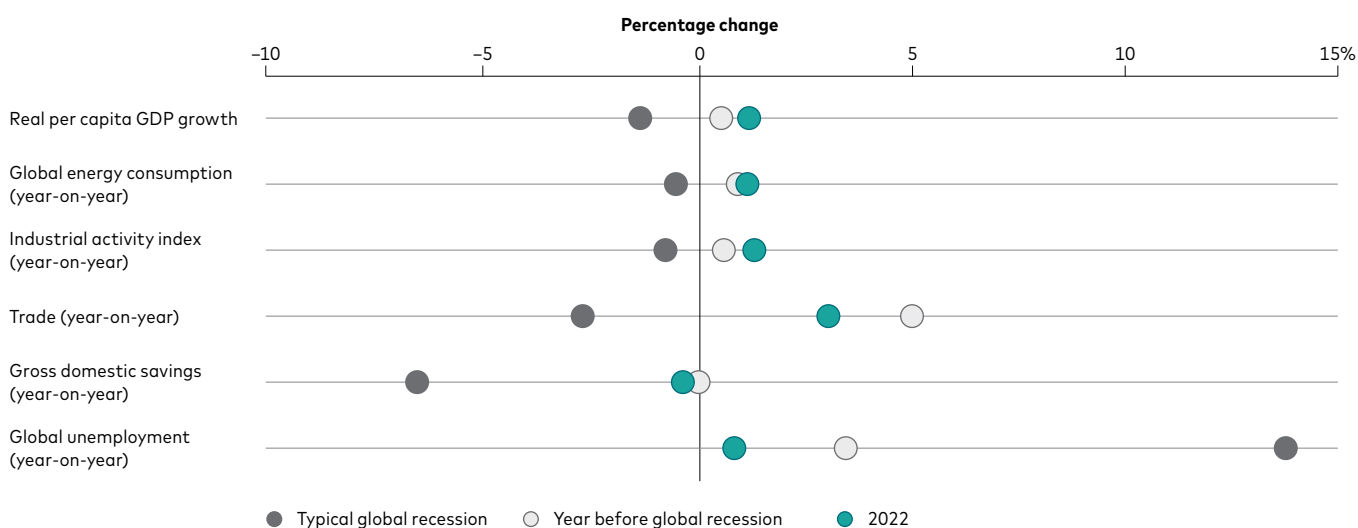
Sources: World Bank, British Petroleum Statistical Review of World Energy, OECD, Federal Reserve Bank of St. Louis FRED database, OeNB, CPB Netherlands Bureau for Economic Policy Analysis and UNCTAD, as at 31 October 2022. Global unemployment data are from Kose, Sugawara and Terrones (2020).

1 While there is no universal definition of a global recession, the World Bank defines a global recession as a period in which (1) annual global real GDP per capita declines and (2) there is strong evidence for a broad-based decline in multiple global economic activity indicators (Kose, Sugawara and Terrones, 2020).
2 See World Bank, 2022, *Risk of Global Recession in 2023 Rises Amid Simultaneous Rate Hikes*, press release issued 15 September 2022, available at www.worldbank.org/en/news/press-release/2022/09/15/risk-of-global-recession-in-2023-rises-amid-simultaneous-rate-hikes.
3 A recession did occur in the US from March to November 2001, though a global recession as defined by the World Bank was avoided.

Periods of global recession tend to be associated with considerable economic and financial market pain (Figure I-5). This is in part because, rather than simply a drop in demand or an increase in supply constraints, there is typically broader dislocation in macroeconomic fundamentals or the functioning of financial markets. In 1974 and 1981, global economies were locked in a stagflationary environment brought about by oil supply shocks and an unhinging of inflation expectations; that led to wages and prices moving ever higher in a vicious cycle broken only by substantial monetary policy tightening and ensuing recessions. In 2007, the global

financial system nearly came to a halt as liquidity constraints led to solvency concerns at systemically important financial institutions exposed to securities tied to US mortgage debt. And in 2020, large portions of the global economy essentially shut down in efforts to stem the health risks of the Covid-19 pandemic. The starting point for the global economy in 2022 was stronger than in a typical year before a global recession (Figure I-5): output and industrial activity were a little stronger and unemployment significantly lower. Taken at face value, a stronger footing into the recession could result in a milder downturn supported by strong balance sheets.

FIGURE I-5
Comparison: global recessions versus now



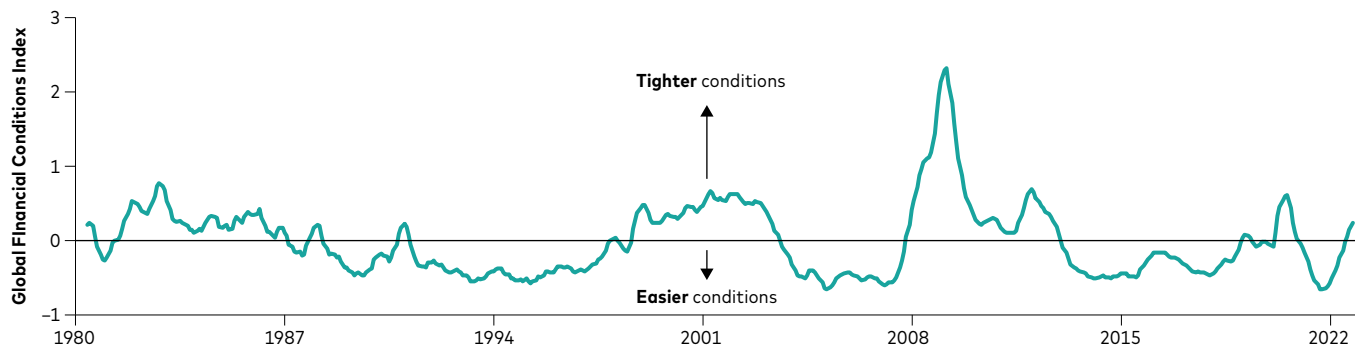
Notes: Global recession years were 1975, 1982, 1991, 2009 and 2020. Year before includes the year before each, excluding 2019. Vanguard calculations are as at 31 October 2022. The typical global recession reflects the median result for each category in the global recession years.

Sources: World Bank, British Petroleum Statistical Review of World Energy, OECD, Federal Reserve Bank of St. Louis FRED database, OeNB, CPB Netherlands Bureau for Economic Policy Analysis, UNCTAD and Our World in Data, as at 31 October 2022. Global unemployment data and years of global recession are from Kose, Sugawara and Terrones (2020).

Today, policymakers face a threat from global inflation brought on by a combination of a strong post-Covid recovery, lingering supply-chain disruptions, the war in Ukraine and overly accommodative fiscal and monetary policy. In response, monetary policy has begun to swing toward restrictive conditions, much as it did during the 1980s (**Figure I-6**), though on a more coordinated scale. There are similarities between the global recessions of the 1970s and what may transpire in coming months, such as relatively tight labour markets (**Figure I-7**) and the presence of supply-side shocks, but there are also key differences. Firstly, rather than double-digit inflation rising ever higher and on the back of rising inflation expectations and wages, inflation expectations have largely stayed contained, particularly those that look out over longer periods (**Figure I-8**). Should that change, central

banks will increase the urgency of their tightening processes. Secondly, central banks have built up credibility regarding their resolve and ability to keep inflation at their target rates. This is mainly due to successful efforts to bring inflation down in the 1980s and maintain it at around 2% over the past 30 years. The credibility gained by central banks is what has helped anchor inflation expectations today. This is the key reason why the likelihood of central banks changing their inflation targets amid a high-inflation environment remains low for now, as doing so could hurt their credibility and thus their ability to address inflation in future episodes. That said, a change in the inflation target at some future date cannot be ruled out should it be supported by changes in policy preferences or the structure of the economy (Gagnon and Collins, 2019).

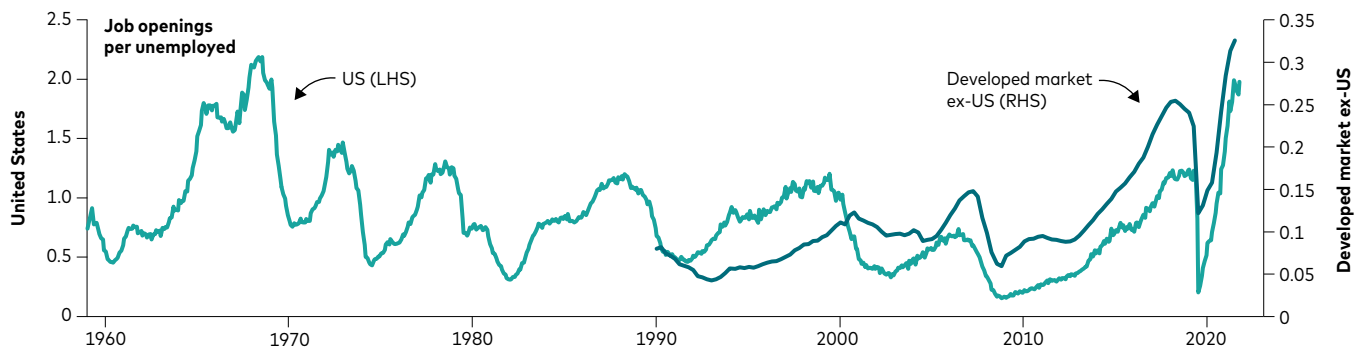
FIGURE I-6
Global financial conditions continue to tighten



Note: The global index is a GDP-weighted average of the Vanguard US, Bloomberg UK, Vanguard euro zone and Goldman Sachs Japan financial conditions indices.

Sources: Vanguard calculations based on data from Thomson Reuters Datastream, Bloomberg and Goldman Sachs, as at 31 October 2022.

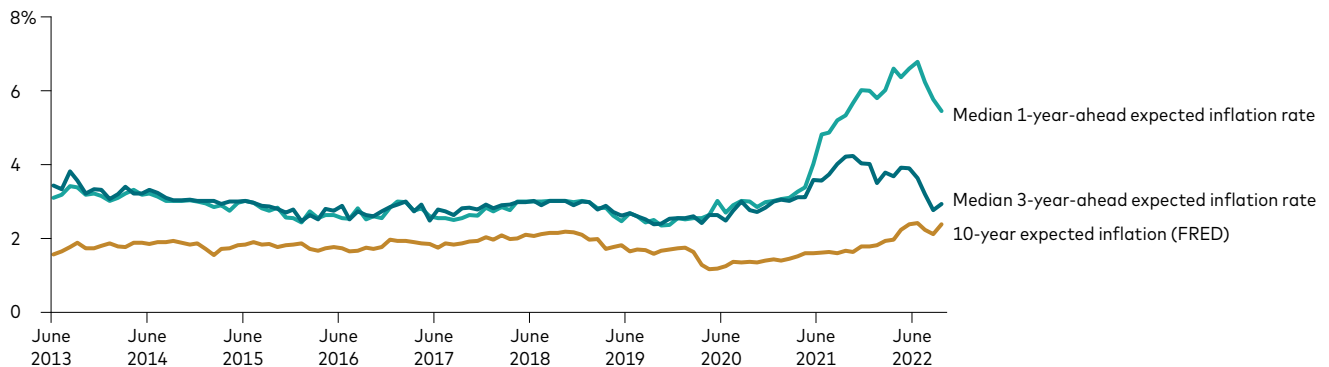
FIGURE I-7
Employers having trouble filling vacant jobs



Note: Data include Australia, Austria, Belgium, the Czech Republic, Finland, Germany, Japan, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States.

Sources: Vanguard calculations based on data from Thomson Reuters Datastream, as at 31 October 2022.

FIGURE I-8
Long-term inflation expectations have remained anchored



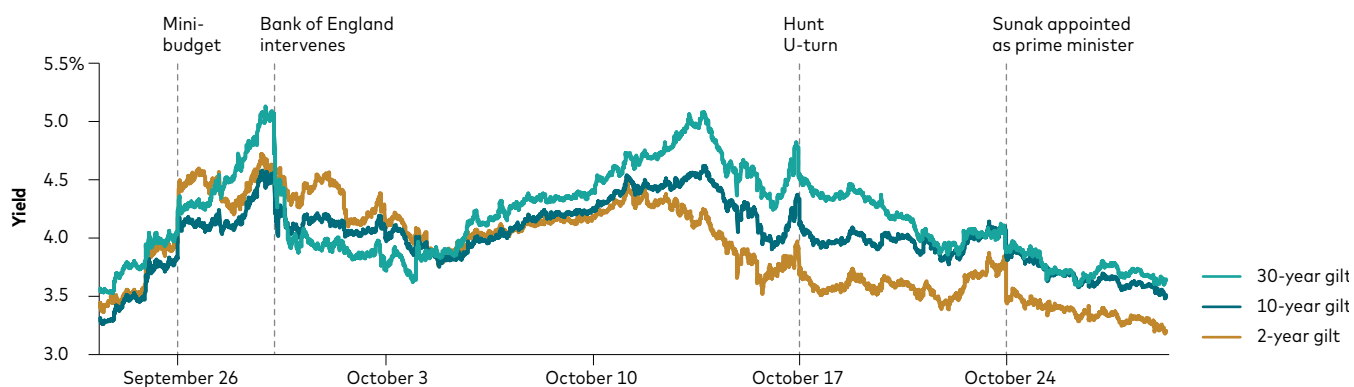
Notes: Global inflation expectations were calculated for G7 countries based on GDP weights. Subcomponent contributions were calculated on a GDP-weighted basis. For CPI subcomponent weights at the country level, 2021 weights were used for the US, the UK, the EU and Canada; 2020 weights were used for Japan. West Texas Intermediate (WTI) spot data were used for oil prices and WTI forward prices were used for forecast estimates.

Sources: Survey of Consumer Expectations, Federal Reserve Bank of New York and Federal Reserve Bank of St. Louis FRED database.

Credibility can affect fiscal policy as well. The market response to the UK's "mini-budget" was swift and harsh (**Figure I-9**), a clear signal that the proposed tax and spending changes negatively affected the perceived willingness and ability of the UK government to service its debts. This should serve as a stark reminder that markets will not tolerate unfunded expenditures (tax cuts or spending increases) beyond a certain level. Following the appointment of Jeremy Hunt as chancellor and Rishi Sunak as prime minister,

the UK has seen a return of fiscal orthodoxy. Tax rises and spending cuts worth 2.5% of GDP over the next five years have placated markets. The UK fiscal watchdog – the Office for Budget Responsibility (OBR) – has affirmed that the latest fiscal plans put public sector net debt to GDP on a sustainable path. Gilt yields have returned to levels seen prior to the mini-budget and sterling has recovered against the dollar and euro.

FIGURE I-9
UK gilt yields have declined to pre-mini-budget levels



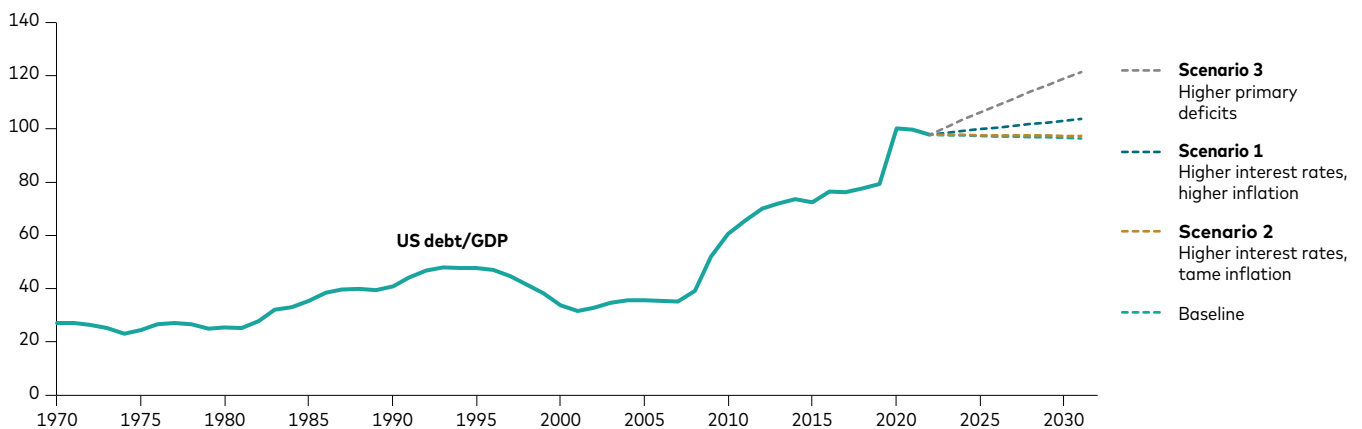
Notes: Intraday data from 22 September 2022, to 27 October 2022. "Mini-budget" refers to the growth plan announced by Chancellor of the Exchequer Kwasi Kwarteng on 23 September 2022. The Bank of England intervened on 28 September to restore financial stability, announcing it would buy an unlimited amount of long-term gilts. On 17 October, new Chancellor of the Exchequer Jeremy Hunt reversed almost all the measures of the mini-budget. On 24 October, Rishi Sunak was announced as the new UK prime minister.

Source: Bloomberg, as at 31 October 2022.

Last year we introduced the theory of fiscal space as one approach to estimating how much debt countries can maintain without risking sustainability and likely interest rate increases (Ostry et al., 2010 and Zandi, Cheng and Packard, 2011). Taking the US situation as an example, **Figure I-10** shows that the current high-inflation, high interest-rate environment does little to affect the sustainability of current debt levels, as the two forces offset each other, but if deficits are to average 5% as the

Congressional Budget Office in the US expects under current US tax and spending policies, the upward trajectory of debt quickly becomes unsustainable. Although the debts taken on during the pandemic were necessary to prevent suffering on a global scale, something needs to be done going forward to start reining in gaps between taxes and spending before financial markets begin to take action themselves. The time is not now, but it is approaching.

FIGURE I-10
US debt ratio is expected to remain flat even in a higher-rate, higher-inflation environment



Notes: Debt-to-GDP ratios were forecasted according to a standard debt accumulation equation. We used real GDP growth taken from July 2022 Congressional Budget Office (CBO) extended baseline projections. The other variables are defined as follows (based on 2022–2032 averages): in the base case, nominal interest rates were assumed to be 1.6%, inflation was assumed to be 2% and the primary deficit was assumed to be 2%. We modified those assumptions as indicated by the labels in the figure. For Scenario 1, we used 2.5% for the nominal interest rate. For Scenario 2, we used 2.5% for the nominal interest rate and 2.8% for inflation. For Scenario 3, we used 5% for the primary deficit.

Sources: CBO July 2022 extended baseline projections and Vanguard, as at 4 November 2022.

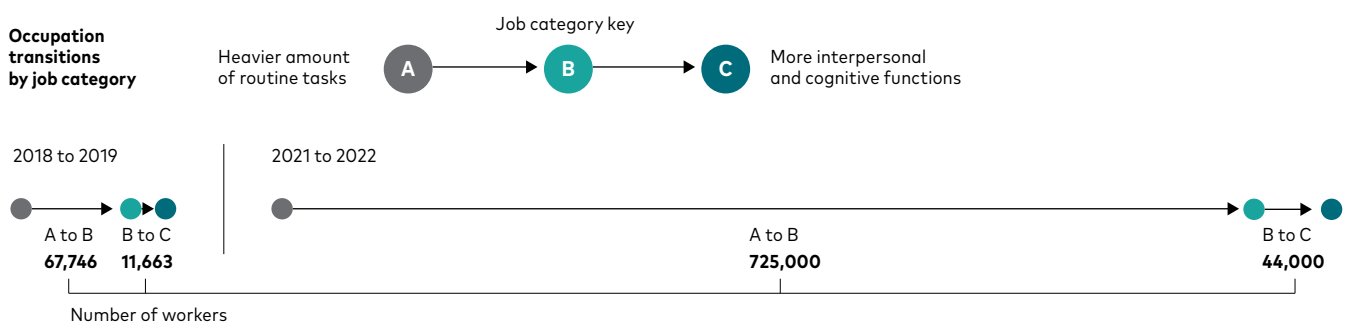
In addition to previously mentioned goods and energy supply shocks and accommodative policy considerations, labour market dislocations have played a role in shaping our current environment. Our research has shown that, as with the other factors, this is in part due to the pandemic and its lingering impacts (Clarke, Tan and Schickling, 2022). That said, the factors driving labour market frictions over the last few years (slowing population growth, increasing retirements and changing skill supply-and-demand dynamics) are likely an acceleration of labour market trends that had been in place well before Covid-19 and the policy responses to it that threw economic and financial markets into turmoil.

