October 17, 2023

Navigating a changing real estate landscape

Annual Fall Client Forum

Presented by Econometric Advisors

Agenda

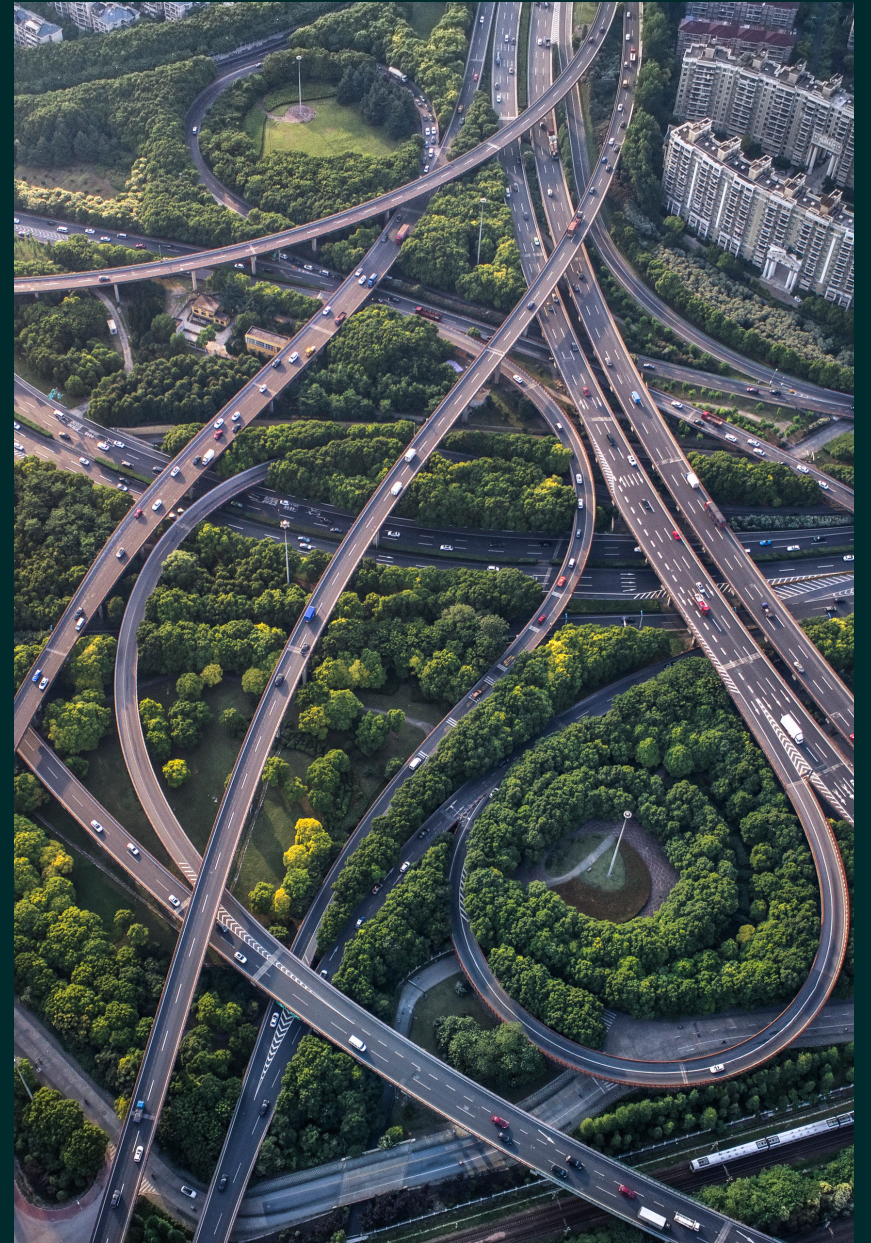# Geospatial Data Analysis at EA

ECONOMETRIC ADVISORS
Franz Limoges

Principal Data Scientist
franz.limoges@cbre.com

Warehouse Ramp Proximity

Does warehouse stock cluster near highway on ramps?
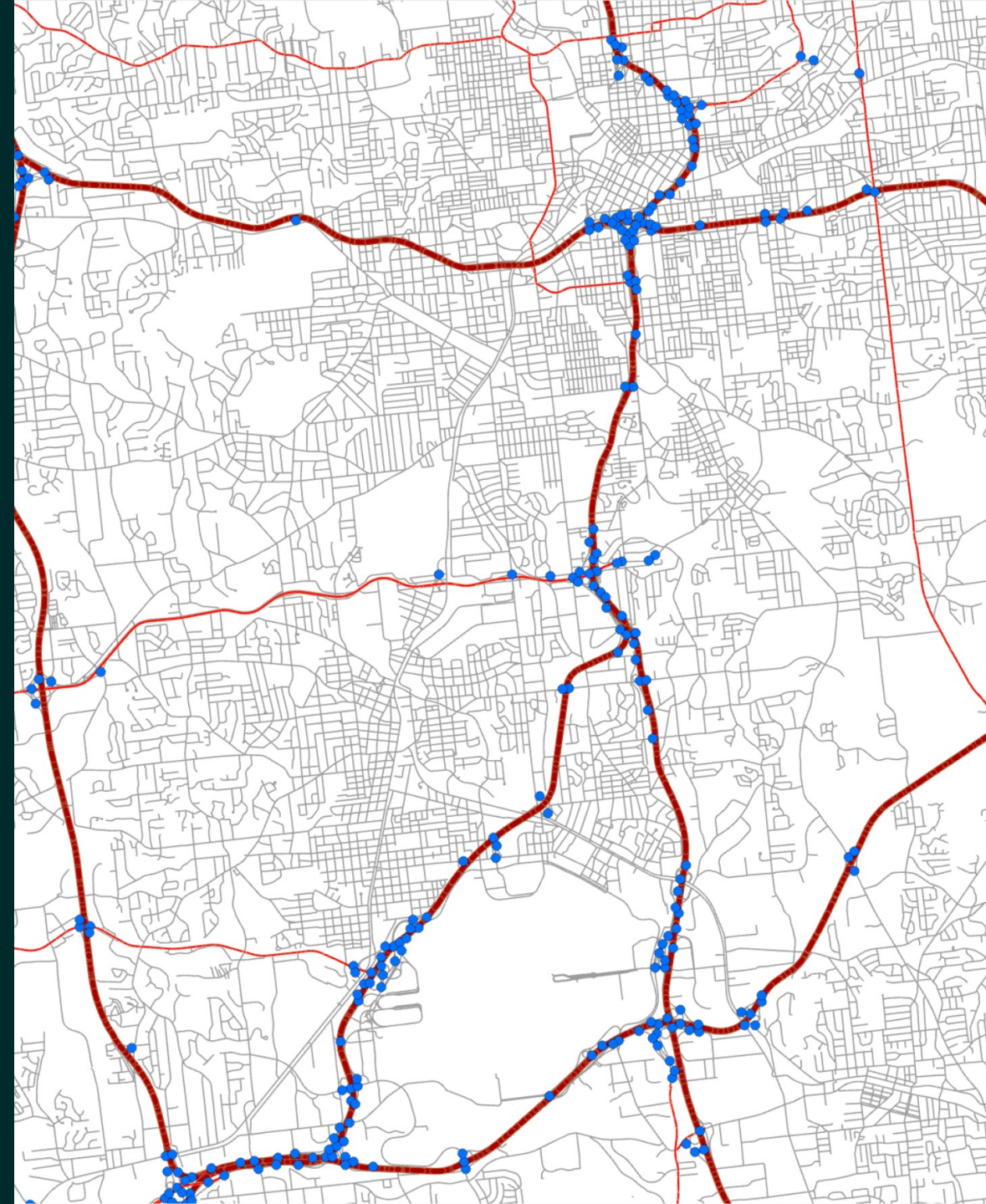
Step 1

Action Plan
Define scope and definition of proximity and acquire layers.

Step 2

Overlay highway network map on to the base map and observe the way it divides/complements neighborhoods. Take note of the interplay between the road network and density of people and real estate. (RED lines)

Step 3

Identify egress points on the highway network system. (BLUE dots)

Step 4

Begin the analysis by buffering the individual egress points. Dense areas of egress points tend to overlap.

Note the density of the ramps around the airport where you would expect considerable traffic to and from warehouses. Interchanges connecting two highways throughout the Atlanta area also have a heavy density of ramps.
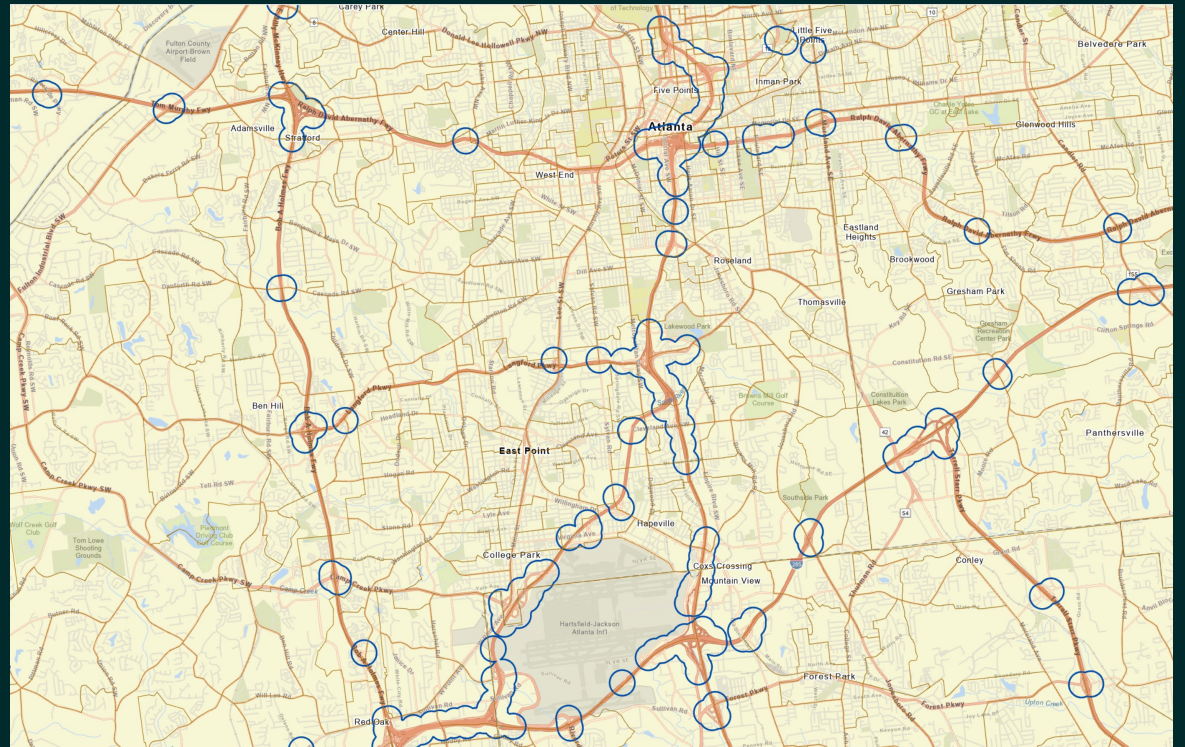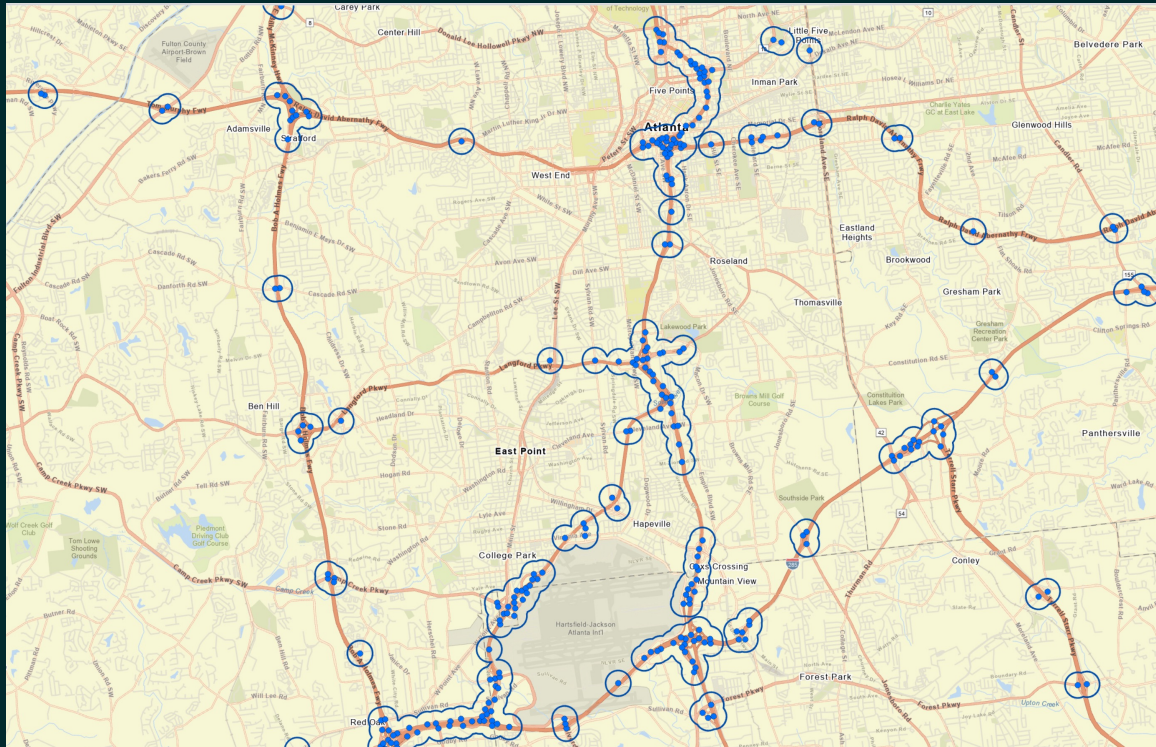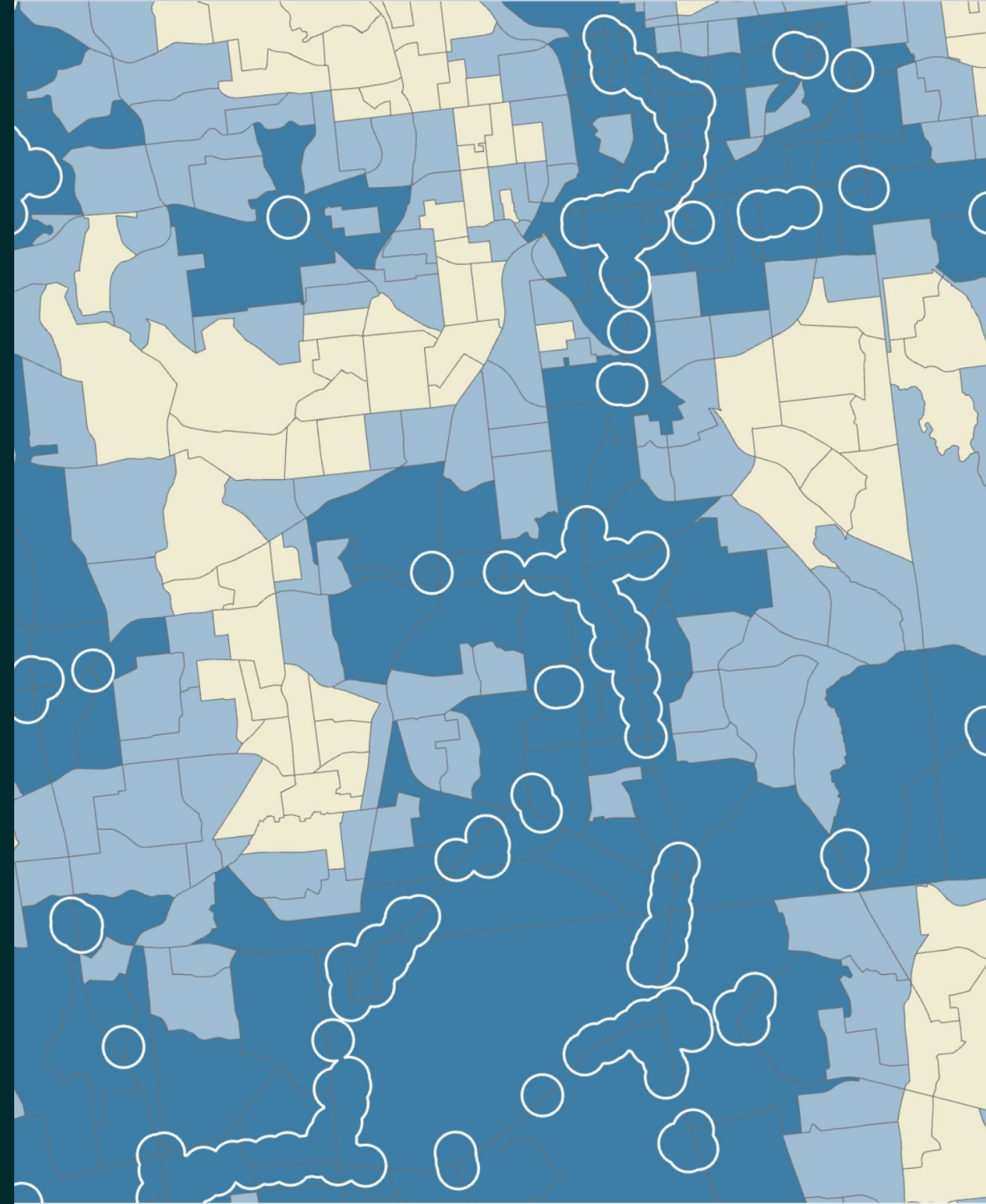
Step 5

Because density appears to affect the analysis, we chose to use Census block groups as the geographic units on which to base "zones."

We define the block groups in the following Zone designations:

— Zone 1: Contains an egress
— Zone 2: Borders a Zone 1
— Zone 3: All others

Zones are represented here from dark to light, respectively.

Step 6

Analysis - Warehouse buildings are coded for the "zone" to which they belong, and aggregates are produced. Unmistakable trends pop out with Zone 1: the egress ramp zones containing most of the industrial stock in Atlanta. Zone 2 was preferred over Zone 3.

Market age is a confounding factor. Markets with a long history prior to the building of the federal highway system tend to follow this trend less.
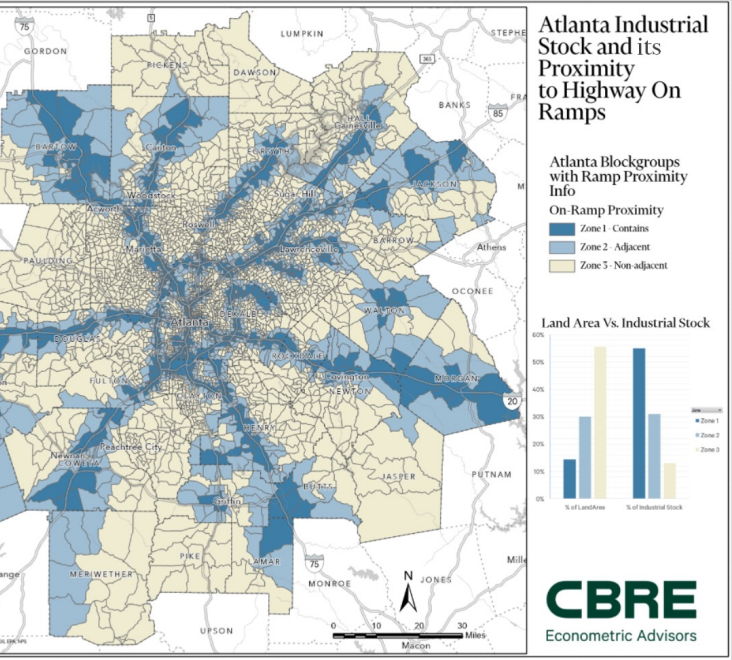
Older markets include, for example, Chicago, Boston and Philadelphia.

Analysis is written, data produced and now available for purchase.
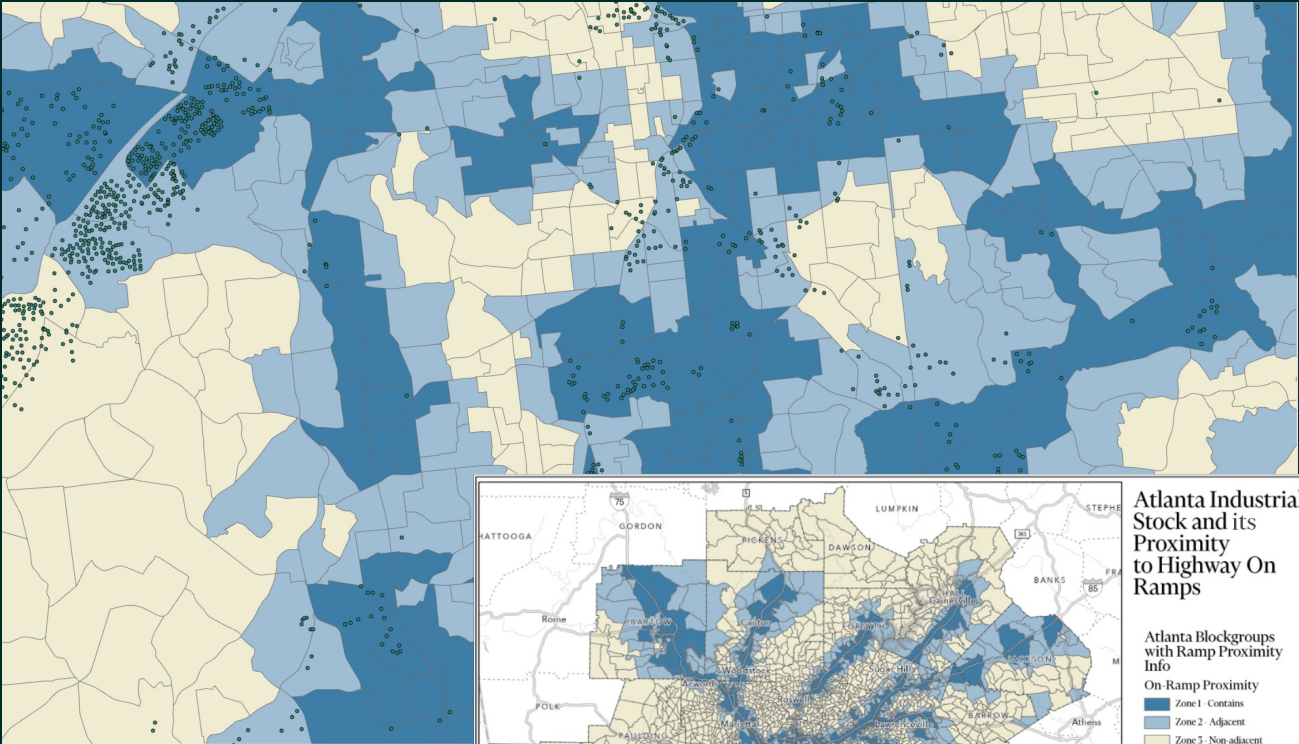
We then overlaid the industrial buildings in each zone. Interestingly, just over half of Atlanta's industrial stock was packed into Zone 1, which accounts for just over 10% of the metro's land area. This zone appears to be getting increasingly crowded. Of the 50 million sq. ft. constructed in metro Atlanta during the past 10 years, 63% was built in Zone 1, with Zone 2 accounting for 25% and Zone 3, 12%.

Market	Zone	Average size	Completions last 10 Years	% Of 10 Year Comps	% Multi - Tenant	Stock %	Vacancy %	Net Rent
Atlanta	1	95,451	109,928,254	63%	33.4	55.4%	3.2	$8.43
Atlanta	2	70,298	43,940,240	25%	35.2	31.3%	2.9	$8.80
Atlanta	3	57,096	21,900,270	12%	26.9	13.3%	4.3	$6.90

Atlanta Industrial Stock and its Proximity to Highway On Ramps

Atlanta Blockgroups with Ramp Proximity Info

On-Ramp Proximity
- Zone 1 - Contains
- Zone 2 - Adjacent
- Zone 3 - Non-adjacent

Land Area Vs. Industrial Stock

Commercial Real Estate at Risk

FEMA Risk Data Used to Give a Composite Risk Level for Commercial Real Estate Properties

NRI action plan

1. Download the Nation Risk Index (NRI) layers at Census tract level.

2. Load them into mapping software and use symbology by risk rating composite.

3. Visually we observe that a great deal of the land falls in relatively moderate to relatively high.

Census Tracts
National Risk Index - Rating - Composite

- Very High
- Relatively High
- Relatively Moderate
- Relatively Low
- Very Low
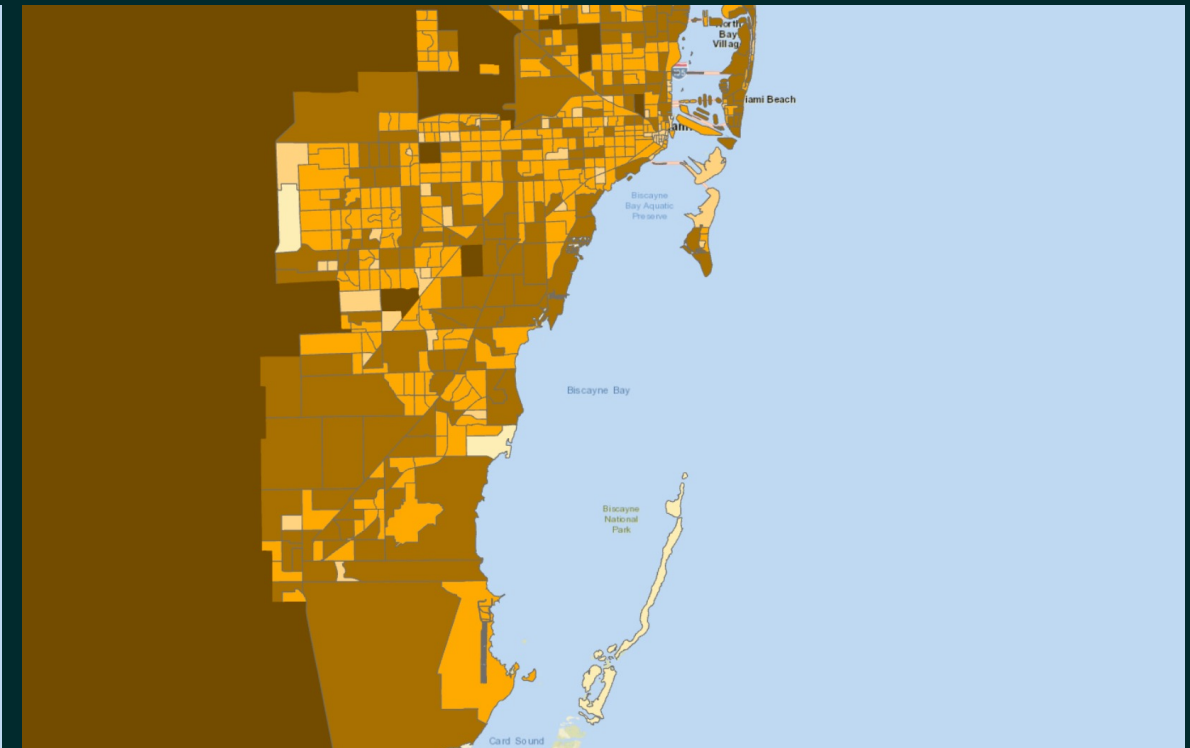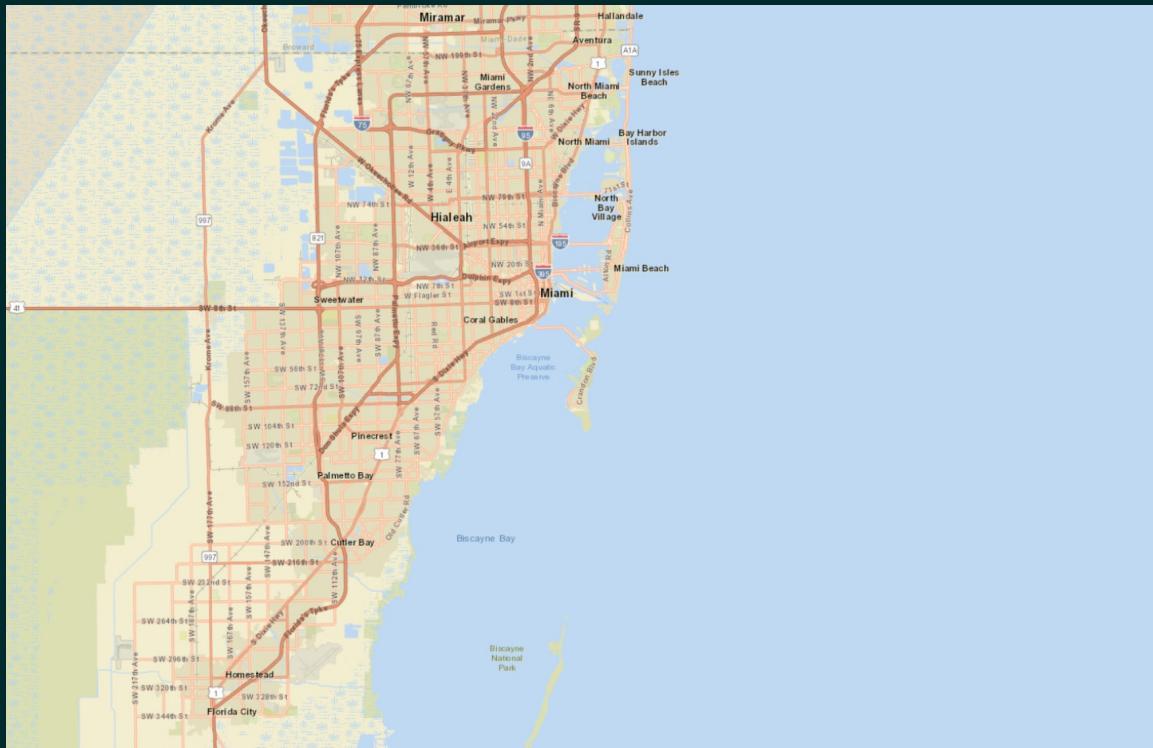
Building and footprint layer plan

— Query database and retrieve all the buildings tracked in the market.

