SERS 2024 Board Retreat
Friday, February 16, 2024

Join Zoom Meeting
https://ohsers.zoom.us/j/98309919238?pwd=OE91VFFNazJiWFY4ejZyVlFkZzUwdz09

Meeting ID: 983 0991 9238 **Password:** 12345

To Join by Phone, Dial: (**301) 715-8592** and enter the **Meeting ID:** 983 0991 9238 and **Password:** 12345 when prompted.

8:30 a.m. – 8:35 a.m.	**Introduction/Overview**	**Richard Stensrud,** **SERS Executive Director**
8:35 a.m. – 9:45 a.m.	**The Good, The Bad, & The Ugly** **Educational Session under R.C. 171.50 and 3309.051**	**Dr. Anirban Basu - Chairman & CEO** **Sage Policy Group, Inc.**
9:45 a.m. – 10:00 a.m.	**Break**	
10:00 a.m. – 11:30 a.m.	**Outlook for 2024: Glass Half Full** **Educational Session under R.C. 171.50 and 3309.051**	**Dave McNellis and Ari Barkan** **KKR**
11:30 a.m. – 12:30 p.m.	**Lunch**	
12:30 p.m. – 1:45 p.m.	**Artificial Intelligence (AI) Presentation** **Educational Session under R.C. 171.50 and 3309.051**	**Nathan Haws** **Associate Principal Consultant** **Linea Solutions, Inc**
1:45 p.m. – 2:00 p.m.	**Break**	
2:00 p.m. – 3:15 p.m.	**Pension Sustainability** **Educational Session under R.C. 171.50 and 3309.051**	**John Garrett and Todd Green** **Cavanaugh Macdonald Consulting**
3:15 p.m. – 3:30 p.m.	**Closing Remarks**	**Richard Stensrud, SERS Executive Director**

FY2024 SERS Board Roll Call

Frank Weglarz	_____
Matthew King	_____
Jeffrey DeLeone	_____
James Haller	_____
Catherine Moss	_____
Barbra Phillips	_____
James Rossler	_____
Aimee Russell	_____
Daniel Wilson	_____

Anirban Basu, MPP, MA, JD, Ph.D.
Chairman & Chief Executive Officer
Sage Policy Group, Inc.
575 South Charles Street Suite 505
Baltimore, MD 21201
410-522-7243
email: abasu@sagepolicy.com

Career Brief

Anirban Basu is Chairman & CEO of Sage Policy Group, Inc., an economic and policy consulting firm headquartered in Baltimore, Maryland with an office in Orlando, Florida. The firm provides strategic analytical services to energy suppliers, law firms, medical systems, government agencies, and real estate developers among others.

In 2014, Maryland Governor Larry Hogan appointed him Chair of the Maryland Economic Development Commission (2014-2021). He serves as Chairman of the Baltimore County Economic Advisory Committee. He also serves the chief economist function for Associated Builders and Contractors, the Construction Financial Management Association, the Modular Building Institute, the Maryland Bankers Association, and several others.

He has taught at several universities, most frequently at the Johns Hopkins University. He currently teaches History of Economic Thought at Goucher College as their Distinguished Economist in Residence.

In 2007, 2016, and 2022, the *Daily Record* newspaper selected Dr. Basu as one of Maryland's 50 most influential people. The Baltimore Business Journal named him one of the region's 20 most powerful business leaders in 2010.

Dr. Basu is currently on the boards of the University of Maryland School of Law, St. Mary's College, the University of Maryland Medical Center, the University System of Maryland Foundation, the Lyric Opera House and the Archdiocese of Baltimore School System. He is also on Truist Bank's advisory board.

Dr. Basu earned his B.S. in Foreign Service at Georgetown University. He earned his Master's in Public Policy from Harvard University's John F. Kennedy School of Government, and his Master's in Economics from the University of Maryland, College Park. He acquired his Juris Doctor at the University of Maryland School of Law. He completed his doctoral work at UMBC with a concentration in health economics.

The Good, The Bad, & The Ugly

By: Anirban Basu
MPP, MA, JD, PHD
Sage Policy Group, Inc.

On Behalf of

School Employees
Retirement System of Ohio
2024 Annual Board Retreat

February 16, 2024

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The Good

Current Momentum

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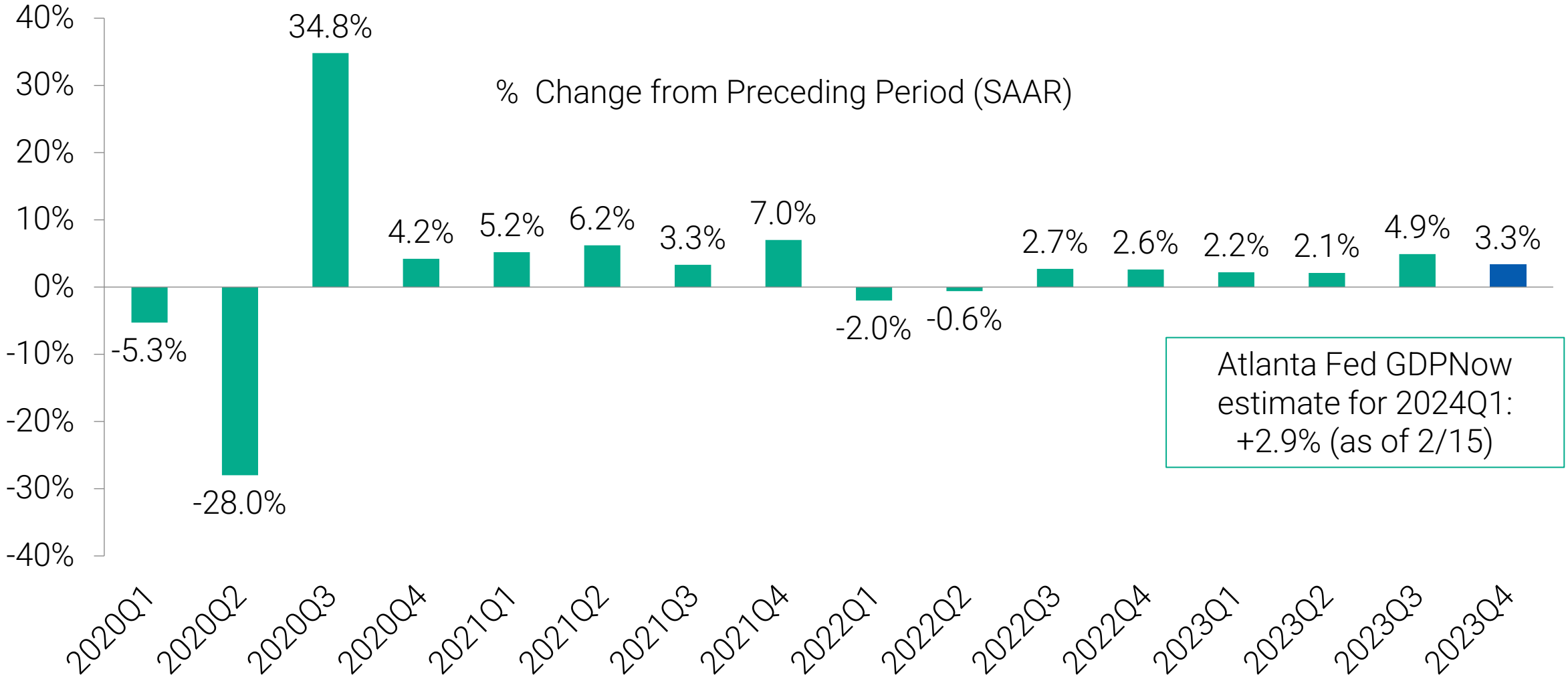
Where Eagles Dare

U.S. Gross Domestic Product Growth, 2020 – 2023Q4



Atlanta Fed GDPNow estimate for 2024Q1: +2.9% (as of 2/15)

Source: U.S. Bureau of Economic Analysis *2023Q4: 1st (advance) estimate **Where Eagles Dare was a 1969 film

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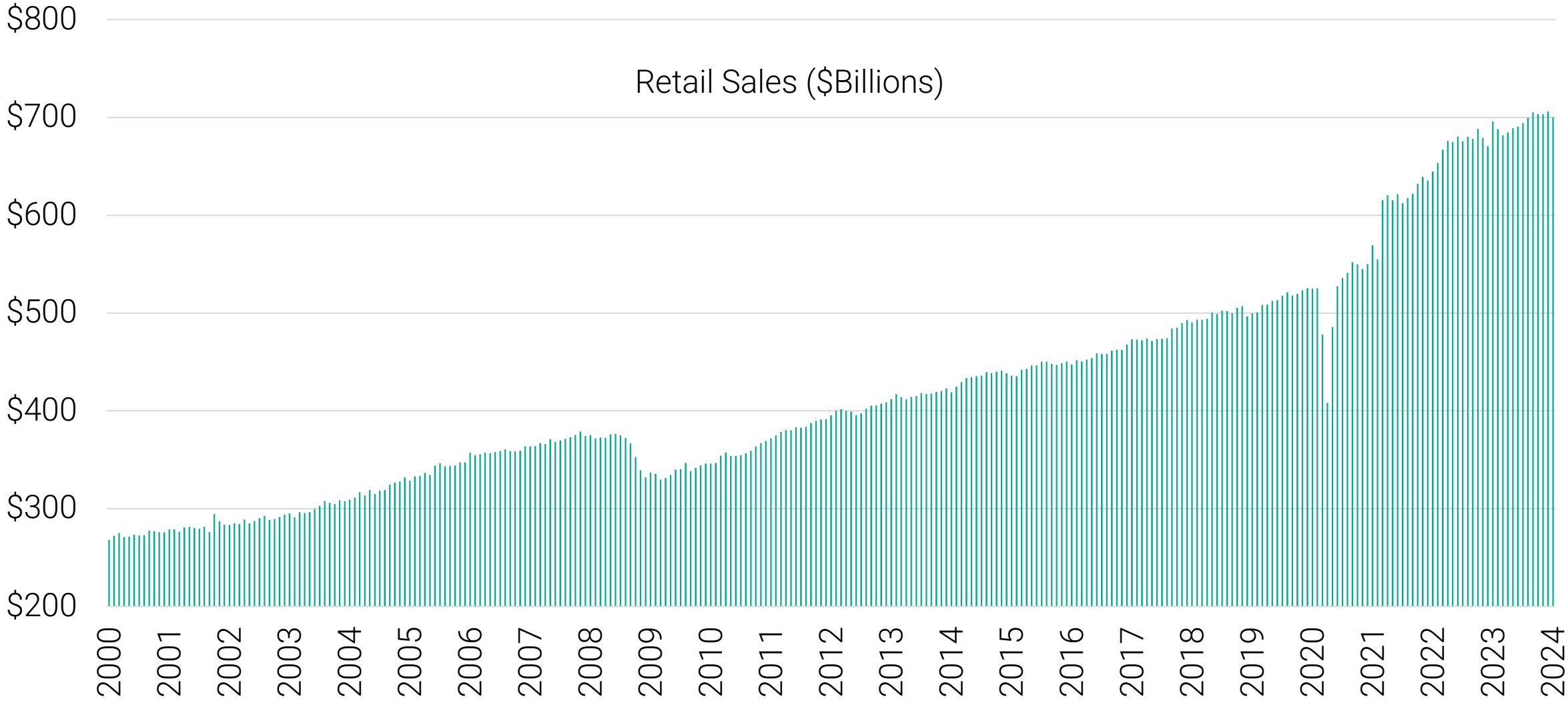
A Fistful of Dollars (a 1964 Film)

U.S. Retail Sales, 2000 – January 2024



Source: U.S. Census Bureau

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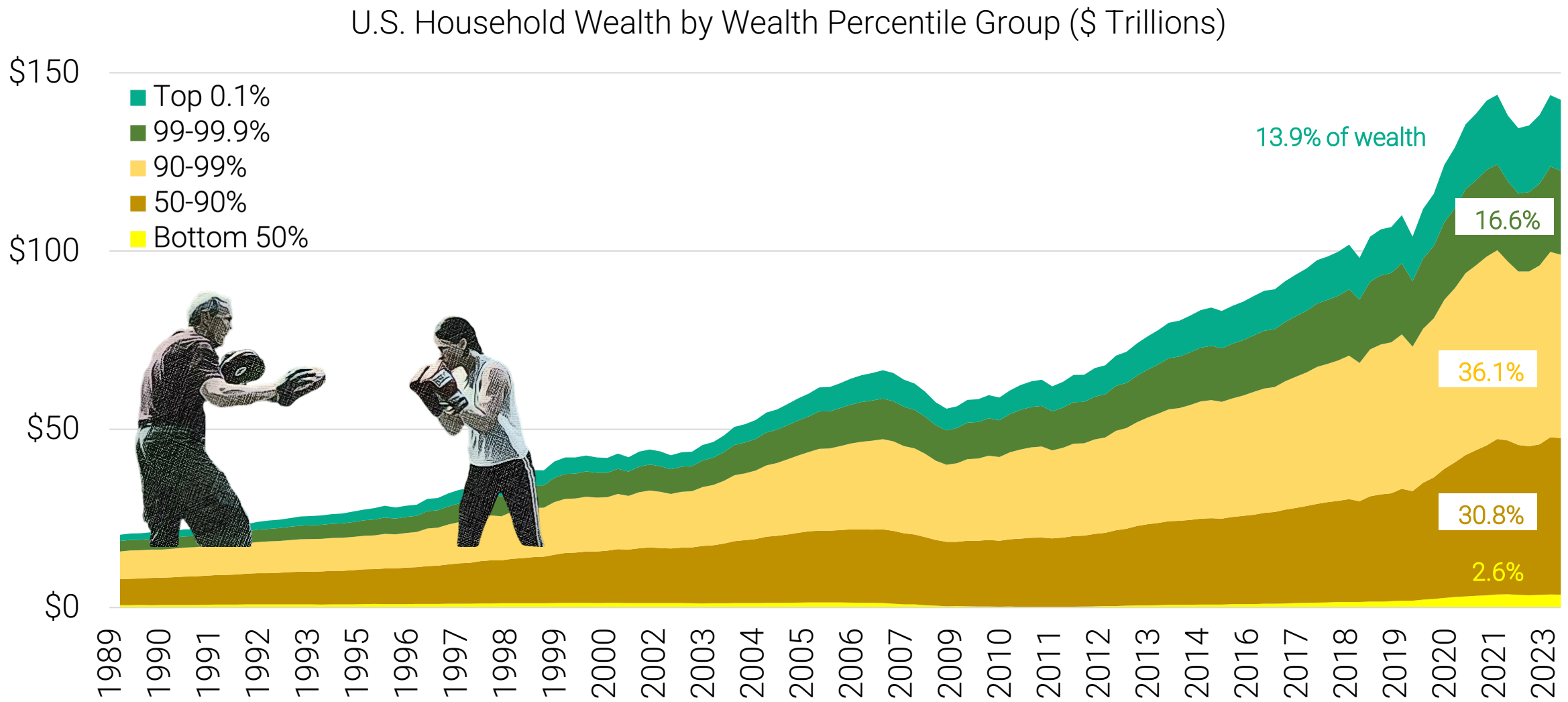
Million Dollar Baby (a 2004 Flick)



Source: Federal Reserve Board, Distributional Financial Accounts (DFAs)

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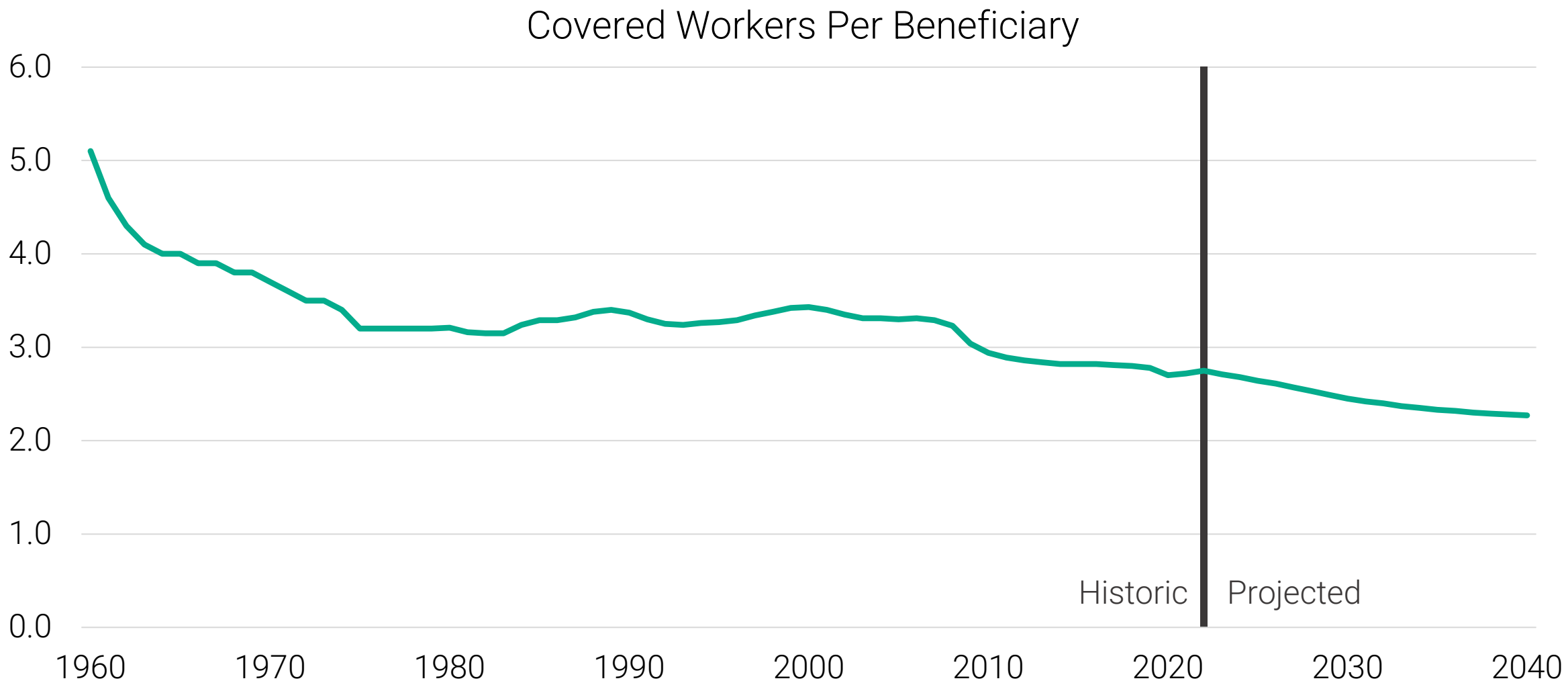
U.S. Workers Per Social Security Beneficiary

1960 – 2040 Projected



Source: Social Security Administration, "The 2023 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds". Note: Beneficiaries: are beneficiaries of Old-Age, Survivors Insurance, and Federal Disability Insurance (OASDI).

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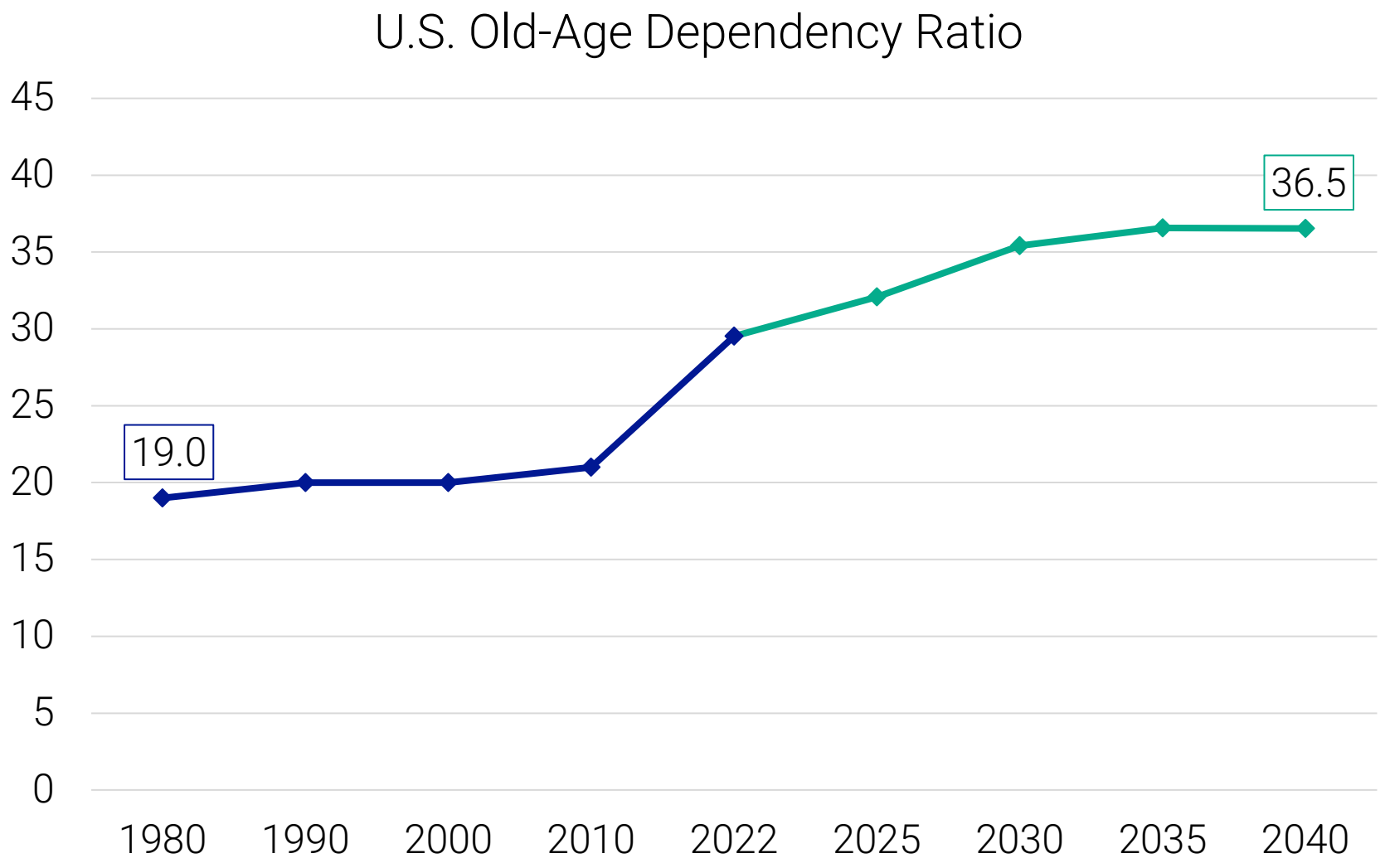
U.S. Old-Age Dependency Ratio, 1980 – 2040 Projected



- In 1980 there were 19 retirement age adults (age 65+) for every 100 working age Americans (ages of 18-64).
- The Census Bureau projects that that number will rise to almost 37 retirement aged adults for every 100 Americans of working age by 2040.

Source: U.S. Census Bureau. Note. Old age dependency ratio: A measure derived by dividing the population 65 years and over by the 18 to 64 years population and multiplying by 100.

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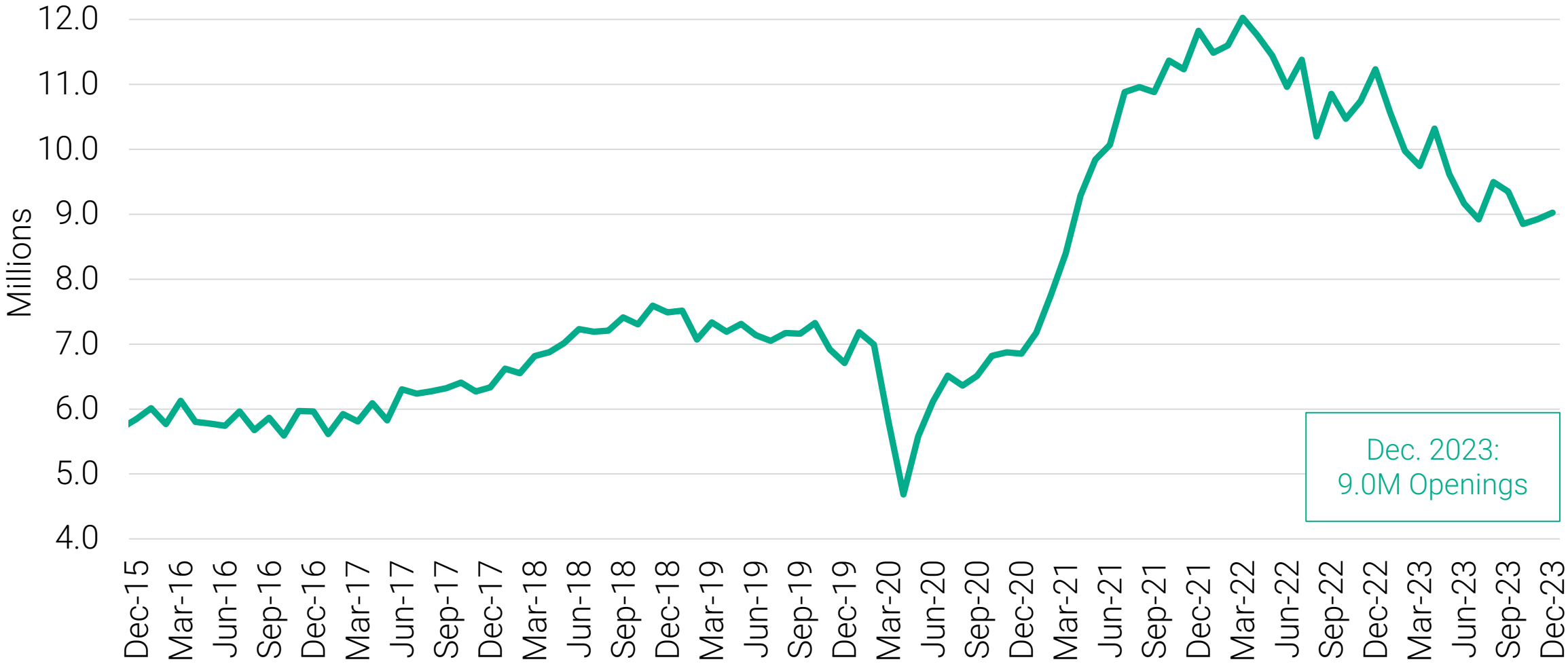
U.S. Job Openings, 2015 – December 2023



Source: U.S. Bureau of Labor Statistics

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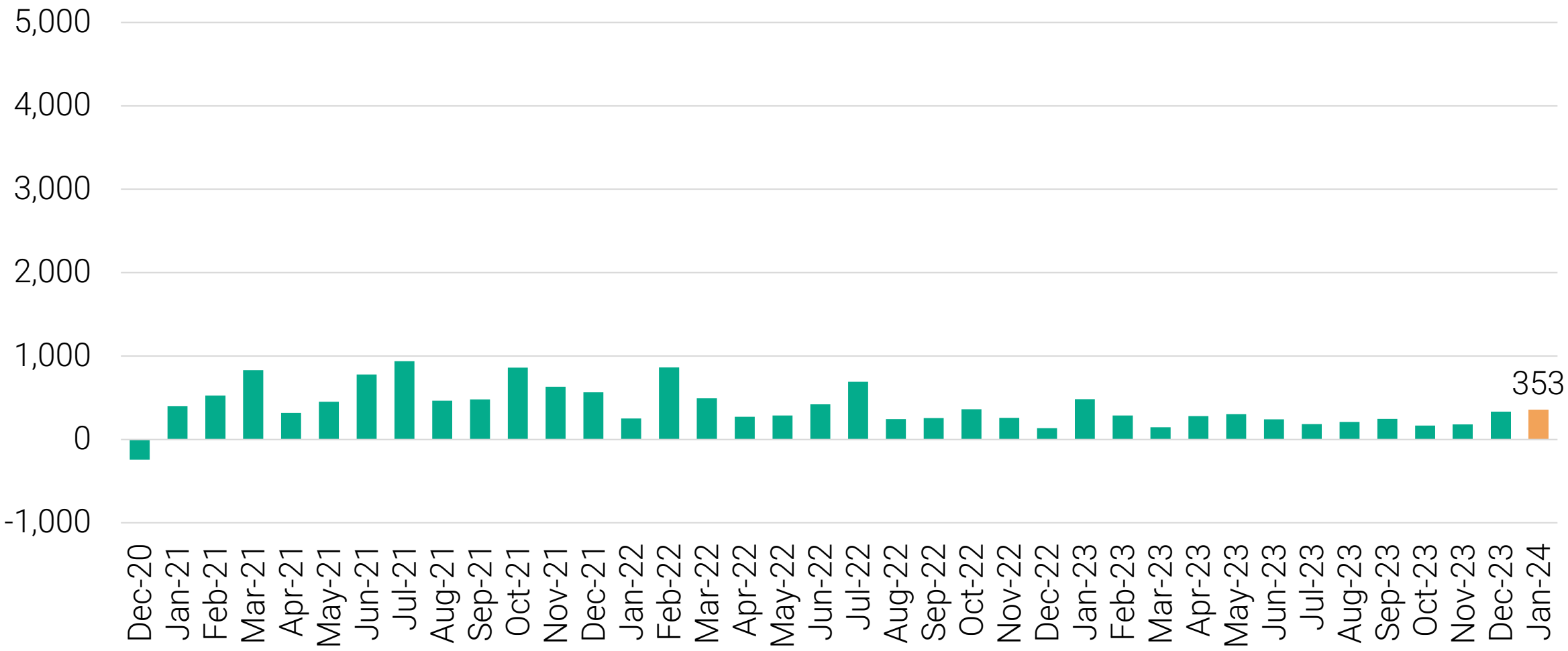
U.S. Job Growth, Monthly

December 2020 – January 2024

1-M Net Change, 000s



Source: U.S. Bureau of Labor Statistics

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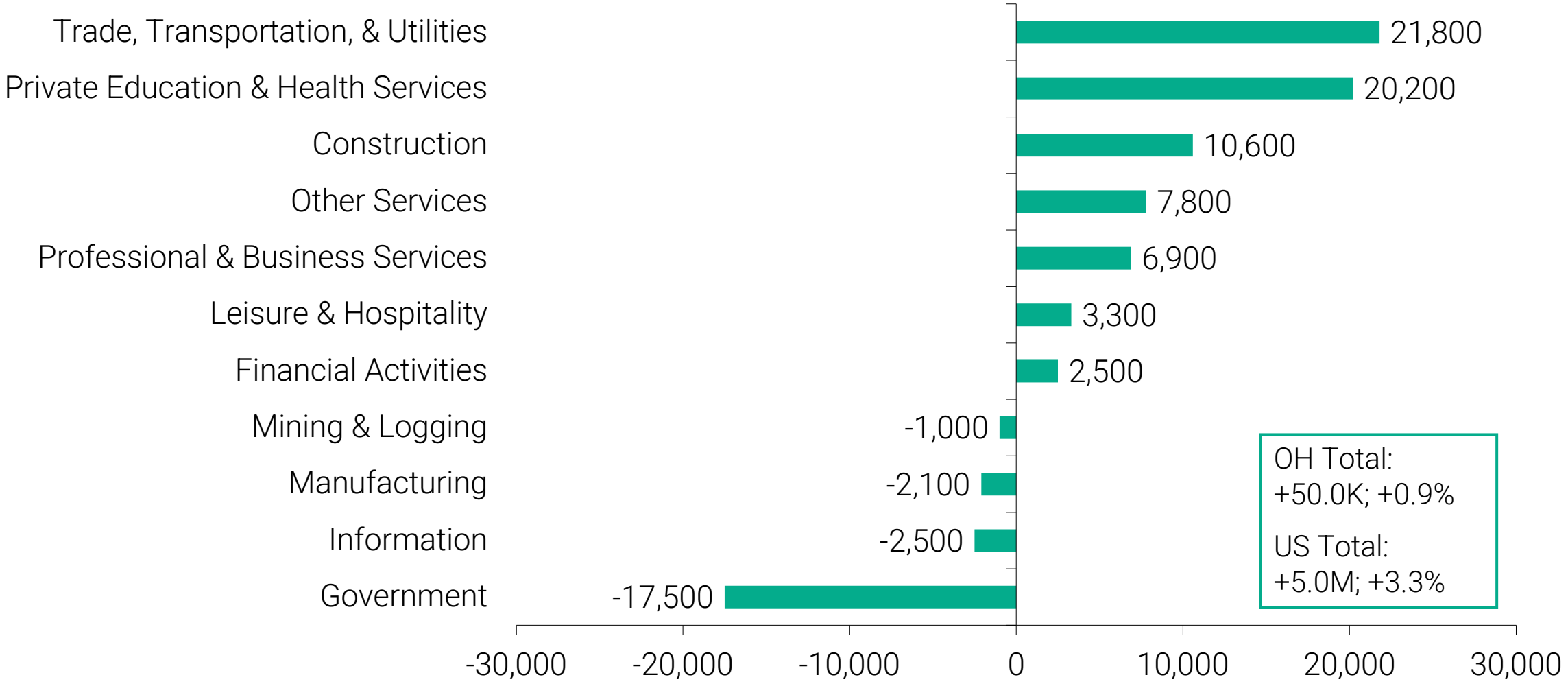
Ohio Nonfarm Employment

February 2020 v. December 2023 Absolute Change



*According to the Local Area Unemployment Statistics (LAUS) program
OH lost 56,232 jobs between February 2020 and December 2023.

Source: U.S. Bureau of Labor Statistics
*Data are seasonally adjusted (SA)

Employment Growth, 25 Largest Metros

February 2020 v. December 2023 % Change

Rank	MSA	%
1	Dallas-Fort Worth-Arlington, TX	13.6%
2	Tampa-St. Petersburg-Clearwater, FL	10.1%
3	San Antonio-New Braunfels, TX	9.8%
4	Charlotte-Concord-Gastonia, NC-SC	8.8%
5	Orlando-Kissimmee-Sanford, FL	8.6%
6	Riverside-San Bernardino-Ontario, CA	8.5%
7	Phoenix-Mesa-Scottsdale, AZ	8.4%
8	Atlanta-Sandy Springs-Roswell, GA	8.2%
9	Miami-Fort Lauderdale-West Palm Beach, FL	7.3%
10	Houston-The Woodlands-Sugar Land, TX	6.7%
11	Philadelphia-Camden-Wilm., PA-NJ-DE-MD	6.2%
12	San Diego-Carlsbad, CA	5.0%
13	Seattle-Tacoma-Bellevue, WA	3.9%

Rank	MSA	%
14	St. Louis, MO-IL	3.4%
15	Denver-Aurora-Lakewood, CO	3.3%
16	Boston-Cambridge-Nashua, MA-NH	2.9%
16	Portland-Vancouver-Hillsboro, OR-WA	2.9%
18	New York-Newark-Jersey City, NY-NJ-PA	2.6%
19	Los Angeles-Long Beach-Anaheim, CA	2.5%
20	Chicago-Naperville-Elgin, IL-IN-WI	2.4%
21	Baltimore-Columbia-Towson, MD	1.9%
22	San Francisco-Oakland-Hayward, CA	1.7%
23	Washington-Arlington-Alexandria, DC-VA-MD-WV	1.2%
24	Minneapolis-St. Paul-Bloomington, MN-WI	1.0%
25	Detroit-Warren-Dearborn, MI	-0.5%

Source: Bureau of Labor Statistics
Current Employment Statistics (CES) Survey. Note: data are not seasonally adjusted.

U.S. % Change 2/2020 v. 12/2023: +3.3%

Unemployment Rates, 25 Largest Metros, December 2023

Rank	MSA	%
1	Baltimore-Columbia-Towson, MD	2.0%
2	Miami-Fort Lauderdale-West Palm Beach, FL	2.4%
2	Minneapolis-St. Paul-Bloomington, MN-WI	2.4%
4	Washington-Arlington-Alexandria, DC-VA-MD-WV	2.5%
5	Atlanta-Sandy Springs-Roswell, GA	2.8%
6	Orlando-Kissimmee-Sanford, FL	3.0%
6	St. Louis, MO-IL	3.0%
8	Charlotte-Concord-Gastonia, NC-SC	3.1%
8	San Antonio-New Braunfels, TX	3.1%
8	Tampa-St. Petersburg-Clearwater, FL	3.1%
11	Boston-Cambridge-Nashua, MA-NH	3.2%
12	Dallas-Fort Worth-Arlington, TX	3.3%

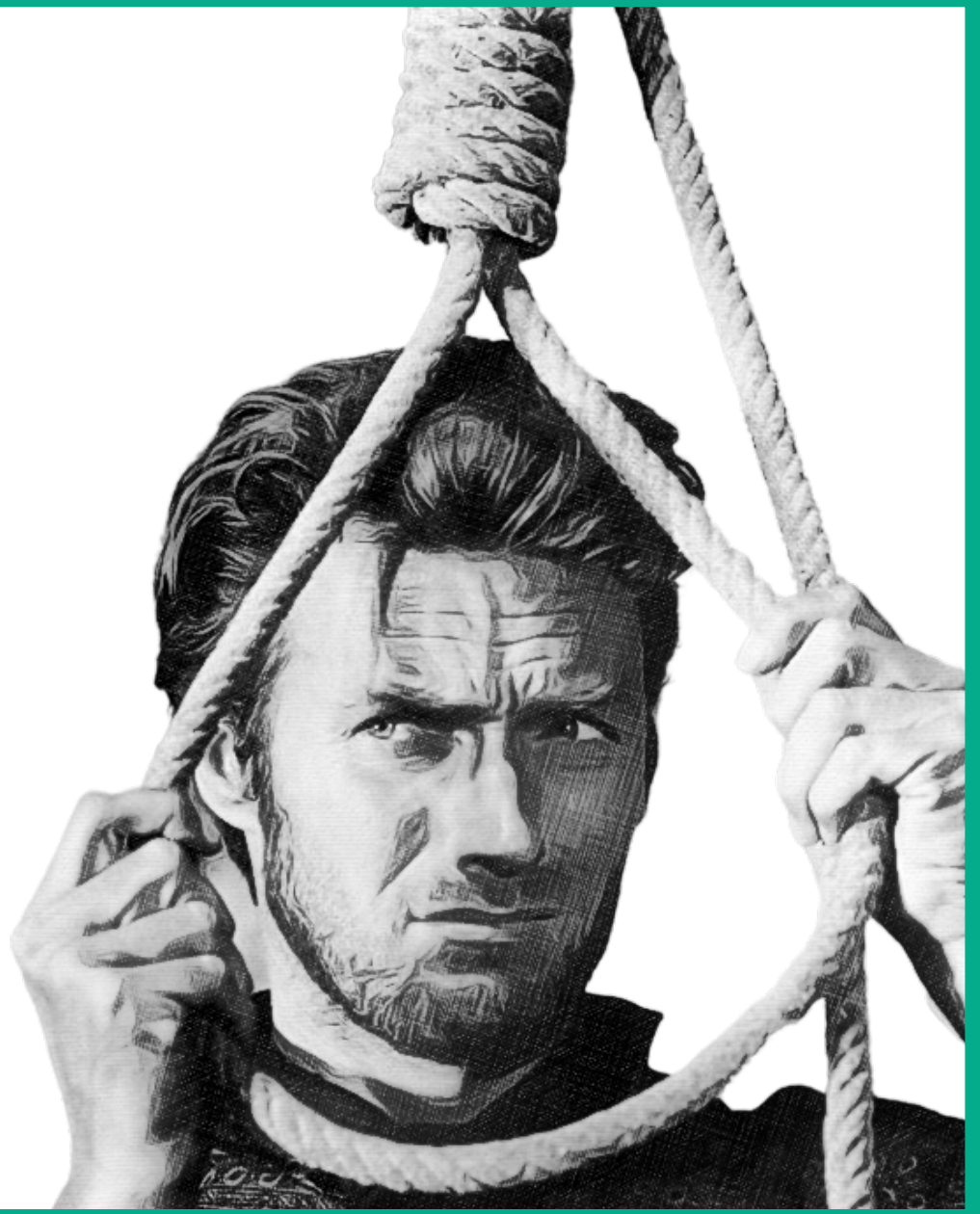
Rank	MSA	%
12	Denver-Aurora-Lakewood, CO	3.3%
12	Detroit-Warren-Dearborn, MI	3.3%
12	Philadelphia-Camden-Wilm., PA-NJ-DE-MD	3.3%
16	Phoenix-Mesa-Scottsdale, AZ	3.4%
17	Houston-The Woodlands-Sugar Land, TX	3.8%
17	Portland-Vancouver-Hillsboro, OR-WA	3.8%
19	Seattle-Tacoma-Bellevue, WA	3.9%
20	San Francisco-Oakland-Hayward, CA	4.0%
21	Chicago-Naperville-Elgin, IL-IN-WI	4.1%
22	San Diego-Carlsbad, CA	4.3%
23	New York-Newark-Jersey City, NY-NJ-PA	4.5%
24	Los Angeles-Long Beach-Anaheim, CA	4.7%
25	Riverside-San Bernardino-Ontario, CA	5.1%

Source: Bureau of Labor Statistics
Local Area Unemployment Statistics (LAUS) program. Note: data are not seasonally adjusted

U.S. Unemployment Rate—Dec/Jan: 3.7%

The Bad

Not Sustainable



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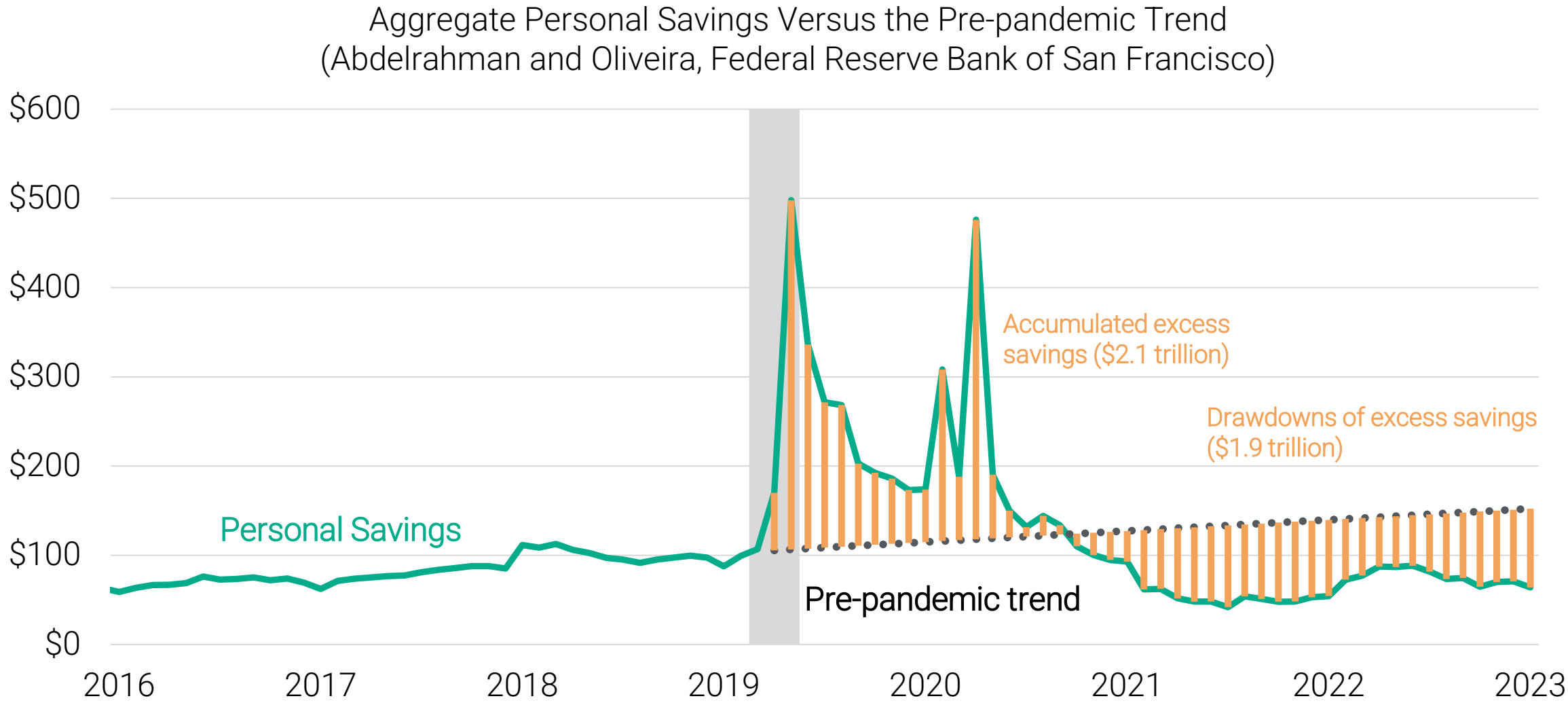
Drawdown of Pandemic Related Excess Savings