In 2018 we presented a more optimistic perspective on automation's impact on labour markets, outlining why automation and broader trends in the skills required of jobs meant that labour demand, rather than declining, was likely to shift to incorporate different skill sets (Tufano et al., 2018). Mirroring what has been the case during most economic downturns (Kopytov, Roussanov and Tashereau-Dumouchel, 2018), increasing numbers of studies and our analysis in **Figure I-11** highlight how people took the time to upskill during the pandemic (Ganguli et al., 2022), because of more time

spent at home, concern about the viability or safety of their current industry and/or their increased ability to spend time and money acquiring those additional skills. In **Figure I-11**, the one-third of jobs with the least amount of interpersonal or cognitive capabilities fall into Category A, the middle one-third into Category B and the one-third with the highest requirement of interpersonal and cognitive capabilities into Category C. As individuals move from a Category A role to a Category C role, they typically require increasing amounts of training to allow them to develop the interpersonal and cognitive capabilities required of that type of role. Our work shows that the movement from A to B to C roles from 2021 to 2022 is substantially greater than that which occurred in 2018 to 2019, before the pandemic.

In addition to the movement of workers between types of jobs, this upskilling also implies future productivity increases over time that would in part offset any inflationary pressures associated with higher wages. But the road to that point will be painful. Staffing shortages (**Figure I-12**) are likely in the near term, meaning that wage pressures and the risks they pose to inflation are likely to persist in the absence of intervention from central banks and the impacts outlined earlier.

FIGURE I-11
Job upskilling is a tailwind for potential economic growth



Notes: Occupations categorised as A entail more routine tasks, while B and C occupations entail more cognitive and interpersonal job functions. Average 2021 pay levels for each category in our sample data were \$37,200, \$51,800 and \$60,500.

Sources: Vanguard calculations based on data from the Bureau of Labor Statistics Current Population Survey, as at 30 September 2022.

FIGURE I-12

A global recession will offer only temporary relief from a tight US labour market

Labour supply-demand balance	2022	2025
Supply:		
Expected civilian labour force	165 million	165.5 million
Demand:		
Employment + job openings	170 million	174 million
Current shortfall	5 million	8.5 million

Labour shortfalls likely offset

Labour shortfalls	2025
1 Non-uniquely human to uniquely human job transitions	+ 1.5 million
2 Legal migration returns to pre-Covid 19 rate	+ 3 million
3	
a. Work-from-anywhere dividend	+ 600 thousand
b. Demographic dividend	+ 1.8 million
Implied 2025 shortfall	1.6 million

A milder, but still tight labour market

Implied	2022	2025
Vacancy/Unemployment (V/U)	2.0	1.2
Wage growth	6%	4%
Inflation (CPI)	5%–6%	2%–3%

Notes: Non-uniquely human to uniquely human job transitions reduce the labour shortfall since the workers' output per hour increases after the transition. The work-from-anywhere dividend is an estimate of the increase in labour force participation brought on by increased remote work opportunities. The demographic dividend refers to the sizeable percentage of non-working individuals ages 60 to 75 who report a desire to return to the labour force if conditions are right.

Sources: Vanguard calculations based on data from the Bureau of Labour Statistics, as at 30 September 2022.

From an economic, financial market and social perspective, the last few years have left us with no shortage of volatility and pain. That is, unfortunately, likely to persist in the near term as we work through the lasting impacts of the pandemic and subsequent policy reactions. A recession, probably global in nature, seems likely in the next year and, with it, job and output losses that hopefully lead to declines in inflation. That said, households, businesses and financial institutions are in a much better position to handle the eventual downturn, such that drawing parallels with the 1970s, 1980s, 2008 or 2020 seems misplaced.

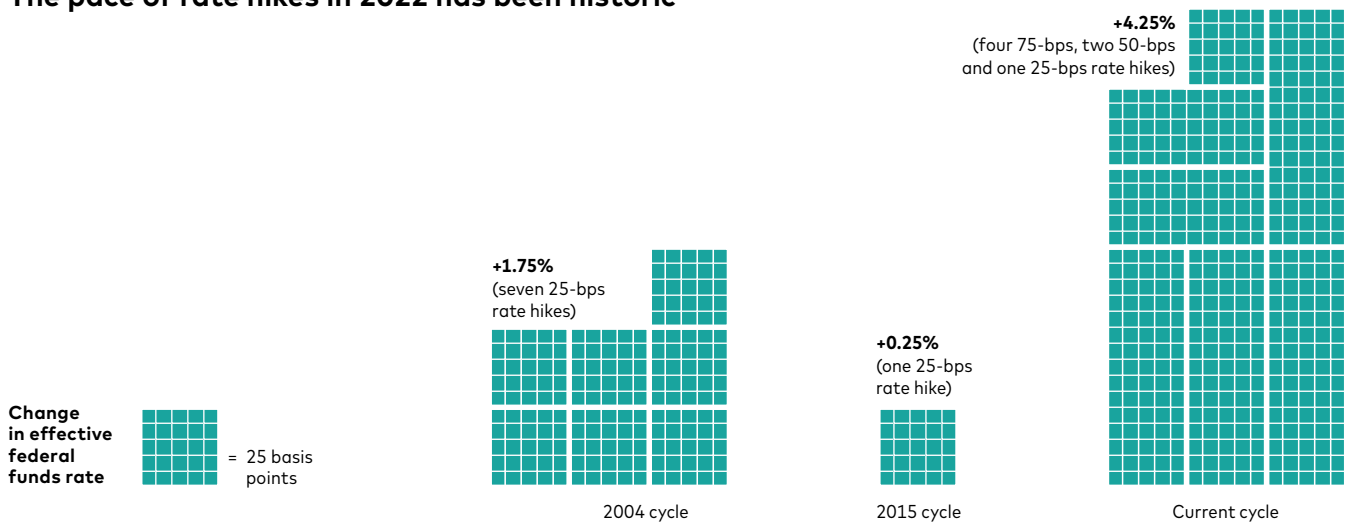
US: A narrow path gets narrower

Economic outcomes in the US for 2023 – much like in the rest of the developed world – will be dominated by monetary policy efforts to accelerate the path of inflation back to target. Growth slowed materially in 2022, but inflation has remained stubbornly elevated and the labour market strong. Further slowdowns in growth and a weakening of the labour market are necessary conditions for disinflation.

Compared with recent history, the current monetary tightening cycle is historic and leaves the narrowest of paths for the economy to escape without a period of recession. **Figure I-13** illustrates the rapid rise in the policy rate over the last four quarters and relative to previous cycles.

FIGURE I-13

The pace of rate hikes in 2022 has been historic



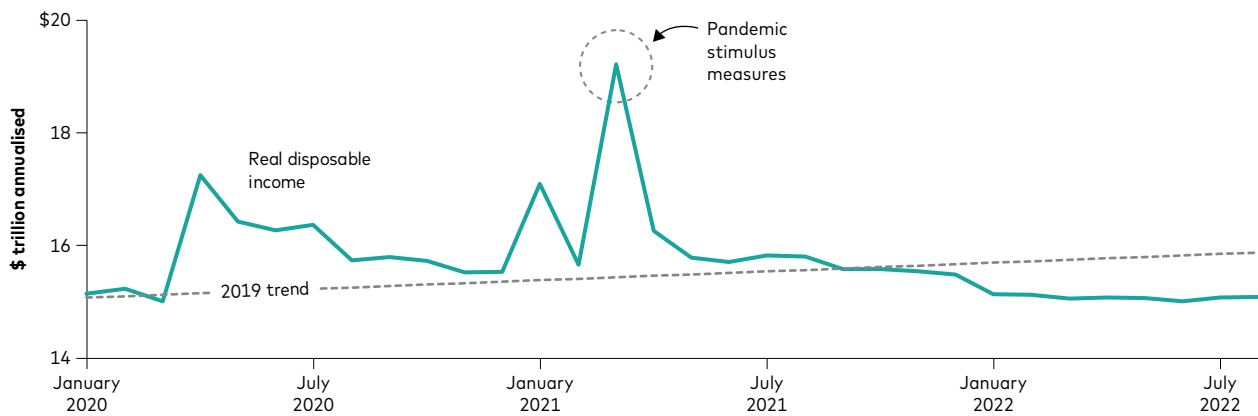
Notes: The figure shows changes in the effective federal funds rate during the first four quarters of each hiking cycle. The current cycle assumes an additional 50 bps of tightening will occur at the December 2022 Federal Open Market Committee meeting. A basis point equals one-hundredth of a percentage point.

Sources: Vanguard and the Federal Reserve Bank of St. Louis, as at 31 October 2022.

Overall, we expect GDP growth of around 0.25% over the course of 2023. Key interest-rate-sensitive sectors of the economy such as housing have already abruptly slowed and consumers are facing wage gains that, while nominally strong, have turned sharply negative in real terms. We estimate that given the pace of inflation relative to wages, the average household experienced a \$400 shortfall per month in its standard of living

relative to before the pandemic. **Figure I-14** shows the current severity of real income shortfall compared with the pre-Covid income trend. Households in aggregate have thus far absorbed rising prices by relying on a strong labour market and a remaining savings buffer built up during the pandemic, but inflation has depressed sentiment and overall growth activity has slowed below trend as we head into 2023.

FIGURE I-14
Real purchasing power is a key headwind to growth

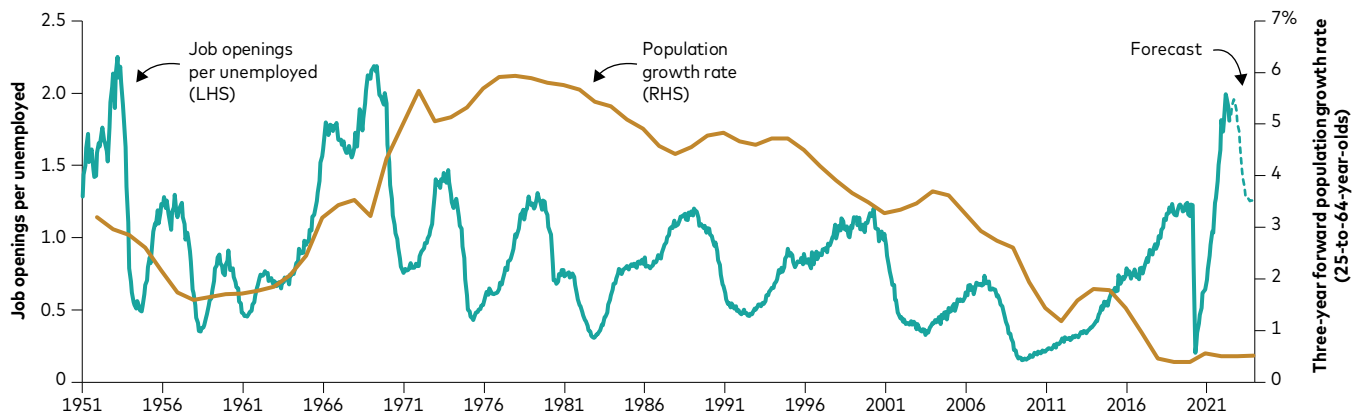


Sources: Vanguard and Refinitiv, as at 31 October 2022.

Although the US labour market has been surprisingly resilient to these mounting economic challenges, aided by structural labour-supply constraints, we expect that demand for labour will moderate as consumers and companies brace for a recession. But considering how tight the labour market is entering this recession – as shown in **Figure I-15** in job openings per unemployed and the slower pace of new entrants into the workforce as a result of slower population

growth – unemployment may peak around 5%, a historically low rate for a recession. Furthermore, as a result of the moderation in labour demand and declining consumer confidence, job turnover rates are likely to return to more normal levels, which will help reduce wage inflation to a more sustainable 4% nominal growth rate. We expect a weaker labour market on a number of fronts as outlined above, which will hopefully put downward pressure on inflation.

FIGURE I-15
Tepid working-age population growth limits the downside for the US labour market



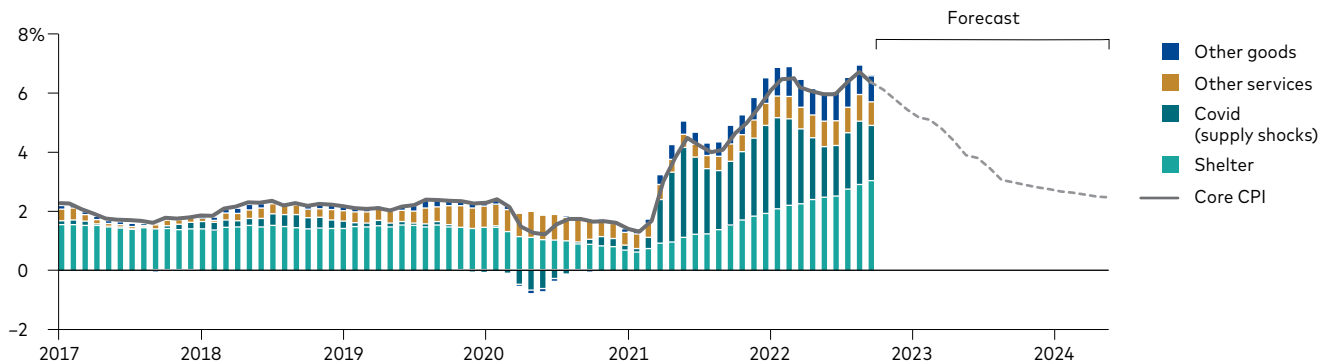
Sources: Vanguard calculations based on data from Datastream, DataBuffet and the Bureau of Labor Statistics, as at 31 October 2022.

Among the drivers of US inflation, in addition to a tight labour market, 2022 saw the lagged impact of supply constraints resulting from pandemic-era dynamics pushing inflation higher (Figure I-16). As we step into 2023, early signs of a recovery in goods supply and softening demand could help balance supply and demand for consumption goods and bring prices lower. But expectations

of a stronger pickup in services – especially the stickier component of shelter inflation – will keep inflation from falling back quickly. We see inflation by the end of 2023 settling at 3%, which is higher than the Fed’s inflation target of 2%. In other words, we do not see inflation returning to target next year.

FIGURE I-16

Inflation has proved more persistent because of Covid-related shocks and the shelter component



Notes: The Covid supply shocks component includes subcomponents that faced extreme supply bottlenecks and demand shocks during peak Covid, namely transportation services and vehicles. Other goods includes apparel, household furnishings and recreational goods. Other services includes health care, education and communication, recreational services and other services. Energy price shocks are not directly included in transportation services but are indirectly included through higher airfares. Shelter inflation is the component that captures the effect of shelter costs in the overall CPI. Shelter includes prices for both renters and homeowners. For renters, shelter inflation measures both rent and utility payments. For homeowners, the BLS calculates what it would cost to rent a similar house.

Sources: Vanguard calculations based on data from the Bureau of Labor Statistics, as at 31 October 2022.

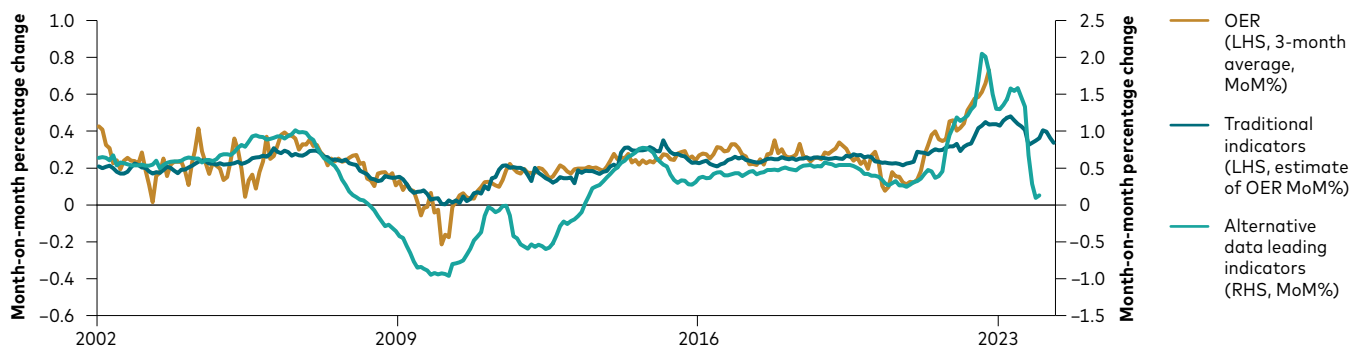
As we discussed earlier, monetary policy and the communications from policymakers have squarely focused on inflation and policy rates are currently at levels broadly considered restrictive for economic activity, with more likely in coming quarters. That said, we're starting to see signs of progress in the fight against inflation. Prime among these is housing activity, where signs of slowing momentum are already evident. Given the lag with which housing activity filters into inflation, this will eventually result in a slower pace of shelter inflation sometime in the second half of 2023. In early 2023, shelter inflation will remain strong, reflecting the still-robust housing market momentum of early 2022 (Figure I-17). The stronger gains in shelter inflation, in our view, will be offset by a faster deceleration in goods

inflation and a slowdown in wages as a tighter policy rate environment begins showing its full effect on the economy in 2023.

Given such price and labour dynamics of late, our monetary policy outlook has become more hawkish and we expect a "higher for longer" policy rate environment ahead. Our baseline outlook envisions the policy rate tightening to reach a peak of 5% by early 2023 and remaining at similar levels throughout the year. Given the uncertainty that the inflation path has posed thus far, we expect the Fed to favour a pace of tightening based strongly on data dependence, with wage and inflation expectations being key watch variables that will influence the Fed's ultimate path.

FIGURE I-17

Both traditional and alternative data suggest a slowdown in shelter inflation only after mid- to late-2023, keeping core inflation elevated at year-end 2023



Notes: Owners' equivalent rent (OER) represents the CPI subcomponent of owner-imputed rent, which holds the highest weight in core CPI. Traditional indicator estimates of OER MoM% are based on a Vanguard proprietary model used to forecast OER MoM gains. Alternative data indicators contain publicly provided data from private rental and housing firms. Weighted average of MoM changes in alternative data has been a relatively good signal of turning points in the monthly pace of shelter inflation.

Sources: Vanguard calculations based on data from Zillow, Apartment List, the Bureau of Labor Statistics, the U.S. Bureau of Economic Analysis, Refinitiv and Moody's, as at 31 October 2022.

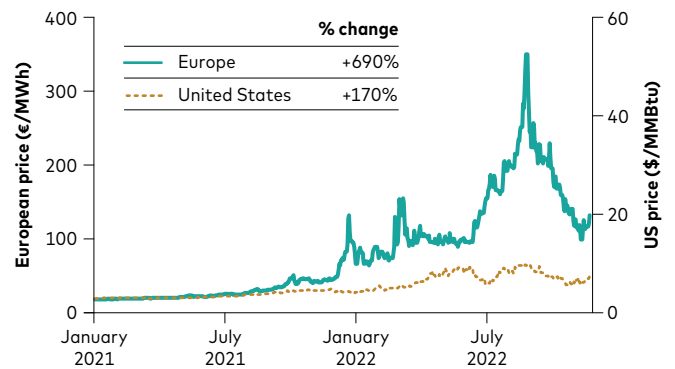
Euro area: The European Central Bank (ECB) will continue to tighten despite recession

Inflation and the policies enacted to address it have played a large role in shaping the economic conditions in the euro area. The war in Ukraine added another layer of uncertainty, volatility and price pressures in 2022. Activity held up well in the first half of the year, supported by a strong post-pandemic recovery. Growth momentum, though, slowed sharply in the second half as higher energy prices (**Figure I-18a**), tighter financial conditions, depressed sentiment and weakening global growth all weighed on the economy. We expect euro-area GDP growth to slow from around 3% in 2022 to 0% in 2023.

