



2024 Board of Trustees Retreat

March 19-20, 2024

*The Westin Richmond
6631 West Broad Street
Richmond, Virginia 23230*



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Virginia Retirement System Board of Trustees Retreat

March 19-20, 2024

Westin Richmond Hotel ♦ Chesapeake Salon: A & B

Tuesday, March 19

3:00 p.m. Welcome & Opening Remarks
A. Scott Andrews – Virginia Retirement System
Chairman, Board of Trustees

Patricia Bishop - Virginia Retirement System
Director

Andrew Junkin - Virginia Retirement System
Chief Investment Officer

3:15 p.m. Macro/Economic Overview
David Lebovitz - JP Morgan
Global Market Strategist

4:05 p.m. Portfolio Resilience
Karen Karniol-Tambour - Bridgewater
Co-Chief investment Officer

4:55 p.m. Day 1 Closing Remarks
Andrew Junkin, Chief Investment Officer; VRS

5:00 p.m. Reception – Sponsored by BNY Mellon
Chesapeake Foyer

6:00 p.m. Buffet Dinner – Chesapeake Salon C

Welcome & Remarks
A. Scott Andrews – Virginia Retirement System
Chairman, Board of Trustees

Guest Speaker: Artificial Intelligence
Gregory Bond - Man Numeric
Chief Executive Officer



Virginia
Retirement
System

Welcome

A. Scott Andrews
Chairman, VRS Board of Trustees





Virginia
Retirement
System

Welcome

Patricia S. Bishop
Director, VRS





Virginia
Retirement
System

Welcome

Andrew Junkin

Chief Investment Officer, VRS

Virginia Retirement System
1200 East Main Street



Guest Speaker: Macro/Economic Overview

David Lebovitz

Global Market Strategist,
JP Morgan



David Lebovitz ● Global Market Strategist

JP Morgan



David Lebovitz, Managing Director, is a Global Strategist on the Multi-Asset Solutions Strategy Team, based in New York. In this role, he works to establish the broad asset allocation framework that is reflected across portfolios managed by the team globally. Previously, David was a member of the J.P. Morgan Global Market Insights Strategy Team, where he was responsible for delivering timely market and economic insights to clients across the country. David has appeared on both Bloomberg TV and CNBC and is often quoted in the financial press.

David joined J.P. Morgan in 2010; prior to joining the firm, he was a Research Analyst at Kobren Insight Management. David obtained a B.A. in Political Science and Philosophy, with a concentration in Leadership Studies, from Williams College in 2009. He earned a dual-MBA degree from Columbia University and London Business School in 2015.



Making sense of a mixed picture: A Guide to the Markets

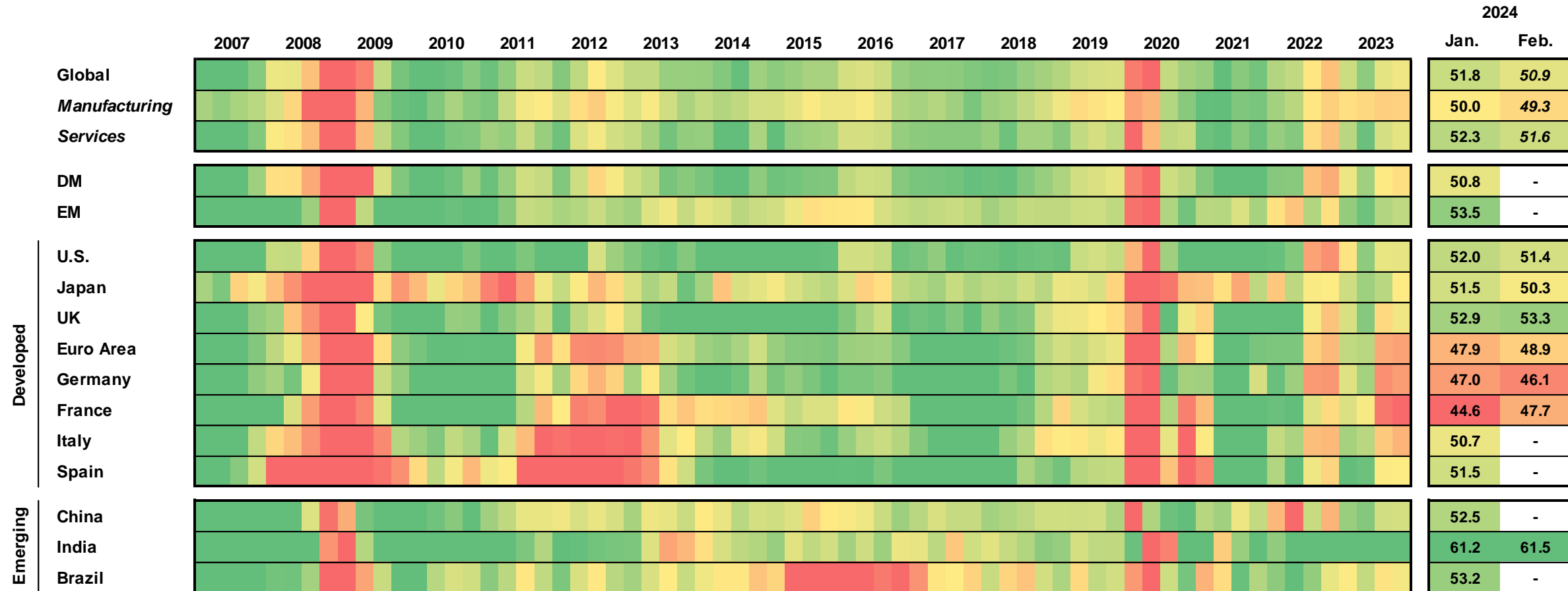
David Lebovitz, Global Strategist, Multi-Asset Solutions
J.P. Morgan Asset Management
March 2024





Global growth has room for improvement this year

Global Composite (manufacturing & services combined) Purchasing Managers' Index, quarterly



International

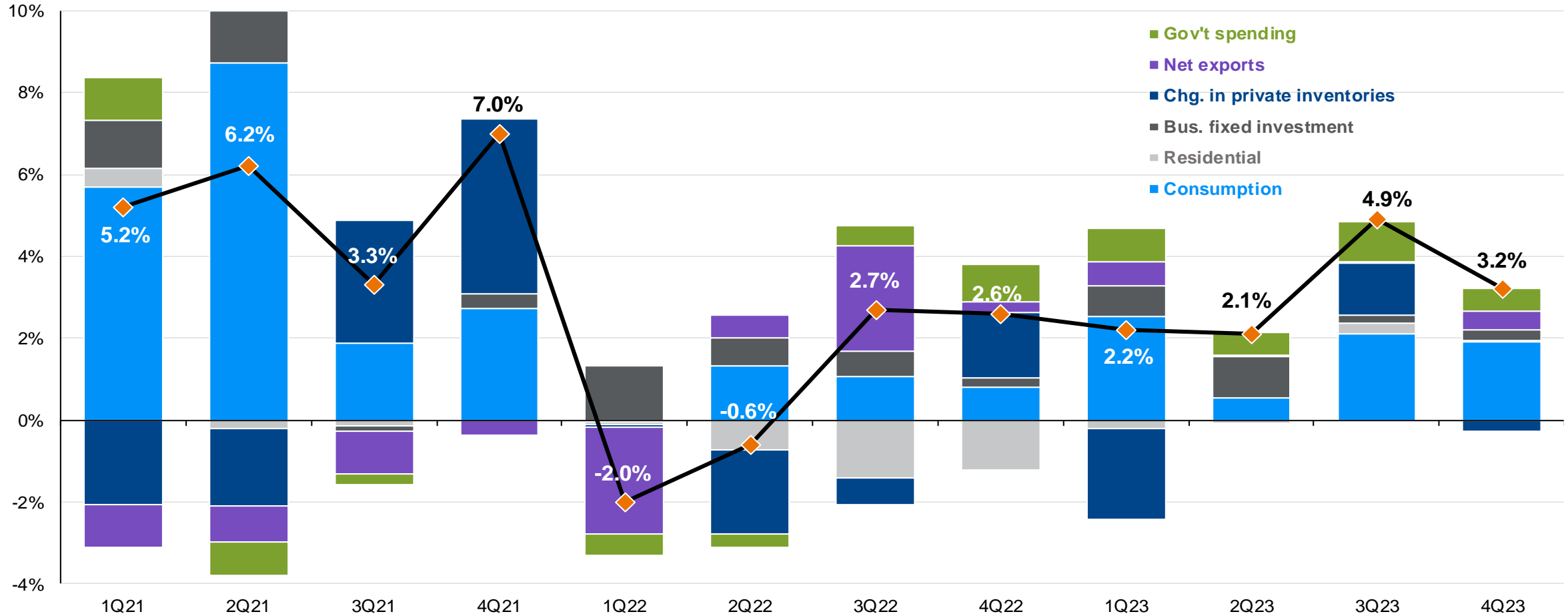
Source: J.P. Morgan Economic Research, Standard & Poor's, italicized figures are estimates by J.P. Morgan Asset Management. The Composite PMI includes both manufacturing and services sub-indices. The Global, Manufacturing and Services figures for December are estimates by J.P. Morgan Asset Management. Heatmap colors are based on PMI relative to the 50 level, which indicates acceleration or deceleration of the sector, for the time period shown. Heatmap is based on quarterly averages, except for the two most recent figures, which are single month readings. Data for the U.S. are back-tested and filled in for 2007-2009. Data for Japan are back-tested and filled in for the first two quarters of 2007. DM and EM represent developed markets and emerging markets, respectively. *Guide to the Markets – U.S.* Data are as of February 27, 2024.



Although we expect more trend-like growth in the U.S.

Contributors to real GDP growth

q/q % change, annualized rate



Source: BEA, FactSet, J.P. Morgan Asset Management. Guide to the Markets – U.S. Data are as of February 27, 2024.

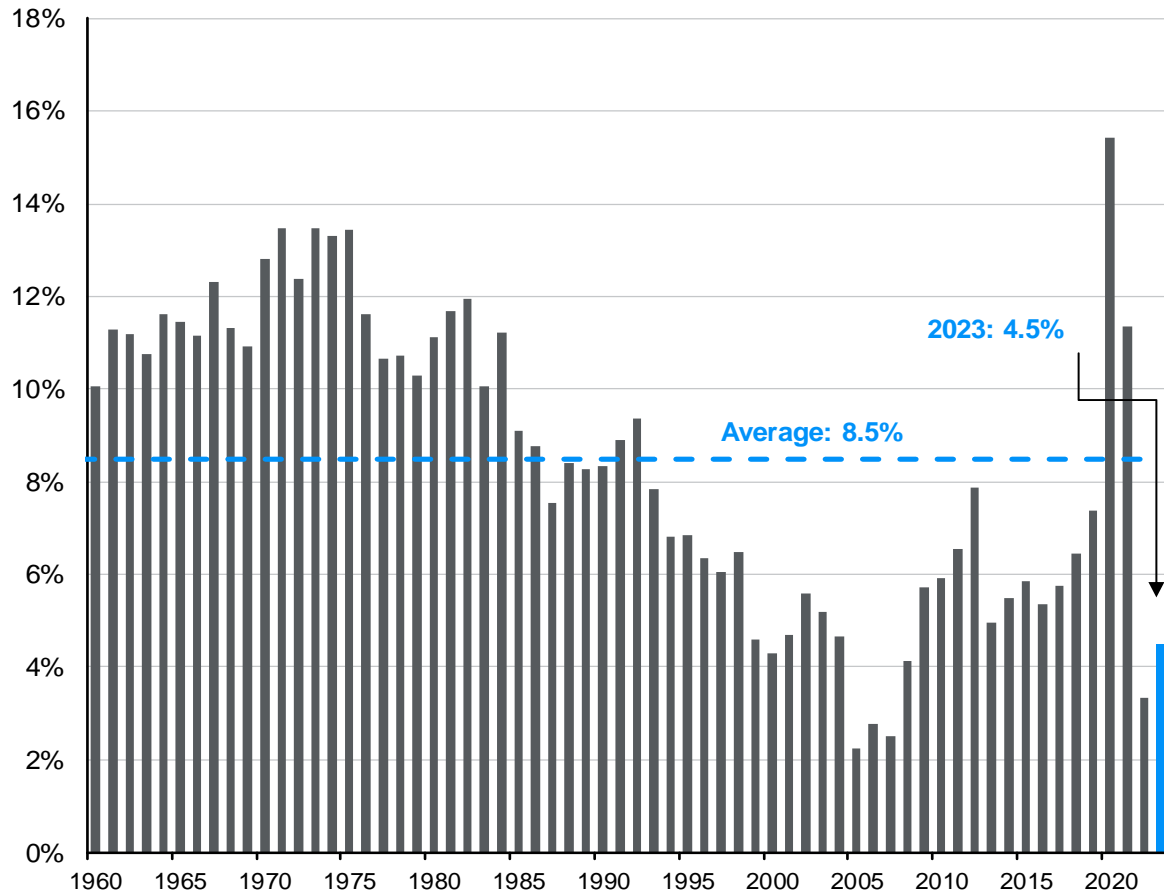


The consumer remains supportive

Economy

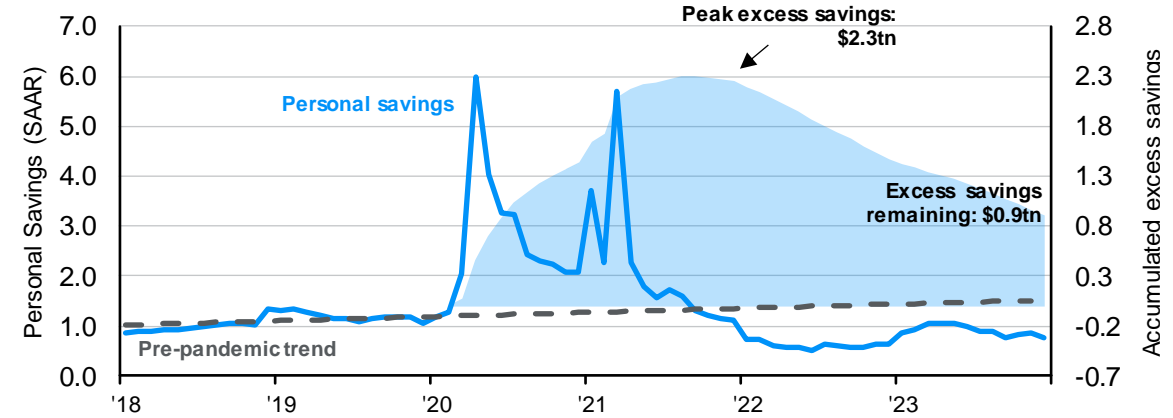
Personal saving rate

Personal savings as a % of disposable personal income, annual



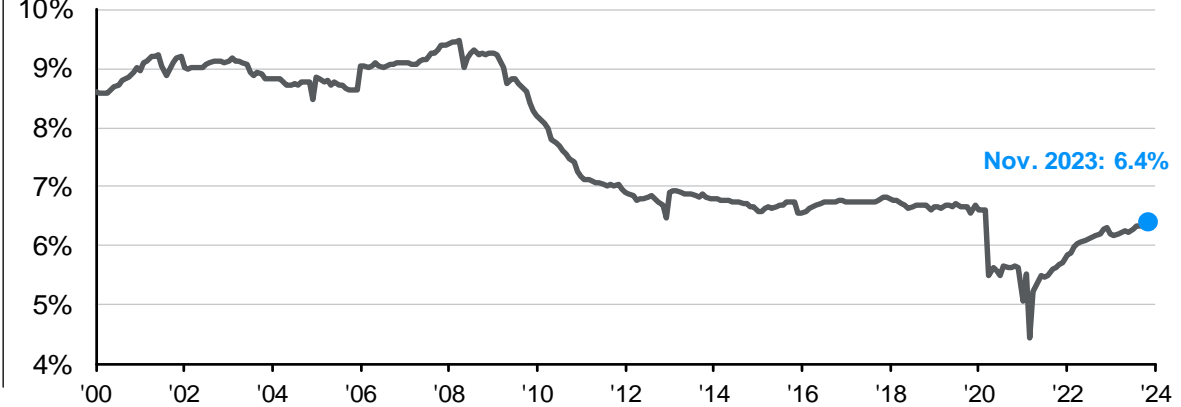
Household excess savings

Trillions of USD



Revolving consumer credit outstanding

% of disposable income, SAAR



Source: BEA, Federal Reserve, J.P. Morgan Asset Management. From March 2020 to August 2021, consumers amassed a peak \$2.3 trillion in excess savings relative to the pre-pandemic trend. Since August 2021, consumers have drawn down on those excess savings, with the remaining reflected in the chart annotation. *Guide to the Markets – U.S.* Data are as of February 5, 2024.

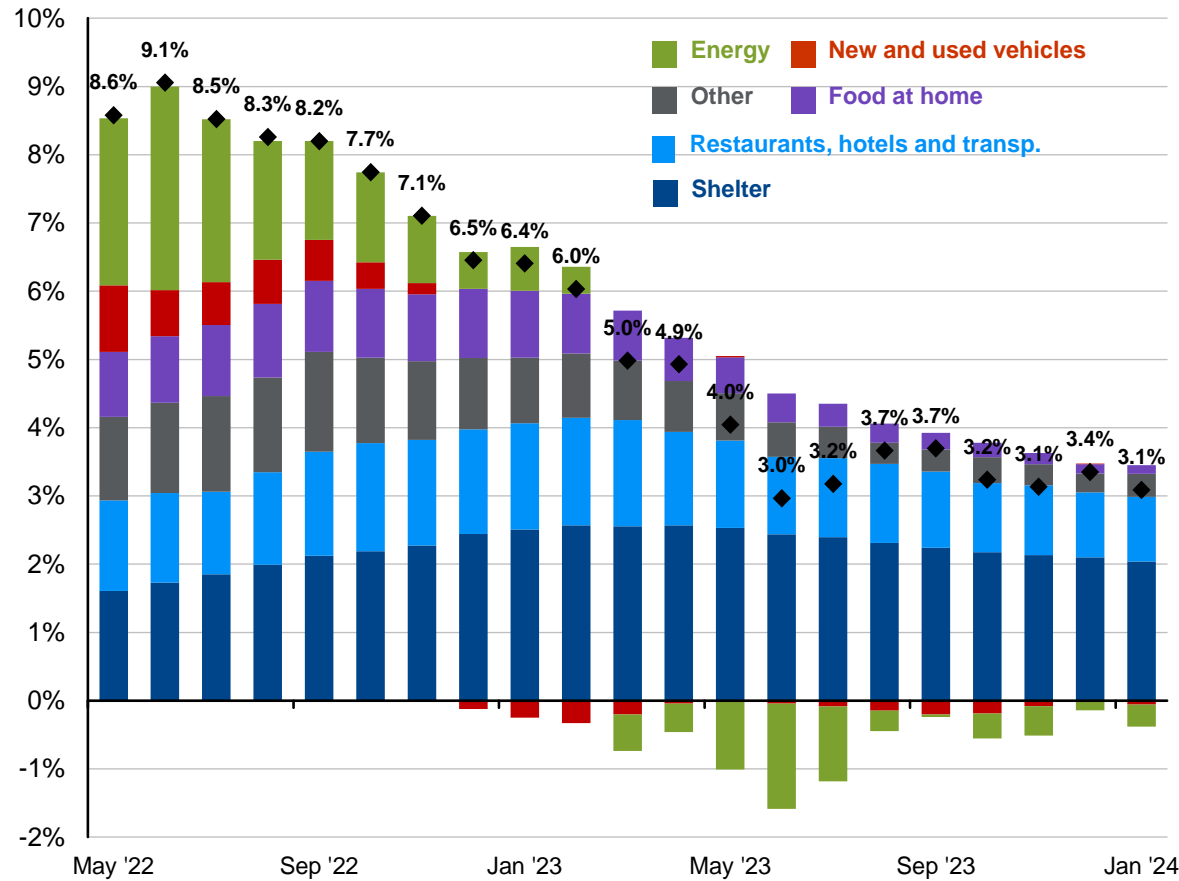


But there are questions about how quickly we will get back to 2%

Economy

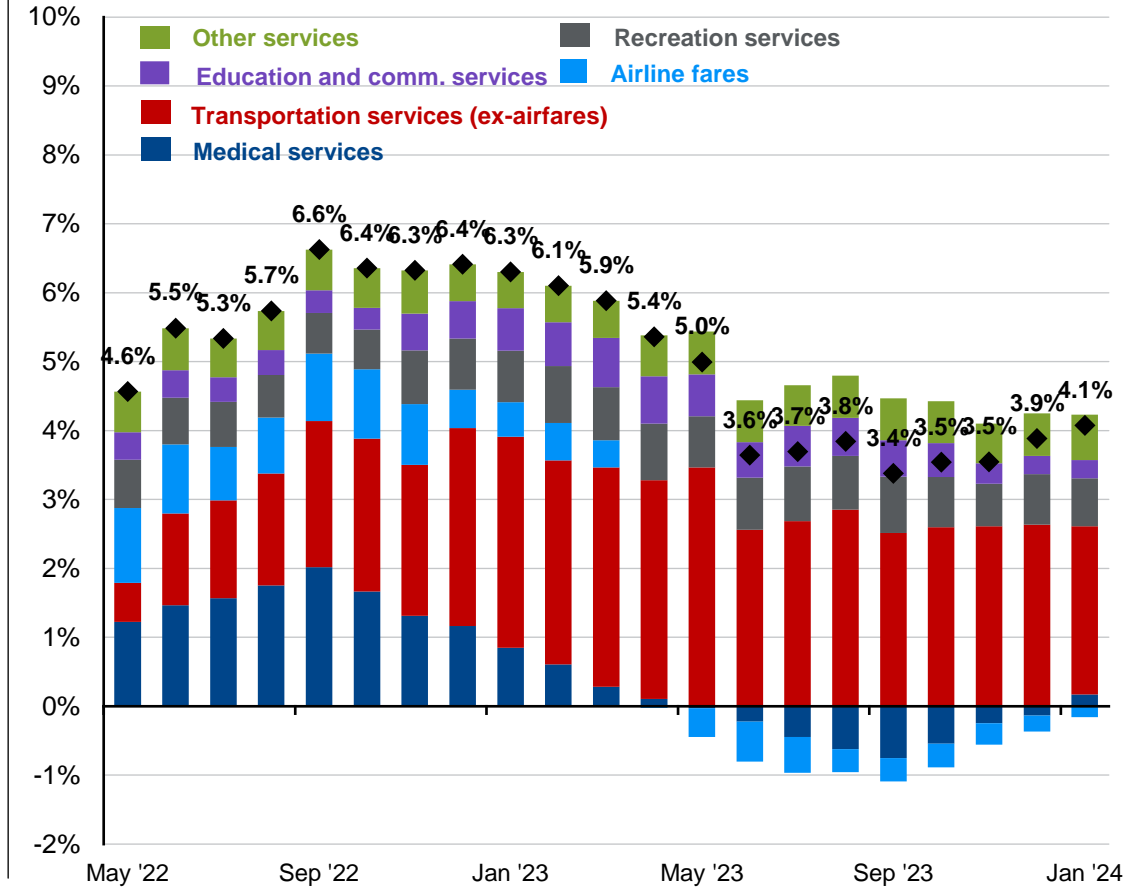
Contributors to headline CPI inflation

Contribution to y/y % change in CPI, non-seasonally adjusted



Contributors to core services ex-shelter CPI inflation*

Contribution to y/y % change in custom CPI index, non-seasonally adj.



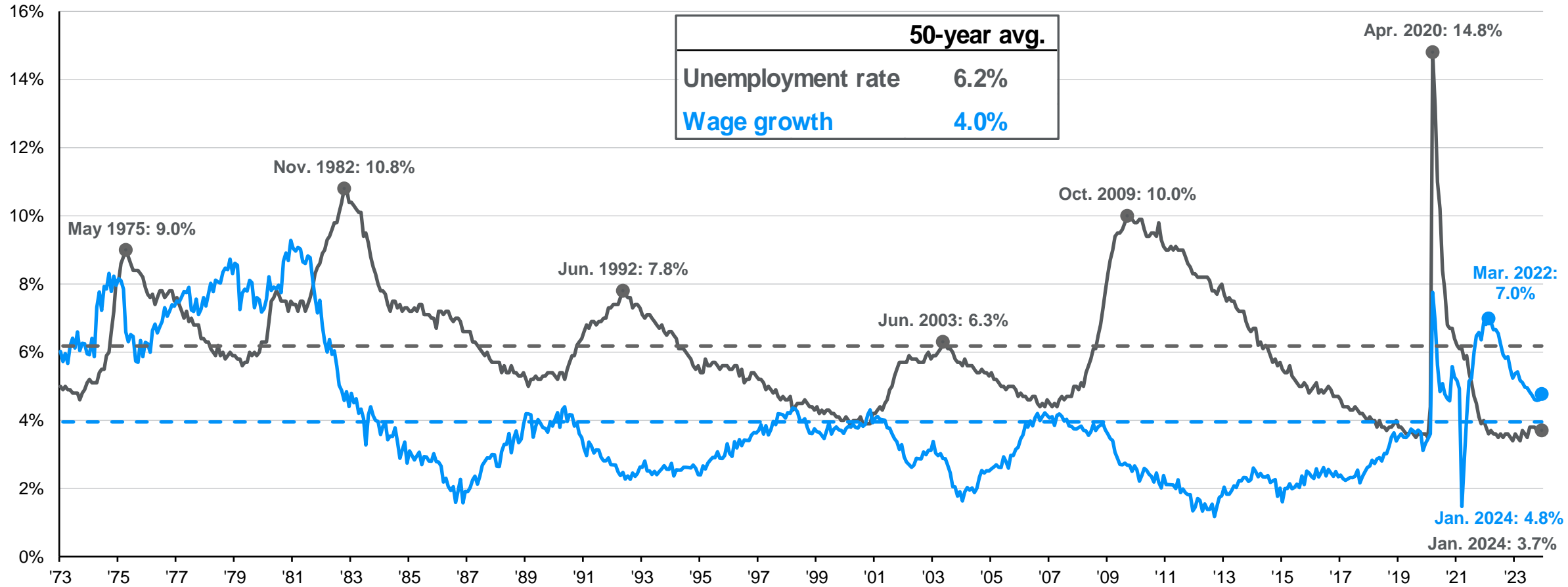
Source: BLS, FactSet, J.P. Morgan Asset Management. Contributions mirror the BLS methodology on Table 7 of the CPI report. Values may not sum to headline CPI figures due to rounding and underlying calculations. *Core services ex-shelter CPI is a custom index using CPI components created by J.P. Morgan Asset Management. (Left) "Shelter" includes owners' equivalent rent and rent of primary residence; "Other" primarily reflects household furnishings, apparel, education and communication services, medical care services and other personal services. (Right) "Transportation services" primarily includes leased cars and trucks, motor vehicle insurance and motor vehicle maintenance and repair. Airline fares are broken out from transportation services. Guide to the Markets – U.S. Data are as of February 27, 2024.