Source: Federal Reserve Bank of San Francisco

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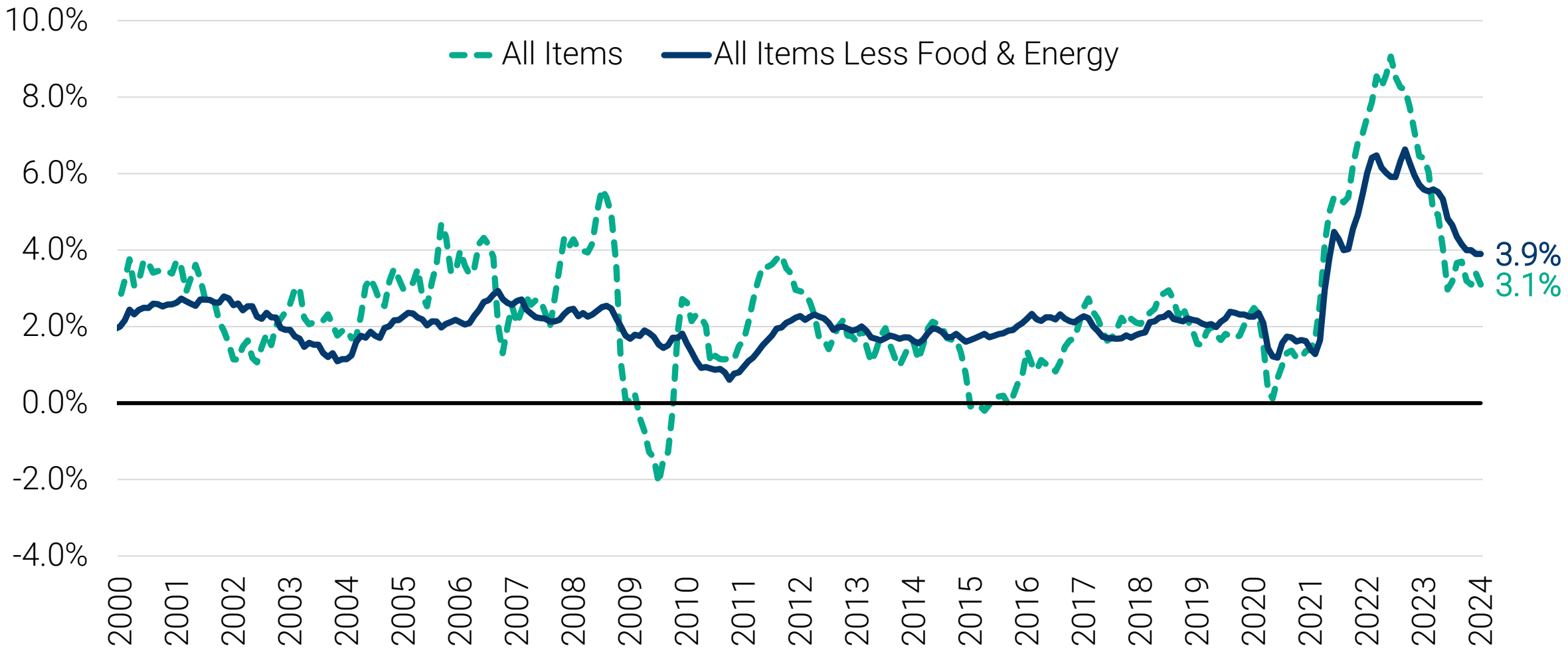
Consumer Price Index (NSA)

12-Month % Change, 2000 – January 2024



Source: U.S. Bureau of Labor Statistics

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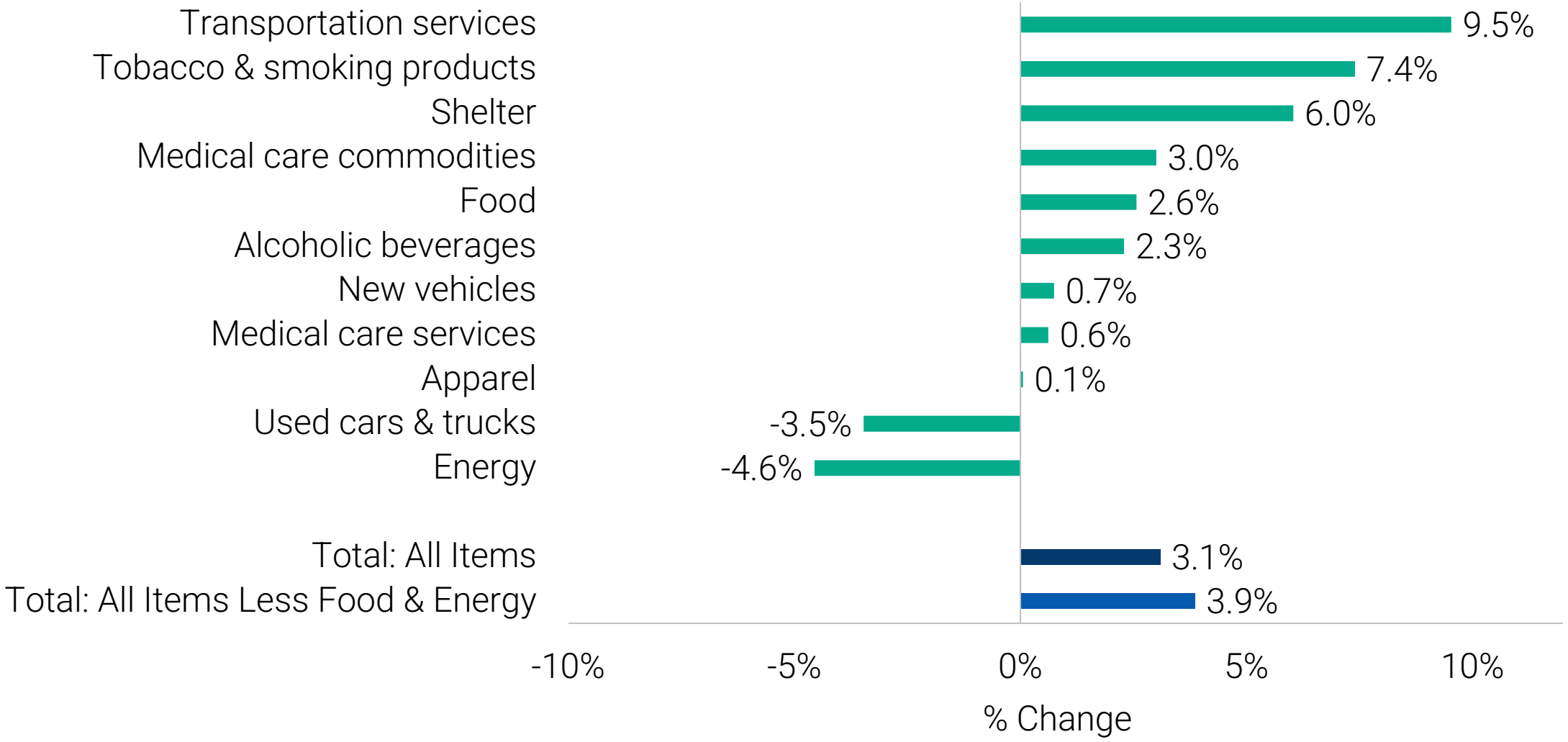
Consumer Price Index, Select Categories (NSA)

YOY % Change [January 2023 v. January 2024]



Source: U.S. Bureau of Labor Statistics

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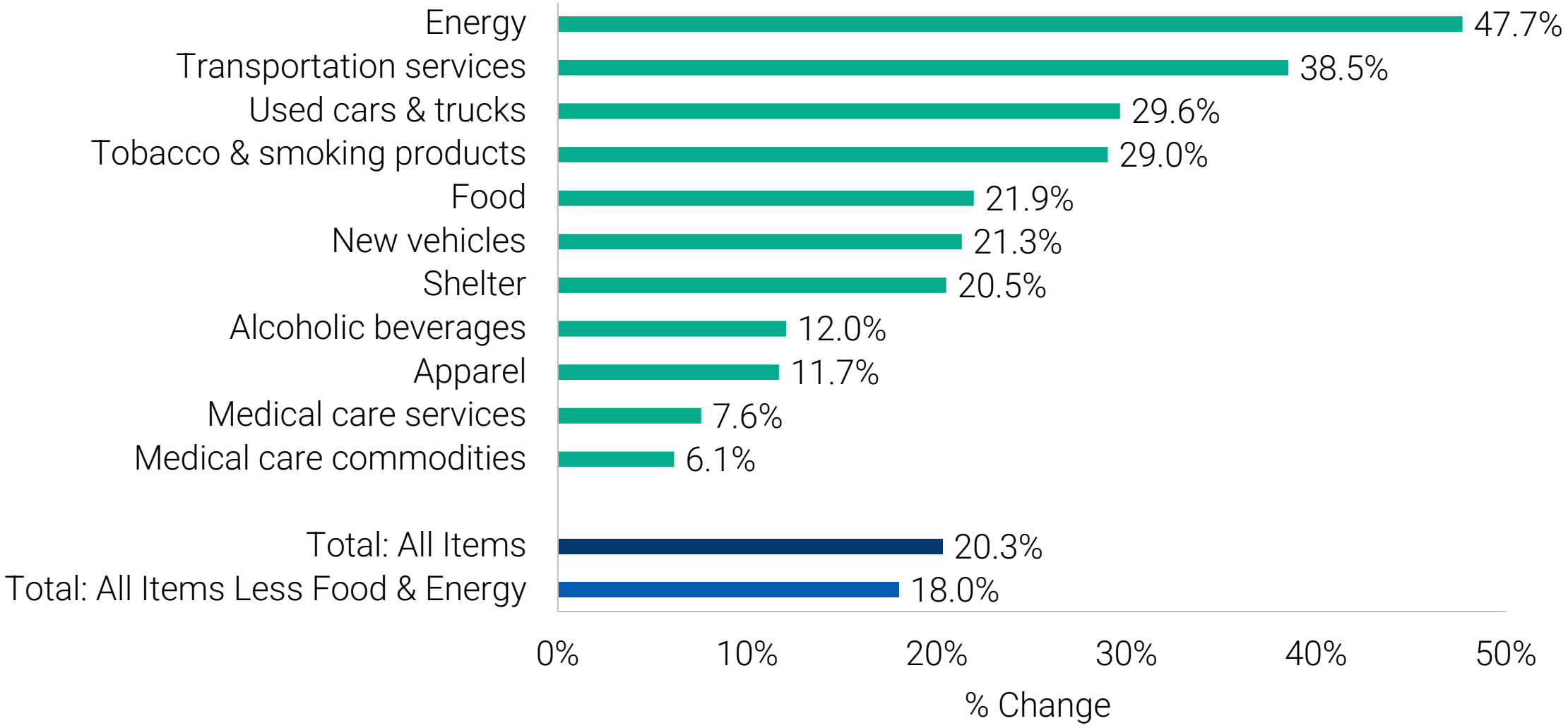
Consumer Price Index, Select Categories (NSA)

% Change May 2020 v. January 2024



Source: U.S. Bureau of Labor Statistics

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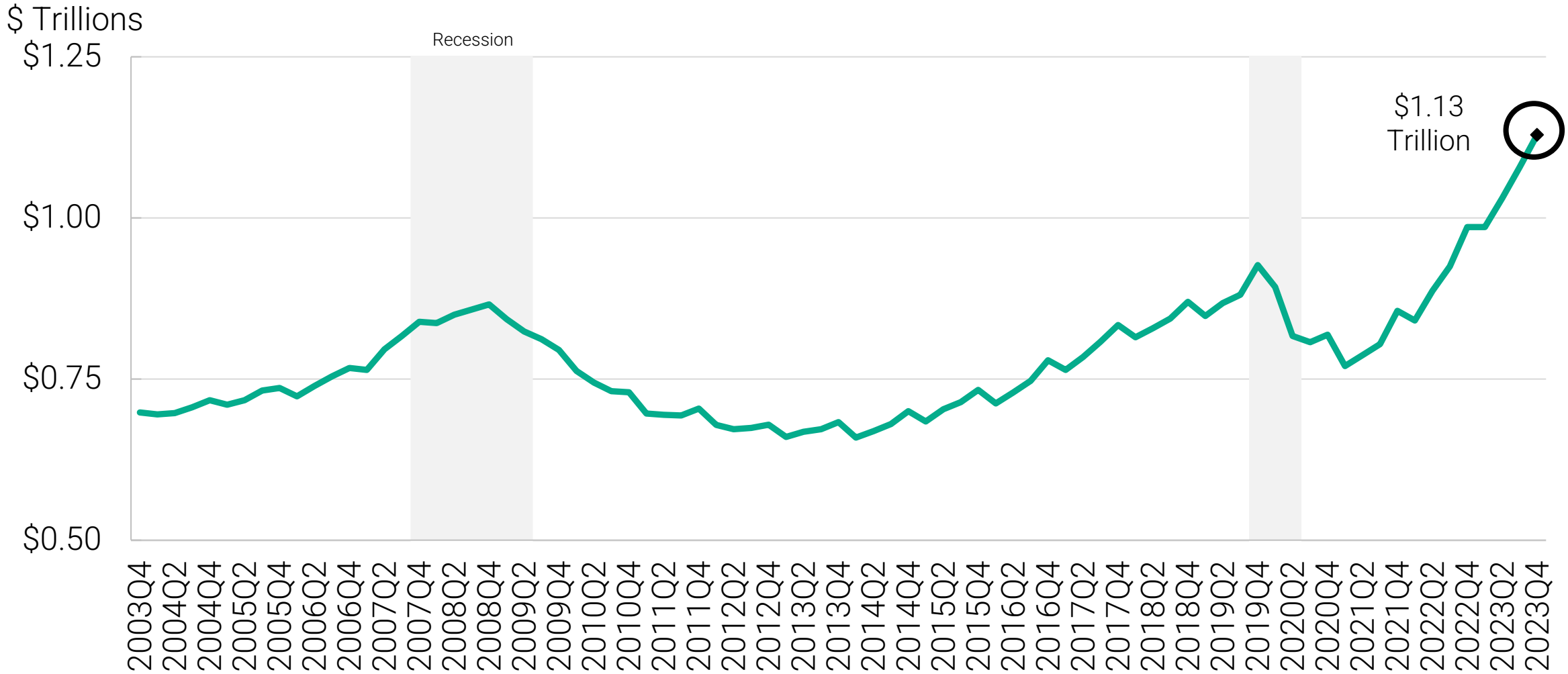
For a Few Dollars More

U.S. Credit Card Debt, 2003 – 2023



Source: FRED; New York Fed Consumer Credit Panel/Equifax

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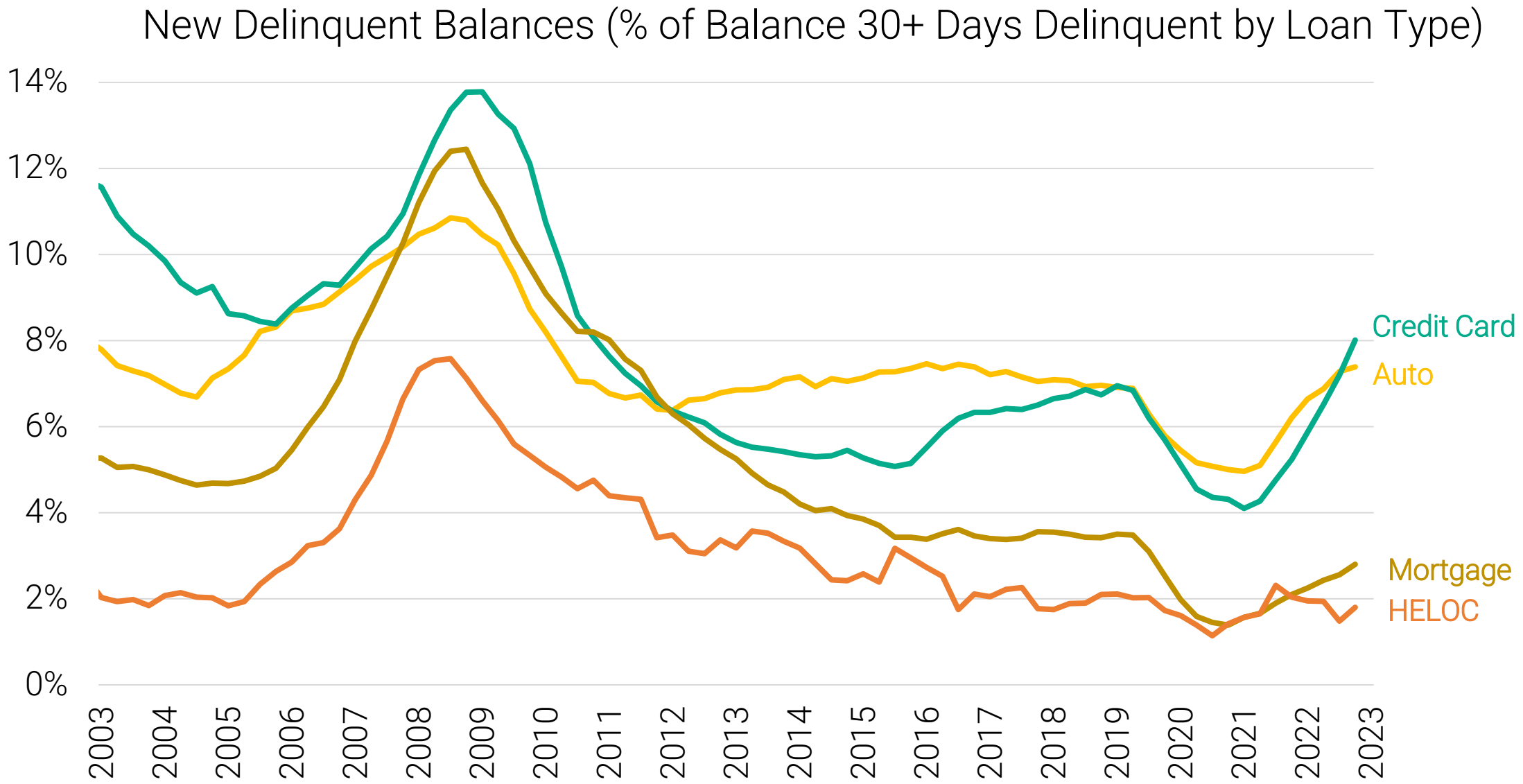
Heartbreak Ridge (a 1986 Film)



Source: Federal Reserve Bank of New York Consumer Credit Panel/Equifax

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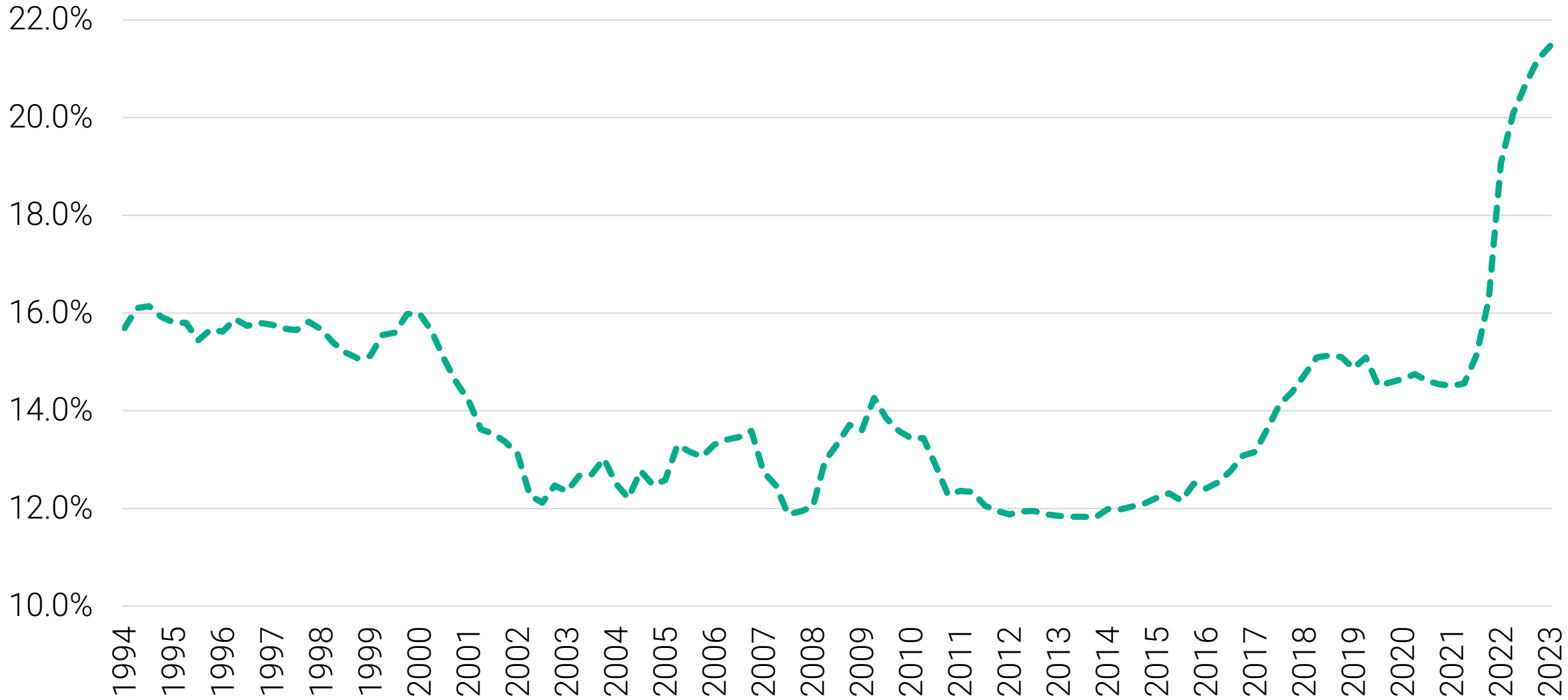
High Interest Grifter

Commercial Bank Interest Rates On Credit Card Plans



Source: Board of Governors of the Federal Reserve System; *High Plains Drifter was a 1973 film

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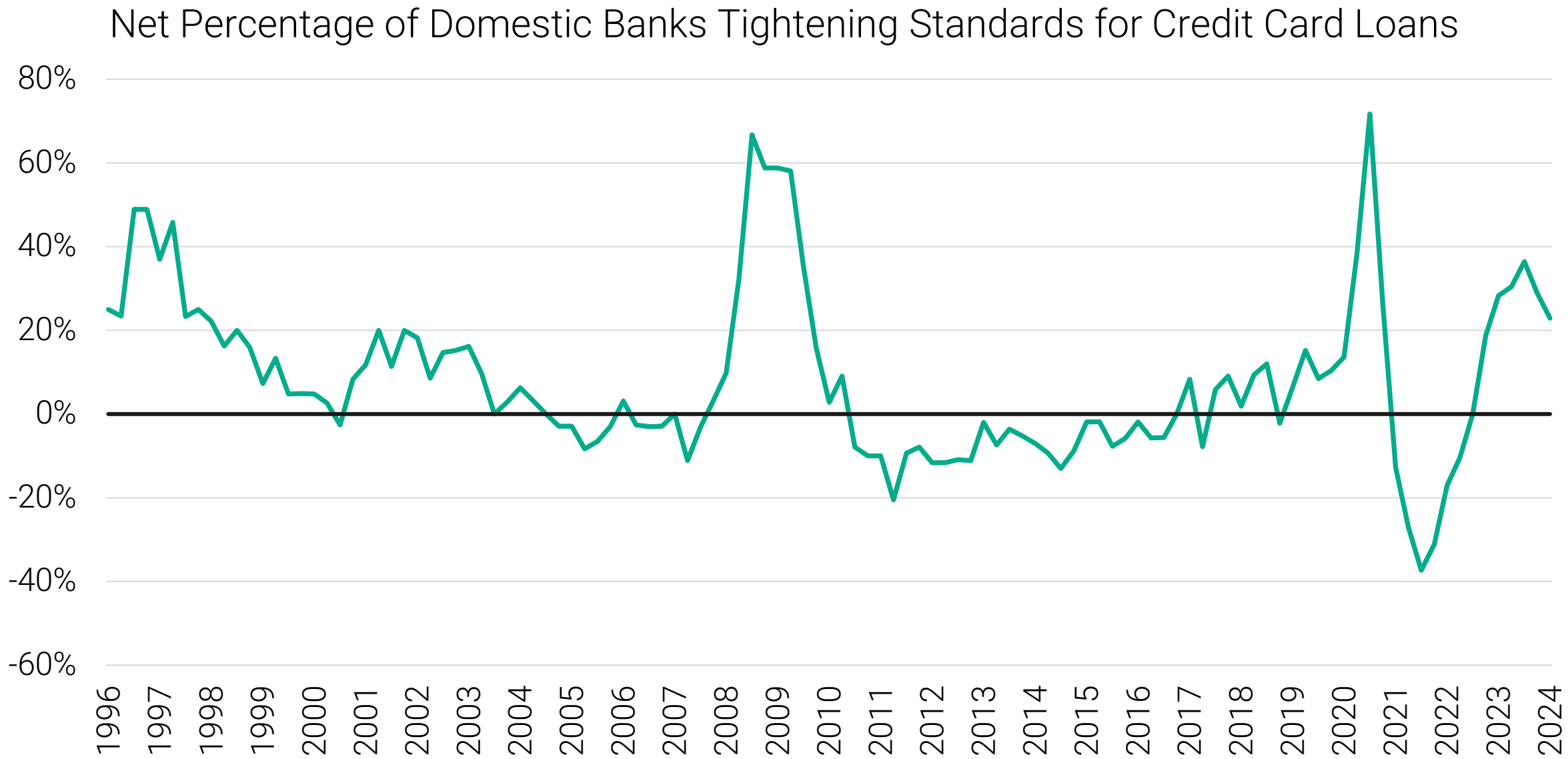
Heartbreak Ridge (a 1986 Film) II



Source: Board of Governors of the Federal Reserve System, Senior Loan Officer Opinion Survey on Bank Lending Practices

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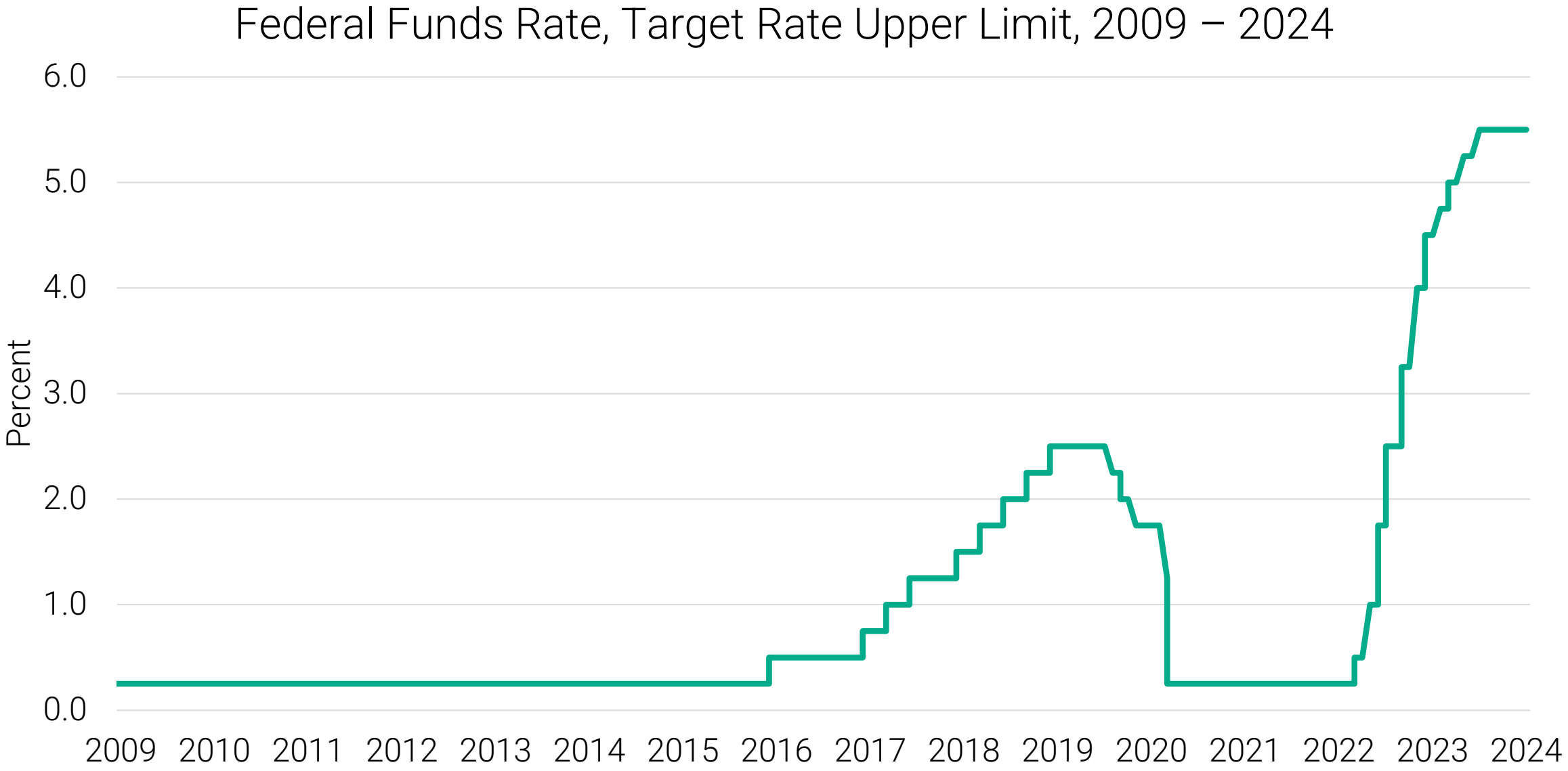
Not So Sudden Impact (a 1983 Film)



Source: Board of Governors of the Federal Reserve System

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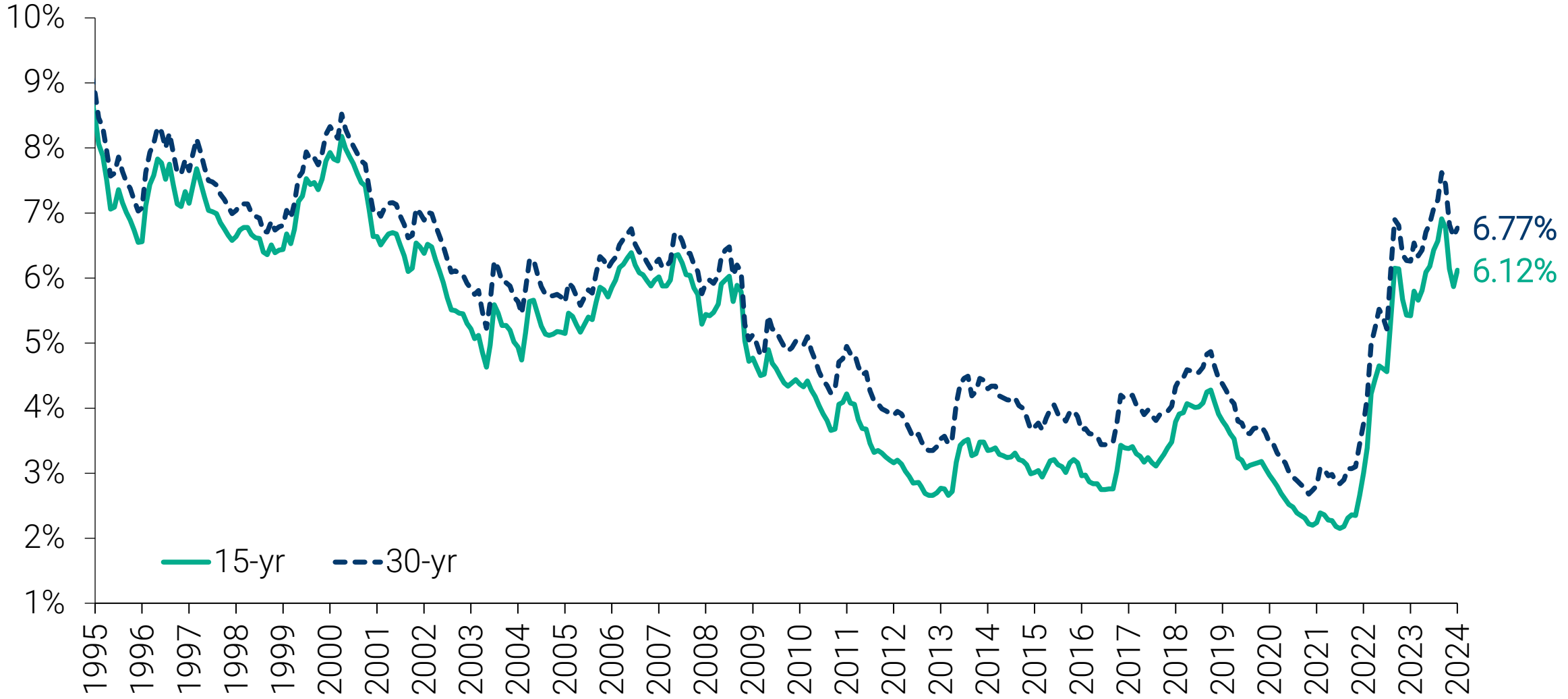
Monetary Policy Lags

- “A large body of research tells us it can take 18 months to two years or more for tighter monetary policy to materially affect inflation.” - Raphael Bostic, President and Chief Executive Officer, Federal Reserve Bank of Atlanta
- Some reasons for the lag: how fixed people’s expectations are; the gradual response of investment (both business investment and consumer investment in durables/dwellings); long-term contracts (rent); gradual transmission from sectors of the economy immediately affected (ex. lending) to other sectors.
- In the meantime, higher rates reduce investment, slow hiring and wage growth, and eventually increase unemployment.

Lend 'Em High (Hang 'Em High, 1968)

U.S. 15-Year & 30-Year Fixed Mortgage Rates, 1995 – February 2024*



Source: Freddie Mac *Week ending 2/15/2024

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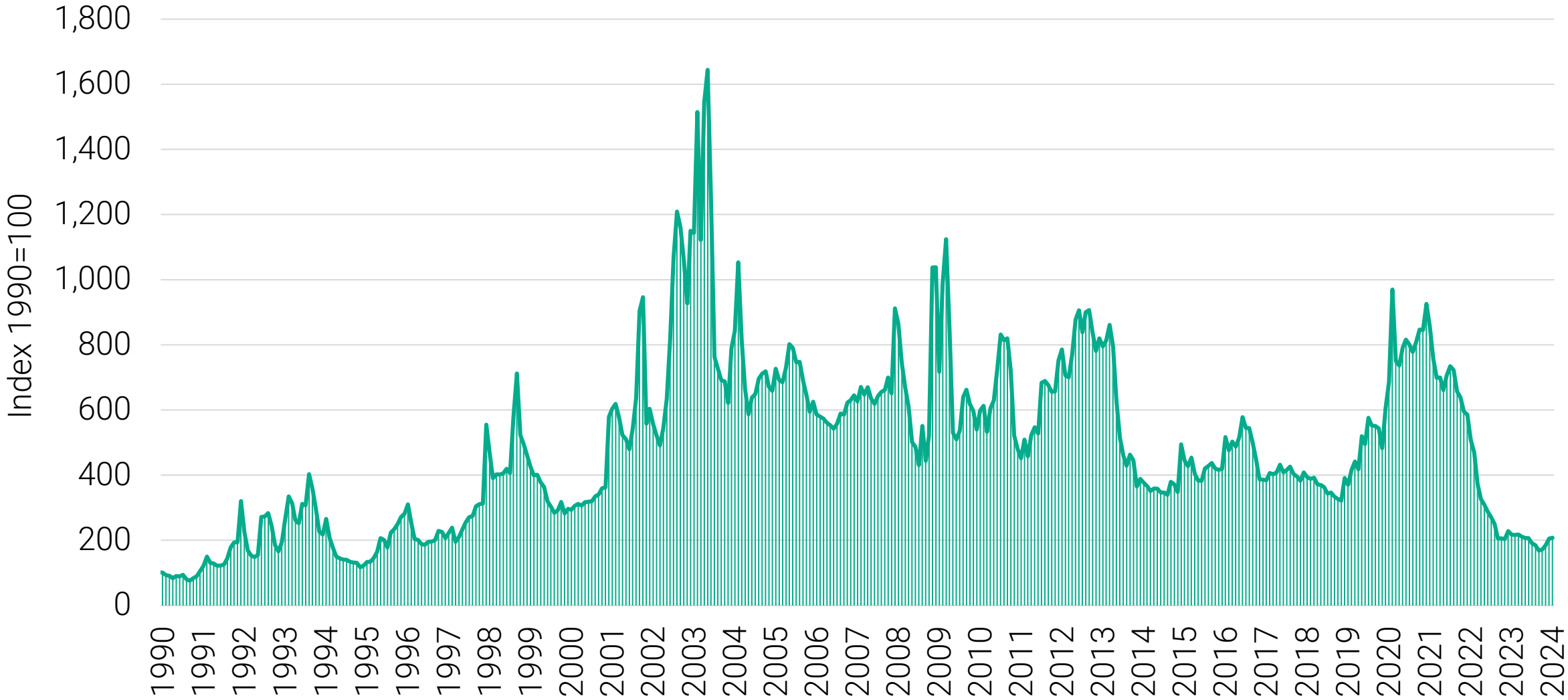
U.S. Mortgage Loan Applications Composite Index

1990 – February 2024



Source: Mortgage Bankers Association (MBA)

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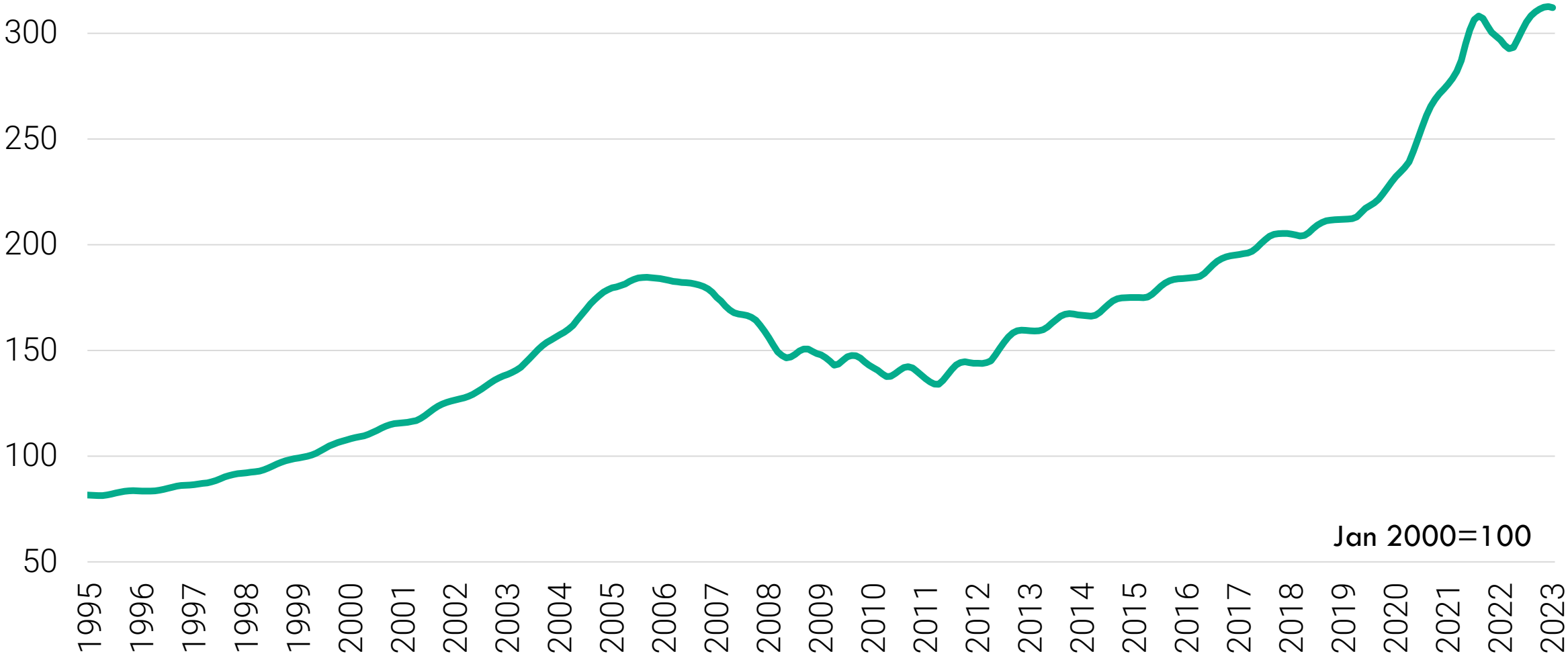
S&P Case-Shiller Home Price Index