— Combine those with a building footprint layer that describes the base shape of each property.

— Layer those over the base map.
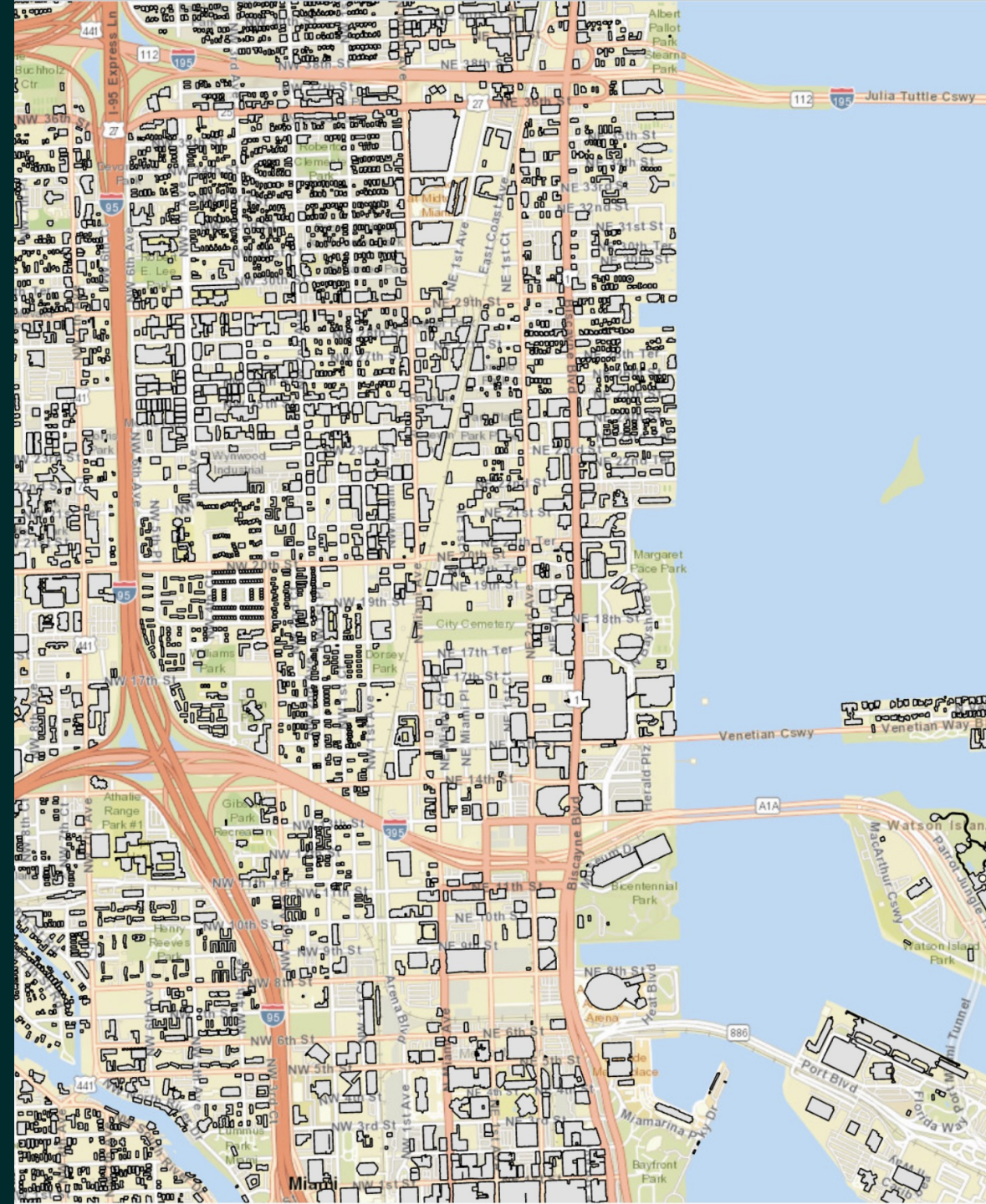
Symbology

Color code each of the footprints based on the property type they represent. On this map we can see some of the largest footprints are industrial buildings, though other property types may be larger because they are taller. Non-commercial buildings are cut from the analysis.
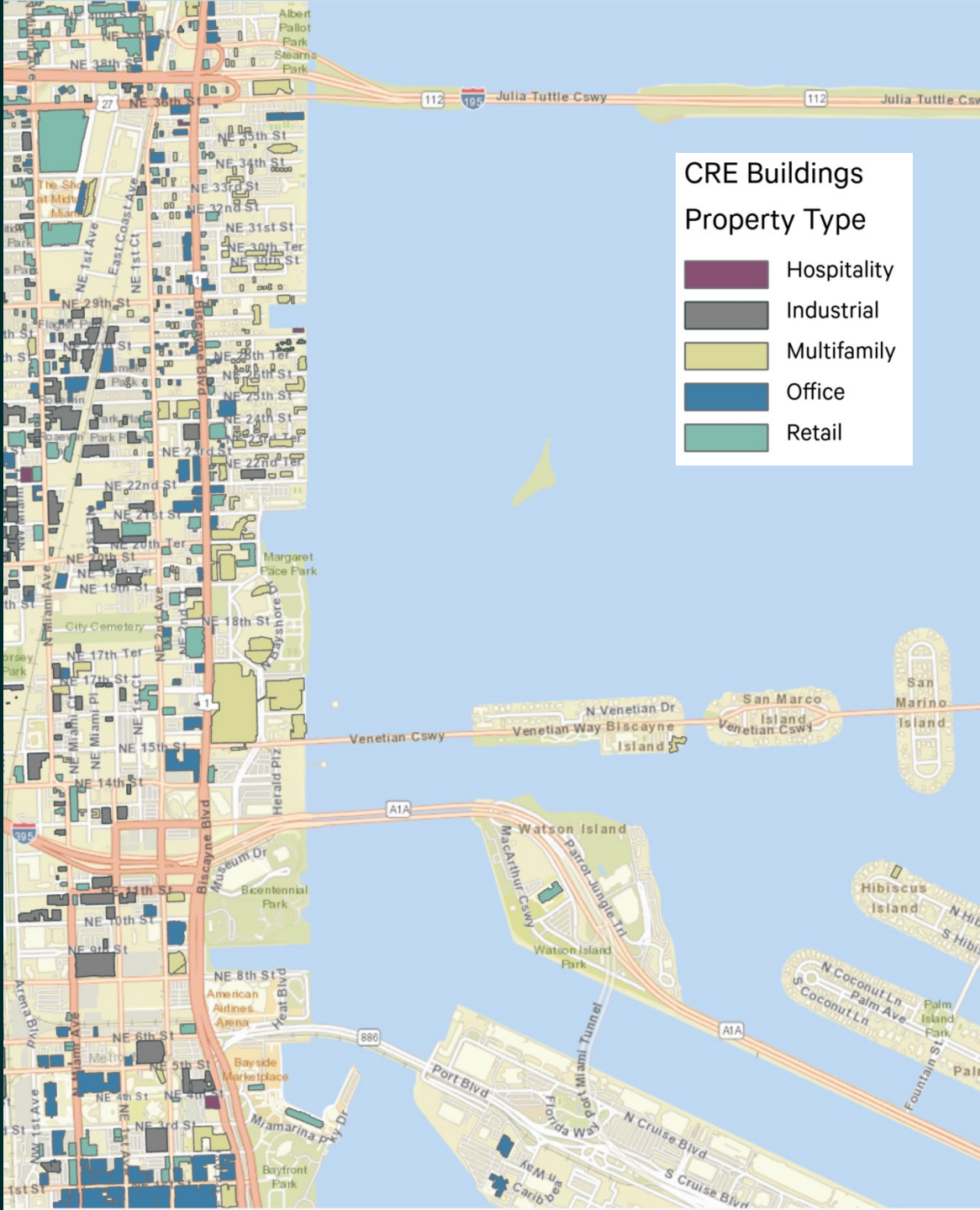
More symbology

Combining the color-coded NRI layer with the color-coded CBRE building database gives us a more comprehensive picture of which types of buildings are in the "At Risk" tracts.

We follow this up with a detailed write up and data expressing concerns.

Census Tracts
National Risk Index - Rating - Composite

- Very High
- Relatively High
- Relatively Moderate
- Relatively Low
- Very Low

Building Counts by Property Type within FEMA Risk Areas

Property Type	FEMA Risk Rating				
	Very Low	Relatively Low	Relatively Moderate	Relatively High	Very High
Hospitality	0	31	154	424	52
Industrial	3	33	887	3578	3062
Multifamily	0	381	4099	4836	266
Office	0	129	1539	2093	330
Retail	0	310	4437	5350	550
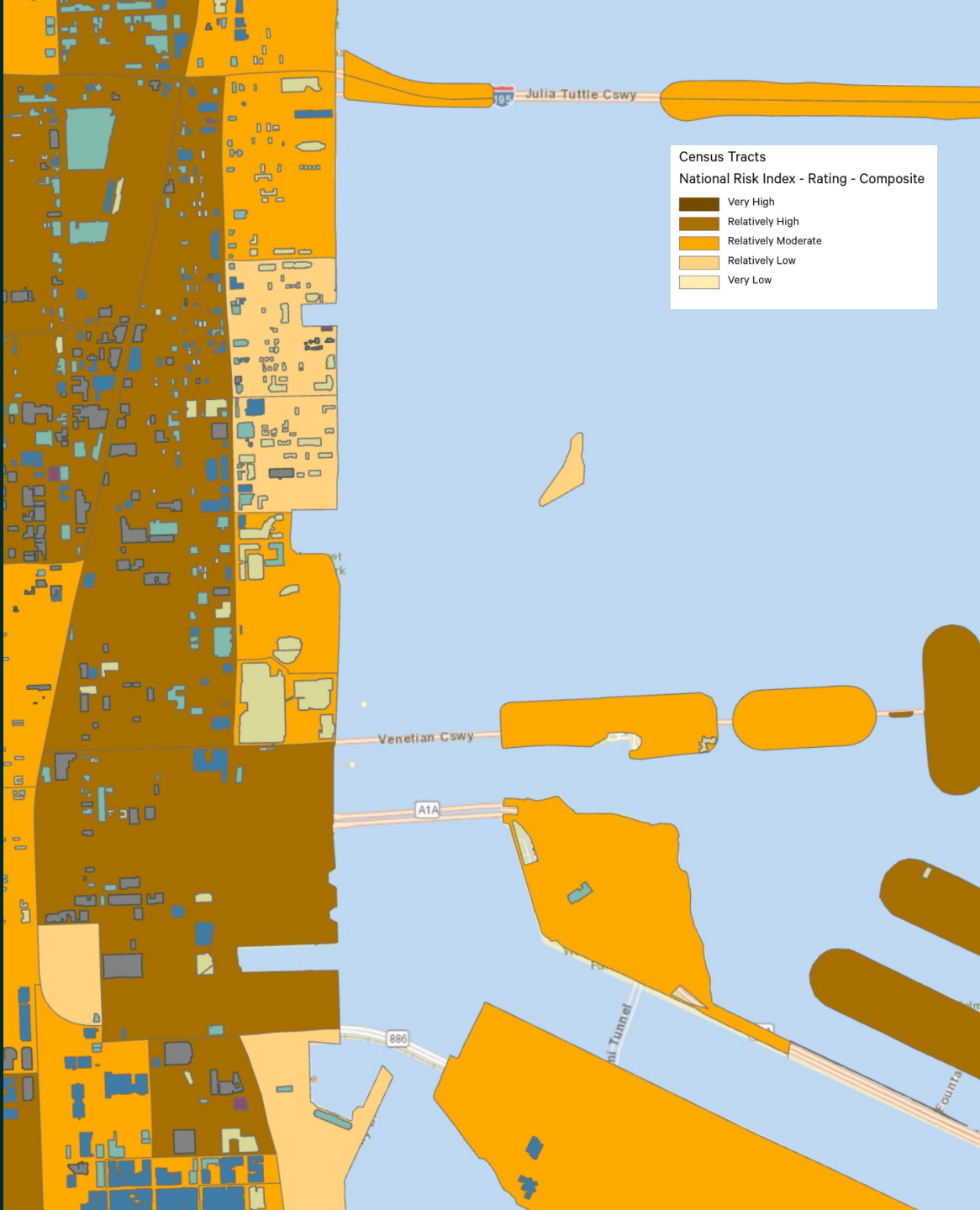
Investment Opportunities

Southern California
Warehouse Space

Investment action plan

1. Goal is to cluster and compare price per square foot versus rent per square foot to inform a buy, hold or sell strategy.

2. Load tables of warehouse asking rent data and sales transactions and cluster the sales transactions.

3. Create an ad hoc geography on which rents can be aggregated in each cluster.

4. Do bivariate analysis comparing rents to price.

Clustering of transactions

— Buildings close to each other often share characteristics.

— Next step: use proximity to each other to create transaction clusters.

— These clusters are based on the DBSCAN algorithm that uses a minimum number of transactions and a minimum distance from another transaction to be considered part of a cluster.

— Determine and finalize these parameters and run the algorithm over the transaction data.

— Each transaction is tagged with a cluster ID.

Generalize the geography

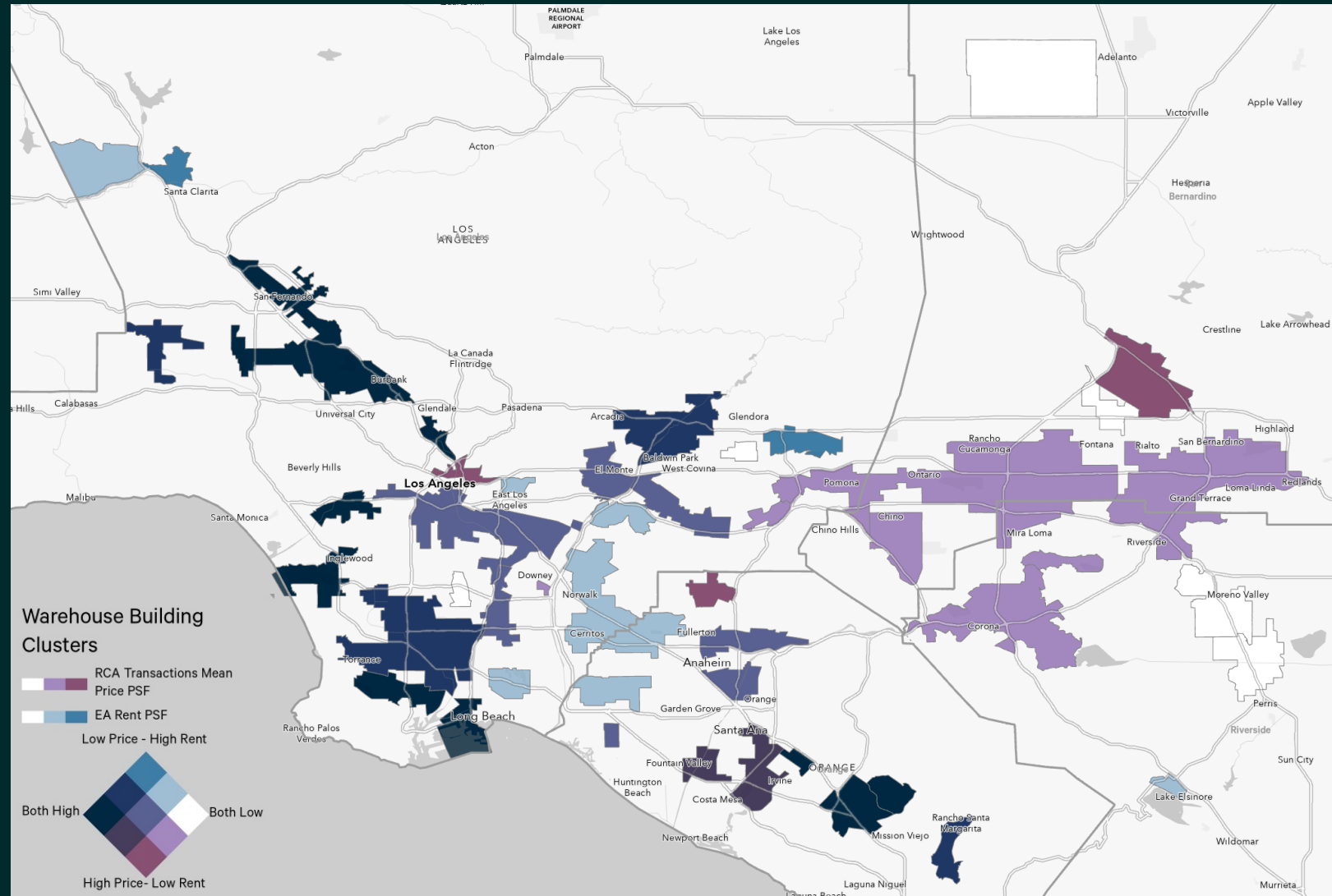- The next step was to move from Points to Polygons, specifically U.S. Census tracts.

- Census tracts that contain one or more transactions are tagged with a cluster ID.

- Gaps are filled to create contiguous tract polygons.

- Tract boundaries within each cluster are dissolved to create distinct cluster areas based on Census tracts.
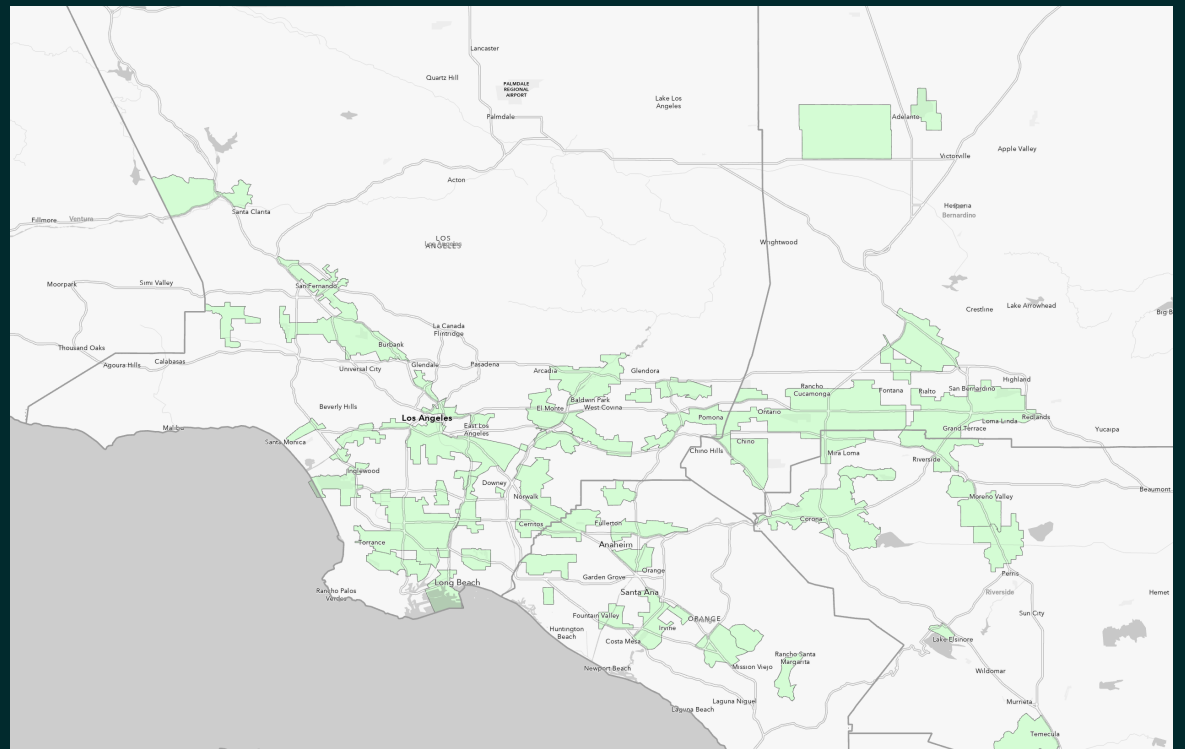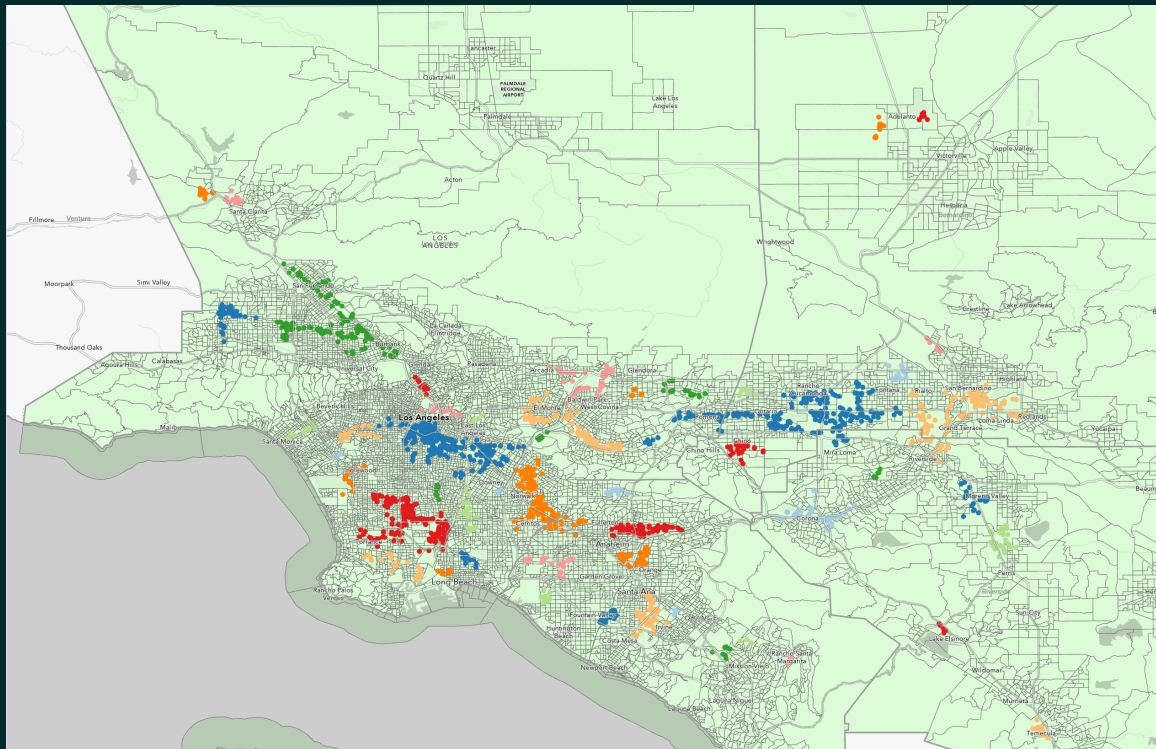
Compare rents vs. sales transactions and deliver insights

— Geocoded building rents enter the analysis and are aggregated using the sales transaction clusters.

— In addition to rents, additional building characteristics are considered (e.g. year built & ceiling height).

— Final data allows us to compare sales price per square foot to rents per square foot within each cluster.

— Some clusters have lower than average sales transaction prices while also delivering higher than average rents.

— Visualize these variables using a bivariate legend which makes it easier to identify areas of opportunity.

Warehouse Building Clusters

RCA Transactions Mean Price PSF
EA Rent PSF
Low Price - High Rent
Both High
Both Low
High Price- Low Rent

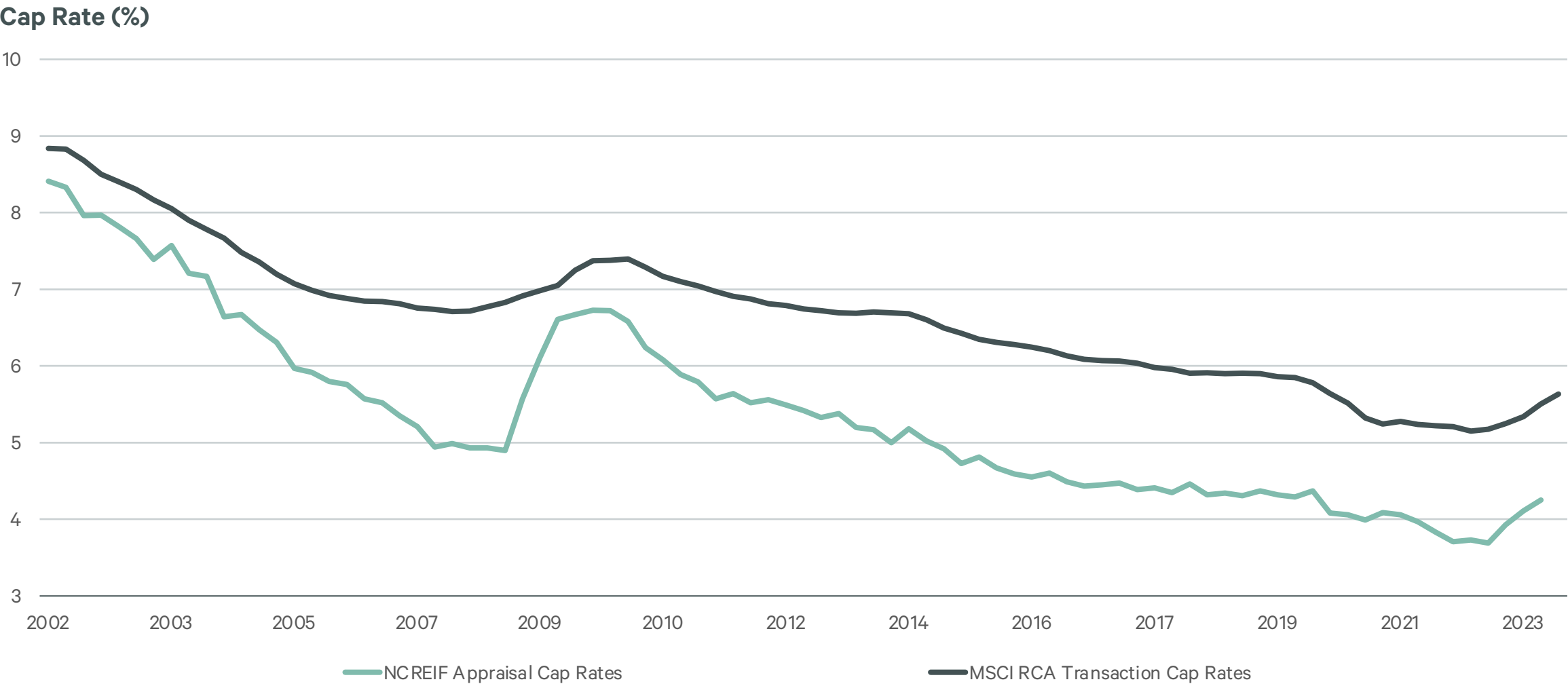# CBRE EA Cap Rates

ECONOMETRIC ADVISORS
Matt Mowell

Sr. Managing Economist
Macro
matt.mowell@cbre.com

ECONOMETRIC ADVISORS
Jing, Ren, Ph.D.

Sr. Economist
Capital Markets
jing.ren@cbre.com

Why change our investment performance metrics?