Part of this will be a function of the labor market

Civilian unemployment rate and year-over-year wage growth

Private production and non-supervisory workers, seasonally adjusted, percent



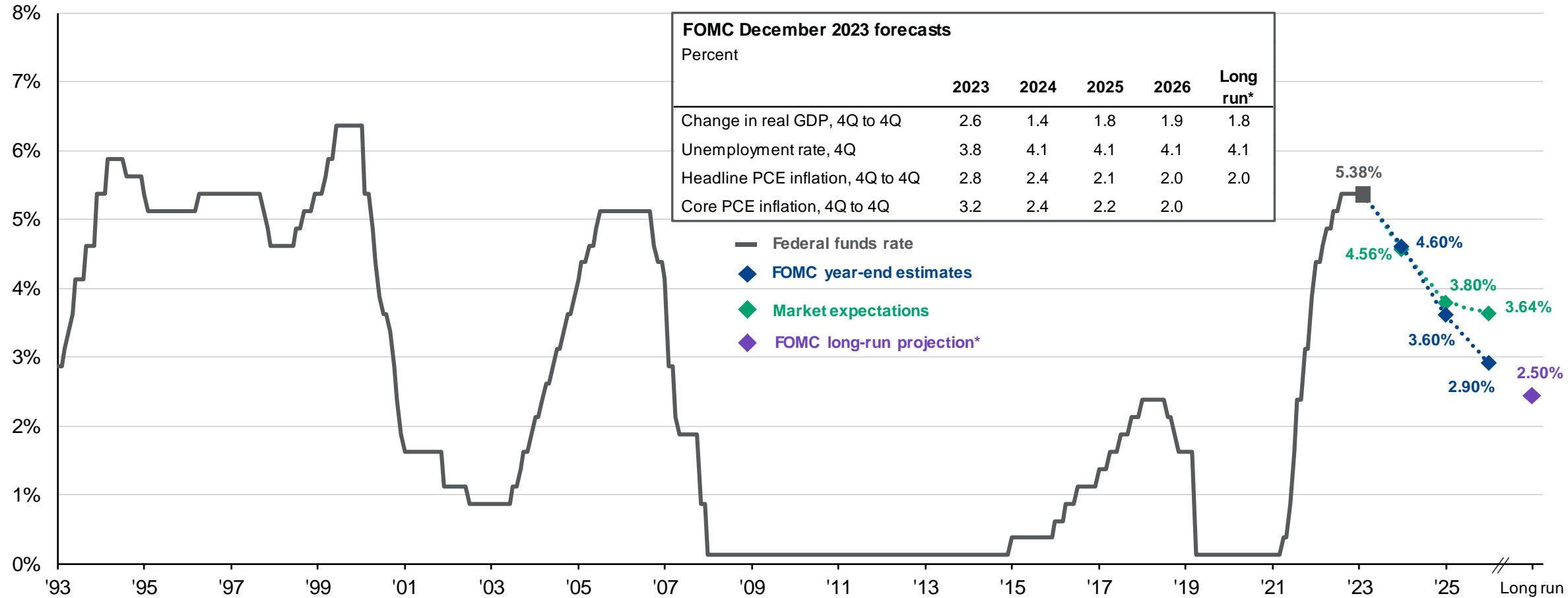
Source: BLS, FactSet, J.P. Morgan Asset Management. Private production and non-supervisory jobs represent just over 80% of total private nonfarm jobs. Guide to the Markets – U.S. Data are as of February 27, 2024.



But we do expect the Fed to cut slowly this year

Federal funds rate expectations

FOMC and market expectations for the federal funds rate



Source: Bloomberg, FactSet, Federal Reserve, J.P. Morgan Asset Management.

Market expectations are based off of USD Overnight Index Swaps. *Long-run projections are the rates of growth, unemployment and inflation to which a policymaker expects the economy to converge over the next five to six years in absence of further shocks and under appropriate monetary policy. Forecasts are not a reliable indicator of future performance. Forecasts, projections and other forward-looking statements are based upon current beliefs and expectations.

They are for illustrative purposes only and serve as an indication of what may occur. Given the inherent uncertainties and risks associated with forecasts, projections or other forward-looking statements, actual events, results or performance may differ materially from those reflected or contemplated.

Guide to the Markets – U.S. Data are as of February 27, 2024.

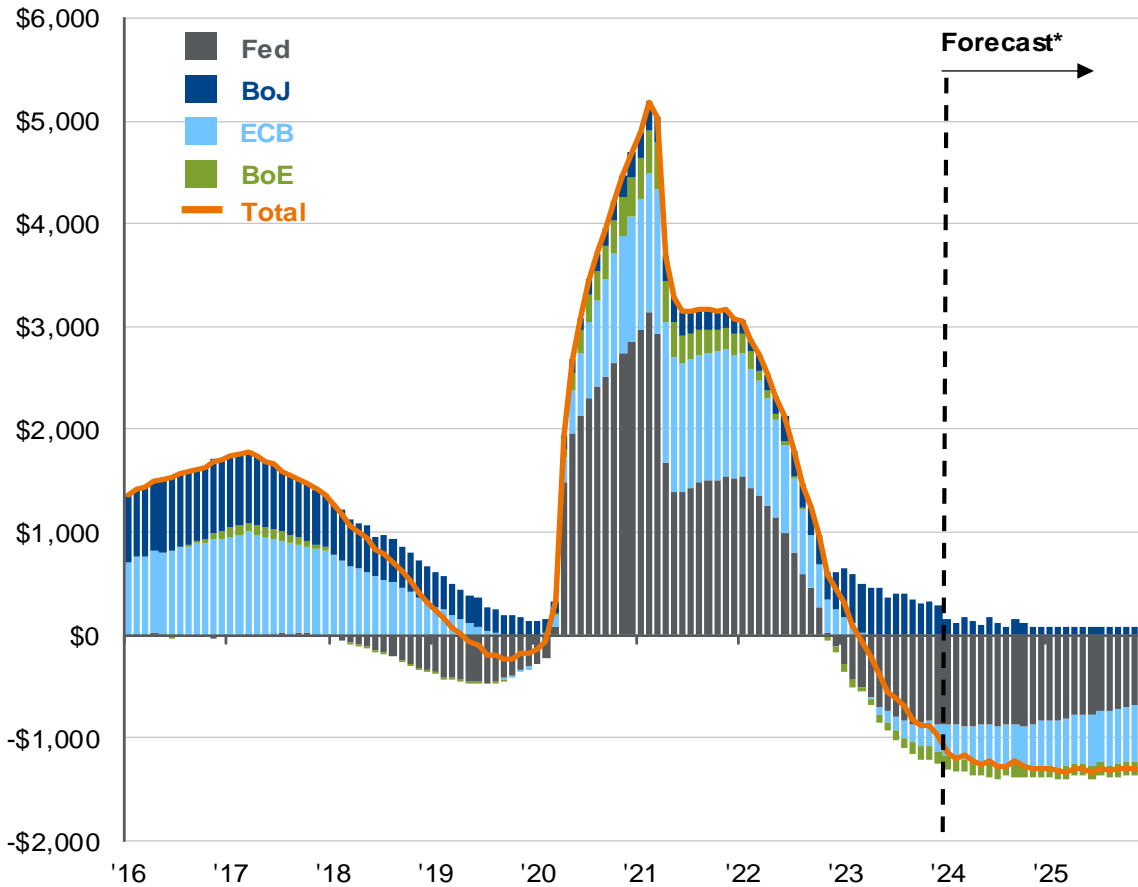


Opening the door for other central banks to follow suit

Fixed Income

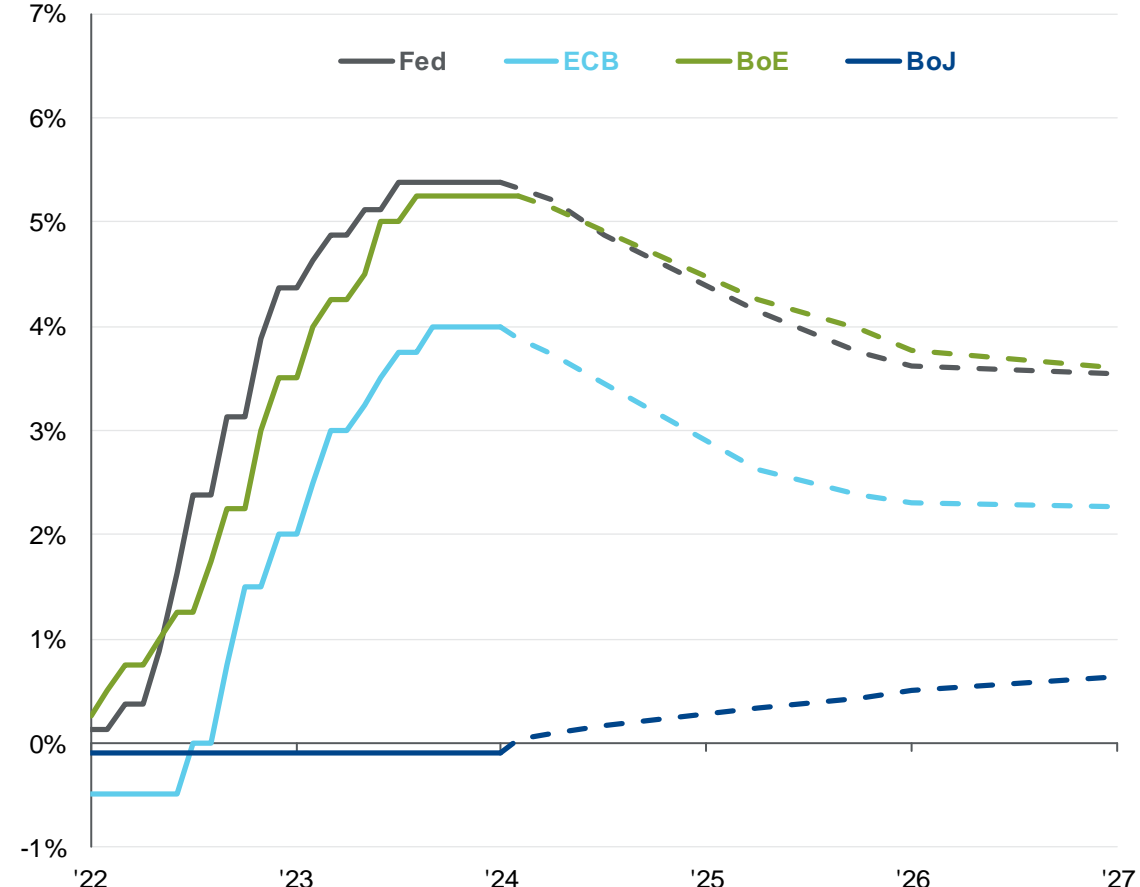
Developed market central bank bond purchases

USD billions, 12-month rolling flow



Historical policy rates and forward curves

Target policy rates and market implied forward rates



Source: BIS, Bloomberg, FactSet, J.P. Morgan Asset Management; (Left) Bank of England (BoE), Bank of Japan (BoJ), European Central Bank (ECB), Federal Reserve System (Fed), J.P. Morgan Global Economic Research. *DM bond purchase forecasts are internal assumptions based on government bond purchases as outlined in the most recent monetary policy announcements from the BoE, BoJ, ECB and Federal Reserve through December 2025. Implied policy rates are sourced from Bloomberg and are derived from Overnight Index Swaps. Forecasts, projections and other forward-looking statements are based upon current beliefs and expectations. They are for illustrative purposes only and are not a reliable indicator of future performance. Given the inherent uncertainties and risks associated with forecasts, projections or other forward-looking statements, actual events, results or performance may differ materially from those reflected or contemplated. *Guide to the Markets* – U.S. Data are as of February 27, 2024.

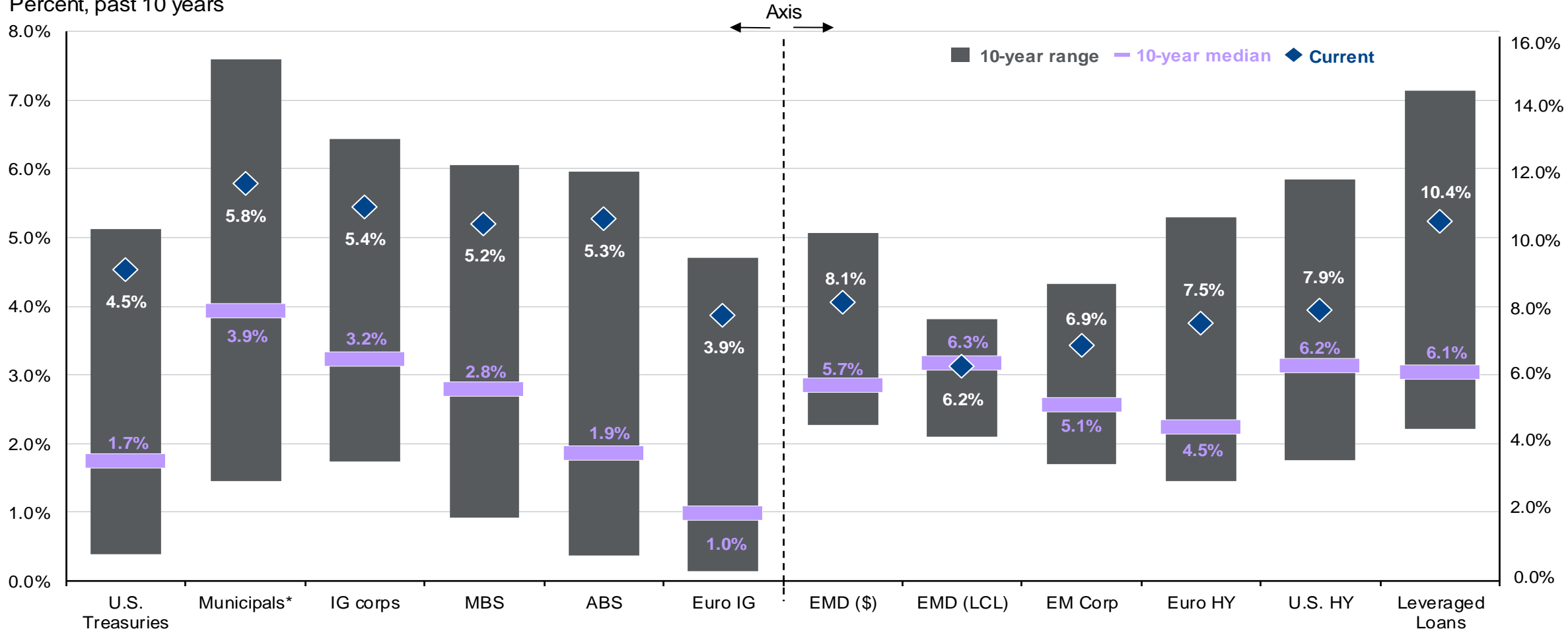


The absolute level of yields remains attractive

Fixed Income

Yield-to-worst across fixed income sectors

Percent, past 10 years



Source: Bloomberg, FactSet, J.P. Morgan Credit Research, J.P. Morgan Asset Management.

Indices used are Bloomberg except for emerging market debt and leveraged loans: EMD (USD): J.P. Morgan EMIGLOBAL Diversified Index; EMD (LCL): J.P. Morgan GBI-EM Global Diversified Index; EM Corp.: J.P. Morgan CEMBI Broad Diversified; Leveraged Loans: JPM Leveraged Loan Index; Euro IG: Bloomberg Euro Aggregate Corporate Index; Euro HY: Bloomberg Pan-European High Yield Index. Yield-to-worst is the lowest possible yield that can be received on a bond apart from the company defaulting and considers factors like call provisions, prepayments and other features that may affect the bonds cash flows. *All sectors shown are yield-to-worst except for Municipals, which is based on the tax-equivalent yield-to-worst assuming a top-income tax bracket rate of 37% plus a Medicare tax rate of 3.8%.

Guide to the Markets – U.S. Data are as of February 27, 2024.

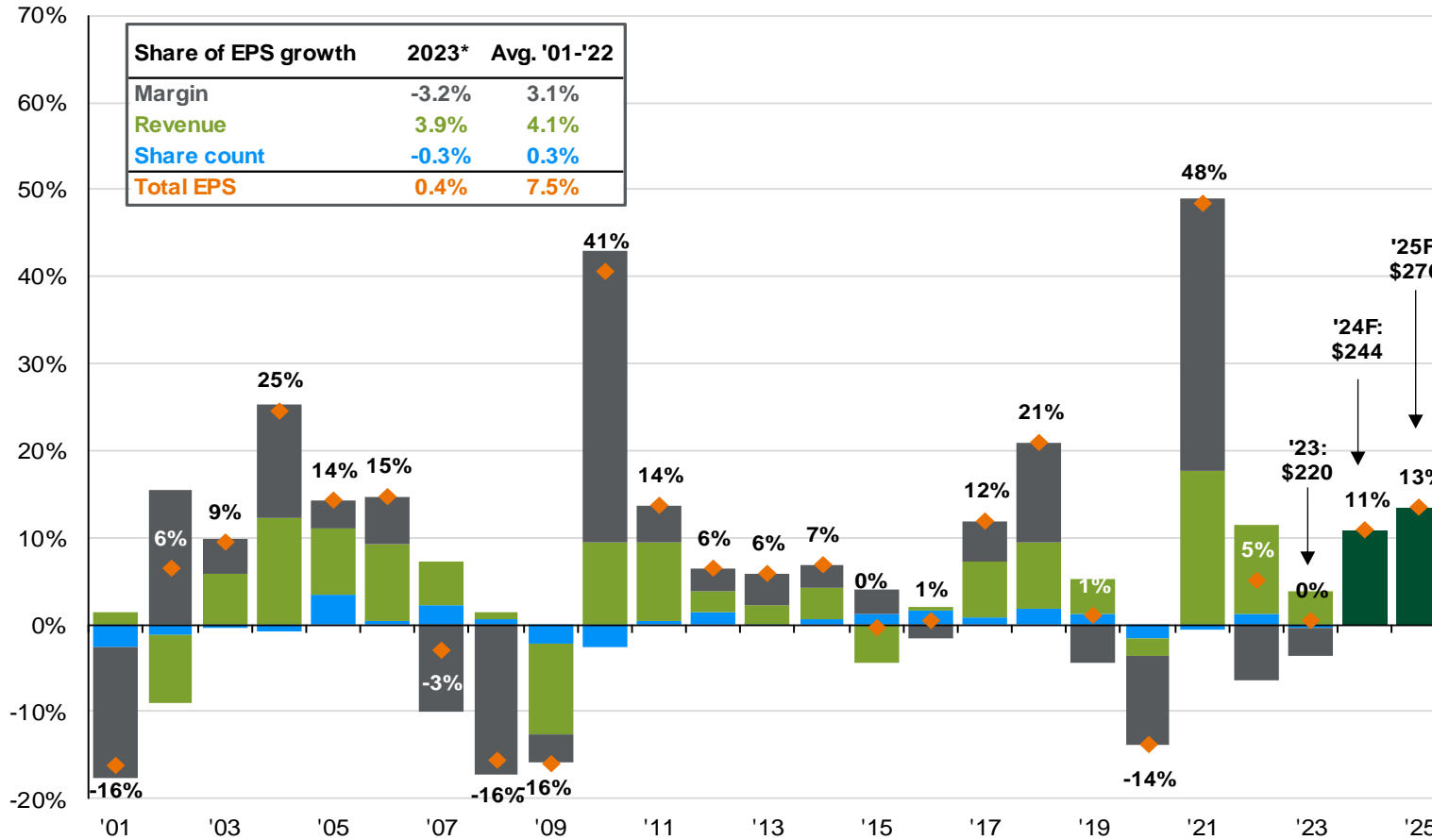


Profit growth will be a function of margins

Equities

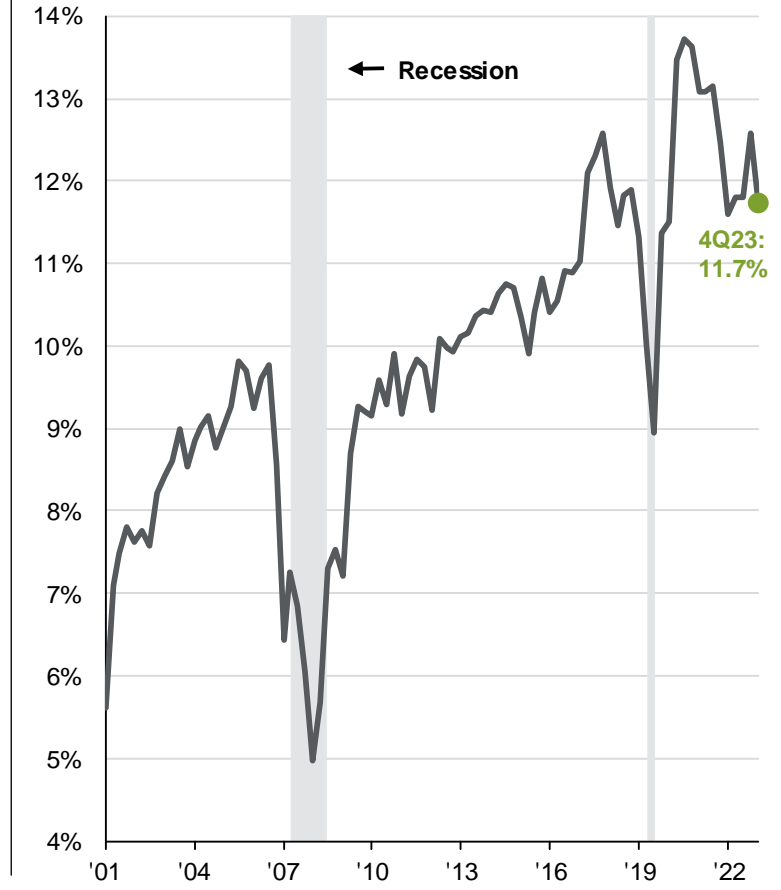
S&P 500 year-over-year pro-forma EPS growth

Annual growth broken into changes in revenue, profit margin and share count



S&P 500 profit margins

Quarterly earnings/sales



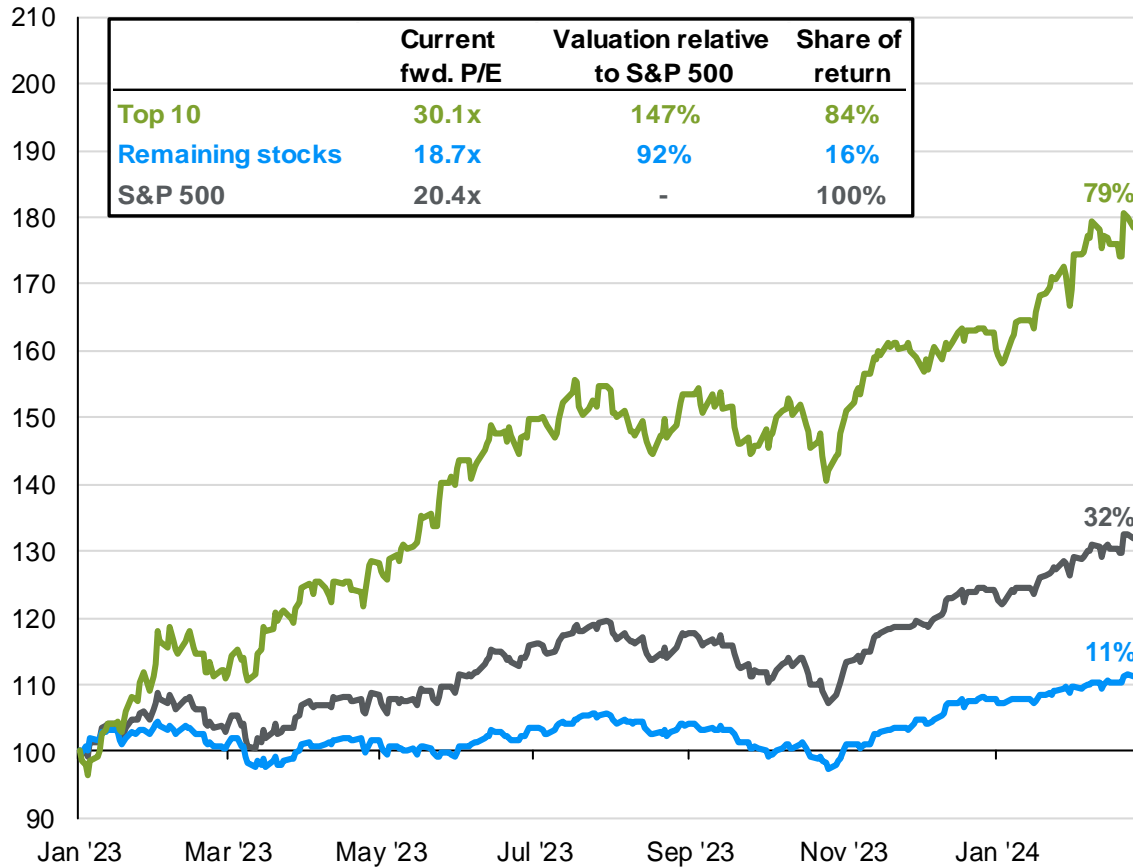
Source: Compustat, FactSet, Standard & Poor's, J.P. Morgan Asset Management.
 Historical EPS levels are based on annual pro-forma earnings per share. 2023 EPS growth is based on actual results and consensus analyst expectations for 4Q23. 2024 and 2025 EPS growth are based on consensus analyst estimates for each calendar year. Past performance is not indicative of future returns.
 Guide to the Markets – U.S. Data are as of February 27, 2024.



How worried should we be about market concentration?

Performance of the top 10 stocks in the S&P 500

Indexed to 100 on 1/1/2023, price return, top 10 held constant



Weight of the top 10 stocks in the S&P 500

% of market capitalization of the S&P 500



Earnings contribution of the top 10 in the S&P 500

Based on last 12 months' earnings



Source: FactSet, Standard & Poor's, J.P. Morgan Asset Management.

(Left) The top 10 companies used for this analysis are held constant and represent the S&P 500's 10 largest index constituents at the start of 2023.

The top 10 stocks are: AAPL, MSFT, AMZN, NVDA, GOOGL, BRK.B, GOOG, META, XOM, UNH, and TSLA. The remaining stocks represent the rest of the 494 companies in the S&P 500. (Right) The top 10 companies used for these two analyses are updated monthly and are based on the 10 largest index constituents at the beginning of each month. As of 12/31/2023, the top 10 companies in the index were AAPL (7.0%), MSFT (6.9%), AMZN (3.5%), NVDA (3.0%), GOOGL (2.1%), META (2.0%), GOOG (1.8%), TSLA (1.8%), BRK.B (1.6%), AVGO (1.2%) and JPM (1.2%).