1995 – November 2023



Source: Standard & Poor's

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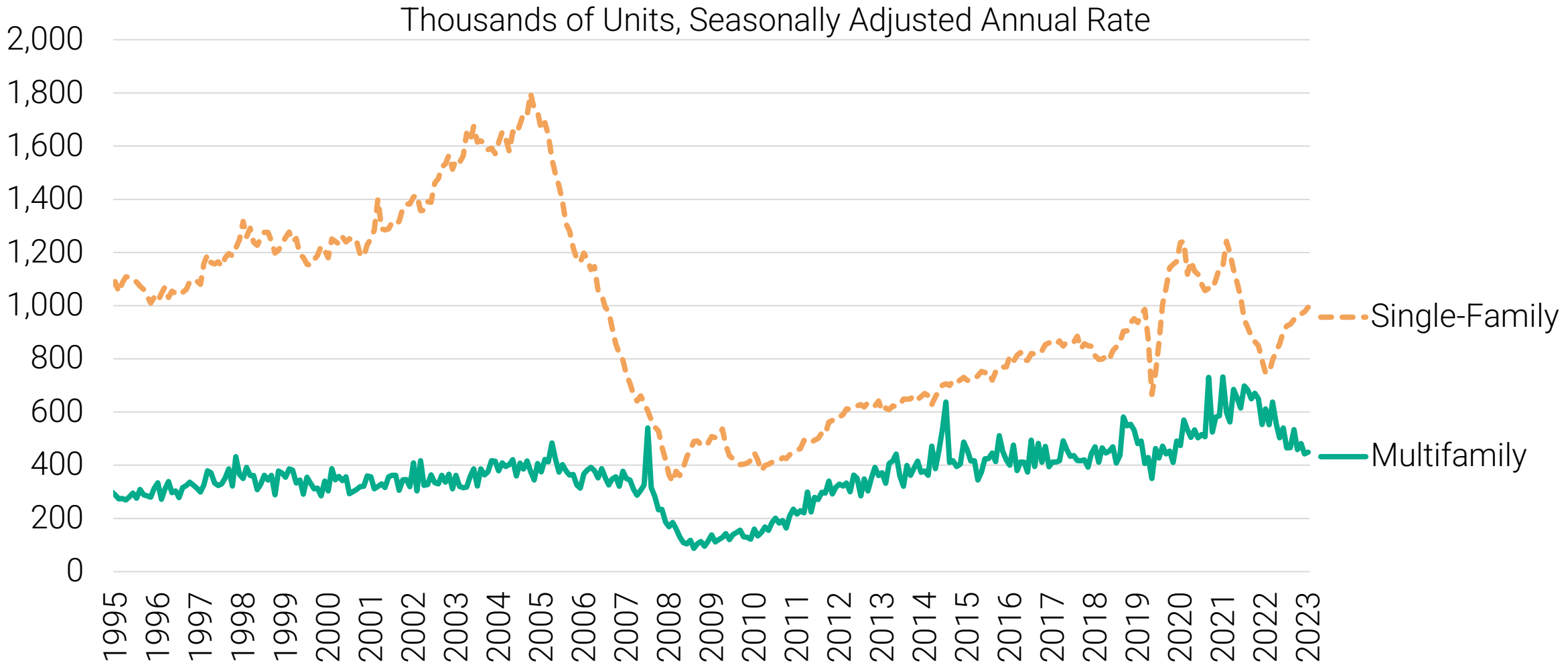
U.S. Residential Building Permits

1995 – December 2023



Source: U.S. Census Bureau

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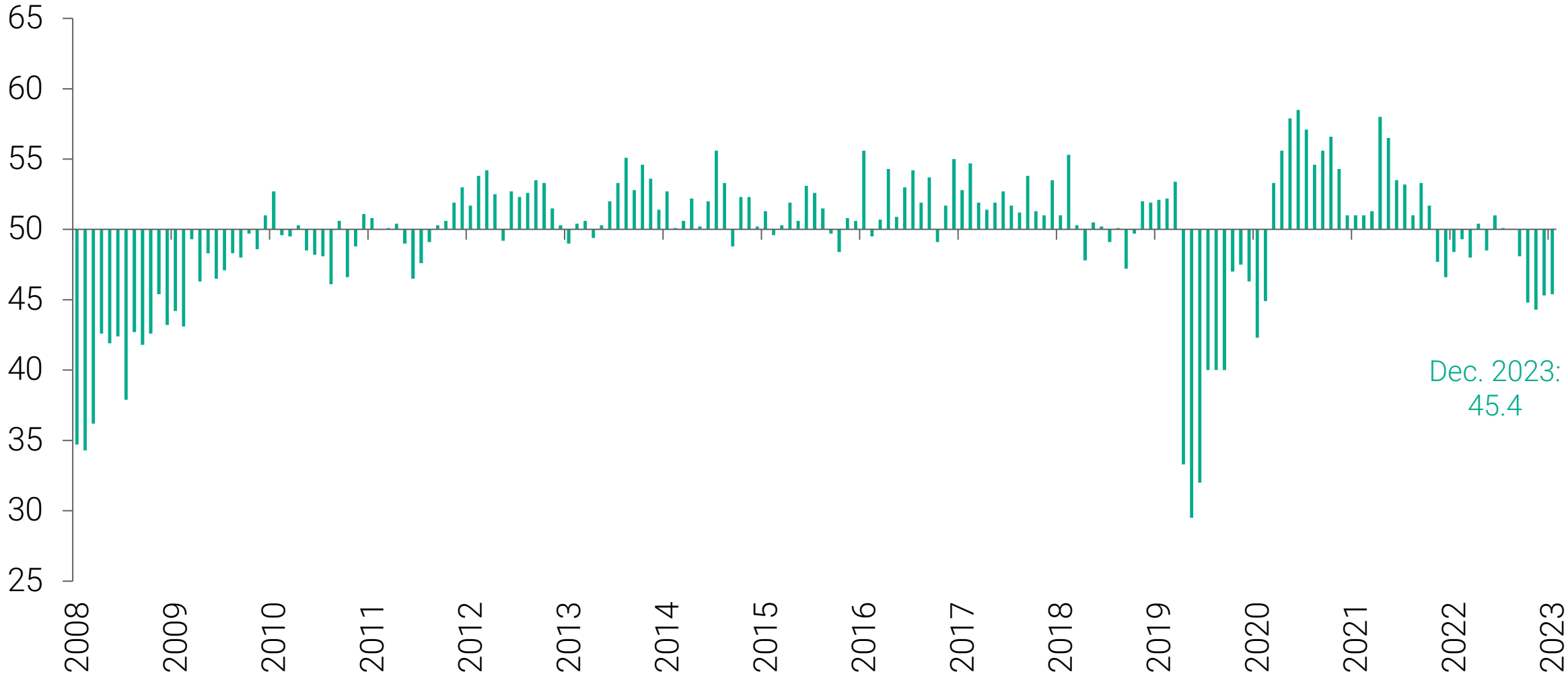
Architecture Billings Index

2008 – December 2023



Source: The American Institute of Architects

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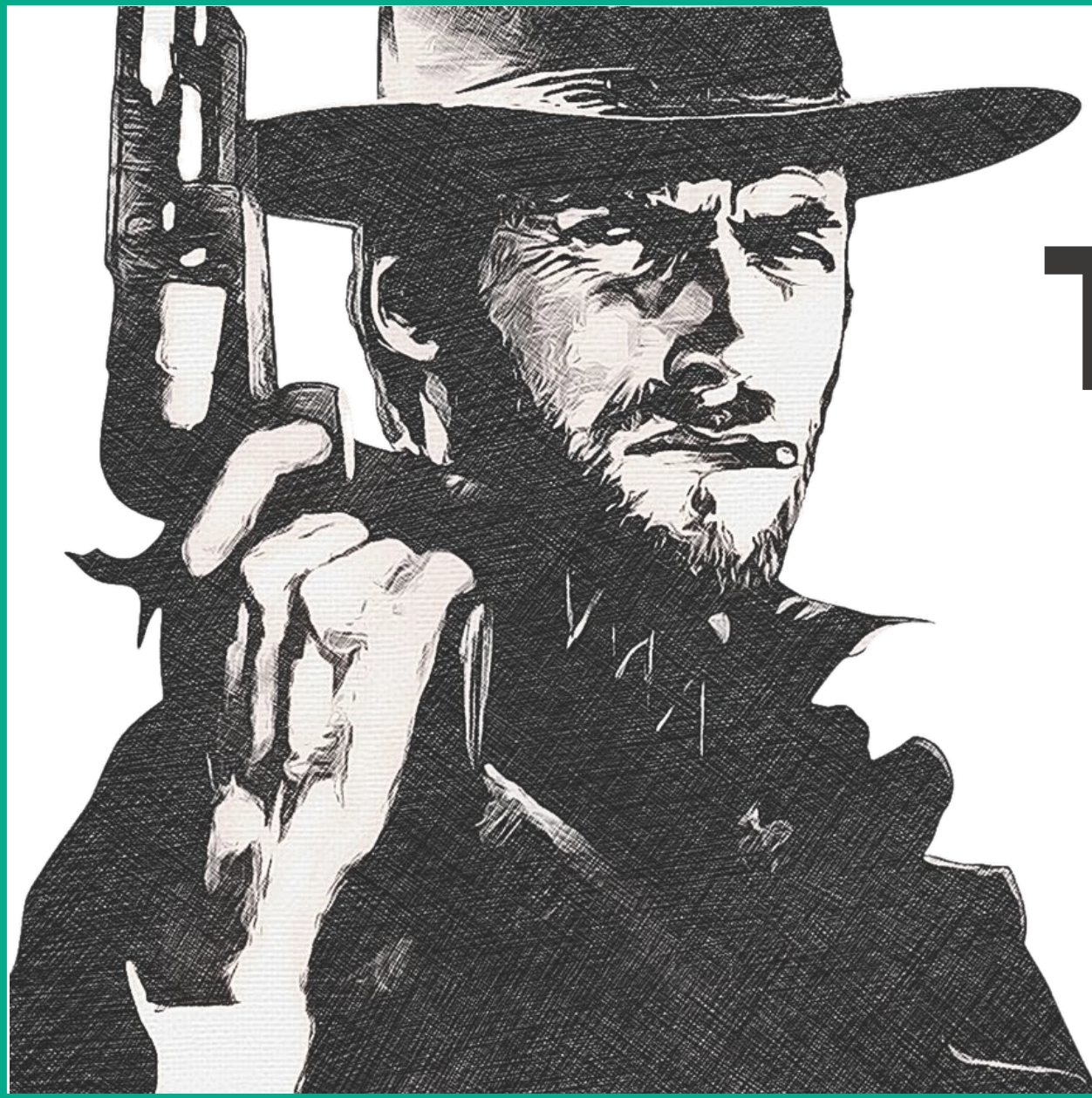

The Ugly

Office Market

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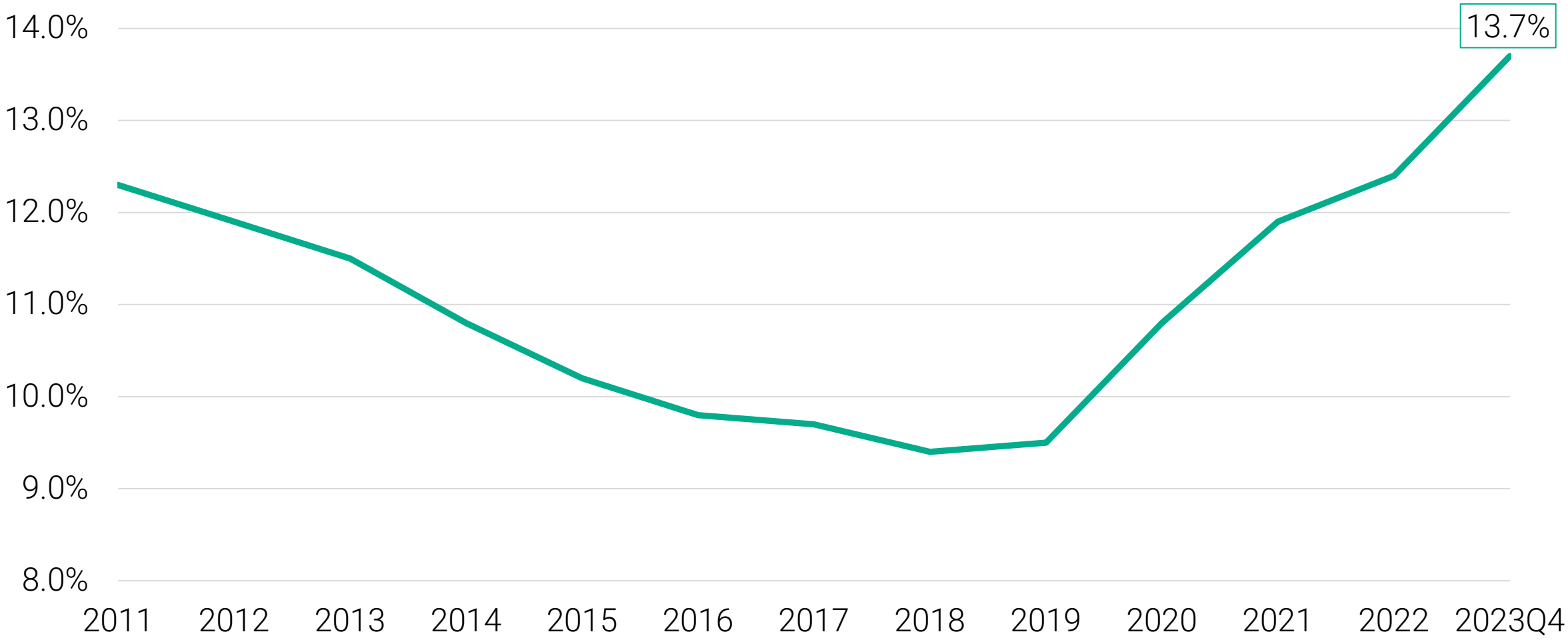
Every Which Way But Down

U.S. Office Vacancy, 2011 – 2023



Source: Costar; *Every Which Way But Loose was a 1978 film

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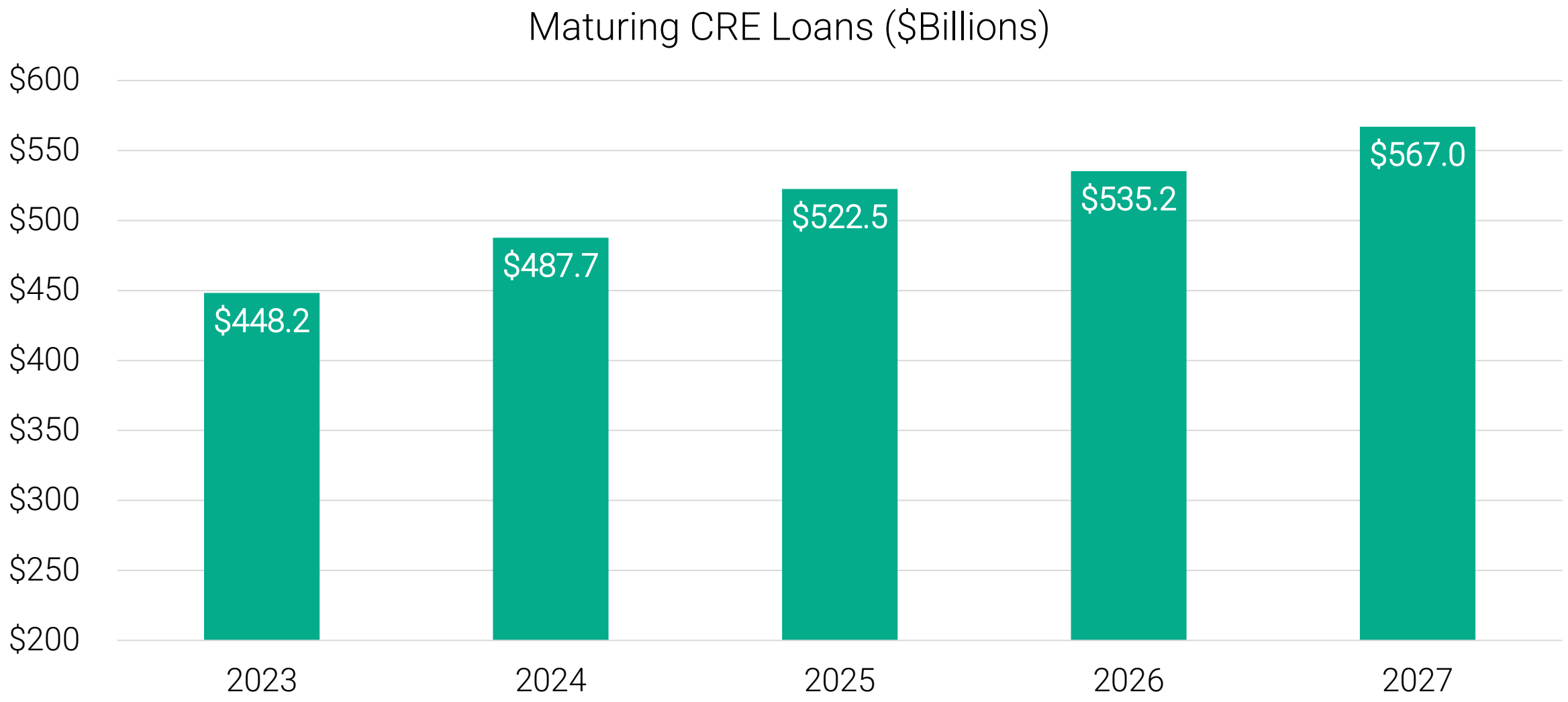
CRE Debt Maturities: $2.5 Trillion in the Next 5 Years



Source: Trepp analysis of Federal Reserve data

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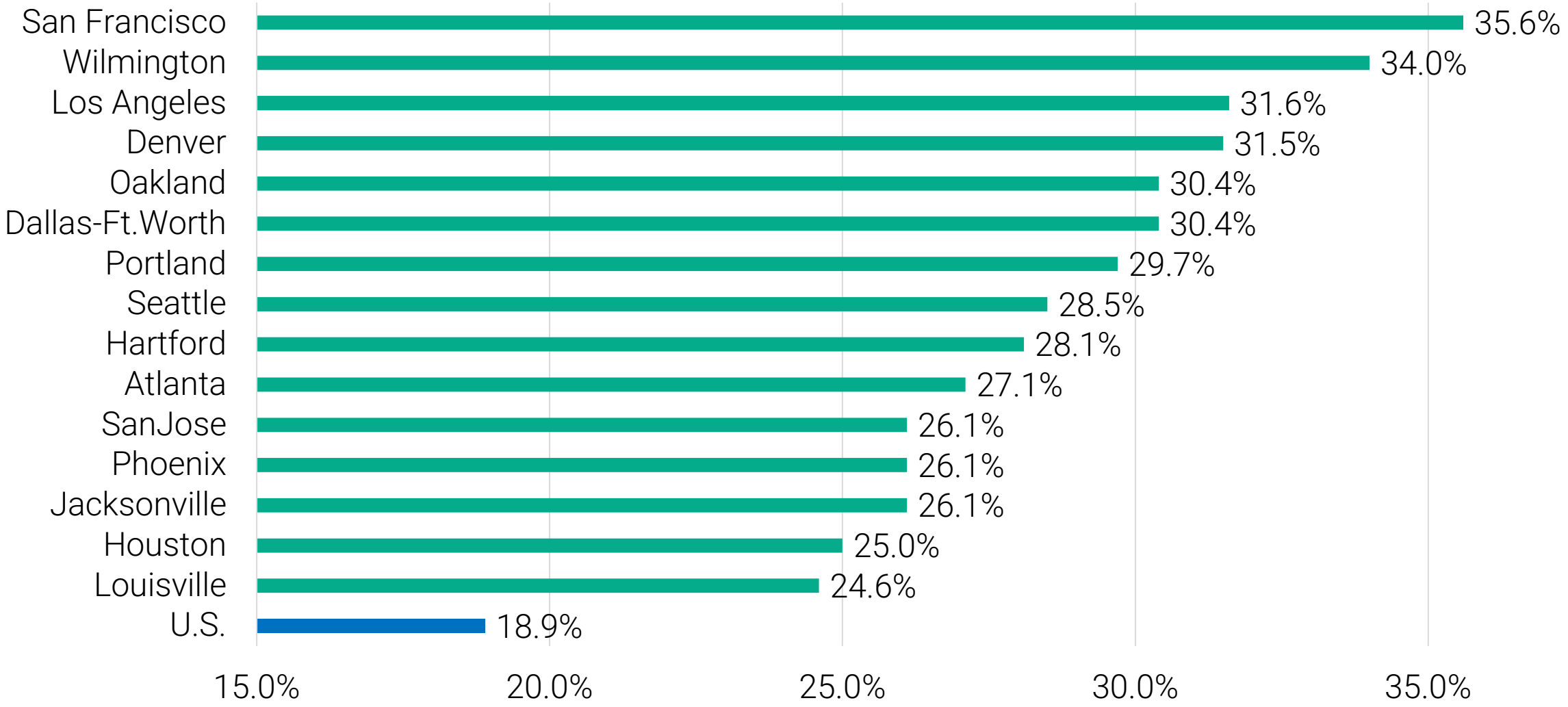
Highest Downtown Office Vacancy Rates, 2023Q4



Source: CBRE

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Go Ahead, Make My Day

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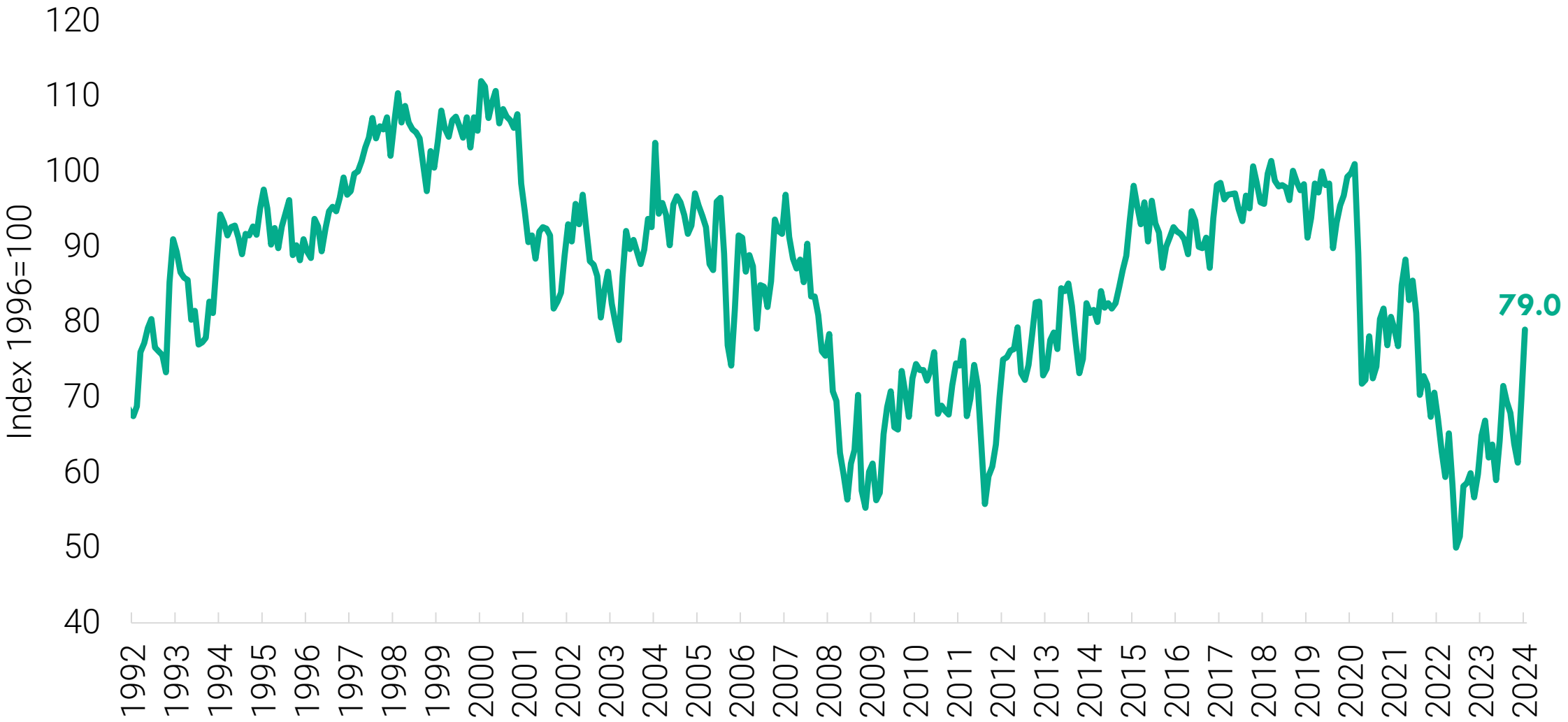
University of Michigan Index of Consumer Sentiment

1992 – January 2024



Source: University of Michigan

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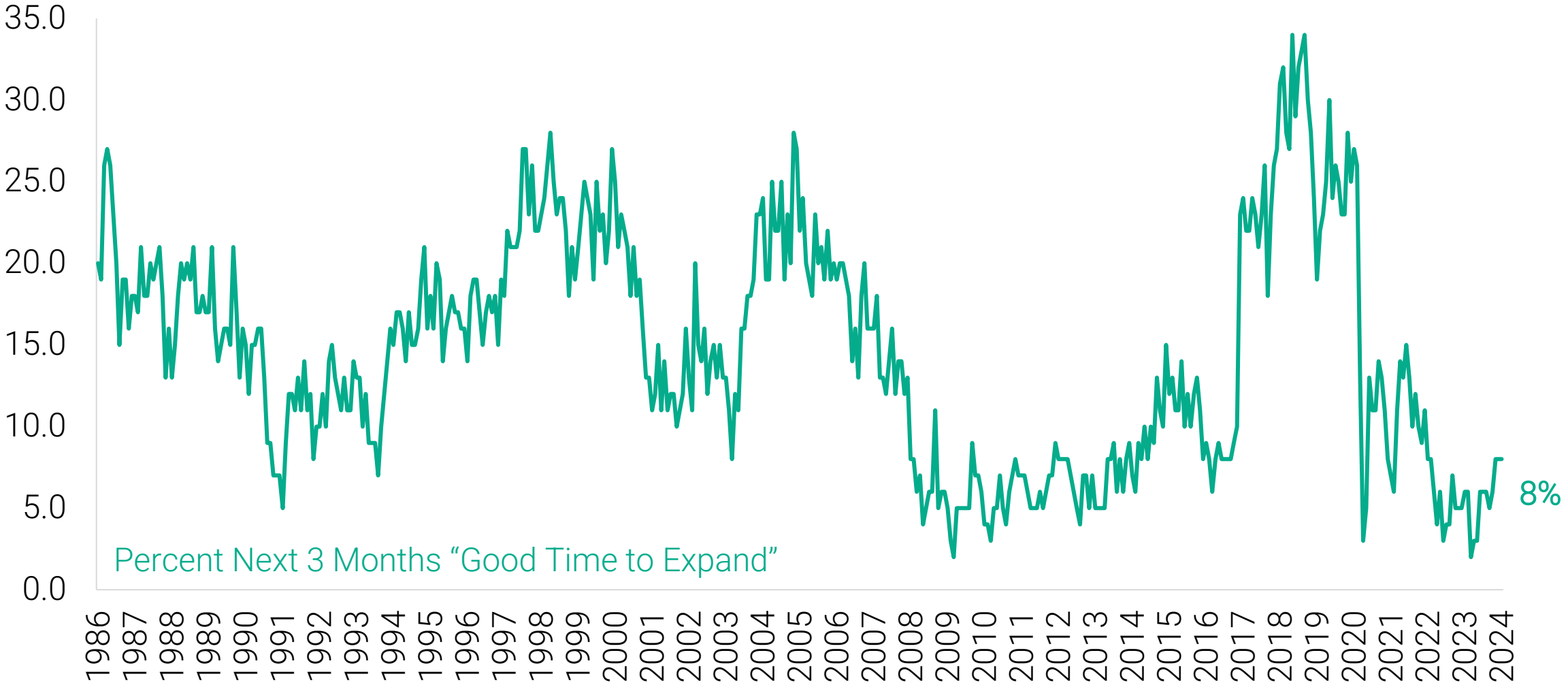
NFIB Index of Small Business Optimism

1986 – January 2024



Source: National Federation of Independent Business (NFIB)

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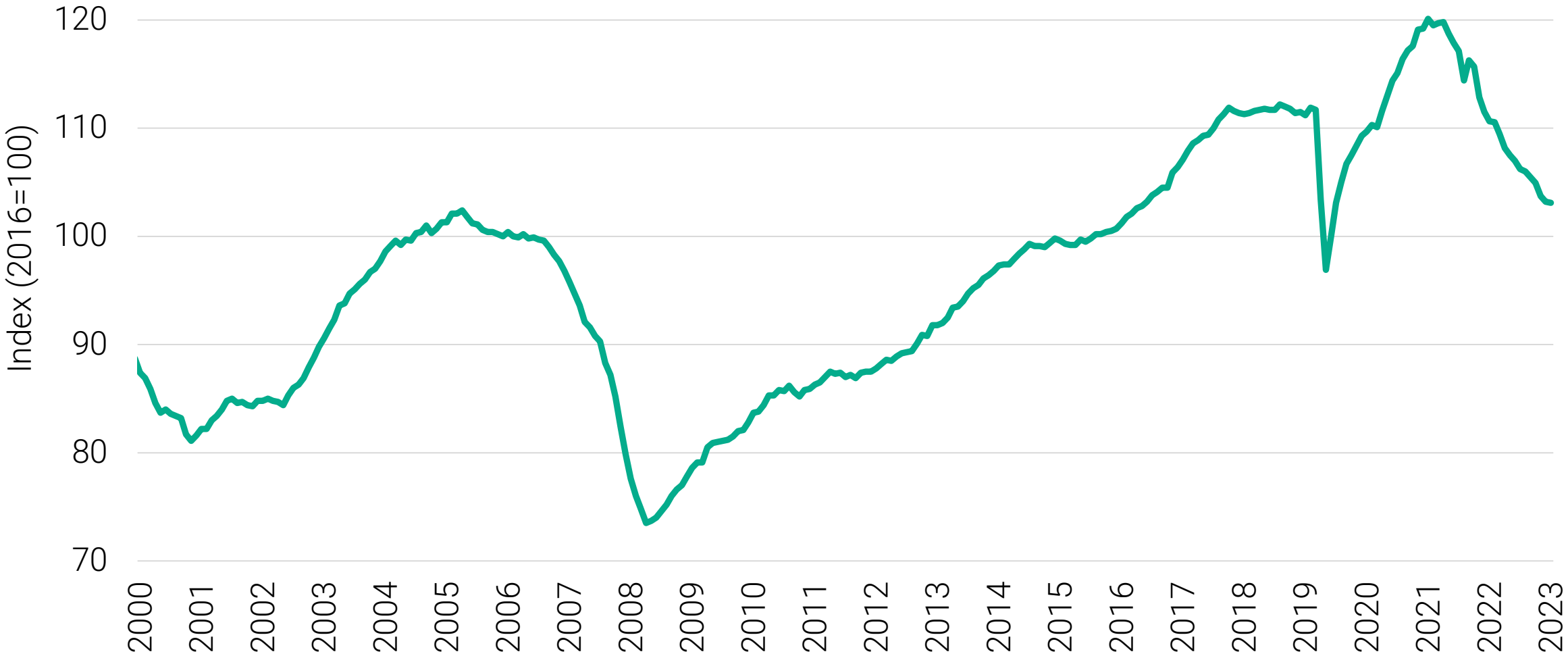
Conference Board: U.S. Leading Economic Index

2000 – December 2023



Source: The Conference Board

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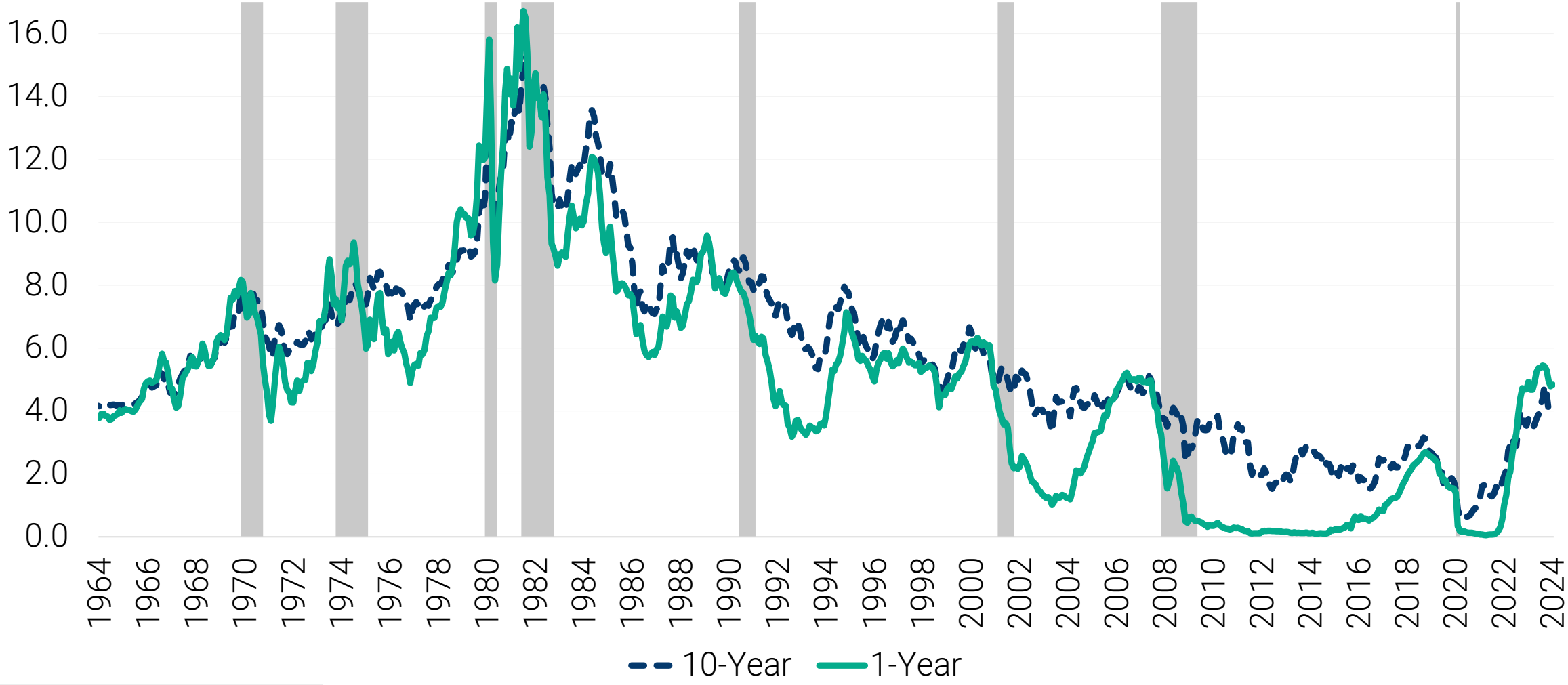
U.S. Treasury Yields : 10-Year v. 1-Year

1964 – February 2024



Shaded areas indicate U.S. recessions

Source: Federal Reserve Bank of St. Louis

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Go Where You're Lookin', and Look Where You're Goin'

- We are a deeply indebted society currently facing high borrowing costs;
- That makes me pessimistic regarding the near-term outlook;
- Geopolitics and federal elections don't help – sources of additional concern, distraction, and risk;
- It will come nearly a year after I initially anticipated, but recession is coming in 2024.

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Thank You

Please contact us when you require economic research & policy analysis: www.sagepolicy.com

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- A monthly Q&A session
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Q&A

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KKR

Outlook for 2024: Glass Half Full

FEBRUARY 2024

Presenters

David McNellis joined KKR in 2011 and serves as Head of Research and U.S. Macro for KKR's Global Macro, Balance Sheet and Risk team. Prior to joining KKR, Mr. McNellis was a managing director at Morgan Stanley Investment Management where he was head of research and a portfolio manager for the global macro and asset allocation team. Prior to his time at Morgan Stanley, he was a macro strategist at Fortress Investment Group and a U.S. equity strategist within equity research at Morgan Stanley. Mr. McNellis was also a member of Morgan Stanley's asset allocation committee. He earned a B.A. in Philosophy from Yale University and is a CFA Charterholder.

Ari Barkan joined KKR in 2012 and is a Managing Director in Global Client Solutions. He serves as the Head of the U.S. Central Region for Institutional Client Solutions. Prior to joining KKR, Mr. Barkan was a managing director in Credit Suisse Asset Management performing a similar role from 2009 until early 2012. Previously, he spent 12 years at Citigroup where he held both asset management and corporate banking roles. At Citigroup, Mr. Barkan served as a director in the Citi Alternative Distribution Group, chief of staff to the vice chairman of Citigroup and, for six years, held various corporate banking and management positions in Turkey, Indonesia, Singapore, Mexico, Hungary, and Australia. Before joining Citigroup, Mr. Barkan worked as an oil and gas equity analyst for Creditanstalt in Russia. Mr. Barkan holds a Masters in International Affairs from Columbia University, a Bachelor of Arts from the University of California, Berkeley, and was a Rotary Ambassadorial Fellow at the Moscow State Institute for International Relations.

Executive Summary: Glass Half Full

1. We still think we are in a good environment for risk assets, including areas beyond large capitalization growth stocks

2. Investors are likely too defensively positioned; at the same time, central bank balance sheets are still quite accommodative, which is important for all valuations

3. Lack of central bank tightening should allow the cost of capital to become more definable in 2024, which should accelerate capital markets and M&A activity

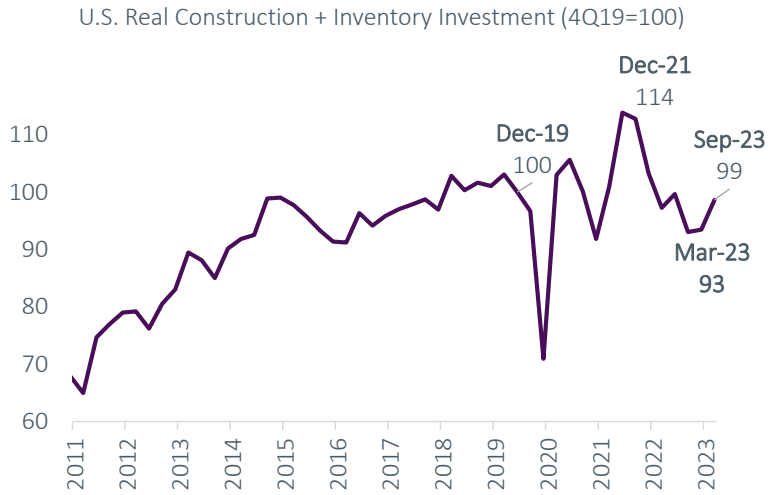
4. We see disinflation in the near-term, but our four fundamental drivers of our Regime Change thesis remain in force

5. Asset Allocation: Overweight Opportunistic Credit, Collateral Based Cash Flows (Infra, Asset Based Finance & Real Estate Credit), and Control Private Equity positions

Section I: Backdrop for Growth & Investing

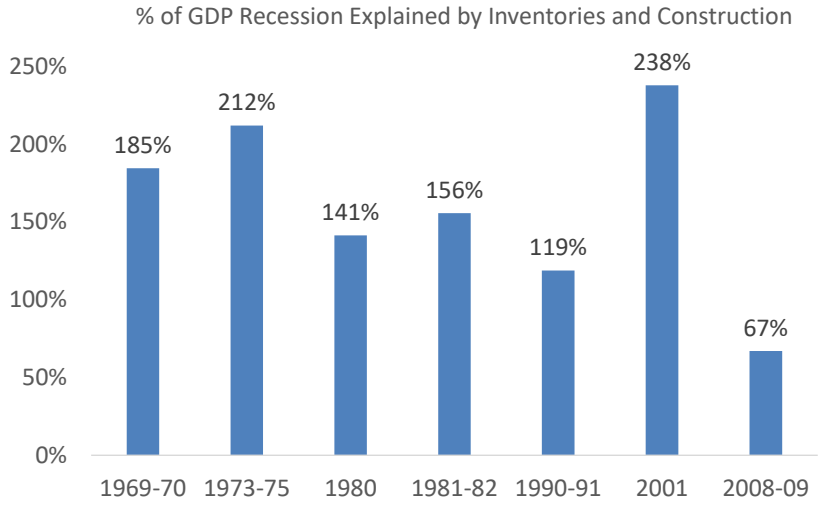
We Are Not a Buyer of the 'Hard Landing' Thesis

Recessions Are Typically Caused by Housing and Inventory Issues. That Backdrop Does Not Look Likely This Cycle



Data as at September 30, 2023. Source: U.S. Bureau of Economic Analysis, Haver Analytics, KKR Global Macro & Asset Allocation analysis.

Consistently, Across Cycles, Inventory and Construction Capex Contractions Have Driven the Great Bulk of Recessionary Downturns



Recession periods examined: 3Q69-2Q70, 4Q73-1Q75, 1Q80-3Q80, 3Q81-1Q82, 3Q90-1Q91, 2Q01-4Q01, 2Q08-2Q09. Data as at November 10, 2023. Source: BEA, Haver, KKR Global Macro & Asset Allocation analysis.

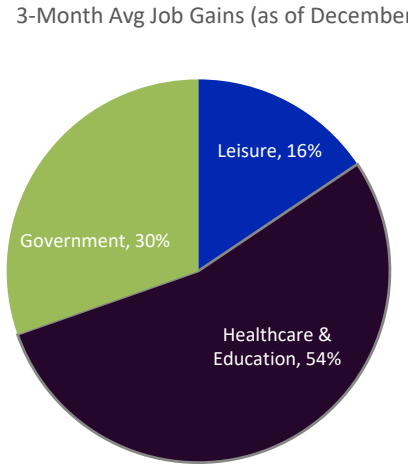
The Job Market, in Particular, Is Confirming Our Thesis

U.S. jobs resiliency refutes the hard landing thesis, one to which we do not ascribe

Job Growth Is Slowing, But Non-Cyclical Sectors Are Providing Some Stability

Data as at December 31, 023. Source: KKR GMAA Analysis.

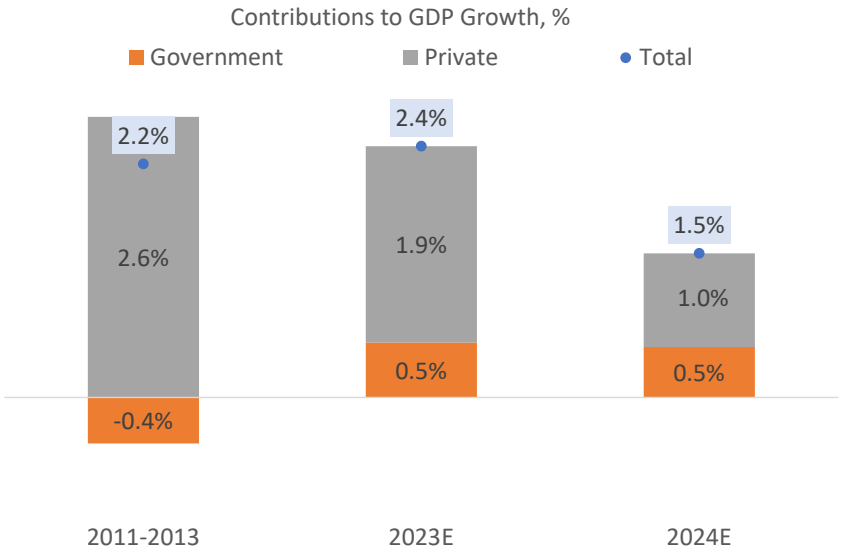
Three Sectors Accounted for All of the Three-Month Average Job Growth Thru December



Data as at December 31 2023. Source: KKR GMAA Analysis.