Looking ahead, we are encouraged by Europe's flexibility in adapting to the sharp reduction in Russian gas imports. Over 90% of its gas storage capacity has been filled, helped by additional imports from other pipeline and liquefied natural gas suppliers and efforts have been made to use alternative energy sources in some industries. This should help soften the blow. That said, we still expect gas demand to contract by about 15% this winter relative to last year (**Figure I-18b**) given the war-related supply constraints.

FIGURE I-18
A European energy crisis

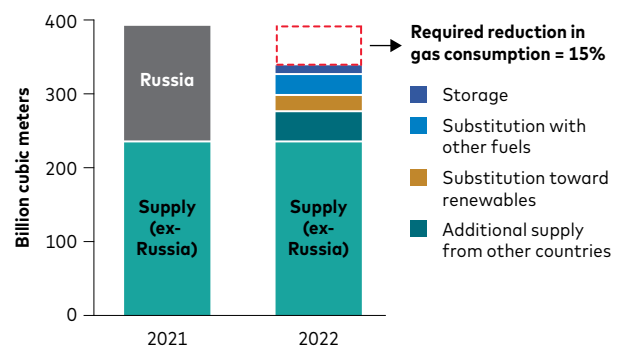
a. European natural gas prices remain elevated



Notes: Increase since 31 December 2020. ICE Dutch TTF natural gas price for Europe and Henry Hub natural gas price for the the US. Daily data from 1 January 2021 to 23 November 2022.

Source: Bloomberg, as at 23 November 2022.

b. European gas imports: how the gap will be plugged



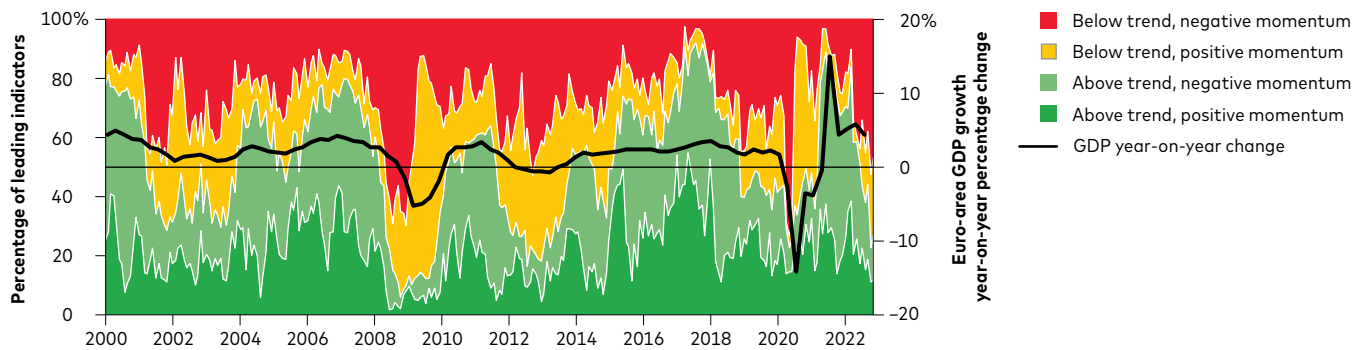
Sources: International Energy Agency, European Commission and Vanguard estimates, as at 31 October 2022.

Forward-looking data, including Vanguard's leading economic indicator, point to continued weakness ahead (Figure I-19). In our base case, we expect that the euro-area economy will have entered recession from the fourth quarter of 2022, with growth turning positive only in the second half of 2023. We anticipate that Germany and Italy will underperform, given their relatively large energy-intensive industrial sectors. The

risks to this view are skewed to the downside: we do not rule out the prospect of a double-dip recession in the second half of 2023 given that European gas supply will be starting from a much lower base than in 2022 and financial conditions will be tighter. Upside risks include milder-than-expected weather or an earlier-than-expected resolution to the war. As with the US, many of the risks come down to luck.

FIGURE I-19

Vanguard leading economic indicator points to further deterioration in economic growth



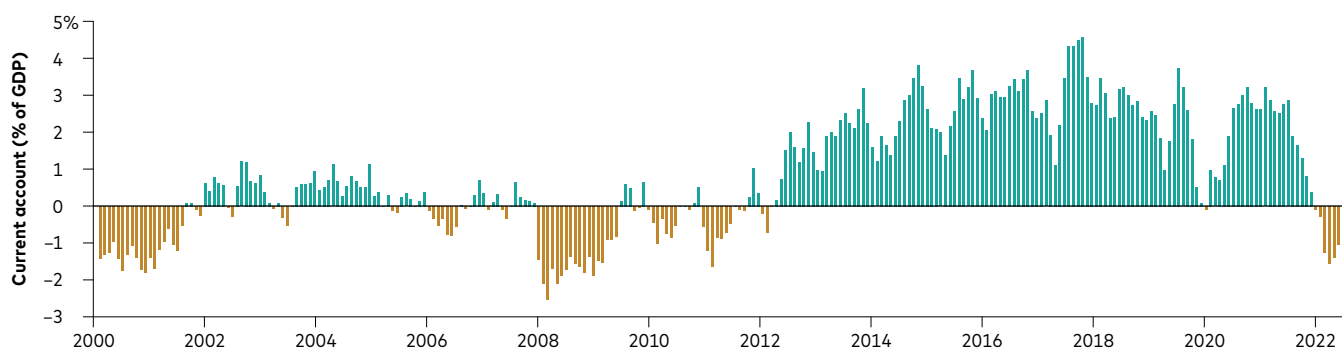
Notes: Monthly data from January 2000 to October 2022. The Vanguard leading economic indicator (VLEI) dashboard considers a range of leading indicators, sorted based on current levels relative to trend and underlying momentum. Indicators include consumer confidence, industrial production, retail sales, trade-weighted euro, factory orders and stock market indices.

Source: Vanguard, as at 31 October 2022.

Also similar to the US situation is that the central challenge for European policymakers remains rising inflation. To be successful in guiding inflation back down to target, the ECB will need a combination of good decision-making, good communication and good luck. The headline CPI rate doubled, from 5% at the start of 2022 to 10% in November, predominantly because of accelerating energy and food prices. A weakening of the euro, partly driven by the war-induced negative terms-of-trade shock (**Figure I-20**), has amplified this inflationary pressure, as it raised the cost of imports priced in foreign currencies, putting downward pressure on growth⁴.

The breadth of inflation has also increased throughout 2022. Some 80% of the CPI is now tracking at an annual rate above 3% and core inflation accelerated from 2.6% at the start of the year to 5% as at November. We expect both headline and core inflation to peak in December 2022 and then fall gradually in 2023 as energy and food price base effects unwind and demand softens. We still, though, expect inflation to average 5.5%–6% in 2023, well above the ECB’s target of around 2%, as services inflation persists and core goods pressures dissipate only gradually (**Figure I-21a**).

FIGURE I-20
The current account has switched from surplus to deficit



Note: Monthly data from January 2000 to August 2022.

Sources: Vanguard calculations based on data from Bloomberg, as at 24 October 2022.

⁴ A country's terms of trade refers to the relative price of exports compared with imports.

The ECB will be concerned about the stickiness of inflation, particularly in the services component, amid a still-tight labour market. Indeed, the unemployment rate is at a record low of 6.5% (as at October 2022), wage growth has increased to 4% year-on-year compared with a pre-pandemic average of 2%⁵, and there is tentative evidence that high inflation is now flowing through to longer-term inflation expectations (Figure I-21b).

We therefore expect the ECB to build on the 200 basis points' worth of rate increases it has already delivered, with the deposit rate having risen from -0.5% at the start of 2022 to 1.5% at the October 2022 meeting. (A basis point is one-hundredth of a percentage point.) Our base case is for the deposit rate to reach at least 2% by year-end and to peak at 2.5% in early 2023. We expect this restrictive policy stance to be maintained throughout 2023, with risks to our terminal rate view skewed to the upside given the underlying strength of the labour market.

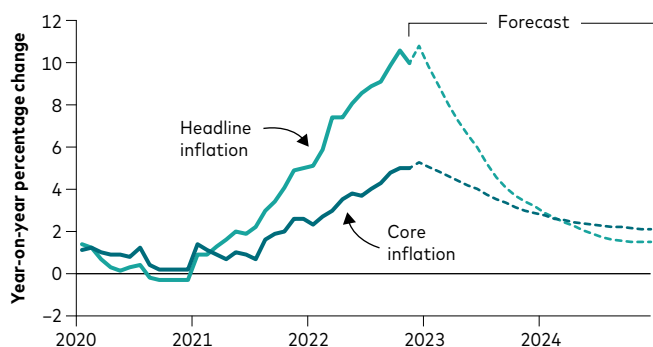
As policymakers continue to raise rates, they will need to be mindful of the risk of euro-area fragmentation, which would impair the proper

functioning of monetary policy. The introduction of the Transmission Protection Instrument will help allay concerns here. In our central scenario, the presence of this tool, coupled with a delay of quantitative tightening until the second half of 2023, will limit any material blowout in peripheral spreads.

Finally, given our central scenario of recession, we expect euro-area governments to keep energy-related fiscal measures for at least the first half of 2023 in order to cushion demand, which we estimate will average between 2% and 3% of GDP. This will delay any plans for fiscal consolidation until the latter part of 2023 at the earliest. Given weak growth, continued energy support and rising interest costs, euro-area debt-to-GDP ratios are unlikely to fall meaningfully in the near term. Italy will be under the most scrutiny because of its relatively high debt burden and the election of a new government. Debts will remain sustainable in the near term, but solutions to growing debt burdens must be discussed going forward.

FIGURE I-21
Inflation is a challenge for policymakers

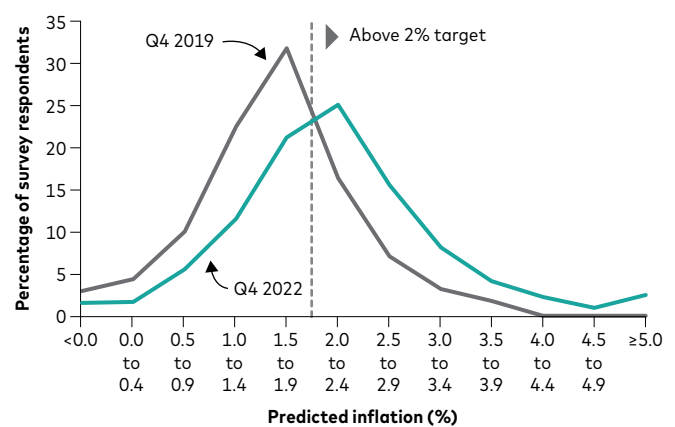
a. Peak in inflation is yet to come



Note: Monthly data from January 2020 to November 2022 and Vanguard forecasts thereafter.

Sources: Vanguard calculations based on data from Bloomberg, as at 22 November 2022.

b. Long-term inflation expectations have become stickier



Note: Longer-term expectations refer to 2027 in Q4 2022 and to 2024 in Q4 2019.

Sources: ECB and Survey of Professional Forecasters, as at 28 October 2022.

⁵ As measured by the euro-area employment cost index.

UK: Recession looms large as cost-of-living crisis intensifies

The war in Ukraine, the unique structure of the UK energy market and domestic political instability posed challenges to the UK economy in 2022. Activity slowed consistently throughout the year as higher commodity prices, tighter financial conditions, very low confidence and a weak global growth backdrop all dragged on demand. This was before the mini-budget was announced and then renounced weeks later in an effort to appease financial markets. We expect 2022 UK GDP growth of about 4%, coming from a low 2021 base, but – as with other major developed markets – slowing to –1% to –1.5% in 2023.

We expect the economy to have entered recession in the third quarter of 2022. Business surveys are now consistent with a sharp contraction in output and consumer confidence metrics are at historical lows. Forward-looking indicators, including Vanguard's leading economic indicator, suggest further weakness ahead. We expect the recession to last at least six quarters and to be deeper than in the euro area.

The UK's annual rate of CPI inflation doubled in 2022, from 5.4% at the start of the year to 11.1% as at October 2022. The acceleration was

primarily driven by higher energy and food prices, though the core goods and services components also rose significantly. The government's Energy Price Guarantee (EPG) policy, which caps unit energy prices, should keep a lid on inflation in the near term.

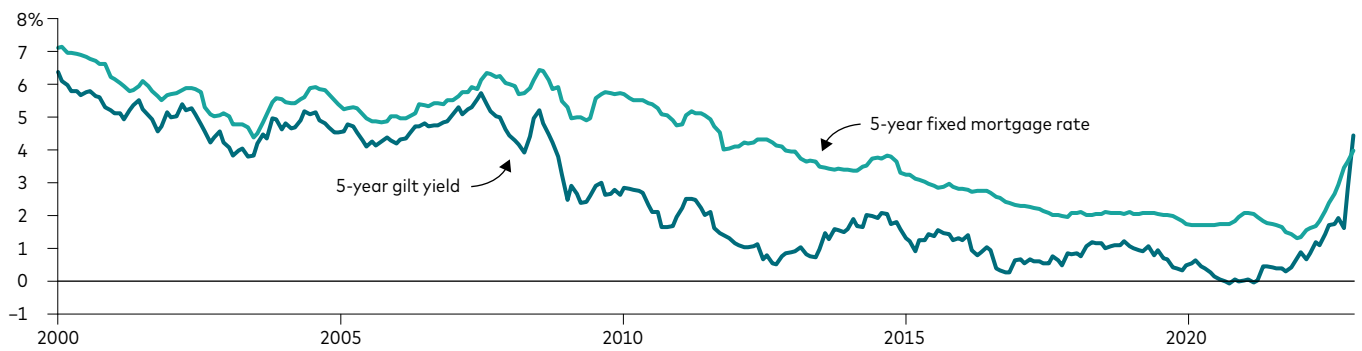
In our base case, we expect inflation to fall gradually from a peak of above 11% in the last quarter of 2022 and to average 6% to 6.5% in 2023, well above the BoE's 2% target.

Aside from energy prices, the BoE will be closely monitoring developments in the labour market to calibrate its appropriate policy response. As in the US, job vacancies in the UK remain close to record highs and wage pressures have intensified, with wages rising roughly 6% year-on-year. The latter issue is of particular concern as strong wage growth will lead to more persistent inflationary pressure, predominantly through the stickier services component. In our central scenario, we expect the BoE to raise interest rates to around 3.5% by the end of 2022 and to a peak rate of 4.5% in early 2023. We expect this restrictive policy stance to persist throughout 2023.

With the implementation of the EPG and higher interest rates, we expect the narrative of the UK's "cost-of-living" crisis to shift away from higher energy prices and towards higher mortgage interest payments. If the Bank Rate does reach 4.5%, this would imply new mortgage rates of at least 5.5% for the average borrower – a near-quadrupling of interest costs (**Figure I-22**). As a

large proportion of UK mortgagors are on fixed rates, it will take time for this effect to feed through to the economy. That said, we estimate that 35% to 45% of the total stock of UK mortgages will be repriced to newer rates over the course of 2023. This will further weaken the outlook for the consumer and exert downward pressure on housing valuations.

FIGURE I-22
New mortgage rates have moved in line with higher UK bond yields



Note: Monthly data from 31 January 2000 to 30 September 2022.

Source: Bloomberg, as at 21 October 2022.

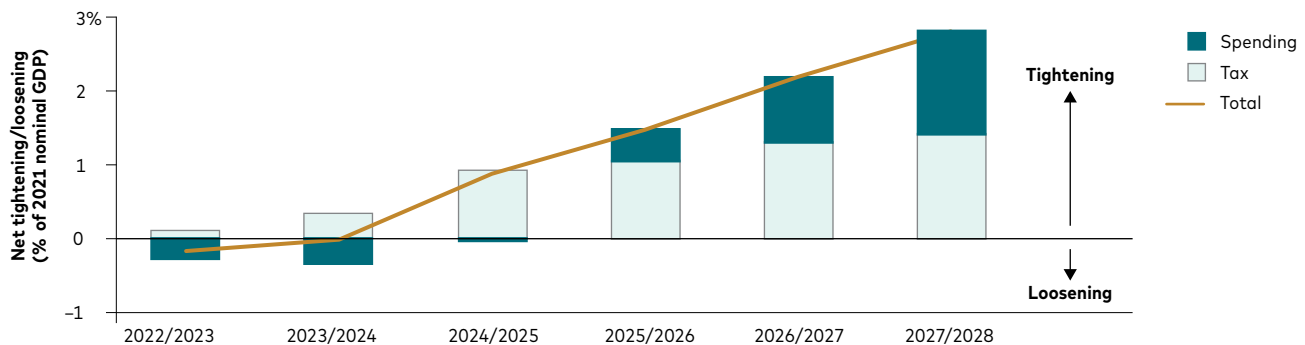
The year 2022 was also one of political instability for the UK. Disagreements within the Conservative Party led to three different prime ministers (and four different chancellors). Despite the aggregate fiscal consolidation of the Autumn Statement, policy is actually set to ease in the next two financial years to protect the economy during recession, with the expected tightening occurring thereafter (Figure I-23).

Concerns remain over the sustainability of the UK's debt profile. Although the debt-to-GDP ratio, at below 100%, is lower than in many other developed economies, substantial fiscal consolidation was pencilled in the Autumn Statement to prevent it from rising significantly in the next five years (Figure I-23).

The UK is arguably in a more fragile situation than other developed economies. Growth is already weak and global inflation shocks are amplified given that it is a small, open economy. To bring inflation back down to target, the economic sacrifice – ultimately through higher unemployment – could be larger.

Raising interest rates sharply to address this heightened inflation challenge may also unveil hidden risks, particularly given the UK's relatively large financial sector. The stress experienced by some domestic pension funds amid volatility in the gilt market earlier this year is one example of this risk to financial stability.

FIGURE I-23
A modest loosening in fiscal policy until 2024



Sources: Vanguard and the OBR, as at 21 November 2022.

China: A cyclical bounce meets a structural downturn

As in major developed economies, policy has played and will play a large role in economic outcomes in China, but for different reasons. China's economic fortunes are governed by what we have termed an "impossible trilemma", in which policymakers must balance three competing priorities: maintaining a zero-Covid policy (ZCP), ensuring financial stability and sustaining strong levels of economic growth. In 2022, policymakers focused on upholding ZCP and ensuring financial stability at the cost of growth. As a result, we forecast GDP growth to end 2022 at around 3%, well below the historical average and official targets of 5.5%. In 2023, we expect that policymakers' focus is likely to gradually shift away from maintaining a strict ZCP toward achieving slightly stronger economic growth levels.

This will most likely result in a cyclical bounce in 2023 of 4.5% GDP growth with risks skewed to the upside on that view, driven by gradual loosening of Covid controls and a stabilising real estate sector (**Figure I-24**). Nonetheless, we believe

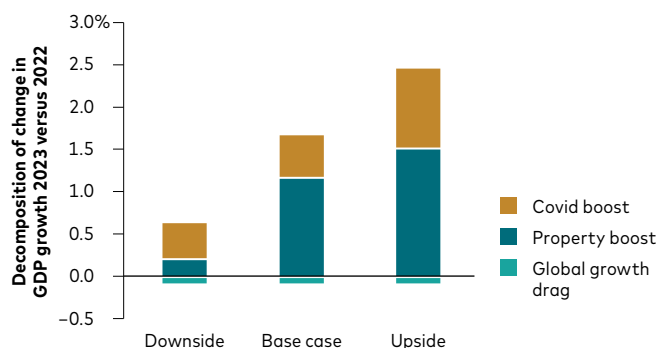
that the cyclical bounce will be modest compared with those that followed the global financial crisis in 2009 and the 2020 Wuhan lockdown, given the expected global recession, uncertainty around the exit path from Covid-19, the lack of willingness and capacity to overstimulate the economy and a structural slowdown of growth potential in the long run.