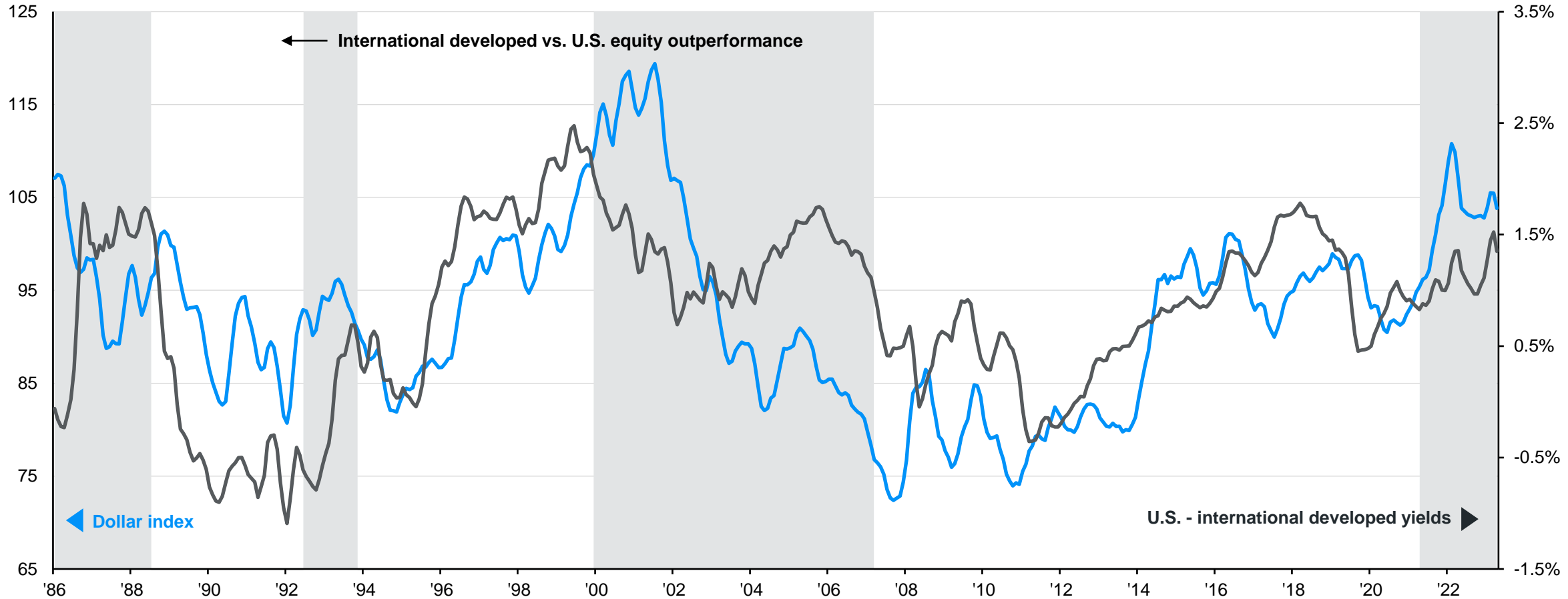
Guide to the Markets – U.S. Data are as of February 27, 2024.



The dollar may remain rangebound this year

U.S. dollar and interest rate differentials

3-month moving average



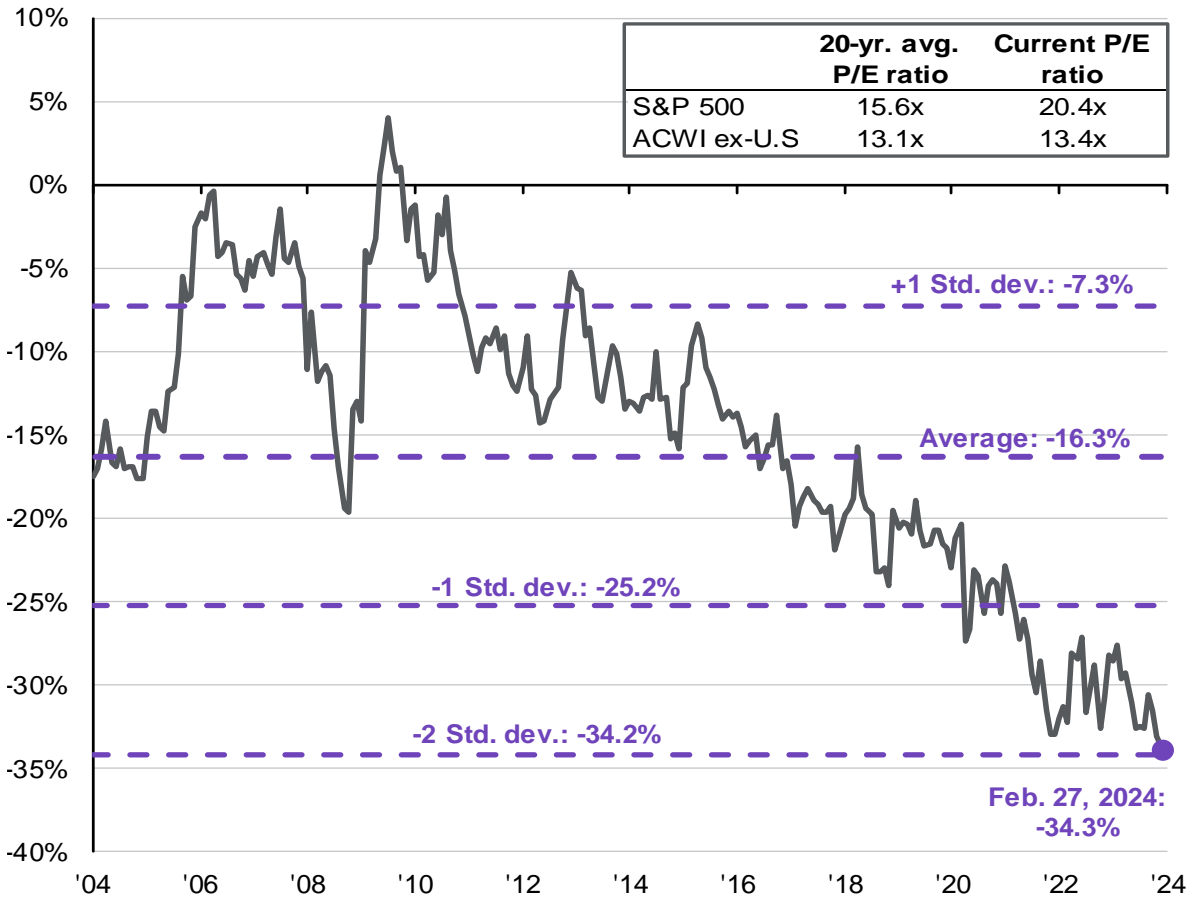
Source: Bank of Canada, FactSet, Federal Reserve Economic Data (FRED), Ministry of Finance of Japan, MSCI, OECD, Standard & Poor's, J.P. Morgan Asset Management. The dollar index (DXY Index) is a nominal trade-weighted index of major trading partners' currencies. Major currencies are the British pound, Canadian dollar, euro, Japanese yen, Swedish kroner and Swiss franc. DM is developed markets, and the yield is calculated as a GDP-weighted average of the 10-year government bond yields of Australia, Canada, France, Germany, Italy, Japan, Switzerland and the UK. DM ex. U.S. = MSCI EAFE Index, U.S. = S&P 500 Index. Past performance is not a reliable indicator of current and future results.
 Guide to the Markets – U.S. Data are as of February 27, 2024.



International equities still look cheap, but need a catalyst

International: Price-to-earnings discount vs. U.S.

MSCI All Country World ex-U.S. vs. S&P 500, next 12 months



International: Difference in dividend yields vs. U.S.

MSCI All Country World ex-U.S. minus S&P 500, next 12 months



International

Source: FactSet, MSCI, Standard & Poor's, J.P. Morgan Asset Management. Guide to the Markets – U.S. Data are as of February 27, 2024.

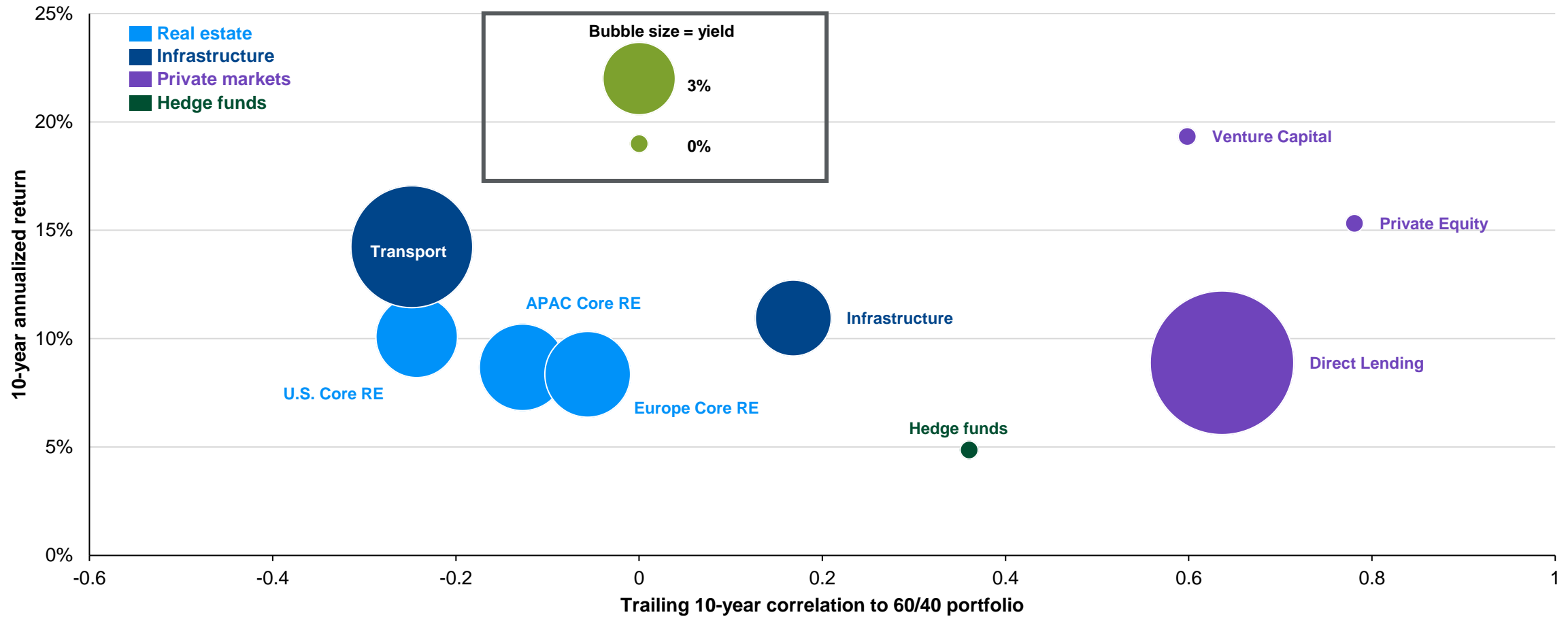


Alternatives continue to offer income, alpha, and diversification

Alternatives

Correlations, returns and yields

10-year correlations and 10-year annualized total returns, quarterly, 2013-2022



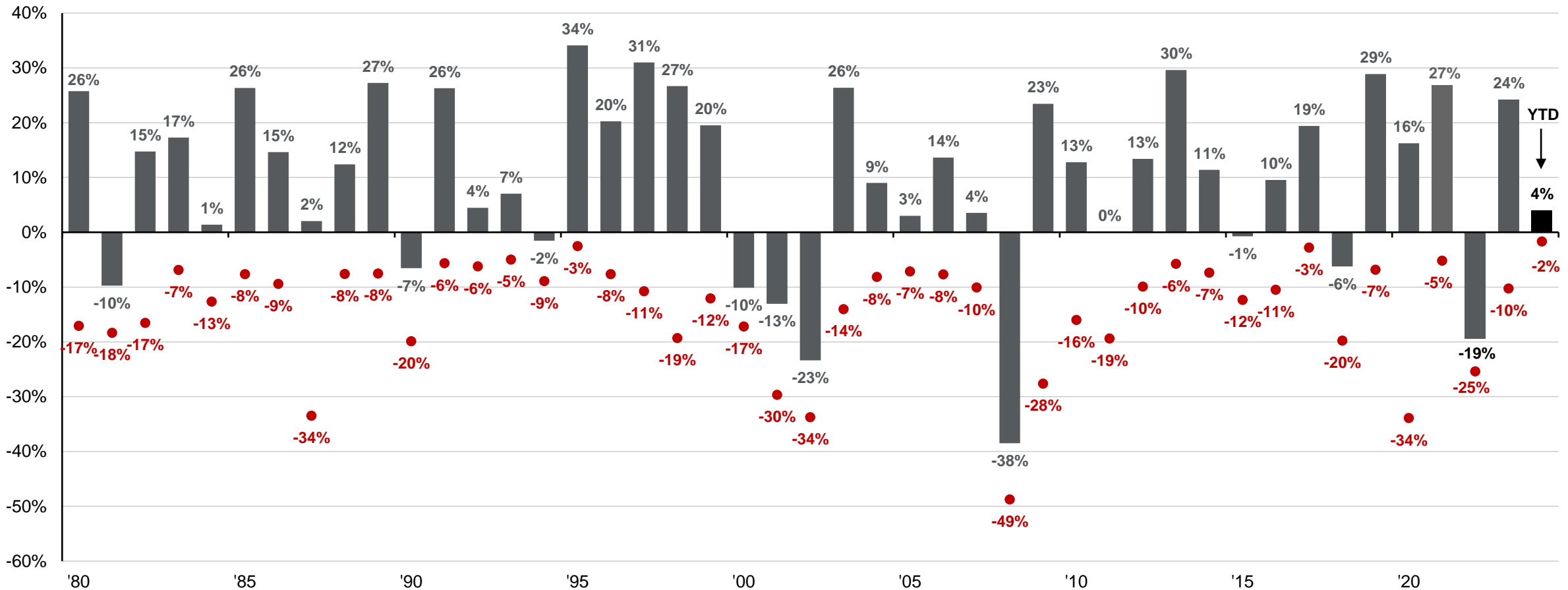
Source: Burgiss, Cliffwater, Gilberto-Levy, HFRI, MSCI, NCREIF, FactSet, J.P. Morgan Asset Management. Correlations are based on quarterly returns over the past 10 years through 2022. A 60/40 portfolio is comprised of 60% stocks and 40% bonds. Stocks are represented by the S&P 500 Total Return Index. Bonds are represented by the Bloomberg U.S. Aggregate Total Return Index. 10-year annualized returns are calculated from 2013 – 2022. Indices and data used for alternative asset class returns and yields are as described on pages 8,9, and 11 of the *Guide to Alternatives*. Yields are based on latest available data as described on page 8 of the *Guide to Alternatives*. This slide comes from our [Guide to Alternatives](#). *Guide to the Markets – U.S.* Data are as of February 27, 2024.



Volatility is normal and should be expected

S&P intra-year declines vs. calendar year returns

Despite average intra-year drops of 14.2%, annual returns were positive in 33 of 44 years



Source: FactSet, Standard & Poor's, J.P. Morgan Asset Management.

Returns are based on price index only and do not include dividends. Intra-year drops refers to the largest market drops from a peak to a trough during the year. For illustrative purposes only. Returns shown are calendar year returns from 1980 to 2023, over which time period the average annual return was 9.0%.

Guide to the Markets – U.S. Data are as of February 5, 2024.

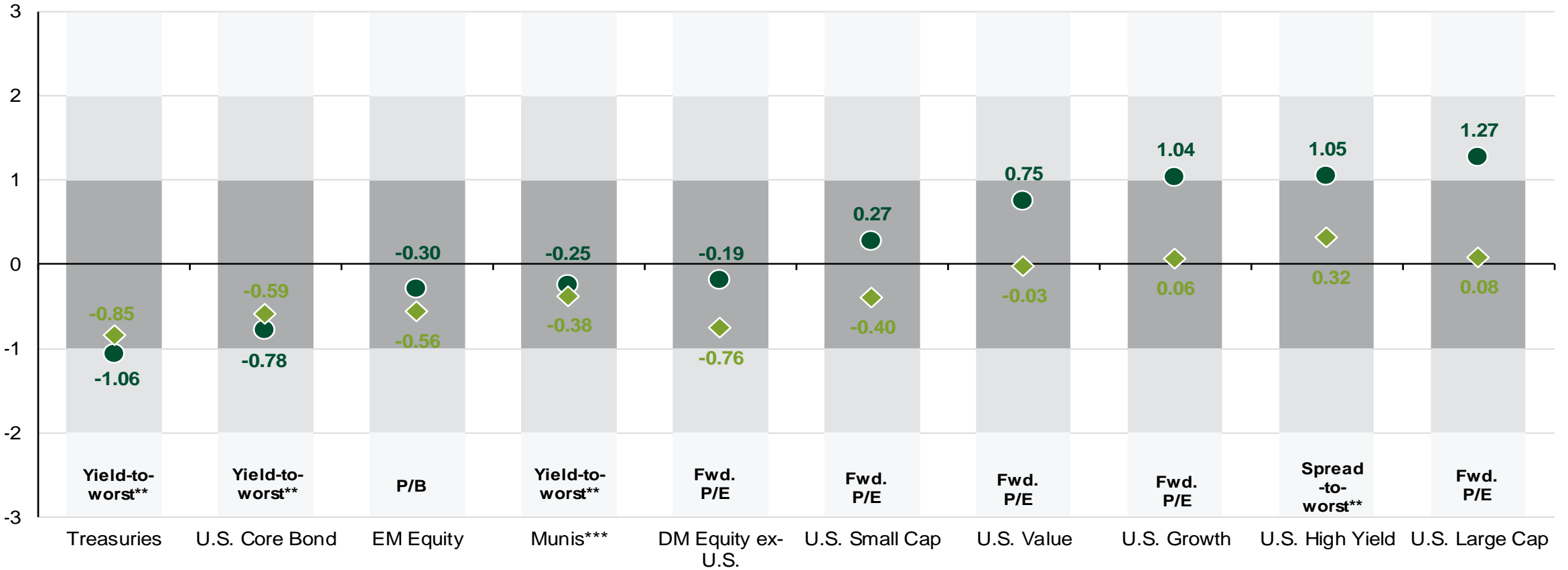


And the valuation picture remains mixed

Asset class valuations

Z-scores based on 25-year average valuation measures*

◆ December 31, 2022 ● Current



Source: Bloomberg, BLS, CME, FactSet, MSCI, Russell, Standard & Poor's, J.P. Morgan Asset Management.
 U.S. Large Cap: S&P 500, U.S. Small Cap: Russell 2000, EM Equity: MSCI EME, DM Equity: MSCI EAFE, U.S. Value: Russell 1000 Value, U.S. Growth: Russell 1000 Growth, U.S. High Yield: J.P. Morgan Domestic High Yield Index, U.S. Core Bond: Bloomberg US Aggregate, Treasuries: Bloomberg U.S. Aggregate Government – Treasury, Munis: Bloomberg Municipal Bond. *Averages for U.S. High Yield and U.S. Small Cap are since January 1999 and November 1998, respectively, due to limited data availability. **Yield-to-worst and spread-to-worst are inversely related to fixed income prices. ***Munis yield-to-worst is based on the tax-equivalent yield-to-worst assuming a top-income tax bracket rate of 37% plus a Medicare tax rate of 3.8%.
 Guide to the Markets – U.S. Data are as of February 27, 2024.



J.P. Morgan Asset Management – Index definitions

GTM

U.S.

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All indexes are unmanaged and an individual cannot invest directly in an index. Index returns do not include fees or expenses.

Equities:

The **Dow Jones Industrial Average** is a price-weighted average of 30 actively traded blue-chip U.S. stocks.

The **MSCI ACWI (All Country World Index)** is a free float-adjusted market capitalization weighted index that is designed to measure the equity market performance of developed and emerging markets.

The **MSCI EAFE Index (Europe, Australasia, Far East)** is a free float-adjusted market capitalization index that is designed to measure the equity market performance of developed markets, excluding the US & Canada.

The **MSCI Emerging Markets Index** is a free float-adjusted market capitalization index that is designed to measure equity market performance in the global emerging markets.

The **MSCI Europe Index** is a free float-adjusted market capitalization index that is designed to measure developed market equity performance in Europe.

The **MSCI Pacific Index** is a free float-adjusted market capitalization index that is designed to measure equity market performance in the Pacific region.

The **Russell 1000 Index**® measures the performance of the 1,000 largest companies in the Russell 3000.

The **Russell 1000 Growth Index**® measures the performance of those Russell 1000 companies with higher price-to-book ratios and higher forecasted growth values.

The **Russell 1000 Value Index**® measures the performance of those Russell 1000 companies with lower price-to-book ratios and lower forecasted growth values.

The **Russell 2000 Index**® measures the performance of the 2,000 smallest companies in the Russell 3000 Index.

The **Russell 2000 Growth Index**® measures the performance of those Russell 2000 companies with higher price-to-book ratios and higher forecasted growth values.

The **Russell 2000 Value Index**® measures the performance of those Russell 2000 companies with lower price-to-book ratios and lower forecasted growth values.

The **Russell 3000 Index**® measures the performance of the 3,000 largest U.S. companies based on total market capitalization.

The **Russell Midcap Index**® measures the performance of the 800 smallest companies in the Russell 1000 Index.

The **Russell Midcap Growth Index**® measures the performance of those Russell Midcap companies with higher price-to-book ratios and higher forecasted growth values. The stocks are also members of the Russell 1000 Growth index.

The **Russell Midcap Value Index**® measures the performance of those Russell Midcap companies with lower price-to-book ratios and lower forecasted growth values. The stocks are also members of the Russell 1000 Value index.

The **S&P 500 Index** is widely regarded as the best single gauge of the U.S. equities market. The index includes a representative sample of 500 leading companies in leading industries of the U.S. economy. The **S&P 500 Index** focuses on the large-cap segment of the market; however, since it includes a significant portion of the total value of the market, it also represents the market.

Fixed income:

The **Bloomberg 1-3 Month U.S. Treasury Bill Index** includes all publicly issued zero-coupon US Treasury Bills that have a remaining maturity of less than 3 months and more than 1 month, are rated investment grade, and have \$250 million or more of outstanding face value. In addition, the securities must be denominated in U.S. dollars and must be fixed rate and non convertible.

The **Bloomberg Global High Yield Index** is a multi-currency flagship measure of the global high yield debt market. The index represents the union of the US High Yield, the Pan-European High Yield, and Emerging Markets (EM) Hard Currency High Yield Indices. The high yield and emerging markets sub-components are mutually exclusive. Until January 1, 2011, the index also included CMBS high yield securities.

The **Bloomberg Municipal Index**: consists of a broad selection of investment-grade general obligation and revenue bonds of maturities ranging from one year to 30 years. It is an unmanaged index representative of the tax-exempt bond market.

The **Bloomberg US Dollar Floating Rate Note (FRN) Index** provides a measure of the U.S. dollar denominated floating rate note market.

The **Bloomberg US Corporate Investment Grade Index** is an unmanaged index consisting of publicly issued US Corporate and specified foreign debentures and secured notes that are rated investment grade (Baa3/BBB or higher) by at least two ratings agencies, have at least one year to final maturity and have at least \$250 million par amount outstanding. To qualify, bonds must be SEC-registered.

The **Bloomberg US High Yield Index** covers the universe of fixed rate, non-investment grade debt. Eurobonds and debt issues from countries designated as emerging markets (sovereign rating of Baa1/BBB+/BBB+ and below using the middle of Moody's, S&P, and Fitch) are excluded, but Canadian and global bonds (SEC registered) of issuers in non-EMG countries are included.

The **Bloomberg US Mortgage Backed Securities Index** is an unmanaged index that measures the performance of investment grade fixed-rate mortgage backed pass-through securities of GNMA, FNMA and FHLMC.

The **Bloomberg US TIPS Index** consists of Inflation-Protection securities issued by the U.S. Treasury.

The **J.P. Morgan Emerging Market Bond Global Index (EMBI)** includes U.S. dollar denominated Brady bonds, Eurobonds, traded loans and local market debt instruments issued by sovereign and quasi-sovereign entities.

The **J.P. Morgan Domestic High Yield Index** is designed to mirror the investable universe of the U.S. dollar domestic high yield corporate debt market.

The **J.P. Morgan Corporate Emerging Markets Bond Index Broad Diversified (CEMBI Broad Diversified)** is an expansion of the **J.P. Morgan Corporate Emerging Markets Bond Index (CEMBI)**. The CEMBI is a market capitalization weighted index consisting of U.S. dollar denominated emerging market corporate bonds.

The **J.P. Morgan Emerging Markets Bond Index Global Diversified (EMBI Global Diversified)** tracks total returns for U.S. dollar-denominated debt instruments issued by emerging market sovereign and quasi-sovereign entities: Brady bonds, loans, Eurobonds. The index limits the exposure of some of the larger countries.

The **J.P. Morgan GBI EM Global Diversified** tracks the performance of local currency debt issued by emerging market governments, whose debt is accessible by most of the international investor base.

The **U.S. Treasury Index** is a component of the U.S. Government index.



J.P. Morgan Asset Management – Definitions

GTM

U.S.

70

Other asset classes:

The **Alerian MLP Index** is a composite of the 50 most prominent energy Master Limited Partnerships (MLPs) that provides investors with an unbiased, comprehensive benchmark for the asset class.

The **Bloomberg Commodity Index** and related sub-indices are composed of futures contracts on physical commodities and represents twenty two separate commodities traded on U.S. exchanges, with the exception of aluminum, nickel, and zinc

The **Cambridge Associates U.S. Global Buyout and Growth Index**[®] is based on data compiled from 1,768 global (U.S. & ex –U.S.) buyout and growth equity funds, including fully liquidated partnerships, formed between 1986 and 2013.

The **CS/Tremont Hedge Fund Index** is compiled by Credit Suisse Tremont Index, LLC. It is an asset-weighted hedge fund index and includes only funds, as opposed to separate accounts. The Index uses the Credit Suisse/Tremont database, which tracks over 4500 funds, and consists only of funds with a minimum of US\$50 million under management, a 12-month track record, and audited financial statements. It is calculated and rebalanced on a monthly basis, and shown net of all performance fees and expenses. It is the exclusive property of Credit Suisse Tremont Index, LLC.

The **HFRI Monthly Indices (HFRI)** are equally weighted performance indexes, utilized by numerous hedge fund managers as a benchmark for their own hedge funds. The HFRI are broken down into 4 main strategies, each with multiple sub strategies. All single-manager HFRI Index constituents are included in the HFRI Fund Weighted Composite, which accounts for over 2200 funds listed on the internal HFR Database.

The **NAREIT EQUITY REIT Index** is designed to provide the most comprehensive assessment of overall industry performance, and includes all tax-qualified real estate investment trusts (REITs) that are listed on the NYSE, the American Stock Exchange or the NASDAQ National Market List.

The **NFI-ODCE**, short for NCREIF Fund Index -Open End Diversified Core Equity, is an index of investment returns reporting on both a historical and current basis the results of 33 open-end commingled funds pursuing a core investment strategy, some of which have performance histories dating back to the 1970s. The NFI-ODCE Index is capitalization-weighted and is reported gross of fees. Measurement is time-weighted.

Definitions:

Investing in **alternative assets** involves higher risks than traditional investments and is suitable only for sophisticated investors. Alternative investments involve greater risks than traditional investments and should not be deemed a complete investment program. They are not tax efficient and an investor should consult with his/her tax advisor prior to investing. Alternative investments have higher fees than traditional investments and they may also be highly leveraged and engage in speculative investment techniques, which can magnify the potential for investment loss or gain. The value of the investment may fall as well as rise and investors may get back less than they invested.

Bonds are subject to interest rate risks. Bond prices generally fall when interest rates rise.

Investments in **commodities** may have greater volatility than investments in traditional securities, particularly if the instruments involve leverage. The value of commodity-linked derivative instruments may be affected by changes in overall market movements, commodity index volatility, changes in interest rates, or factors affecting a particular industry or commodity, such as drought, floods, weather, livestock disease, embargoes, tariffs and international economic, political and regulatory developments. Use of leveraged commodity-linked derivatives creates an opportunity for increased return but, at the same time, creates the possibility for greater loss.

Derivatives may be riskier than other types of investments because they may be more sensitive to changes in economic or market conditions than other types of investments and could result in losses that significantly exceed the original investment. The use of derivatives may not be successful, resulting in investment losses, and the cost of such strategies may reduce investment returns.

Distressed Restructuring Strategies employ an investment process focused on corporate fixed income instruments, primarily on corporate credit instruments of companies trading at significant discounts to their value at issuance or obliged (par value) at maturity as a result of either formal bankruptcy proceeding or financial market perception of near term proceedings.

Investments in **emerging markets** can be more volatile. The normal risks of investing in foreign countries are heightened when investing in emerging markets. In addition, the small size of securities markets and the low trading volume may lead to a lack of liquidity, which leads to increased volatility. Also, emerging markets may not provide adequate legal protection for private or foreign investment or private property.