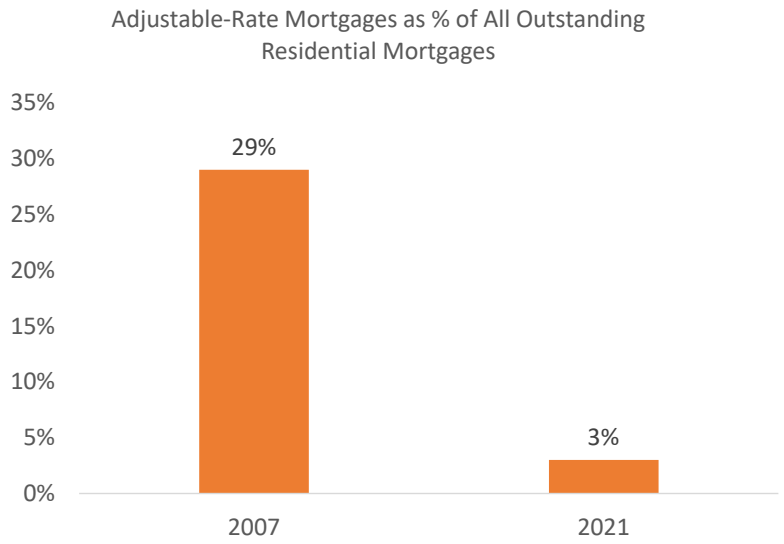
It’s Hard to Get Hurt Falling Out of a Basement Window

The Government Has Moved From Being a Deterrent to Being a Driver of GDP Growth This Cycle



Data as at November 30, 2023. Source: Bureau of Economic Analysis, KKR Global Macro & Asset Allocation analysis.

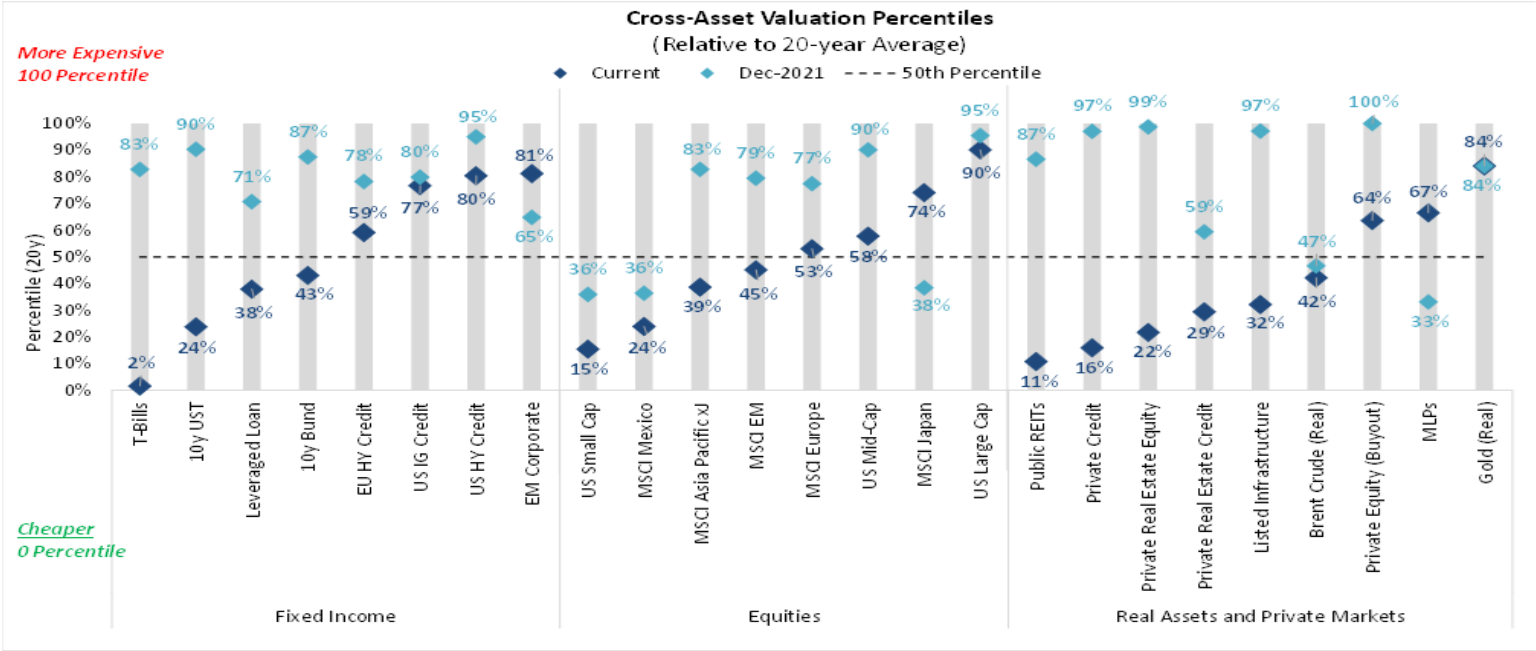
As Such, It is the Government – Not the Consumer or Corporate, That Is Over Levered in the Current Regime



For consumers, income defined as total personal income (before tax or interest expense). For corporates, income defined as EBITDA. For government, income defined as total revenue. Data as September 30, 2023. Source: BofA, KKR Global Macro & Asset Allocation analysis.

Outside of U.S. Large Capitalization Equities, Valuations Still Appear Reasonable in Many Parts of the World

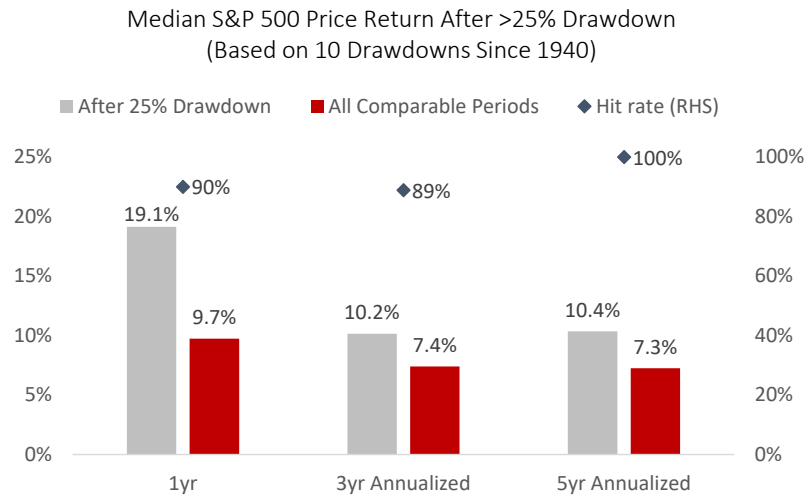
There Are Still Significant Opportunities for Investors Across Multiple Asset Classes



Data as at December 31, 2023. Source: KKR Global Macro and Asset Allocation analysis.

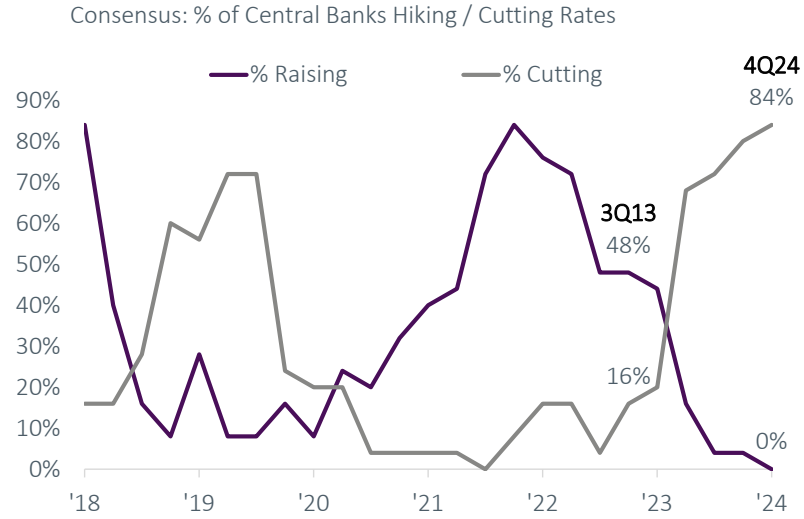
Capital Markets: We Still Think the Bear Market in Risk Assets Actually Ended in October 2022

We Are Still in a Recovery Bull Market. The Bear Market Ended in 2022, We Believe



Data as of September 30, 2023; Note: 3-year and 5-year annualized returns are based on nine episodes only since the 2020 drawdown was too recent. Source. Bloomberg.

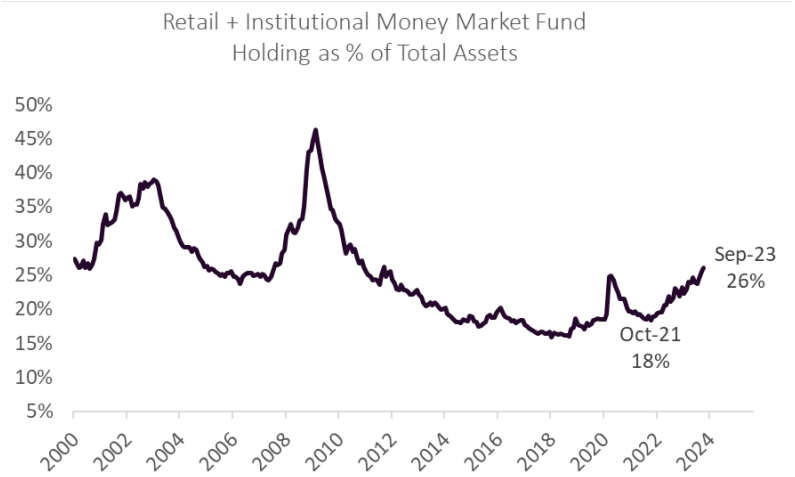
Central Bank Tightening Should Be Less of an Issue in 2024



Data as of September 30, 2023; Hiking / cutting rates defined as an increase in rates over the past three months. Data for US, JP, CN, AU, CA, E2, NZ, NO, SE, GB, JP, CH, IN, ID, KR, PH, TW, TH, VN, BR, CL, ZA, TR, IL, CZ, HU, PL. Source: Bloomberg, KKR Global Macro & Asset Allocation analysis

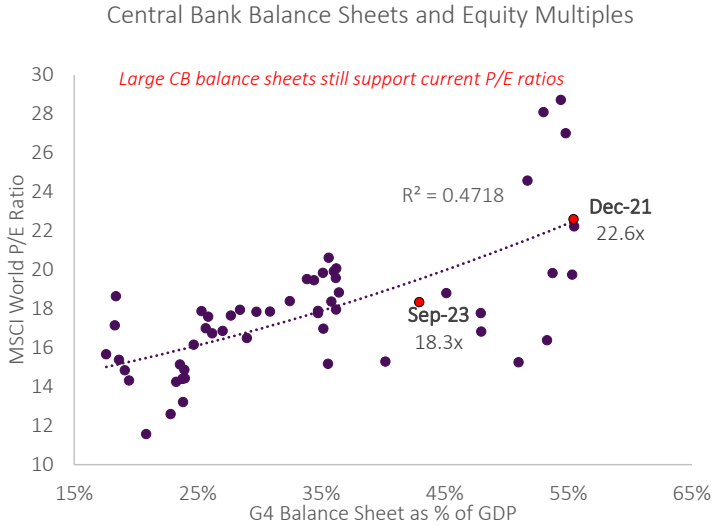
The Technical Picture Remains Quite Compelling

Retail + Institutional Money Market Cash Holdings Are At $5.6 Trillion, Representing 26% of Total Assets, the Highest Since November 2010



Data as of September 30, 2023. Source: ICI.

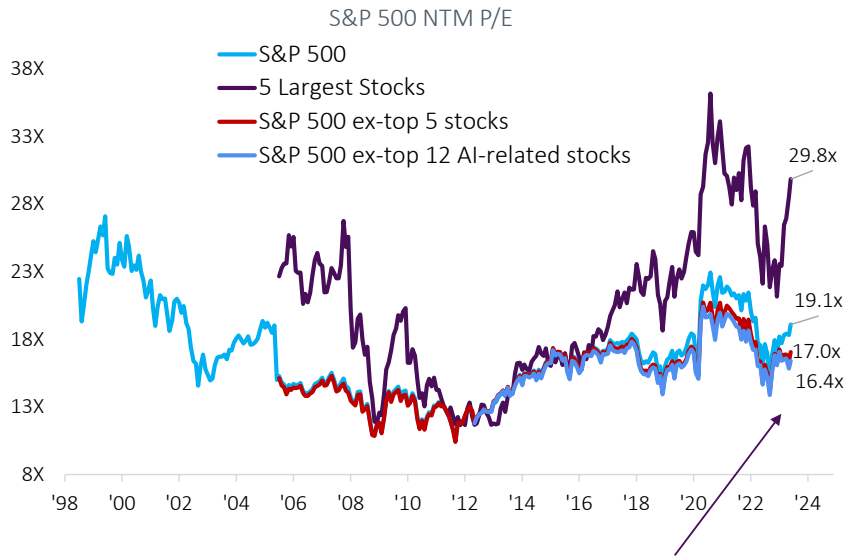
Large Central Bank Balance Sheets Are Still Supportive of Valuations



Data as at September 30, 2023. Source: Federal Reserve Board, Bloomberg, KKR GMAA Analysis..

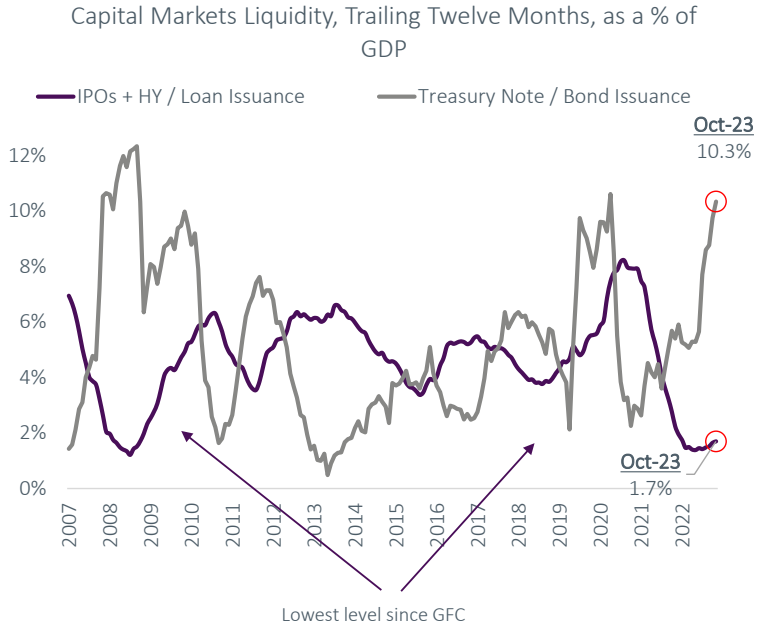
However, We Fully Acknowledge That In Certain Instances You Do Have to Look Under the Surface to Find Opportunities

While Mega-cap Tech and AI-Related Stocks Look Expensive, There Is Still Value in Other Parts of the S&P 500



Most valuations are actually in-line with historical averages, and small cap is cheap!

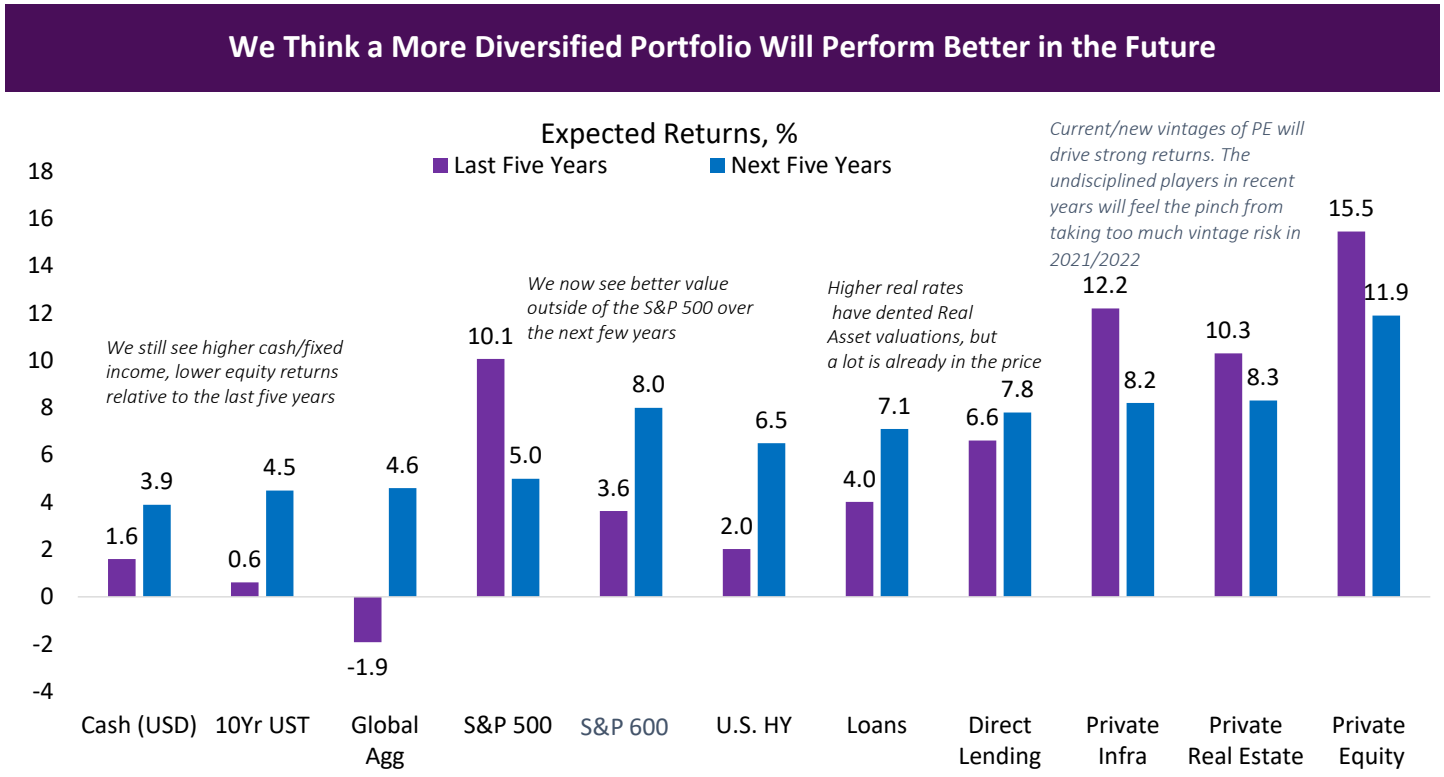
Capital Markets Conundrum: Net Supply Is Really Tight, Except When It Comes to Government Bonds



Lowest level since GFC

Note: top 5 stocks include Apple, Microsoft, Amazon, Nvidia and Google AI-related stocks include Apple, Microsoft, Amazon, Nvidia, Google, Meta, Tesla, Broadcom, AMD, Salesforce, Netflix and Oracle Data as at 6/22/2023.Source: KKR GMAA, Bloomberg, S&P

Our Asset Class Expected Returns Reflect Our 'Glass Half Full' Framework

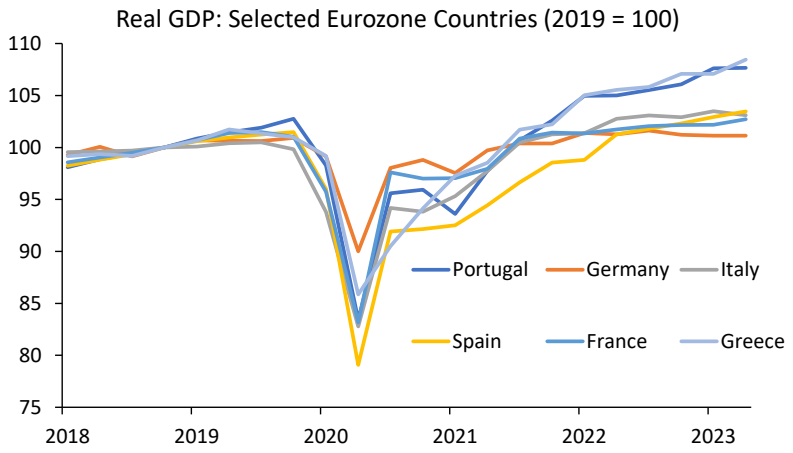


Data as at December 5, 2023. Source: Bloomberg, BofA, Cambridge Associates, Greenstreet, KKR Global Macro & Asset Allocation analysis.

KKR

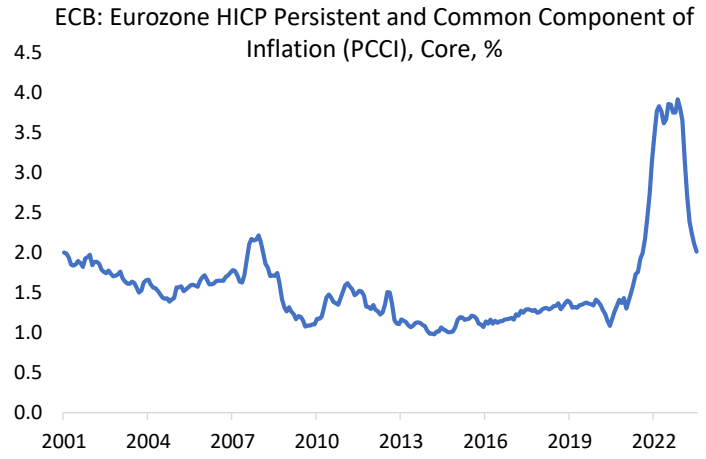
Europe: We See a Faster Deceleration of Headline Inflation Than the Consensus Expects

The Periphery Has Led the European Recovery



Data as at September 30, 2023. Source: Eurostat.

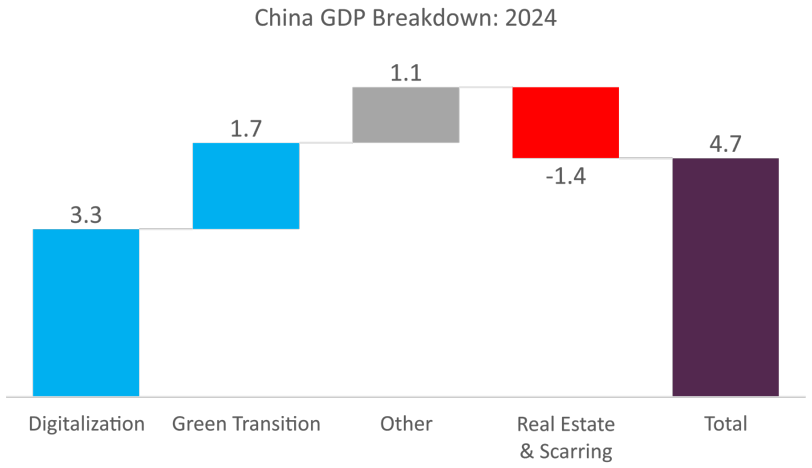
Persistent Core Inflation as Estimated by the ECB Is Now at Two Percent



Data as at September 30, 2023. Source: ECB.

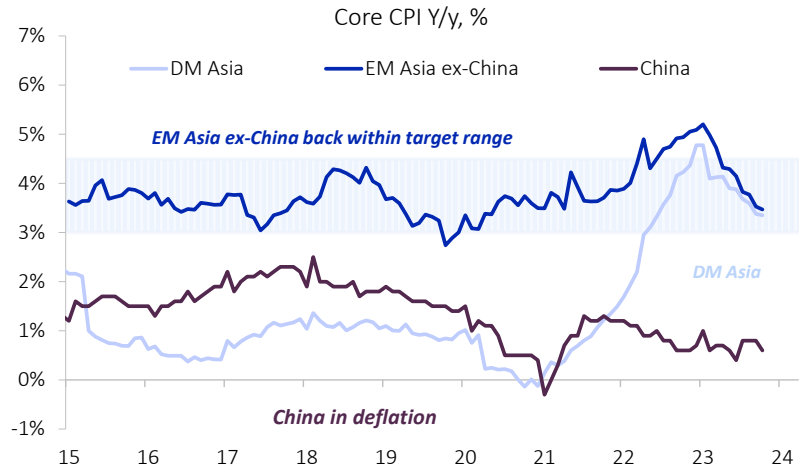
China: The Economy Is Undergoing a Substantial Change

We Continue to See Strong Support from the New Economy for Growth, While Policy Easing Will Help Mitigate the Drag from Real Estate, Scarring Effects and Negative Wealth Effects



Note: 'Green transition' is based on green finance and transition investment studies from Beijing Institute of Finance and Sustainability as well as as reported by BNEF. 'Digital economy' added value is as reported by CAICT, including added value of the information industry and added value that the information industry brings to other industries. The drag of real estate is estimated by the KKR GMAA team with an IO table and includes the real estate industry itself and the industry's impact on upstream and downstream. Data as at November 30, 2023. Source: Beijing Institute of Finance and Sustainability. China National Bureau of Statistics, BNEF, CAICT, KKR Global Macro & Asset Allocation analysis.

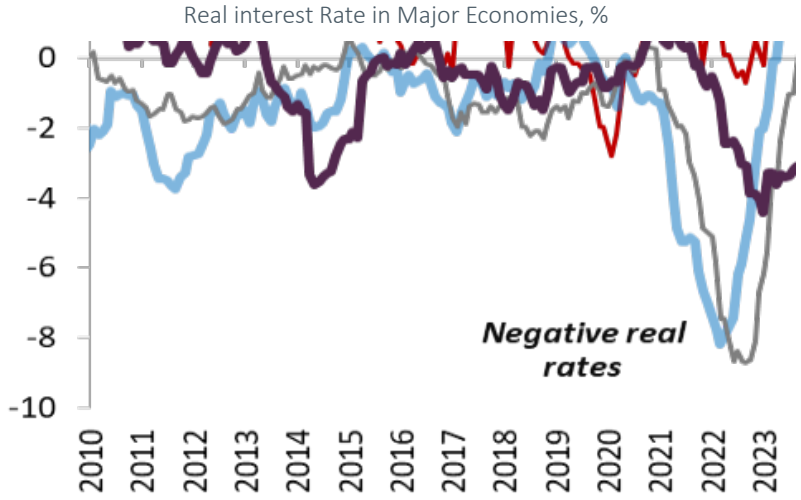
Inflation in Asia Is Not Far From 'Normal', While China Is Still Quite Low and Near Deflationary Levels



Data as at November 30, 2023. Nominal GDP weighted. Source: National statistical agencies, central banks, Haver Analytics, KKR Global Macro & Asset Allocation analysis

Japan: We Think Japan Is Exiting Deflation for the First Time in Decades

The Wide Divergence in Real Rates Around the Globe Speaks to the Asynchronous Nature of This Recovery



Note: Real interest rate is measured here as 10-year government bond yield – headline CPI inflation. Data as at November 30, 2023. Source: WIND, KKR Global Macro & Asset Allocation analysis.

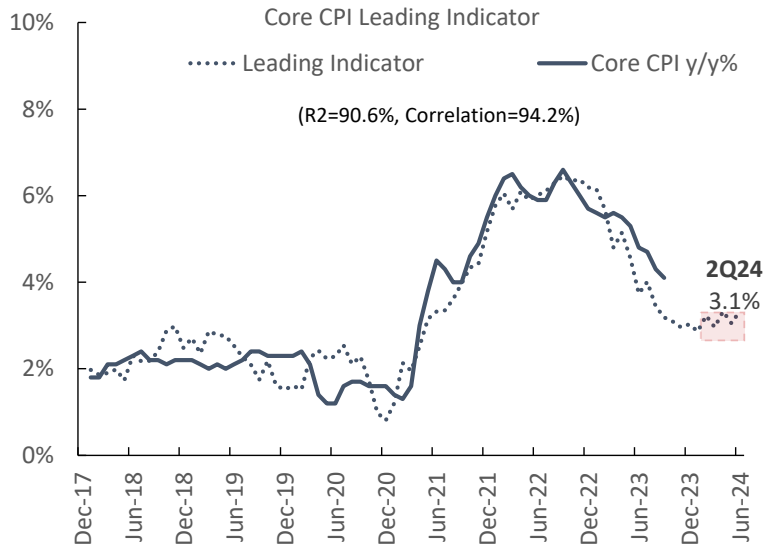
Tight Labor Markets Are Helping to Put More Upward Pressure on Japan Inflation

Data as at November 30, 2023. Source: KKR Global Macro & Asset allocation analysis.

Section II: Inflation & Its Implications for Asset Allocation

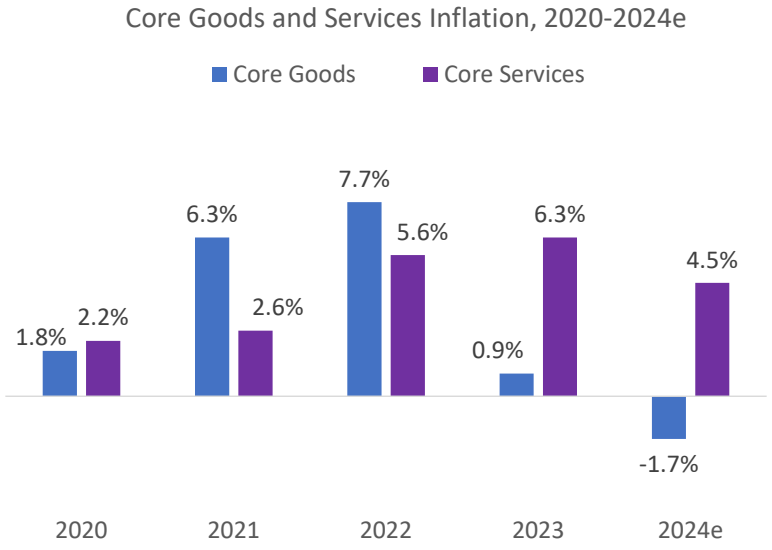
Inflation: Though Cooling in the U.S, We Still See a Higher Resting Heart Rate This Cycle

Our Core CPI Model Does Show Some Improvement in Inflation in 2024



Data as of November 30, 2023; Model retrained on monthly basis to better reflect latest CPI inflation trends.. Source: Bloomberg, KKR Global Macro & Asset Allocation analysis.

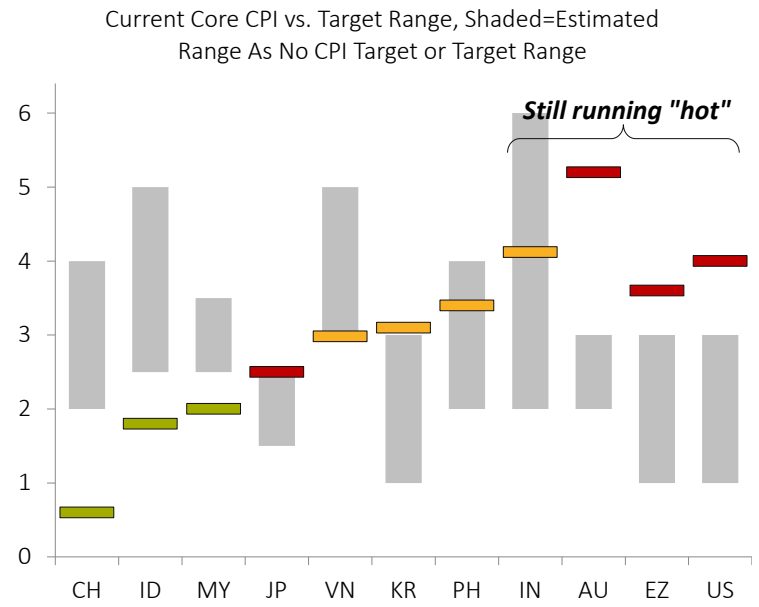
Core Goods Will Be Deflationary in 2024, While Core Services Will Begin to Come Off the Boil



Data as at November 15, 2023; Source: Bloomberg, KKR Global Macro & Asset Allocation analysis.

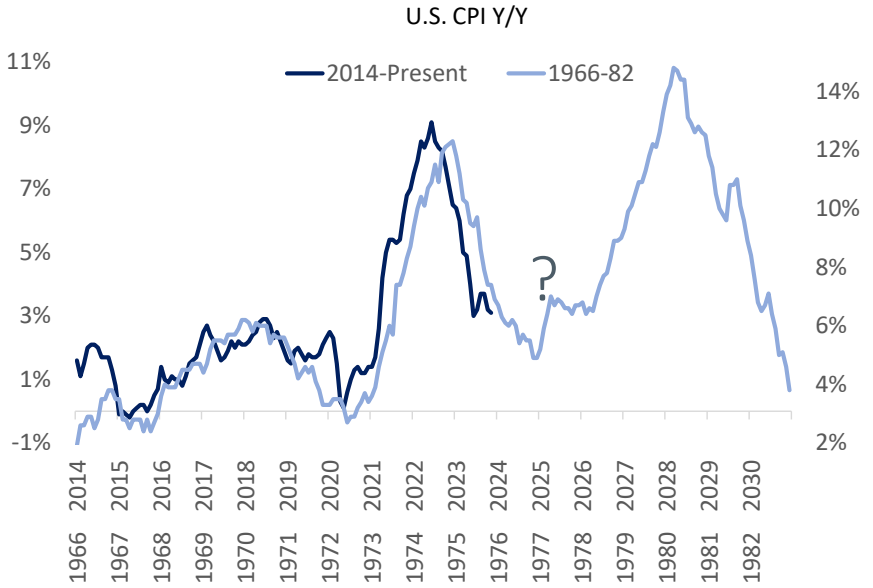
With Inflation, Both Global and Historical Perspectives Are Required

There Is No One Inflation in an Unsynchronized Global Economy



Data as at November 30, 2023. Source: Bloomberg, KKR Global Macro & Asset Allocation analysis.

Regime Change for Inflation Often Leads to Volatility Along the Way



Data as at November 30, 2023. Source: Bloomberg.

Our Global Rate Forecasts: Our Instinct Is That Things Are Not Going Back to the Way They Were

For 2024 and 2025, We Are Considering a Range of Outcomes, Highlighting the Asynchronous Nature of Capital Markets

KKR GMAA 10-Year Interest Rate Forecast and Probability, %				
	Base	**Low**	**High**	**Consensus**
U.S.	**60%**	**20%**	**20%**	
2024e	4.0%	3.0%	5.0%	3.8%
2025e	4.0%	2.5%	5.0%	3.63%
Euro Area	**60%**	**20%**	**20%**	
2024e	2.6%	1.75%	3.25%	2.28%
2025e	2.8%	1.75%	3.75%	2.25%
China	**60%**	**20%**	**20%**	
2024e	2.6%	2.4%	2.8%	2.67%
2025e	2.5%	2.3%	2.7%	2.58%
Japan	**65%**	**15%**	**20%**	
2024e	1.25%	.65%	1.75%	0.96%
2025e	1.5%	.65%	2.0%	1.03%

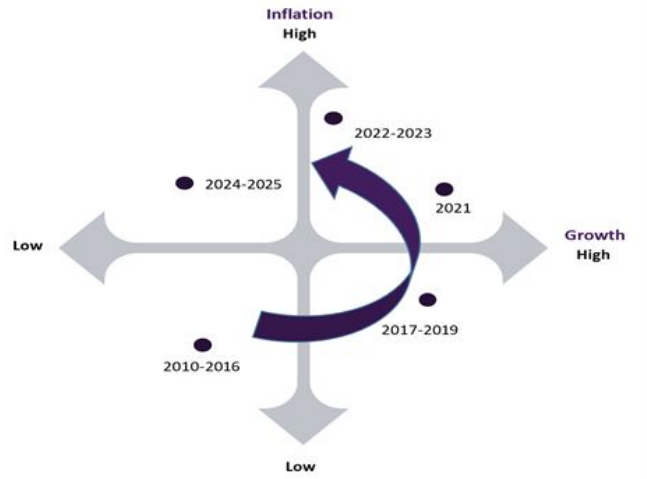
In the U.S. and Eurozone for 2023 and 2024 we assign a probability of 60% for the base case, 20% for the bear case, and 20% for the bull case. For China: In 2023, we assign a probability of 60% for the base case, 20% for the bear case, and 20% for the bull case. In 2024, we assign a probability of 50% for the base case, 25% for the bear case, and 25% for the bull case. Note that the bear case in the U.S. assumes a deep recession in 2023, but also assumes a bit more of a snapback in 2024. Data as at November 30, 2023. Source: KKR Global Macro & Asset Allocation analysis.

Overall, We Still Think We Are in a New Investing Regime…

We still see higher headline nominal GDP growth this cycle, but the underlying mix is increasingly shifting towards inflation relative to real growth

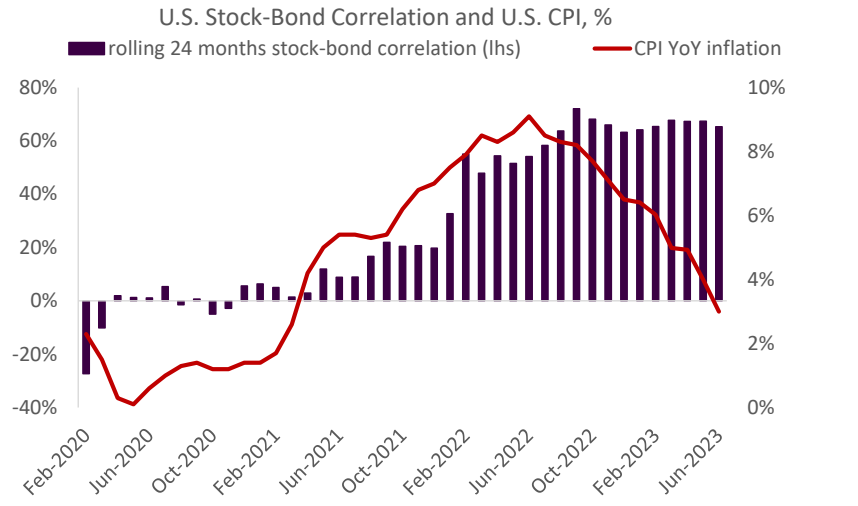
While 2023 Should Be a Lower Inflation Environment, We Believe a Regime Change Has Occurred

Low and High Growth and Inflation Regimes



Data as at May 31, 2023. Source: KKR Global Macro & Asset Allocation analysis.

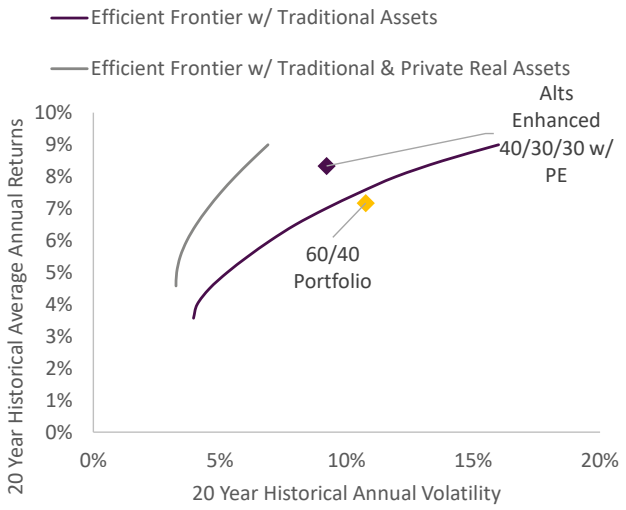
Despite Inflation Falling on a Cyclical Basis, the 'New' Positive Relationship Between and Bonds Remains Strong



Note: Stocks refers to the S&P 500 and Bonds refers to the 10-year Treasury Yield. Data as at September 30, 2023. Source: KKR Global Macro & Asset Allocation analysis.

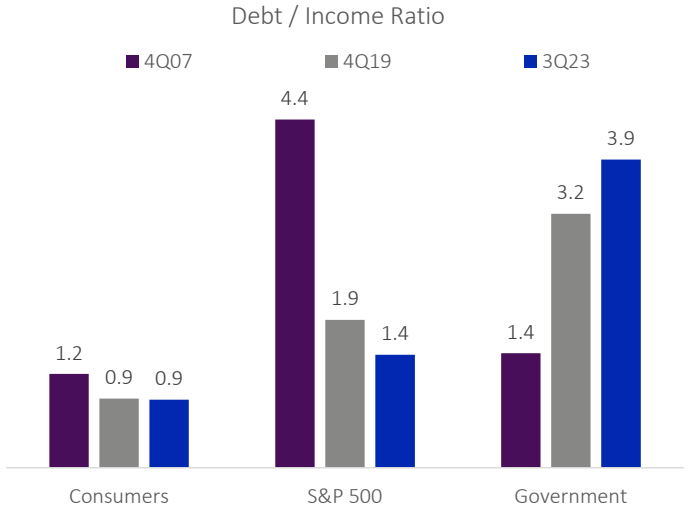
…So, Think Differently

We Think That a More Diversified Portfolio, Including Alternatives, Can Help Boost Returns



Example pension liabilities and asset portfolio. Analysis models the example pension liabilities as a short position in a bond with coupon payments over 50 years that escalate annually. Surplus excess returns and surplus risk are estimated as the difference in returns between an underfunded portfolio and the modeled pension liabilities. Data as at June 30, 2023. Source: KKR Global Macro, Balance Sheet & Risk analysis.

The Government – Not the Consumer or Corporates – Is Over-Levered This Cycle



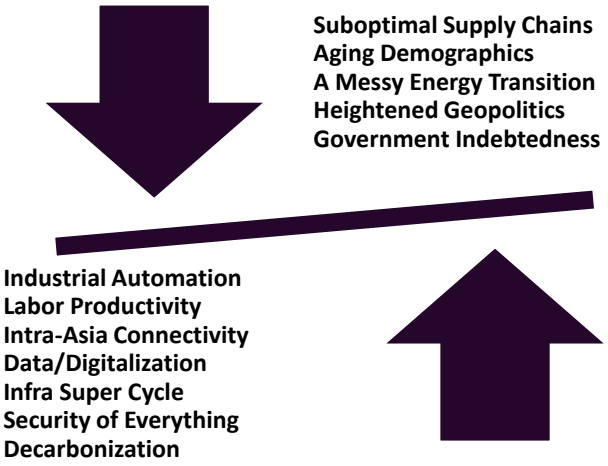
For consumers, income defined as total personal income (before tax or interest expense). For corporates, income defined as EBITDA. For government, income defined as total revenue. Data as September 30, 2023. Source: BofA, KKR Global Macro & Asset Allocation analysis.