Policymakers have announced that they plan to prepare to reopen the economy by relaxing Covid-19 controls, promoting vaccine and drug development and improving hospital facilities. This could engineer a long-awaited recovery in consumption and service activities. Crucially, however, we think the exit from Covid-19 is unlikely to be smooth, as China's health care system remains vulnerable to large outbreaks. A gradual reopening is more likely, in our view, as booster vaccination rates for the older population improve and an mRNA vaccine and/or effective treatment becomes widely available, which should lead to a more evident rebound in the economy following the National People's Congress (NPC) next March.

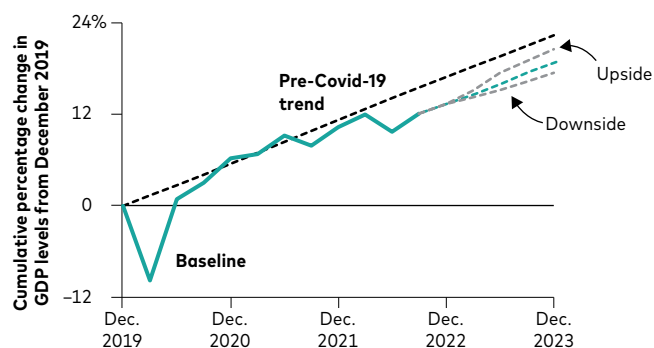
FIGURE I-24

Cyclical bounce expected in 2023 as the zero-Covid policy is unwound and the real estate sector stabilises

a. 2023 cyclical GDP bounce decomposed into drivers



b. Chinese GDP unlikely to fully recover to pre-Covid levels



Sources: Vanguard calculations based on data from Bloomberg, as at 31 October 2022.

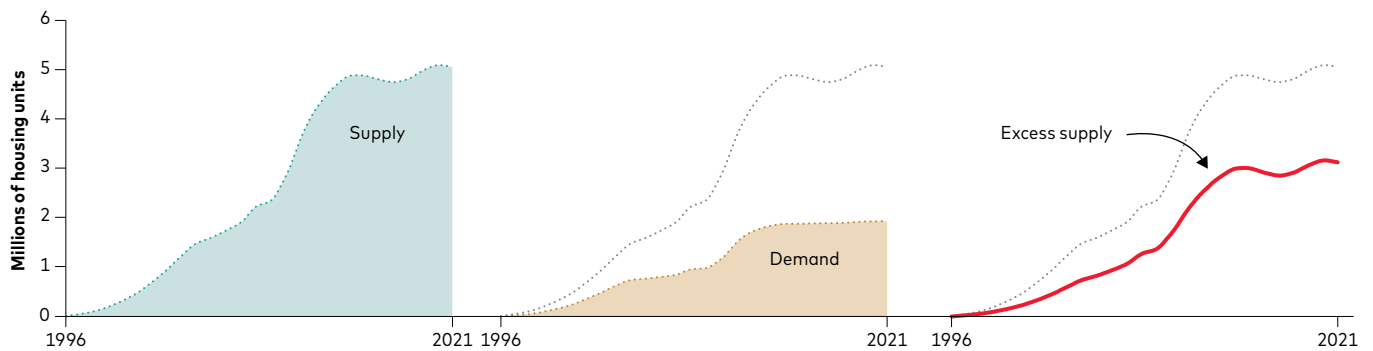
Notes: The baseline assumes a gradual decline in Covid restrictions with the pace accelerating after the March NPC meetings, but no complete abolishment. It also assumes that real estate investment stabilises but does not rebound. The downside scenario assumes Covid restrictions remain at pandemic highs by the March leadership meetings and decline gradually towards year-end, plateauing at a high level. It also assumes real estate investment continues to fall but at a slower pace than in 2022. The upside scenario assumes Covid restrictions are largely abolished after the March NPC meetings while real estate investment has a modest recovery.

Along with ZCP, China's real estate sector was a major drag on headline growth in 2022, subtracting around 2%. In 2023, we expect a cyclical rebound in the sector, which may boost growth by slightly more than 1 percentage point relative to 2022. This rebound is driven by supportive fiscal and monetary policy, stabilising sentiment and real estate investment and

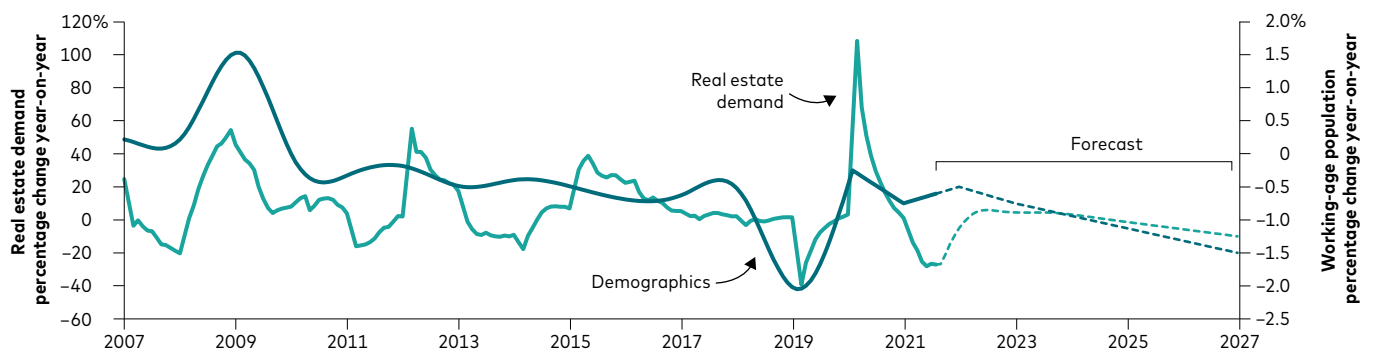
reopening the economy, which will help boost demand at a low level following a nearly 10% contraction in 2022. We believe the rebound will be restrained by the significant structural challenges facing China's real estate sector, including oversupply, poor affordability and worsening demographic trends (**Figure I-25**).

FIGURE I-25
Despite easing regulation, the housing market is unlikely to rebound because of a structural downturn

a. Housing remains oversupplied in China, with increased demand providing only a slight offset to supply growth



b. Cyclical factors will provide near-term support to housing, but structural factors will lower demand over the next five years



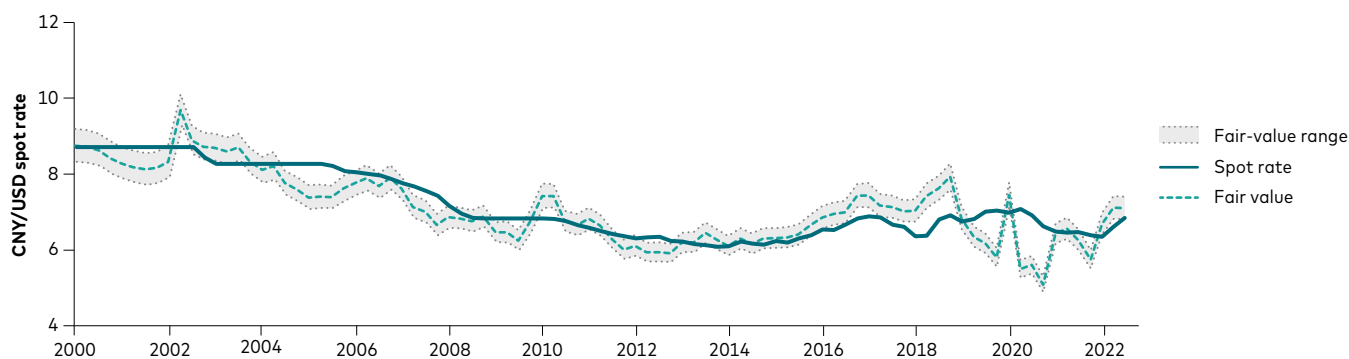
Sources: Vanguard calculations based on data from Bloomberg, as at 31 October 2022.

A modest cyclical bounce, following the deep downturn in 2022, suggests that a negative output gap is likely to persist towards the end of next year even in our upside scenario, with the normalisation in consumption and services continuing to lag behind that of production. Such an incomplete and uneven recovery of the economy would keep consumer inflation subdued. We expect headline CPI to average 2.2% in 2023, with core inflation below 1%. As such, the People's Bank of China (PBoC) is likely to continue with modest liquidity easing and interest rate cuts in the near term, bucking the global trend. Nonetheless, we also believe that policymakers will refrain from overstimulating the housing market and the broader economy in 2023, given concerns about ever-rising leverage and financial

stability risks. In fact, once the economy starts to rebound in the second quarter, we expect policy to switch to a more neutral stance. In addition, the depreciation in the renminbi in the second half of 2022 is a reminder that Chinese policymakers have limited space to stimulate, as further and more aggressive easing may lead to capital outflows and higher inflation. The currency is likely to remain under pressure in 2023 as developed-market central banks continue raising interest rates in efforts to curb inflation, though the improved growth outlook in China and the interventions by the PBoC to prevent panic about financial stability could help stabilise the renminbi down the road. Our fair-value model (**Figure I-26**) suggests that the renminbi is now close to fair value based on fundamentals.

FIGURE I-26

Our fair-value model is showing the renminbi fairly valued at current levels



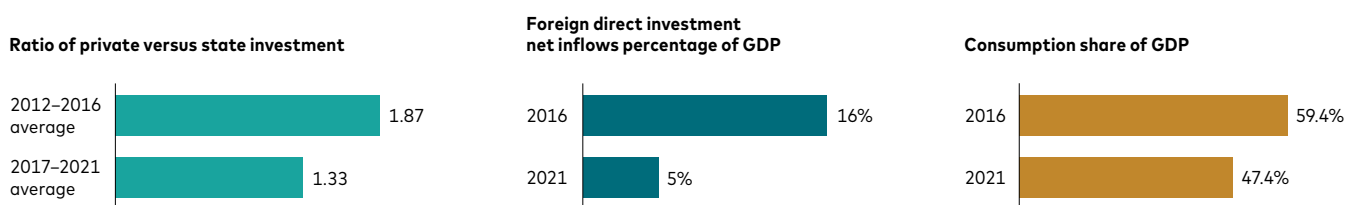
Sources: Vanguard calculations based on data from DataStream, as at 31 October 2022.

In addition to policymakers' reluctance to overstimulate, a worsening structural growth outlook is expected to restrain the recovery in 2023 and the growth outlook in the years ahead. Foreign direct investment flows into China over 2017–2021 were significantly lower than they had been in the prior five years, amid a slowing globalisation trend and rising geopolitical tension, while the pace of private sector investment

slowed notably over the same time frame (**Figure I-27**). These developments will weigh on productivity growth, a key determinant of potential growth rates. Also concerning is that progress has reversed during the pandemic on the shift from an investment-led economy to a consumption-led one, exacerbating concerns about growth sustainability in the medium term.

FIGURE I-27

Japanification warning signs, with rising concerns about long-term growth sustainability



Sources: Vanguard calculations based on data from Bloomberg and the CEIC, as at 31 October 2022.

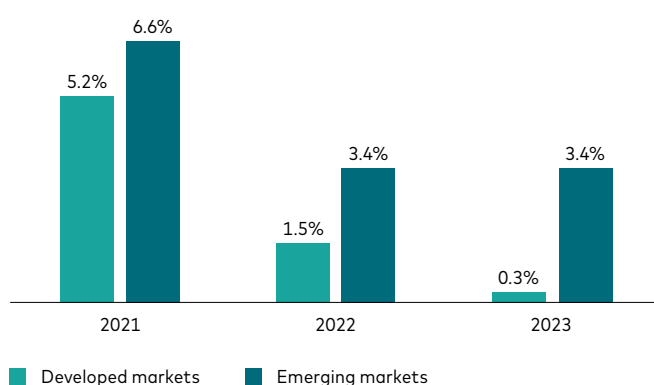
Emerging markets: Headline growth resilience meets underlying economic divergence

The story of emerging markets (EM) in 2022 has been one of remarkable resilience (**Figure I-28a**) despite myriad macroeconomic shocks. Although food and energy prices rose, financial conditions tightened significantly and Chinese growth disappointed, EM growth, foreign exchange and inflation have not underperformed developed markets. However, the relative headline resilience masks the regional divergence (**Figure I-28b**).

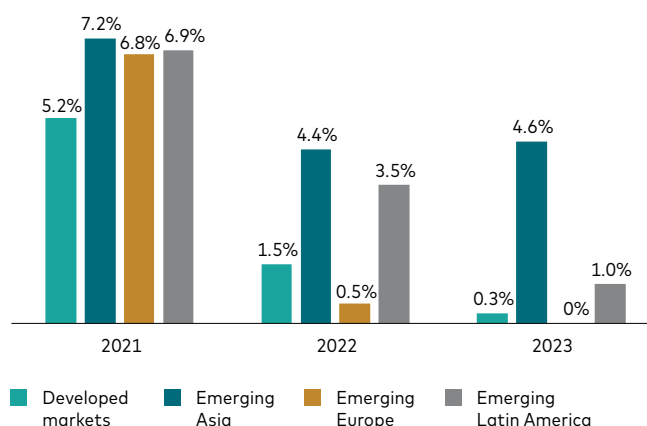
We expect EM growth of 3.4% in 2023 to significantly outperform developed-market growth of 0.3%, but we are likely to see notable divergence once again across regions. While Asia will benefit from a cyclical bounce in China and falling inflation, EM Europe will continue to face inflation pressures from uncertain energy supply and a weak European growth backdrop. In Latin America, growth is likely to disappoint consensus as US growth slows materially in 2023, prompting central banks to adjust policy rates down from very high levels.

FIGURE I-28
Diverging fortunes for emerging-market economies

a. Emerging market GDP growth will remain resilient relative to developed markets growth in 2023



b. But we expect significant divergence among regions to continue in 2023



Note: Vanguard forecasts for 2022 and 2023.

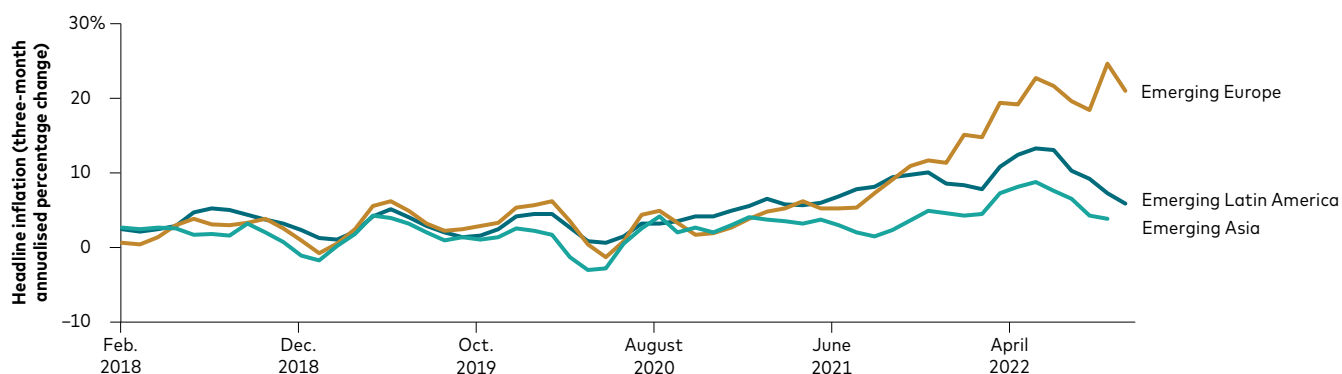
Sources: Vanguard calculations based on data from Thomson Reuters Datastream, as at 31 October 2022.

Our below-consensus outlook for the Latin American region is driven by a few factors. First is our below-consensus US growth outlook. Some 70% of Mexican exports go to the US and Mexican exports are highly correlated with the US inventory cycle (excluding autos). After a strong build over the last year, we expect inventory growth to slow along with the slowing US economy. This will put downside pressure on both Mexican growth and the Mexican current account. Second, Latin America is the only EM region with central bank interest rates above inflation. However, inflation is falling quickly across many Latin American economies (**Figure I-29**). This means interest rates will be even more restrictive at current levels, further slowing economic growth.

In EM Asia, we are expecting 2023 GDP growth of 4.6%, broadly in line with consensus. Our view is driven by two countervailing forces. Our forecast for a cyclical growth rebound in China supports a positive EM Asian growth outlook. Additionally, as inflation in EM Asia falls, we expect central banks to end their hiking cycle, which will support growth. EM Asian export growth has been a major growth support during the recovery from the pandemic. We believe that consensus expectations for a mix of modest rate hikes and cuts and broadly flat inflation are fair.

FIGURE I-29

Inflation in emerging Europe is mainly energy-driven at this point, while inflation in both emerging Latin America and emerging Asia looks more persistent

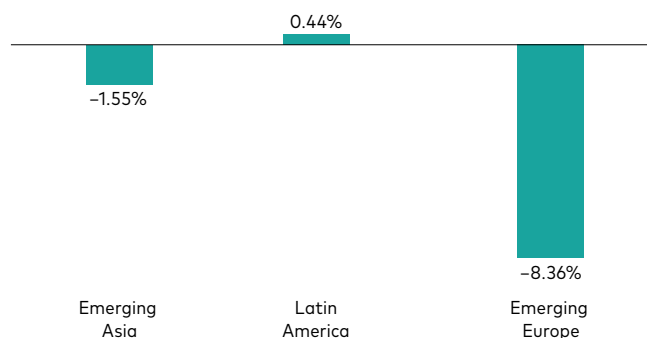


Sources: Vanguard calculations based on data from Refinitiv, as at 31 October 2022.

In EM Europe, we expect 2023 GDP growth to be flat at 0%, below consensus of 0.6%. Our below-consensus view is driven by our below-consensus developed-market European outlook as well as an inflation outlook that we expect to remain precarious throughout 2023. EM European inflation continues to accelerate, though a recent reprieve has come in the form of energy price subsidies. These expensive subsidies can lead to widening fiscal deficits, which lead to tighter financial conditions and lower growth. Should governments try to limit deficit expansion, the energy price subsidy would likely crowd out other government spending priorities, possibly limiting potential growth. The big risk for Europe is that, should inflation remain stubbornly high because of a structural energy shortage, central banks would likely need to continue hiking interest rates to get them to restrictive territory. **Figure I-30** shows that EM European interest rates are a long way from being positive on a real basis, in contrast to their EM peers.

FIGURE I-30

European real spot rates remain deeply negative, while Latin American rates look as though they have room to come down



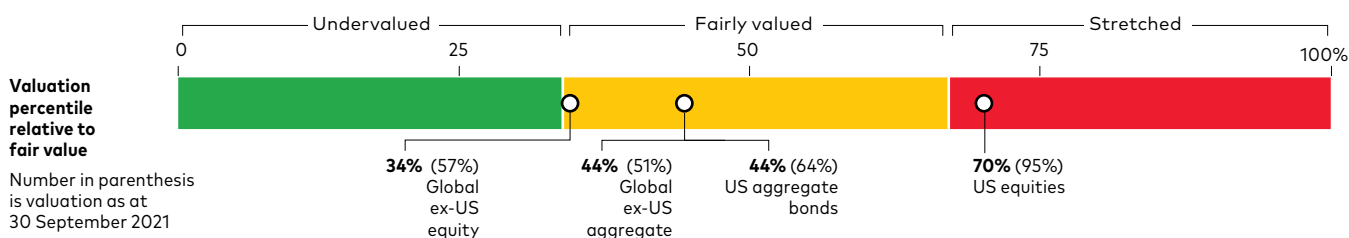
Sources: Vanguard calculations based on data from Refinitiv, as at 31 October 2022.