The price of **equity** securities may rise, or fall because of changes in the broad market or changes in a company's financial condition, sometimes rapidly or unpredictably. These price movements may result from factors affecting individual companies, sectors or industries, or the securities market as a whole, such as changes in economic or political conditions. Equity securities are subject to "stock market risk" meaning that stock prices in general may decline over short or extended periods of time.

Equity market neutral strategies employ sophisticated quantitative techniques of analyzing price data to ascertain information about future price movement and relationships between securities, select securities for purchase and sale. Equity Market Neutral Strategies typically maintain characteristic net equity market exposure no greater than 10% long or short.

Global macro strategies trade a broad range of strategies in which the investment process is predicated on movements in underlying economic variables and the impact these have on equity, fixed income, hard currency and commodity markets.

International investing involves a greater degree of risk and increased volatility. Changes in currency exchange rates and differences in accounting and taxation policies outside the U.S. can raise or lower returns. Some overseas markets may not be as politically and economically stable as the United States and other nations.

There is no guarantee that the use of **long and short positions** will succeed in limiting an investor's exposure to domestic stock market movements, capitalization, sector swings or other risk factors. Using long and short selling strategies may have higher portfolio turnover rates. Short selling involves certain risks, including additional costs associated with covering short positions and a possibility of unlimited loss on certain short sale positions.

Merger arbitrage strategies which employ an investment process primarily focused on opportunities in equity and equity related instruments of companies which are currently engaged in a corporate transaction.

Mid-capitalization investing typically carries more risk than investing in well-established "blue-chip" companies. Historically, mid-cap companies' stock has experienced a greater degree of market volatility than the average stock.

Price to forward earnings is a measure of the price-to-earnings ratio (P/E) using forecasted earnings. **Price to book value** compares a stock's market value to its book value. **Price to cash flow** is a measure of the market's expectations of a firm's future financial health. **Price to dividends** is the ratio of the price of a share on a stock exchange to the dividends per share paid in the previous year, used as a measure of a company's potential as an investment.

Real estate investments may be subject to a higher degree of market risk because of concentration in a specific industry, sector or geographical sector. Real estate investments may be subject to risks including, but not limited to, declines in the value of real estate, risks related to general and economic conditions, changes in the value of the underlying property owned by the trust and defaults by borrower.

Relative Value Strategies maintain positions in which the investment thesis is predicated on realization of a valuation discrepancy in the relationship between multiple securities.

Small-capitalization investing typically carries more risk than investing in well-established "blue-chip" companies since smaller companies generally have a higher risk of failure. Historically, smaller companies' stock has experienced a greater degree of market volatility than the average stock.



J.P. Morgan Asset Management – Risks & disclosures

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The Market Insights program provides comprehensive data and commentary on global markets without reference to products. Designed as a tool to help clients understand the markets and support investment decision-making, the program explores the implications of current economic data and changing market conditions.

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Unless otherwise stated, all data are as of February 27, 2023 or most recently available.

Guide to the Markets – U.S.

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Guest Speaker: Portfolio Resilience

Karen Karniol-Tambour
Co-Chef Investment Officer,
Bridgewater



Karen Karniol-Tambour ● Co-Chief Investment Officer

Bridgewater



Karen Karniol-Tambour is Co-Chief Investment Officer at Bridgewater Associates, responsible for managing the company's investment process. Karen oversees the systemization of Bridgewater's research into trading strategies, manages the development of proprietary investment management models, directs the design and implementation of client investment strategies, and publishes timely market understanding to clients and global policy makers via *Bridgewater's Daily Observations*. She also co-leads the firm's Sustainable Investing efforts, overseeing the design of new investment solutions with both financial and sustainability objectives. Karen joined Bridgewater in 2006 after graduating from Princeton University. She serves on the boards of Search for Common Ground and Seeds of Peace. Karen is a World Economic Forum Young Global Leader, was included in Fortune's "40 Under 40" most influential leaders in business in 2019 and has been named to Barron's list of "Most Influential Women in US Finance" for three years in a row.



Today's Environment and Considerations for Engineering a Resilient Portfolio

March 2024

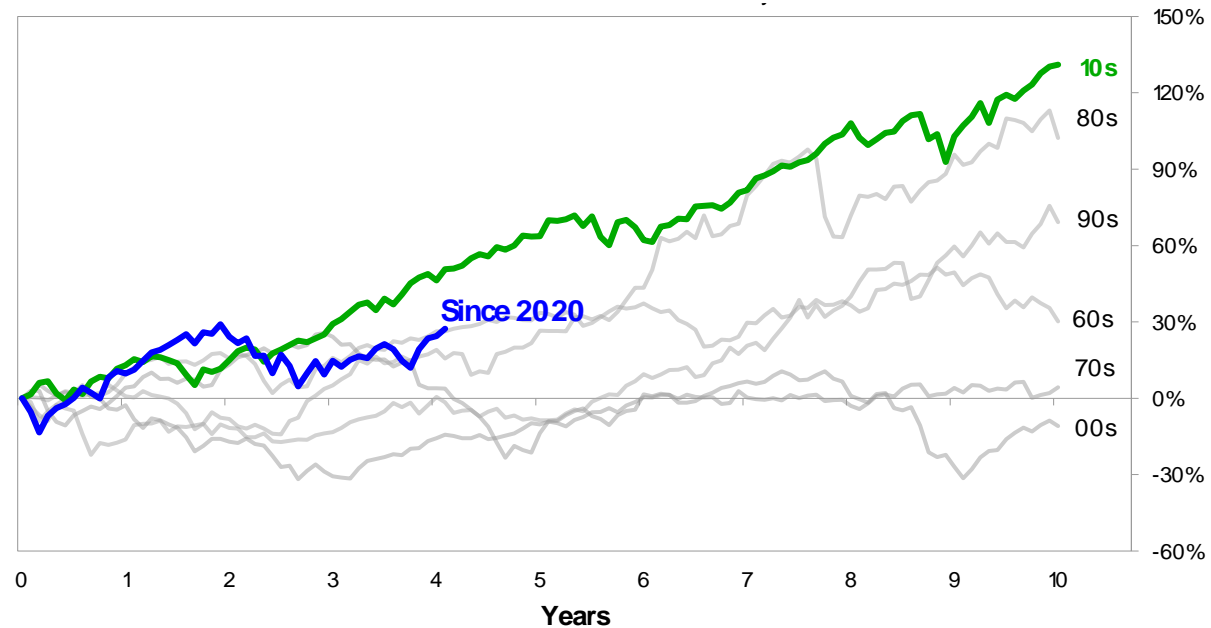
CONTENTS

- I. The Big Picture: An Environment of Secular Change
- II. A Framework for Portfolio Resiliency
- III. Engineering More Resilient Portfolios

**The Big Picture:
Today's Environment is One of Secular Change**

WE ARE COMING OUT OF AN EXCEPTIONALLY FAVORABLE DECADE FOR INVESTORS

Repeat Performance? History Suggests That's Unlikely
Global 70/30 Cumulative Excess Returns by Decade



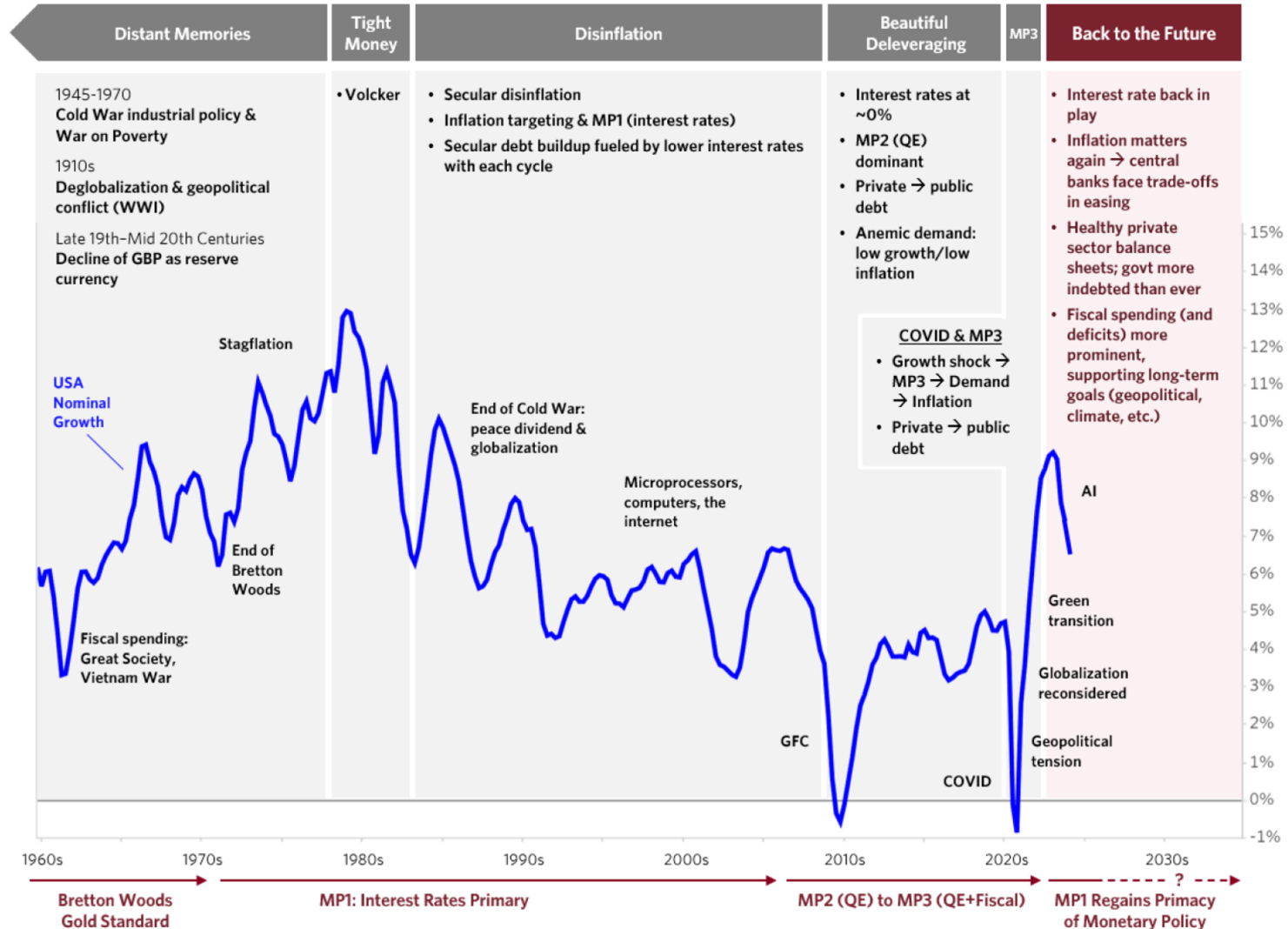
Data as of January 2023. The global 70/30 is comprised of 70% developed world equities and 30% developed world nominal government bonds. Data shown are global 70/30 10-year cumulative excess returns, sampled every 10 years (e.g., January 1960-December 1969, January 1970-December 1979, etc.). Past performance is not indicative of future results. There can be no guarantee that any expected performance can or will be achieved and expected performance should not be solely relied upon in making an investment decision. Please review the "Important Disclosures and Other Information" located at the end of this report.

A REPEAT PERFORMANCE IS UNLIKELY

		1960s	1970s	1980s	1990s	2000s	2010s	2020s
Global 70/ 30 Avg Ann Returns		2.7%	-0.2%	8.1%	5.2%	-1.3%	8.5%	?
Starting Valuations		Normal	Normal	Cheap	Normal	Expensive	Cheap	Expensive
Cyclical Drivers	<i>Growth</i>	Strong	Weak	Strong	Strong	Weak	Steady	Strong (so far)
	<i>Inflation</i>	Rising	High	Falling	Falling	Low	Low	High (so far)
	<i>Fed Policy</i>	Neutral	Tight	Easy	Neutral	Neutral	Easy	Tight (so far)
Secular Drivers	<i>Geopolitical Risks</i>	Elevated	Elevated	Moderate	Low	Elevated	Rising	Elevated
	<i>Increasing Globalization</i>	Neutral	No	Yes	Yes	Yes	Yes	No
	<i>Pro-Business Policy</i>	No	No	Yes	Yes	Yes	Yes	No
	<i>Energy Backdrop</i>	Neutral	Oil Shocks	Efficiency gains	Efficiency gains	Rising prices	Shale	Transition
	<i>Tech Advances</i>	Neutral	Neutral	Manufacturing	Computing	Computing	Internet	AI

As of Mar-2023. The global 70/30 is comprised of 70% developed world equities and 30% developed world nominal government bonds. Past performance is not indicative of future results. There can be no guarantee that any expected performance can or will be achieved and expected performance should not be solely relied upon in making an investment decision. Please review the "Important Disclosures and Other Information" located at the end of this report.

WE'VE TRANSITIONED TO A NEW ERA



THE FUTURE LOOKS SIMILAR TO THE PAST IN SOME WAYS, BUT VERY DIFFERENT IN OTHERS

Looks Like The (Distant) Past...

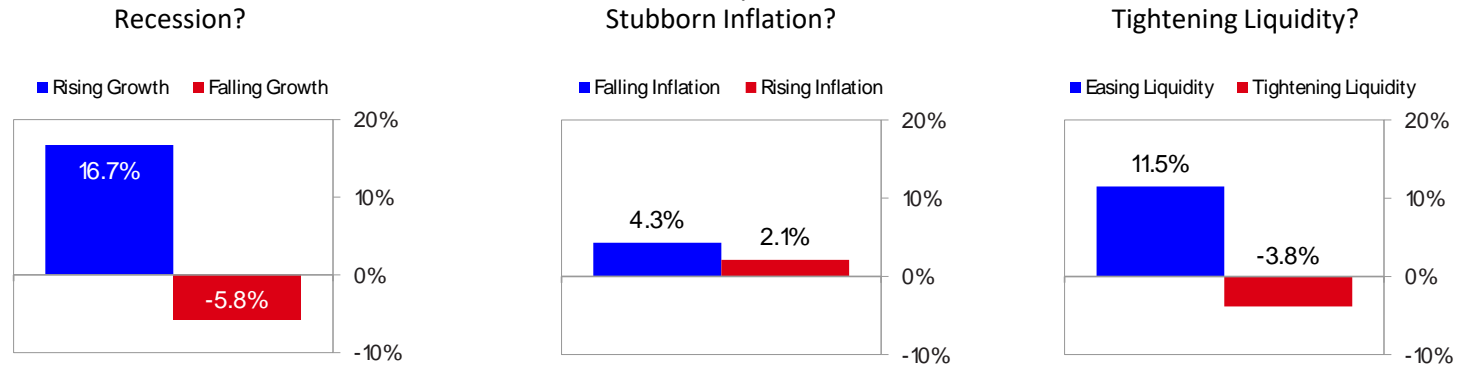
- ✓ Interest rates matter again
- ✓ Inflation no longer a “non-factor”
- ✓ Monetary policy will be slower to ease, quicker to tighten
- ✓ Deleveraging largely behind us, with household balance sheets healthy
- ✓ High geopolitical tensions

Different Than Anything We’ve Experienced...

- ✗ Massive public sector indebtedness outside of wartime
- ✗ US asset dominance in global markets
- ✗ Climate change presenting an unprecedented type of challenge
- ✗ New AI/ML technologies
- ✗ China and the US engaged in strategic competition

...MAKING RESILIENCY IMPORTANT

Is Your Portfolio Resilient to... *Average Annualized Excess Returns of Global Equities in Different Scenarios (Since 1970)*



Performance data as of Feb-2023. Estimates are based on Bridgewater analysis. Past performance is not indicative of future results. Please review the "Important Disclosures and Other Information" located at the end of this presentation.

CHANGING DRIVERS OF RETURN

- ◆ You don't need to make a bold call about the future to be concerned that the drivers of exceptional beta returns may be behind us
- ◆ Cash is positioned to be an important part of returns; alpha will be more needed

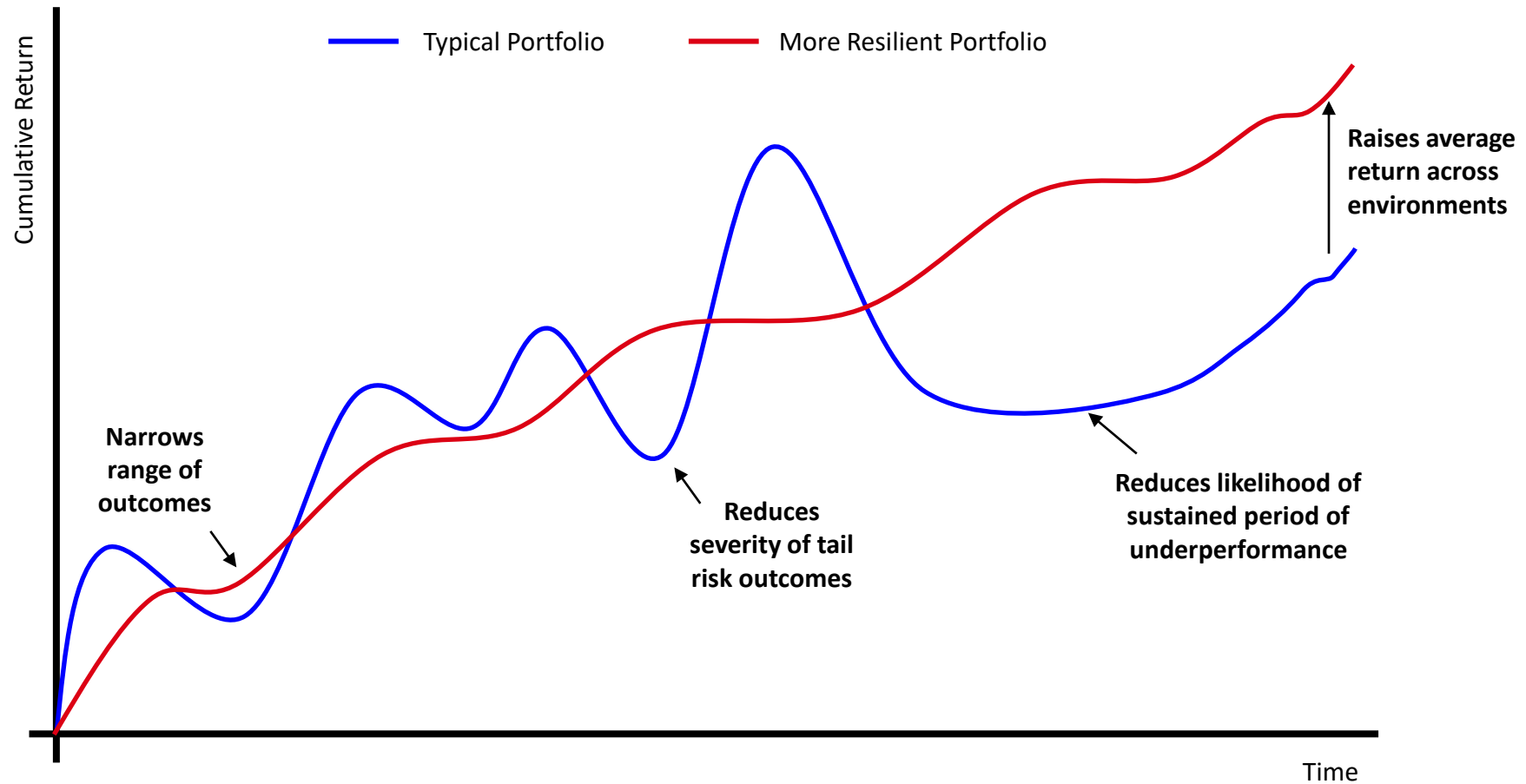
Total Return	=	Cash Return (risk-free position)	+	Beta Return (holding assets)	+	Alpha Return (taking views)
Last Decade		Negative Real Return		Exceptional		Not Needed
Today		Positive Real Return		At Risk		More Needed (and More Opportunities)

There can be no guarantee that any expected performance can or will be achieved and expected performance should not be solely relied upon in making an investment decision. Past performance is not indicative of future results. Please review the "Important Disclosures and Other Information" located at the end of this presentation.

A Framework for Portfolio Resiliency

WHY DOES RESILIENCY MATTER?

Portfolio resiliency is a portfolio's ability to consistently achieve target returns through a wide range of potential future scenarios.

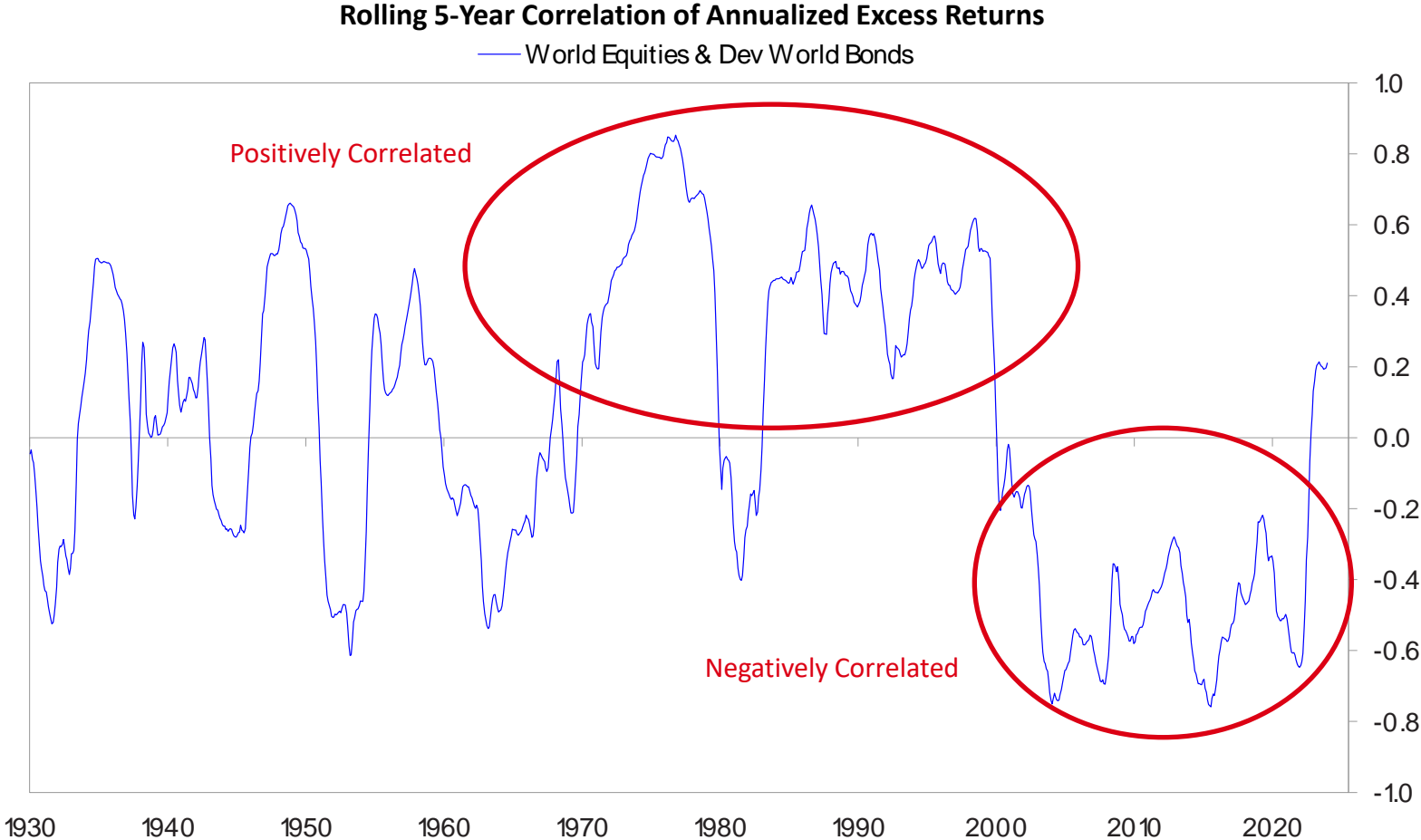


For illustrative purposes only. There can be no guarantee that any expected performance can or will be achieved and expected performance should not be solely relied upon in making an investment decision. Please review the "Important Disclosures and Other Information" located at the end of this presentation.

A FRAMEWORK FOR ACHIEVING PORTFOLIO RESILIENCE

- 1 Identify cross-cutting environments that impact portfolio performance
- 2 Map the performance of your portfolio in each of these environments to identify strengths and vulnerabilities
- 3 Choose vulnerabilities to mitigate — usually in the environments that are most important to you and where the portfolio is most vulnerable
- 4 Pull the levers available to mitigate those chosen vulnerabilities

CORRELATIONS ARE UNSTABLE AND UNRELIABLE



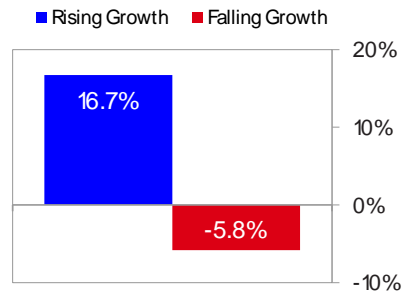
Analysis shown from 1925 through December 2023. For illustrative purposes only. Past performance is not indicative of future results. Please review the "Important Disclosures and Other Information" located at the end of this presentation.

ALL ASSETS HAVE ENVIRONMENTAL BIASES BASED ON LOGICAL AND RELIABLE FUNDAMENTAL LINKAGES

Equities tend to do well when...

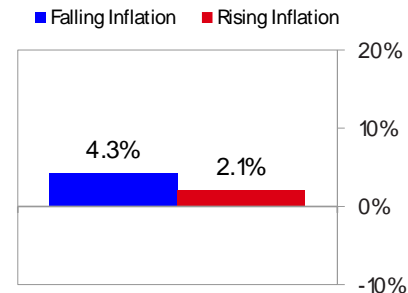
Growth is rising

...which lifts expectations for revenues, margins, and corporate profits



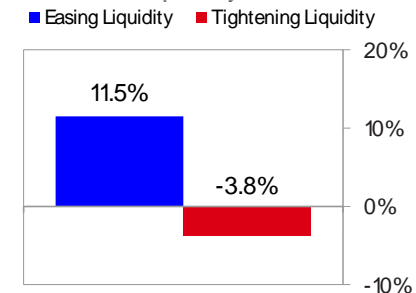
Inflation is falling

...as margins increase (where output prices are stickier than inputs) and expectations for interest rates decline



Liquidity is easing

...because of the sensitivity of all assets to discount rates and risk premiums



Average Annual Excess Returns of Equities (Since 1970)

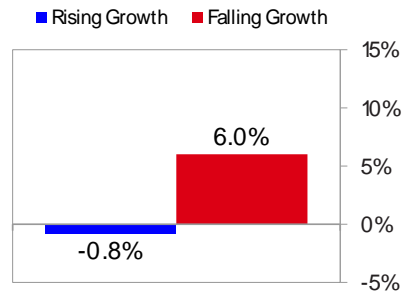
Performance data as of Feb-2023. These charts show the returns of developed world equities. Estimates are based on Bridgewater analysis. Past performance is not indicative of future results. Please review the "Important Disclosures and Other Information" located at the end of this presentation.

ALL ASSETS HAVE ENVIRONMENTAL BIASES BASED ON LOGICAL AND RELIABLE FUNDAMENTAL LINKAGES

Bonds tend to do well when...