Section III: Key Themes

Importantly, Recent Uncertainties Have Created Growth Opportunity in Many Instances

While We Fully Acknowledge Some Global Macro Headwinds, Our Travels Continue to Uncover Some Powerful 'Glass Half Full' Themes to Invest Behind

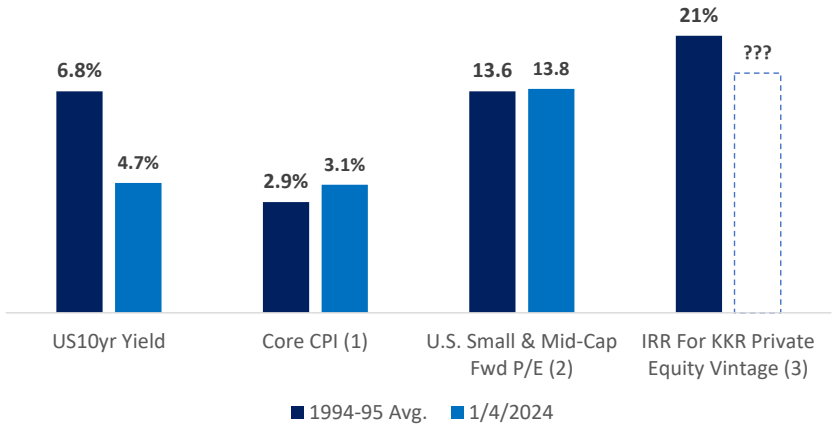
Macro Headwinds vs. Tailwinds



Data as of November 22, 2023. Source: KKR Global Macro and Asset Allocation analysis.

We Are More Constructive on Private Market Returns in the Current Macroeconomic Environment

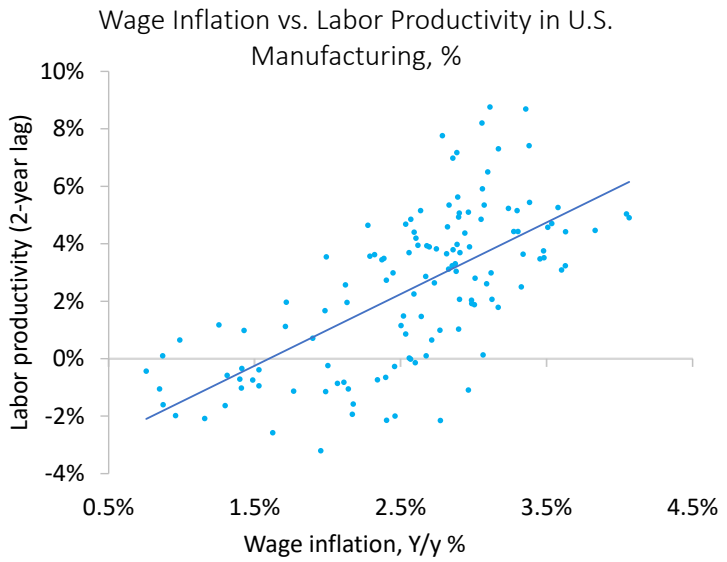
Private Markets Investing: Back to the Future?



Data as at January 4, 2024. Source: Bloomberg, Cambridge Associates, KKR Global Macro & Asset Allocation analysis.

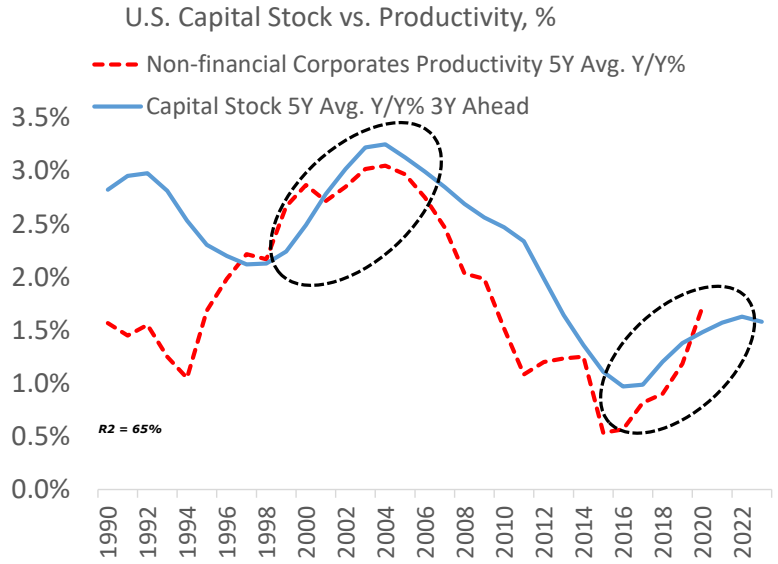
#1: Labor Productivity/Workforce Development: Periods of Labor Scarcity Have Historically Been Opportunities for Greater Automation

Wage Gains Have Historically Led to Periods of Rising Productivity



Data as at May 31, 2022. Source: BofA Quantitative Research.

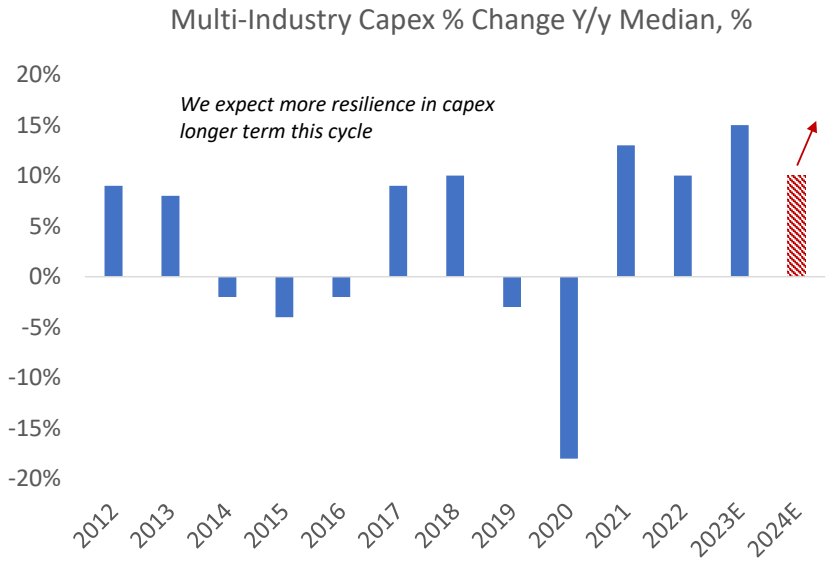
Capital Investment Leads to Productivity Gains. The Last Major Wave of Capital Investment Occurred in the 1990s and Another Is Currently Underway, We Believe



Data as at December 31, 2021. Source: U.S. Bureau of Economic Analysis, U.S. Bureau of Labor Statistics, Cornerstone Research, Haver Analytics.

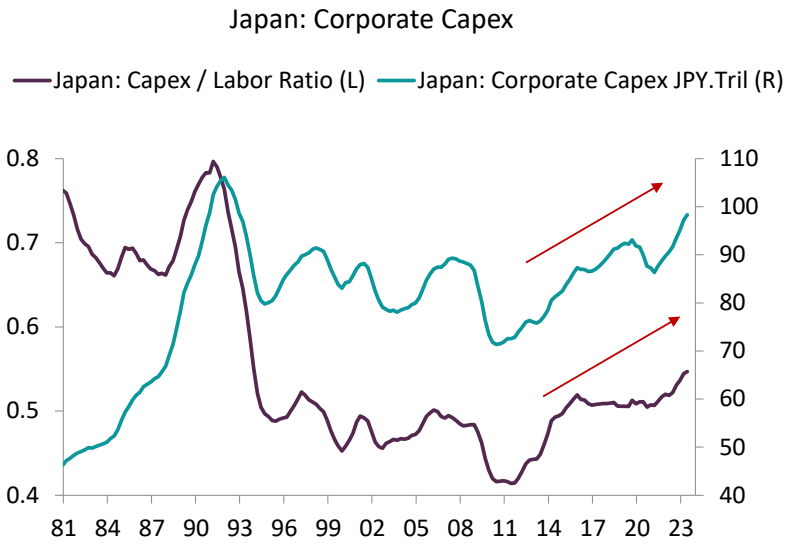
#2: Industrial Automation: Critical When Labor Costs and Other Rising Inputs May Pressure Margins

Many Factors From AI and ESG Spend to Reshoring to Past Underinvestment to CHIPS Act/IRA Stimulus Are Contributing to the Uptick in Current Capex Spend



Data as at September 30, 2023. Source: Melius Research.

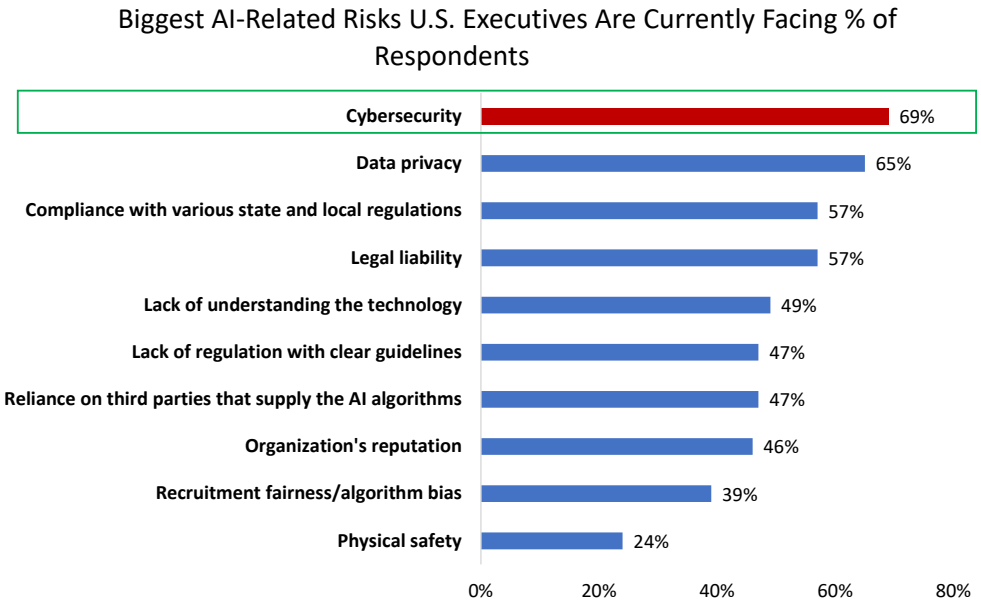
Japan Corporate ROE Has Been Robust Supporting Higher Corporate Capex, Especially When Labor Shortage Gets Worse



Data as at November 30, 2023. Source: KKR GMAA Analysis.

#3: Security of Everything: CEOs Need Resiliency When It Comes to Key Inputs Such as Energy, Data, Transportation, and Pharma

Cybersecurity Has Become a Major Risk Surrounding Generative AI Models



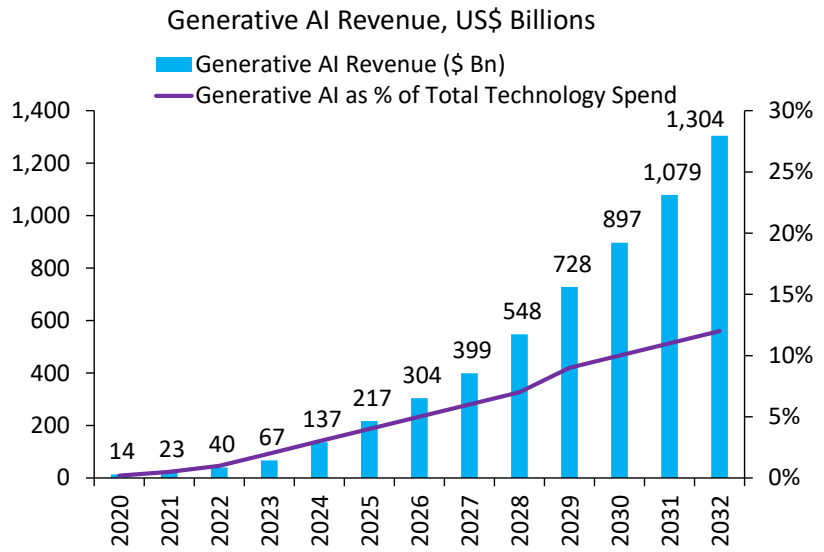
Data as at February 28, 2023. Source: Bank of America, Baker McKenzie, Insider Intelligence.

Shifting of Supply Chains Is Creating Opportunities

Data as October 31, 2023. Source: U.S. Census Bureau.

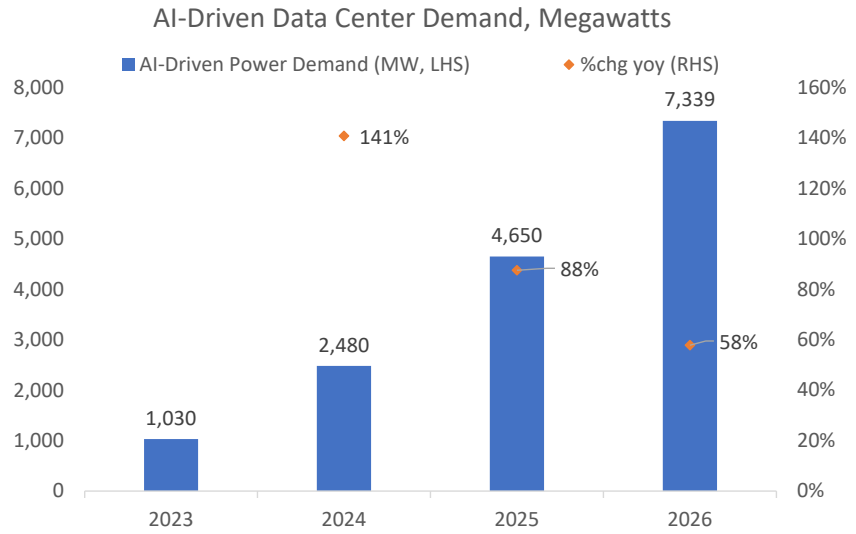
#4: Artificial Intelligence: We Think There Will Be a Massive Investment Cycle to Develop the Underlying AI Infrastructure

Spending on Generative AI Looks Set to Explode in the Coming Years



Data as at September 30, 2023. Source: Melius Research.

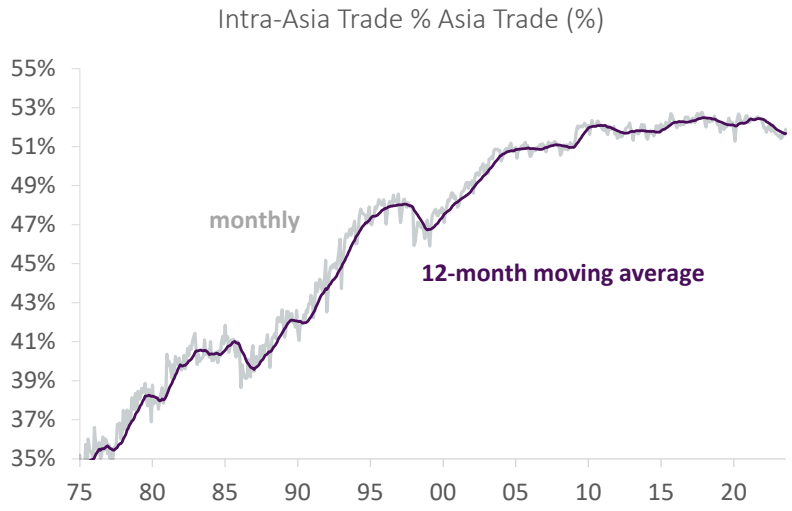
AI Workflows Are More Computation Intensive and Server Racks Use More Energy, Which Will Drive Power Demand



Data as at June 30, 2023. Source: Evercore Research

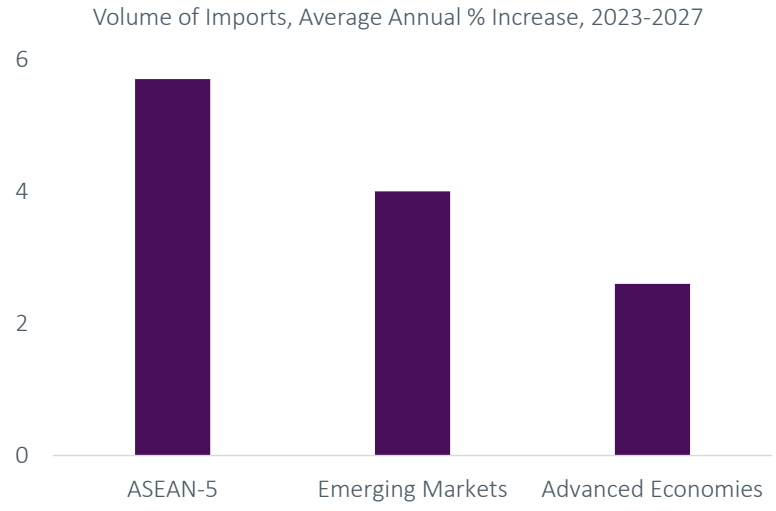
#5: Intra-Asia: In 1990 Just 46% of Asian Trade Took Place Within Asia; By 2021, That Figure Had Reached 58%

Asian Trade Is Becoming More Local



Data as at August 31, 2023. Source: KKR GMAA.

Rising Asian Consumption Also Makes Local Markets More Attractive



ASEAN 5 equals Indonesia, Malaysia, Philippines, Singapore and Thailand. Data as at September 2023.
Source: The Economist.

Overall, We Have a 'Glass Half Full' Orientation to Investing , While Also Acknowledging the Unique Nature of the Current Cycle

This Cycle Won't Feel Like Past Ones

What's Different This Cycle	
1. Asia	Japan is experiencing inflation, while China is flirting with deflation
2. Europe	The periphery of Europe, including once maligned Greece, is outperforming traditional economic stalwarts like Germany
3. Leverage	It is the government, not consumer, that is over-leveraged this cycle
4. Real Rates	Real rates will be rising as the Fed begins cutting short-term interest rates
5. Inflation	We expect near-term disinflation, but our longer-term call is still for a 'higher resting heart rate' of inflation this cycle
6. Growth	Nominal GDP will slow materially in 2024, but corporate earnings growth will actually re-accelerate. We also do not expect a major uptick in unemployment
7. Shock Absorbers	Traditional safe haven assets such as the U.S. dollar/JPY and U.S. Treasuries are not rallying consistently during risk-off periods
8. Less Boom, Less Bust	Inventories and Housing have remained resilient, which is why we believe that, though there is 'Less Boom' this cycle, there will also be 'Less Bust' too, especially in 2024

Data as at December 31, 2023. Source: KKR Global Macro & Asset Allocation analysis.

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RECESS FOR LUNCH

Nate Haws

Associate Principal Consultant and AI Researcher

at Linea Solutions has over 20 years of experience working with public and private sector retirement plan administration. He has worked on multiple large-scale information technology projects as a business analyst, project manager and many other roles. He has worked on Pension Administration System implementation projects from the research/feasibility phases to the implementation phases. Nate is currently working with California State Teachers Retirement System to implement their new system and improve business processes across the enterprise. They are working together to develop the organization's AI strategy and implementing AI chatbot knowledgebases. Before that has working with South Carolina Public Employee Benefit's Authority, New York City Police Pension Fund, and Educational Employees' Supplementary Retirement System of Fairfax County, Virginia.

Nathan is a member of the International Institute of Business Analysis (IIBA) and is a Six Sigma Black Belt (SSBB), Certified Data Analyst, a Chartered Financial Consultant (ChFC), a Chartered Life Underwriter (CLU) and a certified expert in business process management (OCEB2).

Linea Background:

Linea Solutions is a technology consulting firm, specializing in public sector pension and benefits. They have advised hundreds of US and Canadian organizations through technology transformation programs for over 25 years. Linea is the largest consulting firm in the public pension industry providing technology strategy, procurement and project oversight, cybersecurity, change management and data conversion services. More recently, Linea is providing strategic guidance and industry leadership in helping public pension organizations carefully adopt new Generative AI technologies and realize the benefits AI has to offer.

AI INTRODUCTORY TRAINING

February 16, 2024

Agenda

1. What is Digital Debt?
2. What is AI?
3. What are the Public Pension Industry trends in AI?
4. What can AI do (demo)?
5. How is SERS carefully adopting AI?
6. What other opportunities exist for AI at SERS?
7. How do we manage AI related risks?

Poll Questions

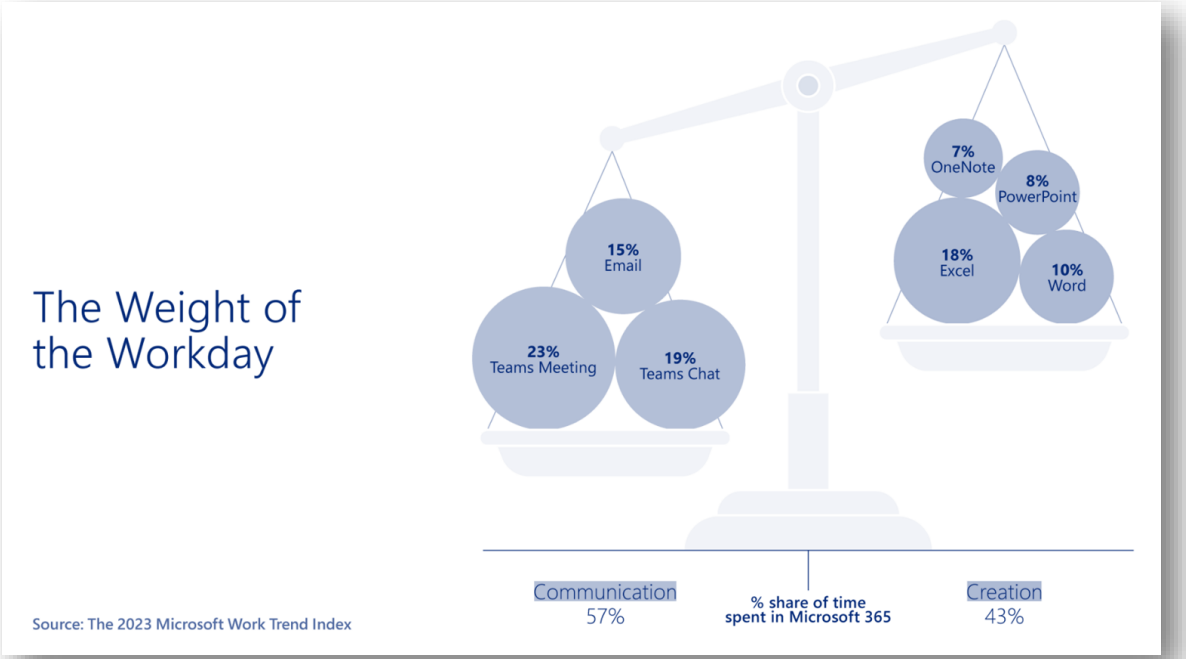
Learning Objectives

1. Increase your knowledge on AI – opportunities and challenges for SERS
2. Embrace change that AI will bring – provide leadership & accountability
3. Provide assurance that ERM is working to mitigate organizational risks
4. Ensure the AI policy is well understood
5. Introduce AI Oversight Committee's responsibility to assesses risks & prioritize

What is Digital Debt?

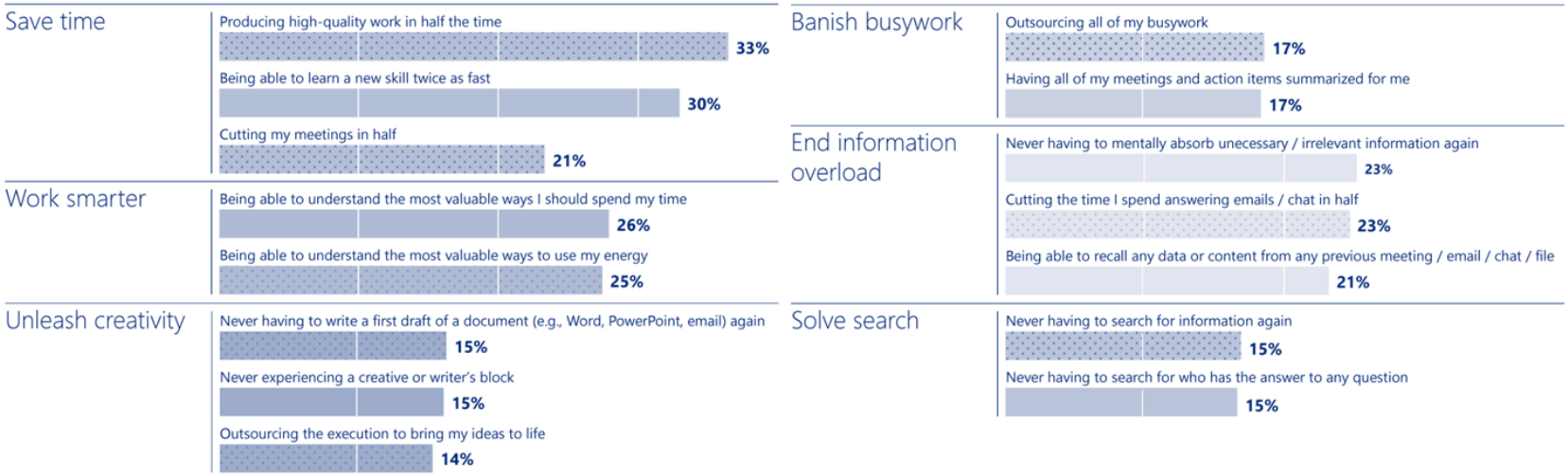
Microsoft describes **Digital Debt** as the circumstance we have where we are no longer able to keep up with the administration of our lives, and we spend more time in each of our days in meetings, answering emails, answering calls and texts, and less time producing or creating

- Workers spend 57% of workday communicating
- 68% of people say they don't have enough uninterrupted focus time during the workday



What is Digital Debt?

AI will provide the ability to recover from Digital Debt.

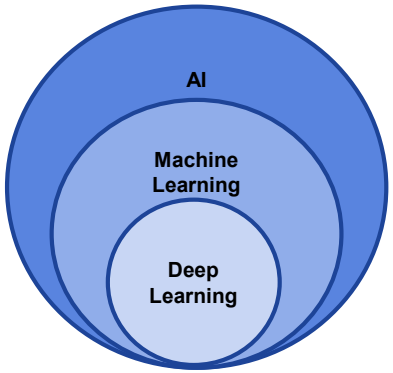


Source: The 2023 Microsoft Work Trend Index

What is AI?

Artificial Intelligence – Computer systems able to perform tasks normally requiring human intelligence.

- It has been around for decades (Siri, Netflix recommendations, autocorrect, etc.)



Umbrella Term encompasses all types of AI	Trained models that can detect patterns and learn how to make predictions	ML models that process more complex patterns (Generative AI & LLMs)
Artificial Intelligence AI	Machine Learning ML	Deep Learning DL

SERS' will implement an AI Culture that balances risks and opportunities from AI technologies.

What is AI?

Generative AI (GAI): *A type of Deep Learning AI that **creates new content** based on what it has learned from existing content (a.k.a. "AI training").*

1. You submit a prompt
2. GAI uses statistics to predict a response, based on its training data, and **generates something new**

GAI is the reason why AI is such a **hot topic** right now

- **Text/General** (ChatGPT, Claude, Bard, BingChat)
- **Image** (Midjourney, Dall-E, Stable Diffusion)
- **Audio** (Suno, Voicebox, AudioCraft)
- **Video** (Synthesia, HeyGen, Pika Labs)
- **Code** (AlphaCode, GitHub Copilot, Code Whisperer)

What are the Public Pension Industry trends in AI?

- Early adopters of GAI focusing on **Governance and Policy**
- State & Local governments issuing executive orders & drafting legislation guiding public employee use of AI/GAI
- Different degrees of risk tolerance for GAI tool adoption

<u>Use Case Trends include:</u>

- ML
    - Pattern detection for in house investment decisions with “human in the loop”
    - Third party money managers also leveraging ML pattern detection tools
    - Cybersecurity threat detection and management
- GAI
    - Chatbots trained on internal documentation implemented to help staff find information
        - Any source of truth (system designs, Customer Service knowledge base, etc.)
        - Chatbots are not being trained on member data at this time, too much risk
        - *We will demo one of these chatbots*
    - Shadow adoption of tools like ChatGPT & Claude
        - Once you have used them at work, you will not want to go back to the old way
        - Enterprise capabilities haven’t been extended to small/medium organizations
    - Communications divisions are creating text and image content with GAI tools
    - Pennsylvania state government partnered with OpenAI to implement Enterprise ChatGPT

What are the Public Pension Industry trends in AI?

Gartner Long Term AI Predictions

By 2025:

- 70% of enterprises will identify the sustainable and ethical use of AI among their top concerns
- 35% of large organizations will have a chief AI officer who reports to the CEO or COO

- **Through 2026**, despite all of the advancements in AI, the impact on global jobs will be neutral – there will not be a net decrease or increase

- **By 2030:**
- AI could reduce global CO2 emissions by 5 to 15% and consume up to 3.5% of the world's electricity
- Decisions made by AI agents **without human oversight** will cause $100 billion in losses from asset damage

- **By 2033**, AI solutions will result in more than half a billion net-new human jobs

What can AI do?

How is SERS carefully adopting AI right now?

Numerous opportunities for the SERS organization and stakeholders

Artificial Intelligence (AI) Usage Policy

- Sets guidelines to protect our data, mitigate risks & use AI responsibly
- Worked with industry peers and consultants to create the AI policy using best practices

AI Committee

- As we intended to further implement AI, this governing body will ensure that our values are protected
- Responsible for AI related decisions & use case approvals with Representation from Legal, IT, Security, Ops

Tool/Use-Case Intake Form and Approval Process

- Overseen by the AI Committee to gather AI use case opportunities for SERS related work
- Tools evaluated on consistent parameters (costs, benefits, security standards, etc.)

How is SERS carefully adopting AI right now?

SERS' AI Policy Overview

Responsible AI Uses
Virtual assistants or chatbots to support customer service.
Brainstorm ideas for a project or research topic.
Create software tool efficiencies.
Develop, debug or test software code.
Generate draft communications.
Statistical data analysis and predictive modeling.
Security and fraud-preventive controls.
Other uses, as approved by SERS' AI Oversight Committee.

Prohibited AI Uses
Conduct illegal, unethical, or malicious activities.
Threaten digital security of individuals or systems.
Discriminate or apply bias against individuals
Sharing Personally Identifiable Information (PII), Personal Health Information (PHI), or sensitive/proprietary data.
Disseminate misleading information with the intent to deceive.
Invade privacy or use personal information without authorization/consent.
Present AI-generated content as human-made when interacting with others, unless explicitly disclosed.
Use SERS-provided AI technologies for personal use.

How is SERS carefully adopting AI right now?

AI Related Risks and Mitigation Strategies

AI Risks:

- GAI tool “Hallucinations”
- Data & information security
- Bias

Mitigation Approaches:

- Internal facing tools to help staff help SERS members
- Human-in-the loop decisions
- Tools that cite sources
- Assistance from industry experts
- Prompt engineering techniques
- Training & communications with staff
- Thorough testing any AI tool under consideration
- Enterprise security settings, management & oversight
- Careful rollout plans with feedback loops when implemented (POC, pilots)

How can SERS benefit from AI opportunities?

Personal Productivity

- First draft communications, in compliance with style guide / communication standards
- Automated meeting minutes & action item tracking
- Data transformation, code generation, database query assistance, etc.
- Image generation & AI avatars for slide decks & communication /publication content

Pension Business Uses

- Chatbots assisting in delivering customer service to members & retirees
- Cybersecurity & automated threat detection & Identity Verification services to keep member data safe, secure emails
- AI pattern detection for investment opportunity detection & decision-making assistance
- IT Software development, debugging code, explaining legacy code, enhancing code

Head to the Appendix for more use cases.

How can SERS benefit from AI opportunities?

Road Map & Next Steps

Use case identification and management by AI committee

Strategic opportunity quick win implementations (low risk, low effort, internal facing, high ROI) to improve Member service

Confirming tools are providing the benefits

Build internal advocacy

Monitor for emerging risks

Ongoing oversight

Continue working with industry consultants

Key Takeaways

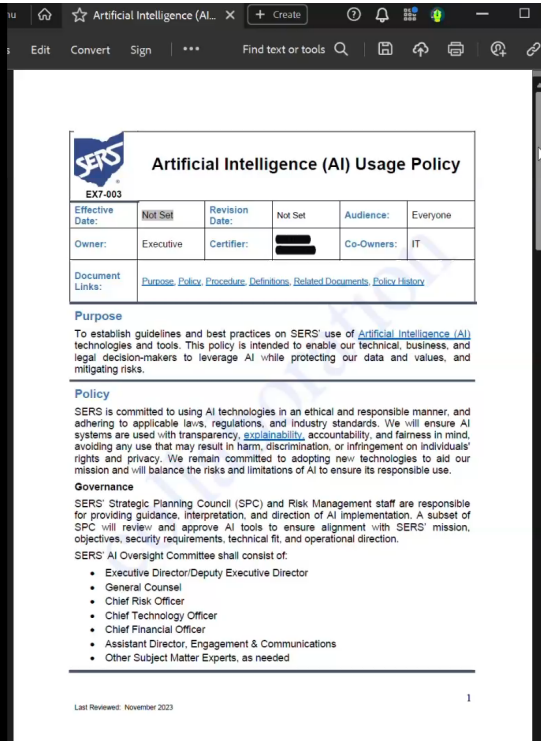
1. AI understanding increased
2. Understanding how AI provides great opportunities for SERS to improve business
3. AI risks are being carefully managed
4. A policy is in place providing guidelines for responsible AI use
5. An oversight committee is in place to ensure that AI tools provide business benefits and meet security standards

Questions?

Appendix

ChatGPT Communication/Email Demo

Here we have SERS' AI policy with names redacted.



Artificial Intelligence (AI... Create

Edit Convert Sign ••• Find text or tools

Artificial Intelligence (AI) Usage Policy

EX7-003

Effective Date:	Not Set	Revision Date:	Not Set	Audience:	Everyone
Owner:	Executive	Certifier:	[redacted]	Co-Owners:	IT
Document Links:	Purpose, Policy, Procedure, Definitions, Related Documents, Policy History				

Purpose

To establish guidelines and best practices on SERS' use of Artificial Intelligence (AI) technologies and tools. This policy is intended to enable our technical, business, and legal decision-makers to leverage AI while protecting our data and values, and mitigating risks.

Policy

SERS is committed to using AI technologies in an ethical and responsible manner, and adhering to applicable laws, regulations, and industry standards. We will ensure AI systems are used with transparency, explainability, accountability, and fairness in mind, avoiding any use that may result in harm, discrimination, or infringement on individuals' rights and privacy. We remain committed to adopting new technologies to aid our mission and will balance the risks and limitations of AI to ensure its responsible use.

Governance

SERS' Strategic Planning Council (SPC) and Risk Management staff are responsible for providing guidance, interpretation, and direction of AI implementation. A subset of SPC will review and approve AI tools to ensure alignment with SERS' mission, objectives, security requirements, technical fit, and operational direction.

SERS' AI Oversight Committee shall consist of:

- Executive Director/Deputy Executive Director
- General Counsel
- Chief Risk Officer
- Chief Technology Officer
- Chief Financial Officer
- Assistant Director, Engagement & Communications
- Other Subject Matter Experts, as needed

1

Last Reviewed: November 2023

Other Potential AI Use Cases

1. Generative AI Tools
   - Chat GPT / Claude (chat interface)
   - Bing Enterprise (chat interface, verify data source)
   - M/S 365 Copilot (chat interface)
   - Internal/Board Meeting Recap (M/S Intelligent Recap – GCC Tenant)
   - Custom Chatbots (Heavy Data Sources - CalSTRS; SMART)
   - Website Chatbot (Content Facing Analysis On User Activity)
2. Contact Center (CCaaS Communications, Observe AI – Missouri PSRS)
3. Software Development/Review/Refactoring (GitHub Copilot - Missouri PSRS)
4. Identity Verification/Proofing/Fraud (MSS Portal - Socure, OPERS/DAS)
5. Investments (Machine Learning Algorithms - Predictive Analytics, TxTRS)
6. Cybersecurity Tools (security monitoring, email)
7. Finance – Travel Real-Time Receipts (CalSTRS)
8. Staffing – Recruitment/Hiring, Performance
9. AI Resource Query – ‘Futuretools.io’

Cavanaugh Macdonald
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The experience and dedication you deserve

Ohio School Employees Retirement System Risk Assessment

February 16, 2024

Todd Green, ASA, EA, FCA, MAAA
John Garrett, ASA, FCA, MAAA

www.CavMacConsulting.com

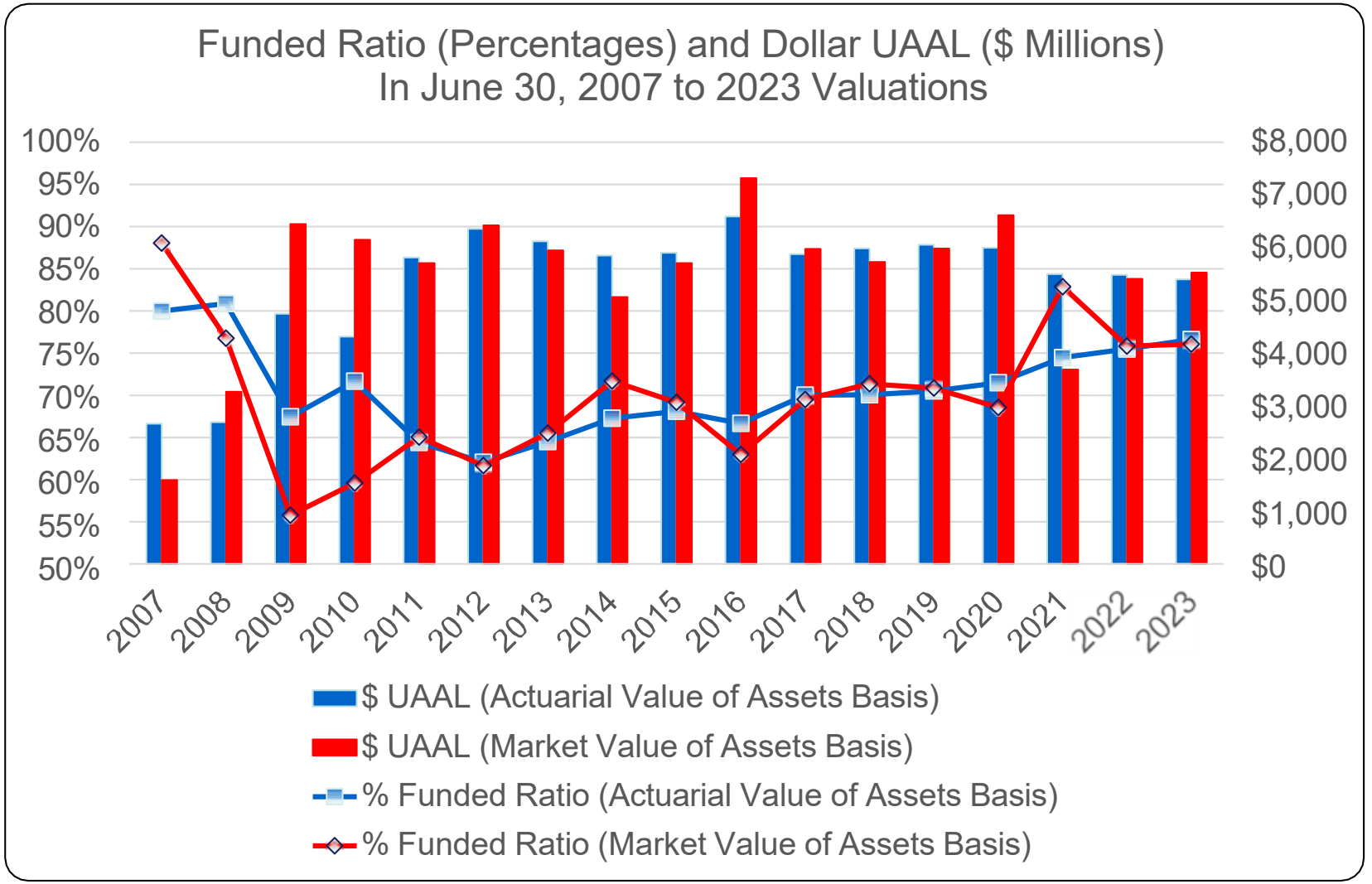
Examples of Risk

- Actuary is to identify risks that may affect the Plan's future financial condition
- Examples that are relevant for most public plans
  - ***Investment risk***: potential that return will be different than expected
  - ***Longevity risk***: potential that mortality experience will be different than expected
  - ***Covered payroll risk***: potential that covered payroll will not increase as assumed (especially important if UAL is amortized as level percent of payroll)
  - ***Active population risk***: potential for number of active members to decline or plan closed to new entrants
  - ***Contribution rate risk***: potential for contribution rates to be too high for the plan sponsor/employer to pay

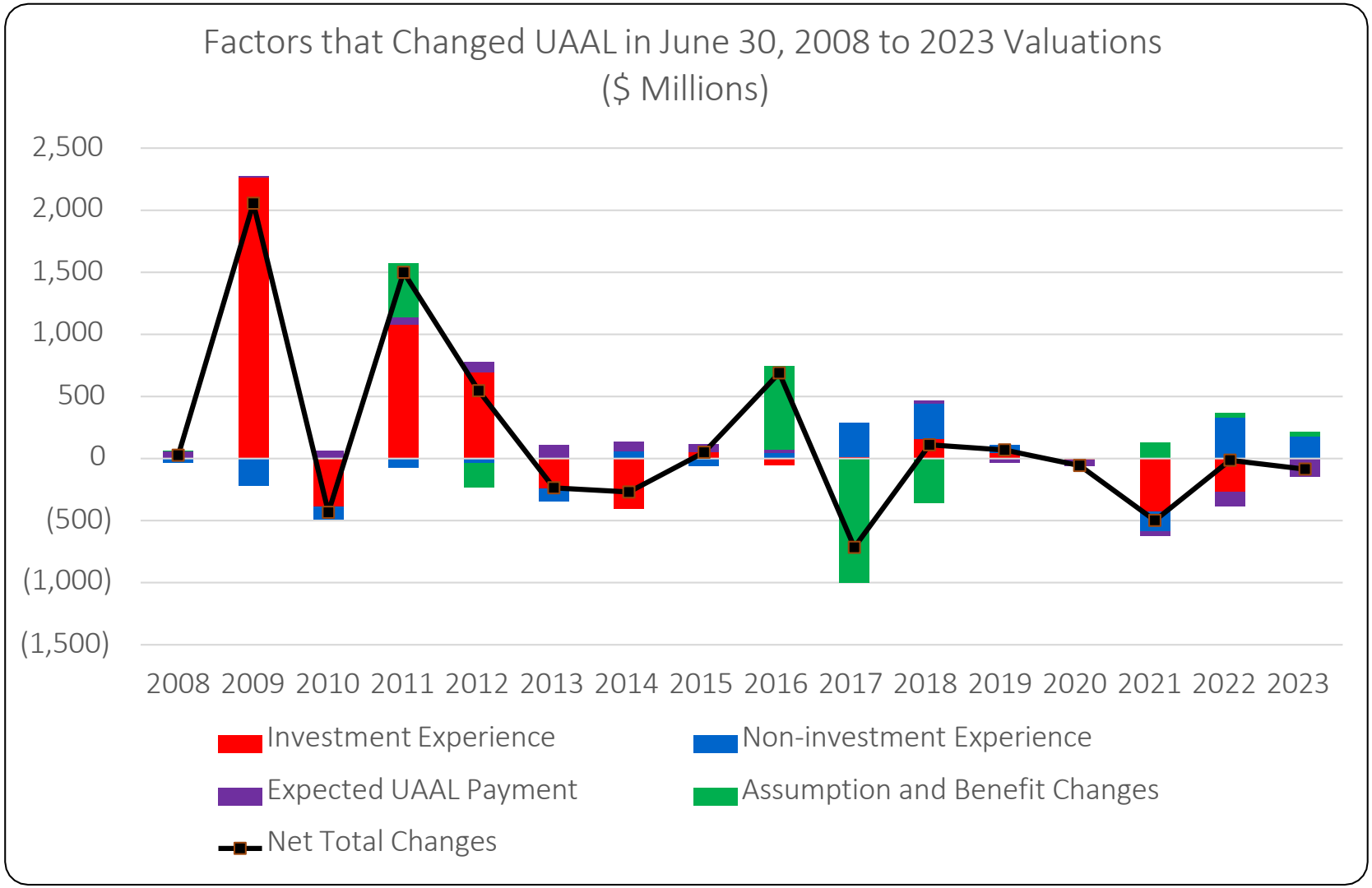
Examples of Risk Measurements

- Plan maturity measurements – actuary should calculate and disclose plan maturity measures, *which in the actuary's professional judgment*, are significant to understanding the risks associated with the Plan
- These are important, and have previously been discussed in the valuation report
  - Ratio of market value of assets to payroll (called the asset volatility ratio)
  - Ratio of net cash flow to market value of assets
  - Ratio of retired liability to total liability
  - Ratio of actives to retirees