Cap Rate (%)

NCREIF Appraisal Cap Rates   MSCI RCA Transaction Cap Rates

Source: MSCI Real Capital Analytics, NCREIF.

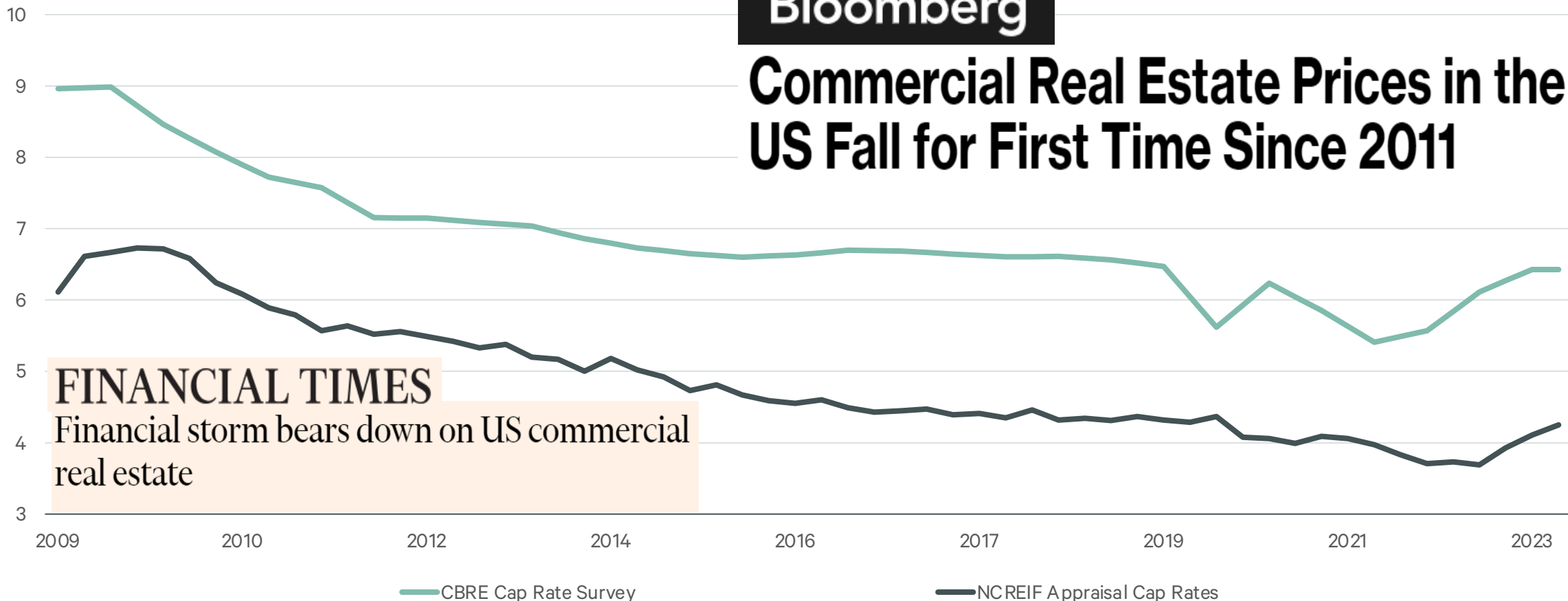# A solution: CBRE's Cap Rate Survey (CRS)

Cap Rate (%)

Bloomberg

Commercial Real Estate Prices in the US Fall for First Time Since 2011

FINANCIAL TIMES
Financial storm bears down on US commercial real estate

Legend: CBRE Cap Rate Survey — NCREIF Appraisal Cap Rates

Cap Rate Survey Challenges

Challenges

Can be volatile

Only goes back to 2009

Does not cover all markets

Solutions

Model against appraisal cap rates and key drivers of yield

Back cast beyond 2009

Assume some markets mimic others

Estimating our new historic cap rate series

Stability

– Use current model to capture long-term trend

Business Cycle

– Use GDP growth to determine momentum and inflection points

Capital Markets

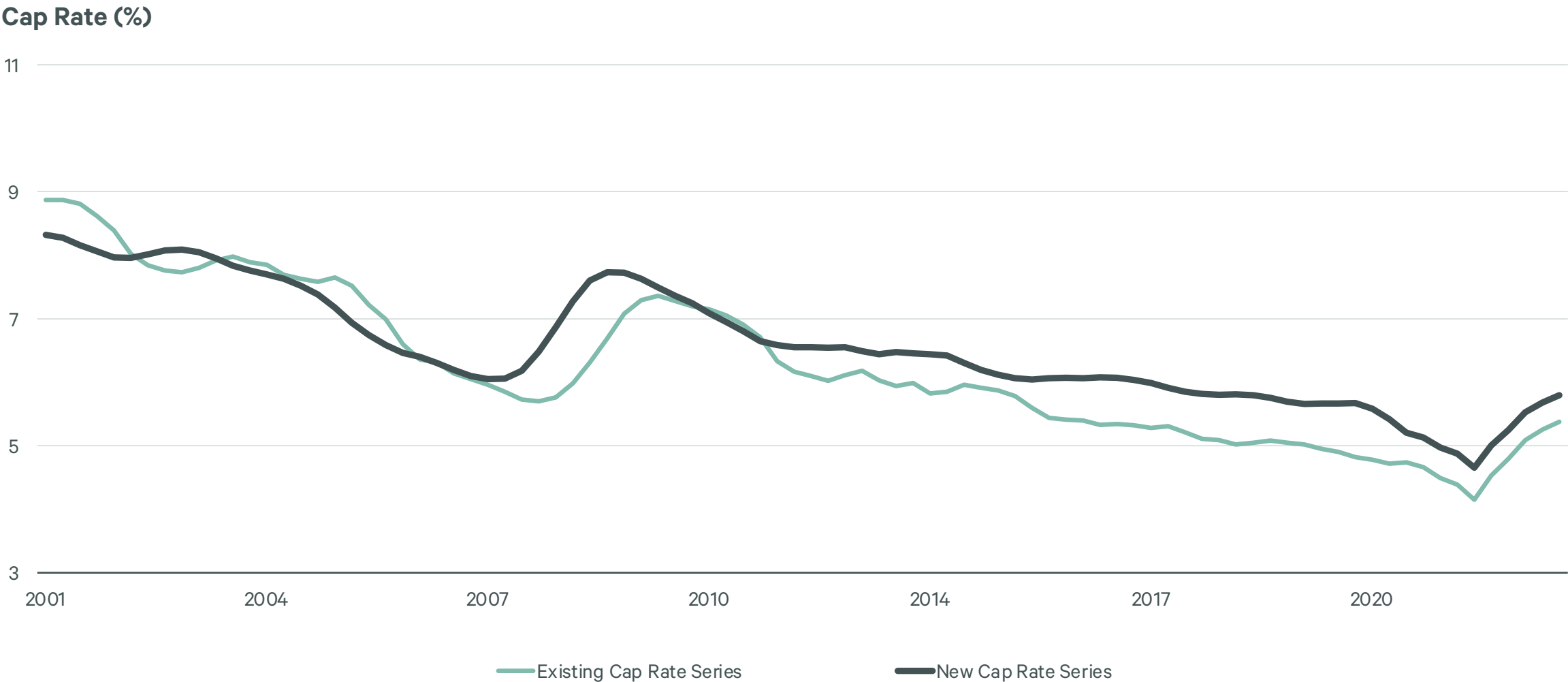– Employ U.S. Treasury to reinforce trends

New Cap Rate Series

$$Surveyed\ CapRate_{it} = \alpha + \beta_1 * (NCREIF_{it+[0,4]}) + \beta_2 * (CycleIndex_t) + \beta_3 * (Tbond_{t-1}) + Error_{it}$$

Estimated $\widehat{Surveyed\ CapRate}_{it}$ is the new cap rate.

An example: Chicago industrial

Cap Rate (%)
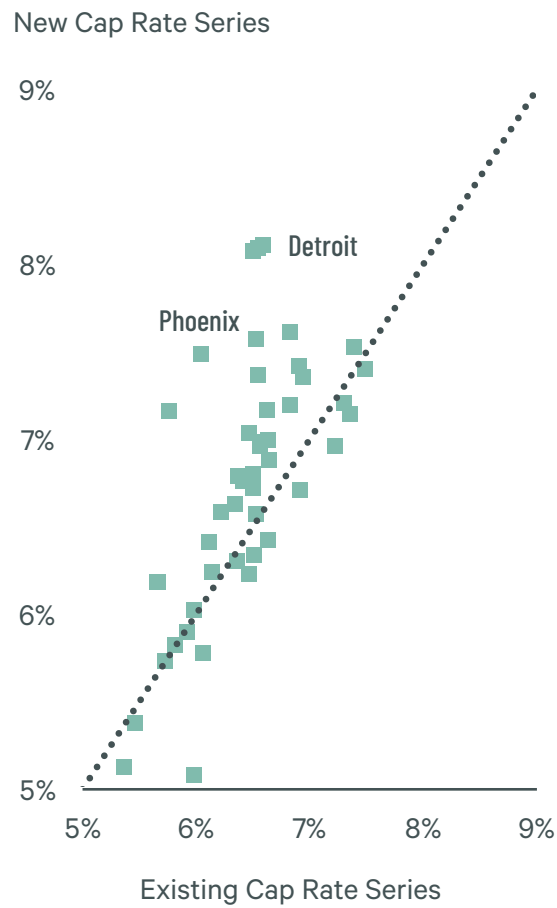

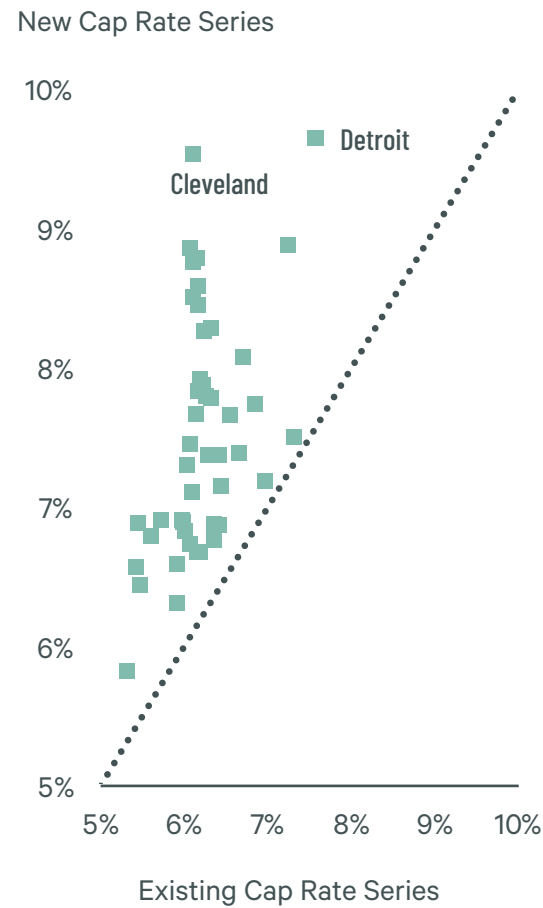Legend: Existing Cap Rate Series — New Cap Rate Series

Source: CBRE Econometric Advisors.

An example: Atlanta office

Cap Rate (%)

Legend: Existing Cap Rate Series — New Cap Rate Series

Source: CBRE Econometric Advisors.
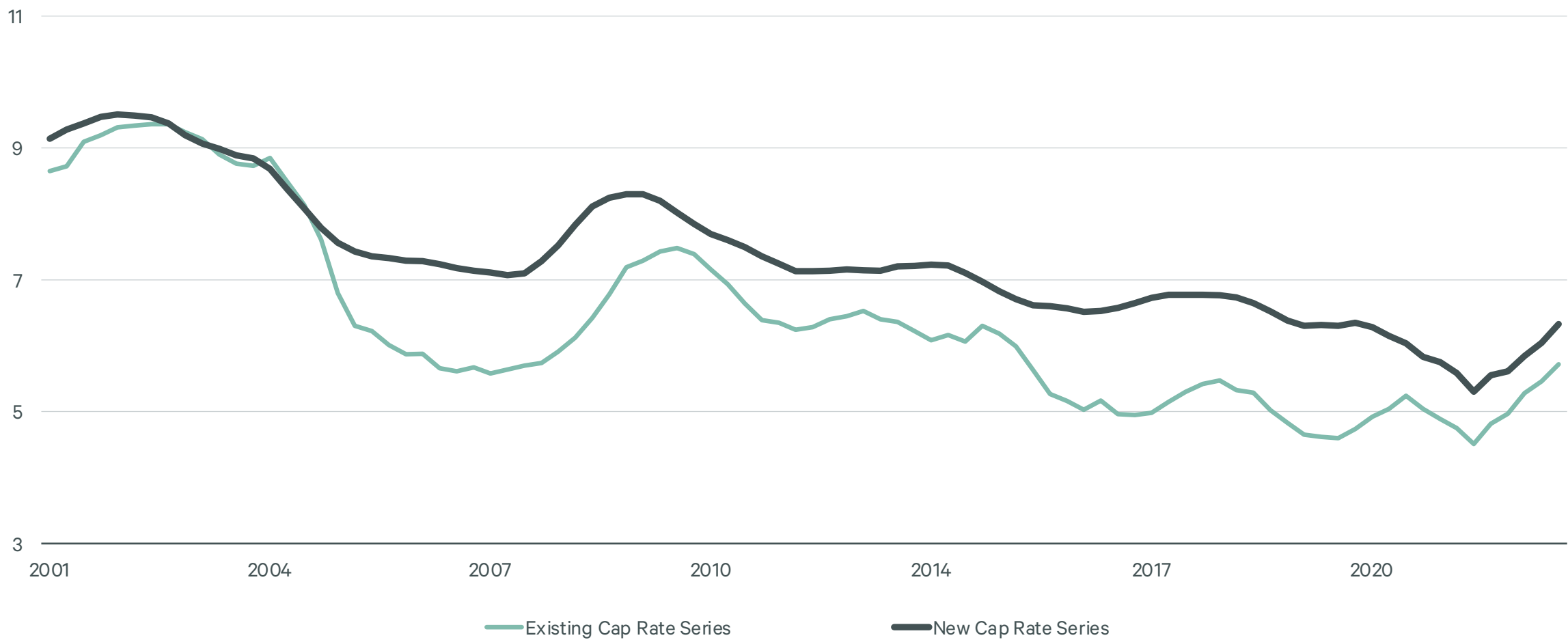
Putting our new series in context

Industrial

New Cap Rate Series

Detroit, Phoenix labeled. Axis range 5%–9% on both New Cap Rate Series (y) and Existing Cap Rate Series (x).

Source: CBRE Econometric Advisors.

Office

New Cap Rate Series

Detroit, Cleveland labeled. Axis range 5%–10% on both New Cap Rate Series (y) and Existing Cap Rate Series (x).

Source: CBRE Econometric Advisors.

Multifamily

New Cap Rate Series

Cleveland, Pittsburgh labeled. Axis range 4%–8% on both New Cap Rate Series (y) and Existing Cap Rate Series (x).

Source: CBRE Econometric Advisors.

Retail

New Cap Rate Series

Detroit, Cleveland labeled. Axis range 5%–9% on both New Cap Rate Series (y) and Existing Cap Rate Series (x).
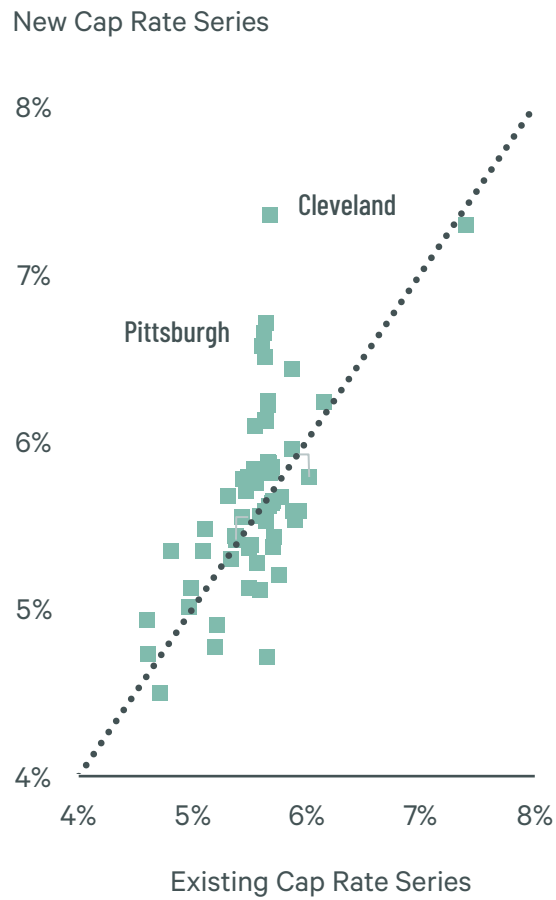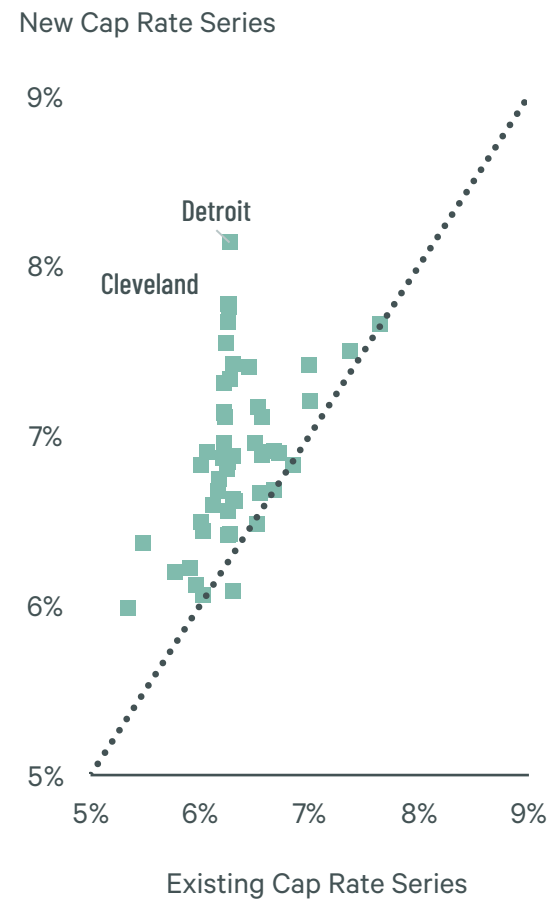
Source: CBRE Econometric Advisors.

Welcome

ECONOMETRIC ADVISORS
Dennis Schoenmaker, Ph.D.

Principal Economist
Executive Director
dennis.schoenmaker@cbre.com

What's Next for the U.S. Economy?

GLOBAL RESEARCH
Richard Barkham, Ph.D.

Global Chief Economist
Head of Research
richard.barkham@cbre.com

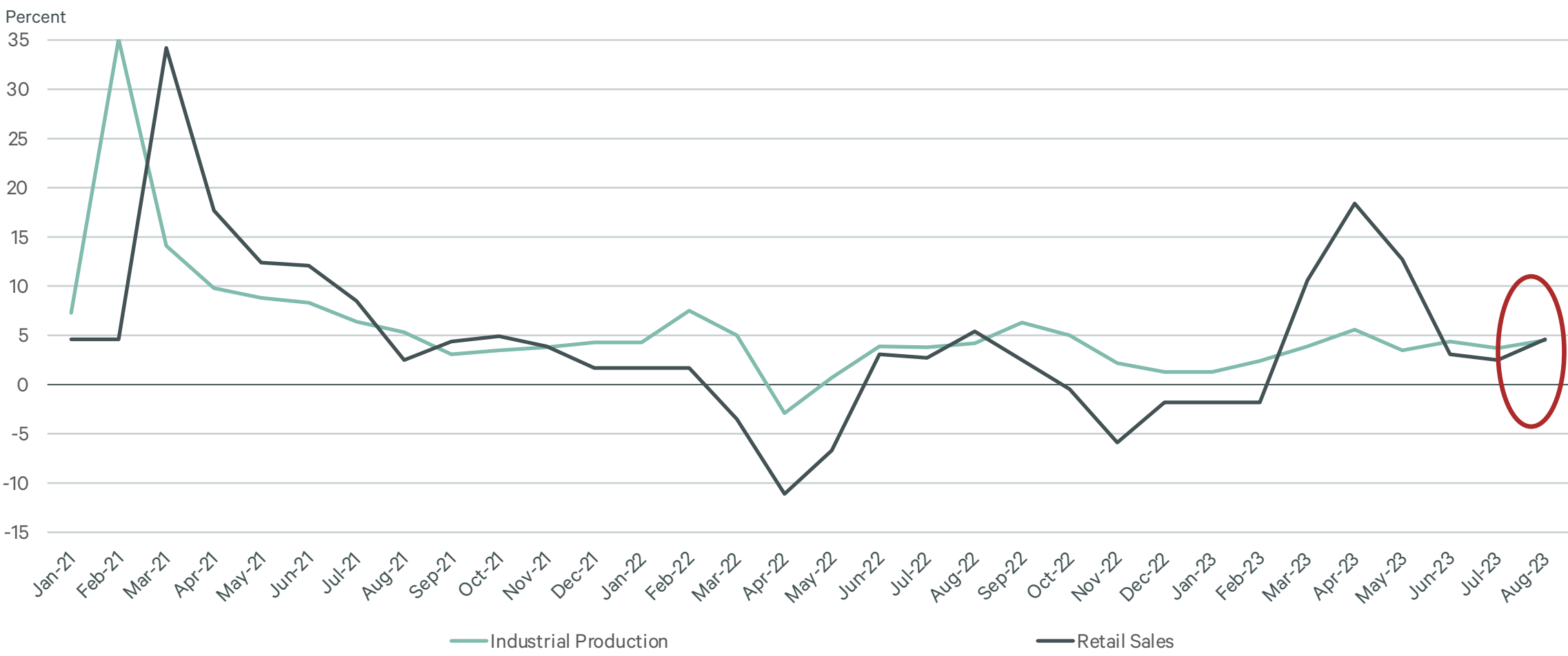# Recent Developments in the Global Economy

Chinese economy appears to have stabilized

China Industrial Production and Retail Sales (Y-o-Y % Change)

Source: China National Bureau of Statistics, CBRE Research Q3 2023.

Europe is 'flirting' with recession – about stalled

Composite PMI

Over 50 signals expansion

Under 50 signals contraction

Bloomberg

German Business Outlook Plummets as Recession Shadow Lingers

Legend: Germany — France — UK — Italy — Baseline
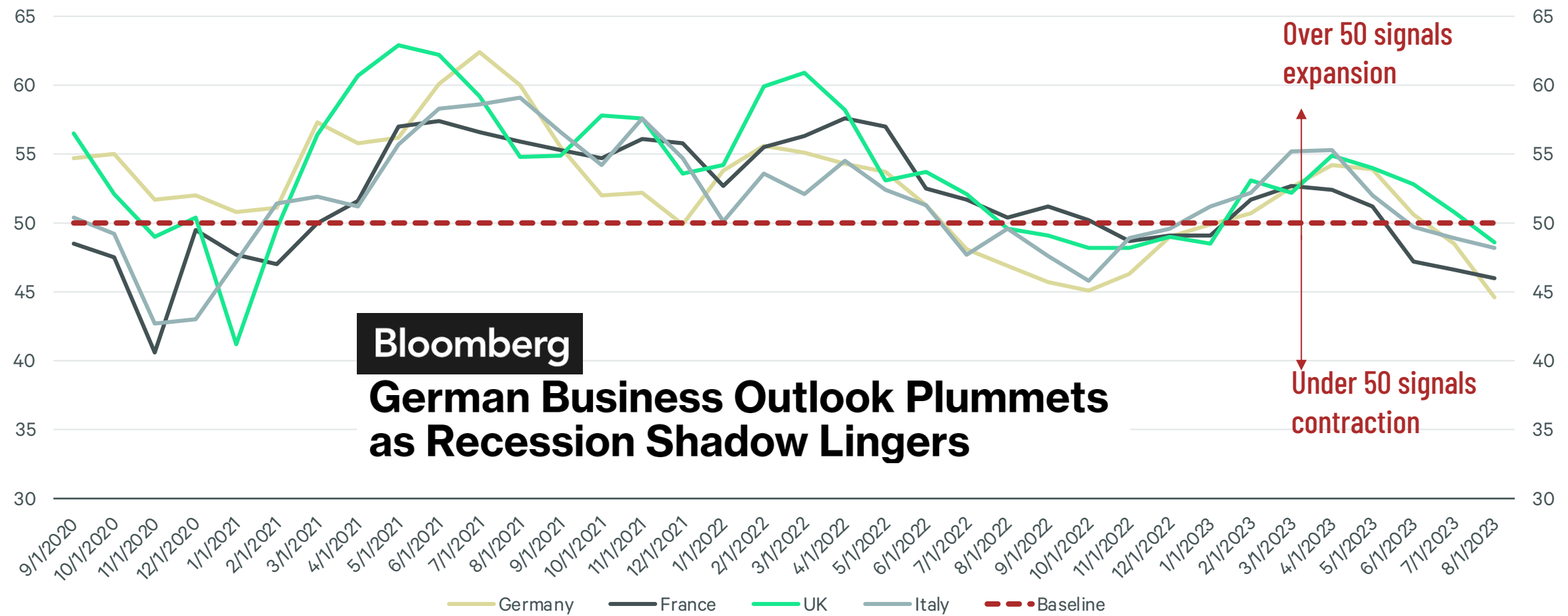
Source: S&P Global, CBRE Research Q3 2023

Core inflation in the U.S. is falling decisively

U.S. CPI Inflation (Y-o-Y Change %), Past 3m-on-Previous 3m (Annualized Change %)

Legend: CPI — Core CPI — Fed's Target — Core CPI 3m-on-3m Annualized
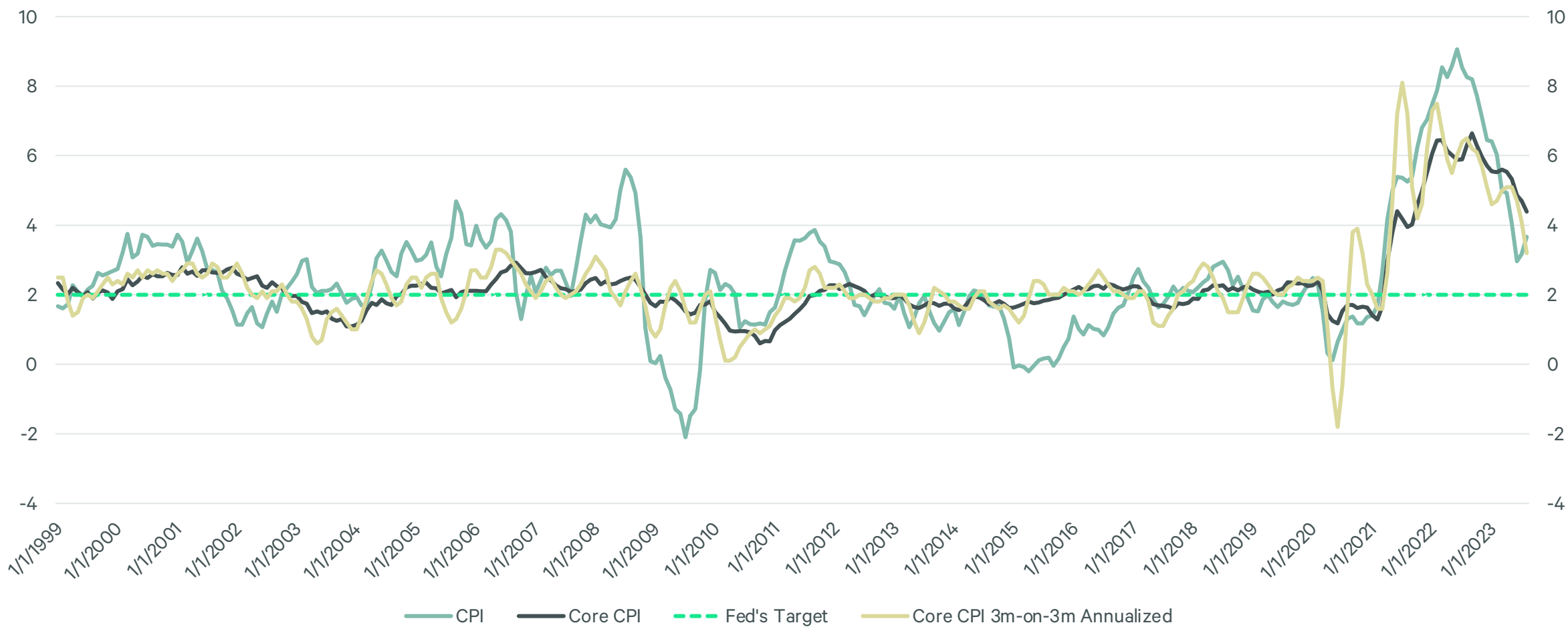
Oil prices spiked, and then unspiked, but upside risk dominates

Crude Oil WTI - $ per Barrel

U.S. economic growth continues to be hugely resilient

Quarter-over-Quarter GDP Growth, Annualized Rate

Percent

| | GDP | Baseline |
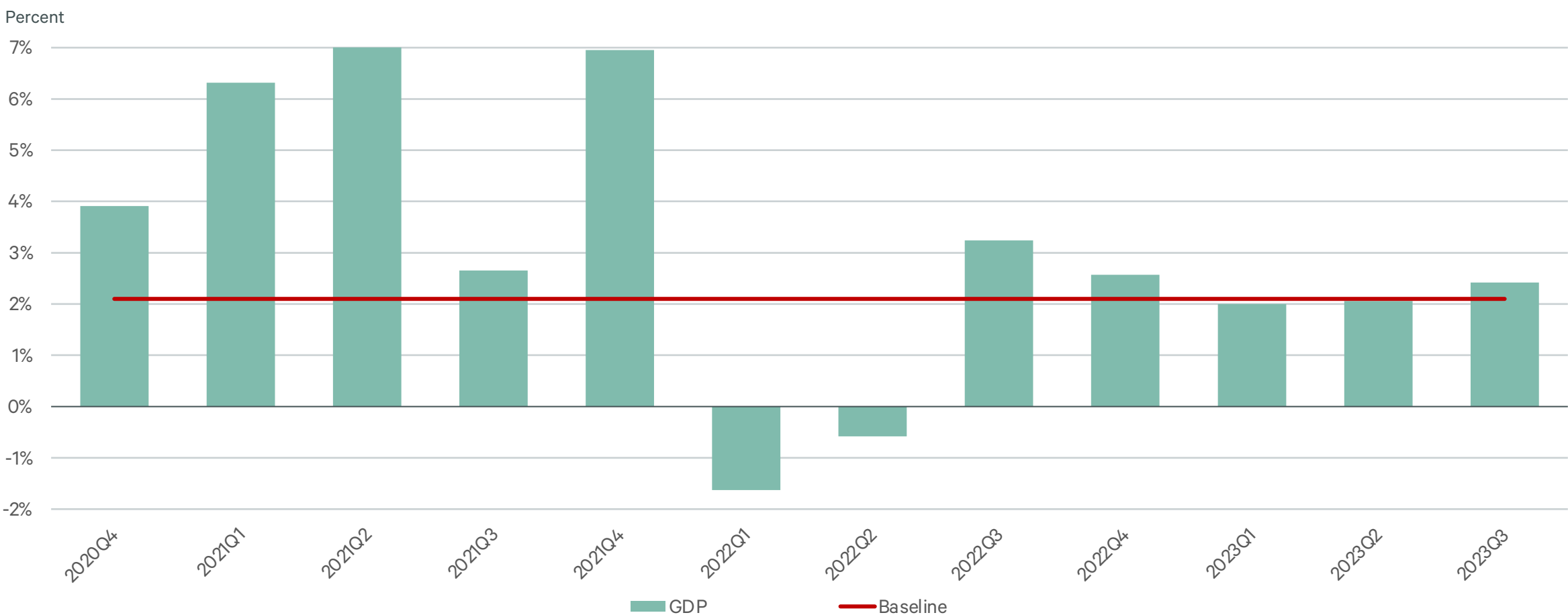
Source: CBRE House-View, Q3 2023.