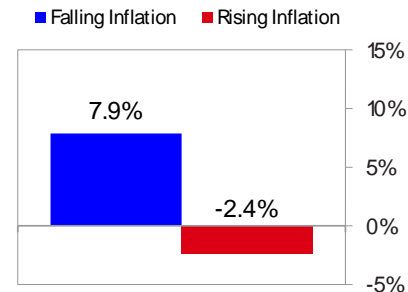
Growth is falling

...which puts downward pressure on yields as demand for borrowing is weak and interest rate expectations fall



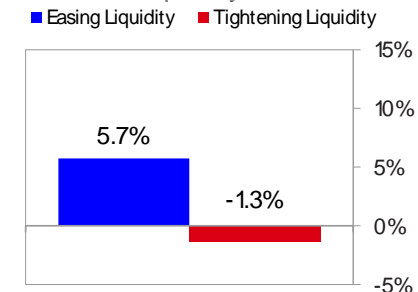
Inflation is falling

...which increases the value of promised future cash flows today and lowers interest rate expectations



Liquidity is easing

...because of the sensitivity of all assets to discount rates and risk premiums

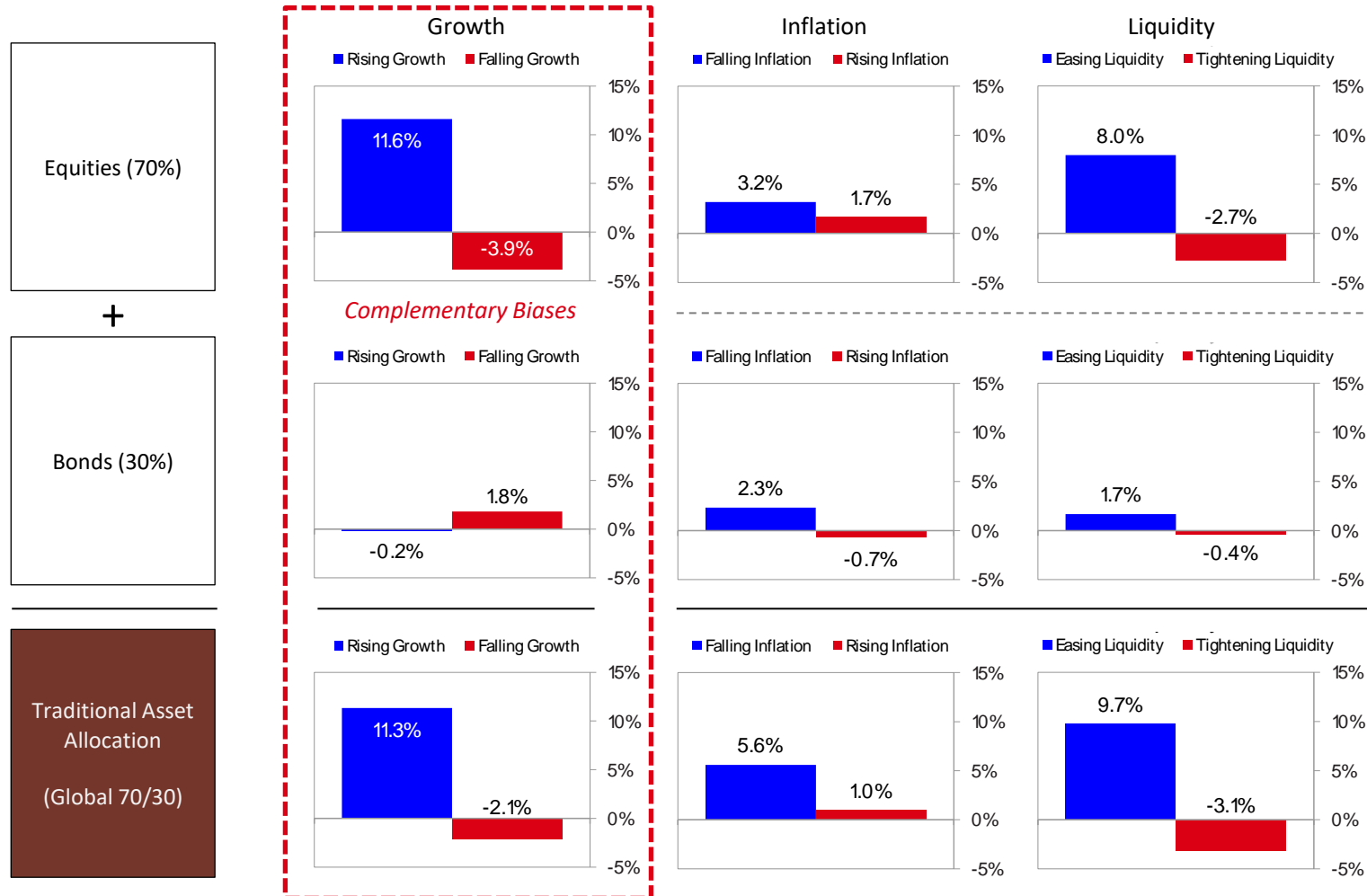


Average Annual Excess Returns of Bonds (Since 1970)

Performance data as of Feb-2023. These charts show the returns of developed world nominal government bonds. Estimates are based on Bridgewater analysis. Past performance is not indicative of future results. Please review the "Important Disclosures and Other Information" located at the end of this presentation.

COMBINING ASSETS WITH OPPOSITE BIASES CREATES A MORE RESILIENT PORTFOLIO

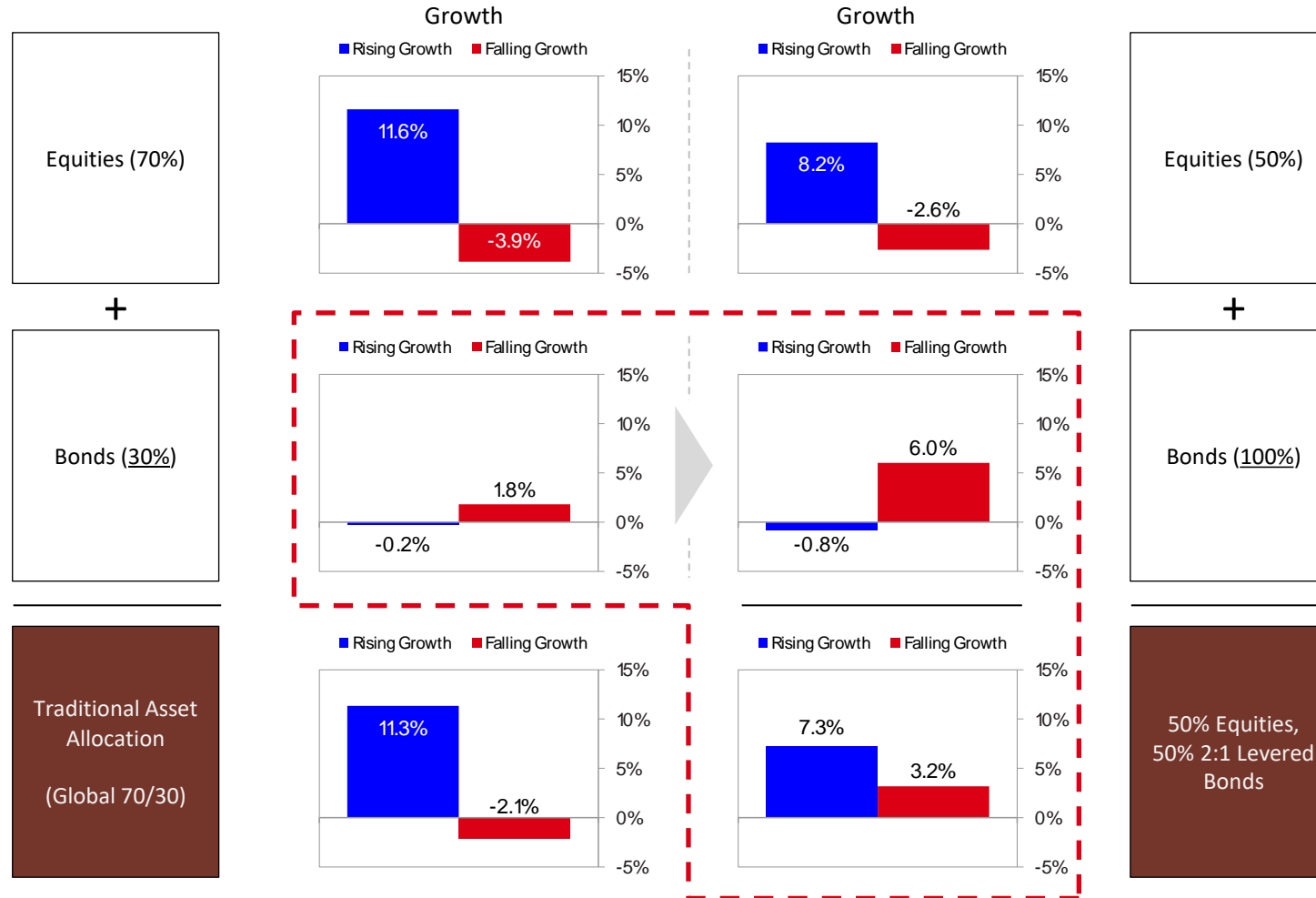
Historical Average Annual Excess Returns (Sim., Since 1970)



Performance data as of Feb-2023. These charts show the global 70/30, which is comprised of 70% developed world equities and 30% developed world nominal government bonds, and the separate equity and bond components at their respective allocation. Estimates are based on Bridgewater analysis. Past performance is not indicative of future results. There can be no guarantee that any expected performance can or will be achieved and expected performance should not be solely relied upon in making any investment decision. Please review the "Important Disclosures and Other Information" located at the end of this presentation.

LEVERAGE LETS YOU TAKE ASSETS THAT ARE DIVERSIFYING BUT LESS RISKY, AND MAGNIFY THEIR IMPACT IN THE PORTFOLIO

Historical Average Annual Excess Returns (Sim., Since 1970)



Performance data as of Feb-2023. These charts show the global 70/30, which is comprised of 70% developed world equities and 30% developed world nominal government bonds, and a portfolio of 50% developed world equities and 100% developed world nominal government bonds, and the separate equity and bond components at their respective allocation. Estimates are based on Bridgewater analysis. Past performance is not indicative of future results. There can be no guarantee that any expected performance can or will be achieved and expected performance should not be solely relied upon in making any investment decision. This graph does not refer to any Bridgewater product. Improperly managed leverage can introduce significant risks. Please review the "Important Disclosures and Other Information" located at the end of this presentation.

LEVERAGE LETS YOU TAKE ASSETS THAT ARE DIVERSIFYING BUT LESS RISKY, AND MAGNIFY THEIR IMPACT IN THE PORTFOLIO

Cumulative Excess Returns Since 1970 (Ln)



For illustrative purposes only. Data shown through February 2024. Nominal bonds are held at 7.5 years duration. All assets shown hedged to USD. There can be no guarantee that any expected performance can or will be achieved and expected performance should not be solely relied upon in making any investment decision. This graph does not refer to any Bridgewater product. Improperly managed leverage can introduce significant risks. Please review "Important Disclosures and Other Information" at the end of this report.

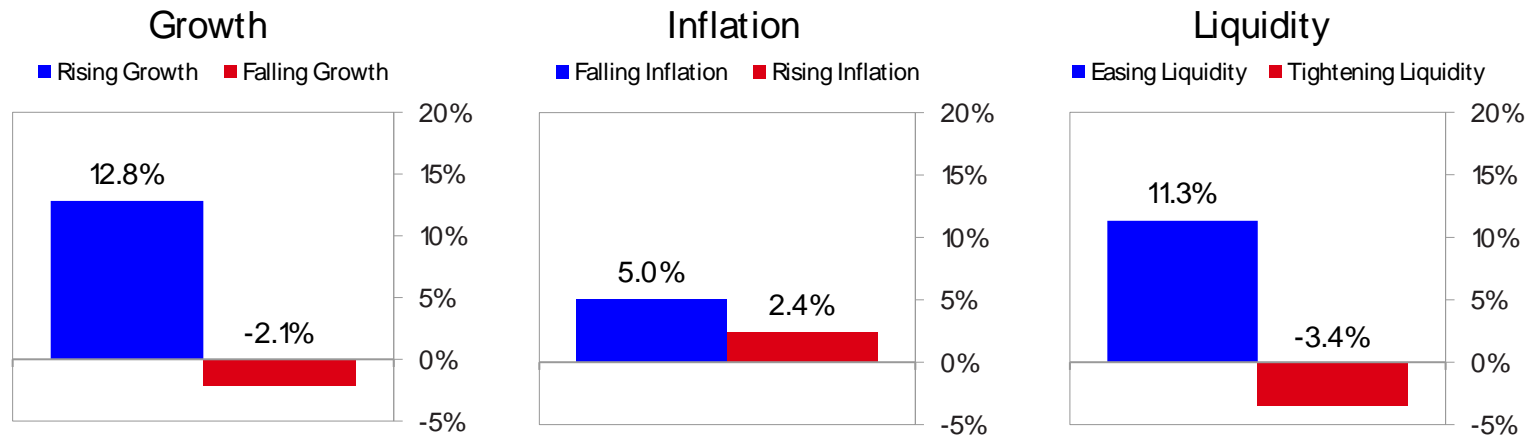
QUESTIONS WE WOULD ASK IF WE WERE IN YOUR SHOES

- ◆ **What are your goals?**
 - What is your **return target**, or **required rate of return**?
 - How does your portfolio support you in achieving the **overall goal for your organization**?
- ◆ **What is risk to you?**
 - What is your **distribution requirement**?
 - Do you foresee any additional **distribution change**?
- ◆ How do you define **unacceptable outcomes**?
 - Not just “risk”, what is true failure?
 - Are there any unacceptable outcomes beyond failing the YFYS benchmark tests?
- ◆ What are your **constraints** (e.g., leverage)?
- ◆ How do you think about **liquidity**?
 - How liquid do the strategies need to be?
 - How much of the liquidity needs to be weekly, monthly, or quarterly (i.e., longer term)?
- ◆ **Active risk:** How much active risk are you comfortable taking?

Engineering More Resilient Portfolios

YOUR STARTING POINT

Historical Average Annual Excess Returns VRS Illustrative Portfolio (Simulated, Since 1970)



Performance as of Jan-2024. For more information on the "VRS Illustrative Portfolio" see the related disclosure at the end of this presentation. HYPOTHETICAL PERFORMANCE RESULTS HAVE MANY INHERENT LIMITATIONS, SOME OF WHICH ARE DESCRIBED BELOW. NO REPRESENTATION IS BEING MADE THAT ANY ACCOUNT WILL OR IS LIKELY TO ACHIEVE PROFITS OR LOSSES SIMILAR TO THOSE SHOWN. IN FACT, THERE ARE FREQUENTLY SHARP DIFFERENCES BETWEEN HYPOTHETICAL PERFORMANCE RESULTS AND THE ACTUAL RESULTS SUBSEQUENTLY ACHIEVED BY ANY PARTICULAR TRADING PROGRAM. ONE OF THE LIMITATIONS OF HYPOTHETICAL PERFORMANCE RESULTS IS THAT THEY ARE GENERALLY PREPARED WITH THE BENEFIT OF HINDSIGHT. IN ADDITION, HYPOTHETICAL TRADING DOES NOT INVOLVE FINANCIAL RISK, AND NO HYPOTHETICAL TRADING RECORD CAN COMPLETELY ACCOUNT FOR THE IMPACT OF FINANCIAL RISK IN ACTUAL TRADING. FOR EXAMPLE, THE ABILITY TO WITHSTAND LOSSES OR TO ADHERE TO A PARTICULAR TRADING PROGRAM IN SPITE OF TRADING LOSSES ARE MATERIAL POINTS WHICH CAN ALSO ADVERSELY AFFECT ACTUAL TRADING RESULTS. THERE ARE NUMEROUS OTHER FACTORS RELATED TO THE MARKETS IN GENERAL OR TO THE IMPLEMENTATION OF ANY SPECIFIC TRADING PROGRAM WHICH CANNOT BE FULLY ACCOUNTED FOR IN THE PREPARATION OF HYPOTHETICAL PERFORMANCE RESULTS AND ALL OF WHICH CAN ADVERSELY AFFECT ACTUAL TRADING RESULTS. The recipient should not solely rely upon these hypothetical performance results in making an investment decision. In constructing hypothetical performance and determining their appropriateness for use in materials, Bridgewater has an incentive to do so in a manner that shows beneficial characteristics of a given, hypothetical return stream. There can be no guarantee that any expected performance can or will be achieved and expected performance should not be solely relied upon in making an investment decision. Past performance is not indicative of future results. Please review the "Important Disclosures and Other Information" located at the end of this presentation.

LEVERS TO CONSIDER FOR INCREASING RESILIENCY

1

Shift Your Asset
Allocation

2

Increase Resiliency
Within Your Current
Asset Allocation

3

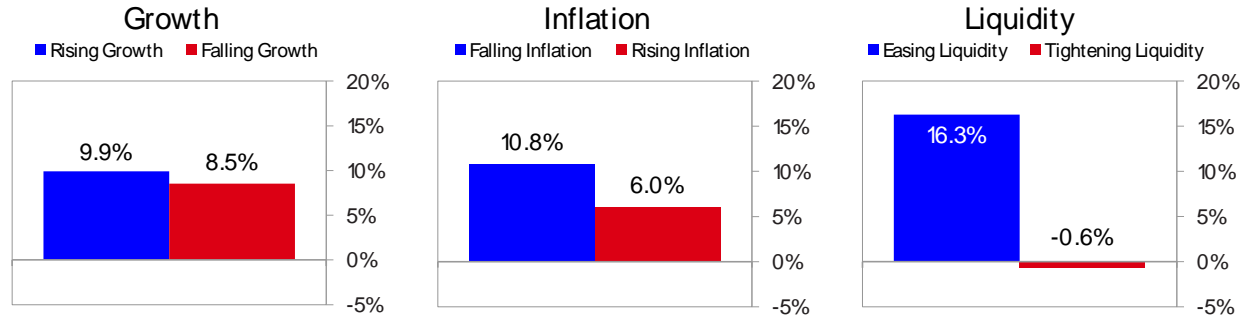
Allocate to Assets that
Directly Mitigate Your
Vulnerabilities

1 SHIFT YOUR ASSET ALLOCATION

Example: Balanced Asset Mix (with Alpha) Historical Average Annual Excess Returns (Simulated, Net, Since Jan-1982)

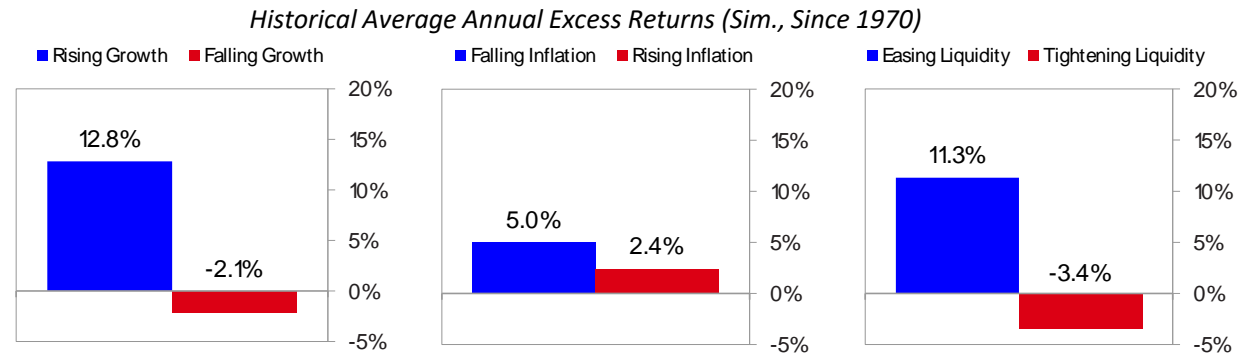
Balanced Asset Mix (with Alpha)

Expected Return (Gross Total): 11.4% at 10% vol, 0.85 ratio



VRS Illustrative Portfolio

Target Return: 6.75%



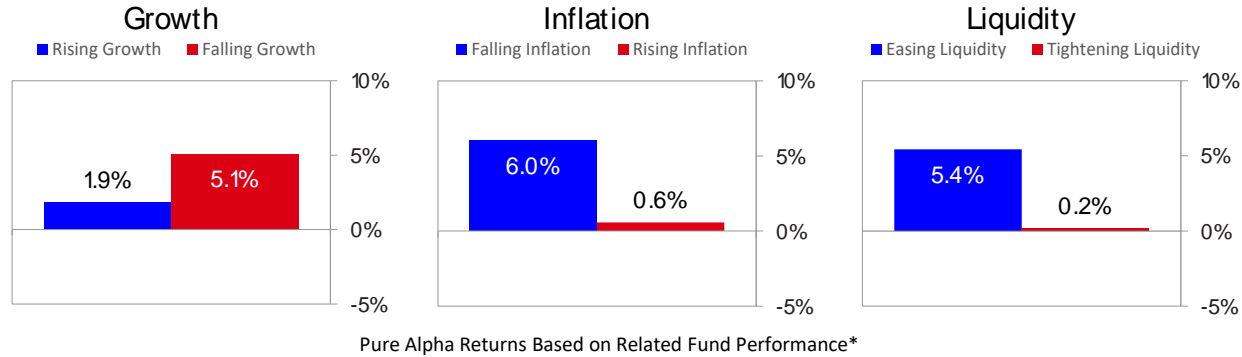
Performance estimated as of Jan-2024. For more information on the "VRS Illustrative Portfolio" see the related disclosure at the end of this presentation. "Balanced Asset Mix (with Alpha)" represents the returns of Active All Weather which are calculated using 0.40% fixed fee and 15% performance fee on excess returns above 2.30%, charged annually. Active AW return simulation is humbled. Total Expected Return includes 2.9% expected cash return. It is expected that the simulated performance will periodically change as a function of both refinements to our simulation methodology and the underlying market data. HYPOTHETICAL PERFORMANCE RESULTS HAVE MANY INHERENT LIMITATIONS, SOME OF WHICH ARE DESCRIBED BELOW. NO REPRESENTATION IS BEING MADE THAT ANY ACCOUNT WILL OR IS LIKELY TO ACHIEVE PROFITS OR LOSSES SIMILAR TO THOSE SHOWN. IN FACT, THERE ARE FREQUENTLY SHARP DIFFERENCES BETWEEN HYPOTHETICAL PERFORMANCE RESULTS AND THE ACTUAL RESULTS SUBSEQUENTLY ACHIEVED BY ANY PARTICULAR TRADING PROGRAM. ONE OF THE LIMITATIONS OF HYPOTHETICAL PERFORMANCE RESULTS IS THAT THEY ARE GENERALLY PREPARED WITH THE BENEFIT OF HINDSIGHT. IN ADDITION, HYPOTHETICAL TRADING DOES NOT INVOLVE FINANCIAL RISK, AND NO HYPOTHETICAL TRADING RECORD CAN COMPLETELY ACCOUNT FOR THE IMPACT OF FINANCIAL RISK IN ACTUAL TRADING. FOR EXAMPLE, THE ABILITY TO WITHSTAND LOSSES OR TO ADHERE TO A PARTICULAR TRADING PROGRAM IN SPITE OF TRADING LOSSES ARE MATERIAL POINTS WHICH CAN ALSO ADVERSELY AFFECT ACTUAL TRADING RESULTS. THERE ARE NUMEROUS OTHER FACTORS RELATED TO THE MARKETS IN GENERAL OR TO THE IMPLEMENTATION OF ANY SPECIFIC TRADING PROGRAM WHICH CANNOT BE FULLY ACCOUNTED FOR IN THE PREPARATION OF HYPOTHETICAL PERFORMANCE RESULTS AND ALL OF WHICH CAN ADVERSELY AFFECT ACTUAL TRADING RESULTS. The recipient should not solely rely upon these hypothetical performance results in making an investment decision. In constructing hypothetical performance and determining their appropriateness for use in materials, Bridgewater has an incentive to do so in a manner that shows beneficial characteristics of a given, hypothetical return stream. There can be no guarantee that any expected performance can or will be achieved and expected performance should not be solely relied upon in making an investment decision. Past performance is not indicative of future results. Please review the "Important Disclosures and Other Information" located at the end of this presentation.