II. Global capital markets outlook

In our economic and market outlook for 2022, we highlighted the risks global capital markets faced from the dual pressures of high equity valuations and interest rates that did not reflect the seriousness of inflation pressures. As the year started, markets began to price this shift and discount rates rose. Rising discount rates, coupled with geopolitical shocks and slowing growth, led to a sell-off that was notable not only for its depth but also for its breadth and persistence. Although it is impossible to say with confidence when equity and bond markets will bottom, valuations and yields are clearly more attractive than they were a year ago.

Looking ahead, our return outlook – which has been on a steady downward trajectory since 2009 – is ticking up. This is especially true in fixed income, where our US and international bond forecasts are more than two times higher than they were a year ago. In equities, US valuations are more attractive than they were last year but are still above our estimate of fair value. International equities, however, are at the low end of our fair-value estimates (**Figure II-1**).

FIGURE II-1
Equity and bond valuations are attractive



Notes: The US valuation measure is the current cyclically adjusted price/earnings ratio (CAPE) percentile relative to fair-value CAPE for the Standard & Poor's Composite Index from 1940 to 1957 and the S&P 500 Index from 1957 to 30 September 2022. Global ex-US equity is a 70% developed markets/30% emerging markets blend. Developed-market equity valuation measures are the current CAPE percentile relative to the fair-value CAPE for the local MSCI index. The ex-US developed-market valuation measure is the market-weighted average of each region's (Australia, UK, euro area, Japan and Canada) valuation percentile. Emerging markets is based on the percentile rank based on our fair-value model relative to the market. US aggregate bonds are the weighted average between intermediate-term credit and Treasury valuation percentiles. The global ex-US aggregate valuation measure is the market-weighted average of each region's (Australia, UK, euro area, Japan and Canada) valuation percentile. The valuation percentiles in parenthesis are as at one year prior.

Sources: Vanguard calculations based on Robert Shiller's website, at aida.wss.yale.edu/~shiller/data.htm, the U.S. Bureau of Labor Statistics, the Federal Reserve Board and Refinitiv, as at 30 September 2022 and 30 September 2021.

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 modelled asset class. Simulations as at 30 September 2022 and 30 September 2021. Results from the model may vary with each use and over time.

Vanguard's distinct approach to forecasting

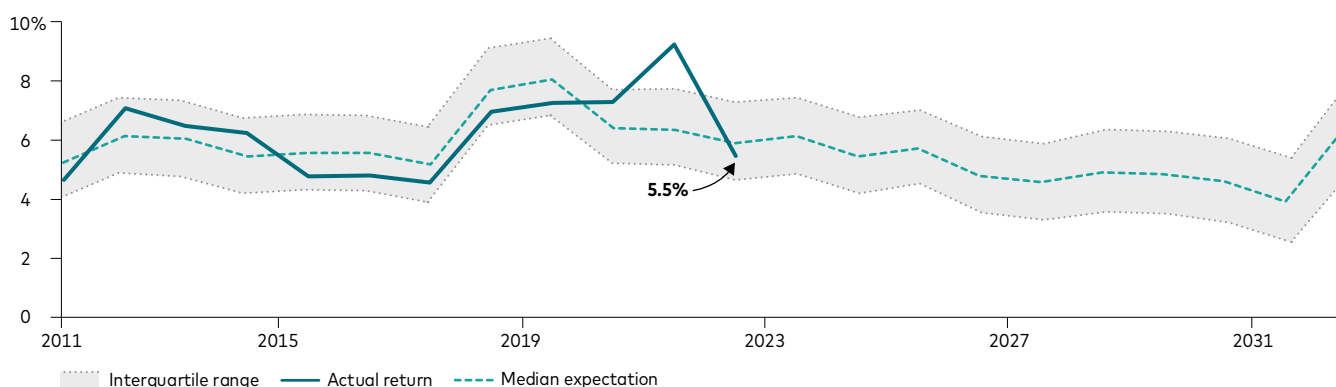
To treat the future with the deference it deserves, Vanguard has long believed that market forecasts are best viewed in a probabilistic framework. This annual publication's primary objectives are to describe the projected long-term return distributions that contribute to strategic asset allocation decisions and to present the rationale for the ranges and probabilities of potential outcomes. This analysis discusses our global outlook from the perspective of a US investor with a dollar-denominated portfolio.

A notable characteristic of the sell-off in global stocks and bonds in 2022 was the degree to which both fell together⁶. **Figure II-2** shows our 10-year outlook and realised returns for a globally diversified 60% stock/40% bond portfolio since 2001. Rising equity valuations in 2021 pushed realised returns above our forecasted range from 10 years prior, but large losses in both equity and fixed income over the last 12 months have brought those returns within the range.

The figure also shows that our outlook for global stocks and bonds has reversed its downward trend in the last decade. This higher return outlook is in large part because of higher interest rates to fight inflation, which caused asset price declines through the equity valuation and bond yield channels. These forces also raised expectations for the next decade, because yields on developed-market sovereign debt are the foundation on which other risky returns are built.

FIGURE II-2
Returns on a 60/40 balanced portfolio are now more in line with our view from 10 years ago

10-year annualised returns



Notes: The chart shows the actual 10-year annualised return of a 60/40 stock/bond portfolio compared with the VCMM forecast for the same portfolio made 10 years earlier. For example, the 2011 data point at the beginning of the chart shows the actual return for the 10-year period 2001–2011 (solid line) compared with the 10-year return forecast made in 2001 (dotted line). After 2022, the dotted line is extended to show how our forecasts made between 2013 and 2022 (ending between 2023 and 2032) are evolving. The interquartile range represents the area between the 25th and 75th percentile of the return distribution. The portfolio is 36% US stocks, 24% international stocks, 28% US bonds and 12% international bonds. See the Appendix section titled “Indices for VCMM simulations” for further details on asset classes.

Source: Vanguard calculations as at 30 September 2022.

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Past performance is no guarantee of future returns. The performance of an index is not an exact representation of any particular investment as you cannot invest directly in an index.

⁶ This breakdown in correlation was disconcerting for many investors and led some to question whether the 60% stock/40% bond portfolio still had merit as an investment tool. Our research finds that correlations can move aggressively over shorter investment horizons but that it would take long periods of consistently high inflation for long-term correlation measures – those that more meaningfully affect portfolio outcomes – to turn positive (Wu et al., 2021).

Global fixed income markets: Sowing the seeds for brighter days ahead

The pain of rising interest rates has been felt most acutely in global fixed income markets. Both the Bloomberg US Aggregate Bond Index and the Bloomberg Global Aggregate ex-USD Index (Hedged) have declined more than in any 12-month period in their histories, down 14.6% and 9.9%, for the year ended 30 September 2022,

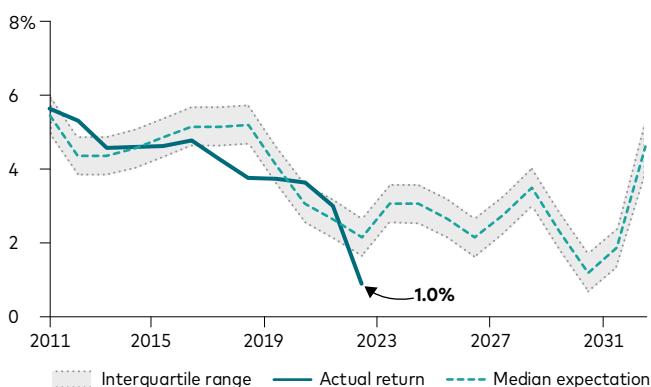
respectively⁷. As shown in **Figure II-3a**, the steep decline in US bonds – along with the 12-month return that rolled off – reduced 10-year annualised returns by 2 percentage points. **Figure II-3b** shows a similar story for international bonds. However, losses there offset previous higher-than-expected returns from lower relative interest rates and brought actual results more in line with our expectations from a decade ago.

FIGURE II-3

Rising interest rates created near-term pain, but have raised our long-term forecast

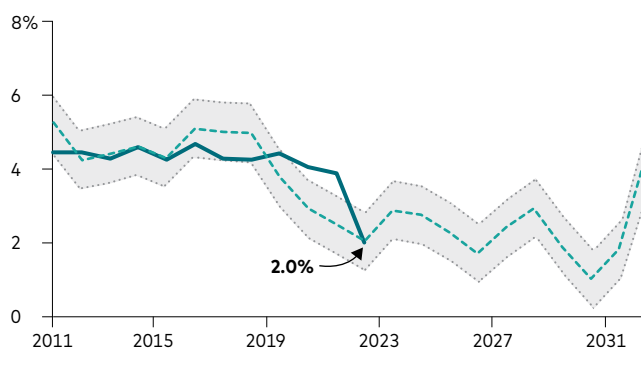
a. Fastest policy tightening in 40 years led to unprecedented losses for US bonds

10-year annualised returns



b. Currency hedging offset similarly large losses on international bonds for US investors

10-year annualised returns



Notes: Figure II-3a shows the actual 10-year annualised return of US bonds compared with the VCMM forecast of 10 years earlier. Figure II-3b shows the actual 10-year annualised return of US dollar-hedged international bonds compared with the VCMM forecast of 10 years earlier. For example, the 2011 data point at the beginning of each chart shows the actual return for the 10-year period 2001–2011 (solid line) compared with the 10-year return forecast made in 2001 (dotted line). After 2022, the dotted line is extended to show how our forecasts made between 2013 and 2022 (ending between 2023 and 2032) are evolving. The interquartile range represents the area between the 25th and 75th percentile of the return distribution. See the Appendix section titled “Indices for VCMM simulations” for further details on asset classes.

Source: Vanguard calculations as at 30 September 2022.

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 modelled asset class. Simulations as at 30 September 2022. Results from the model may vary with each use and over time. Past performance is no guarantee of future returns. The performance of an index is not an exact representation of any particular investment as you cannot invest directly in an index.

⁷ Return data begin in 1975 for the Bloomberg US Aggregate Bond Index and 2000 for the Bloomberg Global Aggregate ex-USD Index Hedged.

Although rising interest rates have created near-term pain for fixed income investors, we expect that those with sufficiently long investment horizons will be better off in end-of-period wealth terms by the end of the decade than if they had just realised our return forecast from the end of last year (**Figure II-4**). This is because of the effect of duration. When interest rates rise, bonds reprice lower immediately. However, cash flows can then be reinvested at higher rates. Given enough time, the increased income from higher coupon payments will offset the price decline and an investor's total return should increase.

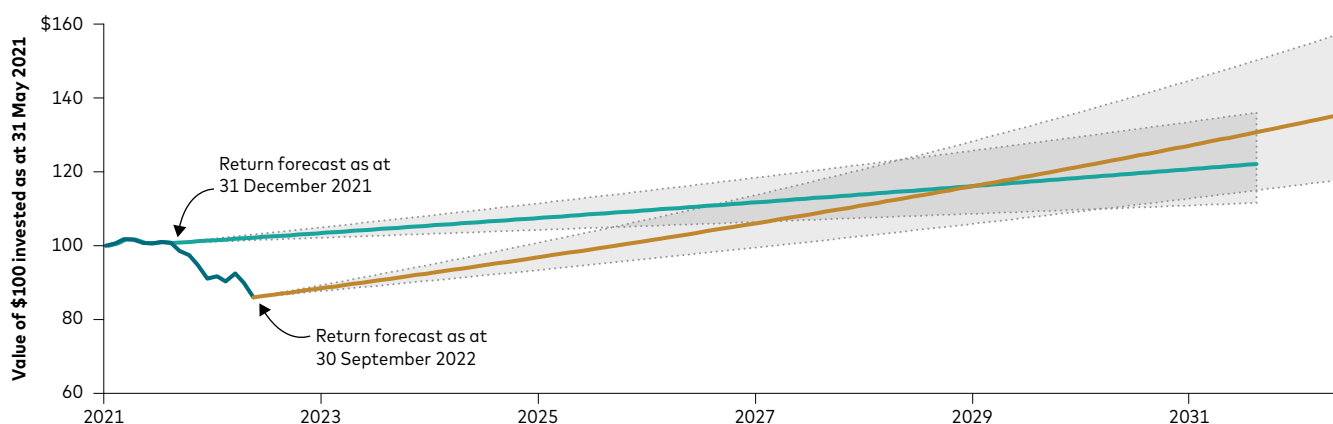
Of course, higher returns are not guaranteed. The median of this analysis is informed by the trajectory of yields implied by the forward yield curve. **Figure II-4** shows that there is a possibility that investors may not have higher wealth at the end of the decade because interest rates continue to rise throughout the next decade. But this

analysis should give long-term investors reasons to be optimistic about the prospects of their fixed income portfolios.

Against a backdrop of rapidly rising rates, our fixed income return outlook for the next decade (**Figure II-5a**) is significantly better than last year's projections, at 4.1%–5.1%, based on more attractive valuations (**Figure II-5b**). Expected returns for non-US bonds in local currency are lower than those of US bonds in light of the relatively lower yields in non-US developed markets, but the differences are negligible once we account for currency impacts. Furthermore, the diversification through exposure to hedged non-US bonds should help offset some risk specific to the US fixed income markets (Philips et al., 2014). Broad US investment-grade bonds should outperform US Treasury bonds by 1.1 percentage points on an annualised basis. Importantly, while recent returns have called into question fixed income's role in portfolios, we continue to believe its inclusion is warranted as a portfolio stabiliser and a long-term diversifier⁸.

FIGURE II-4

We expect investors to be better off because, not in spite, of the sell-off



Notes: The chart shows actual returns for the Bloomberg US Aggregate Bond Index along with Vanguard's forecast for cumulative returns over the subsequent 10 years as at 31 December 2021 and 30 September 2022. The dotted lines represent the 10th and 90th percentiles of the forecasted distribution. Data are as at 30 September 2022.

Sources: Vanguard calculations and Bloomberg, as at 30 September 2022.

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 modelled asset class. Simulations as at 31 December 2021 and 30 September 2022. Results from the model may vary with each use and over time.

Past performance is no guarantee of future returns. The performance of an index is not an exact representation of any particular investment as you cannot invest directly in an index.

⁸ Despite the historic sell-off of fixed income in 2022, its inclusion in the portfolio still improved results, because bonds are a lower-volatility asset. Our research (Wu et al., 2021) finds that asset allocation matters more than correlation regime when estimating outcomes over a long-term horizon.

FIGURE II-5

The green shoots of higher bond returns

a. Higher rates have pushed expected bond returns higher

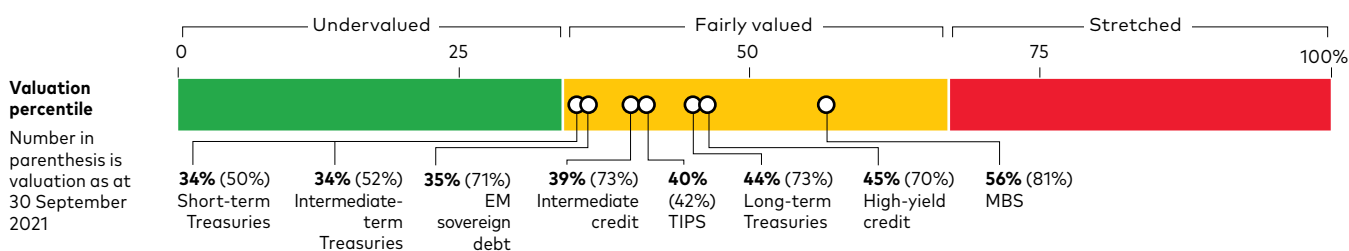
	5th percentile	25th percentile	50th percentile	75th percentile	95th percentile	Median volatility
US high-yield corporate bonds	4.5%	6.1%	7.1%	8.2%	9.8%	10.4%
Emerging sovereign bonds	4.2	6.0	6.9	7.9	9.2	11.0
US Treasury bonds	2.4	3.4	4.2	4.9	6.1	5.8
US intermediate TIPS	1.4	2.6	3.7	4.8	6.6	5.0
US bonds	2.9	3.9	4.6	5.3	6.5	5.6
US mortgage-backed securities	2.7	4.0	4.8	5.5	6.4	4.7
Global ex-US bonds (hedged)	2.4	3.6	4.5	5.4	6.9	4.4
US inflation	0.3	1.6	2.5	3.3	4.6	2.3
US cash	1.7%	2.9	3.9	4.9	6.4	1.4

Notes: The forecast corresponds to the distribution of 10,000 VCMM simulations for 10-year annualised nominal returns in USD for asset classes highlighted here. Median volatility is the 50th percentile of an asset class' distribution of annualised standard deviation of returns. Asset class returns do not take into account management fees and expenses, nor do they reflect the effect of taxes. Returns do reflect reinvestment of dividends and capital gains. Indices are unmanaged; therefore, direct investment is not possible. See the Appendix section titled "Indices for VCMM simulations" for further details on asset classes. US inflation is the 10-year average of year-on-year US headline CPI.

Source: Vanguard calculations as at 30 September 2022.

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 modelled asset class. Simulations as at 30 September 2022. Results from the model may vary with each use and over time.

b. Fixed income is fairly valued



Notes: Credit (emerging sovereign, high-yield and intermediate) and mortgage-backed securities (MBS) valuations are based on current spreads relative to year 30. Treasury valuation is the key rate duration-weighted average of our proprietary fundamental fair-value model. TIPS are calculated using 10-year-ahead annualised inflation expectation relative to years 21–30. The valuation percentiles in parenthesis are as at one year prior.

Source: Vanguard calculations as at 30 September 2022 and 30 September 2021.

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 modelled asset class. Simulations as at 30 September 2022 and 30 September 2021. Results from the model may vary with each use and over time.

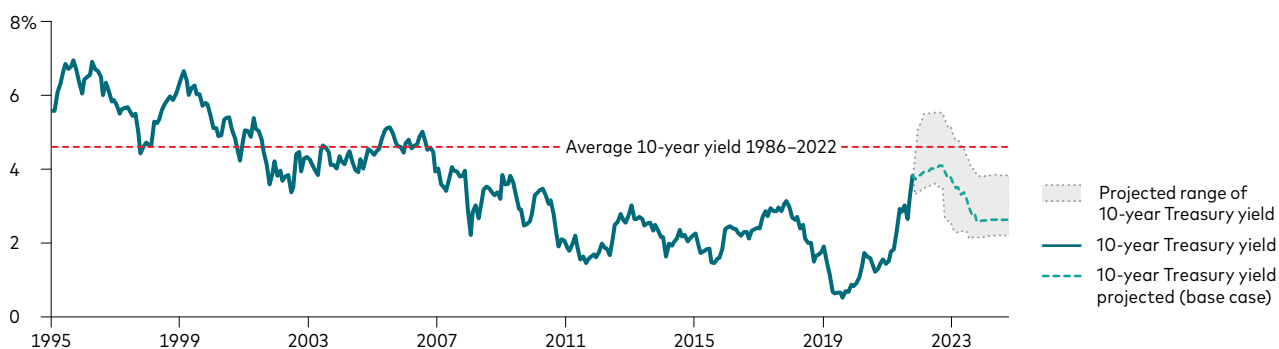
US interest rates: valuations are attractive

After rising by as much as 260 basis points in 2022, the 10-year US Treasury yield has traded in a range of 3.7%–4.3% as the market tries to ascertain the direction of Fed policy. But we believe that the terminal rate and the amount of time policy is held at that level will be what ultimately matters for US Treasury returns. Based on current economic conditions and Fed policy guidance, our Treasury fair-value model suggests that the yield curve is within our fair-value range⁹.