A major run-up in the 10-year Treasury yield

U.S. 10-Year Treasury Yield

Yield

US 10 Year Yield — Current Level

Source: U.S. Department of Treasury, CBRE Research, October 2023.

Why did the bond market sell off?

" **There is a lot going on and I cannot say I have all the answers.**

Raphael Bostic
Atlanta Fed "

JOLTS data showed major job market strength

Job Openings

Job Openings (Millions)

In August, professional & business services accounted for more than 500K of the nearly 700K new job openings.

Source: US Bureau of Labor Statistics, CBRE Research.

Government deficit surge is probably the key issue

Federal Government Surplus and Deficit by Fiscal Year ($ Billions)
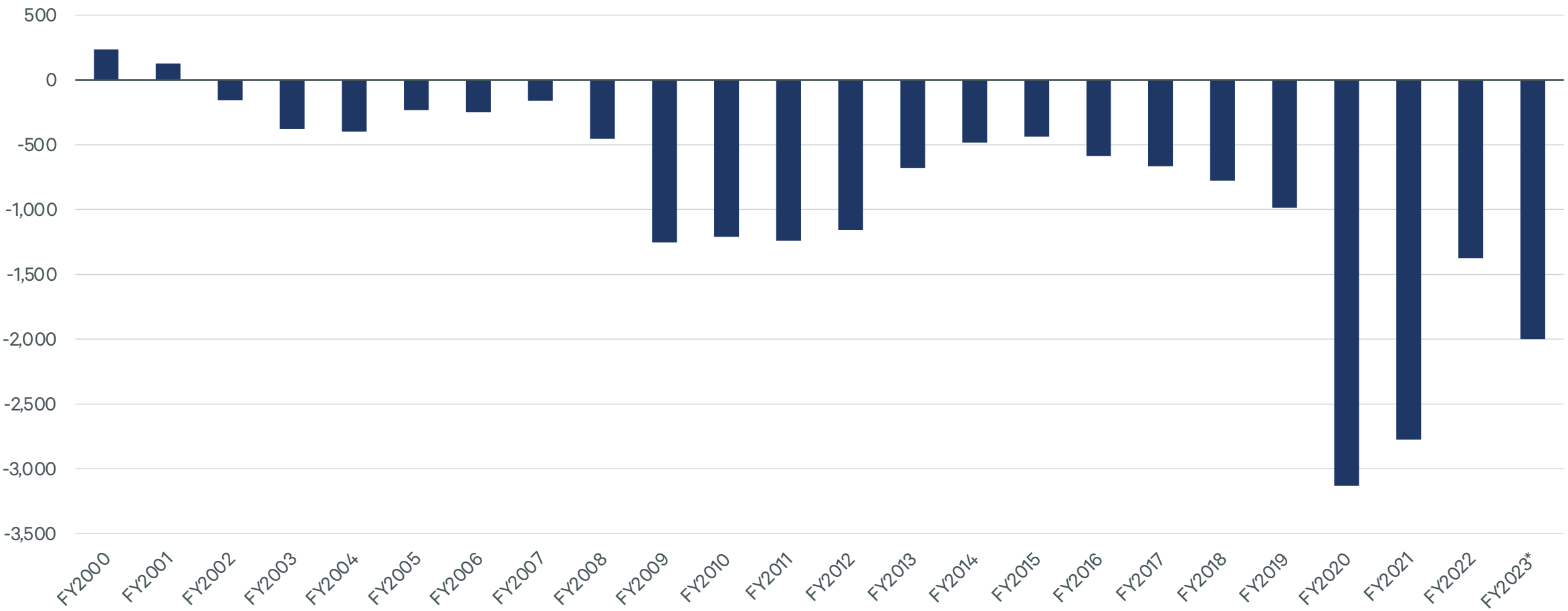
Source: CBO (FY2023 based on forecast), CBRE Research, Q3 2023.

The 'optics' are not good on government finances right now

United States National Debt ($ Trillions)

Over $5.5 trillion has been added to the national debt since 2021.

Nearly $2 trillion in debt has been added since May!
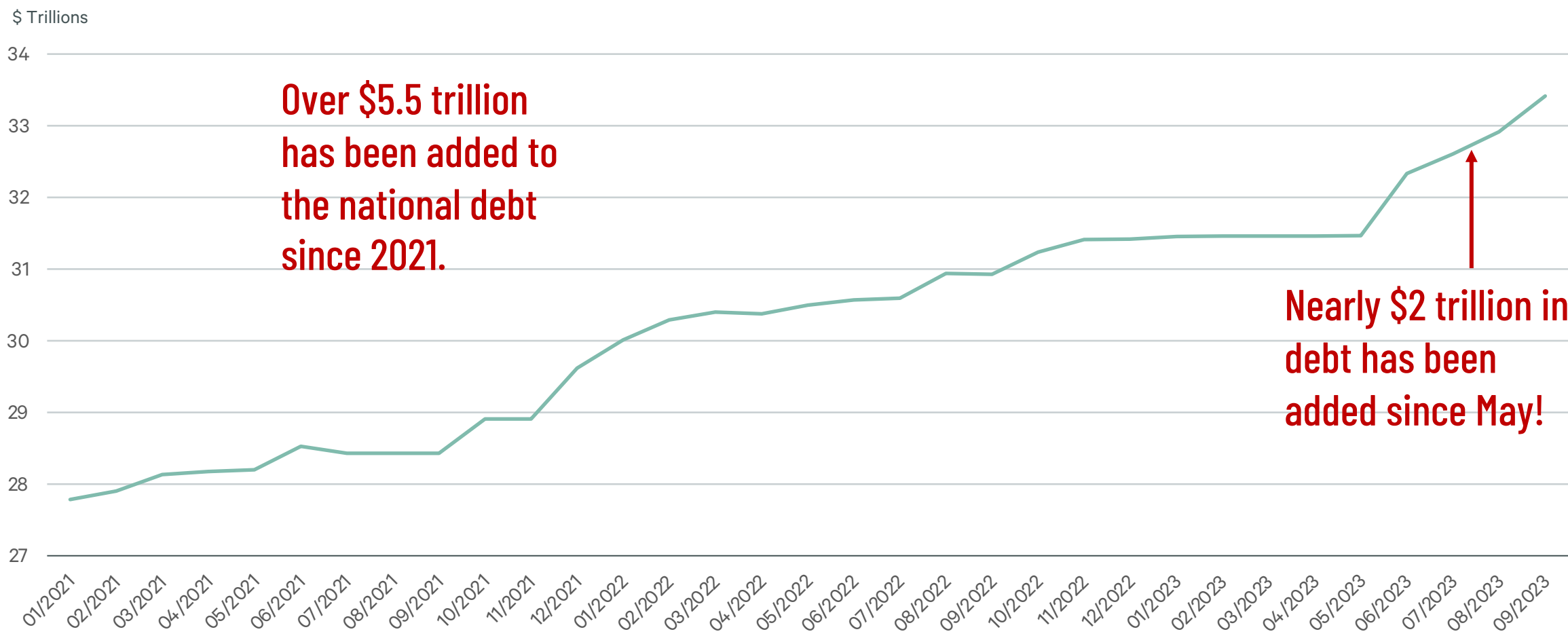
Source: US Dept. of Treasury, CBRE Research.

The Fed is no longer a major buyer of Treasuries and MBS

Federal Reserve Balance Sheet (Forecast Shaded)

$ Trillions

Source: Federal Reserve, CBRE Research.

China is also reducing its holdings of U.S. Treasuries

Holdings of U.S. Treasuries

$ Billions

Legend: Holdings of U.S. Treasury by Japan — Holdings of U.S. Treasury by China
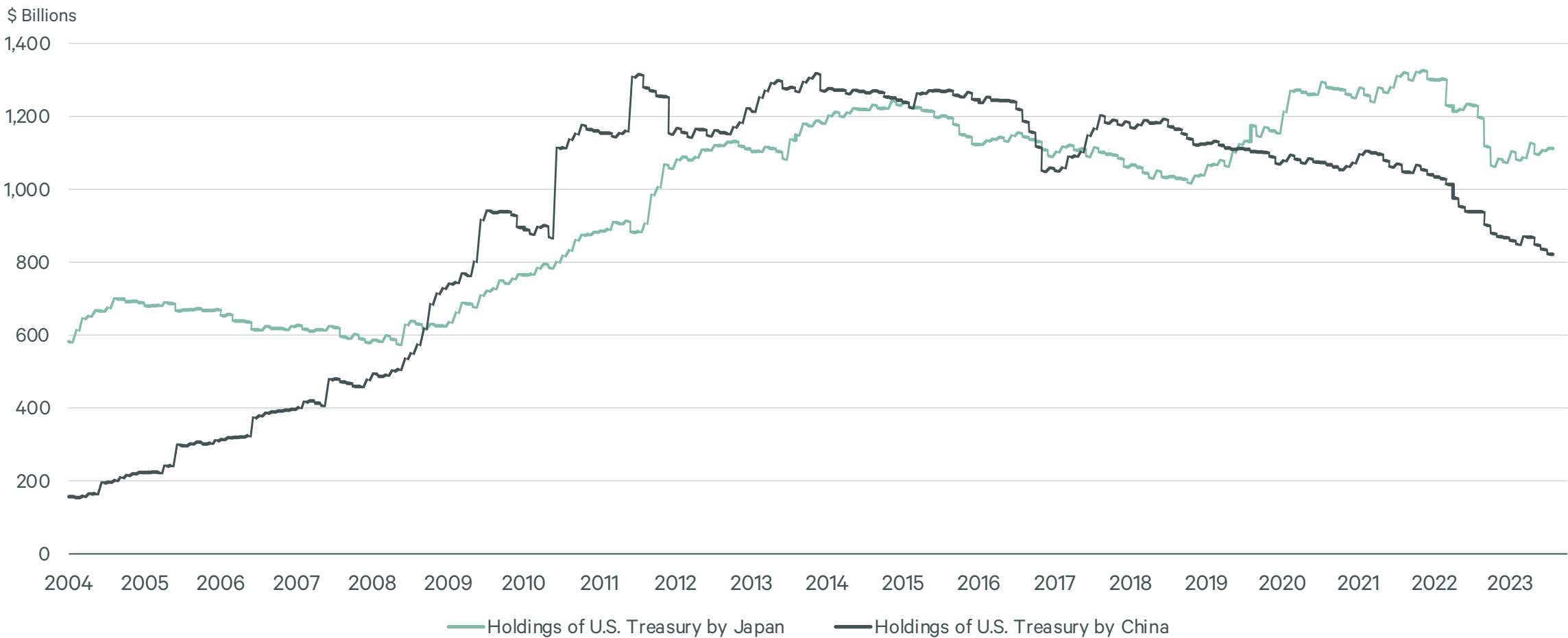
Source: U.S. Department of Treasury, Federal Reserve, CBRE Research.

But it is not about inflation – expectations are on target

10-year Expected Inflation (%)

Recession   10 year Inflation Expectation   2% Target
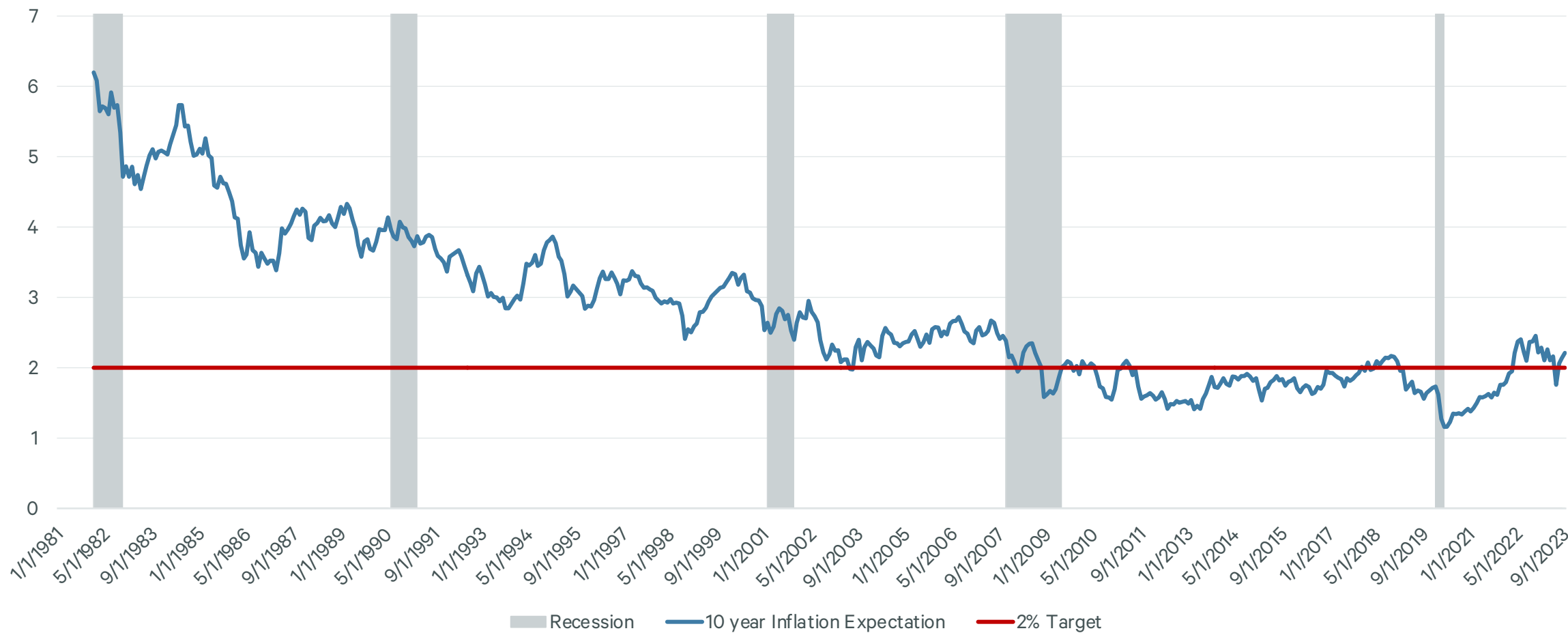
Source: Federal Reserve Bank of Cleveland, CBRE Research, Q3 2023.

Even short-term expectations are trending down

1-Year Inflation Expectations

% Inflation

Legend: NY Fed — Atlanta Fed — Univ. of Michigan
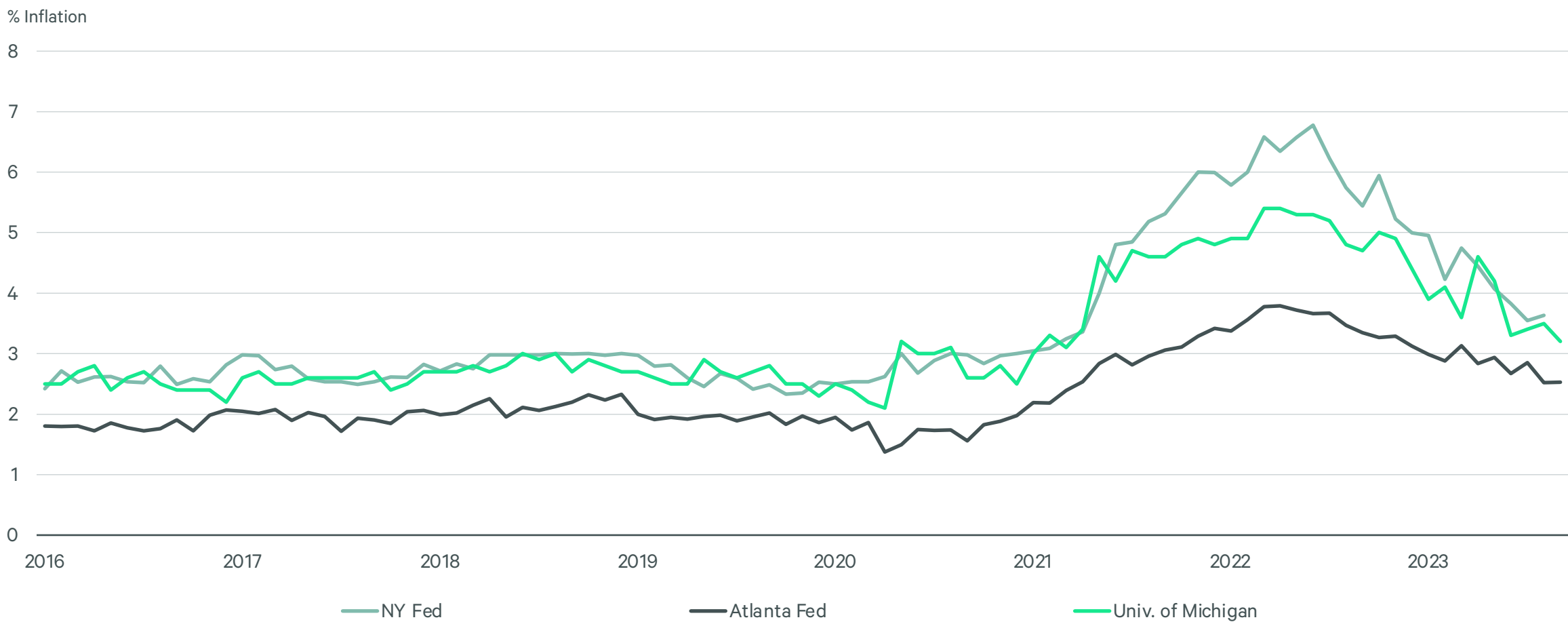
Source: NY Fed, Atlanta Fed, University of Michigan, CBRE Research, Q3 2023.

The Fed's credibility also probably a factor

U.S. Federal Funds Rate and Taylor Rule Recommended Rates (%)

$$i = r^* + \pi^* + 1.5\,(\pi - \pi^*) + 0.5\,y$$

Legend: Fed funds rate — Modified* Taylor Rule Rate — Classic Taylor Rule Rate

Note: modified rule utilizes 1.22 for inflation weight and 0.77 for output gap weight
Source: Federal Reserve, CME, CBRE Research.

What does the spike in the 10YT mean, exactly?

Sharp rise in yields is rarely a good thing

U.S. 10-Year Treasury (Periods of Recession Shaded)

The curve tends to un-invert prior to a recession

Average Times Between Yield Curve Un-inverting (Periods of Recession Shaded)
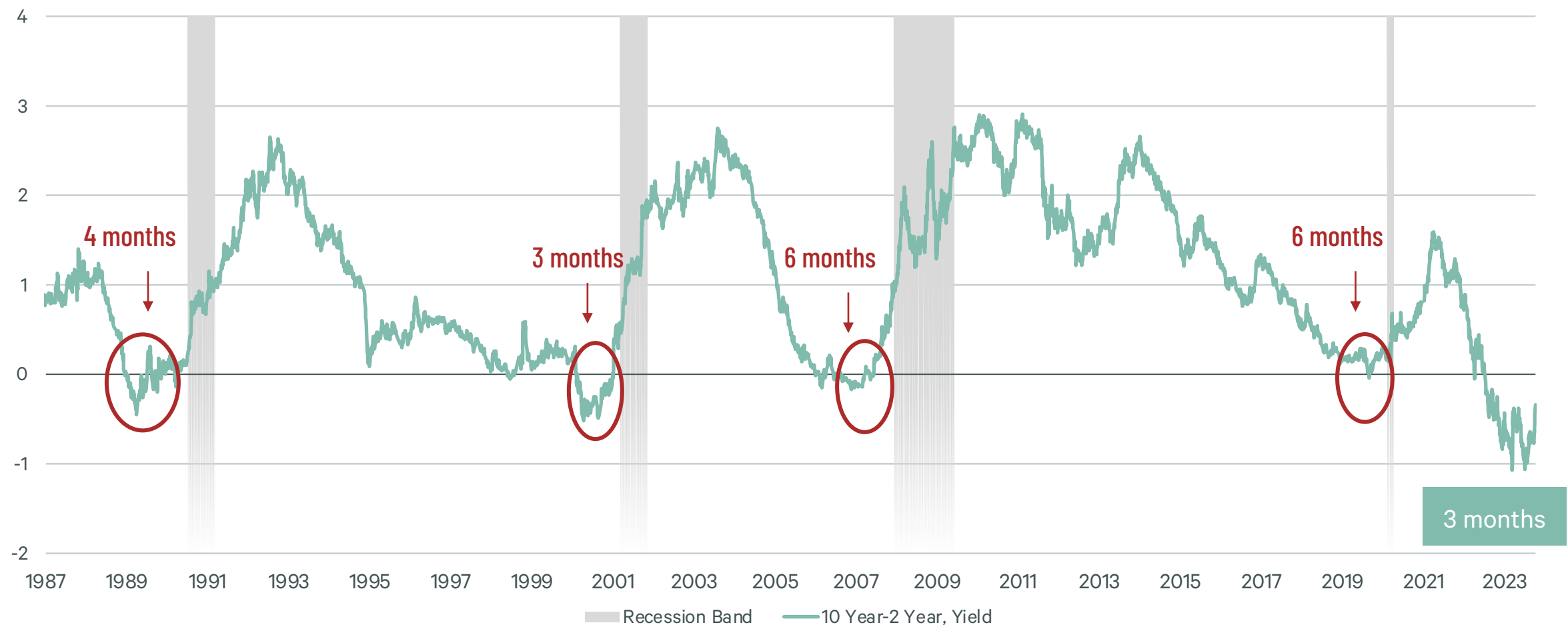
Source: U.S. Department of Treasury, Federal Reserve, NBER, CBRE Research Q3 2023.

Falling values will put bank balance sheets under further stress

Stock Index (March 2023=100)

Chart annotations: SVB Failed; Signature Failed; First Republic Failed; Moody's downgraded 10 regional banks

Legend: S&P Financial Sector — iShares Regional Bank ETF
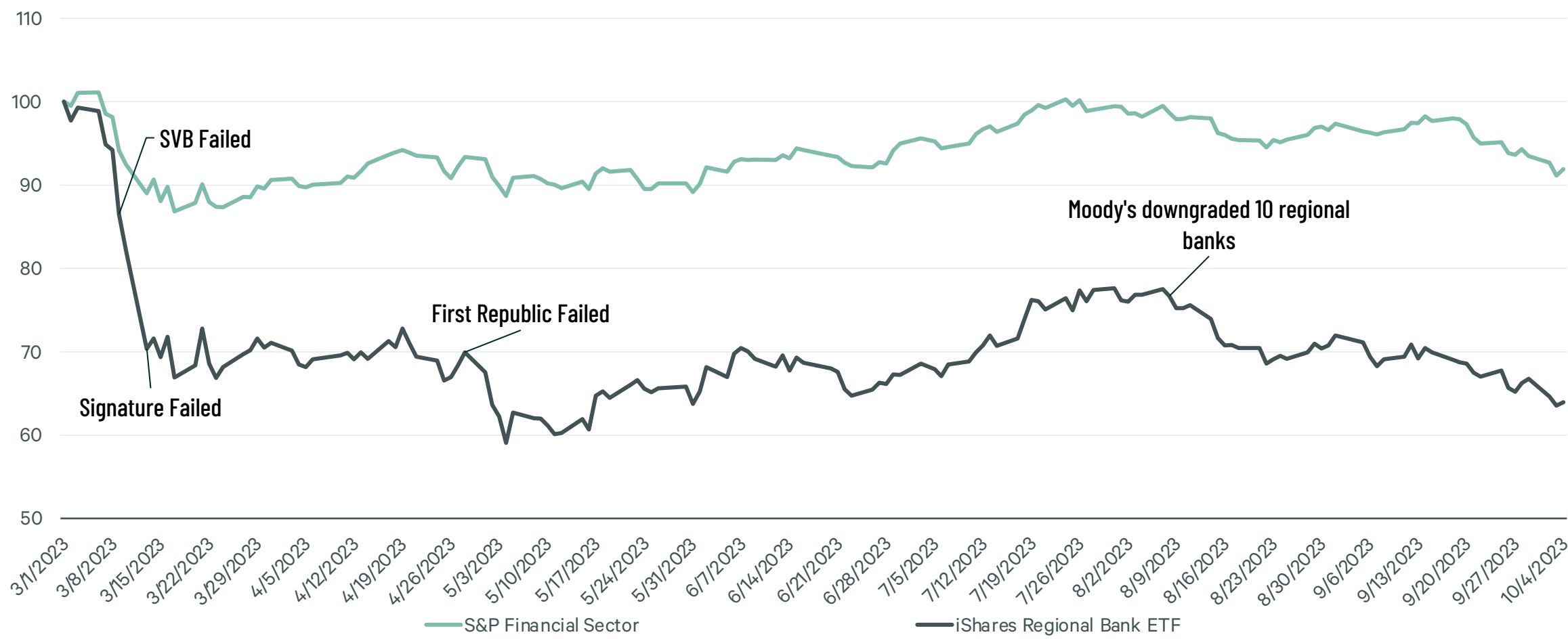
Source: FDIC, CBRE Research.

Other key bond markets are following the 10YT upwards

10-year Government Bond Yields – G7 Countries

Legend: US, UK, Germany, Japan, France, Canada, Italy

Source: Federal Reserve, Macrobond Financial AB, CBRE Research, Q3 2023.