1 SHIFT YOUR ASSET ALLOCATION

Example: Fixed Income with Uncorrelated Alpha Historical Average Annual Excess Returns (Net, Since Dec-1991)

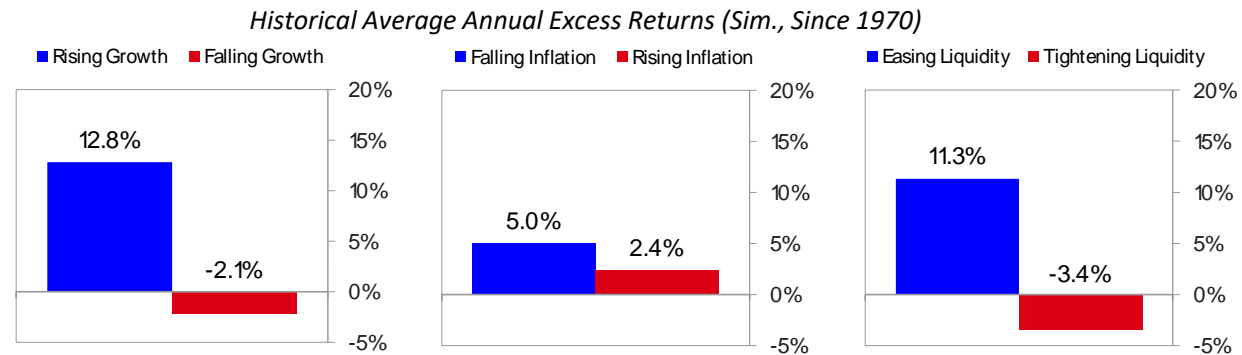
Active Bonds Allocation Benchmarked to US Agg

Expected Return (Gross Total): 7.5%.
4.5% from US Agg,
3.0% alpha at 3% vol.
and 1.0 ratio



VRS Illustrative Portfolio

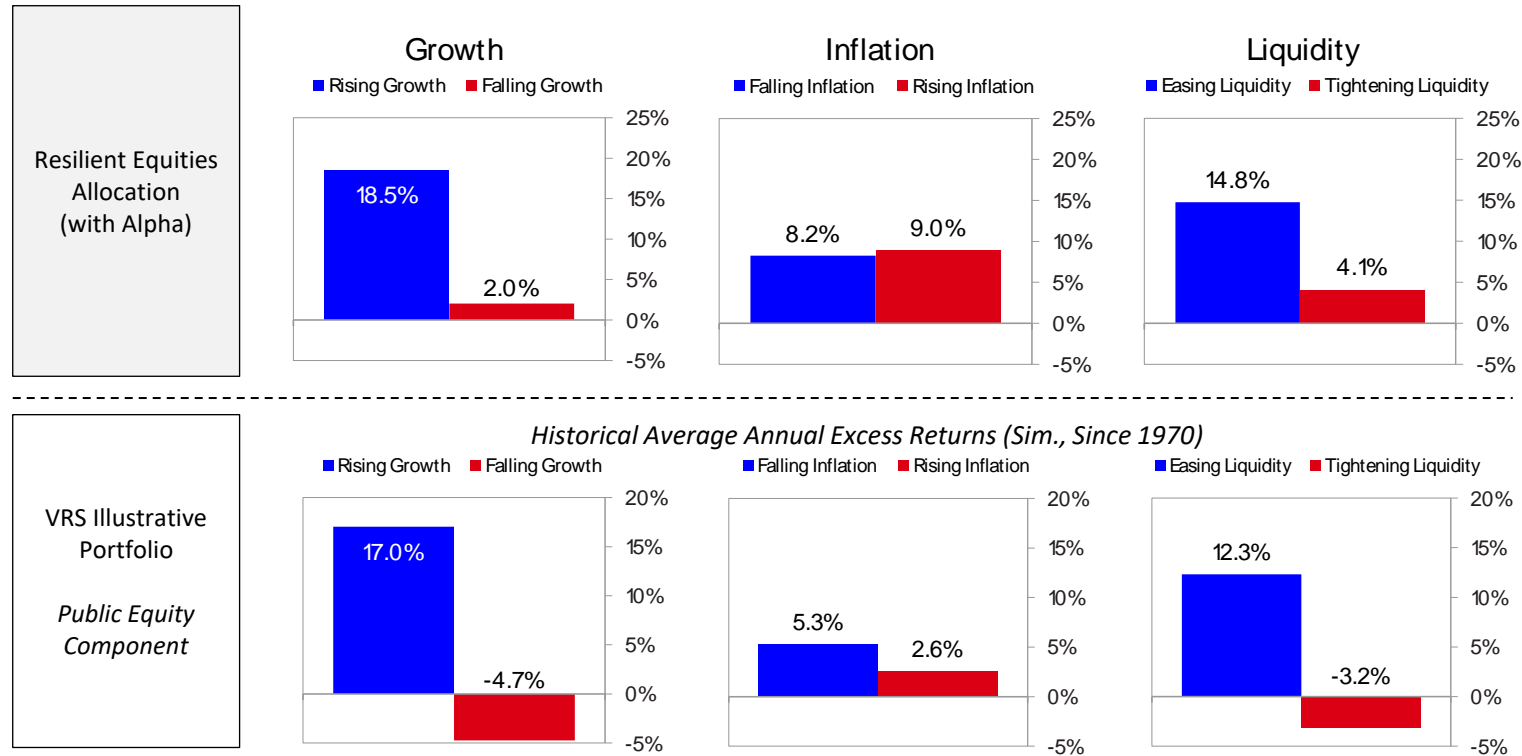
Target Return: 6.75%



Performance estimated as of Jan-2024. For more information on the "VRS Illustrative Portfolio" see the related disclosure at the end of this presentation. "Active Bonds Allocation Benchmarked to US Agg" represents US Agg benchmark with overlay of Pure Alpha 18% at 3% volatility. *Related fund performance is based on the performance of the Pure Alpha Strategy at 12% volatility scaled to 18% volatility. Total Expected Return includes 2.9% expected cash return. HYPOTHETICAL PERFORMANCE RESULTS HAVE MANY INHERENT LIMITATIONS, SOME OF WHICH ARE DESCRIBED BELOW. NO REPRESENTATION IS BEING MADE THAT ANY ACCOUNT WILL OR IS LIKELY TO ACHIEVE PROFITS OR LOSSES SIMILAR TO THOSE SHOWN. IN FACT, THERE ARE FREQUENTLY SHARP DIFFERENCES BETWEEN HYPOTHETICAL PERFORMANCE RESULTS AND THE ACTUAL RESULTS SUBSEQUENTLY ACHIEVED BY ANY PARTICULAR TRADING PROGRAM. ONE OF THE LIMITATIONS OF HYPOTHETICAL PERFORMANCE RESULTS IS THAT THEY ARE GENERALLY PREPARED WITH THE BENEFIT OF HINDSIGHT. IN ADDITION, HYPOTHETICAL TRADING DOES NOT INVOLVE FINANCIAL RISK, AND NO HYPOTHETICAL TRADING RECORD CAN COMPLETELY ACCOUNT FOR THE IMPACT OF FINANCIAL RISK IN ACTUAL TRADING. FOR EXAMPLE, THE ABILITY TO WITHSTAND LOSSES OR TO ADHERE TO A PARTICULAR TRADING PROGRAM IN SPITE OF TRADING LOSSES ARE MATERIAL POINTS WHICH CAN ALSO ADVERSELY AFFECT ACTUAL TRADING RESULTS. THERE ARE NUMEROUS OTHER FACTORS RELATED TO THE MARKETS IN GENERAL OR TO THE IMPLEMENTATION OF ANY SPECIFIC TRADING PROGRAM WHICH CANNOT BE FULLY ACCOUNTED FOR IN THE PREPARATION OF HYPOTHETICAL PERFORMANCE RESULTS AND ALL OF WHICH CAN ADVERSELY AFFECT ACTUAL TRADING RESULTS. The recipient should not solely rely upon these hypothetical performance results in making an investment decision. In constructing hypothetical performance and determining their appropriateness for use in materials, Bridgewater has an incentive to do so in a manner that shows beneficial characteristics of a given, hypothetical return stream. There can be no guarantee that any expected performance can or will be achieved and expected performance should not be solely relied upon in making an investment decision. Past performance is not indicative of future results. Please review the "Important Disclosures and Other Information" located at the end of this presentation.

2 INCREASE RESILIENCY WITHIN YOUR ASSET ALLOCATION (EXAMPLE: EQUITIES)

Example: High Resilience Equities with Alpha Historical Average Annual Excess Returns (Simulated, Net, Since Feb-1985)



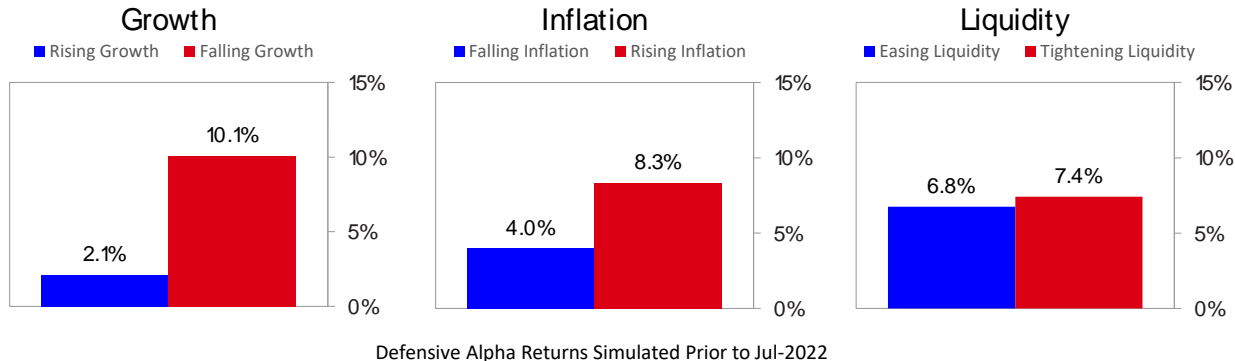
Performance estimated as of Jan-2024. For more information on the "VRS Illustrative Portfolio" see the related disclosure at the end of this presentation. "High Resilient Equities with Alpha" returns represent a proprietary simulated equity allocation designed to deliver higher risk-adjusted returns than overall equity markets, and was derived by applying Bridgewater's investment systems and portfolio construction logic to historical market returns. The simulation shown above is a product of recent Bridgewater research and does not represent any standalone product currently managed by Bridgewater. The results shown are simulated, unhumbled, and calculated using 1.00% fixed fee and 10% performance fee on excess returns charged annually. It is expected that the simulated performance will periodically change as a function of both refinements to our simulation methodology and the underlying market data. HYPOTHETICAL PERFORMANCE RESULTS HAVE MANY INHERENT LIMITATIONS, SOME OF WHICH ARE DESCRIBED BELOW. NO REPRESENTATION IS BEING MADE THAT ANY ACCOUNT WILL OR IS LIKELY TO ACHIEVE PROFITS OR LOSSES SIMILAR TO THOSE SHOWN. IN FACT, THERE ARE FREQUENTLY SHARP DIFFERENCES BETWEEN HYPOTHETICAL PERFORMANCE RESULTS AND THE ACTUAL RESULTS SUBSEQUENTLY ACHIEVED BY ANY PARTICULAR TRADING PROGRAM. ONE OF THE LIMITATIONS OF HYPOTHETICAL PERFORMANCE RESULTS IS THAT THEY ARE GENERALLY PREPARED WITH THE BENEFIT OF HINDSIGHT. IN ADDITION, HYPOTHETICAL TRADING DOES NOT INVOLVE FINANCIAL RISK, AND NO HYPOTHETICAL TRADING RECORD CAN COMPLETELY ACCOUNT FOR THE IMPACT OF FINANCIAL RISK IN ACTUAL TRADING. FOR EXAMPLE, THE ABILITY TO WITHSTAND LOSSES OR TO ADHERE TO A PARTICULAR TRADING PROGRAM IN SPITE OF TRADING LOSSES ARE MATERIAL POINTS WHICH CAN ALSO ADVERSELY AFFECT ACTUAL TRADING RESULTS. THERE ARE NUMEROUS OTHER FACTORS RELATED TO THE MARKETS IN GENERAL OR TO THE IMPLEMENTATION OF ANY SPECIFIC TRADING PROGRAM WHICH CANNOT BE FULLY ACCOUNTED FOR IN THE PREPARATION OF HYPOTHETICAL PERFORMANCE RESULTS AND ALL OF WHICH CAN ADVERSELY AFFECT ACTUAL TRADING RESULTS. The recipient should not solely rely upon these hypothetical performance results in making an investment decision. In constructing hypothetical performance and determining their appropriateness for use in materials, Bridgewater has an incentive to do so in a manner that shows beneficial characteristics of a given, hypothetical return stream. There can be no guarantee that any expected performance can or will be achieved and expected performance should not be solely relied upon in making an investment decision. Past performance is not indicative of future results. Please review the "Important Disclosures and Other Information" located at the end of this presentation.

ALLOCATE TO STRATEGIES THAT MITIGATE VULNERABILITIES

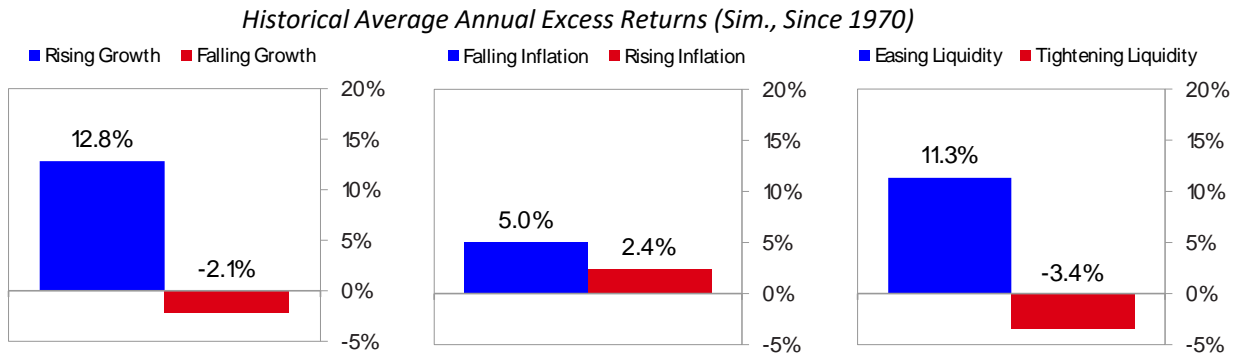
Example: Negatively Correlated Alpha

Historical Average Annual Excess Returns (Simulated, Net, Since 1970)

Negatively Correlated Alpha
Expected Return (Gross Total): 10.9% at 10% vol., 0.8 ratio



VRS Illustrative Portfolio
Target Return: 6.75%



Performance estimated as of Jan-2024. For more information on the "VRS Illustrative Portfolio" see the related disclosure at the end of this presentation. "Negatively Correlated Alpha" represents Defensive Alpha 10%. Prior to July 2022, Defensive Alpha returns are simulated based on a back-testing of Bridgewater's systems. Please see the Defensive Alpha strategy simulation disclosure for more information. Total Expected Return includes 2.9% expected cash return. It is expected that the simulated performance will periodically change as a function of improvements to our investment systems and refinements to both our simulation methodology and the underlying market data. HYPOTHETICAL PERFORMANCE RESULTS HAVE MANY INHERENT LIMITATIONS, SOME OF WHICH ARE DESCRIBED BELOW. NO REPRESENTATION IS BEING MADE THAT ANY ACCOUNT WILL OR IS LIKELY TO ACHIEVE PROFITS OR LOSSES SIMILAR TO THOSE SHOWN. IN FACT, THERE ARE FREQUENTLY SHARP DIFFERENCES BETWEEN HYPOTHETICAL PERFORMANCE RESULTS AND THE ACTUAL RESULTS SUBSEQUENTLY ACHIEVED BY ANY PARTICULAR TRADING PROGRAM. ONE OF THE LIMITATIONS OF HYPOTHETICAL PERFORMANCE RESULTS IS THAT THEY ARE GENERALLY PREPARED WITH THE BENEFIT OF HINDSIGHT. IN ADDITION, HYPOTHETICAL TRADING DOES NOT INVOLVE FINANCIAL RISK, AND NO HYPOTHETICAL TRADING RECORD CAN COMPLETELY ACCOUNT FOR THE IMPACT OF FINANCIAL RISK IN ACTUAL TRADING. FOR EXAMPLE, THE ABILITY TO WITHSTAND LOSSES OR TO ADHERE TO A PARTICULAR TRADING PROGRAM IN SPITE OF TRADING LOSSES ARE MATERIAL POINTS WHICH CAN ALSO ADVERSELY AFFECT ACTUAL TRADING RESULTS. THERE ARE NUMEROUS OTHER FACTORS RELATED TO THE MARKETS IN GENERAL OR TO THE IMPLEMENTATION OF ANY SPECIFIC TRADING PROGRAM WHICH CANNOT BE FULLY ACCOUNTED FOR IN THE PREPARATION OF HYPOTHETICAL PERFORMANCE RESULTS AND ALL OF WHICH CAN ADVERSELY AFFECT ACTUAL TRADING RESULTS. The recipient should not solely rely upon these hypothetical performance results in making an investment decision. In constructing hypothetical performance and determining their appropriateness for use in materials, Bridgewater has an incentive to do so in a manner that shows beneficial characteristics of a given, hypothetical return stream. There can be no guarantee that any expected performance can or will be achieved and expected performance should not be solely relied upon in making an investment decision. Past performance is not indicative of future results. Please review the "Important Disclosures and Other Information" located at the end of this presentation.

APPENDIX

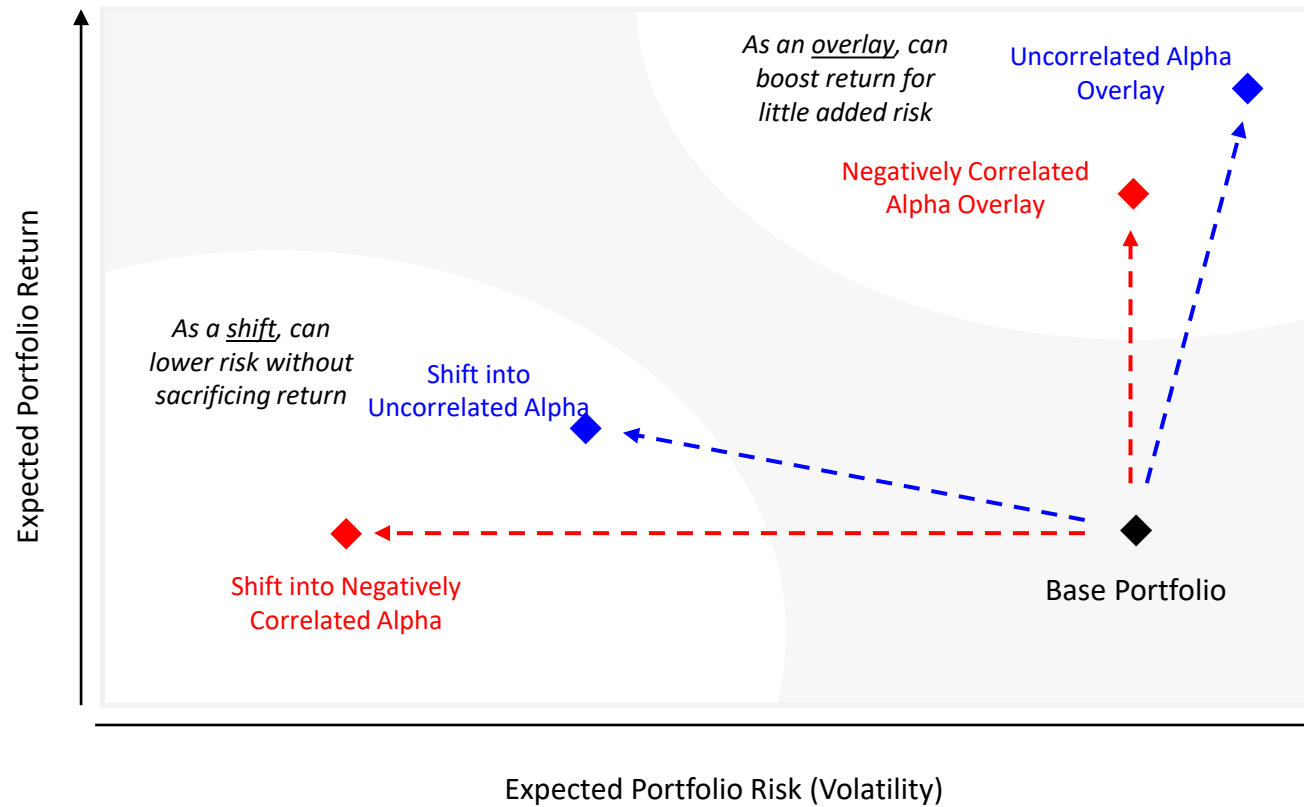
YOU CAN ESTABLISH THE ENVIRONMENTS THAT MATTER FOR YOU

Macro Environments	Asset Environments	Plan-Specific Environments
Growth and Inflation	Currency Volatility	Rising/Falling Contributions
Monetary Policy	Asset Bull/Bear Markets	Rising/Falling Distributions
Risk On/Risk Off	Equity Factor Performance	Rising/Falling Govt Revenues
Early/Mid/Late Cycles	Asset Trend vs Chop	Natural Resource Production
Equilibrium/Disequilibrium	Relative Country Performance	Trading Partner Growth
High/Low Cash Rates	Volatility Regimes	
Policy Divergence/Convergence		
Alpha Potential		

...and any other fundamental environment that matters to you.

ALPHA THAT CAN DO WELL WHEN MARKETS ARE DOWN IS ESPECIALLY VALUABLE

Visualizing the Portfolio Risk and Return Impact of
Negatively Correlated or Uncorrelated Alpha



Base portfolio, negatively correlated alpha and uncorrelated alpha are for illustrative purposes only. There can be no guarantee that any expected performance can or will be achieved and expected performance should not be solely relied upon in making an investment decision. Please review the "Important Disclosures and Other Information" located at the end of this report.

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Bridgewater’s investment process seeks to understand the cause and effect linkages that drive markets over time. To assess and refine its understanding of these linkages, Bridgewater performs historical stress-tests across a wide range of timeframes and market environments. From these stress-tests, Bridgewater is able to simulate how its strategies would have performed prior to their inception. Bridgewater has the ability to run multiple simulations and select the simulation with the best results, returns or performance. For strategies that include active decision making, Bridgewater often “humbles” its simulated alpha returns (by systematically adjusting downward the simulated results that Bridgewater’s current alpha investment logic produces) to account for the possibility that it could be wrong. Because this stress-testing is a core component of Bridgewater’s investment process, it shares these simulations with current and prospective investors to demonstrate its thinking. However, because they do not demonstrate actual results, these simulations are hypothetical, and inherently limited and should not be relied upon to make an investment decision.

The recipient should not solely rely upon these hypothetical performance results in making an investment decision. In constructing hypothetical performance and determining their appropriateness for use in materials, Bridgewater has an incentive to do so in a manner that shows beneficial characteristics of a given, hypothetical return stream.

All hypothetical performance is subject to revision and provided solely as a guide to current expectations. The recipient should not solely rely upon these hypothetical performance results in making an investment decision. Hypothetical performance results can provide insight into the level of risk that a strategy will seek with respect to its investments, with higher hypothetical performance results generally reflecting greater risk. Some or all results may be substantially lower than these hypothetical results and, as with any investment, there is a risk of loss of the entire investment.

Hypothetical performance results rely on numerous criteria, assumptions, risks and limitations and are inherently uncertain. There are multiple assumptions and possible adjustments Bridgewater may make in its underlying calculations that are reasonable, but other criteria, assumptions, methodologies and adjustments could also be reasonable and could lead to materially different and lower actual results and higher risks than those presented. In addition, the hypothetical performance results may prove to be invalid, inaccurate, incomplete or change without notice. Variation in any of these factors (or factors or events that are unknown or unaccounted for) could cause actual returns to substantially differ. In constructing hypothetical returns and determining their appropriateness for use in materials, Bridgewater has an incentive to do so in a manner that shows beneficial characteristics of a given, hypothetical return stream. Furthermore, any hypothetical or mathematical calculations or data might contain errors, and could rely on third-party inputs, which Bridgewater believes to be reliable but whose accuracy cannot be guaranteed.

While Bridgewater believes that there is a sound basis for these hypothetical performance results, no representations are made as to their accuracy, and there can be no assurance that such results will be achieved. This presentation will not be updated or amended even if there are changes in the information or processes upon which they rely.

IMPORTANT DISCLOSURES

Bridgewater believes that a particular return stream should be evaluated against its expected performance or its benchmark. To that end, Bridgewater demonstrates whether its strategies are operating as expected via a cone chart, which shows the performance of a particular strategy over time relative to the strategy's benchmark and also within bands of standard deviation from that benchmark. Separately, to demonstrate the impact of market conditions on the strategies it manages, Bridgewater explains the macro-economic pressures and market conditions that effected performance in the context of client letters, account reviews, or other publications that Bridgewater provides to each current and prospective investor on a regular basis. Additional information about how Bridgewater thinks about setting expectations for its strategies via a benchmark is available upon request.

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Simulated Performance refers to hypothetical performance that shows the returns of a Bridgewater strategy prior to its inception date. Simulated performance does not reflect actual trading by Bridgewater and is constructed by applying Bridgewater's investment management process to available market data.

Related Fund or Related Share Class Performance refers to actual performance that has been adjusted to account for volatility and/or currency differences. Because it is based on actual performance, Related Fund or Related Share Class Performance does reflect actual trading by Bridgewater, which has been adjusted on the basis of currency, volatility, or both and is thus hypothetical. Note that the terms Related Fund or Related Share Class Performance are not being used in the same way that the term 'Related Performance' is used in the Securities and Exchange Commission's Marketing Rule.

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VRS ILLUSTRATIVE PORTFOLIO DISCLOSURE

This page contains the allocation information for the historical simulation of the VRS Illustrative portfolio, from 1925 onwards, as well as forward looking assumptions for expected ratio, volatility, and tracking error, used in this analysis. Correlations are based on either historical market returns when available or Bridgewater Associates' estimates, based on other available data and our fundamental understanding of asset classes. The portfolio capital allocation weights (illustrated below) are estimates based either upon Bridgewater Associates' understanding of standard asset allocation (which may change without notice) or information provided by or publicly available from the recipient of this presentation. Asset class returns are actual market returns where available and otherwise a proxy index constructed based on Bridgewater Associates understanding of global financial markets. Information regarding specific indices and simulation methods used for proxies is available upon request (except where the proprietary nature of information precludes its dissemination). Results are hypothetical or simulated and gross of fees unless otherwise indicated. It is expected that the simulated performance will periodically change as a function of both refinements to our simulation methodology and the underlying market data. HYPOTHETICAL PERFORMANCE RESULTS HAVE MANY INHERENT LIMITATIONS, SOME OF WHICH ARE DESCRIBED BELOW. NO REPRESENTATION IS BEING MADE THAT ANY ACCOUNT WILL OR IS LIKELY TO ACHIEVE PROFITS OR LOSSES SIMILAR TO THOSE SHOWN. IN FACT, THERE ARE FREQUENTLY SHARP DIFFERENCES BETWEEN HYPOTHETICAL PERFORMANCE RESULTS AND THE ACTUAL RESULTS SUBSEQUENTLY ACHIEVED BY ANY PARTICULAR TRADING PROGRAM. ONE OF THE LIMITATIONS OF HYPOTHETICAL PERFORMANCE RESULTS IS THAT THEY ARE GENERALLY PREPARED WITH THE BENEFIT OF HINDSIGHT. IN ADDITION, HYPOTHETICAL TRADING DOES NOT INVOLVE FINANCIAL RISK, AND NO HYPOTHETICAL TRADING RECORD CAN COMPLETELY ACCOUNT FOR THE IMPACT OF FINANCIAL RISK IN ACTUAL TRADING. FOR EXAMPLE, THE ABILITY TO WITHSTAND LOSSES OR TO ADHERE TO A PARTICULAR TRADING PROGRAM IN SPITE OF TRADING LOSSES ARE MATERIAL POINTS WHICH CAN ALSO ADVERSELY AFFECT ACTUAL TRADING RESULTS. THERE ARE NUMEROUS OTHER FACTORS RELATED TO THE MARKETS IN GENERAL OR TO THE IMPLEMENTATION OF ANY SPECIFIC TRADING PROGRAM WHICH CANNOT BE FULLY ACCOUNTED FOR IN THE PREPARATION OF HYPOTHETICAL PERFORMANCE RESULTS AND ALL OF WHICH CAN ADVERSELY AFFECT ACTUAL TRADING RESULTS. The recipient should not solely rely upon these hypothetical performance results in making an investment decision. In constructing hypothetical performance and determining their appropriateness for use in materials, Bridgewater has an incentive to do so in a manner that shows beneficial characteristics of a given, hypothetical return stream.

Asset Type	Asset	Nominal Exposure	% Hedged FX	Beta Volatility	Beta Ratio	Alpha Volatility	Alpha Ratio
Equities	United States PE	19.9%	0%	28.0%	0.14	-	-
Equities	United States Equities	19.6%	0%	16.2%	0.14	-	-
Private Debt	United States Direct Lending	12.5%	0%	7.2%	0.16	-	-
Nominal Bond Agg	United States Bond Aggregate	11.0%	0%	6.3%	0.25	-	-
Equities	Developed World Ex US Equities	10.2%	100%	13.7%	0.37	-	-
Equities	Emerging Market Equities	4.0%	100%	19.4%	0.27	-	-
Real Estate	United States Real Estate	3.7%	0%	21.0%	0.20	-	-
Absolute Return	Absolute Return	3.6%	0%	-	-	7.0%	0.50
High Yield Bonds	United States High Yield Bonds	3.5%	0%	10.9%	0.30	-	-
Real Estate	United States Core Industrial Real Estate	3.1%	0%	17.8%	0.16	-	-
Real Estate	United States Apartment Real Estate	2.4%	0%	29.0%	0.16	-	-
Infrastructure	Private Infrastructure Equity	2.4%	0%	18.3%	0.22	-	-
Real Estate	United States Retail Real Estate	1.1%	0%	30.8%	0.16	-	-
Real Estate	United States Office Real Estate	0.9%	0%	31.7%	0.16	-	-
EM Debt	Emerging Market Debt (US\$)	0.8%	0%	14.8%	0.35	-	-

PURE ALPHA STRATEGY 18% USD DISCLOSURES

Pure Alpha Strategy 18% Volatility Net
(Net Total Returns from Dec 1991 through Jan 2024)

1991	7.6%	2004	20.4%	2017	1.3%
1992	5.1%	2005	3.1%	2018	14.6%
1993	36.8%	2006	1.7%	2019	-0.7%
1994	-3.1%	2007	12.7%	2020	-12.6%
1995	-5.7%	2008	9.4%	2021	8.1%
1996	36.6%	2009	1.9%	2022	9.4%
1997	28.2%	2010	44.8%	2023	-7.7%
1998	37.8%	2011	25.3%	2024 YTD	1.9%
1999	0.1%	2012	0.8%		
2000	-7.9%	2013	5.2%		
2001	6.9%	2014	3.5%	Avg Annual	9.9%
2002	22.1%	2015	4.7%	StDev	15.4%
2003	33.8%	2016	2.5%	Ratio	0.48

Past results are not necessarily indicative of future results. Returns Based on Related Fund Performance Prior to May 2005.