Experience Look-Back



Experience Look-Back



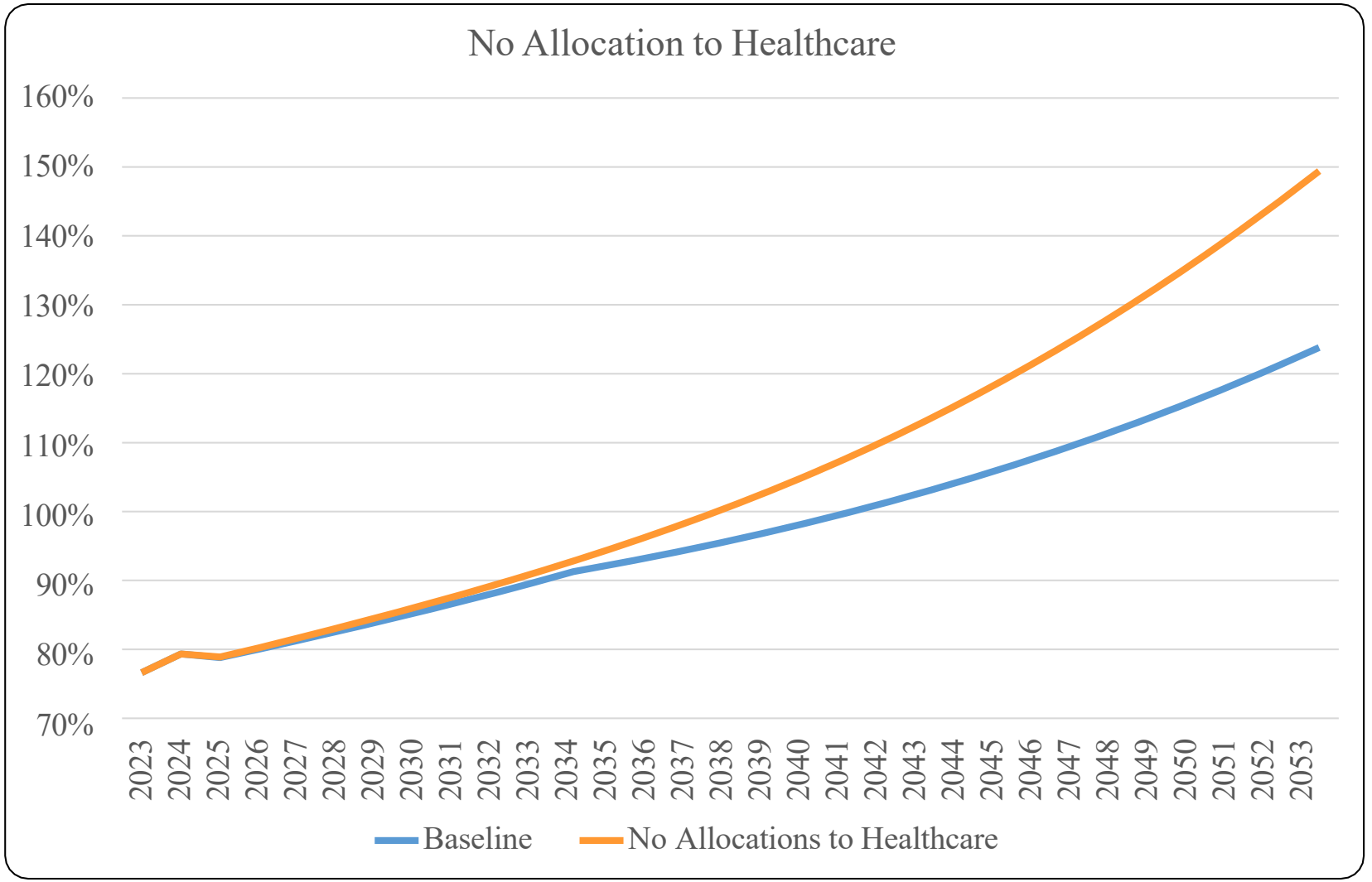
Qualitative Assessment

- Amortization policy
- Size of active membership and growth in total covered payroll

Qualitative Assessment

- Funding Policy
  - The statute sets a contribution cap of 24% of payroll: 14% from employers and 10% from employees. Employer contributions in excess of those required to support the basic benefits may be allocated to retiree health care funding.
  - Effective June 30, 2015, changes were made to funding policy to meet the competing goals of providing Healthcare and improving SERS' long term funding as quickly as possible.
- Funding policy is a positive factor.
- For the risk analysis, we assumed the minimum employer contribution allocated to Basic Benefits is 10% of covered payroll.

Qualitative Assessment



Qualitative Assessment

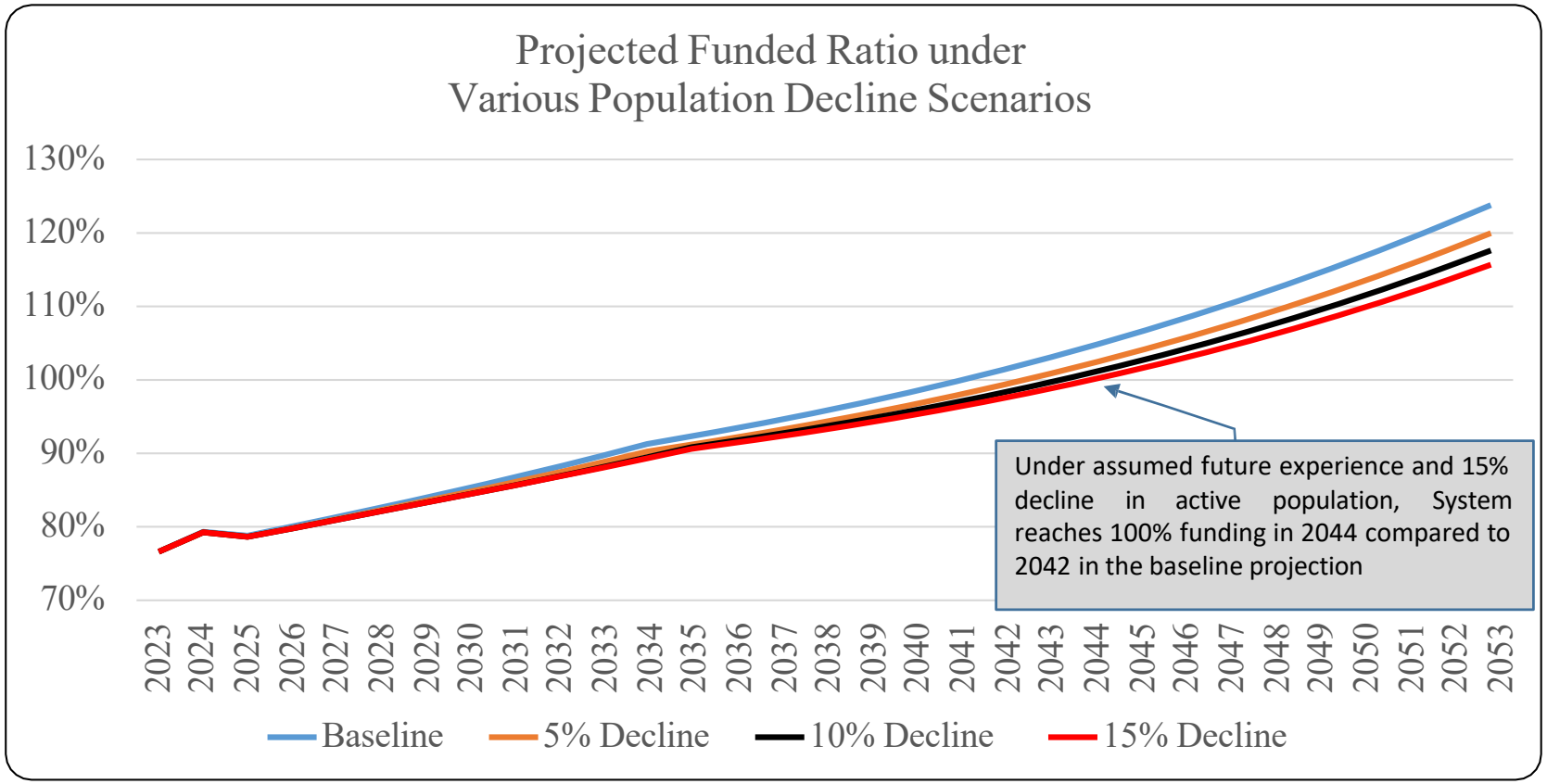
- Amortization policy
  - The SERS Board shall establish a period of not more than thirty years to amortize the SERS unfunded actuarial accrued pension liability. If in any year the period necessary to amortize the unfunded actuarial accrued pension liability exceeds thirty years, as determined by the annual actuarial valuation required by section 3309.21 of the Revised Code, the board, not later than ninety days after receipt of the valuation, shall prepare and submit to the Ohio Retirement Study Commission and the standing committees of the Ohio House of Representatives and the Ohio Senate with primary responsibility for retirement legislation a report that includes the following information:
    - The number of years needed to amortize the unfunded actuarial accrued pension liability as determined by the annual actuarial valuation;
    - A plan approved by the board that indicates how the board will reduce the amortization period of the unfunded actuarial accrued pension liability to not more than thirty years;
    - Whether the board has made any progress in meeting the thirty-year amortization period.
- Amortization Policy is a positive factor

Qualitative Assessment

- Size of active membership and growth in total covered payroll
  - UAL amortized as level percent of payroll so an assumption (1.75%) is used to anticipate future changes in payroll
  - If active membership decreases or salary increases are less than assumed, covered payroll may not increase as assumed
  - Forces the UAL contribution **rate** to increase
  - Last experience reduced the payroll growth assumption which improves the risk profile of the System
- Limited risk to SERS due increased active membership

Stress Testing: Population Decline

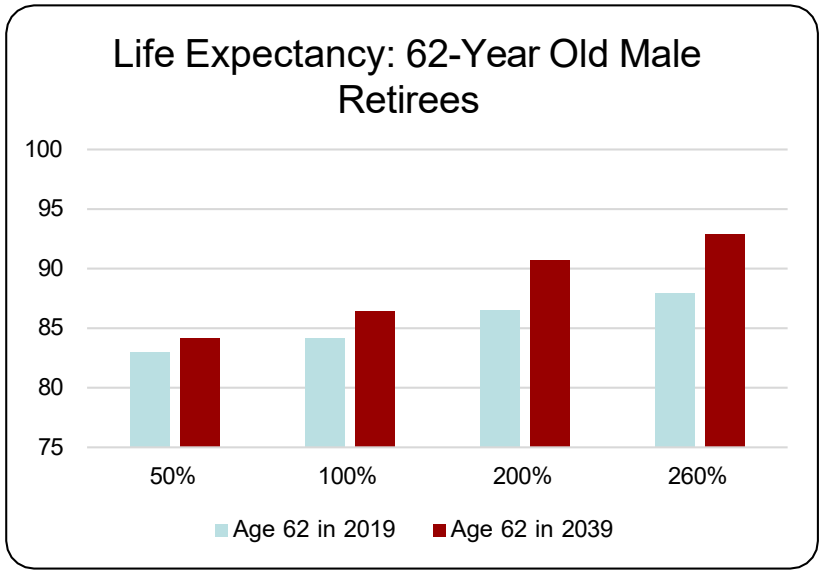
A reduction in population will result in a reduction in covered payroll which will reduce the funding available to the System since employer contributions are limited to 14% of payroll which will ultimately increase the amount of time necessary to completely amortize the unfunded liability



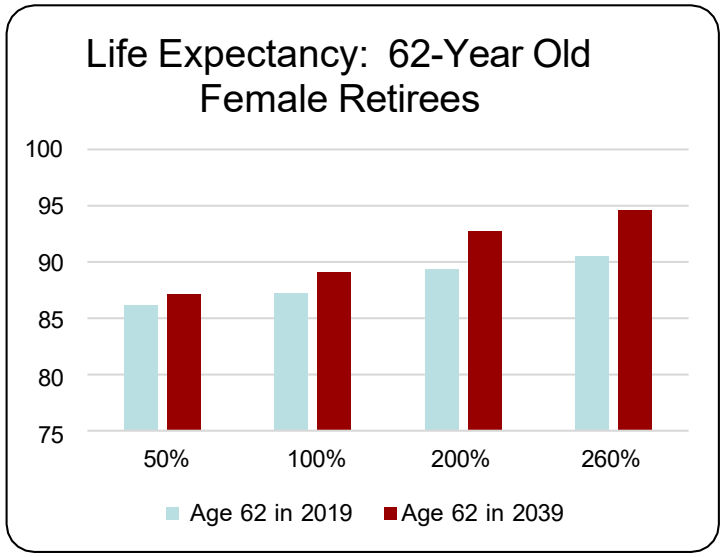
Quantitative Analysis

- Mortality Risk: changes in longevity
  - Valuation assumption anticipates small, continuous improvements in mortality each year in the future (generational mortality)
  - This assumption is reviewed and evaluated in each experience study
  - Risk is the possibility of a sudden shift and longer life expectancy

Mortality Improvement Scale
Life Expectancy at Age 62



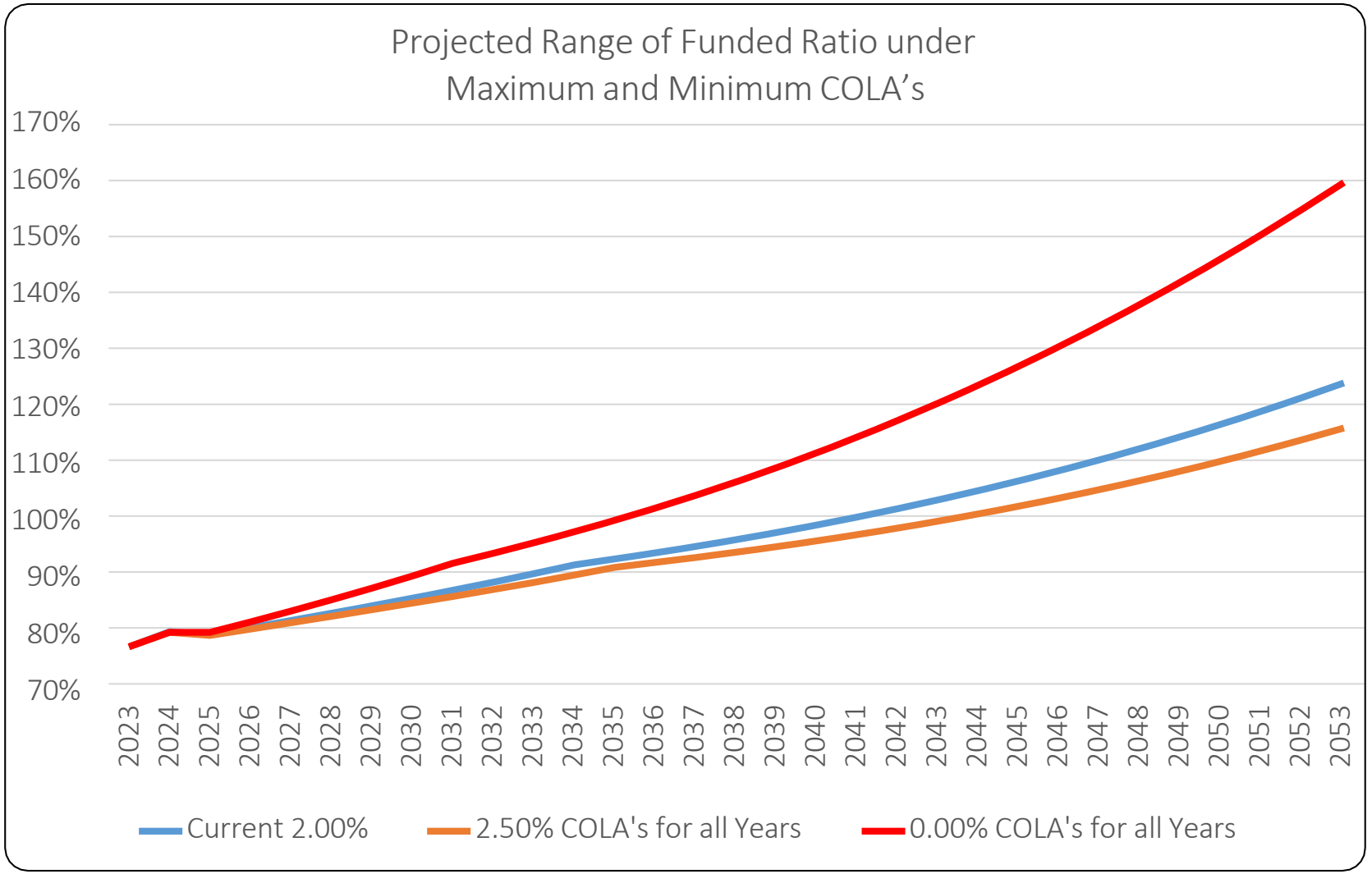
These charts show the effect on life expectancy if future mortality improvement is halved or doubled.



Qualitative Assessment

- Cost of Living Adjustments
  - Before granting a cost-of-living increase, the Board may adjust the percentage of any increase if the board's actuary, in its annual actuarial valuation, or in other evaluations, determines that an adjustment does not materially impair the fiscal integrity of the retirement system or is necessary to preserve the fiscal integrity of the retirement system.
  - The enactment of SB 8 granted authority to the Board to decide how many anniversaries a new benefit recipient must achieve before they become eligible to receive a COLA.
  - The authority granted to SERS in regard to cost of living adjustments is considered a positive factor in this risk assessment. Granting the Board this authority allows SERS to act proactively rather than rely on the legislative process to address an issue and mitigate a portion of the risk.

Qualitative Assessment



Usefulness of Models In Risk Assessment

- "Prediction" is not the goal of modeling. Models are beneficial for:
  - Identifying interactions between inputs that are not self-evident
  - Communicating uncertainties using simple examples or graphs
  - Answering "what if" or comparative questions
  - Identifying sensitivities of outputs to particular inputs, providing guidance on areas that require additional analysis
  - Revealing inconsistencies, discrepancies, or limitations in other types of analysis
- Models are useful as a tool for analyzing the system's objectives and strategies as well as effective as a decision-making tool

Limitations of Modeling

- All models are simplifications of how experience will unfold in the real world
- Actual experience will almost certainly be different and more complex than any scenarios modeled
- Be careful to understand what a model is intended to communicate

Sensitivity Analysis

- **Sensitivity analysis**: an analysis or simulation designed to illustrate the range of potential results when actual experience is different than expected, based on assumptions
  - Vary the rate of return incrementally over specified time period (heat map)
  - Compare results under better/worse than expected scenarios, e.g., current investment return assumption plus scenarios of +1% and -1% returns
  - Compare results under different sets of assumptions

Sensitivity Analysis

Note: investment return assumption is not changed. Actual returns are assumed to be the rate shown over the 10 year period.

Funded Ratio at June 30 Valuation

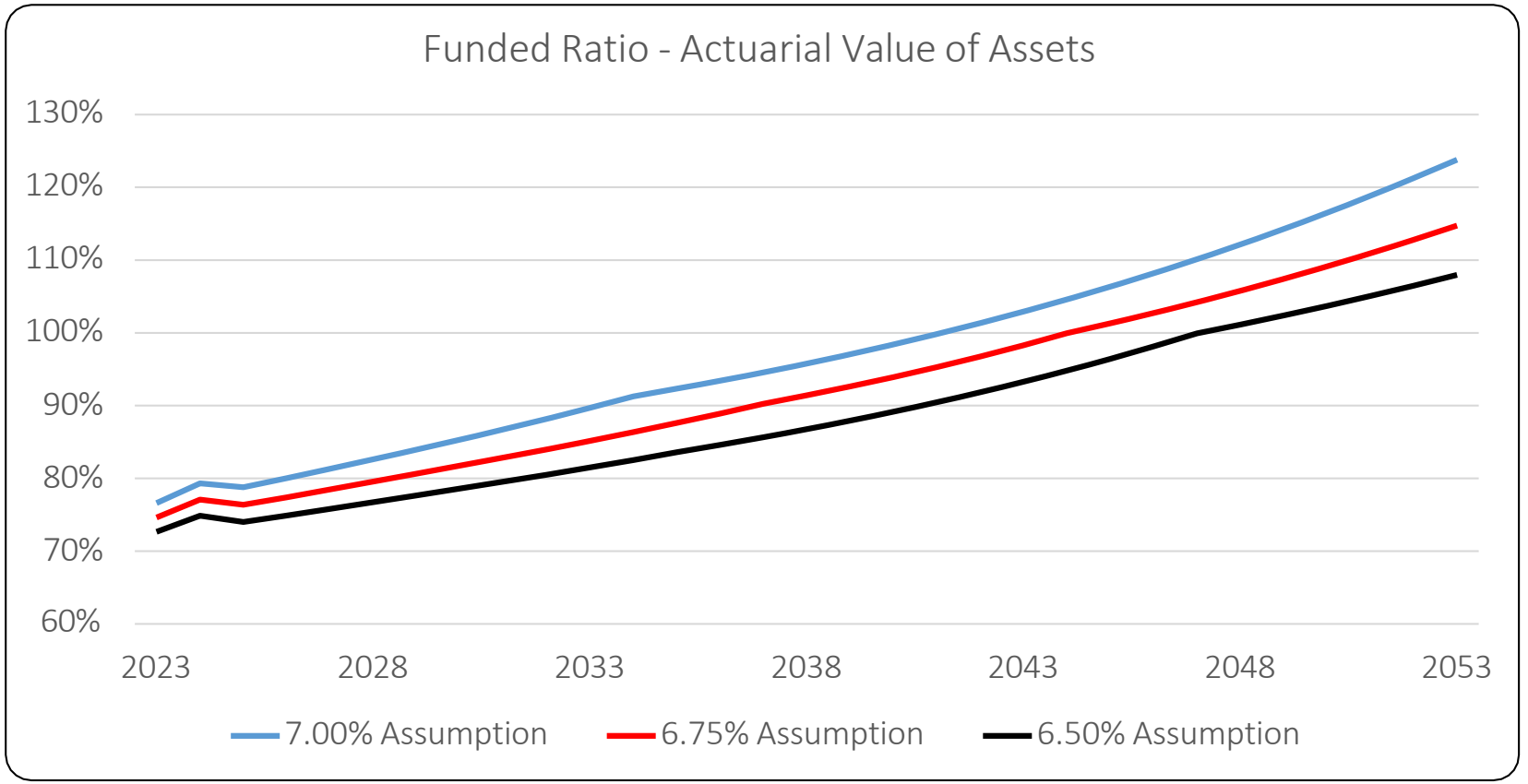
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
5.00%	77%	79%	78%	78%	77%	77%	76%	76%	76%	75%	74%
5.25%	77%	79%	78%	78%	78%	78%	77%	77%	77%	76%	76%
5.50%	77%	79%	78%	78%	78%	78%	78%	78%	78%	78%	78%
5.75%	77%	79%	78%	79%	79%	79%	79%	79%	80%	80%	80%
6.00%	77%	79%	78%	79%	79%	80%	80%	81%	81%	81%	82%
6.25%	77%	79%	78%	79%	80%	80%	81%	82%	82%	83%	84%
6.50%	77%	79%	78%	79%	80%	81%	82%	83%	84%	85%	86%
6.75%	77%	79%	79%	80%	81%	82%	83%	84%	85%	86%	88%
7.00%	77%	79%	79%	80%	81%	83%	84%	85%	87%	88%	90%
7.25%	77%	79%	79%	80%	82%	83%	85%	87%	88%	90%	91%
7.50%	77%	79%	79%	81%	82%	84%	86%	88%	90%	92%	93%
7.75%	77%	79%	79%	81%	83%	85%	87%	89%	91%	93%	95%
8.00%	77%	80%	79%	81%	83%	86%	88%	90%	92%	95%	97%

Uses actuarial value of assets so smoothing of returns is reflected.

Investment Risk: Sensitivity Analysis

Change in Investment Return Assumption

The 7.0% assumption (blue line) has the highest funded ratio because liabilities/costs are lowest and assets grow more quickly than in the other two scenarios. Under 6.50% and 6.75% assumed rate of return (ARR), SERS achieves 100% funded in 2048 and 2044 respectively compared to 2042 under 7.00% ARR



Stress Testing

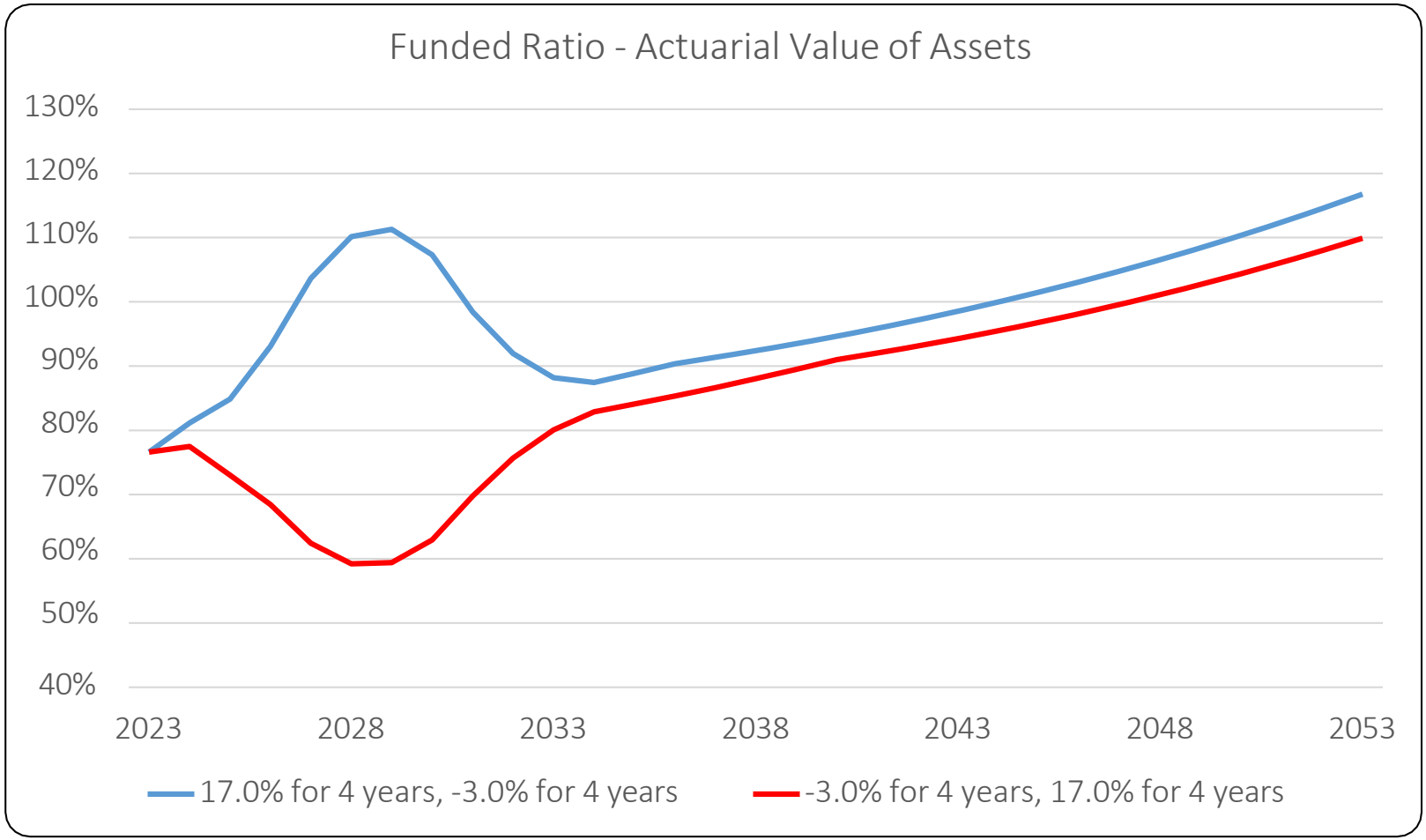
- **Stress test**: an analysis or simulation designed to determine the ability of a financial institution to manage an economic crisis or certain stressors

- **Purpose** is to **identify the stressors** to the System and **optimize policies and procedures** (assumptions, funding policy, and perhaps benefits) in order to **improve sustainability** and **educate stakeholders** of potential risks
  - Focus should be on the decisions to be considered based on the outcomes of the test

Typical Procedure for Stress Test

- Project historical crisis data into the future and simulate what would happen to system's funding
- Deterministic projections using one set of assumed returns
- Take several sets of economic scenarios and project and compare key actuarial metrics

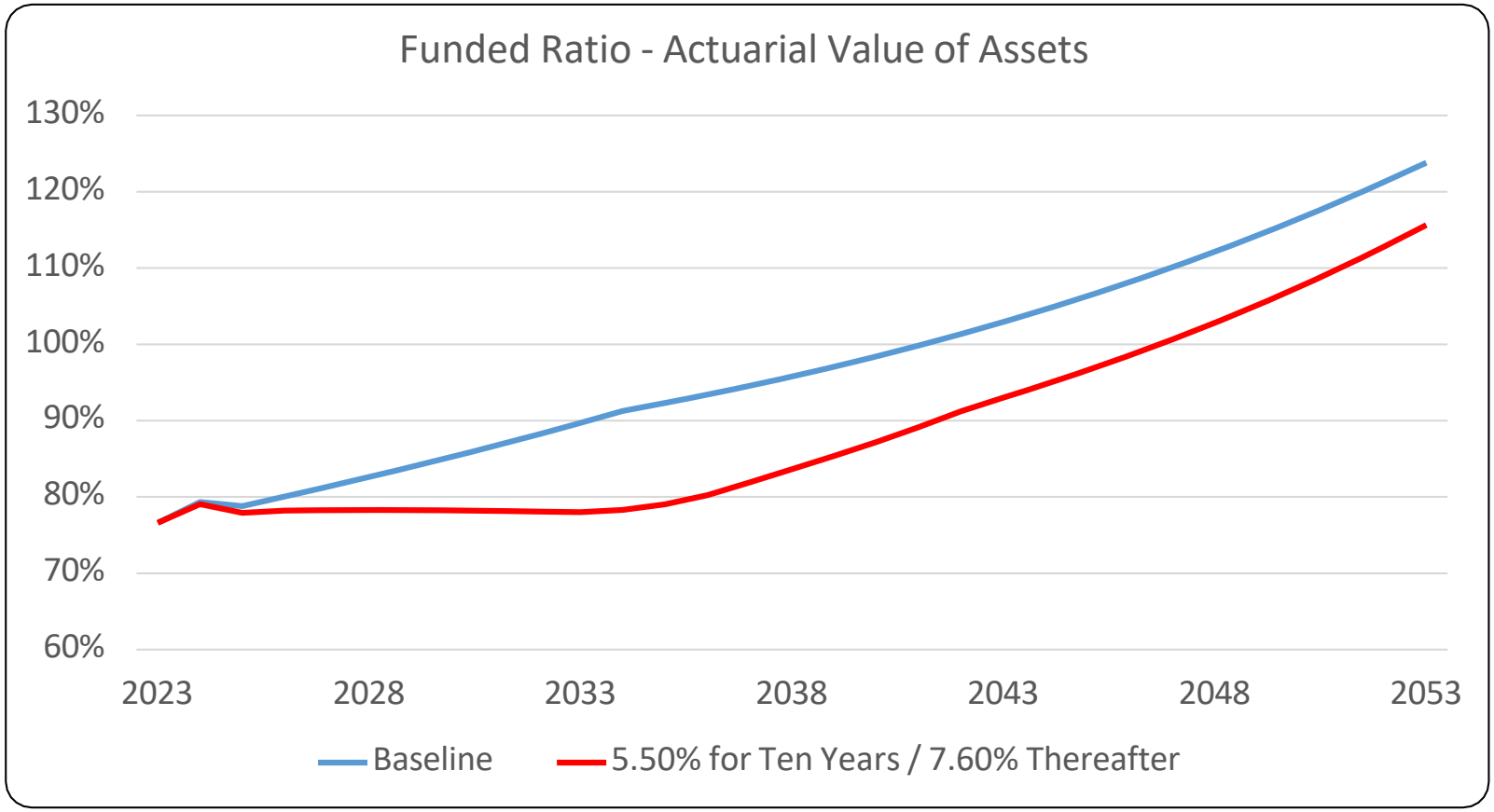
Stress Testing: Order of Returns



The same geometric return occurs over this period, but when low returns occur first, it results in a difference of $2.9 billion in asset value.

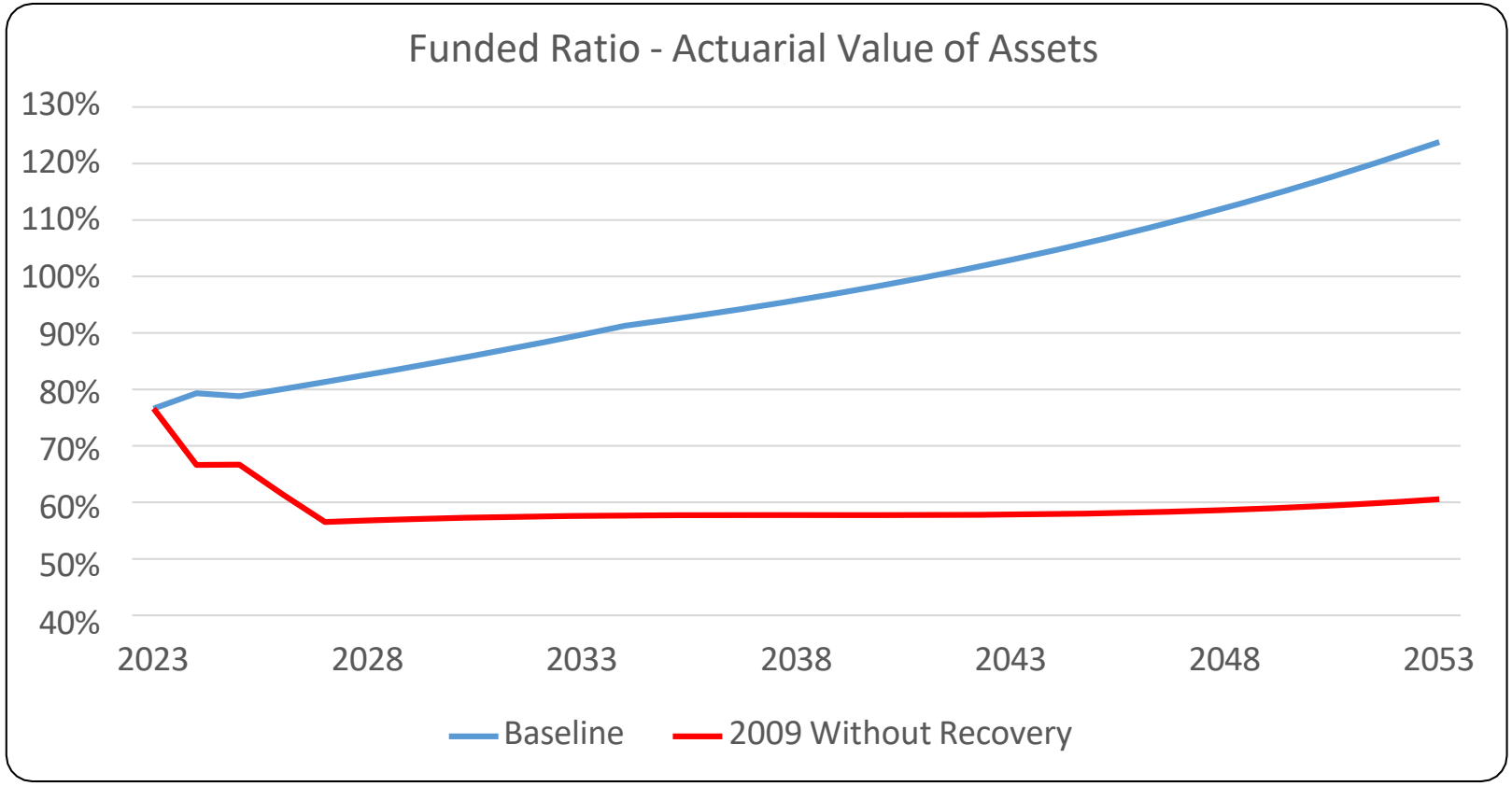
Stress Testing
Low Returns for Sustained Period

Low returns over the next 10 years reduce the funded ratio until 2036. Ultimately, the difference is eliminated and reversed as the higher investment returns result in a higher funded ratio at the end of the period. The gap is the greatest in 2035 reaching a 13.3% difference in the funded ratios



Stress Testing: Shock Return

Under the scenario that the plan suffers a -22.9% return in 2024 without a subsequent market recovery, the funded ratio stabilizes at 58% and begins to improve at the end of the projection period. This represents and improvement since the prior study.



Stochastic Analysis

- Stochastic modeling is the most sophisticated analysis available for investment return impact and provides the Board better information on likelihood of future actuarial outcomes.

- This analysis produces a distribution of possible future valuation results, directly reflecting the impact of investment return volatility on funding over time.

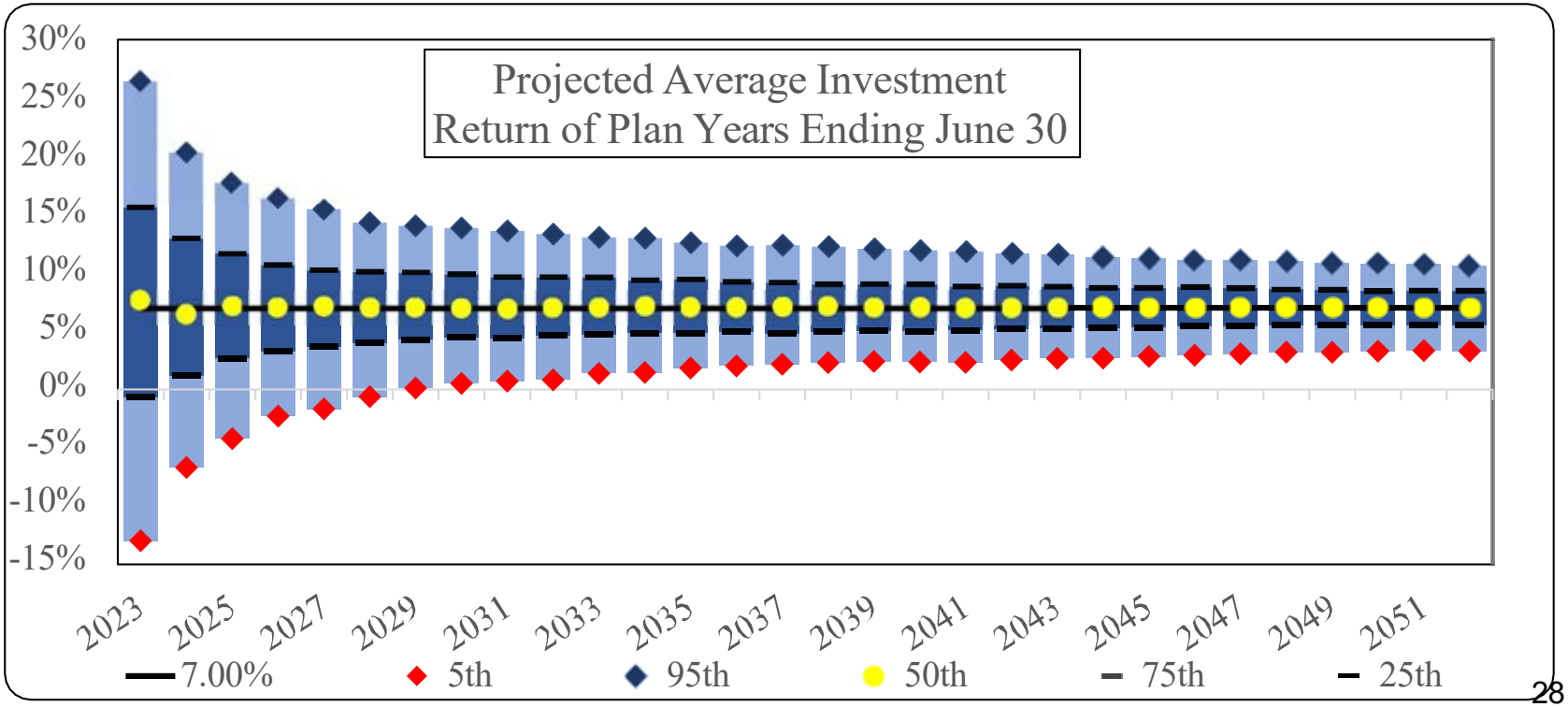
Stochastic Analysis

Probability of funded ratio being lower than a certain threshold at any time during the projection period.