REIT prices signal further falls in real estate values

U.S REIT Index by Sector Index (Jan. 2023 = 100)

Legend: Industrial — Self Storage — Apartments — Office — Health Care — Strip Centers — Hotels — Retail — Malls
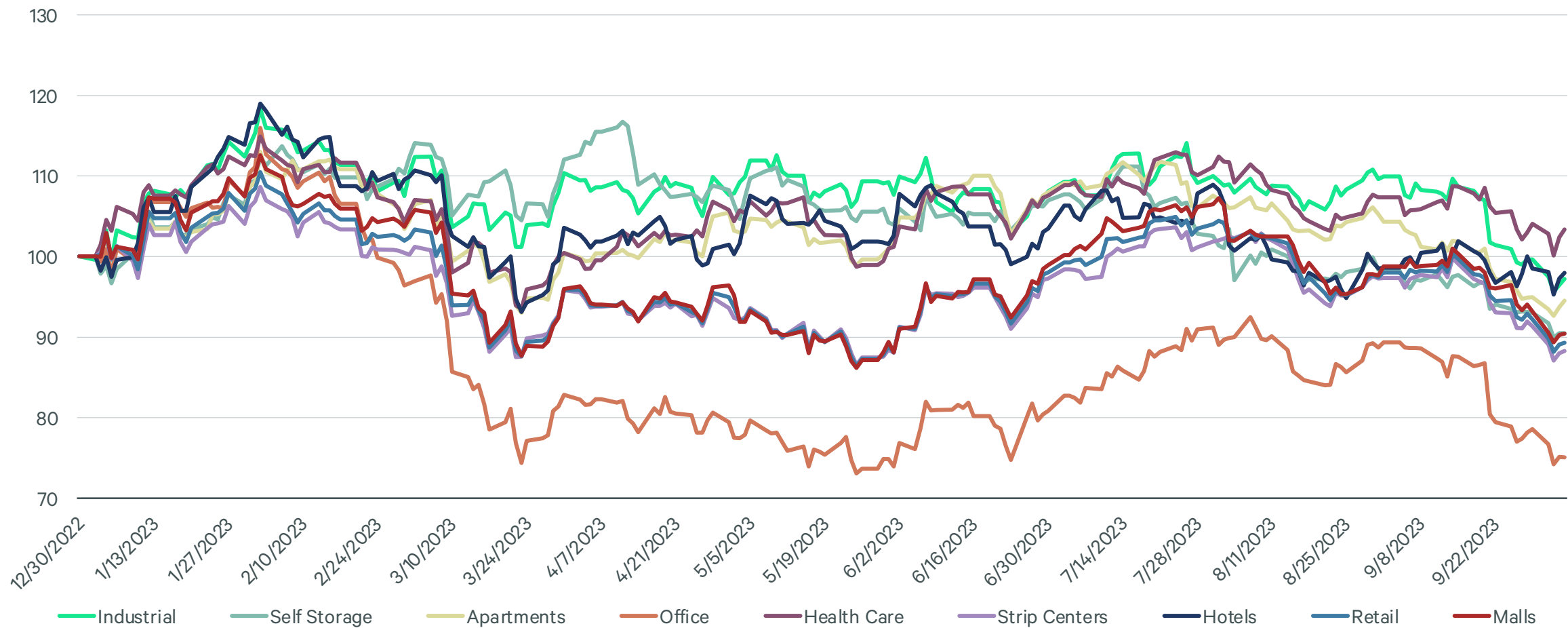
Source: CBRE Research, Wilshire Associates Incorporated, October 2023.

We retain a mild recession as a houseview

Quarter-over-Quarter GDP Growth, Annualized Rate

Forecaster's average

Legend: Deutsche Bank, JPMorgan, PNC, Wells Fargo, Goldman, UBS, CBRE, Morgan Stanley, Bank of America, Average

X-axis: Q2 2023, Q3 2023, Q4 2023, Q1 2024, Q2 2024
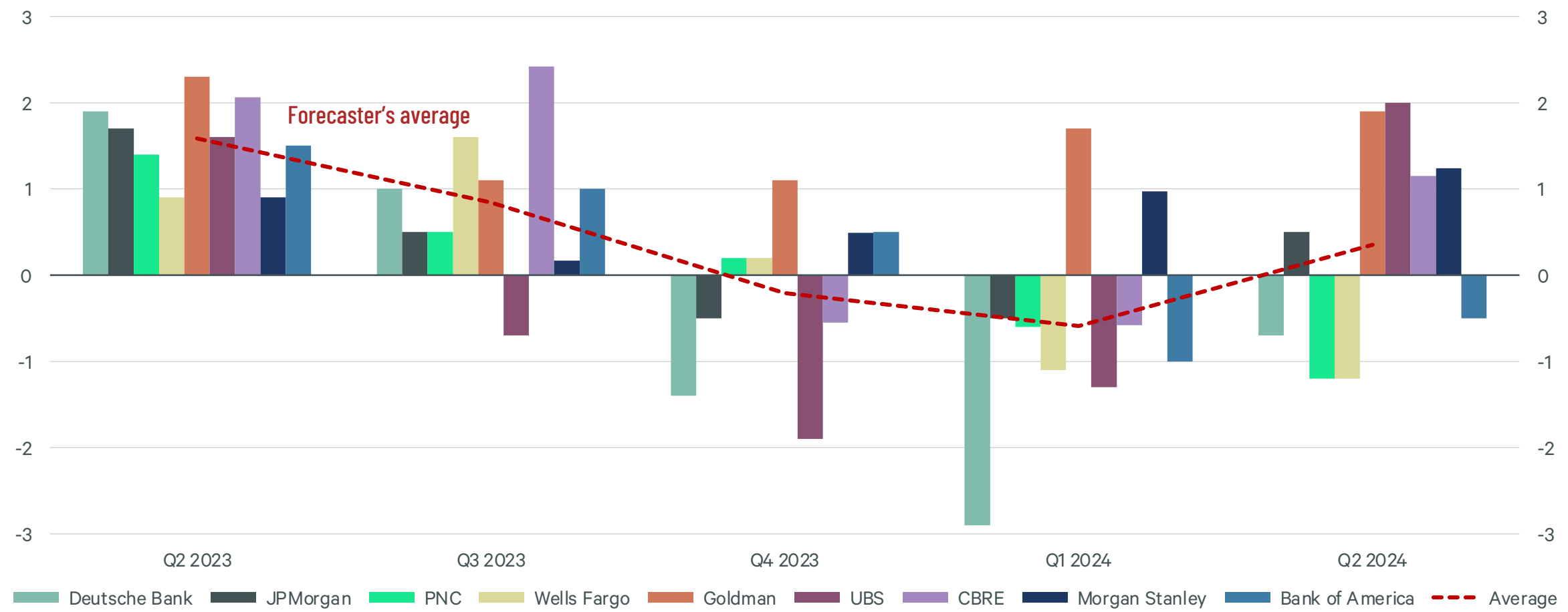
Source: WSJ Survey, CBRE Research, Q3 2023.

Will 10-year Treasuries stick at these levels or go higher?

Job growth has remained extraordinarily strong despite Fed rate hikes

M-o-M Total Non-Farm Payroll Job Gain (2021 to 2023)

September job growth came in stronger than expected

Legend: Jobs Added — Average Monthly Gain 2010 to 2019
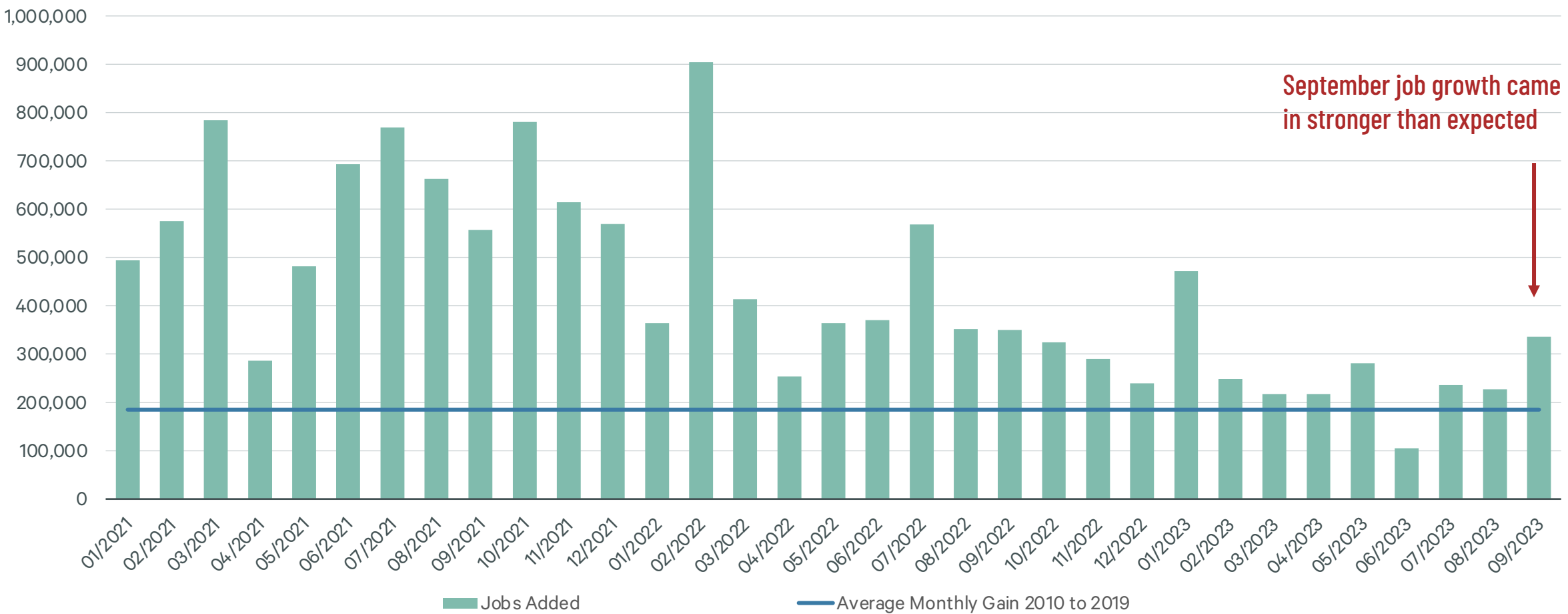
Source: BLS, CBRE Research.

Wage growth elevated but stable, and not too inflationary

% Change in Wage Growth – 3 Month Annualized

Source: Federal Reserve Bank of Atlanta, CBRE Research.

The world still has a 'surplus of savings'

Factor	Mechanism	Impact on Savings and Investment	Impact on Interest Rates	Future
Demographics	Longer life expectancy	More savings	Major and downward	No change
Demographics	Rising inequality	More savings	Minor and downward	No change
Economics	Falling productivity growth	Less investment	Major and downward	No change
Government	More government spending	Less savings / more investment	Major and upward	Change
Globalisation	Capital flows	'More savings' for key economies	Minor and downward	No change – benefits UK and US

Growth is weak in Europe

Purchasing Managers Index

Index

Legend: Germany — United Kingdom — Euro Area — Baseline

Conclusions on the 10YT
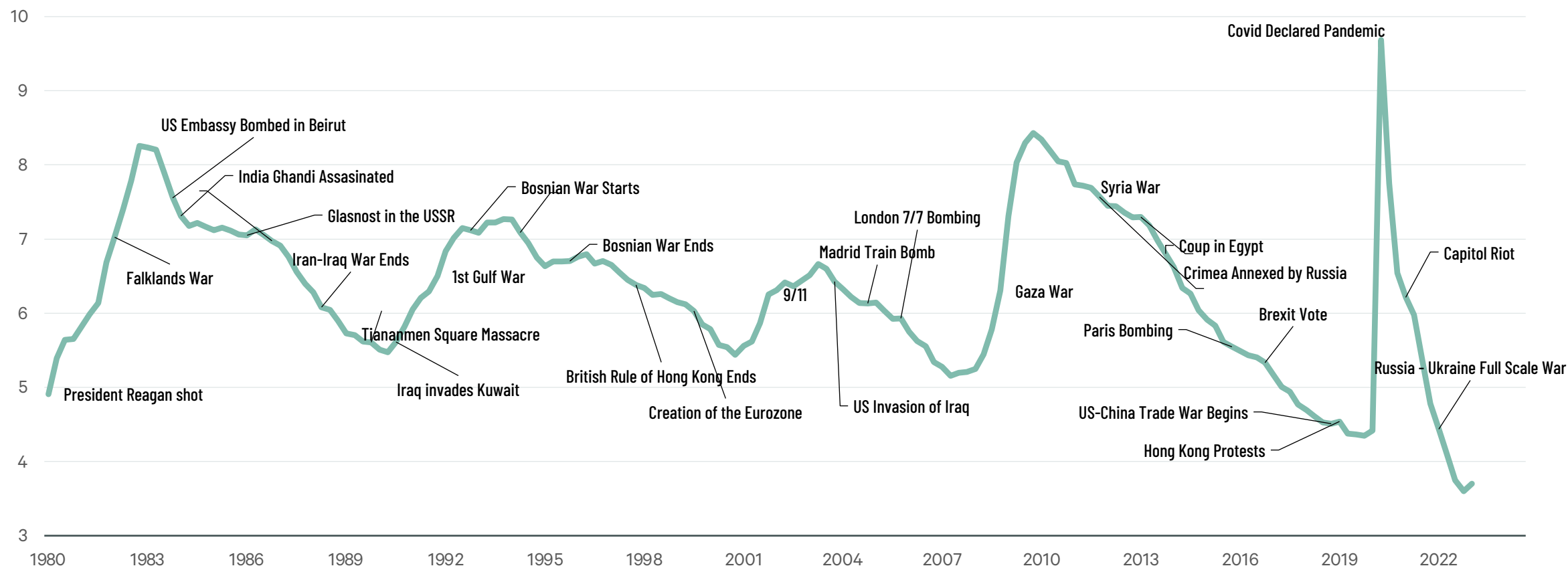
– Increases near- and medium-term headwinds on capital markets

– Increases the risk of recession, deeper recession

– Reduces the chance of another FFR hike

– Increases the chance of earlier cuts to rates

– Unlikely to be sustained at this level, but will take time to ease back

Conclusions

Geopolitics

G7 Unemployment % (G7=Canada, US, Japan, UK, France, Italy, Germany)

The Future of the U.S. Sectors

Matt Mowell

Sr. Managing Economist
Macro

matt.mowell@cbre.com

Stefan Weiss

Sr. Managing Economist
Office

stefan.weiss@cbre.com

Nicholas Rita

Sr. Economist
Industrial

nicholas.rita@cbre.com

Jing Ren, Ph.D.

Sr. Economist
Multifamily/Capital Markets

jing.ren@cbre.com

Daniel Diebel

Economist
Retail

daniel.diebel@cbre.com

Christina Tong

Economist
Office

christina.tong@cbre.com

Coffee
Break

Real Estate Risk: CRE Debt Default Forecasting

GUEST PRESENTER

Emilian Belev, CFA

Head of Enterprise Risk Analytics, Northfield

emilian@northinfo.com

ECONOMETRIC ADVISORS

Dennis Schoenmaker, Ph.D.

Principal Economist Executive Director

dennis.schoenmaker@cbre.com

1

Introduction to the CBRE – Northfield collaboration

CBRE **NORTHFIELD**

CBRE Collaboration with Northfield

– EA's market and submarket leading forecast models on rents and occupancy

– CBRE EA background in debt analytics – CMM model

– Northfield's expertise in risk modelling (ARES award)

– Bringing together the forecast data from EA with the risk tool at Northfield

2

The importance of CRE debt analytics

The Importance of CRE Debt Analytics

3

A
combination
of industry
leading core
competencies

Synergetic Core Competencies

– The ability of CBRE EA to generate forecasts for the expected growth of rents and occupancy. This is done for the vast majority of markets around the globe and each property sector based on industry-leading methodology and research.

– The expertise of Northfield to model the risk of commercial real estate properties. It is embodied in the first-of-breed risk models for commercial real estate that could analyze investments building-by-building. The work of Northfield in this area was recognized by ARES 2015 Best Practitioner Award.

– The rich and unparalleled real estate data set on which both CBRE's forecasts and Northfield risk models are based.

CBRE ◆**NORTHFIELD**

Synergetic Core Competencies (continued)

– The thought leadership of Northfield in the area of credit risk. It is demonstrated by PRIMIA's 2013 New Frontiers in Risk Management Award presented for research on credit risk of assets with illiquid collateral.

– The unique Aspequity simulation technology that captures the full distribution of cash flow and property value outcomes.

– A unique valuation model recognized by ARES and published in Real Estate Finance (2016). Unlike any other valuation model, it does not depend on assumptions of market efficiency, which makes it the best match for illiquid assets.

4

CRE default models
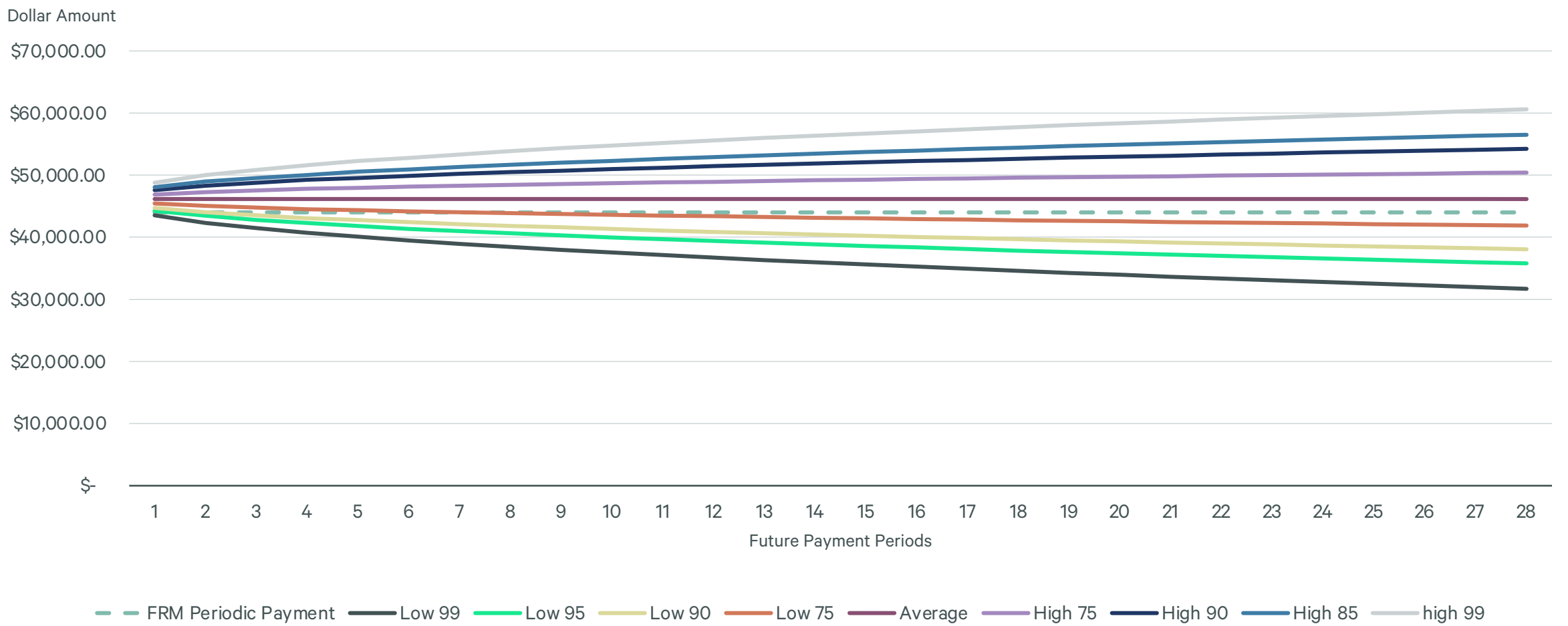
CBRE ◆ **NORTHFIELD**

CRE Default Model Highlights

– Based on periodic solvency:

- This is the most conservative metric assuming that shortfalls of investment cash flows in one period cannot be offset with surpluses in another

– Based on cumulative solvency:

- Compares the cumulative future value of the cash flows from the mortgage vs. that of the collateral property
- *Captures both the capacity and motivation of the borrower to avoid default*
- *Reflects a "going concern" view on the potential of default*

– Based on collateral value:

- Compares the outstanding loan balance to the market value of the collateral property
- Captures the motivation of the borrower to avoid default
- *Reflects a "non-going concern" view on the potential of default*

CBRE Debt Model Advantages

- Unprecedented ability to model the collateral value and cash flows simulated under 1,050 scenario paths

- Simulate floating rate mortgages rate paths and cash flows under the same number of paths

- Award-winning risk methodology from Northfield combined with the global data from one of the world's leading real estate market participants - CBRE

- Flexible market growth inputs, optionally capturing the latest and most advanced forecasts by a leading team of economists at CBRE, or custom user scenarios of interest to the investor

- A mark-to-market valuation model of the collateral that is not limited by assumptions of normal distribution of returns and market efficiency
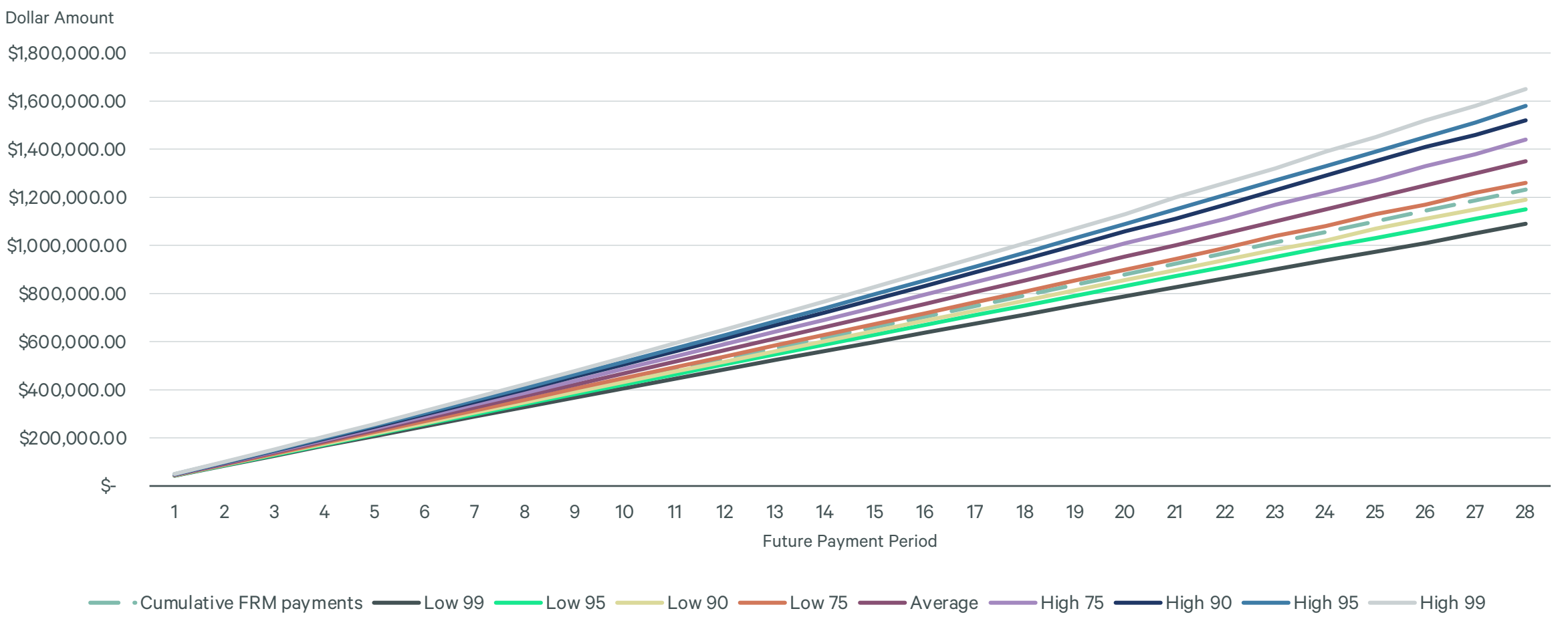
Periodic Solvency

Periodic Mortgage Payment vs. Periodic Property Cash Inflow

Source: Northfield.

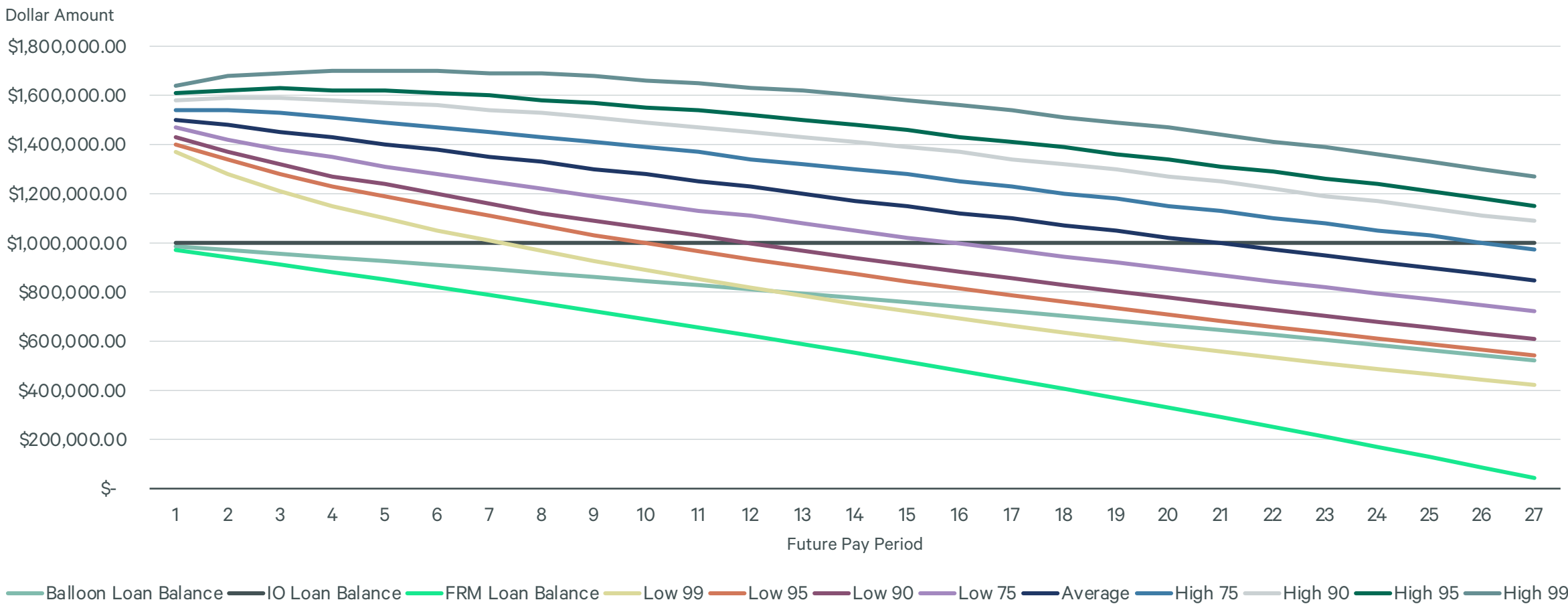# Cumulative Solvency

Cumulative Property Cash Flows vs. Cumulative Mortgage Payments

Dollar Amount

Future Payment Period

Legend: Cumulative FRM payments — Low 99 — Low 95 — Low 90 — Low 75 — Average — High 75 — High 90 — High 95 — High 99

Collateral Solvency

Property Value vs. Outstanding Loan Balance

Dollar Amount

Legend: Balloon Loan Balance — IO Loan Balance — FRM Loan Balance — Low 99 — Low 95 — Low 90 — Low 75 — Average — High 75 — High 90 — High 95 — High 99

Future Pay Period

Source: Northfield.