Average annual returns and Sharpe ratio are calculated using net of fees performance, while the standard deviation is calculated using gross of fees performance.

HYPOTHETICAL PERFORMANCE RESULTS HAVE MANY INHERENT LIMITATIONS, SOME OF WHICH ARE DESCRIBED BELOW. NO REPRESENTATION IS BEING MADE THAT ANY ACCOUNT WILL OR IS LIKELY TO ACHIEVE PROFITS OR LOSSES SIMILAR TO THOSE SHOWN. IN FACT, THERE ARE FREQUENTLY SHARP DIFFERENCES BETWEEN HYPOTHETICAL PERFORMANCE RESULTS AND THE ACTUAL RESULTS SUBSEQUENTLY ACHIEVED BY ANY PARTICULAR TRADING PROGRAM.

ONE OF THE LIMITATIONS OF HYPOTHETICAL PERFORMANCE RESULTS IS THAT THEY ARE GENERALLY PREPARED WITH THE BENEFIT OF HINDSIGHT. IN ADDITION, HYPOTHETICAL TRADING DOES NOT INVOLVE FINANCIAL RISK, AND NO HYPOTHETICAL TRADING RECORD CAN COMPLETELY ACCOUNT FOR THE IMPACT OF FINANCIAL RISK IN ACTUAL TRADING. FOR EXAMPLE, THE ABILITY TO WITHSTAND LOSSES OR TO ADHERE TO A PARTICULAR TRADING PROGRAM IN SPITE OF TRADING LOSSES ARE MATERIAL POINTS WHICH CAN ALSO ADVERSELY AFFECT ACTUAL TRADING RESULTS. THERE ARE NUMEROUS OTHER FACTORS RELATED TO THE MARKETS IN GENERAL OR TO THE IMPLEMENTATION OF ANY SPECIFIC TRADING PROGRAM WHICH CANNOT BE FULLY ACCOUNTED FOR IN THE PREPARATION OF HYPOTHETICAL PERFORMANCE RESULTS AND ALL OF WHICH CAN ADVERSELY AFFECT ACTUAL TRADING RESULTS. The recipient should not solely rely upon these hypothetical performance results in making an investment decision. In constructing hypothetical performance and determining their appropriateness for use in materials, Bridgewater has an incentive to do so in a manner that shows beneficial characteristics of a given, hypothetical return stream.

Bridgewater Pure Alpha Strategy 18% Volatility Performance Disclosure:

Returns after April 2005 are the actual returns of the longest running fully funded Pure Alpha account with a target tracking error of 18%, a United States cash benchmark, and fully unconstrained active management guidelines. From December 1991 through the end of April 2005 the performance history provided is based on the performance of the Pure Alpha strategy run at a 12% target volatility. A description of the 12% target volatility performance is provided below. The value added (or excess returns) of the 12% target volatility gross of fees performance history have been scaled to an 18% target volatility. Monthly value added returns are scaled linearly by a factor of 1.5 (18% divided by 12%). The Benchmark return (an approximation of US cash) is subsequently added back to the adjusted value added to arrive at a total return. For the entire period the Benchmark is an approximation of US cash. Due to the effects of compounding, annualized historical returns, volatilities, and information ratios will not scale linearly. The returns are considered simulated or hypothetical.

Bridgewater Pure Alpha Strategy 12% Volatility Gross Performance Disclosure:

The performance history provided is based on actual Bridgewater Pure Alpha accounts. Returns since the strategy's inception in December 1991 through April 1999 are based on the actual performance of a partially funded account (where interest income has been removed to arrive at the excess returns), and are adjusted to include the imputed interest return on the full notional value using the US repo rate. Returns from May 1999 through present are the actual returns of the longest running fully funded Pure Alpha account with a target tracking error of 12%, an approximation of an United States cash benchmark, and fully unconstrained active management guidelines. Bridgewater manages additional Pure Alpha portfolios not included in this performance history.

Gross of fees performance is gross of management and performance fees and includes the reinvestment of interest, gains, losses, operating expenses and taxes. Returns will be reduced by the investment advisory fees that will be incurred in the management of the account.

Net of fees performance for the entire period shown have been calculated by applying a model fee based on our standard Pure Alpha 18% Volatility Strategy fee schedule, which are the highest standard fees charged. Investment advisory fees are described in Bridgewater's ADV Part 2A. From December 1991 through June 2008, using a monthly high water concept (and after June 2008, using a quarterly high water concept), deduction of incentive fees may vary and may be higher or lower than the fees actually charged to the account for the same time period. These returns reflect all fees (which are at our Pure Alpha standard rates), expenses and interest actually charged or credited to the account.

No representation is being made that any account will or is likely to achieve returns similar to those shown. Trading in futures is risky and can result in losses as well as profits. PAST RESULTS ARE NOT NECESSARILY INDICATIVE OF FUTURE RESULTS. Performance as of the current month is estimated and subject to change.

DEFENSIVE ALPHA STRATEGY 10% VOLATILITY USD

PERFORMANCE DISCLOSURE

Defensive Alpha Strategy 10% Volatility Net
(Net Total Returns from Jul 2022 through Jan 2024)

2022	-10.1%
2023	-6.2%
2024 YTD	1.3%
Avg Annual	-9.4%
StDev	14.9%
Ratio	--

Past results are not necessarily indicative of future results.

Average annual returns, standard deviation, and ratio reported as data available. Standard deviation and ratio calculated using gross of fees performance.

Bridgewater Defensive Alpha 10% Volatility Performance Disclosure

Performance from July 2022 to present is the actual returns of the Defensive Alpha account.

Gross of fees performance is gross of management and performance fees and includes the reinvestment of interest, gains, losses, operating expenses and taxes. Returns will be reduced by the investment advisory fees that will be incurred in the management of the account.

Net of fees performance has been calculated using a model fee based on our standard fee schedule for a minimum size account, which are the highest standard fees we have or would currently charge an account. Investment advisory fees are described in Bridgewater's ADV Part 2A.

No representation is being made that any account will or is likely to achieve returns similar to those shown. Trading in futures is risky and can result in losses as well as profits. PAST RESULTS ARE NOT NECESSARILY INDICATIVE OF FUTURE RESULTS. Performance as of the current month is estimated and subject to change.

DEFENSIVE ALPHA SIMULATION DISCLOSURE

Defensive Alpha Strategy Simulation Net
(Net Total Returns from Feb 1970 through Jun 2022)
(Annualized Total Returns in USD)

Last 1 Year	20.9%
Last 3 Years	8.4%
Last 5 Years	8.2%
Last 7 Years	7.1%
Last 10 Years	6.7%
Avg Annual	12.0%
StDev	11.3%
Ratio	0.64

Average annual returns and Sharpe ratio are calculated using net of fees performance, while the standard deviation is calculated using gross of fees performance. Past results are not necessarily indicative of future results. HYPOTHETICAL PERFORMANCE RESULTS HAVE MANY INHERENT LIMITATIONS, SOME OF WHICH ARE DESCRIBED BELOW. NO REPRESENTATION IS BEING MADE THAT ANY ACCOUNT WILL OR IS LIKELY TO ACHIEVE PROFITS OR LOSSES SIMILAR TO THOSE SHOWN. IN FACT, THERE ARE FREQUENTLY SHARP DIFFERENCES BETWEEN HYPOTHETICAL PERFORMANCE RESULTS AND THE ACTUAL RESULTS SUBSEQUENTLY ACHIEVED BY ANY PARTICULAR TRADING PROGRAM.

ONE OF THE LIMITATIONS OF HYPOTHETICAL PERFORMANCE RESULTS IS THAT THEY ARE GENERALLY PREPARED WITH THE BENEFIT OF HINDSIGHT. IN ADDITION, HYPOTHETICAL TRADING DOES NOT INVOLVE FINANCIAL RISK, AND NO HYPOTHETICAL TRADING RECORD CAN COMPLETELY ACCOUNT FOR THE IMPACT OF FINANCIAL RISK IN ACTUAL TRADING. FOR EXAMPLE, THE ABILITY TO WITHSTAND LOSSES OR TO ADHERE TO A PARTICULAR TRADING PROGRAM IN SPITE OF TRADING LOSSES ARE MATERIAL POINTS WHICH CAN ALSO ADVERSELY AFFECT ACTUAL TRADING RESULTS. THERE ARE NUMEROUS OTHER FACTORS RELATED TO THE MARKETS IN GENERAL OR TO THE IMPLEMENTATION OF ANY SPECIFIC TRADING PROGRAM WHICH CANNOT BE FULLY ACCOUNTED FOR IN THE PREPARATION OF HYPOTHETICAL PERFORMANCE RESULTS AND ALL OF WHICH CAN ADVERSELY AFFECT ACTUAL TRADING RESULTS. The recipient should not solely rely upon these hypothetical performance results in making an investment decision. In constructing hypothetical performance and determining their appropriateness for use in materials, Bridgewater has an incentive to do so in a manner that shows beneficial characteristics of a given, hypothetical return stream.

Defensive Alpha Simulation Performance Disclosure:

The simulated performance of the Defensive Strategy was derived by applying Bridgewater's investment systems and portfolio construction logic to historical market returns. For the high ratio assets component of the Defensive Alpha Strategy Simulation, returns are derived using current investment systems and portfolio construction logic. For the alpha component of the Defensive Alpha Strategy Simulation, returns are derived using Bridgewater's investment systems and portfolio construction logic as of mid-2022 to historical market returns. The alpha component included markets selected for the Defensive Strategy as of June 2022, and the relative weightings at that time. We use actual market returns when available and otherwise use Bridgewater Associates' proprietary estimates, based on other available data and our fundamental understanding of asset classes. In certain cases, market data for an exposure which otherwise would exist in the simulation may be omitted if the relevant data is unavailable, deemed unreliable, immaterial or accounted for using proxies. Examples of markets omitted or accounted for using proxies for part of the simulation period include, but are not limited to, emerging market equities, emerging market debt, and certain commodities. As we are constantly evolving our understanding, we expect that our investment systems, portfolio construction logic, included markets and their relative weightings will change in the future. Unless otherwise indicated, such changes will not be reflected in the alpha component of the Defensive Alpha Strategy Simulation. Note that, if such changes were incorporated into the Defensive Alpha Strategy Simulation, the simulated returns could be materially worse or better than the returns shown in the Defensive Alpha Strategy Simulation during certain periods or throughout the entirety of the simulation.

The Defensive Alpha Strategy simulation is an approximation of our investment process, and is intended to provide our best estimation, at a point in time, of our potential return characteristics. Simulated asset returns are subject to considerable uncertainty and potential error, as there is a great deal that cannot be known about how assets would have performed in the absence of actual market returns. Net of fees performance includes (i) a model management fee and other operating fees, (ii) reinvestment of interest, gains and losses and (iii) modeled transaction costs. Transaction costs are accounted for and are estimates themselves based on historical measured costs and or modeled costs. Actual transaction costs experienced could have been higher or lower than those reflected in the simulation. For total returns shown for Defensive Alpha Simulation in USD, a proxy for the return on US dollar cash is added to the simulation. For total returns shown for Defensive Alpha in a different currency, a proxy for the return on such currency's risk free rate is added to the simulation. Where shown, the Defensive Alpha Strategy Net of Fees returns have been calculated using the expected standard fee schedule for a minimum size account, which are the highest standard fees we would charge an account.

There is no guarantee regarding the Defensive Alpha Strategy's ability to perform in absolute returns or relative to any market in the future, during market events not represented or during market events occurring in the future. Market conditions and events vary considerably, are unpredictable and can have unforeseen impacts resulting in materially adverse results. ACCORDINGLY, PLEASE REACH OUT TO YOUR CLIENT ADVISOR IF YOU HAVE ANY QUESTIONS ABOUT THIS SIMULATION.

Markets included in the Defensive Alpha Simulation

The high ratio assets component of the Defensive Alpha Simulation includes returns from the following markets: global nominal interest rates, global inflation linked bonds, emerging market credit spreads, corporate credit spreads, global equities, and commodities. The alpha component of the Defensive Alpha Simulation is based on the simulated returns of positions in the following markets: global nominal interest rates, global inflation linked bonds, corporate credit spreads, global equities, developed market currencies, emerging market currencies, and commodities.

ACTIVE ALL WEATHER SIMULATION DISCLOSURE

Active All Weather Strategy Simulation
(Net Total Returns From Jan 1982 through Jan 2024)
(Annualized Total Returns in USD)

Last 1 Year	7.6%
Last 3 Years	7.1%
Last 5 Years	8.5%
Last 7 Years	7.0%
Last 10 Years	7.0%
Avg Annual	13.4%
StDev	10.8%
Ratio	0.89

Bridgewater Active All Weather Strategy Simulation Performance Disclosure:

We construct our Active All Weather Strategy simulation by applying select signals from Bridgewater's current investment systems and portfolio construction logic to a balanced portfolio in order to systematically adjust its exposures to geographies, asset classes, environmental betas, and currency denominations.

Gross of fees performance is gross of management and performance fees and includes the reinvestment of interest, gains, losses, expenses and taxes. Returns will be reduced by the investment advisory fees that will be incurred in the management of the account.

Active AW returns are calculated using 0.40% fixed fee and 15% performance fee on excess returns above 2.30%, charged annually. Active AW return simulation is humbled.

No representation is being made that any account will or is likely to achieve returns similar to those shown. Trading in futures is risky and can result in losses as well as profits. PAST RESULTS ARE NOT NECESSARILY INDICATIVE OF FUTURE RESULTS. Performance as of the current month is estimated and subject to change.



Virginia
Retirement
System

Closing Remarks

Andrew Junkin

Chief Investment Officer

Virginia Retirement System
1200 East Main Street



Virginia
Retirement
System

Welcome & Remarks

A. Scott Andrews
Chairman, VRS Board of Trustees

Virginia Retirement System
1200 East Main Street

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Guest Speaker: Artificial Intelligence

Greg Bond

Chief Executive Officer,
Man Numeric



Greg Bond ● Chief Executive Officer

Man Numeric



Gregory ('Greg') Bond is CEO of Man Numeric, Head of the Americas for Man Group, and a special advisor to Man Group's multi-strategy funds. He also serves on the Man Group Executive Committee and the Man Numeric Investment Committee.

Previously, Greg was director of research at Man Numeric, responsible for research initiatives, including the day-to-day management of Man Numeric's strategic alpha research team. Before becoming director of research, he was a portfolio manager for various hedge fund strategies at Numeric as well as being co-head of its hedge fund group, having joined in 2003.

Greg holds a Bachelor of Arts degree in economics and in biology from Yale University and a Master of Business Administration degree from Harvard Business School.



VRS

A.I., Economic Growth
& Competitive Advantage

Greg Bond, Numeric CEO & Head of the Americas

March 2024

Prepared exclusively for VRS. Not for onward distribution.



- Why we may need A.I. to stimulate economic growth
- Where A.I. might help and its limits
- Machine learning in practice at Man Group
- Closing remarks on A.I., technology and competitive advantage

Sustaining Productivity is Hard

Yes, Apple's revenue growth has fallen over the last 10 years, but the prior ten years (2002-2011) was a period of extraordinary innovation (e.g., iPod, iPhone). Perhaps we should cut them some slack? 10% revenue growth per year is still pretty good! Is there anything we should worry about?

	2002-2011	2012-2021	Factor	Annual Rate of Change
	(A)	(B)	(C) = (B) ÷ (A)	(D) = ln[(C)] ÷ 10
Avg. Revenue Growth (real \$'s)	28%	10%	0.4x	-10% ¹

1. This is the growth rate of the growth rate. What is the rate of Apple's revenue growth? Between the two 10-year periods, revenue growth decayed at a rate of 10% per year. To manage outliers in the broader dataset, year-over-year growth rates are computed as $(y1-y0)÷(.5*y1+.5*y0)$. Sources: Numeric calculations, S&P Compustat, Center for Research in Security Prices (CRSP), U.S. Census Bureau (wage data), and U.S. Bureau of Economic Analysis (price deflator). We broadly follow the methodology outlined in Bloom, Nicholas, Charles I. Jones, John Van Reenen, and Michael Webb. 2020. "Are Ideas Getting Harder to Find?" American Economic Review, 110 (4): 1104-44.

Sustaining Productivity is Hard

Apple spent 12.4x more on R&D from 2012-2021 than it did in the previous ten-year period yet generated only 0.4x as much growth.

	Apple Inc.			Annual
	2002-2011	2012-2021	Factor	Rate of Change
	(A)	(B)	(C) = (B) ÷ (A)	(D) = ln[(C)] ÷ 10
Avg. Revenue Growth (real \$'s)	28%	10%	0.4x	-10% ¹
“Researchers & Developers”	8 k	103 k	12.4x	25%

\$'s of R&D spending ÷ average wage of skilled labor

We have converted R&D spending into an “equivalent” number of “researchers & developers” by dividing by the average wage of skilled labor in each period.

1. This is the growth rate of the growth rate. What is the rate of Apple's revenue growth? Between the two 10-year periods, revenue growth decayed at a rate of 10% per year. To manage outliers in the broader dataset, year-over-year growth rates are computed as $(y1-y0)÷(.5*y1+.5*y0)$. Sources: Numeric calculations, S&P Compustat, Center for Research in Security Prices (CRSP), U.S. Census Bureau (wage data), and U.S. Bureau of Economic Analysis (price deflator). We broadly follow the methodology outlined in Bloom, Nicholas, Charles I. Jones, John Van Reenen, and Michael Webb. 2020. "Are Ideas Getting Harder to Find?" American Economic Review, 110 (4): 1104-44.

Sustaining Productivity is Hard

As a result, Apple's research productivity is only 3% of what it was between 2002-2011, implying a 35% annual drop. In contrast, R&D spending is up 25% per year over the same period.

	Apple Inc.			
	2002-2011	2012-2021	Factor	Annual Rate of Change
	(A)	(B)	(C) = (B) ÷ (A)	(D) = ln[(C)] ÷ 10
Avg. Revenue Growth (real \$'s)	28%	10%	0.4x	-10% ¹
"Researchers & Developers"	8 k	103 k	12.4x	25%
R&D Productivity (Growth ÷ No. of R&D'ers)	3.3% per 1k	0.1% per 1k	0.03x	-35%

1. This is the growth rate of the growth rate. What is the rate of Apple's revenue growth? Between the two 10-year periods, revenue growth decayed at a rate of 10% per year. To manage outliers in the broader dataset, year-over-year growth rates are computed as $(y_1 - y_0) / (.5 * y_1 + .5 * y_0)$. Sources: Numeric calculations, S&P Compustat, Center for Research in Security Prices (CRSP), U.S. Census Bureau (wage data), and U.S. Bureau of Economic Analysis (price deflator). We broadly follow the methodology outlined in Bloom, Nicholas, Charles I. Jones, John Van Reenen, and Michael Webb. 2020. "Are Ideas Getting Harder to Find?" American Economic Review, 110 (4): 1104-44.

Looking at the [F]AANGM¹ stocks specifically and at U.S. companies engaged in R&D broadly², we see similar effects: increased expenditure in R&D is more than offset by a drop in R&D productivity. The result: decreases of 2%-10% per year in the rate of revenue growth.

	Between 2002-2011 & 2012-2021 Annual Rate of Change in:					
	Median "R&D'ers" 2012-2021 ³	Revenue Growth ⁴	=	No. of R&D'ers	+	R&D Productivity
AAPL	103 k	-10%		25%		-35%
AMZN	175 k	-2%		31%		-33%
NFLX	9 k	-4%		25%		-29%
GOOG	148 k	-6%		16%		-23%
MSFT	129 k	-2%		4%		-6%
U.S. Non-Financial Firms w/ R&D spending > 0 (n = 363):						
Weighted Avg.	27 k	-6%		9%		-15%
Unweighted Avg.	0.6 k	-4%		7%		-11%

1. Excludes Facebook/Meta which went public in 2012. Tesla went public in 2010 and would have been a good case study too! 2. Includes only companies with R&D spending, at least 5 annual observations in both 10-year periods, and with positive average sales growth in both periods. Each company in the weighted average below is weighted by the average of its median R&D'ers between 2002-2011 & 2012-2021. Excludes companies in the Financials sector and ADR's. 3. Defined as \$'s of R&D spending ÷ average wage of skilled labor. 4. This is the growth rate of the average revenue growth rate between the two 10-year periods. A value of '0' would imply a company's annual growth rate between 2012-2021 equaled the rate between 2002-2011.

Sources: Numeric calculations, S&P Compustat, Center for Research in Security Prices (CRSP), U.S. Census Bureau (wage data), and U.S. Bureau of Economic Analysis (price deflator). We broadly follow the methodology outlined in Bloom, Nicholas, Charles I. Jones, John Van Reenen, and Michael Webb. 2020. "Are Ideas Getting Harder to Find?" American Economic Review, 110 (4): 1104-44.

Ideas are Getting Harder to Find in Multiple Fields

Bloom et al. (2020)¹

Chip industry:

“The number of researchers required today to achieve the famous doubling of...density is more than 18 times larger than the number required in the early 1970s.”

Across all U.S. firms:

“It requires 15 times more researchers today than it did 30 years ago to produce the same rate of firm revenue growth.”

Research Productivity

TABLE 7—SUMMARY OF THE EVIDENCE ON RESEARCH PRODUCTIVITY

Scope	Time period	Average annual growth rate (%)	Half-life (years)	Dynamic diminishing returns, β
Aggregate economy	1930–2015	−5.1	14	3.1
Moore’s Law	1971–2014	−6.8	10	0.2
Semiconductor TFP growth	1975–2011	−5.6	12	0.4
Agriculture, US R&D	1970–2007	−3.7	19	2.2
Agriculture, global R&D	1980–2010	−5.5	13	3.3
Corn, version 1	1969–2009	−9.9	7	7.2
Corn, version 2	1969–2009	−6.2	11	4.5
Soybeans, version 1	1969–2009	−7.3	9	6.3
Soybeans, version 2	1969–2009	−4.4	16	3.8
Cotton, version 1	1969–2009	−3.4	21	2.5
Cotton, version 2	1969–2009	+1.3	−55	−0.9
Wheat, version 1	1969–2009	−6.1	11	6.8
Wheat, version 2	1969–2009	−3.3	21	3.7
New molecular entities	1970–2015	−3.5	20	...
Cancer (all), publications	1975–2006	−0.6	116	...
Cancer (all), trials	1975–2006	−5.7	12	...
Breast cancer, publications	1975–2006	−6.1	11	...
Breast cancer, trials	1975–2006	−10.1	7	...
Heart disease, publications	1968–2011	−3.7	19	...
Heart disease, trials	1968–2011	−7.2	10	...
Compustat, sales	3 decades	−11.1	6	1.1
Compustat, market cap	3 decades	−9.2	8	0.9
Compustat, employment	3 decades	−14.5	5	1.8
Compustat, sales/employment	3 decades	−4.5	15	1.1
Census of Manufacturing	1992–2012	−7.8	9	...

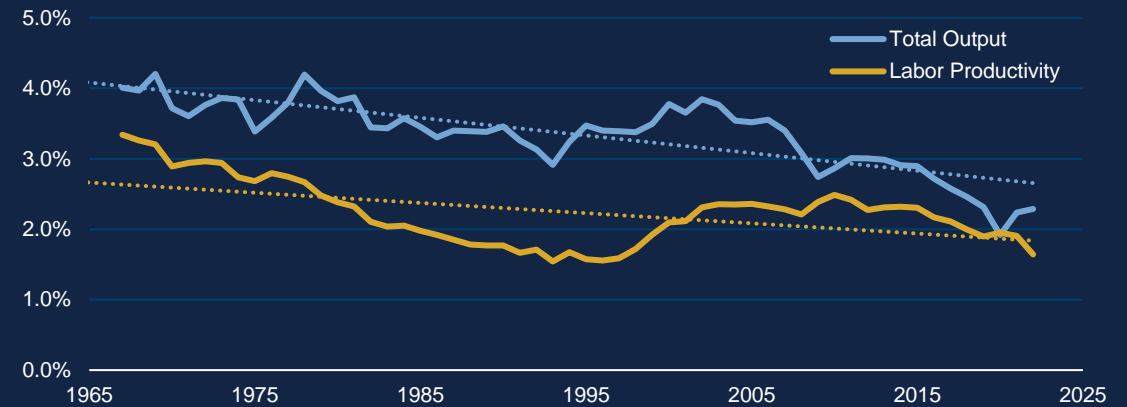
Notes: The growth rates of research productivity are taken from other tables in this paper. The half-life is the number of years it takes for research productivity to fall in half at this growth rate. The last column reports the extent of dynamic diminishing returns in producing exponential growth, according to equation (17). This measure is only reported for cases in which the idea output measure is an exponential growth rate (i.e., not for the health technologies, where units would matter).

1. Bloom, Nicholas, Charles I. Jones, John Van Reenen, and Michael Webb. 2020. “Are Ideas Getting Harder to Find?” *American Economic Review*, 110 (4): 1104–44.

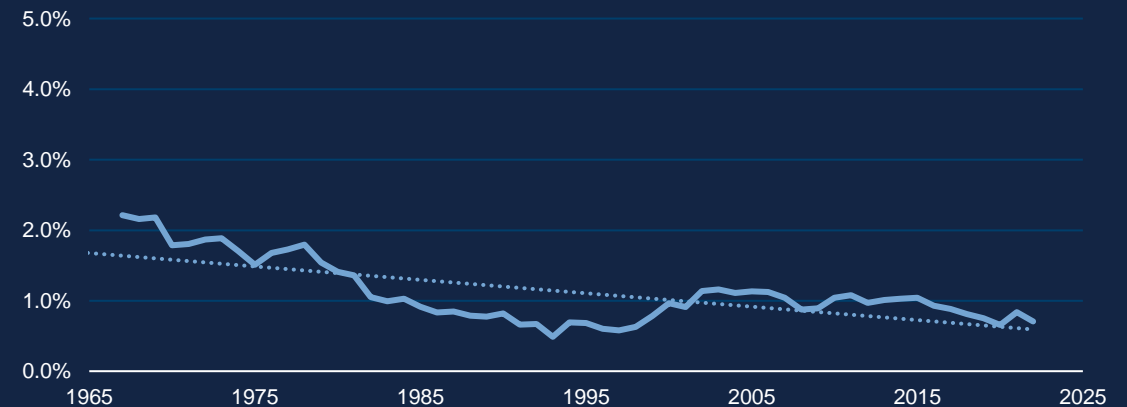
Paradox of the Digital Age: Where's the Growth?

- Growth in both total output and labor productivity (i.e., output per hour worked) is trending downward
- Drop in Total Factor Productivity (TFP) is a key component
 - TFP is the part of output growth not coming from growth in capital or labor
 - A catch-all measurement of technological change
- Significant debate about the drivers of lower growth with some forecasts for the future more pessimistic than others
- How could A.I. help?