The evolution of fair value will depend heavily on the direction of inflation, the Fed's response and the market's expectations for future policy rates. **Figure II-6** shows the expected impact of our economics team's inflation and federal funds rate forecast on the 10-year Treasury yield over the next three years.

FIGURE II-6

Higher long-term yields are possible, but any trip above historical averages is likely to be brief



Notes: The chart shows the actual 10-year Treasury yield quoted on a constant maturity basis since 1995 and Vanguard's forecast based on a range of economic scenarios. The forecasts are derived from a statistical model specification that is a five-variable vector error correction model, including the 10-year Treasury yield, first three principal components of covariance matrix for 10-year trailing inflation, 10-year trailing food inflation, the 10-year trailing hourly earnings growth, effective federal funds rate and 5-year trailing real GDP estimated over the period January 1979–30 September 2022.

Sources: Vanguard calculations based on data from FactSet, the U.S. Bureau of Labor Statistics, the Federal Reserve Board, Refinitiv and Global Financial Data.

⁹ For more details on our Treasury attribution model, see Davis et al., 2021.

In our baseline scenario – in which inflation falls throughout 2023 but remains above the Fed's 2% target and the federal funds rate rises to 4.5% and stays there for the next 12 months before gradually falling to 2.5% – we expect the 10-year yield to peak around its recent highs (4%–4.3%). In a more pessimistic scenario – shown by the top of the grey band in **Figure II-6** – the Fed's fight against inflation forces it to raise rates as high as 5.7%. In this scenario, the 10-year yield could peak as high as 5.5%. If the fight against inflation requires less action from the Fed, the 10-year yield has likely already peaked and we would expect lower 10-year yields as policy rates normalise more quickly. No matter the scenario, our view that the Fed will ultimately be successful in bringing down inflation means that it will be difficult for long-term yields to remain above their historical average from the past 35 years.

Expected long-term inflation rates implied by Treasury Inflation-Protected Securities (TIPS) also support this view. Breakeven inflation rates peaked in the first half of 2022, as energy prices reached record highs, at 2.98% annually over the next decade. These expectations have since moderated to 2.15% as at 30 September 2022. This is below our median VCMM 10-year annualised inflation forecast of 2.5% (see **Figure II-5a**), which leads us to view longer-term inflation protection as cheaper than last year but within our fair-value range (see **Figure II-5b**). Higher TIPS returns are a result of inflation exceeding market expectations. To that end, only upside inflation surprises will create excess return opportunities. Regardless of their attractiveness from a valuation perspective at any point in time, TIPS offer some benefit to long-term investors who are sensitive to inflation risk.

Corporate bonds: cheaper valuations, but downside risks remain

Despite a record pace of Fed tightening and a historic rise in Treasury yields in 2022, credit spreads have remained remarkably resilient. Our fair-value framework, shown in **Figures II-7a** and **II-7b**, uses the same four variables to model investment-grade and high-yield spreads but finds that these variables differ in their importance. For instance, both investment-grade and high-yield spreads are most sensitive to economic conditions, but the slope of the yield curve matters more for investment-grade than for high-yield. Conversely, high-yield is more sensitive to corporate debt fundamentals given its riskier credit profile.

Over the last 12 months, worsening economic conditions from inflation and the Fed's fight to contain it have been the main factors pushing credit spreads higher. Tighter policy is also raising the risk of a recession, which leads the yield curve to invert and could put downward pressure on profits and debt sustainability metrics. Strong balance sheets, however, have prevented spreads (especially high-yield ones) from widening further. Although both investment-grade and high-yield bond spreads are within our fair-value range, it is reasonable to expect that they could widen more given our outlook for weaker economic conditions, high short-term interest rates to fight inflation and slower corporate profit growth.

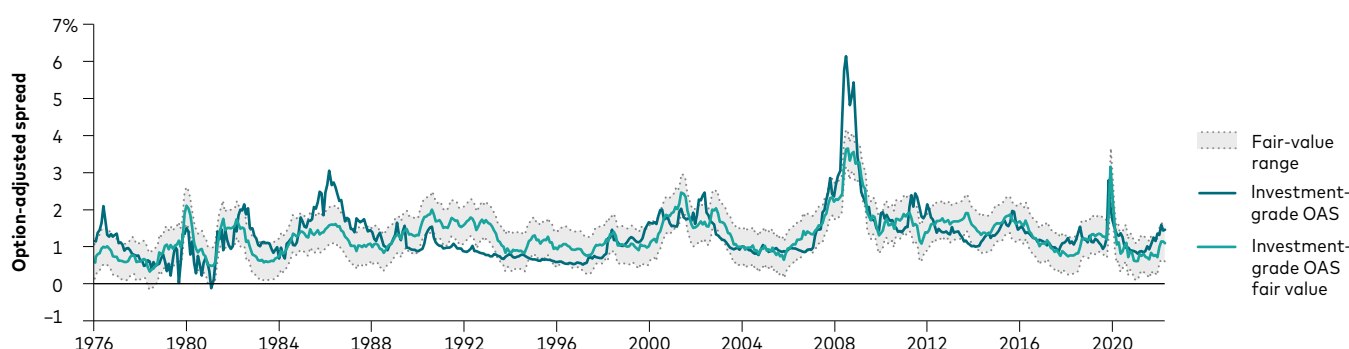
Over the next decade, we expect investment-grade bonds to return 4.8%–5.8% and high-yield bonds to return 6.6%–7.6% per year. These returns are not dissimilar from our forecasted equity returns for the next decade, but they also come with equity-like volatility. Although this volatility may be concerning for investors with

shorter investment horizons, our research finds that for investors with a sufficiently long investment horizon who are looking to maximise their end-of-period wealth, credit can improve portfolio outcomes. This improvement comes from credit's premium over Treasuries and its low correlation with equity¹⁰.

FIGURE II-7

Credit spreads are near fair value, but risks are elevated because of the macro environment

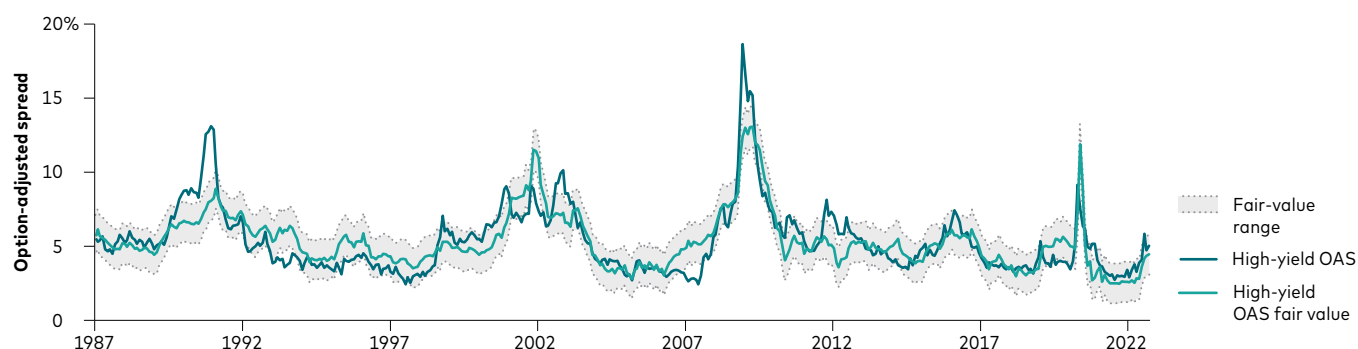
a. Investment-grade



Notes: Investment-grade credit spreads are yields on bonds characterised by their low default risk (credit rating above BBB-) above the yield on a Treasury security of the same duration. Data are from July 1976 to June 2022. Fair value is specified by an Ordinary Least Squares (OLS) regression model where the dependent variable is the investment-grade option-adjusted spread (OAS) of the Bloomberg U.S Corporate Investment Grade Index and the explanatory variables (all one month lagged) are our proprietary Vanguard leading economic indicator (VLEI), the 10-year Treasury yield minus the 2-year Treasury yield (yield curve slope), the debt-to-profit ratio (ratio of US debt outstanding of nonfinancial corporations to US nonfinancial corporate business profits before tax) and year-on-year change in quarterly corporate profits.

Sources: Vanguard calculations based on data from Bloomberg, Refinitiv Datastream and Barclays Live, as at 30 September 2022.

b. High-yield



Notes: High-yield credit spreads are yields on bonds characterised by their elevated default risk (credit rating BB+ or lower) above the yield on a Treasury security of the same duration. Data are from January 1987 to June 2022. Fair value is specified by an Ordinary Least Squares (OLS) regression model where the dependent variable is the high-yield option-adjusted spread (OAS) of the Bloomberg US Corporate High Yield Index and the explanatory variables (all one month lagged) are our proprietary Vanguard leading economic indicator (VLEI), the 10-year Treasury yield minus the 2-year Treasury yield (yield curve slope), the debt-to-profit ratio (ratio of US debt outstanding of nonfinancial corporations to US nonfinancial corporate business profits before tax) and year-on-year change in quarterly corporate profits.

Sources: Vanguard calculations based on data from Bloomberg, Refinitiv Datastream and Barclays Live, as at 30 September 2022.

¹⁰ Our VCMM forecast suggests that median correlations between US equities and investment-grade and high-yield bonds will be 0.22 and 0.31, respectively.

Global equity markets: Normalising return outlook

The sell-off in equity markets this year has been indiscriminate. US, developed ex-US and emerging-market equity indices have all posted losses greater than 20% in the last nine months. Valuation declines were more pronounced in US markets, but a strengthening dollar meant US-based investors realised larger losses on their unhedged international equity exposures than on their local ones. Even though this is negative from a short-term, realised-return perspective, it means that the global opportunity set is now more attractive than it was a year ago.

Figures II-8a and II-8b show that the global sell-off is bringing US returns closer to our forecasts from 10 years ago but that international equities have continued to underperform our expectations. Although discrepancies exist at the regional level, our forecast 10 years ago for global equities has proved accurate¹¹. This underscores the challenges investors face when tilting their portfolio heavily in one direction and it highlights the benefits of global diversification.

FIGURE II-8

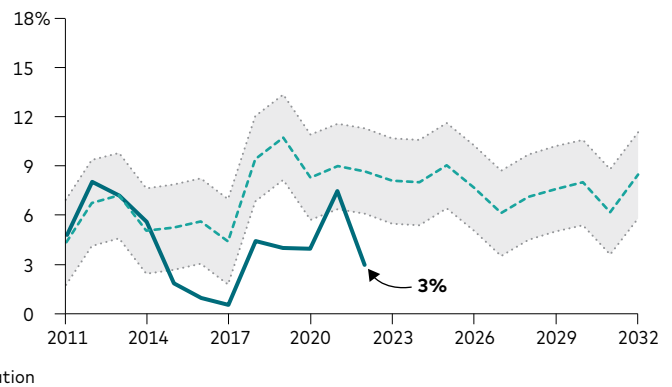
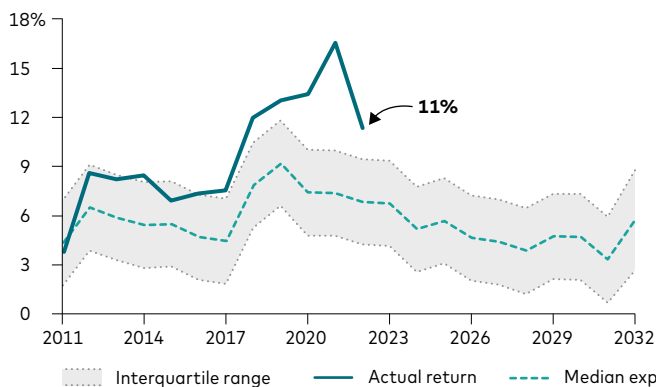
Investors are reassessing their rosy view of equities, which is pushing our return outlook higher

a. US equities are falling back toward our forecast from a decade ago

b. International equities have continued to lag expectations from a decade prior

10-year annualised returns

10-year annualised returns



Notes: Figure II-8a shows the actual 10-year annualised return for US equities compared with the VCMM forecast made 10 years earlier. Figure II-8b shows the actual 10-year annualised return for international equities compared with the VCMM forecast made 10 years earlier. For example, the 2011 data point at the beginning of each chart shows the actual return for the 10-year period 2001–2011 (solid line) compared with the 10-year return forecast made in 2001 (dotted line). After 2022, the dotted line is extended to show how our forecasts made between 2013 and 2022 (ending between 2023 and 2032) are evolving. The interquartile range represents the area between the 25th and 75th percentile of the return distribution. See the Appendix section titled “Indices for VCMM simulations” for further details on asset classes.

Source: Vanguard calculations, as at 30 September 2022.

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 modelled asset class. Simulations as at 30 September 2022. Results from the model may vary with each use and over time.

Past performance is no guarantee of future returns. The performance of an index is not an exact representation of any particular investment as you cannot invest directly in an index.

¹¹ Our median forecast for a market-cap-weighted portfolio of US and international equities for the 10-year period from 30 September 2012 to 30 September 2022 was 7.6% per year and the same portfolio returned 8% over that period.

Figures II-9a and II-9b show our expectations for US-based investor equity returns and our view of valuations across developed and emerging markets and factors. Our valuations and forecasting frameworks are intended to set long-term expectations. Therefore, overvaluation

(or undervaluation) should not, in itself, suggest a short-term action by investors. Time-varying portfolio construction should balance risk and return in a utility-based framework and requires acceptance of model and active risk (Aliaga-Díaz et al., 2022).

FIGURE II-9
Expected returns are higher, but we still see more opportunities internationally

a. Equity market 10-year outlook: setting reasonable expectations

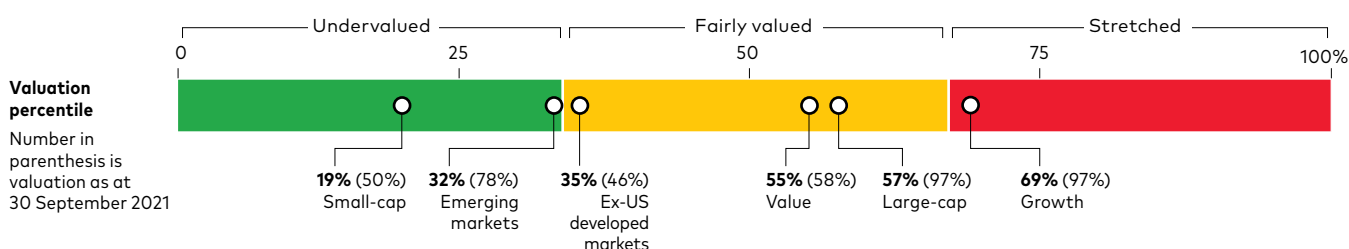
	5th percentile	25th percentile	50th percentile	75th percentile	95th percentile	Median volatility
US small-cap	-2.6%	2.5%	6.1%	9.7%	15.1%	22.9%
US value	-2.7	2.2	5.7	9.1	14.2	19.8
US REITs	-2.6	2.4	5.9	9.4	14.4	20.1
Global ex-US equities	2.2	5.8	8.4	11.0	14.9	18.8
US growth	-3.4	1.0	4.1	7.1	11.6	18.6
US equity	-1.3	2.8	5.7	8.6	12.9	17.4
US large-cap	-1.5	2.7	5.6	8.5	12.8	17.1
Commodities	-13.0	-2.9	4.3	11.8	23.4	16.6

Notes: The forecast corresponds to the distribution of 10,000 VCMM simulations for 10-year annualised nominal returns in USD for asset classes highlighted here. Median volatility is the 50th percentile of an asset class's distribution of annualised standard deviation of returns. Asset class returns do not take into account management fees and expenses, nor do they reflect the effect of taxes. Returns do reflect reinvestment of dividends and capital gains. Indices are unmanaged; therefore, direct investment is not possible. See the Appendix section titled "Indices for VCMM simulations" for further details on asset classes.

Source: Vanguard calculations as at 30 September 2022.

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 modelled asset class. Simulations as at 30 September 2022. Results from the model may vary with each use and over time.

b. Valuations are more attractive than a year ago



Notes: With the exception of emerging markets and ex-US developed markets, valuations are relative to US equities as the base at the 50th percentile. Growth, value and small-cap are all based on the percentile rank based on our fair-value model relative to the market. Large-cap valuations are composite valuation measures of the style factor to US relative valuations and the current US CAPE percentile relative to its fair-value CAPE. The ex-US developed markets valuation measure is the market-weighted average of each region's (Australia, UK, euro area, Japan and Canada) valuation percentile. Emerging markets are based on the percentile rank based on our fair-value model relative to the market. Valuation percentiles in parenthesis are as at one year prior.

Sources: Vanguard calculations based on Robert Shiller's website, at aida.wss.yale.edu/~shiller/data.htm, the U.S. Bureau of Labor Statistics, the Federal Reserve Board and Refinitiv, as at 30 September 2022 and 30 September 2021.

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 modelled asset class. Simulations as at 30 September 2022 and 30 September 2021. Results from the model may vary with each use and over time.

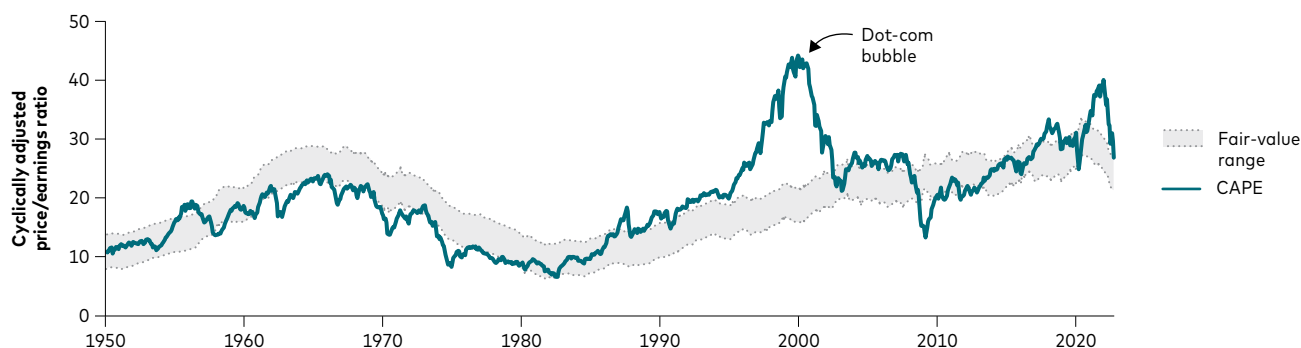
Valuations are more favourable, but the opportunity set is still limited

High inflation and rising real interest rates have caused Robert Shiller's CAPE ratio for the Standard & Poor's 500 Index and our estimate of fair value to decline. **Figure II-10** shows our model estimate and suggests that although equity valuations have improved, they are still overvalued.

Our median fair-value estimate sits at 23.7 times the trailing 10-year average of real earnings. Higher (lower) inflation and a more (less) aggressive Fed could cause our fair value to settle lower (higher). Our analysis indicates that much larger, more persistent shifts in the inflation and interest rate environments are needed to move valuations meaningfully beyond the standard error of our fair-value estimate.

FIGURE II-10

US equity valuations are more attractive than they were a year ago



Notes: The US fair-value CAPE is based on a statistical model that corrects CAPE measures for the level of inflation and interest rates. The statistical model specification is a three-variable vector error correction model including equity-earnings yields, 10-year trailing inflation and 10-year US Treasury yields estimated from January 1940 to 30 September 2022. Details were published in Davis (2017). A declining fair-value CAPE suggests that higher equity-risk premium (ERP) compensation is required, whereas a rising fair-value CAPE suggests that the ERP is compressing.

Sources: Vanguard calculations based on data from Robert Shiller's website, at aida.wss.yale.edu/~shiller/data.htm, the U.S. Bureau of Labor Statistics, the Federal Reserve Board, Refinitiv, FTSE Russell, FactSet, Barclays Live and Global Financial Data, as at 30 September 2022.