Default Forecast Metrics

– Probability of default

– Loss given default

– Default correlations among a portfolio of investments

– Credit value-at-risk and conditional credit value-at-risk

– All of these metrics vary along time horizons

Sample estimated probabilities of default

CBRE **NORTHFIELD**

Payment Default Probability (%) for FRM			
Year	Houston Industrial	NYC Office	Mixed Metro
1	5.06	12.83	0.0
2	7.49	16.01	0.52
3	8.57	17.49	1.24
4	9.03	18.2	1.58
5	9.22	18.37	1.69
6	9.27	18.42	1.80
7	9.31	18.78	1.87

Underwater Default Probability (%) for Balloon Mortgage			
Year	Houston Industrial	NYC Office	Mixed Metro
1	0.0	0.0	0.0
2	0.0	0.0	0.0
3	1.10	0.0	0.0
4	2.86	2.56	0.0
5	3.89	3.61	0.0
6	4.42	4.18	0.0
7	4.55	4.42	0.0

5

The solution: CMAP

Commercial Mortgage Analytics Portal (CMAP)

CBRE

Mortgage and Collateral Analysis

Mortgage Loan Characteristics

Mortgage Type	Maturity In Years	APR	Floating Ref Symbol	Margin Over Reference	Current Loan Balance	Payment Frequency
Please Select ⌄	⌄	⌄	Please Select ⌄	0 ⌄	⌄	Please Select ⌄

Property Collateral Characteristics

Property Type	Location	LTV
Please Select ⌄	Please Select ⌄	0

Calculate

CMAP

CBRE

NORTHFIELD

Mortgage and Collateral Analysis

Mortgage Loan Characteristics

Mortgage Type	Maturity In Years	APR	Floating Ref Symbol	Margin Over Reference	Current Loan Balance	Payment Frequency
Please Select			Please Select	0		Please Select

Property Collateral Characteristics

Property Type	Location	LTV
Please Select	Please Select	0

Calculate

CBRE **NORTHFIELD**

CMAP

CBRE   Home   Mortgage and Collateral Analysis   Hello peter@artbranch.com   Logout   **NORTHFIELD**

Mortgage and Collateral Analysis

Mortgage Loan Characteristics

Mortgage Type	Maturity In Years	APR	Floating Ref Symbol	Margin Over Reference	Current Loan Balance	Payment Frequency
Fixed Rate	7	0.015	NA	0	1000000	Annual

Property Collateral Characteristics

Property Type	Location	LTV
Office	New York	95

Calculate

CMAP - Cumulative Solvency
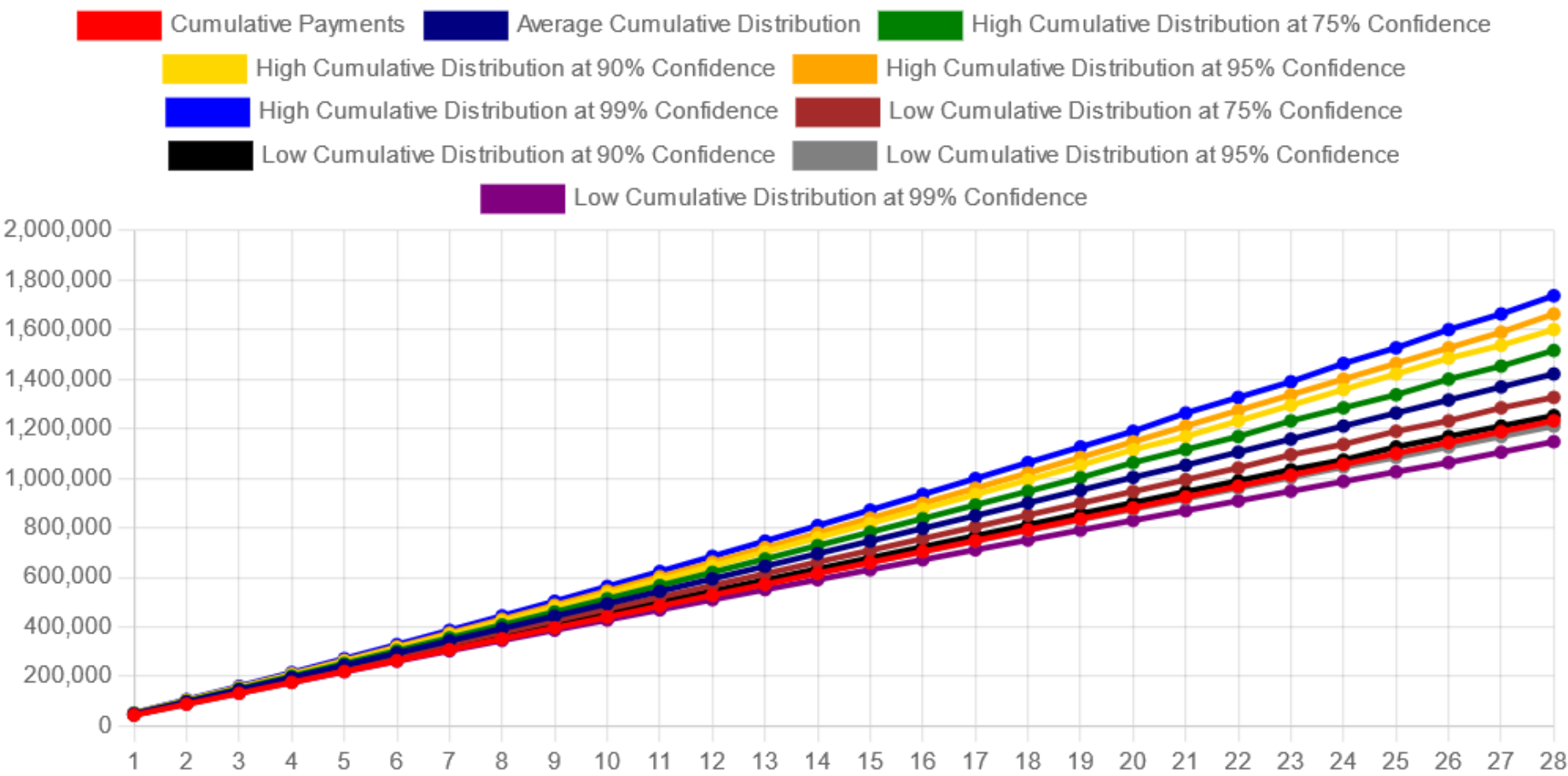
CMAP - Periodic Solvency
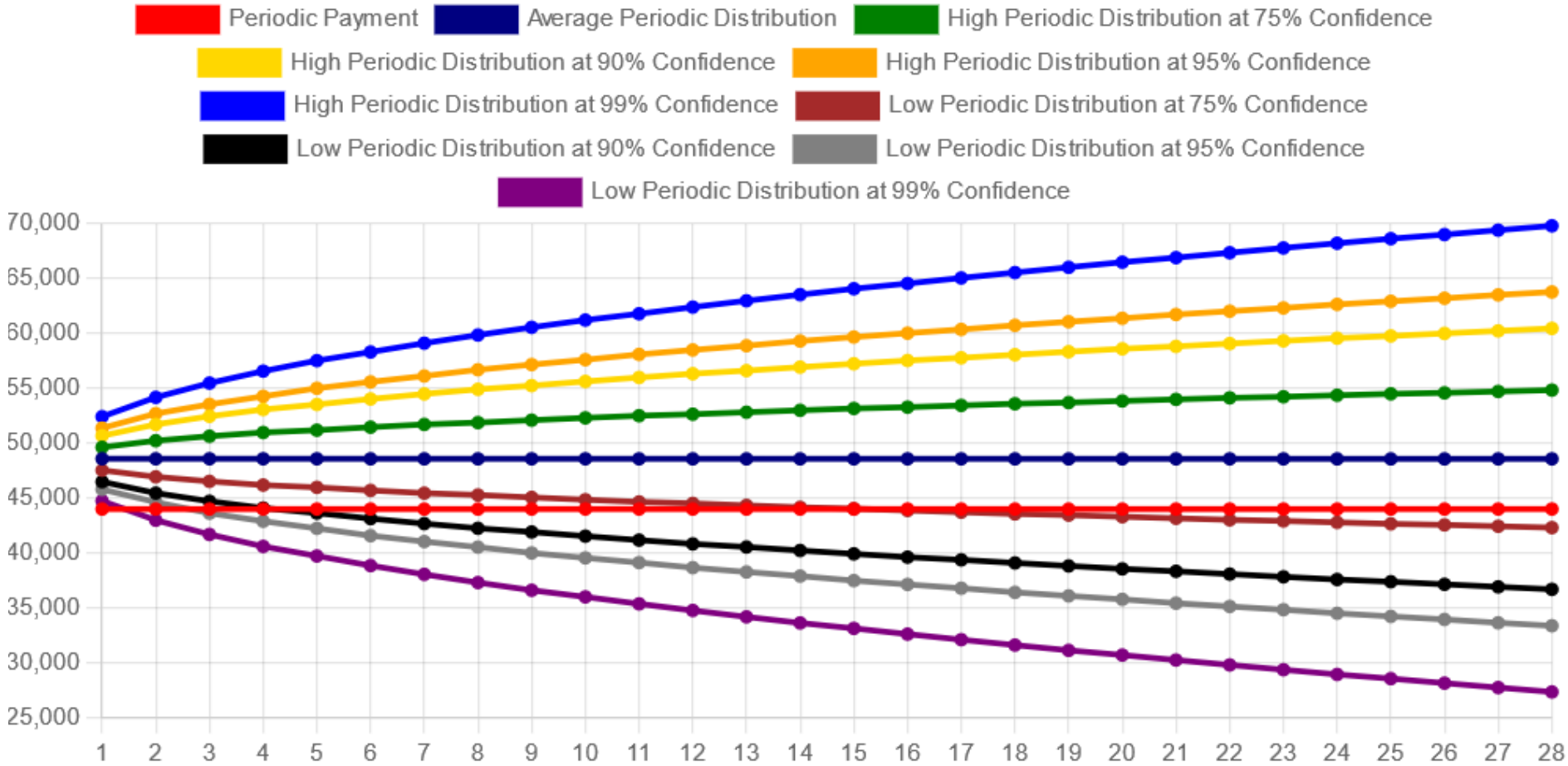
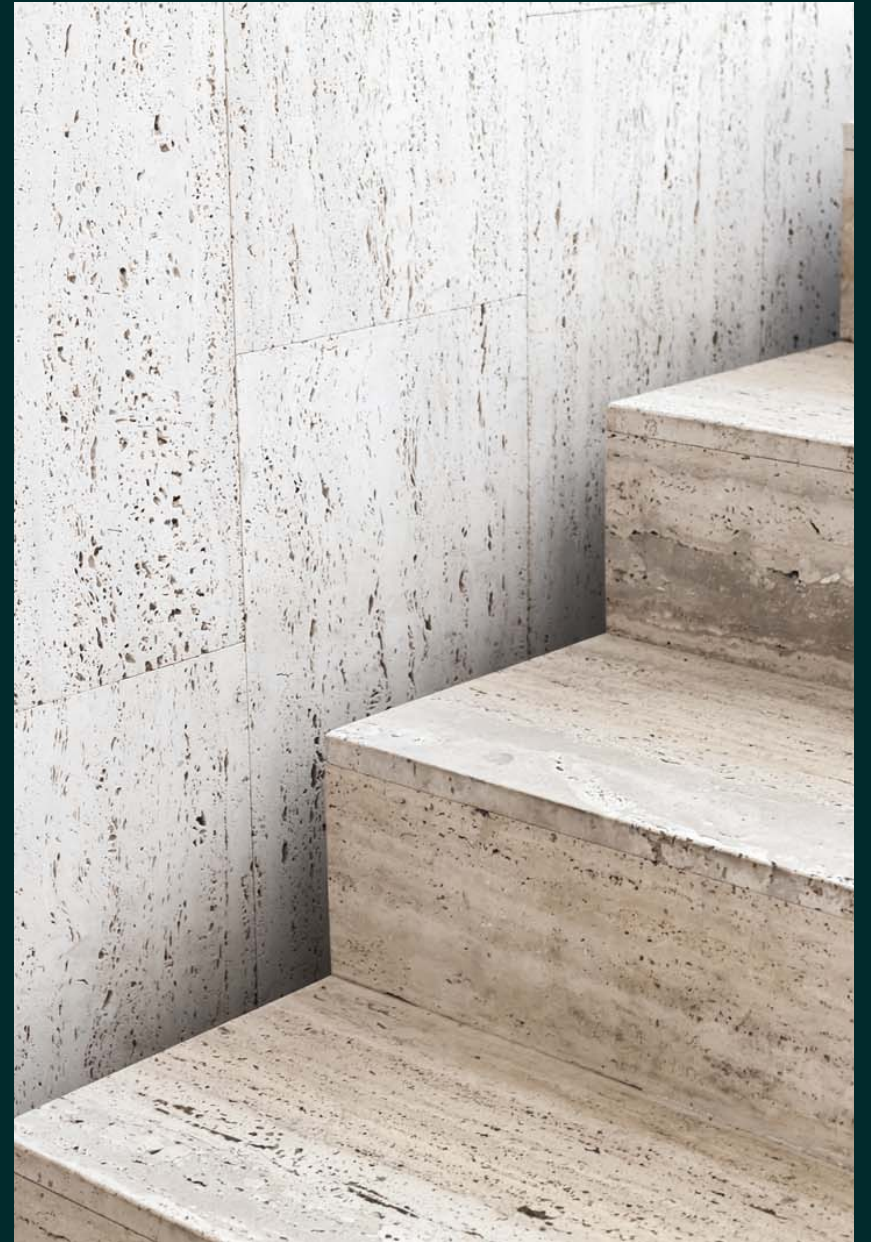# CMAP - Collateral Solvency
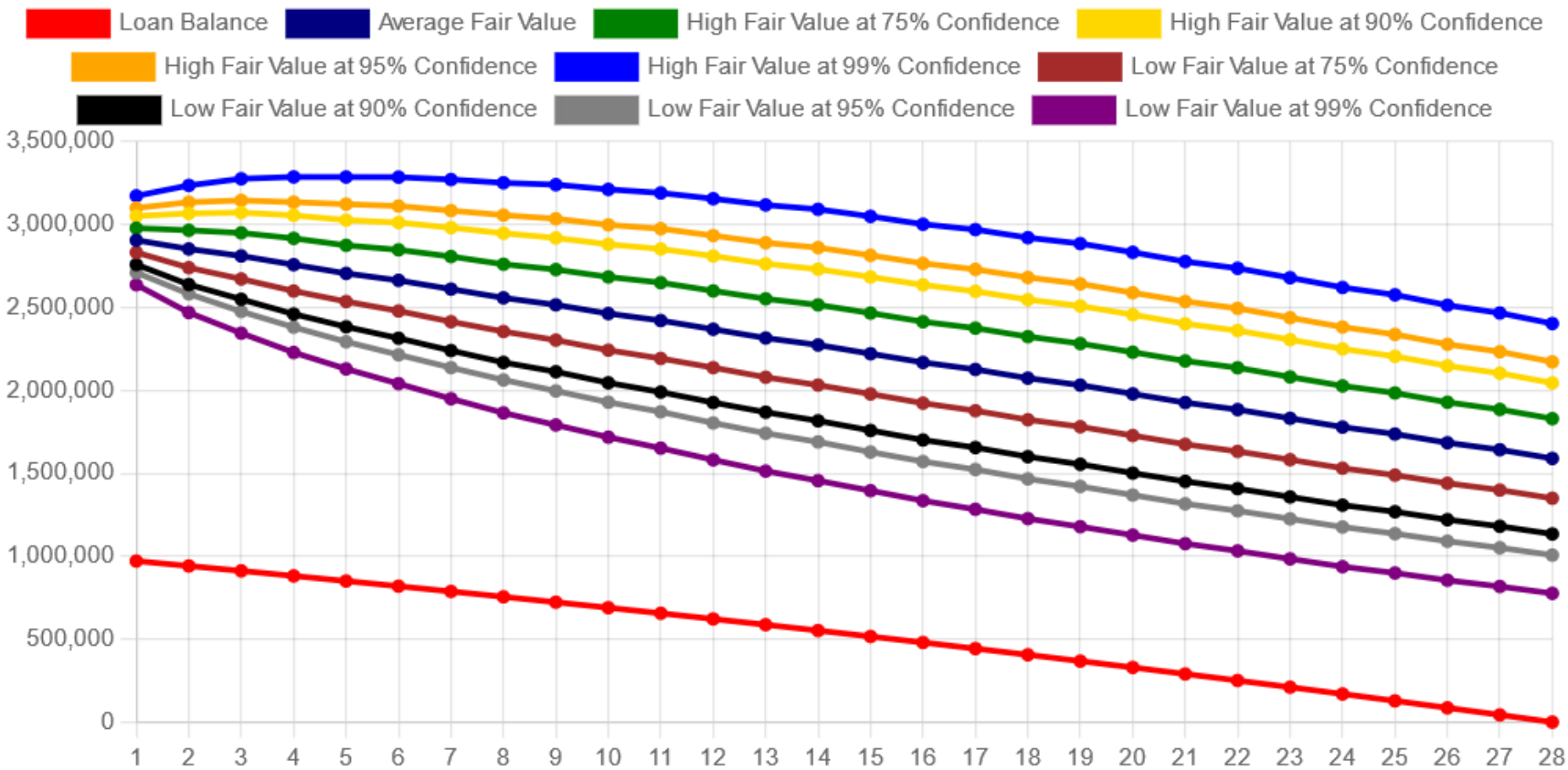
6
Summary

Collaboration in Action

- A powerful partnership of industry leading firms that bring a unique set of core competencies

- A response to the imminent demand of real estate investors and lenders for better information and forecasts under a highly uncertain economic environment

- A solution that is driven by a robust set of award-winning models and data for cash flows, property values, and risk

7

Q&A
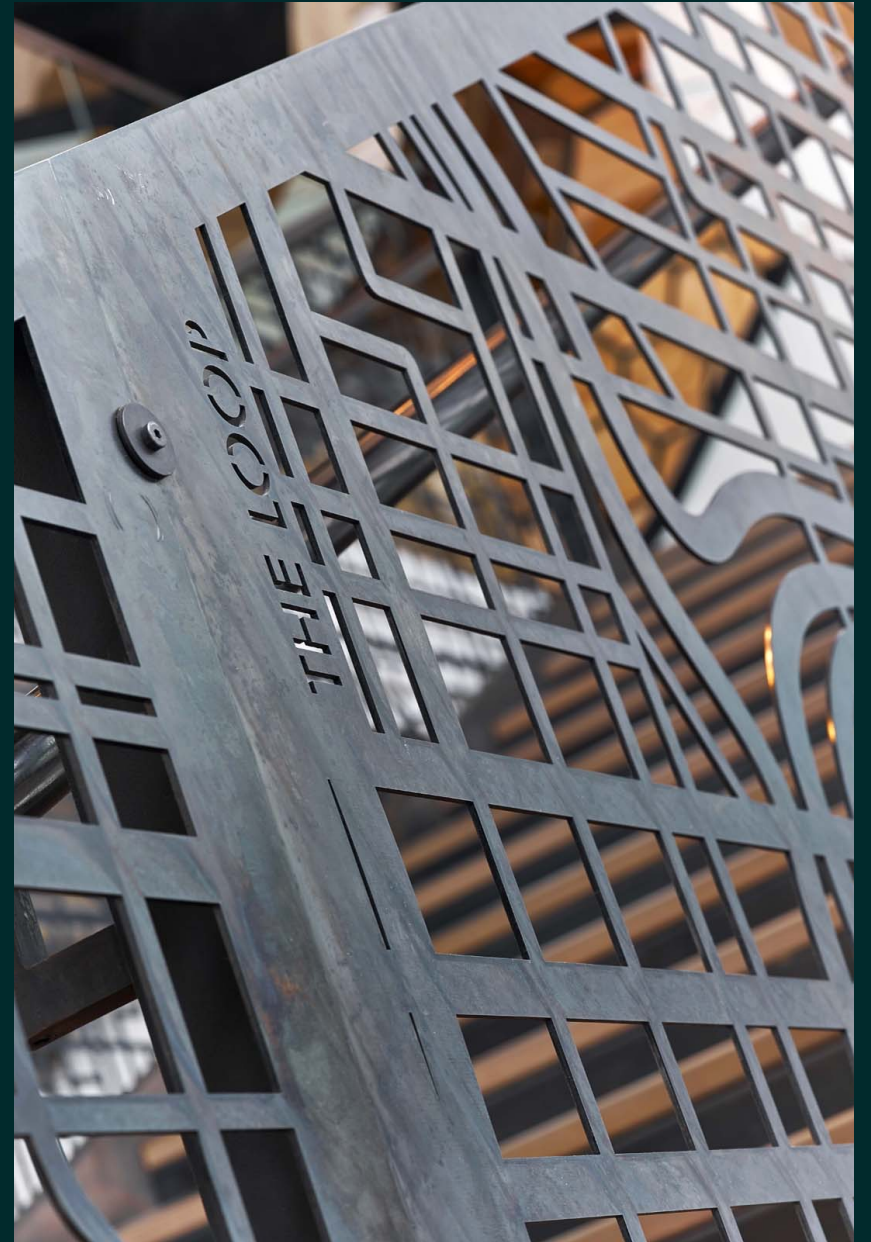
Real Estate in a World of AI

Chris Urwin
Strategic Advisor, Built AI
VARi Knowledge Partners

chris.urwin@rgadvantage.com

Franz Limoges
Principal Data Scientist
Econometric Advisors

franz.limoges@cbre.com

Dennis Schoenmaker, Ph.D.
Principal Economist | Executive Director
Econometric Advisors

dennis.schoenmaker@cbre.com

Climate Risk: Benchmarking U.S. Cities

ECONOMETRIC ADVISORS
Vincent Planque

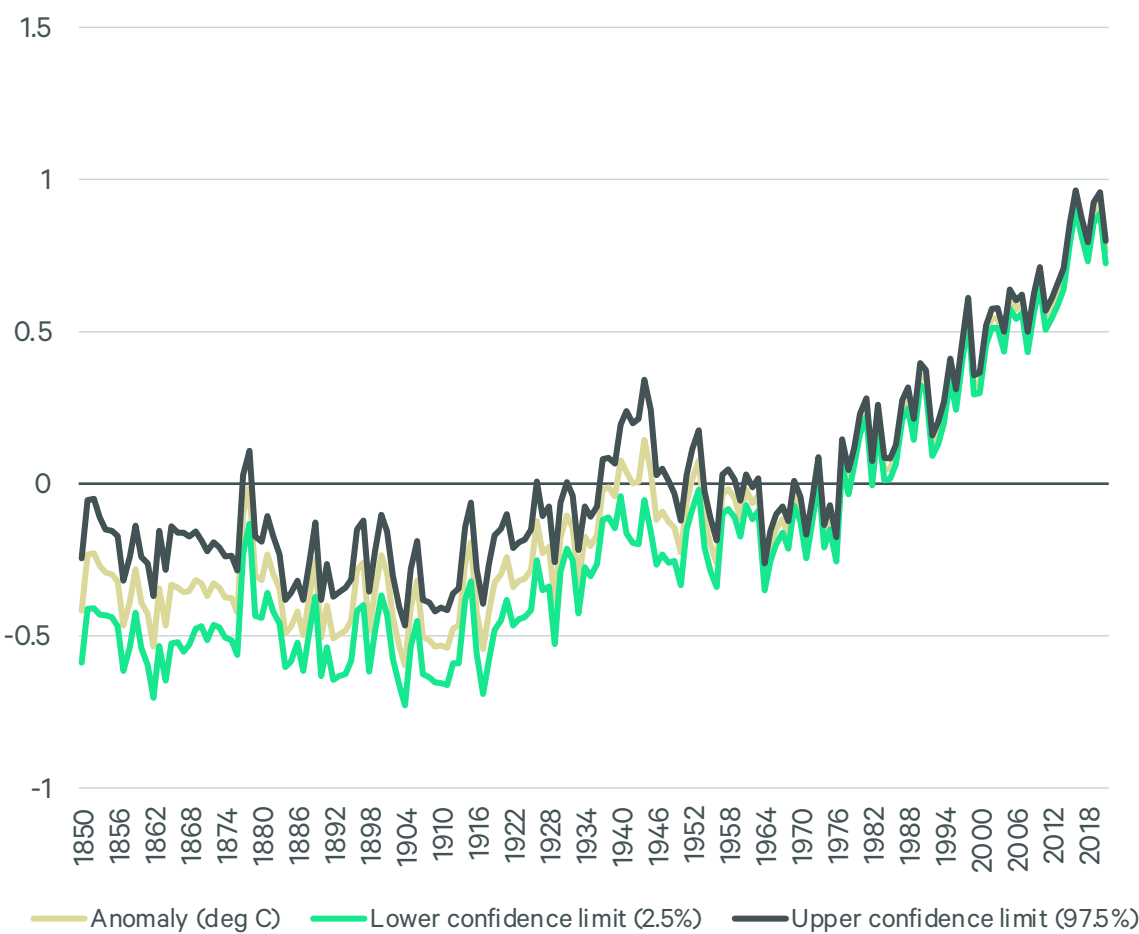Senior Analyst
LEED Green Associate
vincent.planque@cbre.com
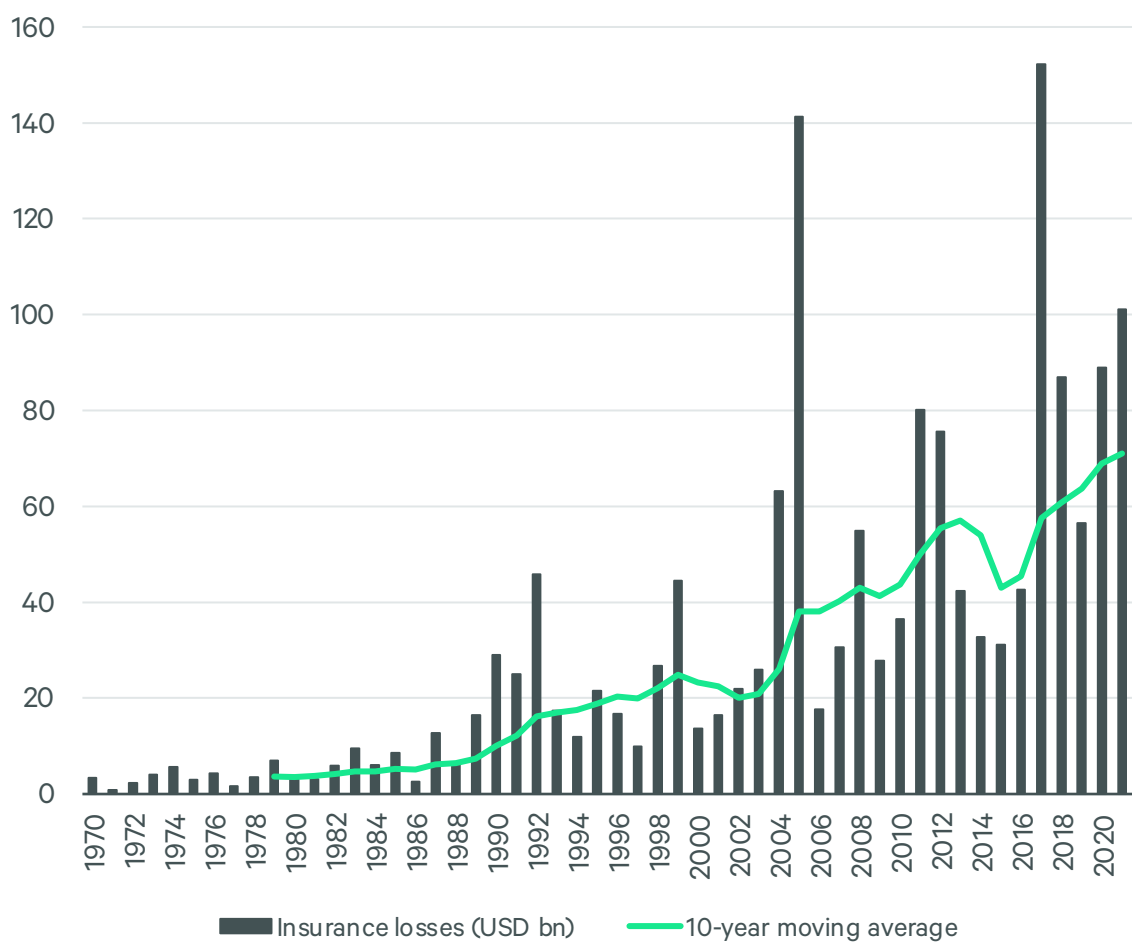
ECONOMETRIC ADVISORS
Dennis Schoenmaker, Ph.D.