U.S. Output Growth¹



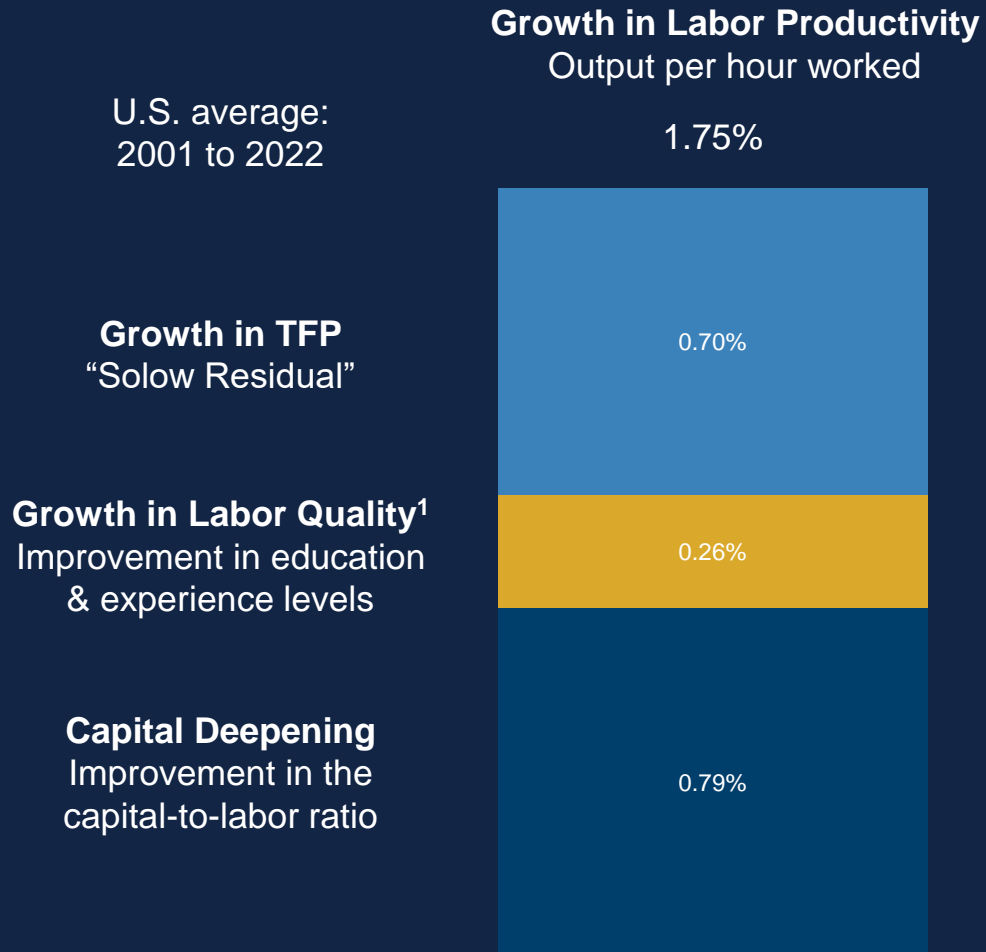
Growth in Total Factor Productivity¹



1. Covers 1948 to 2022. Figures display rolling 20-year averages.

Sources: Numeric calculations & Federal Reserve Bank of San Francisco. John G. Fernald, "A Quarterly, Utilization-Adjusted Series on Total Factor Productivity." FRBSF Working Paper 2012-19 (updated March 2014). Produced on March 07, 2023 10:54 AM by John Fernald/Ethan Goode--fernaljdj@gmail.com (Directory: out\QuarterlyTFP_2023.03.07.2)

A Look at Growth Accounting Levers



Capital Deepening

- Labor force savings via **task automation**
- Rate, not level, of automation drives enhanced growth
- Can we **automate innovation** itself?

Examples:

- Autonomous cars & trucks
- Call center automation
- Autonomous researchers(?)

Growth in TFP

- Firms “catching-up” to the tech frontier
- Easier to measure input costs than benefits
- Assumed J-curve payoff for investments

Examples:

- Optimize energy efficiency & materials usage in a plant
- Forecast product demand or vehicle maintenance

1. Without this quality adjustment, TFP may be biased upwards during recessions due to lower quality workers being disproportionately unemployed. The reverse is true during economic expansions.

Sources: Numeric calculations & Federal Reserve Bank of San Francisco. John G. Fernald, "A Quarterly, Utilization-Adjusted Series on Total Factor Productivity." FRBSF Working Paper 2012-19 (updated March 2014). Produced on March 07, 2023 10:54 AM by John Fernald/Ethan Goode--fernaljdj@gmail.com (Directory: out\QuarterlyTFP_2023.03.07.2). Artificial Intelligence and the Modern Productivity Paradox: A Clash of Expectations and Statistics, Erik Brynjolfsson, Daniel Rock, Chad Syverson. and Artificial Intelligence and Economic Growth, Philippe Aghion, Benjamin F. Jones, Charles I. Jones in The Economics of Artificial Intelligence: An Agenda, Agrawal, Gans, and Goldfarb. 2019. For a broader discussion on productivity growth please see <https://www.man.com/maninstitute/productivity-growth>.

“ For increasing capabilities of computers to lead to the Singularity would require that AI could encompass all human activities, not just add numbers, solve equations, play chess, and interpret speech; but also lay hands on patients, babysit and comfort children, and mediate disputes.”

– William Nordhaus (2021)¹

Limits on A.I.'s Impact – How much will a babysitter cost?

- Relationship is consistent with Baumol hypothesis – negative correlation between growth in output prices and TFP
- Tech hardware is important driver – all observations in the bottom right quadrant are in the sector
- Pharma, rental services (e.g., for cars), and apparel have exhibited the biggest drops in TFP over the period
- Tobacco, legal services, and oil and gas extraction have had among the highest increases in prices

U.S. Growth in Output Prices vs. Growth in TFP by Industry, 1987-2020



Three Stages of Intelligent Machines

Nordhaus (2021)¹



Stage One: Calculation

Machines take orders – read inputs and produce processed data as outputs

Examples: weather forecasts, medical scans, advanced econometrics



Stage Two: Computerized Control & Production

Machines take orders – control other machines & engage in production

Examples: programmable robots, computer assisted design, airline reservations, autonomous cars

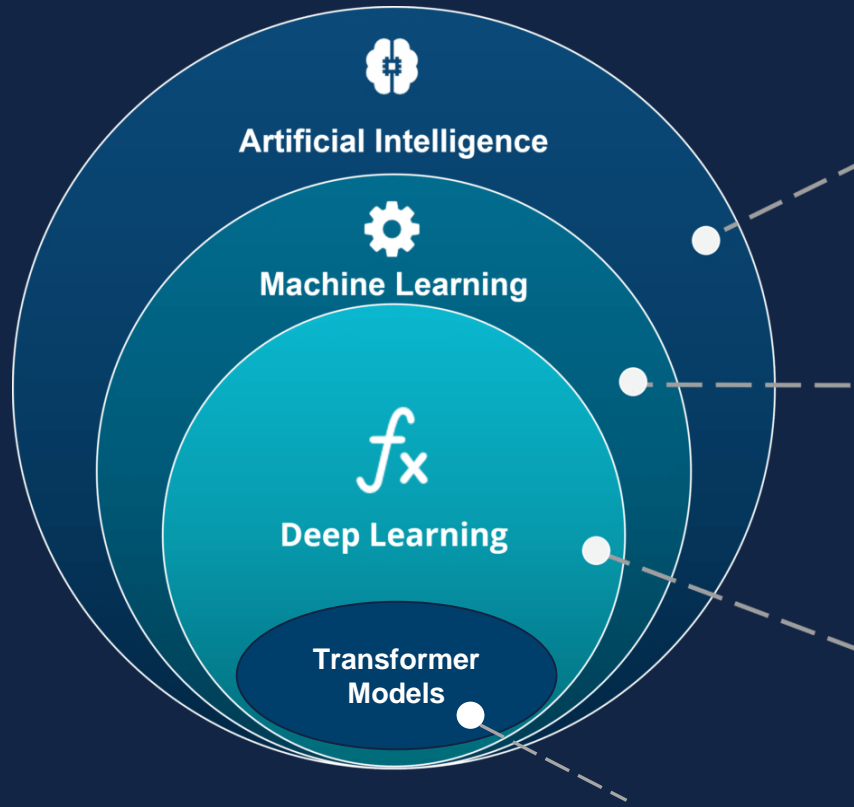


Stage Three: Computerized Innovation

Design new and improved production processes

Examples: automated theorem proving, writing songs, newspaper articles, and poems

Machine Learning in Practice at Man Group



ARTIFICIAL INTELLIGENCE

A technique which enables machines to mimic human behavior

MACHINE LEARNING

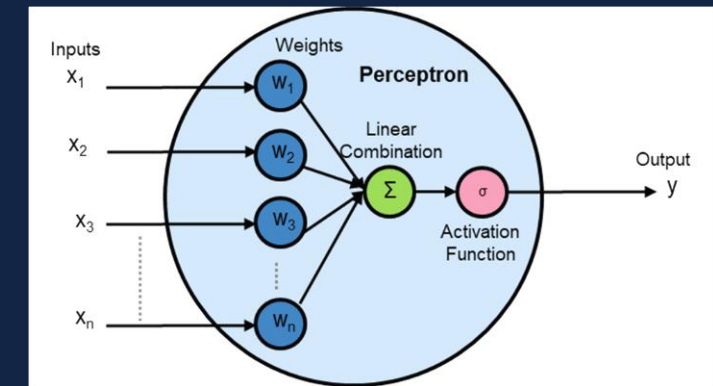
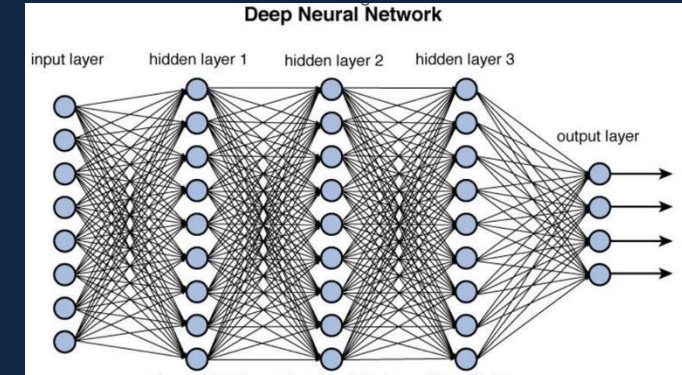
Subset of AI techniques which use statistical methods to enable machines to improve with experience

DEEP LEARNING

Subset of ML which make the computation of multi-layer neural network feasible

TRANSFORMER MODELS

A type of deep learning model which is very applicable to natural languages and which powers ChatGPT

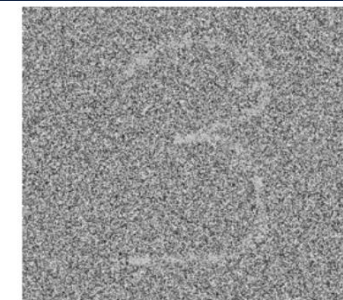


What Financial Problems Can ML Solve?

- Loads of data:
 - Volume, Variety, Veracity, Velocity
- Well defined objective function
- Nonlinear and complex in nature
- Good signal to noise ratio
- Stationary setting

High Signal
to Noise
Ratio

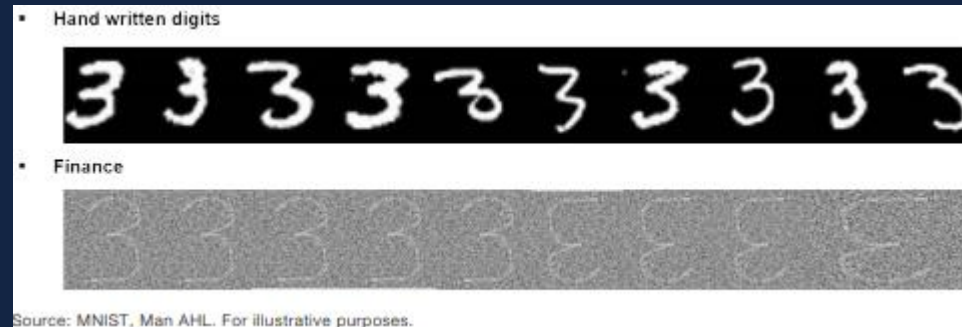
Noise or
Signal?



Source: MNIST, Man AHL. For illustrative purposes.

Stationarity: writing 3 the same way for 100s of years

In Finance, correlations may change



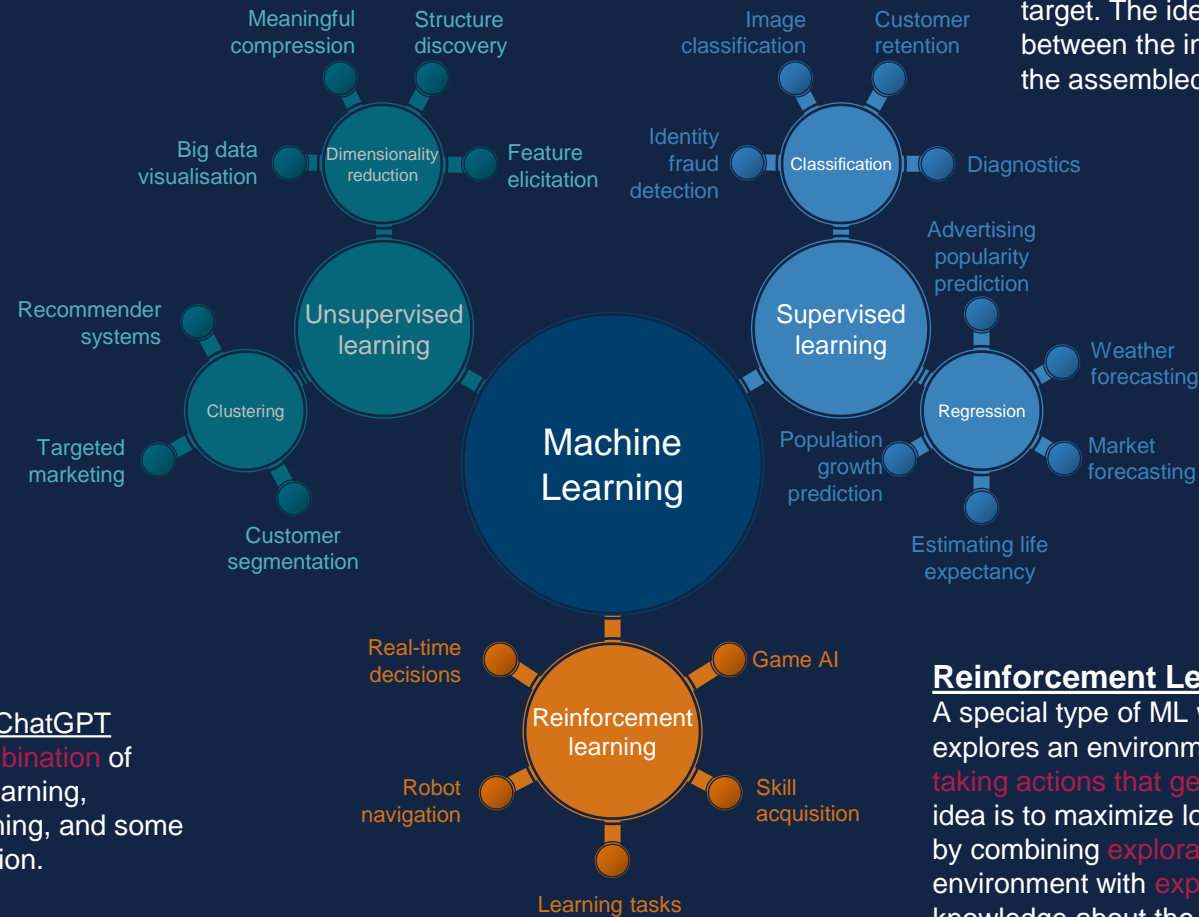
Source: MNIST, Man AHL. For illustrative purposes.

Unsupervised Learning

Elements of the training data do not have outcomes, and the focus is then on **identifying structure** within the training data.

Supervised Learning

Each example in the training data has both input features (things you can observe, measure or infer) and an outcome or target. The idea is to **learn the relationship** between the inputs and the outcomes from the assembled training data.



Quick aside on ChatGPT

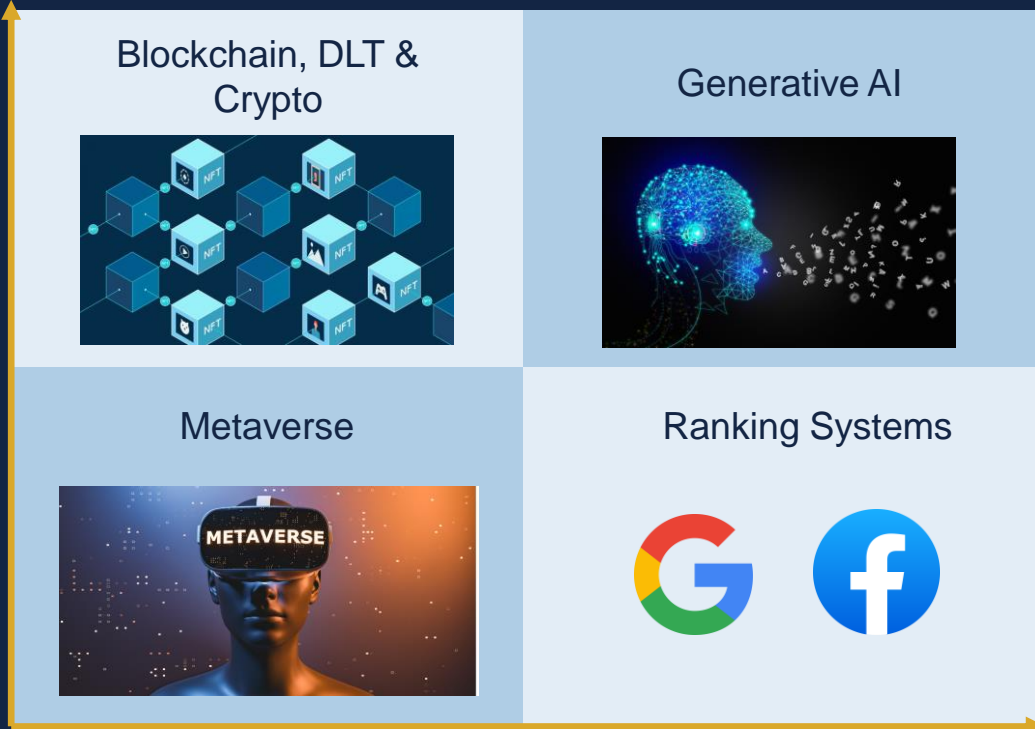
Relies on a **combination** of reinforcement learning, supervised learning, and some human supervision.

Reinforcement Learning

A special type of ML where an agent explores an environment sequentially by **taking actions that generate rewards**. The idea is to maximize long-run total reward by combining **exploration** of the environment with **exploitation** of knowledge about the observed rewards.

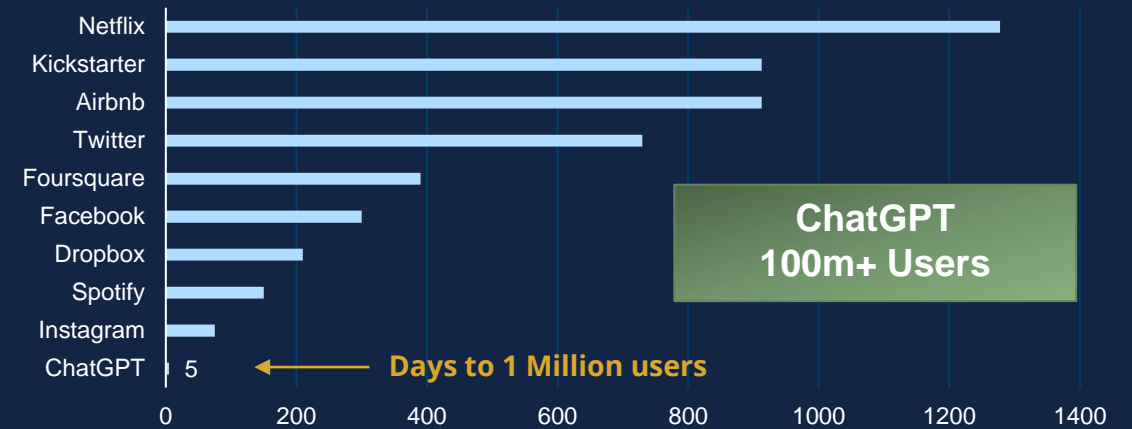
Step in Investment Process:	Unsupervised Learning	Supervised Learning (Target ~ Features)	Reinforcement Learning
Data		<ul style="list-style-type: none"> • Geolocation (facility identification) • Automated Feature Extraction 	
Models	<ul style="list-style-type: none"> • Company network indirect linkages (Ecosystem Model) • MacroScope & extensions (contextual mapping) • Principal Components Based Models 	<ul style="list-style-type: none"> • ESG incident prediction • Security forecasting (non-linear relationships) • NLP – making sense of words (sentiment, topic modeling contextual embedding) 	<ul style="list-style-type: none"> • Security Forecasting (Non-Linear Relationships)
Portfolio Construction	<ul style="list-style-type: none"> • Statistical Factor Risk Model (SFRM) • Clustering Analysis 	<ul style="list-style-type: none"> • Model Ensemble Models 	
Trading		<ul style="list-style-type: none"> • Limit order book modeling (Oxford Man Institute) 	<ul style="list-style-type: none"> • Optimal route selection (AIR model)

Hype



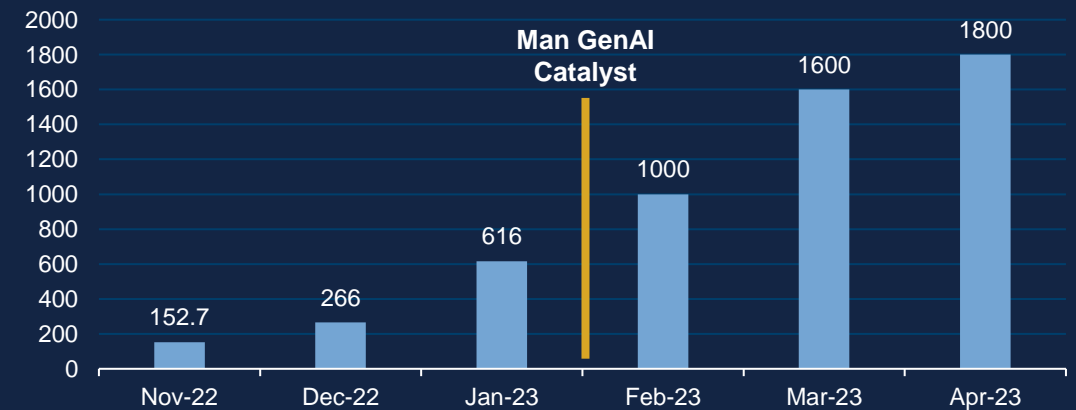
Impact

Fastest Growing App in History¹



ChatGPT
100m+ Users

Growth of ChatGPT Visits (k)¹



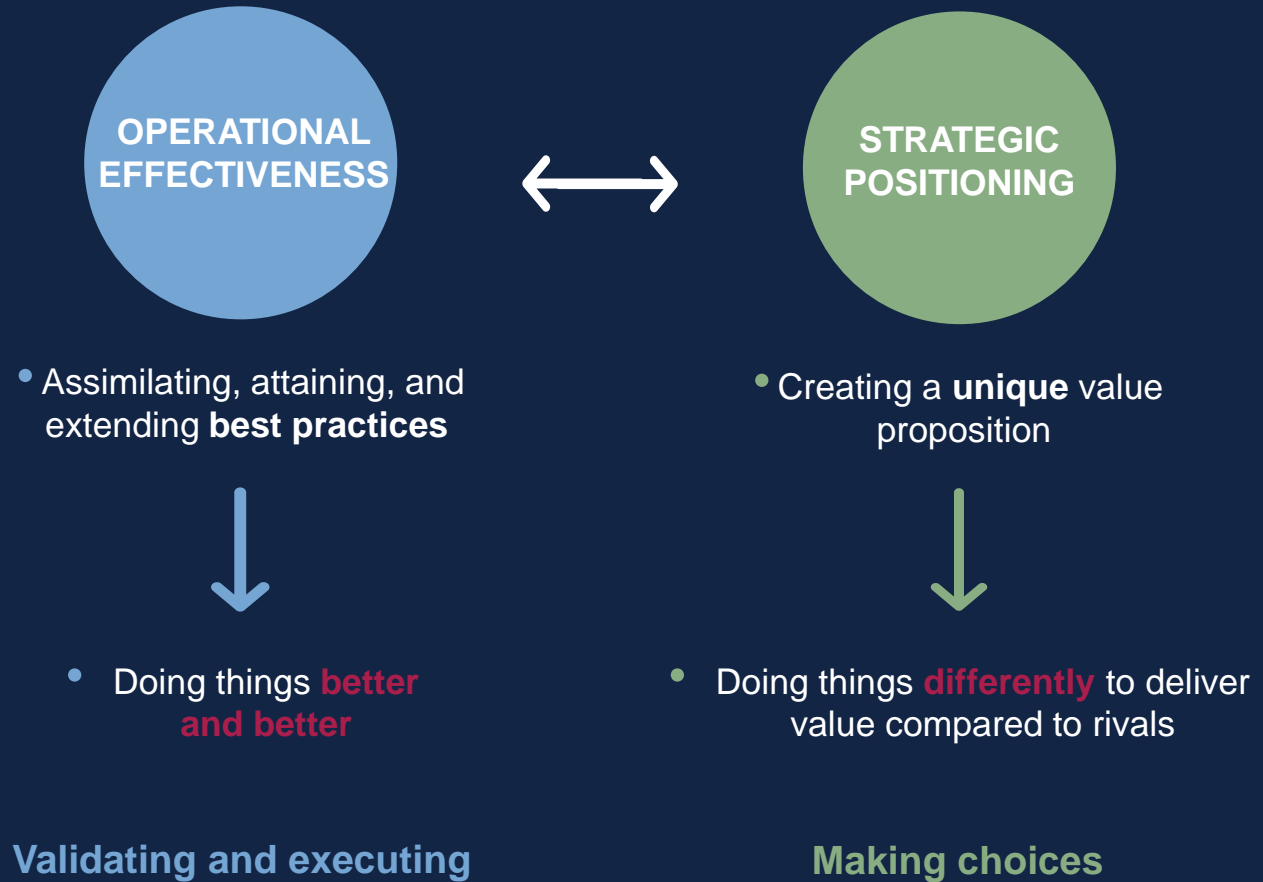
1. <https://explodingtopics.com/blog/chatgpt-users>

Machine Learning & Competitive Advantage

Efficiency is important but it's not strategy

Operational effectiveness is not strategy

Strategy requires choices



1. Source: Michael Porter "What is Strategy?" <https://www.isc.hbs.edu/strategy/business-strategy/Pages/operational-effectiveness-vs-strategy.aspx>

Tech, A.I., and Competitive Advantage

Drivers of Sustainable Advantage

Strong firm philosophy: what we will *and* won't do – tradeoffs are real

Alignment across all firm activities: tech, research, pm, operations, marketing

Deep understanding: How do new techniques / data fit within the firm's philosophy & culture (not the other way around)

The Myth of the “Killer” App

New technologies typically complement *not* replace at least in our experience

“Proprietary” ideas and data often get copied

But, having many, uncorrelated models or concepts creates a natural barrier to imitation

A competitor copying 90% of each of your 50 ideas replicates less than 1% of your overall firm ($0.9^{50} = 0.5\%$)

“Technology” alone is not a source of competitive advantage – it's the interconnection and alignment of all activities across the firm that matters¹

1. See for example, Michael Porter “What is Strategy?” <https://www.isc.hbs.edu/strategy/business-strategy/Pages/operational-effectiveness-vs-strategy.aspx>

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