Profit margins are unlikely to continue powering US earnings

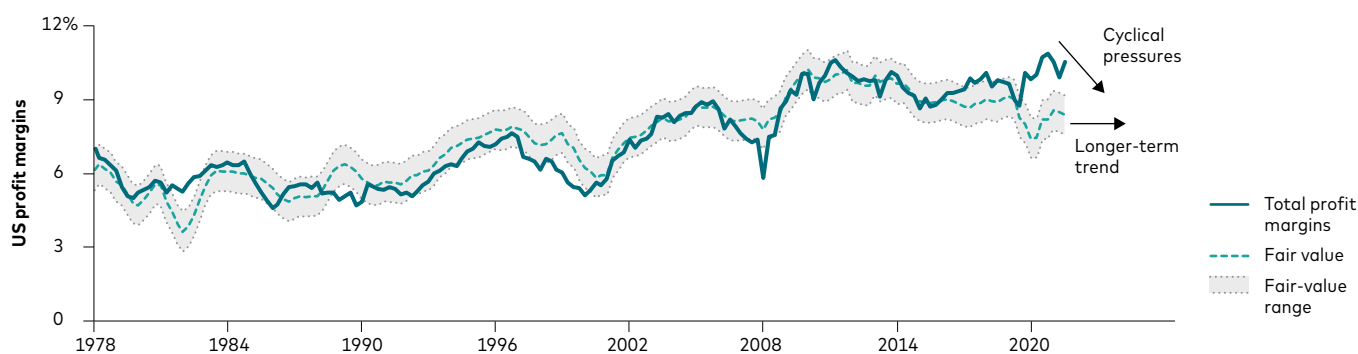
In addition to stretched valuations, the risks posed to earnings by high inflation and the growing likelihood of recession underscore our cautious stance on US equities. Our framework for assessing US earnings growth breaks it down into revenue growth and profit margins. We find that revenue growth is a function of global GDP growth and that profit margins are determined by global trade intensity and labour costs. **Figure II-11** shows our model for US profit margins compared with actuals. Profit margins are currently at a cyclical high and we expect them to decline towards our estimates in the coming years, mostly because of higher labour costs. Longer term, we expect a modest decline

in margins as a slower pace in the trend of globalisation is partially offset by higher productivity because of idea sharing¹².

We expect US earnings growth to average 5% per year over the next decade, which is below the 6.4% that investors experienced over the last decade. Although this information is useful in informing our forecast, long-term investors must remember that what matters most for equity returns is the price paid for earnings, not the earnings themselves. Our research finds that GDP growth explains some of revenue growth, which in addition to profit margins explains earnings growth. But earnings growth explains only about 15% of the variation in equity returns; valuations matter more.

FIGURE II-11

US profit margins may face cyclical pressure in the near term, but should remain above long-term averages



Notes: Profit margins are broken into their cyclical and trend components and forecasted using an Ordinary Least Squares (OLS) regression model with trade intensity (sum of imports and exports) and labour costs as the independent variables. We expect higher productivity to drive higher profit margins given the linear relationship between productivity and profit margins and our view for higher productivity based on our proprietary Idea Multiplier. For more information on the Idea Multiplier, see *The Idea Multiplier: An Acceleration in Innovation Is Coming* (Davis et al., 2019).

Sources: Vanguard calculations based on data from Refinitiv, as at 30 June 2022.

¹² For more information on Vanguard's view on these two "megatrends", see Lemco et al., 2021 and Davis et al., 2019.

After value's resurrection, the risks are more balanced

In the US market, the return of value investing has been a notable narrative that has continued in 2022. Unlike in the first quarter of 2021, value's outperformance over the last 12 months has had more to do with growth's relative weakness than value's relative strength. Our "fair value of value" framework (**Figure II-12a**) shows how interest rates and inflation have driven value's secular decline over the last 40 years. As we highlighted in our economic and market outlook for 2021, however, by the end of 2020, the value trade had been oversold (Davis et al., 2020). This led us to believe that even if the macroeconomic conditions that supported growth persisted, value was likely to outperform in the coming years.

Value's outperformance now means that the risks are more symmetrical¹³. On one hand, recession dynamics historically have helped growth. On the other hand, there's reason to believe that this recession might not look exactly like the past and that higher interest rates and inflation could continue supporting value.

The one part of the US market where our fair-value frameworks see some opportunity is in small-caps, albeit to a much smaller degree than we saw in value last year. We find that similar drivers – interest rates, inflation, volatility and corporate profits – explain 72% of the variations in small-cap versus large-cap price/book ratios (**Figure II-12b**). Currently small-caps sit below our estimate of fair value, even when we account for the mounting inflation pressures and rising interest rates experienced in the last year. Our excess return projections for small-caps, however, are de minimis (20 basis points per year over the next decade) – especially when compared with the 160 basis points of annualised excess return for value over growth.

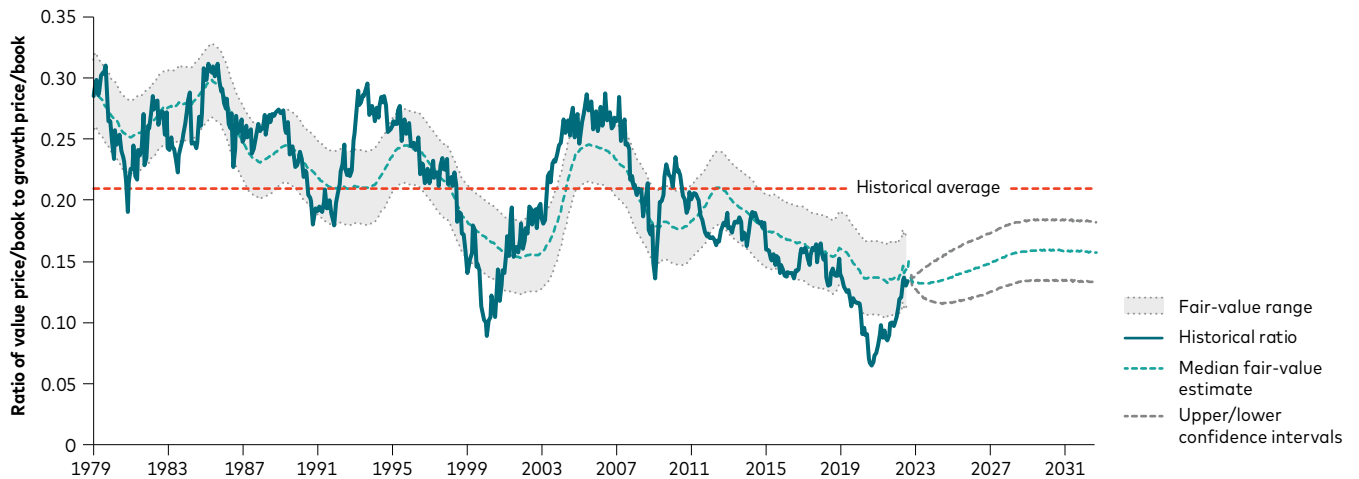
Although more favourable valuations have improved our outlook for US equities compared with last year, we still caution investors against expecting returns similar to the 11.3% per year they experienced in the last decade. In addition to our expected 5% annualised earnings growth, we expect dividend yields to average 1.9% per year (in line with the last decade) but valuations to contract 1.2% annually. All told, these factors underpin our forecast for US equities to return 4.7%–6.7% annually.

¹³ We still expect value to outperform over the next decade, but this outperformance has less to do with relative valuations and more to do with the "value premium" that our research, along with that of academic and other practitioners finds.

FIGURE II-12

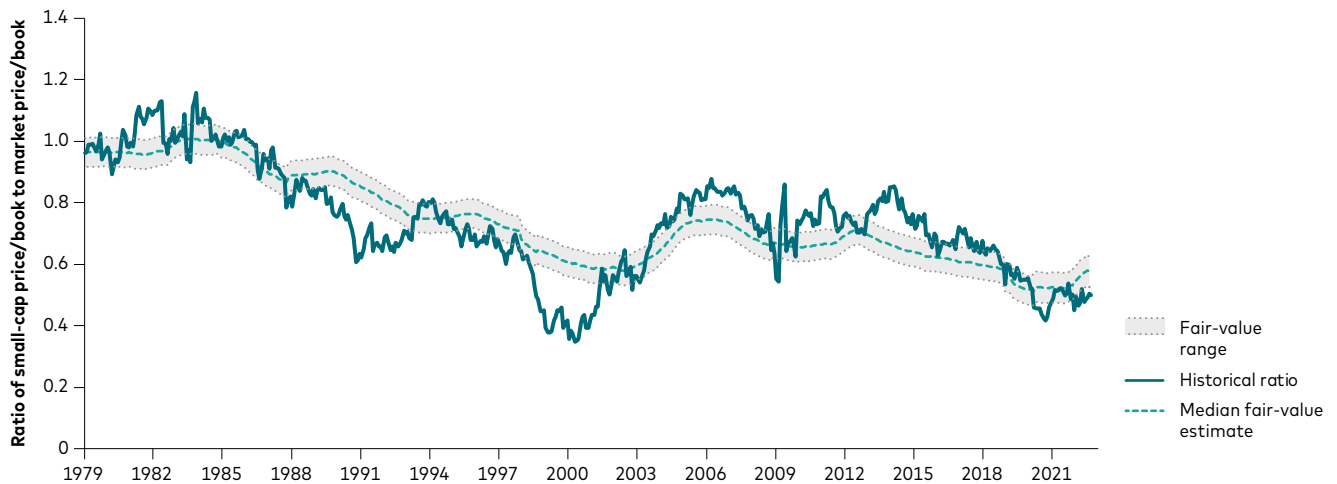
Some parts of the US market are still attractively valued

a. With value/growth valuations at fair value, the risks are more symmetrical



Notes: The valuation ratio is projected based on a vector error correction model and using a five-lag vector autoregression model to project the systematic drivers.
Sources: Vanguard calculations based on data from FactSet, the U.S. Bureau of Labor Statistics, the Federal Reserve Board, Refinitiv and Global Financial Data, as at 30 September 2022.

b. There may still be opportunity in small-caps



Note: The statistical model specification is a five-variable vector error correction model, including a respective ratio of price to book, 10-year trailing inflation, 10-year real Treasury yield, equity volatility and growth of corporate profits, estimated over the period January 1979–September 2022.
Sources: Vanguard calculations based on data from FactSet, the U.S. Bureau of Labor Statistics, the Federal Reserve Board, Thomson Reuters and Global Financial Data, as at 30 September 2022.

International equities: more value with less growth

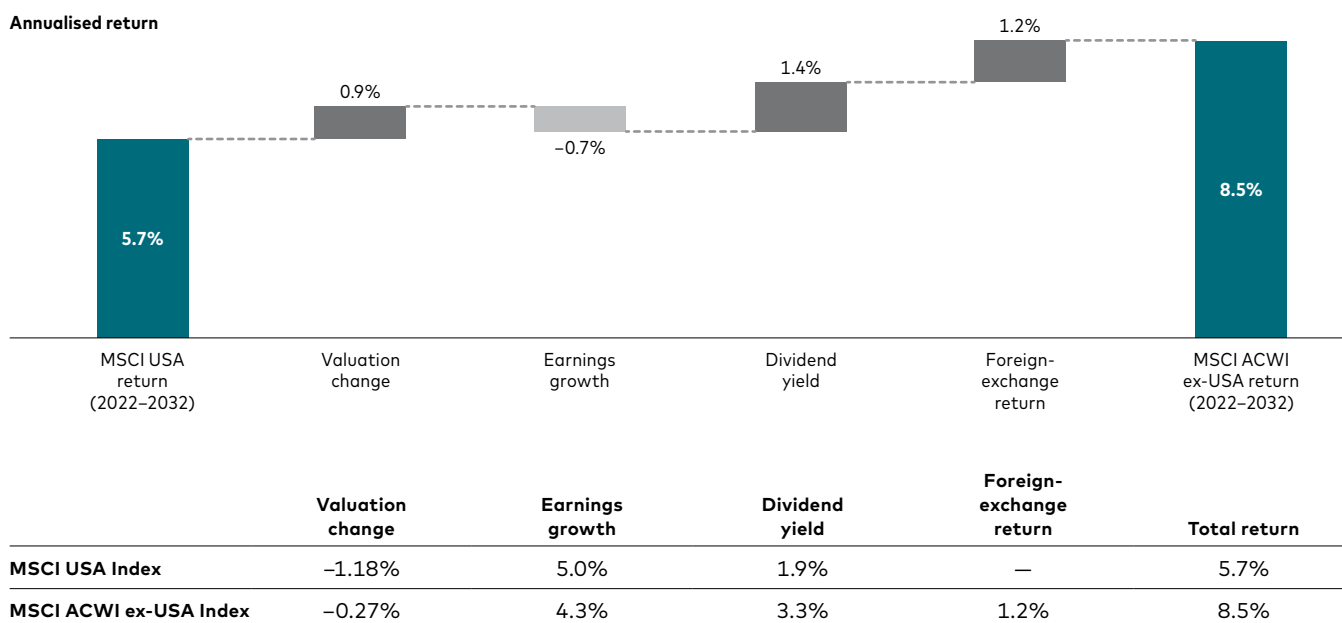
US equities have outperformed their global peers by a very wide margin over the last decade. On a cumulative return basis, a portfolio of US stocks bought in 2012 is worth twice as much as a portfolio of international stocks bought in the same period. Although many reasons have been cited for this outperformance – stronger US growth, a less uncertain economic environment and the sector composition of the US market – our framework focuses on the durable sources of outperformance. To that end, we believe that the valuation-based expansion in US equities is sowing the seeds for lower returns in the decade

ahead. Our outlook is positive for international equities despite our view that the US will have higher earnings growth, though we may need to see a weaker dollar for international outperformance to be sustained.

Figure II-13 shows our outlook for US and international equities and a breakdown of the expected total return difference for the decade ahead. Although the valuations gap has narrowed since last year, we expect more favourable international valuations, higher dividend payout ratios and a weaker dollar to drive international outperformance.

FIGURE II-13

Since relative valuations have improved, a weaker dollar is becoming a more important driver of expected international outperformance



Notes: Forward-looking return estimates are from the VCMM, as at 30 September 2022, for the period 1 October 2022 to 30 September 2032. The US equity return is represented by the MSCI USA Index return; the international equity return is represented by the MSCI ACWI ex-USA Index return. Returns do not take into account management fees and expenses, nor do they reflect the effect of taxes. Returns do reflect reinvestment of dividends and capital gains. The two end bars representing US and international expected returns are median expectations. As a result, this comparison does not account for the correlation between US and international equities. The sum of the individual bars in the middle may not equal the difference between the two end bars because of rounding.

Sources: Vanguard calculations based on data from Refinitiv and Global Financial Data, as at 30 September 2022.

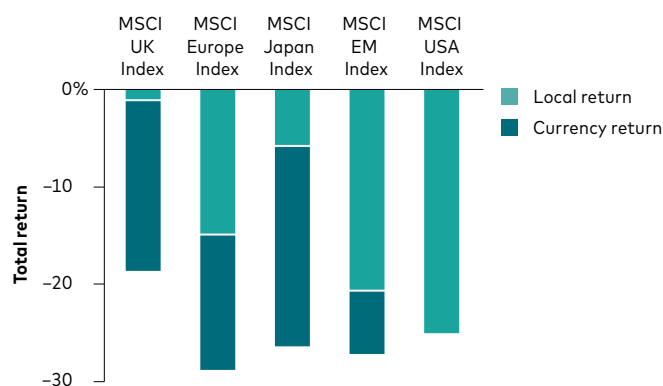
IMPORTANT: The projections and other information generated by the VCMM regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results and are not guarantees of future results. Distribution of return outcomes from VCMM are derived from 10,000 simulations for each modelled asset class. Simulations as at 30 September 2022. Results from the model may vary with each use and over time.

More favourable valuations internationally, however, are not a new story. Nevertheless, international has been unable to generate any significant outperformance relative to the US. This is in large part because of the dollar's strength, which has reduced an unhedged US-based investor's return on international equities this year. As at 30 September 2022, our capital markets model suggests that the US dollar is 13% above what the fundamental, long-term drivers of currency value suggest. This leads us to project a 1.2% annualised decline in the dollar relative to a basket of international currencies over the next decade.

Figure II-14 shows how a strong dollar has amplified losses in international equities for unhedged US-based investors. This effect has been particularly acute in developed markets where returns have held up much better in local currency terms because of less-stretched valuations. Currency returns are notoriously difficult to forecast over short investment horizons and many factors can cause them to deviate from their fundamentals¹⁴. However, over a sufficiently long investment horizon, we expect global inflation and policy convergence to lead to exchange-rate normalisation.

FIGURE II-14

Dollar strength has held back international performance for US investors this year



Notes: The chart breaks down the unhedged USD return from 31 December 2021 to 30 September 2022, into the local and exchange rate return components. The indices used are the MSCI UK Net Total Return Index, the MSCI Europe Net Total Return Index, the MSCI Japan Net Total Return Index, the MSCI Emerging Market Net Total Return Index and the MSCI USA Net Total Return Index. The currency exchange rates are the EUR/USD, GBP/USD and JPY/USD cross-rates. The MSCI Emerging Markets currency return is derived using the local currency index, which accounts for exchange rate differences based on each country's weight in the index.

Sources: Vanguard calculations based on data from Bloomberg and Global Financial Data, as at 30 September 2022.

¹⁴ Because all currencies are relative pairs, it is possible that the headwinds the US dollar faces will be even stronger for international currencies, which would cause the US dollar to strengthen, all else equal.

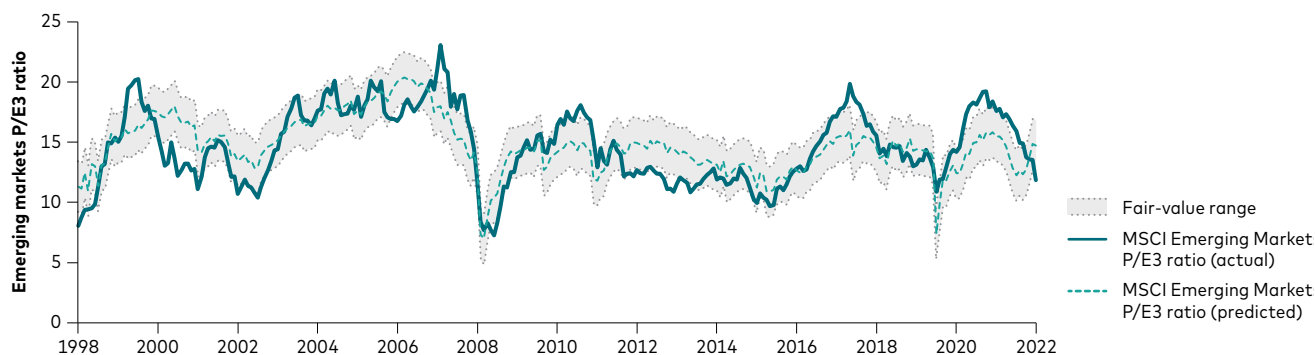
An improved return outlook and consistent diversification benefits from emerging markets

Within international markets, our fair-value framework shown in **Figure II-15** suggests that emerging markets are attractively valued for the first time since the pandemic¹⁵. Steep sell-offs in 2021 and 2022 stemming from elevated inflation, aggressive policy tightening, slowing growth and political risks have increased the emerging-market risk premium. Although near-term risks in the form of a strong dollar, global recession and geopolitical tensions remain, the narrative appears oversold. Faster policy normalisation in emerging markets than in the US and slowing economic conditions were the main drivers behind the decline in our fair-value estimate from September 2021 to June 2022. Rate hikes in emerging markets, however, have broadly

slowed and US rates are rising faster. Higher interest rates in the US relative to emerging markets raise fair value because they lead the dollar to trade at a forward discount to emerging-market currencies, which (according to uncovered interest rate parity) should raise expected returns for a US-based investor.