Principal Economist
Executive Director
dennis.schoenmaker@cbre.com

Global warming & weather-related insurance losses to increase

Temperature Degree Difference vs. Reference

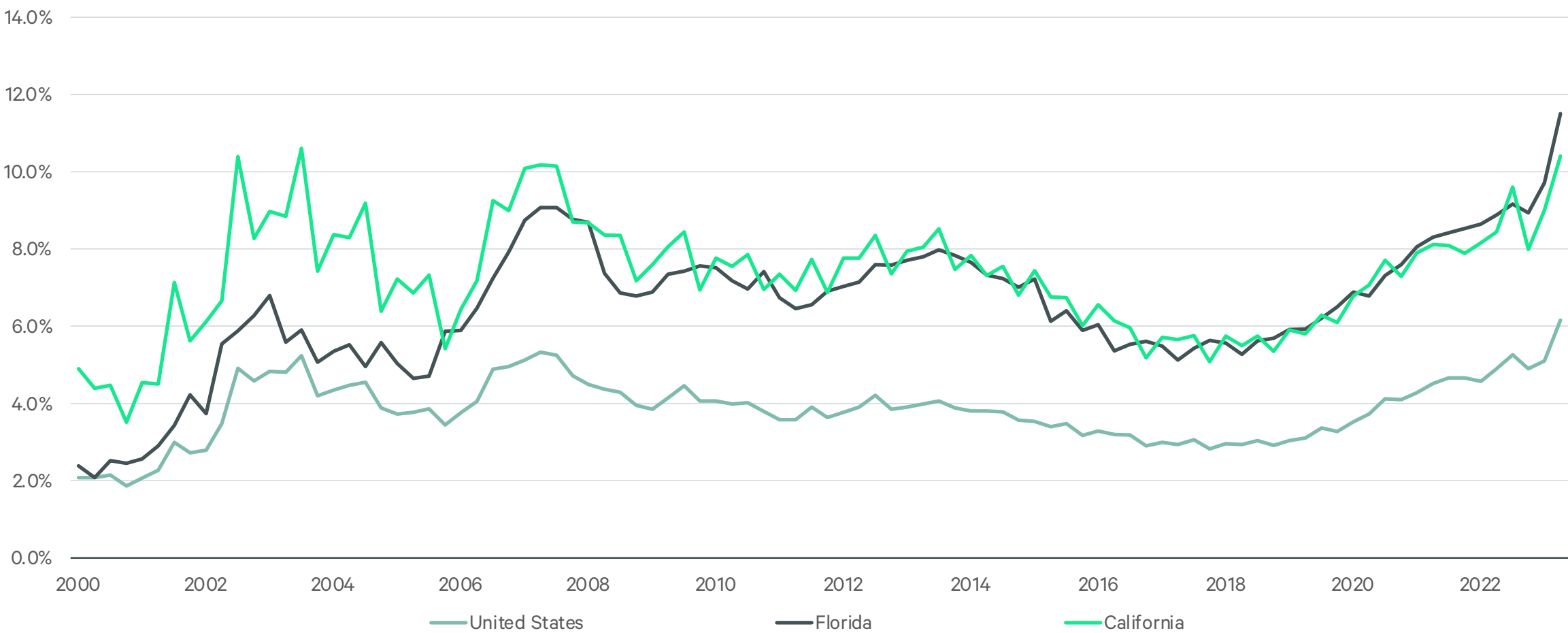Anomaly (deg C) — Lower confidence limit (2.5%) — Upper confidence limit (97.5%)

Weather-related Global Insurance Losses

Insurance losses (USD bn) — 10-year moving average

Source: Met Office Hadley Centre, Sigma explorer & CBRE Research, February 2022.

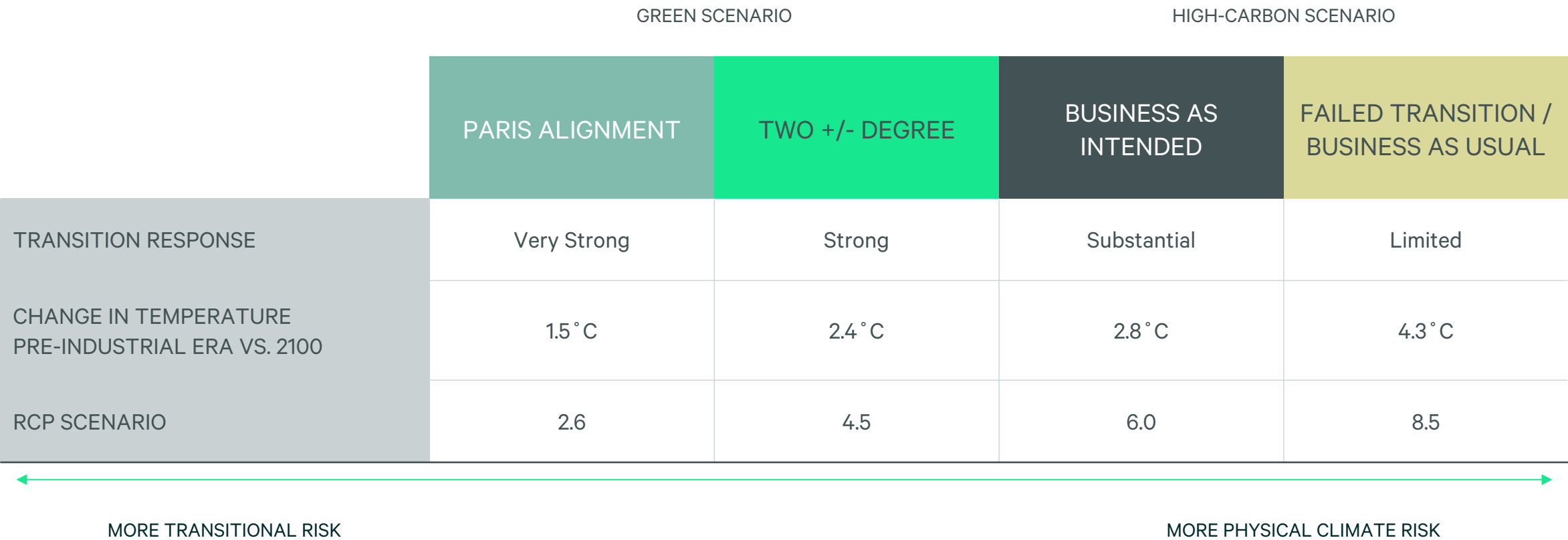# Rising Tides: Understanding the surge in insurance premiums

**Insurance Costs as a Share of Operating Expenses on a Per Square Foot Basis (%)**

Legend: United States, Florida, California

Climate risk scenarios & transitional / physical risk implications

	GREEN SCENARIO		HIGH-CARBON SCENARIO	
	PARIS ALIGNMENT	TWO +/- DEGREE	BUSINESS AS INTENDED	FAILED TRANSITION / BUSINESS AS USUAL
TRANSITION RESPONSE	Very Strong	Strong	Substantial	Limited
CHANGE IN TEMPERATURE PRE-INDUSTRIAL ERA VS. 2100	1.5˚C	2.4˚C	2.8˚C	4.3˚C
RCP SCENARIO	2.6	4.5	6.0	8.5

MORE TRANSITIONAL RISK ←——————————————————————→ MORE PHYSICAL CLIMATE RISK

Source: CFTC 2929 (page 75), CBRE Research, February 2022.

1

The NAM City Sustainability Index
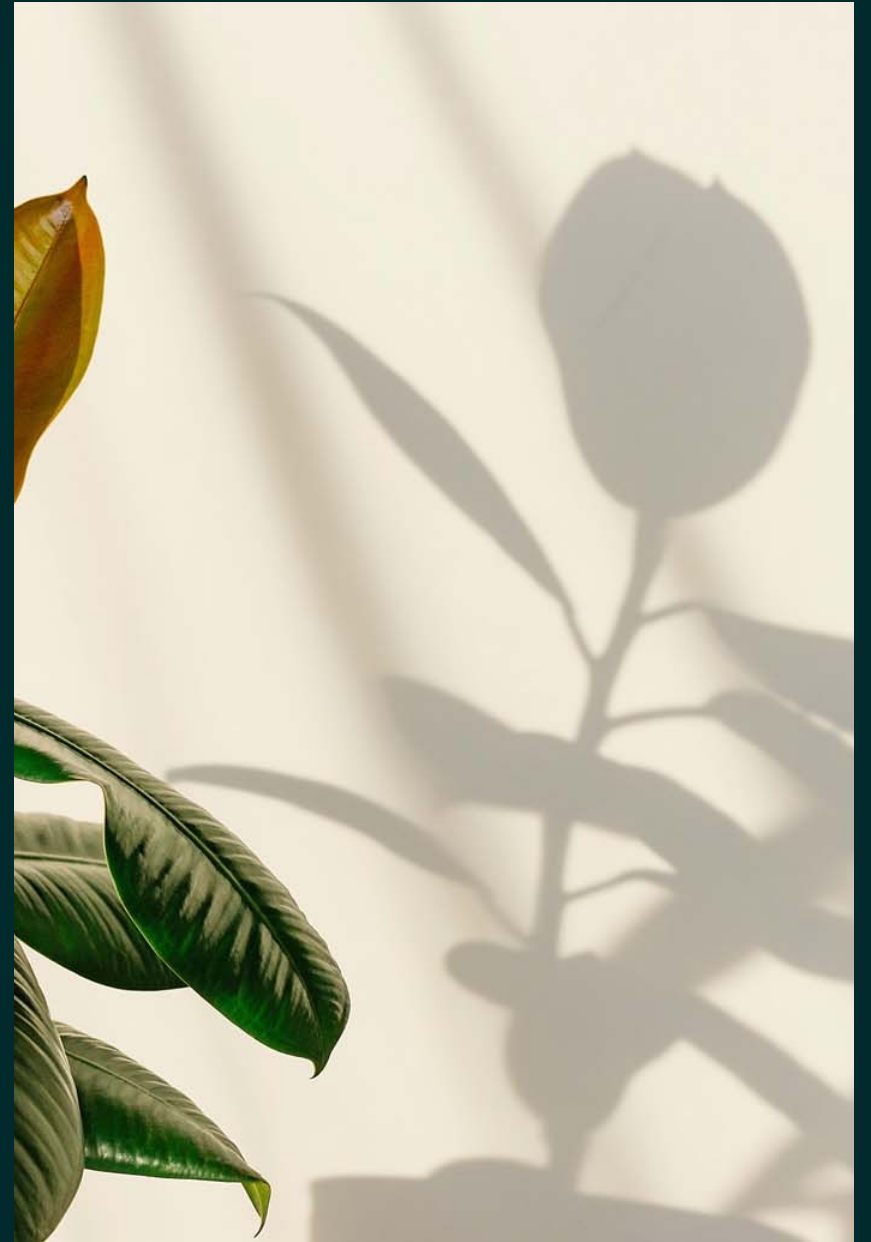
The Why Behind it All: What prompted the North American City Sustainability Index to be formed?

2023 CBRE's Strengthening Value Through ESG Survey. Key Findings:

67%
responses

reported a heightened focus on reducing greenhouse gas emissions.

75%
responses

cite a building's resilience to effects of climate change as having an impact on real estate decisions.

79%
responses

cite green building certifications as having an impact on real estate decisions.

Setting the Stage

The North American (NAM) City Sustainability Index provides the ability to benchmark cities around North America based on environmental resilience. The cities are scored and ranked based on performance in the following environmental categories:

**What is CBRE's
North American
City Sustainability Index?**

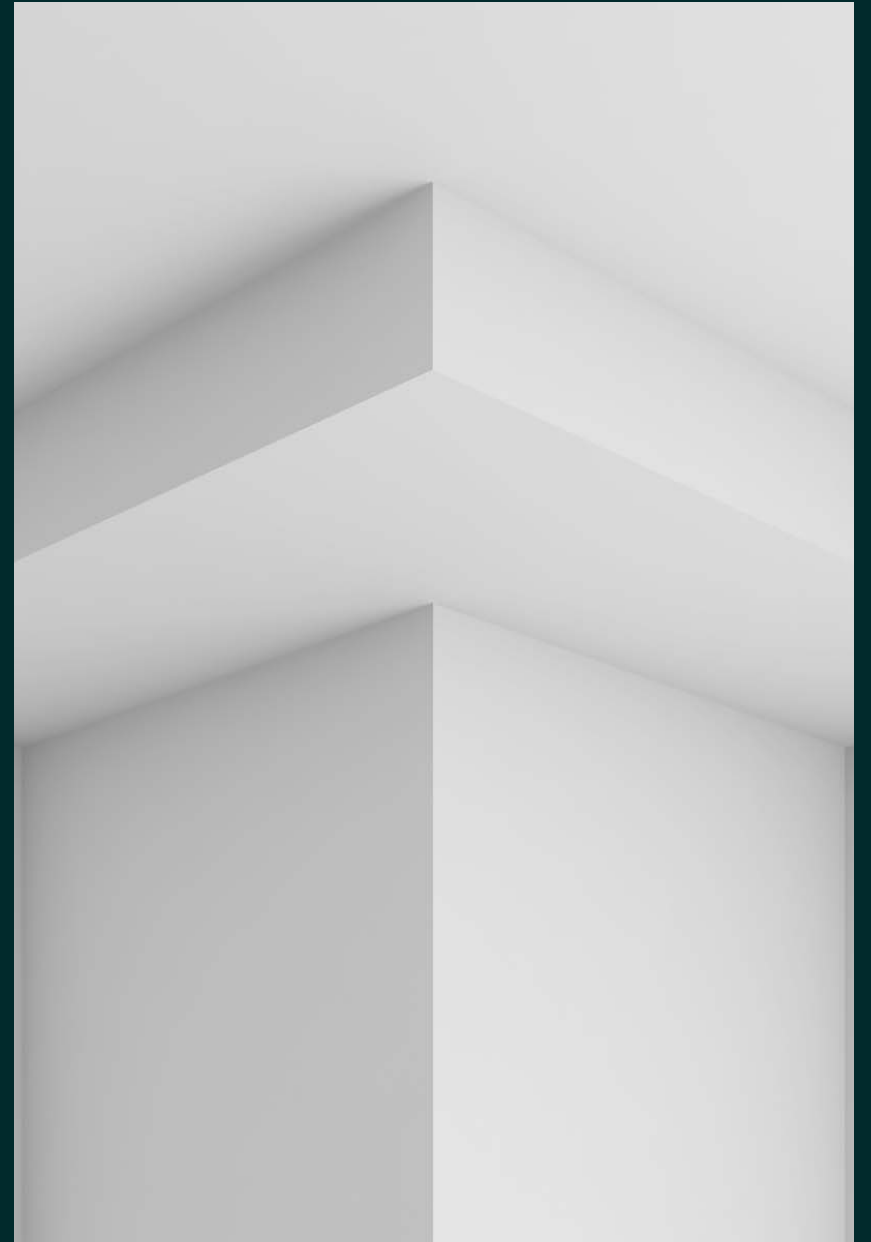| Transition Risk	Physical Climate Risk	Adaption & Migration
40%	**35%**	**25%**
Transition Risk (25%)	Physical Risk (20%)	Renewable Energy (10%)
Emission Reduction Target (10%)	Water Stress (5%)	Green Building (10%)
Building Performance Standards (5%)	Air Pollution (5%)	Green Bond (5%)
	Heating Degree Days (5%)	

Behind the Scenes

What methodology was used for the rankings?

– We use a **Standard Score** methodology to standardize and normalize data across the 10 different variables in the NAM City Sustainability Index.

– A **zero to 100 points score** was used to develop a risk index. The higher the score, the better climate change adaptation measures and level of resilience.

– Together these variable scores illustrate the level of resilience for environmental risks that commercial real estate assets in these markets will face going forward.
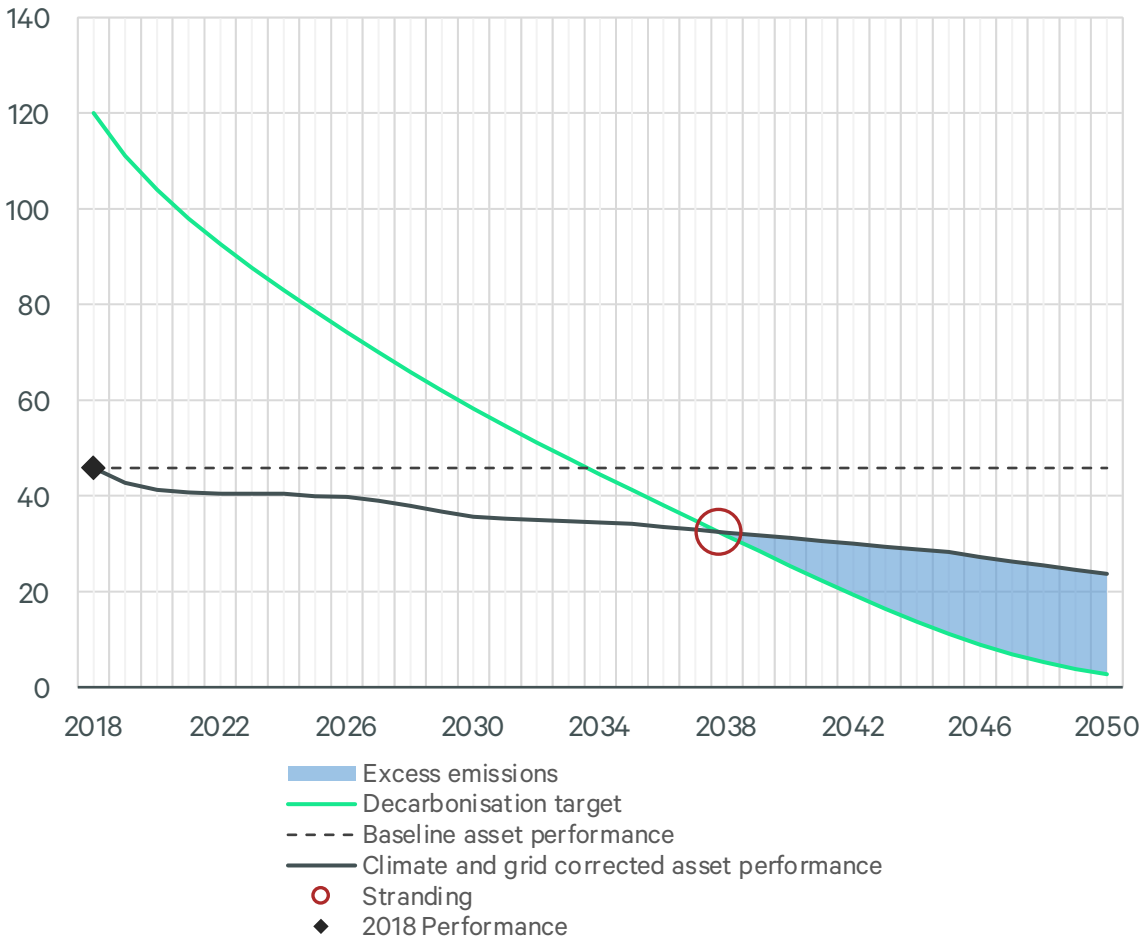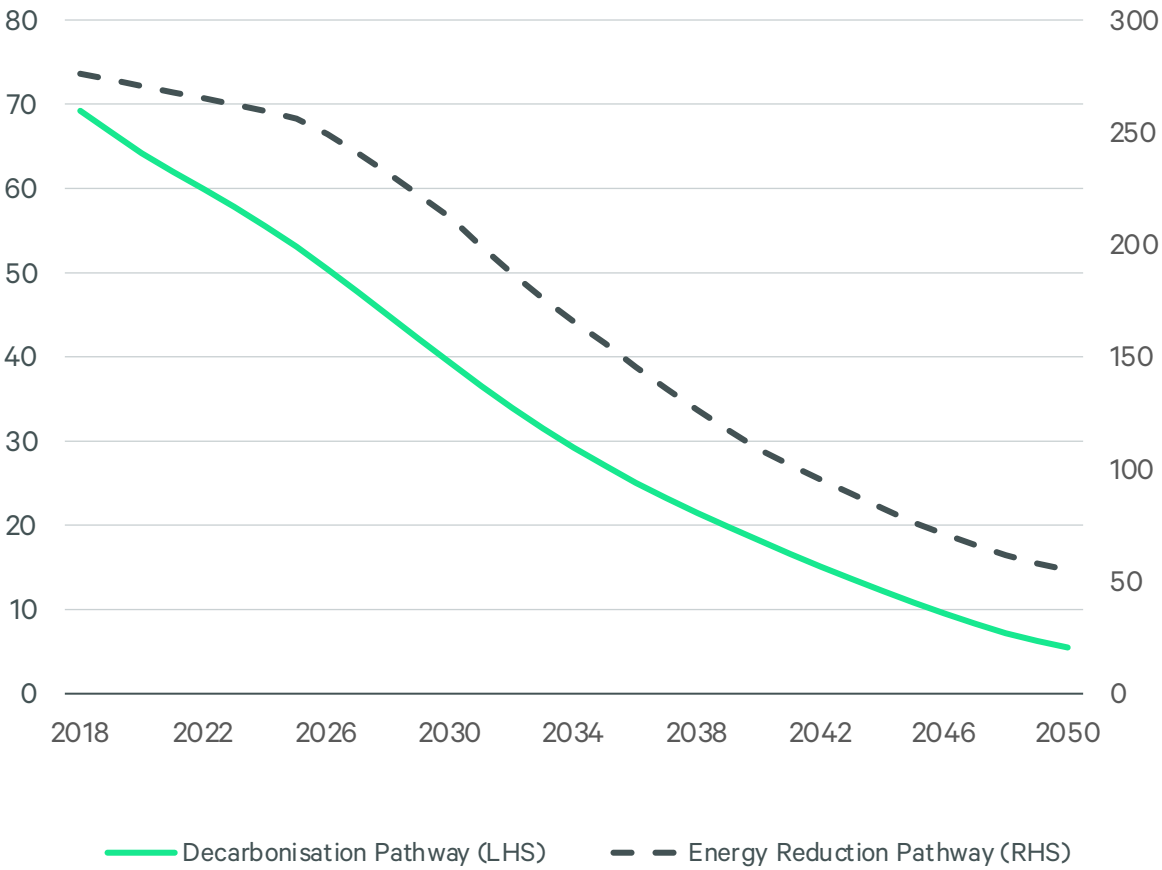
2

Key Drivers

A theoretical framework for transition risk & stranded assets

GHG Intensity kgCO2e/m²/yr

Legend:
- Excess emissions
- Decarbonisation target
- Baseline asset performance
- Climate and grid corrected asset performance
- ○ Stranding
- ◆ 2018 Performance

Energy Intensity Pathway kWh/m²

Legend:
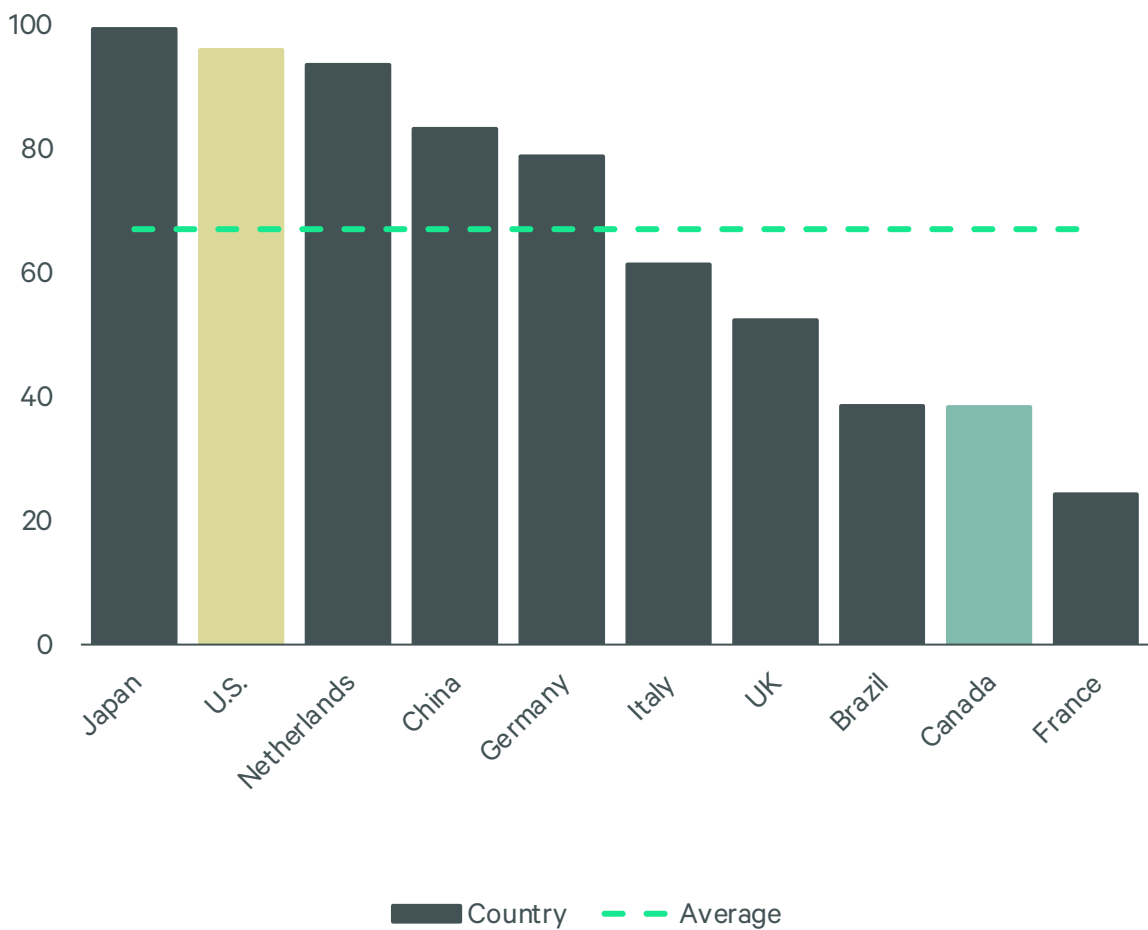- Decarbonisation Pathway (LHS)
- Energy Reduction Pathway (RHS)

Source: CRREM, CBRE Research, February 2022.