	Ratio <40%	Ratio <50%	Ratio <60%	Ratio <70%	Ratio <80%
2023 – 2028	0%	0%	2%	10%	59%
2023 – 2033	1%	2%	7%	16%	50%
2023 – 2038	2%	5%	12%	24%	38%

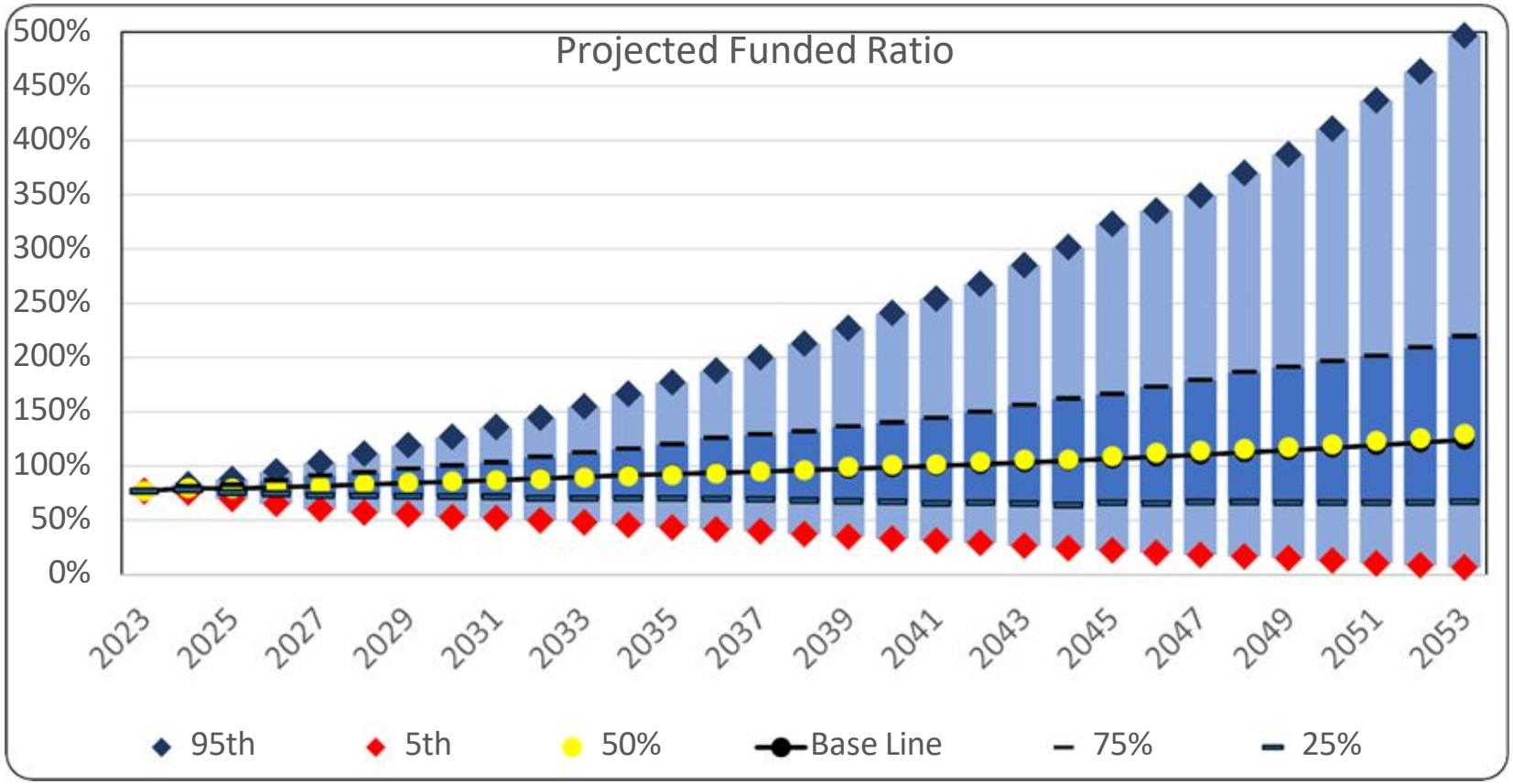
Stochastic Analysis

The chart below is based on the 7.00% expected return with a 12.17% standard deviation. We utilize those assumptions to produce the percentile ranks of expected returns over 30 years. The analysis indicates that over the next 30 years there is a 50% chance the cumulative market returns over the next 30 years will be between 5.54% and 8.46%. The 50th percentile cumulative investment return over the next 30 years is 7.00%.



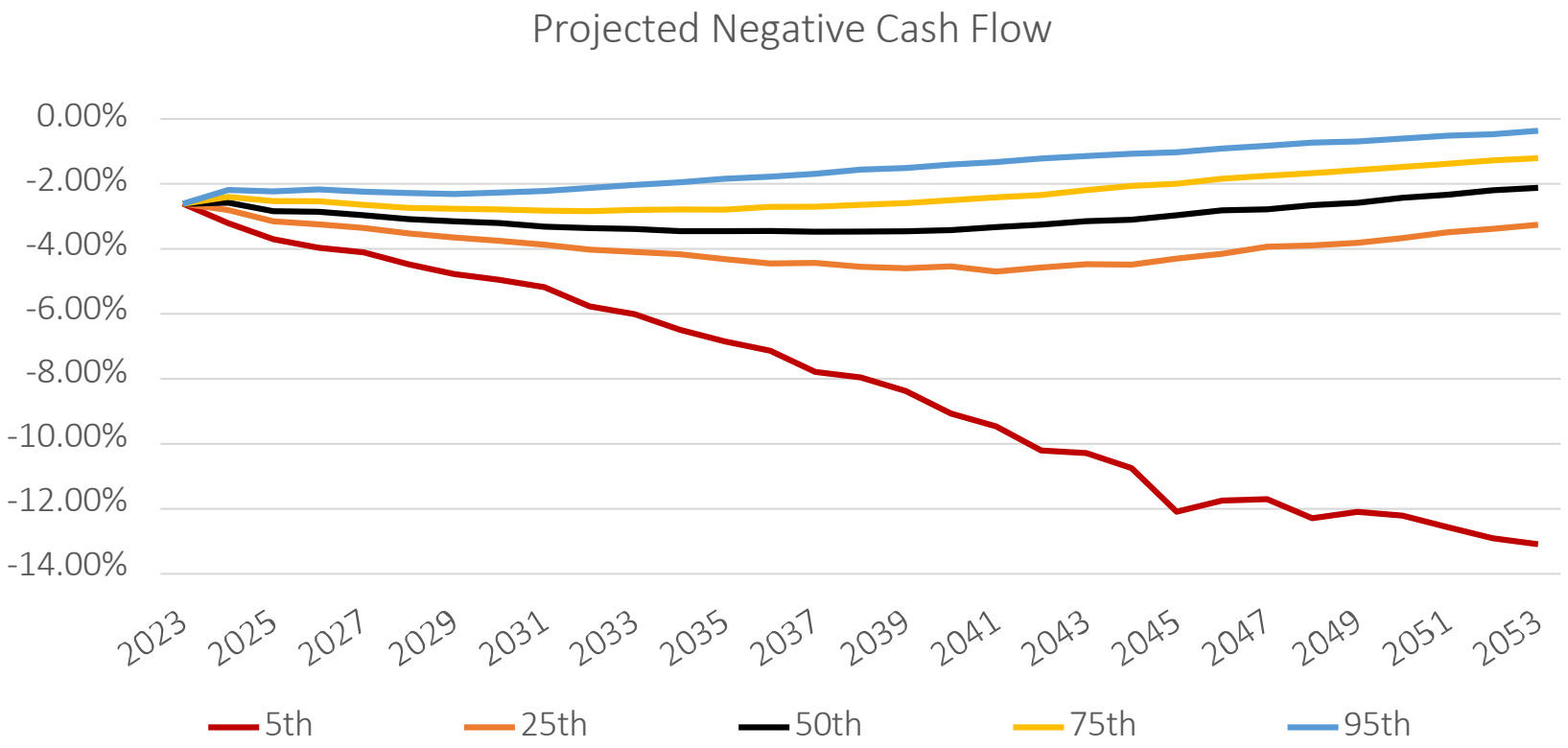
Stochastic Analysis

This graph indicates that in 10 years, the middle 50% of possible outcomes are between 70% and 112% funded. There is a 5% chance of being more than 155% funded, and a 5% chance of being less than 48% funded.



Stochastic Analysis

The median negative cash flow tends to -3.4% over the next 10 years, followed by an improvement over the rest of the projection period. This is a contributing factor to the fact that the median funded ratio is 100% in the projected funded ratio chart on the previous page.



Summary Comments

- Findings
  - Improved risk profile since the June 30, 2022 Assessment due to:
    - Investment performance since June 30, 2022
    - The Board's funding policy has accelerated funding of Basic Benefits by $874 million
    - Since June 30, 2022, covered payroll grew by 7.6% compared to the assumed rate of 1.75%
  - Sustained higher than anticipated COLA's does have a long-term impact to expected funding levels.
  - SERS can sustain a single "shock" return like the one experienced in fiscal year ended 2009 but would likely require Board action to maintain sustainability of SERS.
  - Funding Policy and the authority granted to SERS regarding cost-of-living adjustments are two significant tools to assist the Board in mitigating risk.
  - SERS needs to continue monitor risks.

SCHOOL EMPLOYEES RETIREMENT SYSTEM OF OHIO

Risk Analysis Report
February, 2024

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February 7, 2024

Board of Trustees
School Employees Retirement System of Ohio
300 East Broad Street, Suite 100
Columbus, OH 43215-3746

Re: Risk Analysis Report

Dear Members of the Board:

At your request, we have performed a study of the actuarial-related risks faced by the School Employees Retirement System of Ohio (SERS). This report is designed to support and expand on the latest actuarial valuation report that we prepare annually for basic benefits valuation for SERS. While the exhibits and graphs shown in this report are based on the June 30, 2023, SERS actuarial valuation, the analysis of the results and the discussion of the implications for SERS and its stakeholders are expected to remain substantially unchanged for the next few years.

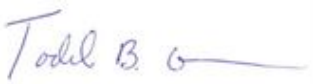
The primary objective of this report is to provide the analysis of risk, as required under Actuarial Standard of Practice Number 51, *Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions.* There are other risks that SERS faces, including issues such as cyber security, a catastrophe to the physical location, embezzlement, and many others. These are outside the scope of our analysis, which focuses only on those risks relating to the variance in the measurement of the benefit obligations as well as the contribution rates. There is no specific action by the SERS Board either required or expected in response to this report, although it is possible that a deeper understanding of the risks faced by SERS may prompt some additional discussion or study.

In preparing our report, we utilized the data, methods, assumptions, and benefit provisions described in the June 30, 2023, actuarial valuation of SERS. That report should be consulted for a complete description of how our work was performed. Some of the results in this report are based upon modifying one or more of the valuation assumptions as noted in the discussion of the analysis being performed. In particular, the minimum employer contribution, regardless of funded status in the projections presented in this report is 10% of annual payroll.

In order to prepare the results in this report, we have utilized actuarial models that were developed to measure liabilities and develop actuarial costs. These models include tools that we have produced and tested, along with commercially available valuation software that we have reviewed to confirm the appropriateness and accuracy of the output. In utilizing these models, we develop and use input parameters and assumptions about future contingent events along with recognized actuarial approaches to develop the needed results.

The consultants who worked on this assignment are pension actuaries with significant public plan experience. In addition, the signing actuaries are independent of the System and the plan sponsor. We are not aware of any relationship that would impair the objectivity of our work.
On the basis of the foregoing, we hereby certify that, to the best of our knowledge and belief, this report is complete and accurate. The valuation, on which this analysis was based, was prepared in accordance with principles of practice prescribed by the Actuarial Standards Board. Furthermore, the actuarial calculations were performed by qualified actuaries in accordance with accepted actuarial procedures, based on the current provisions of the retirement system and on actuarial assumptions that are internally consistent and reasonable based on the actual experience of the System. We are members of the American Academy of Actuaries and meet the Qualification Standards to render the actuarial opinion contained herein.

We respectfully submit the following report and look forward to discussing it with you.



Todd B. Green, ASA, EA, FCA, MAAA
President

John J. Garrett, ASA, FCA, MAAA
Principal and Consulting Actuary

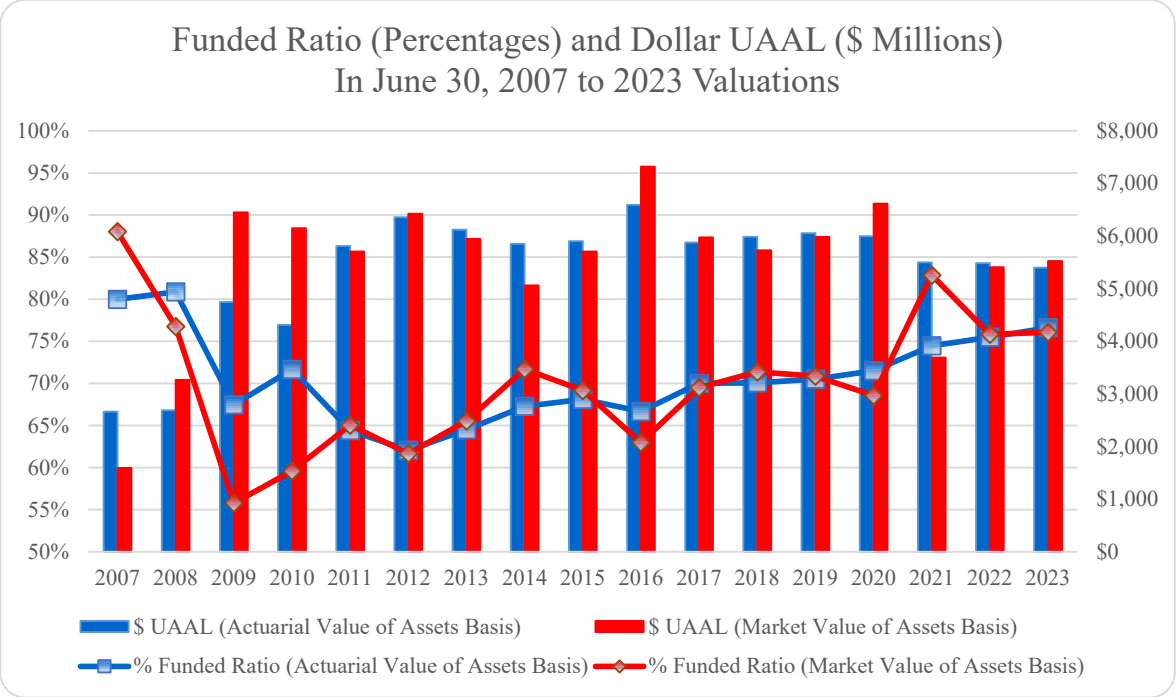
Actuarial Standard of Practice Number 51 (ASOP 51)

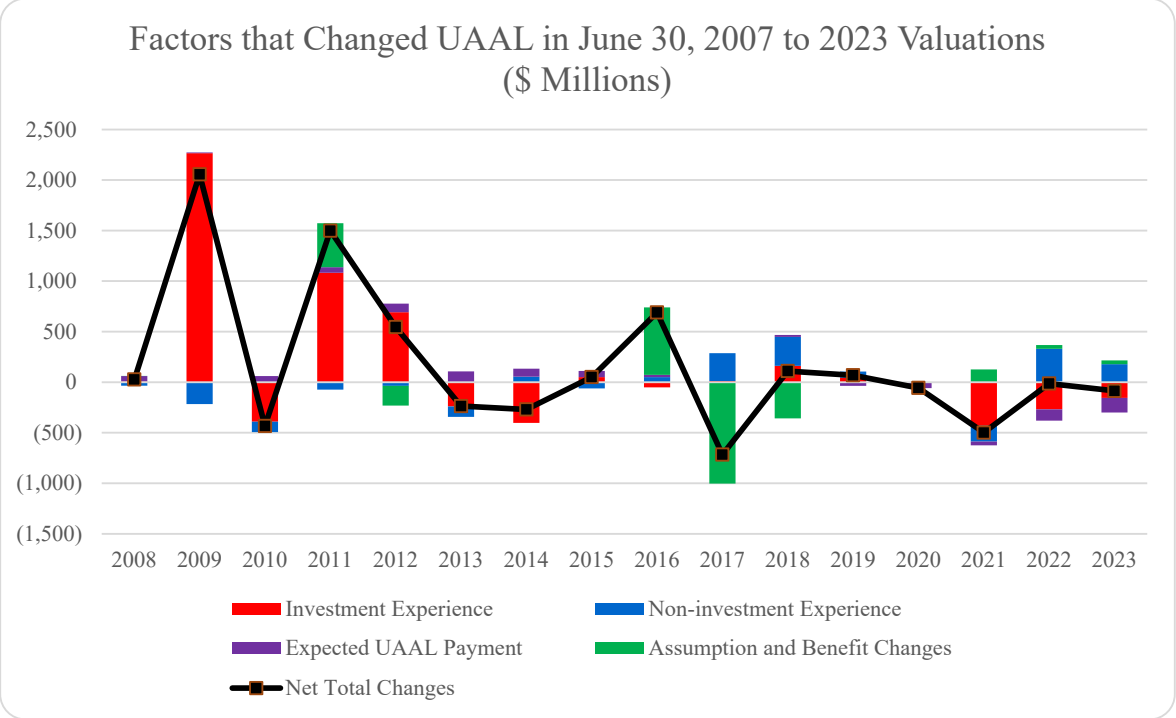
Actuarial Standards of Practice (ASOPs) are issued by the Actuarial Standards Board and are binding for credentialed actuaries practicing in the United States. These standards generally identify what the actuary should consider, document and disclose when performing an actuarial assignment. ASOP 51, *Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions*, applies to funding valuations, actuarial projections, and actuarial cost studies of proposed plan changes.

A typical retirement system faces many different risks. The greatest risk for a retirement system is the inability to make benefit payments when due. If system assets are depleted, benefits may not be paid which could create legal and litigation risk. The term "risk" is most commonly associated with an outcome with undesirable results. However, in the actuarial world risk is defined as uncertainty. The actuarial valuation process uses many actuarial assumptions to project how future contributions and investment returns will meet the cash flow needs for future benefit payments. Of course, we know that actual experience will not unfold exactly as anticipated by the assumptions and that uncertainty, whether favorable or unfavorable, creates risk. ASOP 51 defines risk as the potential of actual future measurements deviating from expected future measurements due to actual experience that is different than the actuarial assumptions.

Factors that have Historically Impacted Funded Status and Employer Contribution Rates

The funding ratios for the past 17 valuations from June 30, 2007 to 2023 measured both actuarial and market value of assets basis and the unfunded actuarial accrued liabilities measured using both the actuarial value of assets and market value of assets basis and the factors that caused changes in the UAL for the past 17 valuations from June 30, 2007 to 2023 are shown in the charts on the following pages.


Funded Ratio (Percentages) and Dollar UAAL ($ Millions)
In June 30, 2007 to 2023 Valuations
100%
95%
90%
85%
80%
75%
70%
65%
60%
55%
50%
$8,000
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
$ UAAL (Actuarial Value of Assets Basis)
$ UAAL (Market Value of Assets Basis)
% Funded Ratio (Actuarial Value of Assets Basis)
% Funded Ratio (Market Value of Assets Basis)


Factors that Changed UAAL in June 30, 2007 to 2023 Valuations
($ Millions)
2,500
2,000
1,500
1,000
500
0
(500)
(1,000)
(1,500)
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Investment Experience
Non-investment Experience
Expected UAAL Payment
Assumption and Benefit Changes
Net Total Changes

Identifying Risks

The first step in a project such as this is to identify the significant risks that affect how SERS liabilities are measured and contributions determined. Some risks, such as investment return for a funded retirement plan, are obvious, but there are others that are not as clear. There is no definition of "significant" to clearly define which risks should be considered, nor is it possible to tell in advance whether certain risks are significant or not.

The identification of risks is also specific to the retirement plan being studied. Different plans expect different risks. Thus, this analysis for SERS is uniquely prepared for SERS and the risks it faces.

Assessing Risks

In this report, we consider a variety of risks faced by SERS. A common theme for most retirement plans is that risks change as a plan matures. Because this is a fundamental issue, ASOP 51 gives special attention to requiring the disclosure of appropriate measures of how a plan is maturing. In the section of this report that considers maturity measures, we provide a number of illustrations to help demonstrate this trend.

There are some risks that are inherently difficult to quantify, as well as some risks that are addressed by the way in which a system is designed to react. In our section on qualitative measures, we discuss some of these risks. We also discuss how the SERS contribution rate policy is designed to help address the way in which SERS faces risks.

Finally, we conclude this report with some numerical assessment of some significant demographic and economic risks. The point of this analysis is to provide some perspective on the magnitude of the risks faced by SERS.

Conclusions

Risk is not necessarily a negative concept. As humans, we regularly take risks such as driving in an automobile because we believe that the gain to be received outweighs the possible negative consequences. We do, however, take steps to mitigate the risk by looking both ways at an intersection before proceeding, wearing seatbelts, etc. We do these things because we have some understanding of the sources of risk. The goal of this report is to help SERS understand the major risks facing SERS funding, thereby allowing a reasoned approach to determining how to move into the future if negative experience emerges.

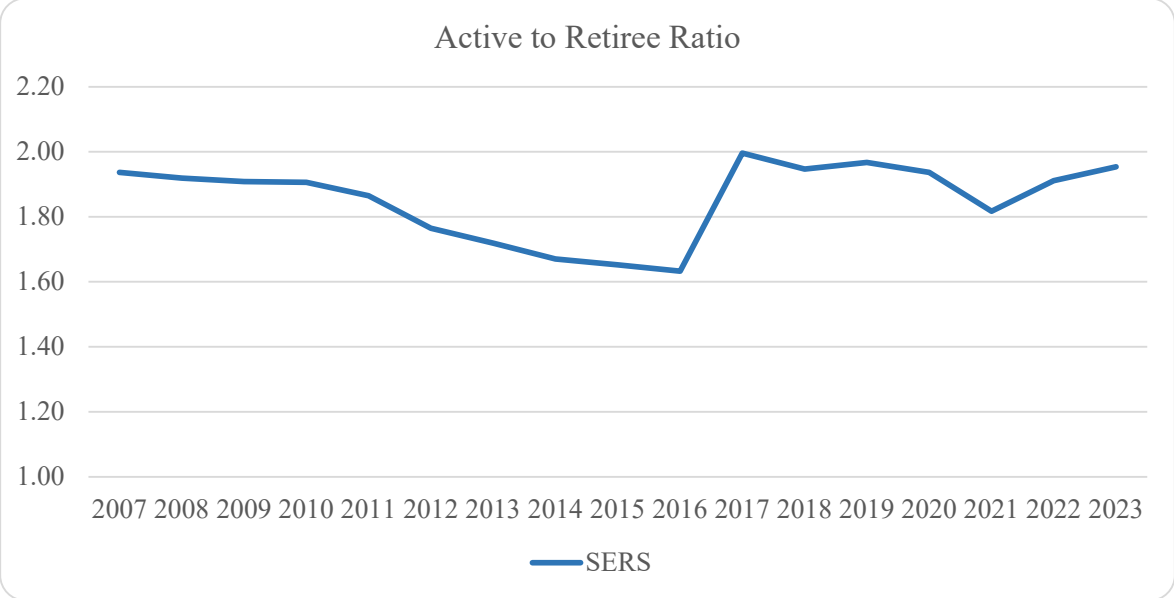
In our opinion there has been a slight improvement in the risk profile of SERS since the previous risk study was performed. The major causes attributing to this improvement are:

- Investment performance since June 30, 2022 has increased the market value of assets by $597 million.
- Employer and member contributions are tied to covered payroll. As covered payroll increases, contributions to SERS increase. Since June 30, 2022, covered payroll increased by 7.61% compared to the assumed rate of 1.75%.
- The Board adopted funding policy has accelerated the funding of Basic Benefits by approximately $874 million since June 30, 2015.

SERS was created in 1937. The aging of the population, including the retirement of the baby boomers, has created a shift in the demographics of most retirement systems. This change is not unexpected and has, in fact, been anticipated in the funding of the retirement systems. Even though it was anticipated, the demographic shift and maturing of the plans have increased the risk associated with funding the systems. There are different ways to measure and assess the maturity level of a retirement system and we will discuss several in this section of the report.

Historical Active to Retiree Ratio

One way to assess the maturity of the system is to consider the ratio of active members to retirees. In the early years after a retirement system is established, the ratio of active to retired members will be very high as the system is largely composed of active members. As the system matures over time, the ratio starts to decline. A very mature system often has a ratio near or below one. In addition, if the size of the active membership declines over time, it can accelerate the decline in the ratio.



Asset Volatility Ratio

As a retirement system matures, the size of the market value of assets increases relative to the covered payroll of active members, on which the System is funded. The size of the plan assets relative to covered payroll, sometimes referred to as the asset volatility ratio (AVR), is an important indicator of the contribution risk for the System. The higher this ratio, the more sensitive a plan's contribution rate is to investment return volatility.

Even though the System is funded with statutory contribution rates, these measures are still meaningful as an indication of the expected pressure on the portion of the statutory employer funding required for pension benefits.

The asset volatility measure reflects the change to contributions which would be necessary to offset the impact of a change in the market value of assets. The following tables show the historical trend for the asset volatility ratio for SERS.

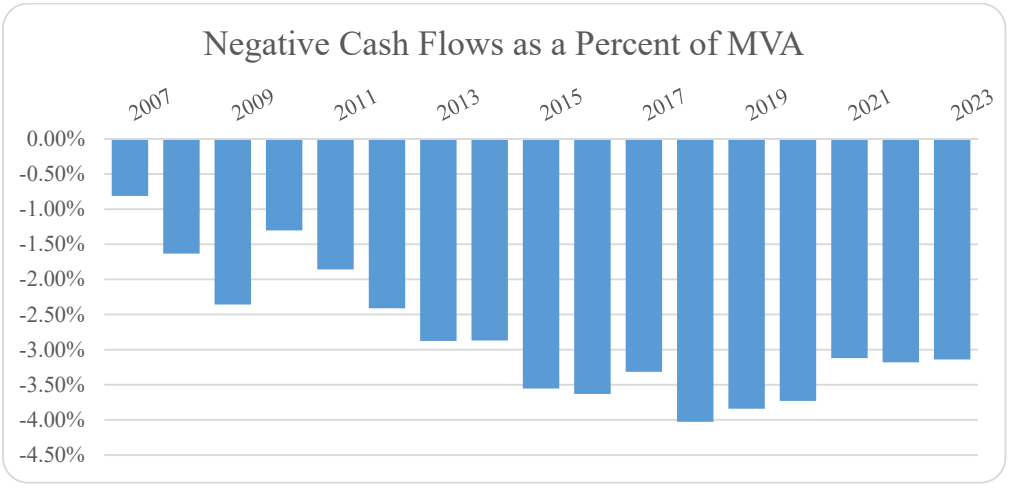
Fiscal Year End	Market Value of Assets ($ Millions)	Covered Payroll ($ Millions)	Asset Volatility Ratio
6/30/07	$11,711.2	$2,603.3	4.50
6/30/08	10,793.5	2,651.8	4.07
6/30/09	8,134.1	2,787.4	2.92
6/30/10	9,071.9	2,842.7	3.19
6/30/11	10,619.2	2,852.4	3.72
6/30/12	10,331.7	2,788.2	3.71
6/30/13	11,300.5	2,746.8	4.11
6/30/14	12,820.9	2,759.3	4.65
6/30/15	12,797.2	2,845.4	4.50
6/30/16	12,451.6	2,932.2	4.25
6/30/17	13,613.6	3,302.8	4.12
6/30/18	14,270.5	3,332.4	4.28
6/30/19	14,544.1	3,462.5	4.20
6/30/20	14,419.6	3,477.6	4.15
6/30/21	17,840.1	3,622.1	4.93
6/30/22	16,962,7	3,994,7	4.25
6/30/23	17,558.8	4,298.7	4.08

As the System's Market Value of Assets increases, market gains and losses due to over or under-performance as compared to the expected return, generate impacts to the unfunded liability in dollar amount that are generally a significant percentage of covered payroll. To Illustrate, as of the 2023 measures, a 3% market rate of return (4% below the 7% assumption) would produce an asset loss in dollar amount approximately equaling 16.3% of payroll (4.08 times 4%). As assets gains and losses are smoothed over four years and the impact of these gains and losses on the plan's required funding are spread over the amortization period, this measure is only to provide the scale of the risks associated with asset performance relative to covered payroll.

Historical Cash Flows

Plans with negative cash flows will experience increased sensitivity to investment return volatility. Cash flows, for this purpose, are measured as contributions less benefit payments and expenses. If the System has negative cash flows and experiences returns below the assumed rate, there are fewer assets to be reinvested to earn the higher returns that typically follow. While any negative cash flow will produce such a result, it is typically a negative cash flow of more than 4% of market value that causes significant concerns.

Fiscal Year End	Market Value of Assets (MVA)	Contributions	Benefit Payments and Expenses	Net Cash Flow	Net Cash Flow as a Percent of MVA
6/30/07	$11,711,235,288	$791,898,275	$886,970,001	($95,071,726)	(0.81%)
6/30/08	10,793,470,372	563,517,862	739,766,146	(176,248,284)	(1.63%)
6/30/09	8,134,107,324	586,857,670	778,564,059	(191,706,389)	(2.36%)
6/30/10	9,071,931,012	703,697,035	821,895,581	(118,198,546)	(1.30%)
6/30/11	10,619,175,301	682,413,480	879,772,413	(197,358,933)	(1.86%)
6/30/12	10,331,658,392	696,696,215	945,748,626	(249,052,411)	(2.41%)
6/30/13	11,300,482,029	695,112,180	1,020,260,801	(325,148,621)	(2.88%)
6/30/14	12,820,884,107	700,720,177	1,068,606,495	(367,886,318)	(2.87%)
6/30/15	12,797,184,030	701,545,178	1,156,439,511	(454,894,333)	(3.55%)
6/30/16	12,451,630,823	750,747,397	1,202,843,730	(452,096,333)	(3.63%)
6/30/17	13,613,638,590	804,424,396	1,255,785,189	(451,360,793)	(3.32%)
6/30/18	14,270,515,748	759,945,694	1,334,666,485	(574,720,791)	(4.03%)
6/30/19	14,544,076,104	809,896,173	1,367,920,194	(558,024,021)	(3.84%)
6/30/20	14,419,598,627	843,900,853	1,381,761,865	(537,861,012)	(3.73%)
6/30/21	17,840,046,988	830,633,505	1,387,181,011	(556,547,506)	(3.12%)
6/30/22	16,962,691,005	900,194,639	1,439,199,522	(539,004,883)	(3.18%)
6/30/23	17,558,801,466	955,568,535	1,506,966,541	(551,398,006)	(3.14%)

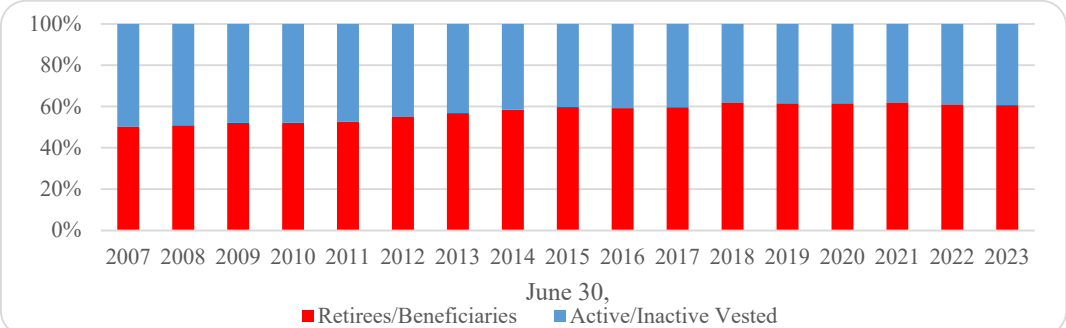


Liability Maturity Measurements

As discussed earlier, most public sector retirement systems, including SERS, have been in operation for over 80 years. As a result, they have aging plan populations indicated by a decreasing ratio of active members to retirees and a growing percentage of retiree liability when compared to the total. The retirement of the remaining baby boomers over the next 7 years is expected to further exacerbate the aging of the retirement system population. With more of the total liability residing with retirees, investment volatility has a greater impact on the funding of the system since it is more difficult to restore the system financially after losses occur when there is comparatively less payroll over which to spread costs.

The retirement system is also growing larger as can be seen by the ratio of actuarial liability to payroll.

Fiscal Year End	Retiree Liability (a)	Total Actuarial Liability (b)	Retiree Percentage (a) / (b)	Covered Payroll (c)	Ratio (b) / (c)
6/30/07	$6,688,590,916	$13,303,223,045	50.3%	2,603,300,211	5.11
6/30/08	7,161,196,395	14,061,894,365	50.9%	2,651,800,981	5.30
6/30/09	7,591,581,493	14,581,977,247	52.1%	2,787,390,954	5.23
6/30/10	7,941,876,226	15,221,613,179	52.2%	2,842,660,159	5.35
6/30/11	8,605,491,444	16,325,004,259	52.7%	2,852,378,614	5.72
6/30/12	9,250,285,737	16,754,566,023	55.2%	2,788,153,585	6.01
6/30/13	9,793,009,567	17,247,161,078	56.8%	2,746,827,535	6.28
6/30/14	10,436,607,389	17,881,827,171	58.4%	2,759,281,606	6.48
6/30/15	11,047,009,232	18,503,280,961	59.7%	2,845,443,802	6.50
6/30/16	11,702,282,405	19,770,708,121	59.2%	2,932,236,551	6.74
6/30/17	11,679,469,034	19,588,417,687	59.6%	3,302,805,662	5.93
6/30/18	12,398,898,951	19,997,700,966	62.0%	3,332,395,171	6.00
6/30/19	12,628,920,814	20,527,251,448	61.5%	3,462,524,396	5.93
6/30/20	12,948,507,140	21,033,809,319	61.6%	3,477,578,726	6.05
6/30/21	13,345,595,908	21,529,757,004	62.0%	3,622,097,199	5.94
6/30/22	13,657,627,450	22,371,468,812	61.1%	3,994,657,693	5.60
6/30/23	13,996,648,497	23,084,316,697	60.6%	4,298,689,195	5.38



ASOP 51 provides that the assessment of risk does not necessarily have to be quantitative, but may be qualitative. This report will provide quantitative analysis for SERS in a later section, but first we will discuss the overall assessment of risk for SERS from a qualitative perspective.

(1) Contribution Rate Funding Policy

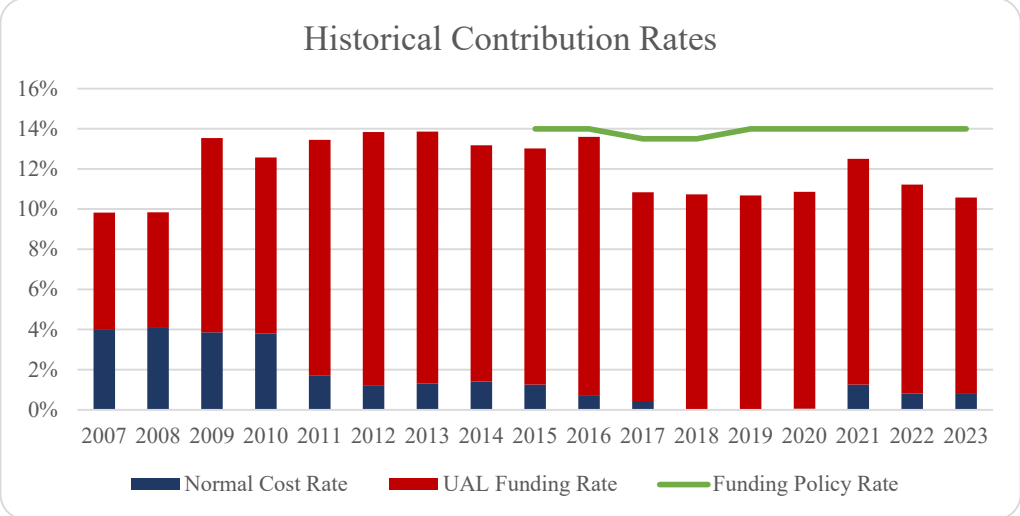
The statute sets a contribution cap of 24% of payroll: 14% from employers and 10% from employees. Employer contributions in excess of those required to support the basic benefits may be allocated to retiree health care funding.

Effective June 30, 2015, changes were made to funding policy to meet the competing goals of providing Healthcare and improving SERS' long term funding as quickly as possible.

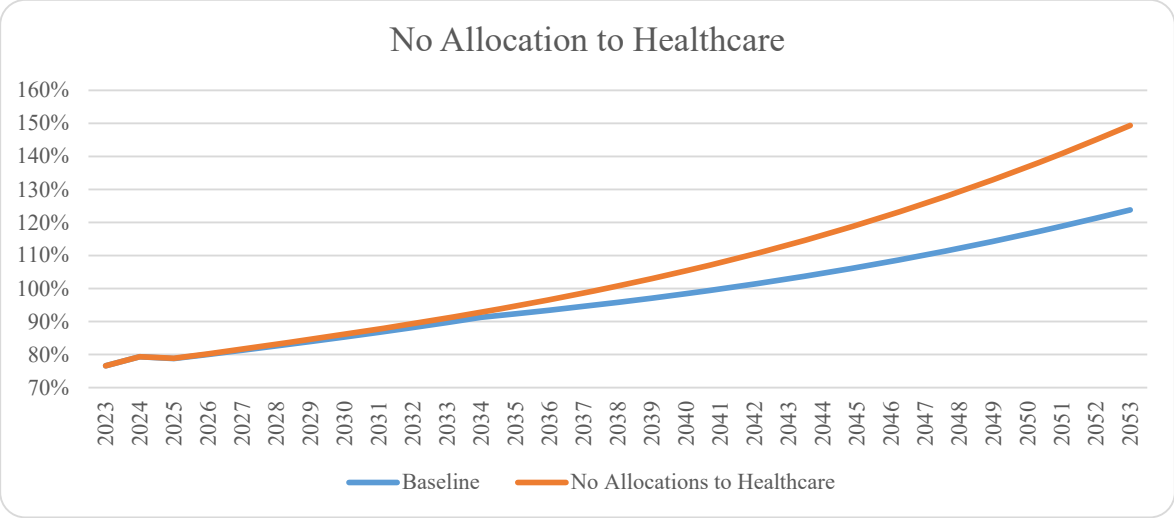
If the funded ratio is less than 70%, the entire 14% employers' contribution shall be allocated to SERS' basic benefits. If the funded ratio is 70% but less than 80%, at least 13.50% of the employers' contribution shall be allocated to SERS' basic benefits, with the remainder (if any) allocated to the Health Care Fund. If the funded ratio is 80% but less than 90%, at least 13.25% of the employers' contribution shall be allocated to SERS' basic benefits, with the remainder (if any) allocated to the Health Care Fund. If the funded ratio is 90% or greater, the Health Care Fund may receive any portion of the employers' contribution that is not needed to fund SERS' basic benefits.

SERS Contribution Rate Funding Policy should be considered as a positive factor in risk assessment because it accelerates funding of the Basic Benefits. Since July 1, 2015, the Board has allocated the entire 14% of payroll employer contribution to Basic Benefits except for the periods beginning July 1, 2017 and July 1, 2018 when the Board allocated 13.50% of compensation to Basic Benefits. This is a positive factor in that it accelerated the funding of Basic Benefits by an estimated $874 million.

A historical summary of the actual contribution rate, split between the normal cost and the remaining amount available to fund the UAL, and the Funding Policy Rate is shown in the following graph:



The chart below shows the projected funded ratio of SERS if no portion of the employer contribution is allocated to Healthcare over the entire projection period. Over the projection period, this improved the funded ratio from 124% to 149%.



(2) Amortization Policy

Actuarial assumptions are intended to be long-term estimates so even if experience follows the assumption over the long-term, short-term fluctuations are to be expected. When this occurs, and when changes to the actuarial assumptions, methods, or benefit structure occur, any deviation in the unfunded actuarial liability is financed based on the provisions of the amortization policy.

SERS Amortization Policy

The SERS Board shall establish a period of not more than thirty years to amortize the SERS unfunded actuarial accrued pension liability. If in any year the period necessary to amortize the unfunded actuarial accrued pension liability exceeds thirty years, as determined by the annual actuarial valuation required by section 3309.21 of the Revised Code, the board, not later than ninety days after receipt of the valuation, shall prepare and submit to the Ohio Retirement Study Commission and the standing committees of the Ohio House of Representatives and the Ohio Senate with primary responsibility for retirement legislation a report that includes the following information:

(A) The number of years needed to amortize the unfunded actuarial accrued pension liability as determined by the annual actuarial valuation;

(B) A plan approved by the board that indicates how the board will reduce the amortization period of the unfunded actuarial accrued pension liability to not more than thirty years;

(C) Whether the board has made any progress in meeting the thirty-year amortization period.

The remaining amortization period as of June 30, 2023 is 21 years. The amortization payments are calculated as a level percentage of payroll assuming payroll will grow at 1.75%.

SERS amortization policy should be considered as a positive factor in risk assessment because it requires the Board to take action if the amortization period exceeds 30 years.

(3) Payroll Growth Assumption and Active Membership

When the actuarial valuation is performed each year, it determines the funded ratio, unfunded actuarial liability and the contribution rates needed to fully fund the System based on SERS funding policy. The contributions needed (normal cost plus UAL amortization) are expressed as a percent of payroll which is consistent with how contributions are collected. Because the amortization payment on the unfunded actuarial liability is determined using the level percent of payroll methodology, an assumption must be used to develop the payment stream for the amortization of the UAL. The current payroll growth assumption for SERS is 1.75% per year which implicitly assumes that the number of active members remains stable over time.

The funding of the System could be impacted if there was a material shift in the SERS active membership. When the payroll of SERS does not grow at the assumed rate, it requires an increase in the amortization rate to maintain the amortization schedule. While the dollar amount of the UAL amortization payment might be the same, the amortization payment as a percent of payroll would increase to result in the same payment amount. Given the statutory limit on the employers and member contributions rates, sustained declines in payroll over a long time could prevent maintaining the amortization schedule. In addition, experience losses due to other sources, such as investment returns, would exacerbate the System decline in funding progress.