Our outlook suggests that emerging markets should return between 7% and 9% (2.3 percentage points higher than US equities) over the next decade. Furthermore, emerging-market equities still have a lower correlation with US equities than developed ex-US markets and a higher inflation beta to US inflation¹⁶. For these reasons, we believe that a balanced allocation to emerging-market equities plays an important role in investors' portfolios.

FIGURE II-15
Emerging-market valuations are attractive



Notes: The statistical model specification is a five-variable Ordinary Least Squares regression that uses the following variables: inflation for six major emerging markets countries (Brazil, China, India, South Korea, Mexico and Taiwan) weighted by MSCI monthly index weights; monthly average of daily real 2-year US Treasury yield; emerging markets central bank policy rates weighted by GDP in US dollars, minus the federal funds rate; Vanguard's leading economic indicators (VLEI) for China, Brazil and Mexico (weighted average based on country GDP in US dollars); and monthly average of daily US equity market volatility, as measured by the CBOE Volatility Index (VIX). P/E3 is the price divided by trailing 3-year average earnings.

Sources: Vanguard calculations based on data from the Federal Reserve Bank of St. Louis FRED database and Bloomberg, as at 30 September 2022.

¹⁵ See Davis et al. (2021) for more details on our fair-value model.

¹⁶ The predicted median correlations for emerging-market equities are 0.70 with US equities and 0.74 with developed ex-US equities. The inflation beta – the linear regression coefficient between the 30-year US inflation forecast and the 30-year asset return forecast – is 0.71 for emerging markets versus -0.44 for developed-market ex-US equities.

Inflation hedging is a multidimensional problem

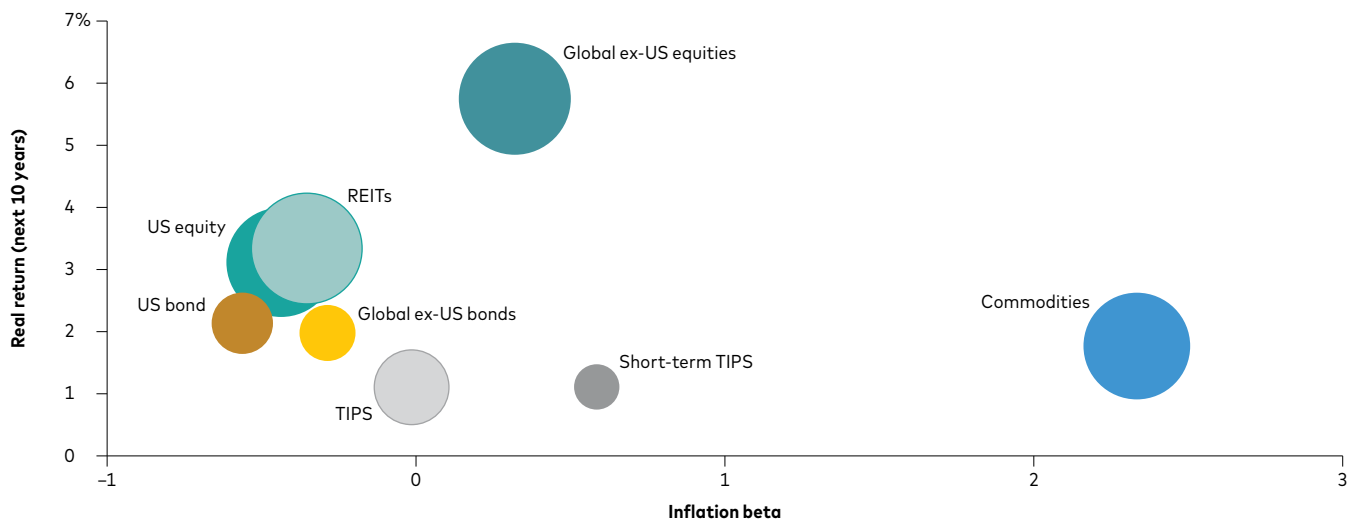
There is no one-size-fits-all solution to inflation hedging – it depends on an investor’s objectives, investment horizon and risk tolerance.

Figure II-16a breaks down the inflation-hedging properties of major asset classes across these three dimensions. For investors looking to generate a positive real return over a very long horizon, equities – especially non-local ones –

provide the best probability of beating inflation¹⁷. Investors with a shorter investment horizon may prefer to maintain their purchasing power by matching inflation. To this end, traditional inflation hedges such as TIPS and commodities are useful. These securities, however, can introduce a real-return drag on the portfolio if they are held for extended periods. Commodities can also introduce high volatility, which could be incongruent with a shorter investment horizon.

FIGURE II-16
Commodities are not an investor’s only tool to fight inflation

a. There is no one-size-fits-all solution to inflation hedging



Notes: The chart compares real (inflation-adjusted) annualised return projections over the next 10 years to the inflation beta for various asset classes. Inflation beta is the slope coefficient of a linear regression of the year 30 return forecast on a constant and the year 30 inflation forecast. The size of each bubble represents the forecasted median annualised volatility over the next 10 years. See the Appendix section titled “Indices for VCMM simulations” for further details on asset classes.

Source: Vanguard calculations as at 30 September 2022.

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 modelled asset class. Simulations as at 30 September 2022. Results from the model may vary with each use and over time.

¹⁷ As long as local and non-local inflation correlation is less than 1, non-local equities will serve as an effective inflation hedge. This is because higher local inflation should cause the local currency to depreciate, which would raise non-local equity returns, all else equal (Rodel, 2014).

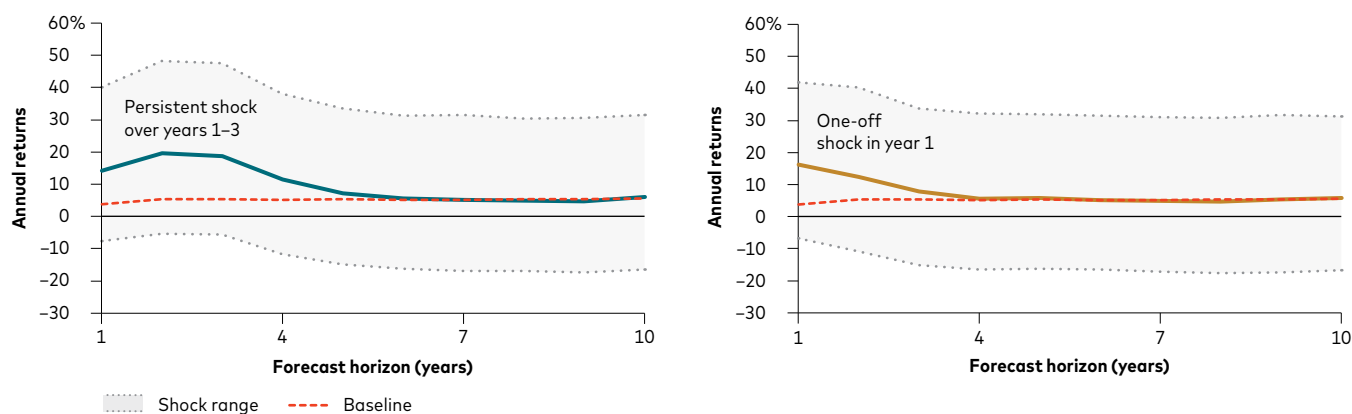
Given the similar energy supply dynamics driving current inflation, it is easy to draw parallels to the 1970s, when oil embargos in the Middle East contributed to inflation pressures in the US and commodity returns provided a useful hedge. Our research indicates that commodity returns are a function of realised inflation and the economic growth environment. We also find that shocks to these drivers are both quickly reflected in commodity prices and short-lived. **Figure II-16b**

shows that a shock to inflation and growth is reflected in commodity prices only for as long as the inflation/growth pressures remain. This means that to realise the full benefit of commodities as an inflation hedge, investors must be able to time their entry into and exit from the position or accept a persistent return drag because of a lower Sharpe ratio¹⁸ for commodities than for US and international equities¹⁹.

FIGURE II-16 (CONTINUED)

Commodities are not an investor's only tool to fight inflation

b. Commodity returns are sensitive to growth and inflation but can decay quickly after a shock



Notes: The figure shows the impact of a shock to inflation and the Vanguard leading economic indicator (VLEI) on nominal commodity returns over time, based on the distribution of return outcomes from the VCMM derived from 10,000 simulations. The solid lines correspond to the median forecast and the shaded area highlights the range from the 25th to the 75th percentile after a shock of the given persistence. The turquoise line and area show the impact of a persistent shock increasing annualised inflation over years 1–3 by one standard deviation and increasing VLEI in years 1–3 by 0.5 standard deviation. The yellow line and area show the impact of a temporary shock increasing inflation in year 1 by one standard deviation and increasing VLEI in year 1 by 0.5 standard deviation. The red dotted line shows the baseline forecast without any additional shocks. See the Appendix section titled "Indices for VCMM simulations" for further details on asset classes.

Source: Vanguard calculations, as at 30 September 2022.

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 modelled asset class. Simulations as at 30 September 2022. Results from the model may vary with each use and over time.

¹⁸ 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. Based on the VCMM median return and volatility forecasts for US and global ex-US equities, cash and commodities in Figure II-5a and Figure II-9a, global ex-US equities have the highest expected Sharpe ratio (0.24), followed by US equities (0.10) and commodities (0.02).

¹⁹ Based on the VCMM median return and volatility forecasts for US and global ex-US equities, cash and commodities in Figure II-5a and Figure II-9a, global ex-US equities have the highest expected Sharpe ratio (0.24), followed by US equities (0.10) and commodities (0.02).

A balanced portfolio still offers the best chance of success

The policy response to higher and more persistent inflation and the subsequent repricing of risk in global capital markets has led to a dramatic shift in our time-varying asset allocation (TVAA) outlook. The TVAA looks to harvest the risk premia for which we think there is modest return predictability based on the VCMM. It leverages the Vanguard Asset Allocation Model (VAAM) to optimise a portfolio that maximises end-of-period wealth with a penalty for dispersion of outcomes based on our 10-year return forecasts (Aliaga-Díaz et al., 2022). **Figure II-17** shows the optimal TVAA portfolio, based on our current outlook, versus its policy benchmark, which is a 60% stock/40% bond portfolio.

TVAA methodology is appropriate for investors who are willing to take on active risk in the form of “model forecast risk”. For investors whose objectives and risk tolerances make it prudent to consider adjusting their asset allocations when market conditions materially change, the VAAM, combined with time-varying VCMM asset returns, provides a consistent and holistic way to analyse the trade-offs in time-varying portfolio solutions.

The TVAA portfolio targets the same risk profile as the traditional benchmark portfolio, with the flexibility to deviate from the benchmark based on the Vanguard projected outlook. The global interest rate tightening cycle in 2022 has raised our expected bond return forecasts by more than the equity market sell-off has raised expected

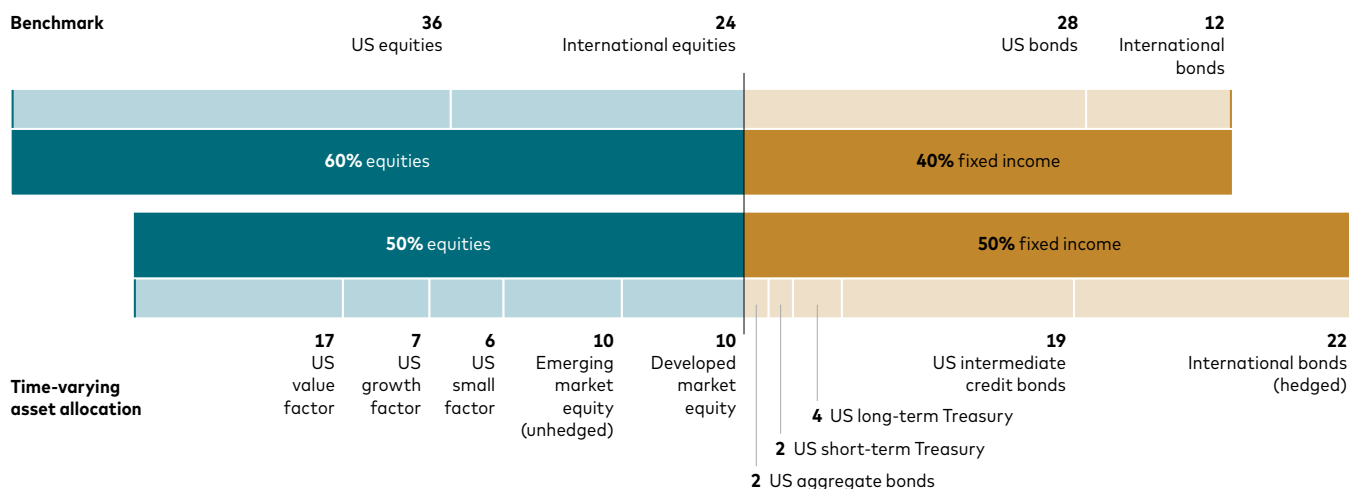
equity returns. Higher bond returns and lower equity returns have reduced the equity risk premium. This is reflected in the TVAA portfolio with a 10-percentage-point decrease in the equity allocation, which is a meaningful derisking move.

This TVAA strategy breaks down the major asset class into smaller sub-assets to provide additional portfolio tilt benefits. On the domestic equity front, we see a tilt toward the value factor given favourable risk and return characteristics. Within international equities, there is an equal allocation to emerging markets and developed (ex-US) markets given emerging markets' lower correlation with US equities. On the domestic fixed income side, the portfolio is tilted toward credit given the time diversification benefits we outlined earlier in this section and the higher expected returns in **Figures II-5a** and **II-9a**.

In short, the TVAA portfolio is inclined towards reducing equity risk because of the compressed equity risk premium and reallocating it toward fixed income with a credit tilt. This results in a lower volatility for the TVAA portfolio while producing expected returns similar to those of the 60/40 benchmark (**Figure II-18**). Although the expected Sharpe ratio and maximum drawdown of the time-varying portfolio are better than that of the benchmark 60/40 portfolio, this comes at the expense of active risk (that is, tracking error to the benchmark) of 2.3%, which translates to a 51% probability of underperforming the benchmark in any given year.

FIGURE II-17

A more attractive risk/return trade-off means our time-varying asset allocation framework favours bonds and emerging markets



Notes: Time-varying portfolio allocations were determined by the VAAM. The assets under consideration were US and non-US equities and fixed income, in addition to real estate investment trusts (REITs), US high-yield corporate bonds and emerging-market equity, which were used to illustrate time-varying allocation not only within equities versus fixed income but also within sub-asset classes. See "Indices for VCMM simulations" in the Appendix for additional details on asset class indices. Maximum home-bias constraint of 60% was applied for US equities and 70% was applied for US fixed income. Allocation to non-US equities would have been higher had there been no home-bias constraint, given its higher expected return. VCMM 10-year projections as at September 2022 were used. The sum of individual sub-asset class allocations may not total 100% because of rounding.

Source: Vanguard calculations, as at 30 September 2022.

FIGURE II-18

We expect a similar return with lower volatility from our time-varying portfolio

	September 2022	
	TVAA	Benchmark
Equity allocation	50%	60%
10-year expected annualised total return	6.4%	6.4%
10-year expected annualised volatility	9.4%	10.3%
10-year expected Sharpe ratio	0.25	0.24
10-year expected maximum drawdown	-7.7%	-9.2%
Excess return to the benchmark	0%	—
Tracking error to the benchmark	2.3%	—
Probability of underperformance relative to benchmark in any given year	51.0%	—

Notes: Vanguard calculations are based on portfolios optimised by the VAAM, using return projections from the VCMM. 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.

Source: Vanguard calculations, as at 30 September 2022.

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 modelled asset class. Simulations as at 30 September 2022. Results from the model may vary with each use and over time.

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III. Appendix

About the 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.

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 US and international equity markets, several maturities of the US Treasury and corporate fixed income markets, international fixed income markets, US money markets, commodities and certain alternative investment strategies. The theoretical and empirical foundation for the Vanguard Capital Markets Model 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 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.

The primary value of the VCMM is in its application to analysing potential client portfolios. VCMM asset-class forecasts – comprising distributions of expected returns, volatilities and correlations – are key to the evaluation of potential downside risks, various risk–return trade-offs and the diversification benefits of various asset classes. Although central tendencies are generated in any return distribution, Vanguard stresses that focusing on the full range of potential outcomes for the assets considered, such as the data presented in this paper, is the most effective way to use VCMM output. We encourage readers interested in more details of the VCMM to read Vanguard's white paper (Davis et al., 2014).

The VCMM seeks to represent the uncertainty in the forecast by generating a wide range of potential outcomes. It is important to recognise that the VCMM does not impose "normality" on the return distributions, but rather is influenced by the so-called fat tails and skewness in the empirical distribution of modelled asset-class returns. Within the range of outcomes, individual experiences can be quite different, underscoring the varied nature of potential future paths. Indeed, this is a key reason why we approach asset-return outlooks in a distributional framework.

Indices for VCMM simulations

The long-term returns of our hypothetical portfolios are based on data for the appropriate market indices to 30 September 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 indices are as follows:

- **US equities:** MSCI US Broad Market Index.
- **Global ex-US equities:** MSCI All Country World ex-USA Index.
- **US REITs:** FTSE/NAREIT US Real Estate Index.
- **US cash:** US 3-Month Treasury – constant maturity.
- **US Treasury bonds:** Bloomberg US Treasury Index.
- **US short-term Treasury bonds:** Bloomberg US 1–5 Year Treasury Bond Index.
- **US long-term Treasury bonds:** Bloomberg US Long Treasury Bond Index.
- **US credit bonds:** Bloomberg US Credit Bond Index.
- **US short-term credit bonds:** Bloomberg US 1–3 Year Credit Bond Index.
- **US high-yield corporate bonds:** Bloomberg US High Yield Corporate Bond Index.
- **US bonds:** Bloomberg US Aggregate Bond Index.
- **Global ex-US bonds:** Bloomberg Global Aggregate ex-USD Index.
- **US TIPS:** Bloomberg US Treasury Inflation Protected Securities Index.
- **US short-term TIPS:** Bloomberg US 1–5 Year Treasury Inflation Protected Securities Index.
- **Emerging-market sovereign bonds:** Bloomberg Emerging Markets USD Aggregate Bond Index.
- **Commodities:** Bloomberg Commodity Index.
- **Mortgage-backed securities (MBS):** Bloomberg US Mortgage Backed Securities Index.

All equity indices below are weighted by market capitalisation:

- **Small-cap equities:** Stocks with a market cap in the lowest two-thirds of the Russell 3000 Index.
- **Large-cap equities:** Stocks with a market cap in the highest one-third of the Russell 1000 Index.
- **Growth equities:** Stocks with a price/book ratio in the highest one-third of the Russell 1000 Index.
- **Value equities:** Stocks with a price/book ratio in the lowest one-third of the Russell 1000 Index.

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Investment risk information

The value of investments, and the income from them, may fall or rise and investors may get back less than they invested.

Past performance is not a reliable indicator of future results.

Any projections should be regarded as hypothetical in nature and do not reflect or guarantee future results.

Some funds invest in emerging markets which can be more volatile than more established markets. As a result the value of your investment may rise or fall.

Investments in smaller companies may be more volatile than investments in well-established blue chip companies.

Funds investing in fixed interest securities carry the risk of default on repayment and erosion of the capital value of your investment and the level of income may fluctuate. Movements in interest rates are likely to affect the capital value of fixed interest securities. Corporate bonds may provide higher yields but as such may carry greater credit risk increasing the risk of default on repayment and erosion of the capital value of your investment. The level of income may fluctuate and movements in interest rates are likely to affect the capital value of bonds.

Important information

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ISGVEMO 122022