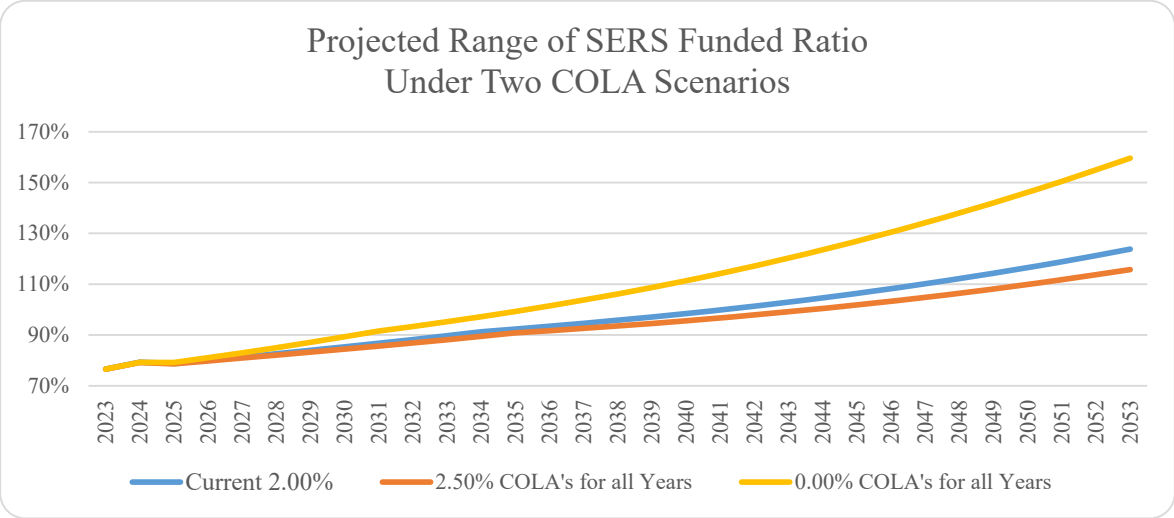
(4) Cost of Living Adjustments

Effective January 1, 2018, the cost-of-living adjustment changed from a fixed 3.00% to a cost-of-living adjustment that is indexed to CPI-W not greater than 2.5% with a floor of 0%. Before granting a cost of living increase, the Board may adjust the percentage of any increase if the board's actuary, in its annual actuarial valuation, or in other evaluations, determines that an adjustment does not materially impair the fiscal integrity of the retirement system or is necessary to preserve the fiscal integrity of the retirement system.

The enactment of SB 8 granted authority to the Board to decide how many anniversaries a new benefit recipient must achieve before they become eligible to receive a COLA. The Board exercised its authority and established that benefit recipients must wait until the fourth anniversary to become eligible for a COLA. This change became effective for benefits commencing on or after April 1, 2018.

The authority granted to SERS in regard to cost of living adjustments should be considered a positive factor in risk assessment. If additional contributions to the System are unlikely, the only alternative to alter trends in the projected funded status are temporary or permanent benefit reductions. Granting the Board this authority allows SERS to act quickly rather than rely on the legislative process to address an issue and mitigate a portion of the risk.

In the most recent experience study we recommended an assumed Cost-of-Living (COLA) adjustments of 2.00% for valuation purposes. The inflation assumption was recommended in a period of persistently low inflation. Since then, inflation has exceeded assumed inflation. The chart below shows the range in the funded projected funded ratio of SERS if the Board where to adopt 2.50% COLA's over the entire projection period and the projected funded ratio of SERS if the Board where to adopt 0.00% COLA's over the entire projection period. The funded ratio ranges from 116% to 160%. If future COLA's are equal to the assumed rate of 2.00%, the funded ratio is projected to be 124%.



There are a number of risks inherent in the funding of a defined benefit plan. These include:

- demographic risks such as mortality, payroll growth, aging population including impact of baby boomers, and retirement ages;
- economic risks, such as investment return and inflation;
- contribution risk, i.e., the potential for contribution rates to be too high for the plan sponsor/employer to pay; and
- external risks such as the regulatory and political environment.

The various risk factors for a given system can have a significant impact – favorable or unfavorable – on the actuarial projection of liabilities and contribution rates. Under ASOP 51, the actuary is required to include plan-specific commentary regarding the risks that are identified. However, such comments can be qualitative rather than quantitative. In this section of the report, we include quantitative analysis to assist with a better understanding of some of the key risks for SERS.

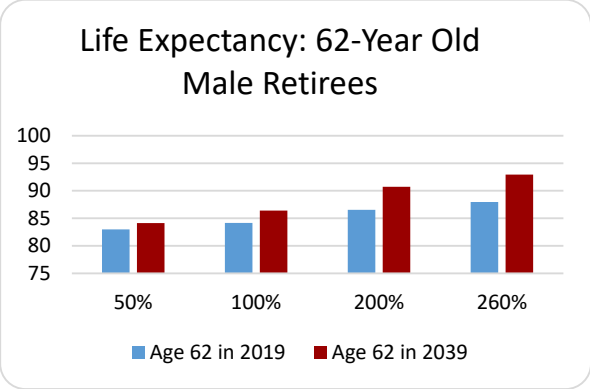
Demographic Risks

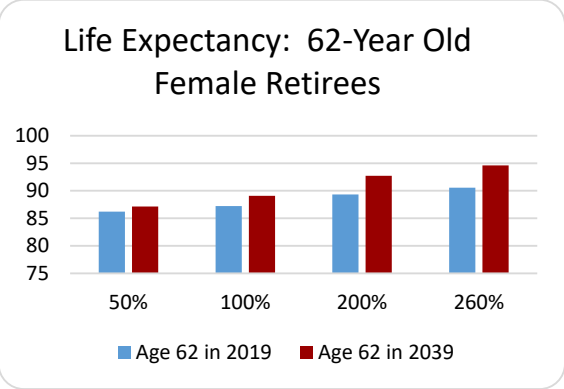
Demographic risks are those arising from the actual behavior of members differing from that expected based on the actuarial assumptions. These changes may arise when a significant portion of members is influenced to take some particular action due to employer or governmental actions, when there are improvements in medicine that affect broad groups of retirees, when societal trends encourage new behavior, or they may simply be random. Examples include early retirement windows, new drugs to treat common diseases, or trends across society to work longer before retiring. Many of these risks are minor in nature since they unfold gradually and generally have a small impact on a retirement system. Some, however, are comparatively more significant and warrant additional discussion.

Mortality Risk

A key demographic risk for all retirement systems, including SERS, is improvement in mortality (longevity) greater or less than anticipated. While the actuarial assumptions used in the valuation reflect small, continuous improvements in mortality experience each year, and these assumptions are evaluated and refined in every experience study, the risk arises because there is a possibility of some sudden shift, perhaps from a significant medical breakthrough that could quickly impact life expectancy and increase liabilities. Likewise, there is some possibility of a significant public health crisis that could result in a significant number of additional deaths in a short time period, which would also be significant, although more easily absorbed.

The mortality projection scale used for the valuation is somewhat more complex than this, but it suffices for illustration to think of the current mortality improvement assumption as also being about 1% per year. To consider longevity risk, we considered the impact of faster improvements in life expectancies of 2.0 and 2.6 times as much improvement, along with only half as much improvement. As the following charts illustrate, a greater improvement factor greatly increases the life expectancy over time.



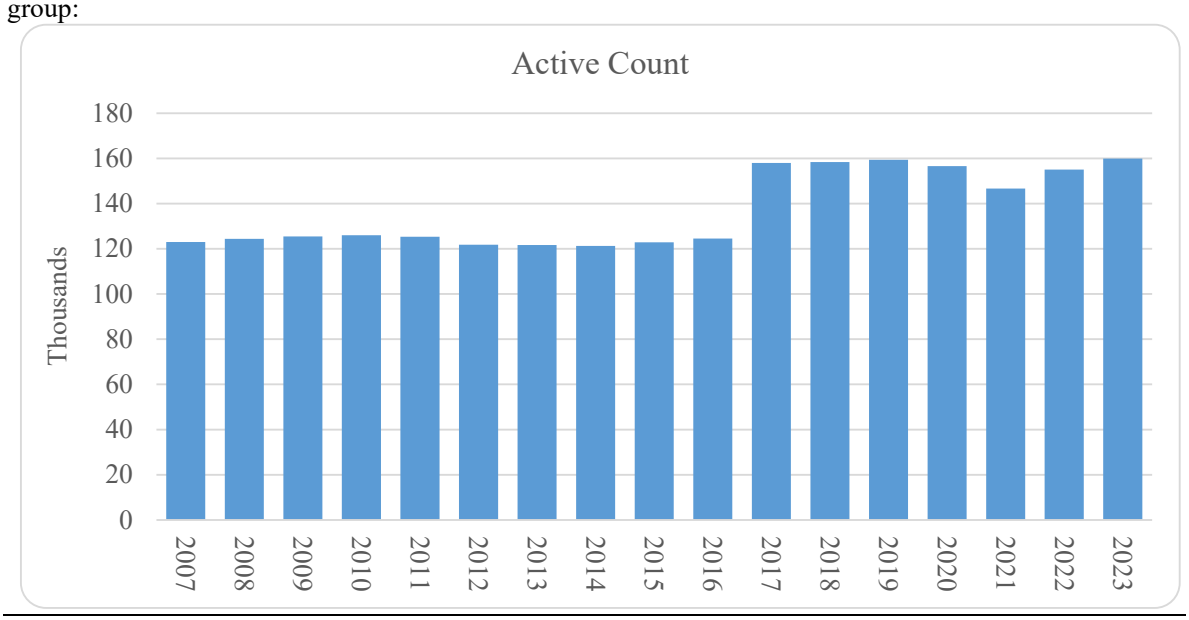


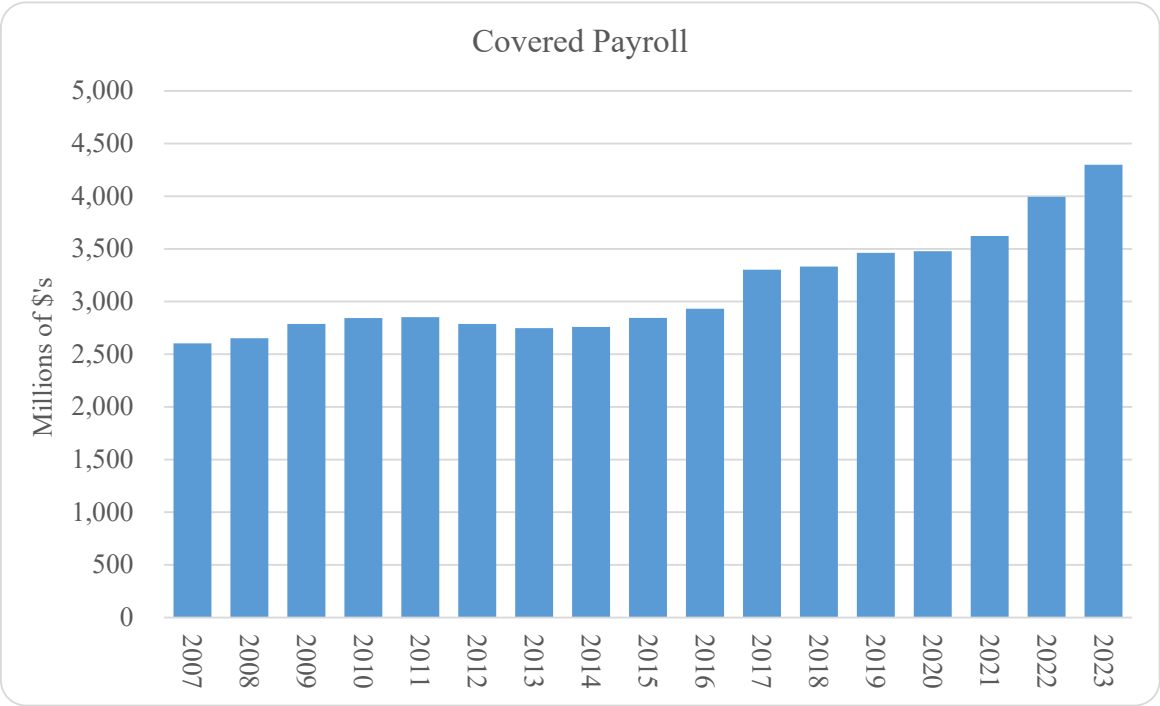
In performing valuations, we do not directly use life expectancy values, but rather apply the mortality rates at each age directly. For 2024, if the mortality improvement scale were cut in half (to a 0.5% per year improvement), the liabilities would decrease by about 1% at age 62, while if the mortality improvement scale were doubled (resulting in approximately a 2% per year improvement), liabilities at age 62 would increase approximately 2%. Over the next 20 years, the impact of either change would roughly double. Note that these changes in mortality improvement are noticeable departures from historical norms, but they are plausible.

Active Population Growth or Decline Risks

Valuations consider the data on a single date and do not make a direct assumption regarding future members, with the exception of the amortization method's assumption of payroll increases that inherently assumes a constant population size. However, the reality is that if the active membership increases or decreases, there will be corresponding decreases or increases in the actuarial contribution rate.

The following graphs show the historical count and covered payroll for active members in each membership group:

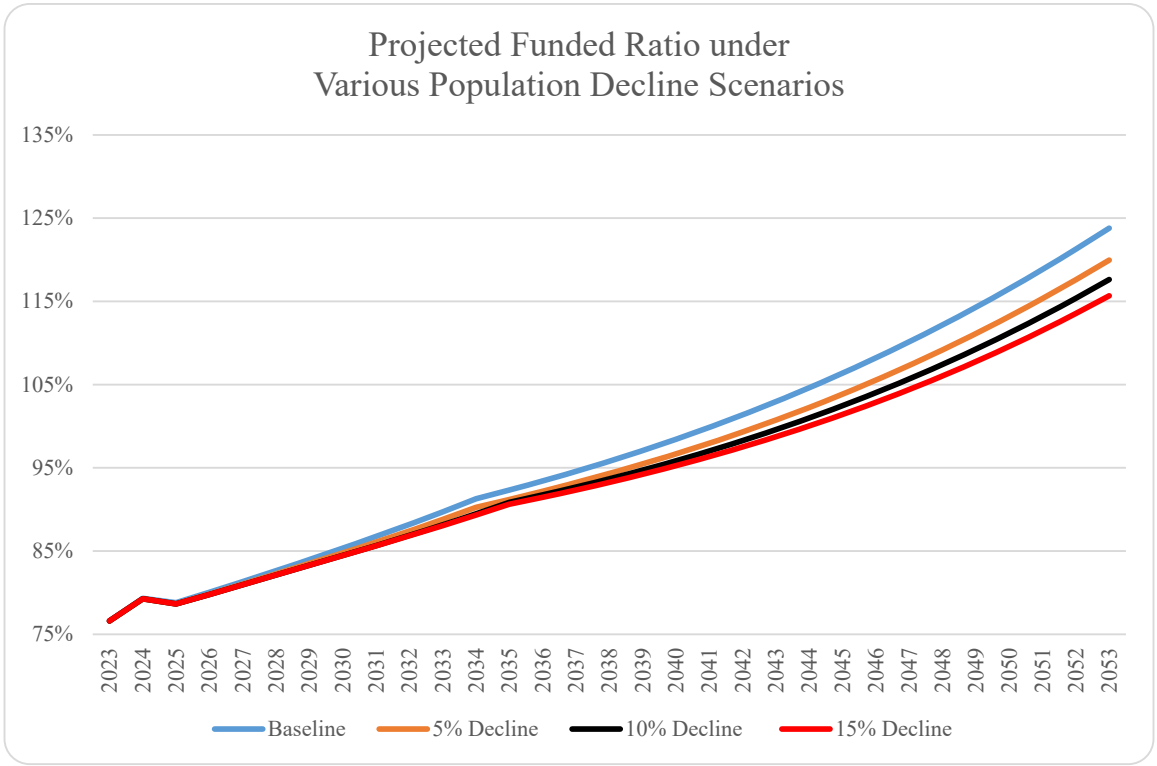



Covered Payroll
Millions of $'s
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023

A decline in SERS active membership could occur for a number of reasons. If the local school systems experiences severe and prolonged fiscal challenges, the number of school employees might be reduced. Alternatively, if there is a decline in the student population, it could reduce the need to maintain the current level of school employees. Another possibility that could impact the number of active members is a shift in the way education is delivered, with higher utilization of online teaching. Regardless of the cause for the decline, a substantial decrease in the active membership by itself could be mitigated.

In the event of a significant decrease in population, the payroll used to amortize the UAL is unlikely to grow at the assumed rate. This will, in turn, increase the actuarial contribution rate, although not the contribution dollar amount, needed to pay off the UAL. Referring to the maturity measures shown earlier in the report, it should be evident that lower payroll will increase the Asset Volatility Ratio. Of course, an increase in active membership would conversely decrease the Asset Volatility Ratio.

The chart below illustrates the projected funded ratio based on three population reduction scenarios. The first assumes an immediate 5% reduction in the population followed by no further reduction in active membership. The second assumes an immediate 5% reduction in the population followed by additional 1% reductions in the active population until the total reduction in the active workforce is 10%. The final scenario assumes an immediate 5% reduction in the population followed by additional 1% reductions in the active population until the total reduction in the active workforce is 15%. Since employer and member contributions to the system are set in statute, any reduction in the workforce reduces the income stream to SERS, thereby prolonging the amount of time SERS will need to achieve 100% funded status. If these population scenarios were combined with investment returns that are less than the assumed rate of return of 7.00% the affects would be magnified.



Other Demographic Risks

Changes to retirement and termination rates are likely to occur through time as the nature of the workforce and societal expectations shift. For instance, over the past decade or so, we have observed a general shift in retirement patterns in which retirements are occurring later. This may be a function of prior plan changes to eligibility, economic considerations, expectations of longer life in retirement, a proportionate decrease in physically-demanding jobs, or changes in family composition. Such changes do affect the funding of the plan, but generally these changes are minor and gradual and are reflected in modified assumptions resulting from regular experience studies.

More significant changes in demographic assumptions are likely to be influenced by something significant such as a legislative change. Obviously, some changes in SERS provisions or state employment rules could quickly change behavior patterns, but these would probably be anticipated as part of the legislation. Externally, a significant change in Social Security or Medicare provisions could change retirement patterns if the changes were implemented rapidly. These changes are not ones that can be easily quantified because the timing of such events, the impact of the event on behavior, and the magnitude of the behavior change cannot be anticipated.

Investment Return Risk

Investment risk volatility is the greatest risk facing SERS, as well as most public retirement systems today. Historically, as interest rates have been in decline, retirement systems had to choose between reducing expected returns which would increase required contributions or increase investment risk and maintain expected returns and contribution levels. Most systems chose to increase investment risk. In 2023 the average yield on the 10-year treasury was 3.96%. Compared to the current assumed rate of return of 7.00%, the risk premium is 3.04%. When investment returns are below the expected return (investment return assumption), the unfunded actuarial liability increases which prolongs the time period necessary for SERS to achieve full funding. Likewise, returns above the expected return, which are easier to absorb, decrease the unfunded actuarial liability and reduce the period necessary for SERS to achieve full funding. Because of the inherent volatility of most retirement system investment portfolios, there is, therefore, volatility in the plans' funded status and contribution requirements.

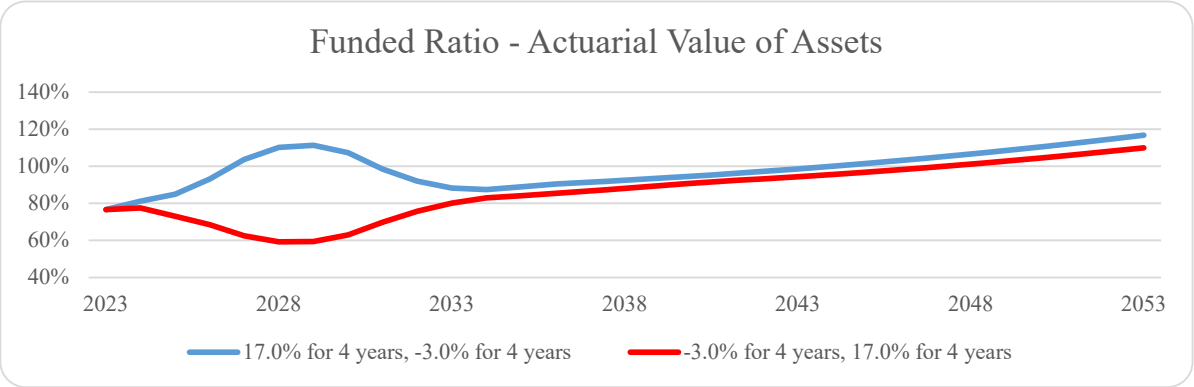
In order to understand the impact of investment volatility, we present a sequence of projections, based on the model prepared for SERS as part of the valuation each year. These "deterministic" projections use one or more selected scenarios to help illustrate certain key concepts. Following these projections, we show a summary of the results of a "stochastic" projection in which 1,000 equally plausible random scenarios are run and summarized.

Risk Due to Return Order

The long-term funding outcome is impacted not only on the returns but also the order in which they occur. In other words, a "good" return followed by a "bad" return can lead to a different final result than the same "bad" return followed by the same "good" return. While this may not be intuitive at first, the concept makes sense once it is realized that there are net cash flows out of the system.

To illustrate this concept, consider the funded ratio for SERS under two different scenarios. In each case, there are four years of returns that are 17.0% (10% above the assumed 7.0% return). There are also four years of -3.0% returns (10% below the assumed return). In one case, we assume the four good years come before the four bad years, while in the other case, we assume that the four bad years are followed by the four good years.

The following graph shows the results:

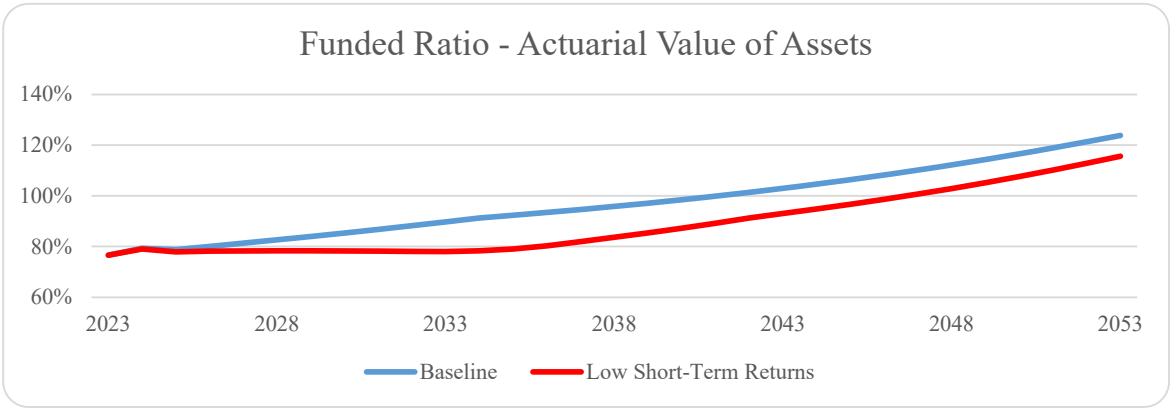


At the end of the projection, the high return followed by low return scenario has a funded ratio of 117%, while the low return followed by a high return is 110% funded. The order of the returns leads to a $2.9 billion dollar difference in market value ($48.6 billion vs. $45.7 billion). While the scenarios displayed here are artificial, they do illustrate that the return order matters.

Risk of Low Returns for Sustained Period

It is important to determine the potential impact of low returns over a sustained period on SERS funding. In particular, we want to examine the scenario, that returns will be 5.5% for the next 10 years, and 7.6% thereafter. It should be noted that such an assumption is not inconsistent with the 7.0% long-term rate of return currently used for the SERS valuation. The difference is really a variant of the prior discussion on order of returns: How does a scenario that has lower returns followed by higher returns compare with a scenario that has the (approximately) average returns for all years?

The following graphs shows the impact of low returns on the funded ratio SERS. In each case, the scenario (5.5% for 10 years, 7.6% thereafter) is compared with the baseline scenario of 7.0% for all years.



In this scenario, the low returns for the next 10 years reduce the funded ratio until 2036. In 2035, the gap is greatest, reaching a 13.3% difference (79.0% funded vs.92.3% funded, reflecting a UAL difference of $3.9 billion). Ultimately, this difference is reduced as the higher investment returns, result in improved funded ratio.

While this scenario on the previous page will not happen exactly as modeled, if the average returns over the next 10 years are around 5.5% and then the average returns increase to around 7.6%, similar patterns as these will emerge. It should be stressed, however, that this is only one plausible scenario and there is not universal consensus on return expectations. Please note, this represents a slight improvement from the previous study.

Risk of Shock in a Single Year

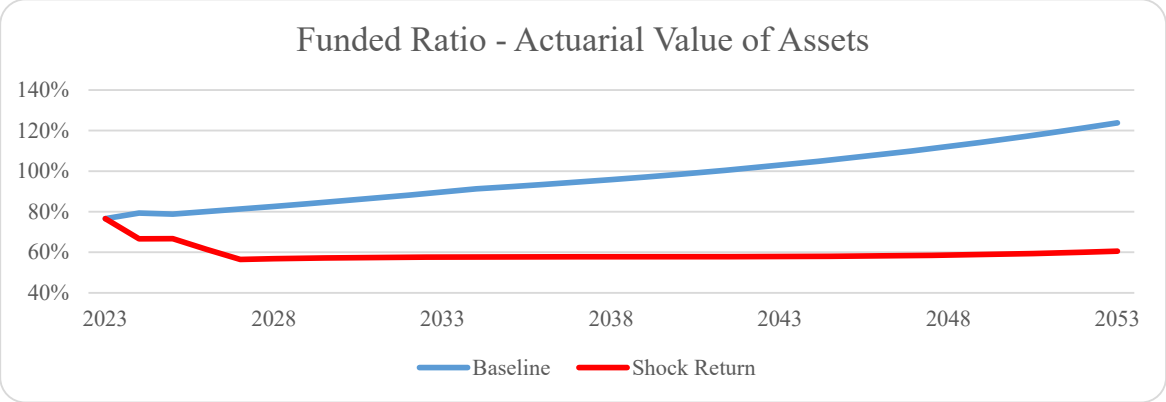
From late 2007 through early 2009, the financial markets crashed both in the U.S. and abroad resulting in the most impactful loss due to investment return ever experienced by SERS. The return on the market value of assets for FY 2009 was -22.9% and this single year dropped the funded status on a market value basis by more than 20%. Like many other systems around the country, SERS and the State of Ohio responded with changes in the benefit structure. Coupled with the financial market recovery, significant progress has been made in improving the situation.

Even with SERS' current Contribution Rate Funding Policy and the progress made toward improving the funding, there is still risk from another shock of this magnitude in a single year. The impact of such an event would be different depending on when it occurs. As the System matures and assets grow in comparison to payroll (increasing the asset volatility ratio), severe investment declines will have a greater impact on the actuarial contribution rate.

To study the impact of a similar shock, we modeled a repeat of 2009 with its -22.9% return in FY 2024, but 7.0% returns in every other year.

First, the probability of such a return in a single year is around 0.5% to 0.6% - meaning an event that occurs maybe every 150 to 200 years. Second, market crashes have been historically followed by significant rebounds in the following few years that have recovered significant portions of the losses. Third, SERS and its stakeholders have a history of proactively addressing significant problems by making changes in the benefit provisions and/or funding policies. This is not to minimize the risk of a shock. Rather, it is a reminder that the risk can be addressed in multiple ways.

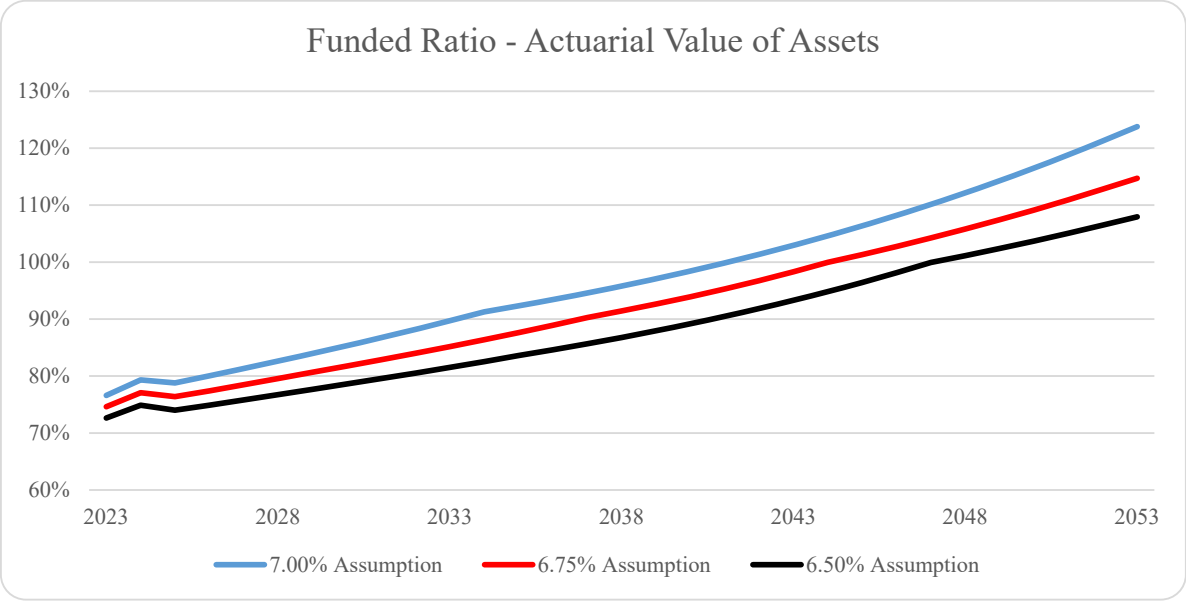
Please note, the graph below is a slight improvement from the previous study when the shock return led to an ultimate funded ratio of 53% compared to 61% in this study.



In this scenario, the funded ratio drops significantly in the initial years. Note that this graph is based on the actuarial value of assets, so the smoothing mechanism delays the recognition of the return over several years. The funded ratio declines initially, but remains constant throughout the projection period and then begins to improve at the end of the projection period.

Sensitivity Analysis

The valuation results are sensitive to the set of economic assumptions used to estimate the System's liabilities. In all scenarios considered thus far, the baseline results are those based on the assumption that all of the current actuarial assumptions (those used in the June 30, 2023 actuarial valuation) will be met in the future. To illustrate the sensitivity of the valuation results to different investment return assumptions, we have modeled the results if the investment return assumption is changed from 7.00% to 6.75% or 6.50%, with no other change in the set of economic assumptions. These illustrations further reflect that the assumed rate of return is actually earned in all years and use the current Contribution Rate Funding Policy.



As would be expected, the 7.0% assumption has the highest funded ratio, largely because the liabilities are the lowest and the assets grow at the highest rate. As should be expected, the 6.5% assumption results in the lowest funded ratio due to the increased measure of liabilities and the lowest annual returns.

Another way to perform sensitivity analysis is to look at how results would unfold if the assumptions remain unchanged, but actual experience varies. Of course, in reality, the assumptions would eventually be updated to reflect actual experience, so this type of analysis is useful only when shorter periods of time are considered. In the following charts, rates of return from 5.0% to 8.0% are considered. The impact is shown using a "heat map" in which the results are color coded from green (most favorable) to red (least favorable) to help visually show trends.

In this analysis, the current investment return assumption is not changed, but the impact of differing actual returns over the next ten years is studied.

Funded Ratio at June 30 Valuation

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
5.00%	77%	79%	78%	78%	77%	77%	76%	76%	76%	75%	74%
5.25%	77%	79%	78%	78%	78%	78%	77%	77%	77%	76%	76%
5.50%	77%	79%	78%	78%	78%	78%	78%	78%	78%	78%	78%
5.75%	77%	79%	78%	79%	79%	79%	79%	79%	80%	80%	80%
6.00%	77%	79%	78%	79%	79%	80%	80%	81%	81%	81%	82%
6.25%	77%	79%	78%	79%	80%	80%	81%	82%	82%	83%	84%
6.50%	77%	79%	78%	79%	80%	81%	82%	83%	84%	85%	86%
6.75%	77%	79%	79%	80%	81%	82%	83%	84%	85%	86%	88%
7.00%	77%	79%	79%	80%	81%	83%	84%	85%	87%	88%	90%
7.25%	77%	79%	79%	80%	82%	83%	85%	87%	88%	90%	91%
7.50%	77%	79%	79%	81%	82%	84%	86%	88%	90%	92%	93%
7.75%	77%	79%	79%	81%	83%	85%	87%	89%	91%	93%	95%
8.00%	77%	80%	79%	81%	83%	86%	88%	90%	92%	95%	97%

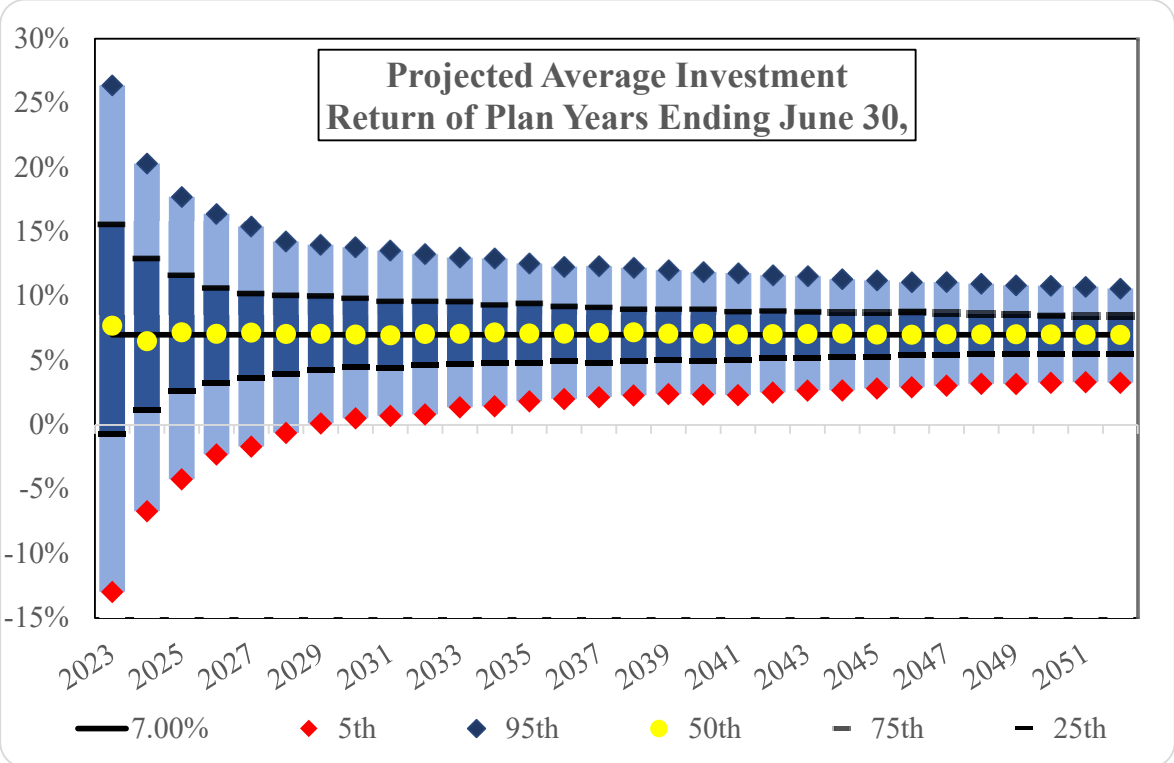
The yellow that predominates the left side of the charts indicates that the system is starting from a position that is comparatively in the middle of the outcomes. Higher returns lead to higher funded ratios, indicated by the green color in the lower right, while lower returns lead to lower funded ratios, as indicated in the red in the upper right.

Variability of Returns – Stochastic Modeling

Deterministic modeling is helpful to compare different scenarios, which can lead to a better understanding of the funding dynamics of the system. Missing in this analysis is an understanding of the likelihood of various scenarios and the plausible range of outcomes from the anticipated volatility associated with the asset allocation. These issues are handled with the more robust approach of stochastic modeling, in which investment performance is varied, based on the expected distribution of portfolio returns. Rather than obtaining a single result, this approach develops the results for many plausible scenarios, so that the distribution of outcomes can be considered.

For this modeling, we generated 1,000 30-year scenarios for the SERS's portfolio based on the expected return of 7.00% and standard deviation of 12.17% and assumed that each year's returns are independent. For each simulation, the asset, liabilities, and actuarial contribution rate were modeled for the next 30 years.

The chart below is based on the expected return and standard deviation noted above. We utilize those assumptions to produce the percentile ranks of expected returns over 30 years. Focusing on the longer time spans, the analysis indicates that over the next 30 years there is a 25% chance that the cumulated rate of return will be below 5.54% and a 25% chance it will be above 8.46%. In other words, there is a 50% chance the cumulative market returns over the next 30 years will be between 5.54% and 8.46%. The 50th percentile compound average investment return over the next 30 years is 7.00%.



Probability of Low Funding Ratios

Because of issues such as asset liquidity and the ability to withstand severe market volatility, low funded ratios are a concern. Consequently, understanding the likelihood of the occurrence of a low funded ratio can be helpful to the Board's considerations. The following tables show the probability of being below a given level during the specified period.

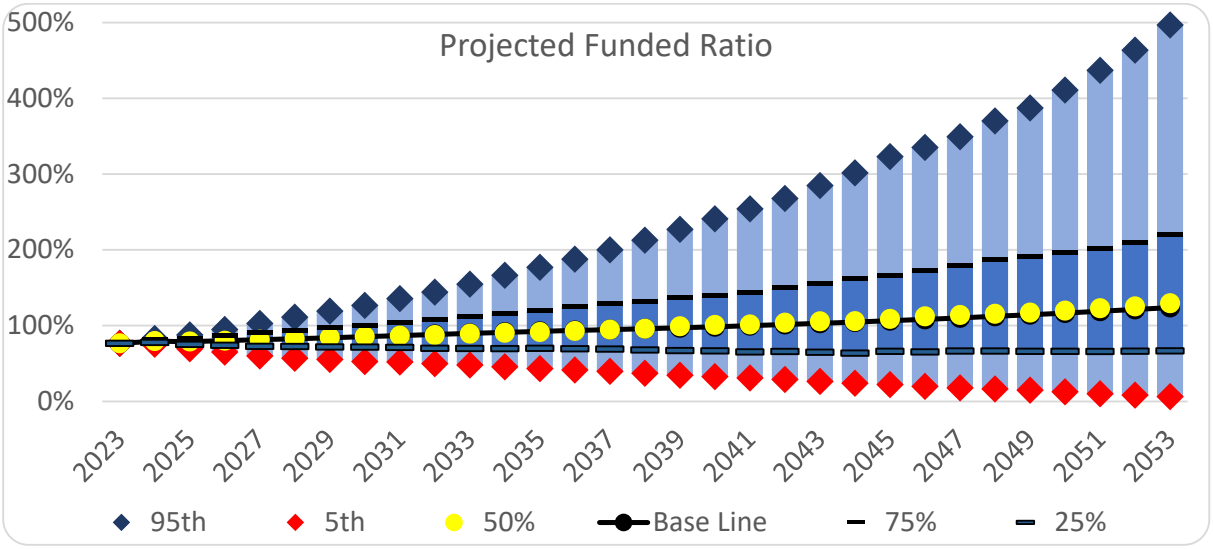
	Ratio <40%	Ratio <50%	Ratio <60%	Ratio <70%	Ratio <80%
2023 – 2028	0%	0%	2%	10%	59%
2023 – 2033	1%	2%	7%	16%	50%
2023 – 2038	2%	5%	12%	24%	38%

It is important to note that these are probabilities of the event occurring at any point during the period. There are scenarios in which the first few years may have low investment returns, leading to a low funded ratio, but due to strong investment returns in later years, the funding ratio after 10 or 15 years may be over 100%. Nonetheless, such scenarios would count in this table as an occurrence of a low funded ratio.

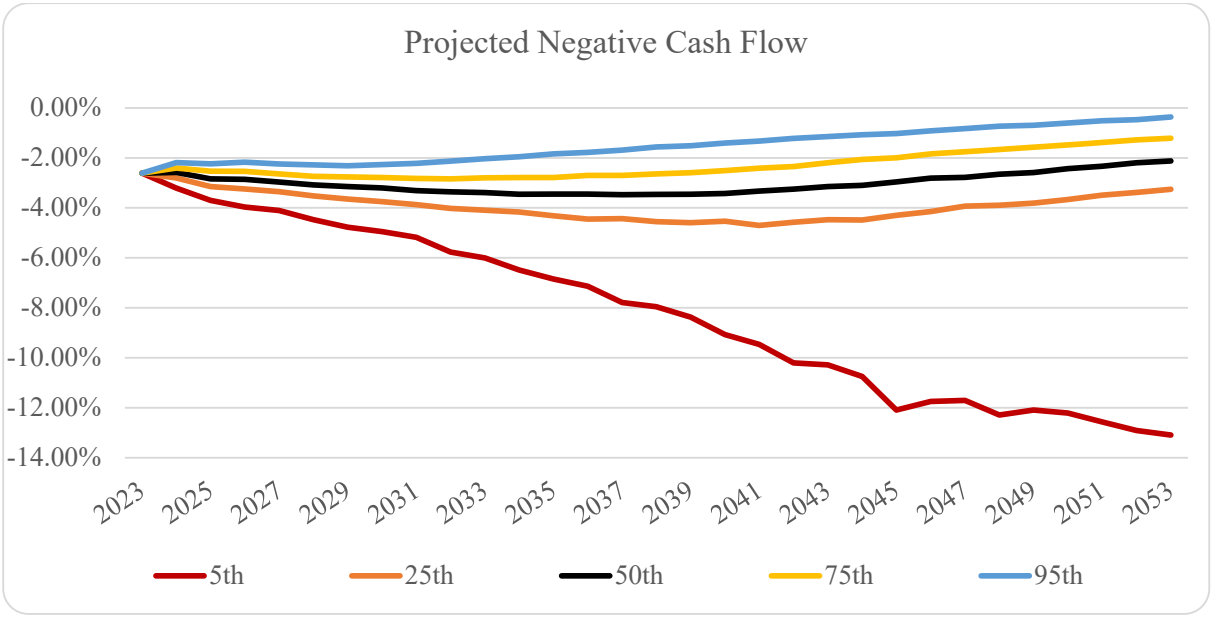
In general, there is a less than 12% chance that the funded ratio will decline below 60% over the next 15 years, and about a 24% chance that it will drop below 70% during the next 15 years. The result of this stochastic analysis reveals that the System's current momentum of funding progress would require a significant decline in market returns, which are less likely, in order to expect a decrease in the current funded ratio in the future.

Distributions of Outcomes

To this point, the discussion of stochastic modeling has focused on the probability of selected outcomes. It can also be useful to examine the distribution of outcomes for insight into the risk associated with investment returns. The following charts show the distribution for the next 30 years of the funded ratio. The darker blue portion of the bar represents the range between the 25th and 75th percentiles, or the middle 50% of results. A yellow line in the middle of the blue portion indicates the median (50th percentile) result. The lighter blue portion of the bars extend to show the 5th and 95th percentile ranges.



This graph indicates that in 10 years, the middle 50% of possible outcomes are between 70% and 112% funded. There is a 5% chance of being more than 155% funded, and a 5% chance of being less than 48% funded. Of course, should these less likely events occur, changes would mostly likely be made, thus changing the results.



The median negative cash flow tends to -3.39% over the next 10 years which is followed by improvement in the negative cash flow over the rest of the projection period. This is a contributing factor to the fact that the median funded ratio exceeds 100% in the projected funded ratio chart above.

ADJOURNMENT(R)

_____ moved that the SERS Retirement board adjourn to meet on Thursday, March 21, 2024, for their next regularly scheduled meeting.

The meeting adjourned at _____ a.m./p.m.

_____
Frank Weglarz – Chair

_____
Richard Stensrud, Secretary