Global GHG emission 1.5°C reduction pathways from 2020 to 2050

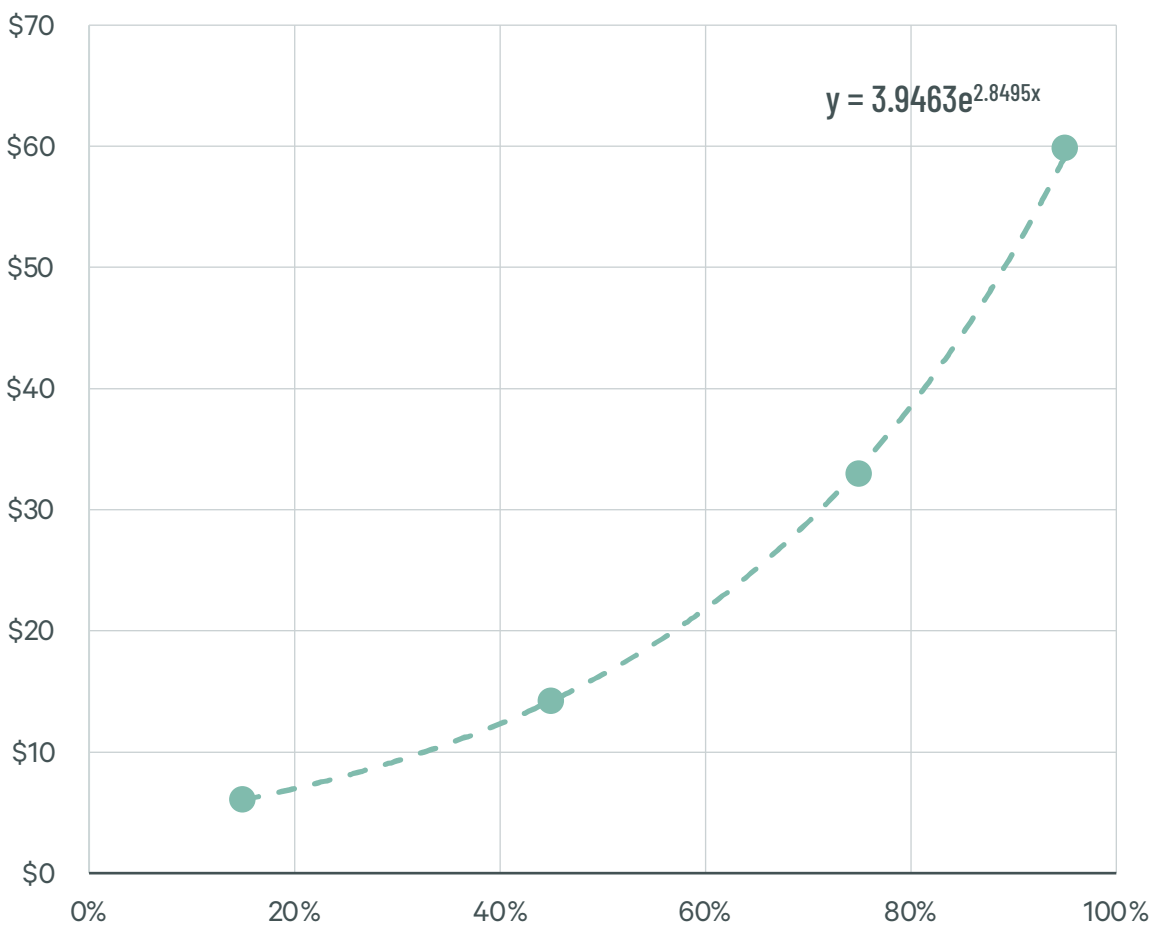**Carbon Intensity Reduction kgCO2e/m²**
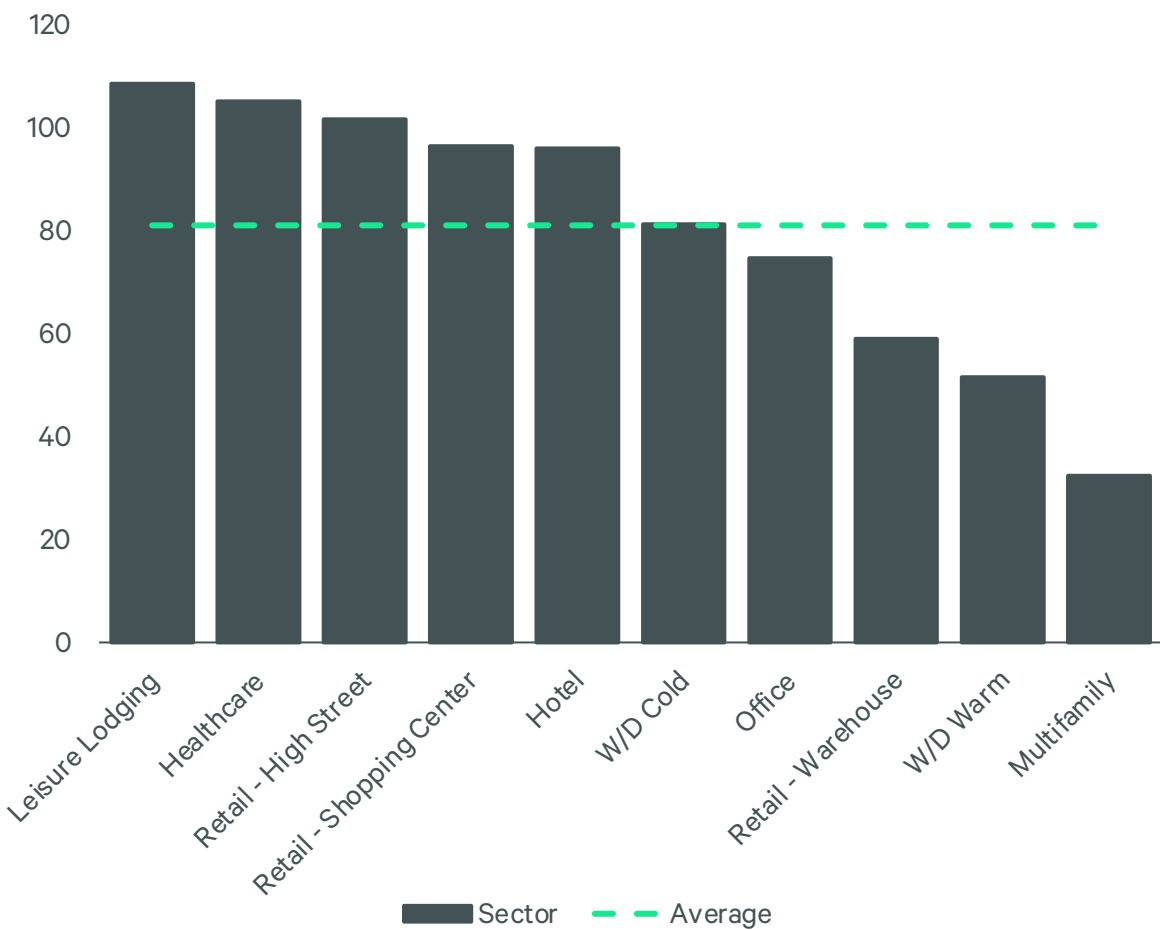
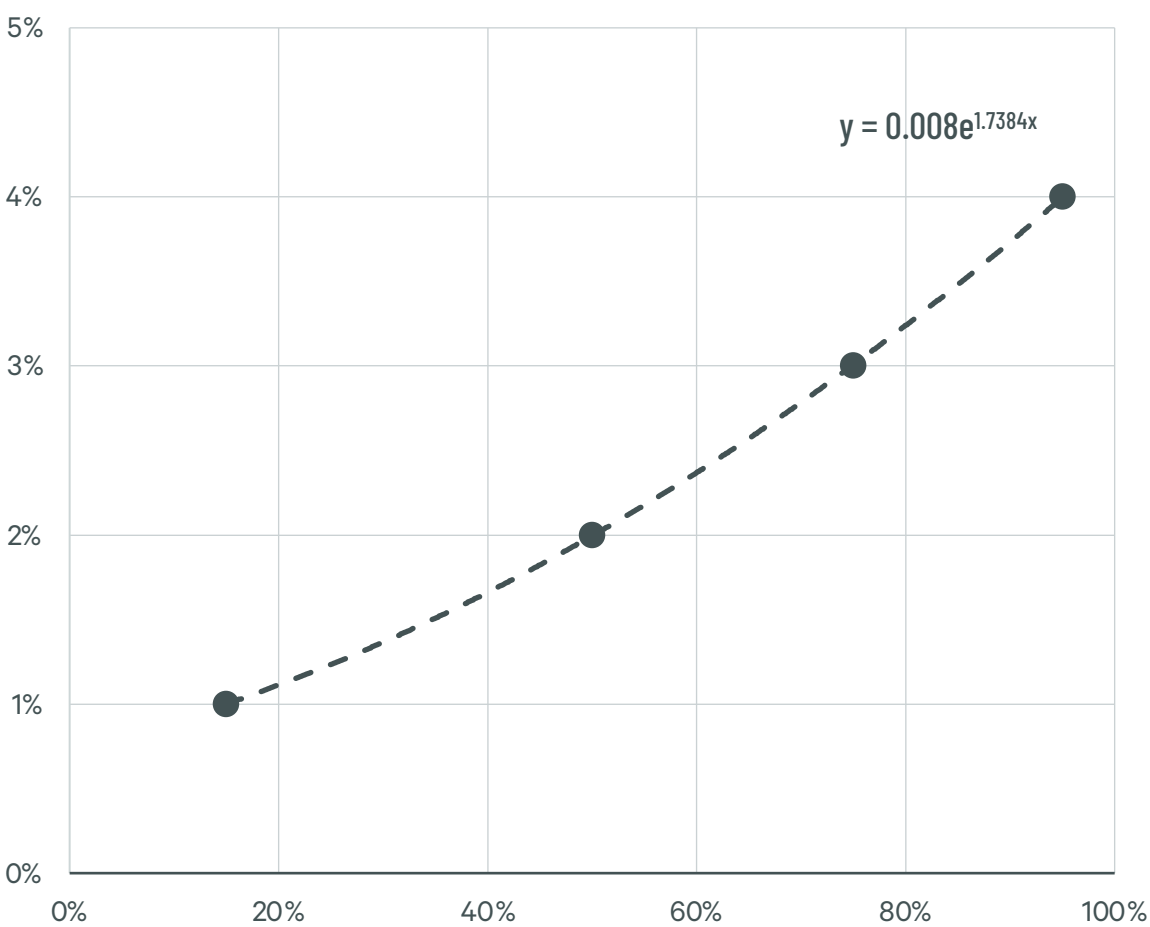**Carbon Intensity Reduction kgCO2e/m²**

Source: CRREM, CBRE Econometric Advisors. * Calculated using unweighted average of countries and sectors.

Retrofit costs exponential and depending on technological innovations

Capex per ft² Energy Reduction (USD)

$$y = 3.9463e^{2.8495x}$$
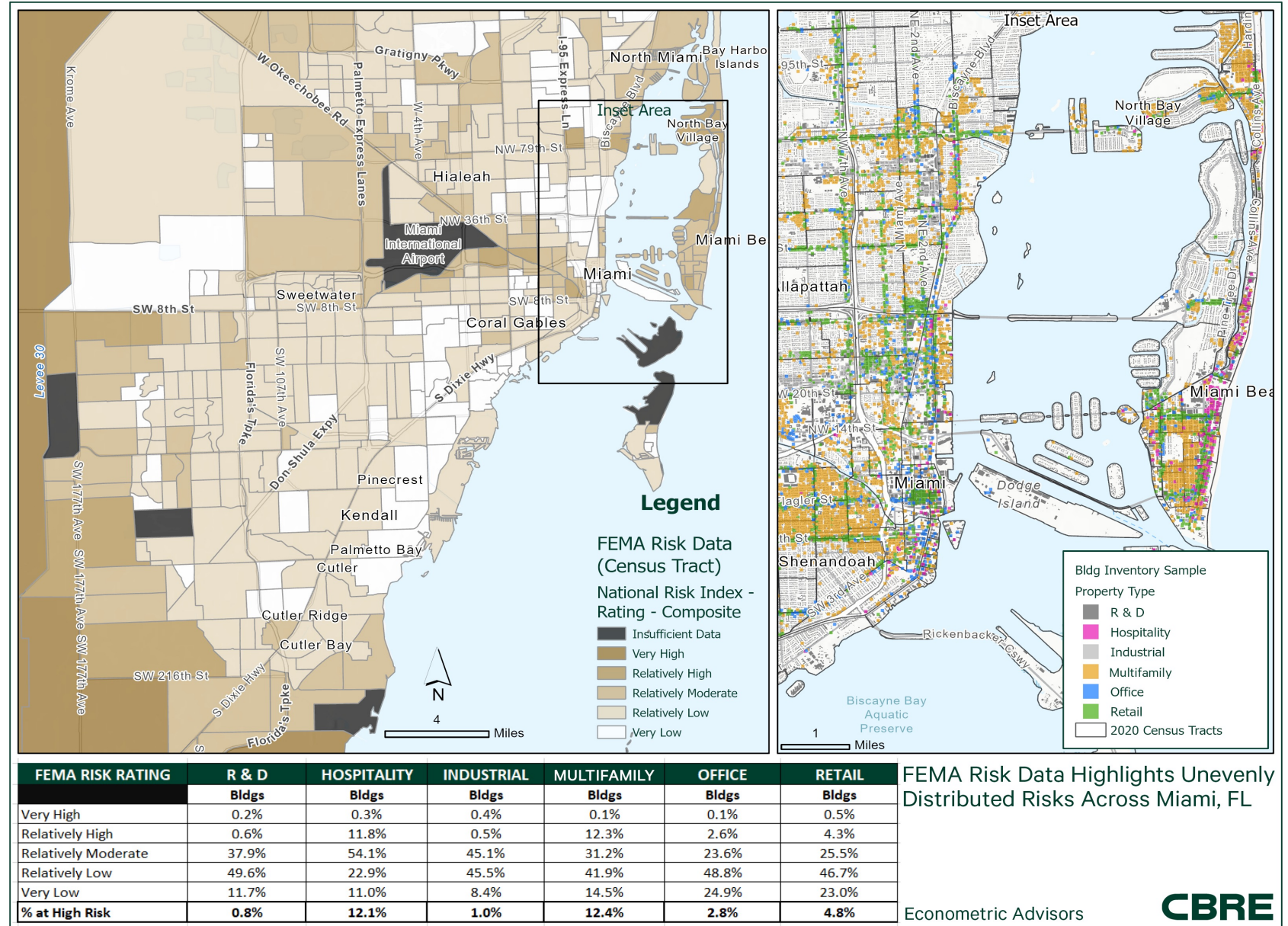
Cost Reduction Function

$$y = 0.008e^{1.7384x}$$

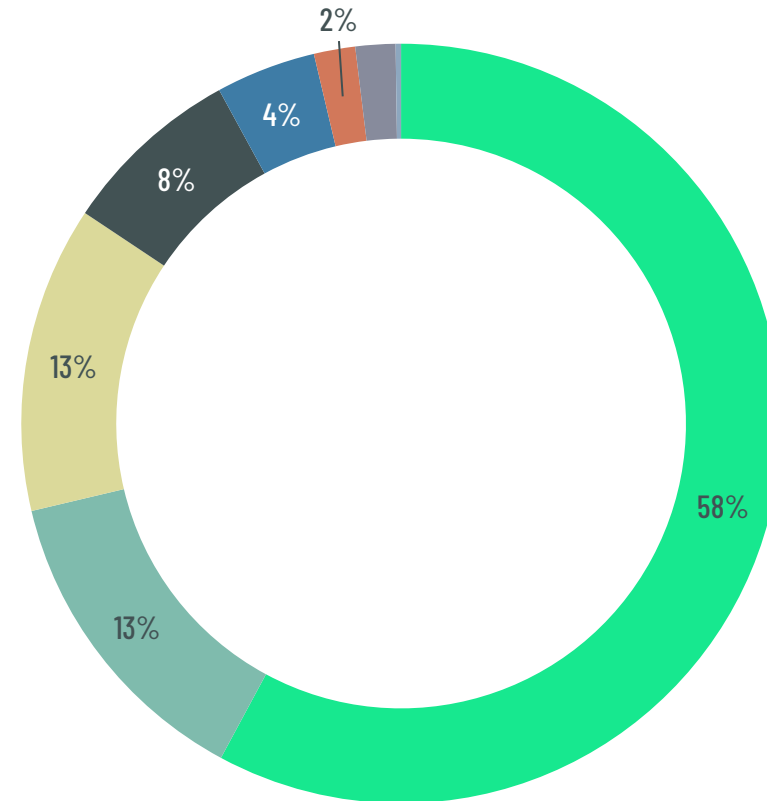# Future cities: Miami and the challenge of physical risks

Miami, FL

As wildfires, polar vortexes and hurricanes frequent headlines, it begs the question: just how vulnerable are real estate markets to natural hazards?

– We looked to Miami - a city associated with strong tropical storms and at the frontier of climate change - to analyze vulnerability.

– The upshot is this spatial data shows Miami's commercial property market is more resilient to typical natural hazards than many may believe.


Legend

FEMA Risk Data (Census Tract)

National Risk Index - Rating - Composite
- Insufficient Data
- Very High
- Relatively High
- Relatively Moderate
- Relatively Low
- Very Low

Bldg Inventory Sample

Property Type
- R & D
- Hospitality
- Industrial
- Multifamily
- Office
- Retail
- 2020 Census Tracts

FEMA Risk Data Highlights Unevenly Distributed Risks Across Miami, FL

FEMA RISK RATING	R & D	HOSPITALITY	INDUSTRIAL	MULTIFAMILY	OFFICE	RETAIL
	Bldgs	Bldgs	Bldgs	Bldgs	Bldgs	Bldgs
Very High	0.2%	0.3%	0.4%	0.1%	0.1%	0.5%
Relatively High	0.6%	11.8%	0.5%	12.3%	2.6%	4.3%
Relatively Moderate	37.9%	54.1%	45.1%	31.2%	23.6%	25.5%
Relatively Low	49.6%	22.9%	45.5%	41.9%	48.8%	46.7%
Very Low	11.7%	11.0%	8.4%	14.5%	24.9%	23.0%
% at High Risk	**0.8%**	**12.1%**	**1.0%**	**12.4%**	**2.8%**	**4.8%**

Econometric Advisors

CBRE

Shifting Power: Examining the Transformation in Electricity Sources

2023 FALL FORUM

Percentage of Electricity Generation by Source, 2018 - 2022
Canada

58% — Hydro
13% — Nuclear
13% — Natural Gas
8% — Wind
4% — Coal
2% — (Oil/Geothermal)

Legend: Hydro · Nuclear · Natural Gas · Wind · Coal · Solar · Geothermal · Oil

Percentage of Electricity Generation by Source, 2018 - 2022
United States

40% — Natural gas
20% — Coal
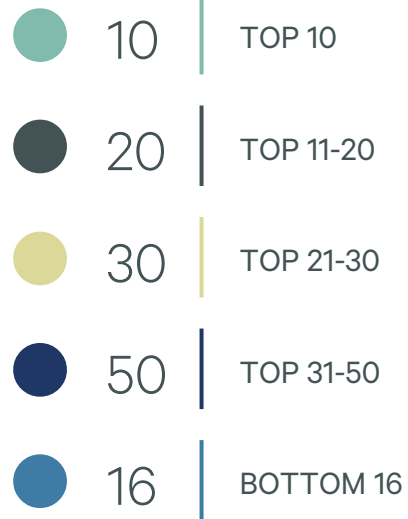18% — Nuclear
15% — Renewables
6% — Hydro
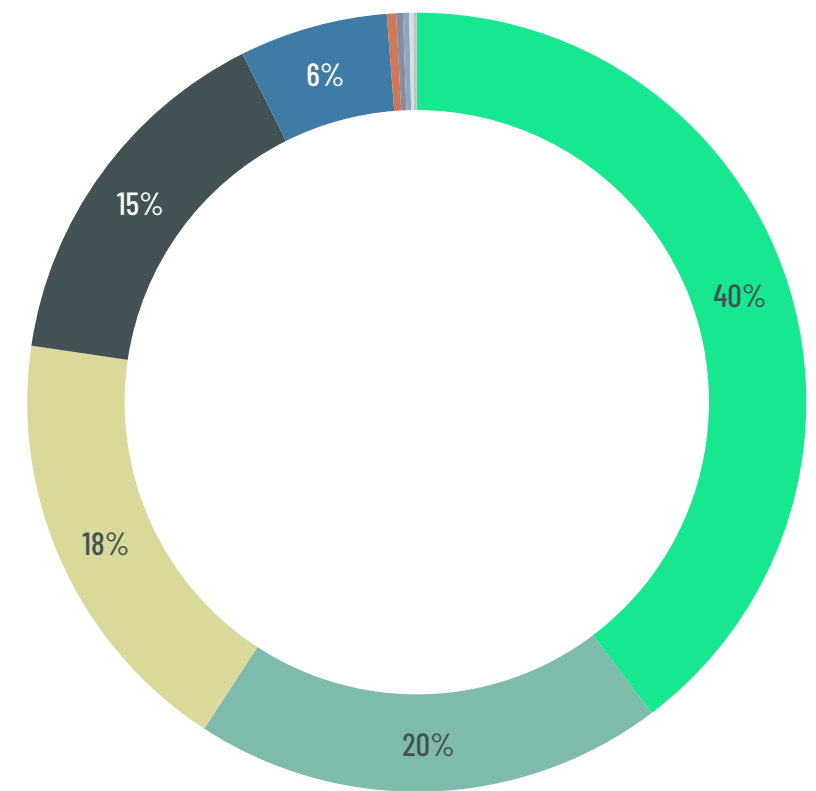
Legend: Natural gas · Coal · Nuclear · Renewables · Hydro · Oil · Other gases · Other

3

The Results
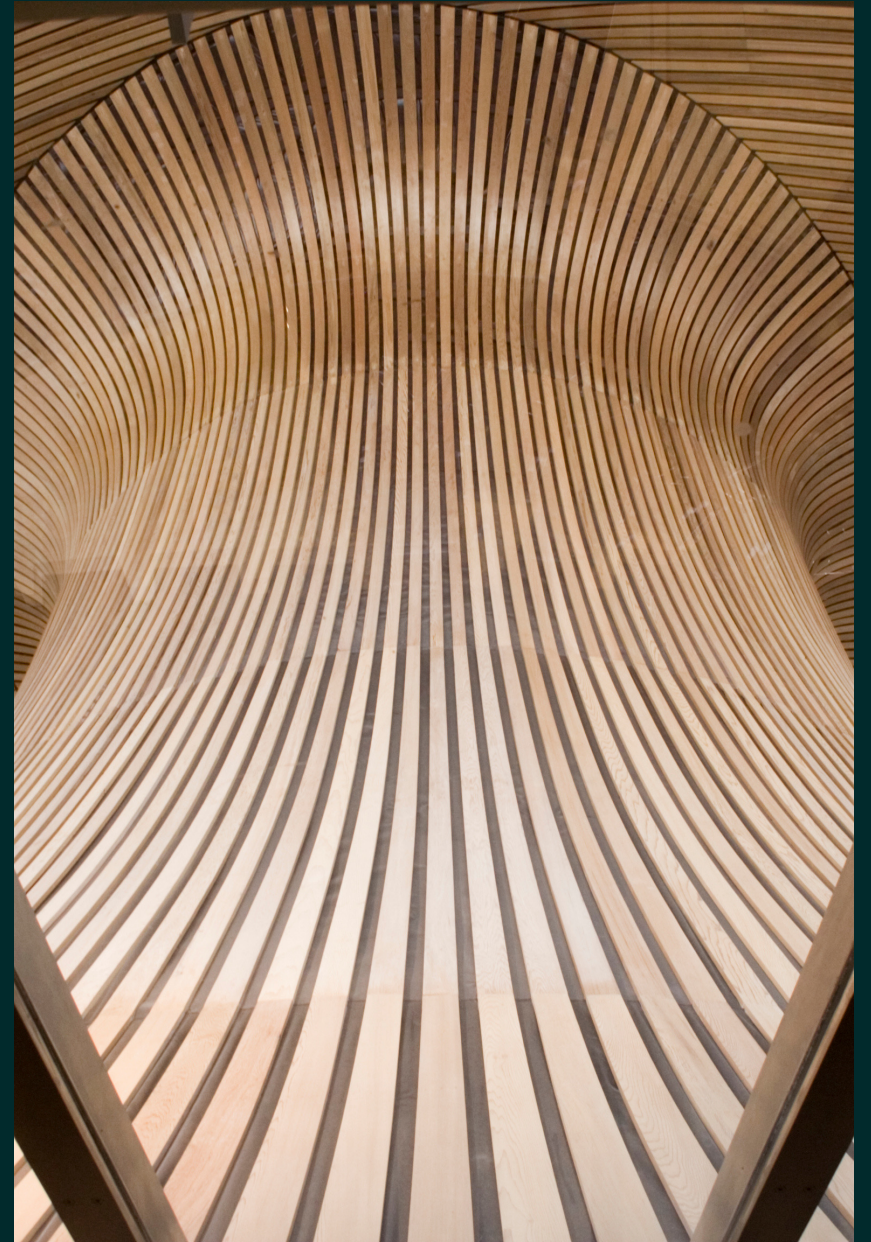
Navigating the Resilience Landscape: from Data to Decisions

Legend:
- 10 — TOP 10
- 20 — TOP 11-20
- 30 — TOP 21-30
- 50 — TOP 31-50
- 16 — BOTTOM 16

Map labels: Vancouver, Edmonton, Calgary, Winnipeg, Halifax, Seattle, Portland, Montreal, Ottawa, Albany, Boston, Toronto, Hartford, Minneapolis, Milwaukee, Detroit, Westchester, New York City, Sacramento, Chicago, Cleveland, Philadelphia, Oakland, Toledo, Pittsburgh, Wilmington, San Francisco, Salt Lake City, Denver, Indianapolis, Cincinnati, Columbus, Baltimore, San Jose, Kansas City, Washington, DC, St. Louis, Norfolk, Las Vegas, Louisville, Richmond, Tulsa, Nashville, Riverside, Albuquerque, Memphis, Raleigh, Los Angeles, Oklahoma City, Irvine, Phoenix, Atlanta, Charlotte, San Diego, Tucson, Jacksonville, Fort Worth, Dallas, Austin, Orlando, San Antonio, Houston, Tampa, Honolulu, Fort Lauderdale, Miami

Resilient cities in focus: Balancing physical & transition risk

High Transition Risk, Low Physical Climate Risk

Low Overall Risk

High Overall Risk

High Physical Risk, Low Transition Risk
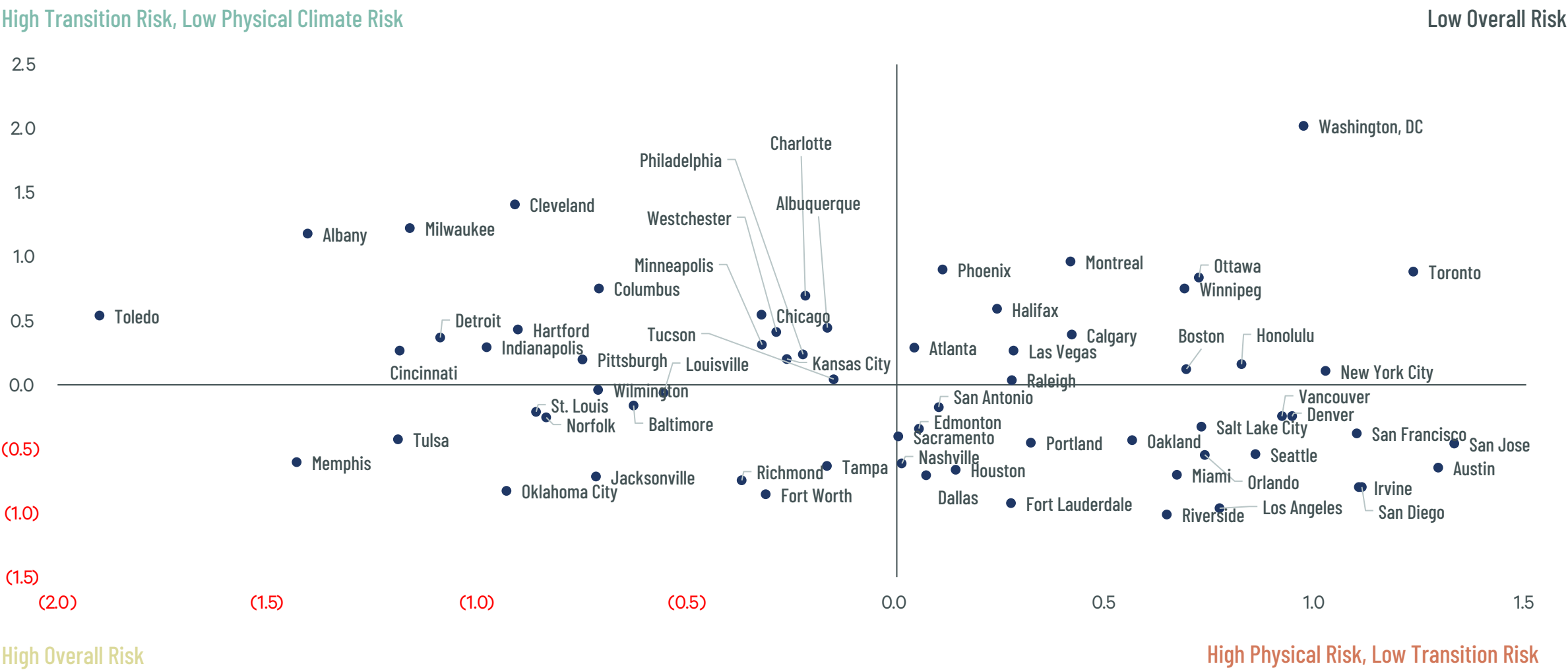
Four quadrants of resilience in city settings or reshaping tomorrow's cities

Quadrant-powered benchmarking for resilience

HIGH TRANSITION RISK, LOW PHYSICAL RISK High value-at-risk from transition risk but low value from physical climate risk	HIGH OVERALL RISK High value-at-risk from both transition and physical climate risks	LOW OVERALL RISK Low value-at-risk from both transition and physical climate risks	HIGH PHYSICAL RISK, LOW TRANSITION RISK Low value-at-risk from transition risk but high value from physical climate risk
18	**12**	**14**	**22**
Chicago	Fort Worth	Washington, D.C.	Denver
Albuquerque	Tampa	Toronto	San Francisco
Charlotte	St. Louis	Boston	Austin
Minneapolis	Wilmington	Ottawa	San Jose
Cleveland	Baltimore	New York City	Vancouver
Westchester	Richmond	Montreal	Irvine
Kansas City	Norfolk	Winnipeg	San Diego
Milwaukee	Louisville	Las Vegas	Oakland
Columbus	Tulsa	Honolulu	Seattle
Albany	Oklahoma City	Calgary	Los Angeles
Tucson	Jacksonville	Atlanta	San Antonio
Philadelphia	Memphis	Phoenix	Salt Lake City
Indianapolis		Halifax	Portland
Hartford		Raleigh	Orlando
Detroit			Houston
Pittsburgh			Miami
Cincinnati			Dallas
Toledo			Sacramento
			Riverside
			Edmonton
			Fort Lauderdale
			Nashville

Did you know the NAM is available for bespoke work?

We can map your journey to bespoke destinations across North America.

Digital Frontier: Benchmarking Cities on the Map
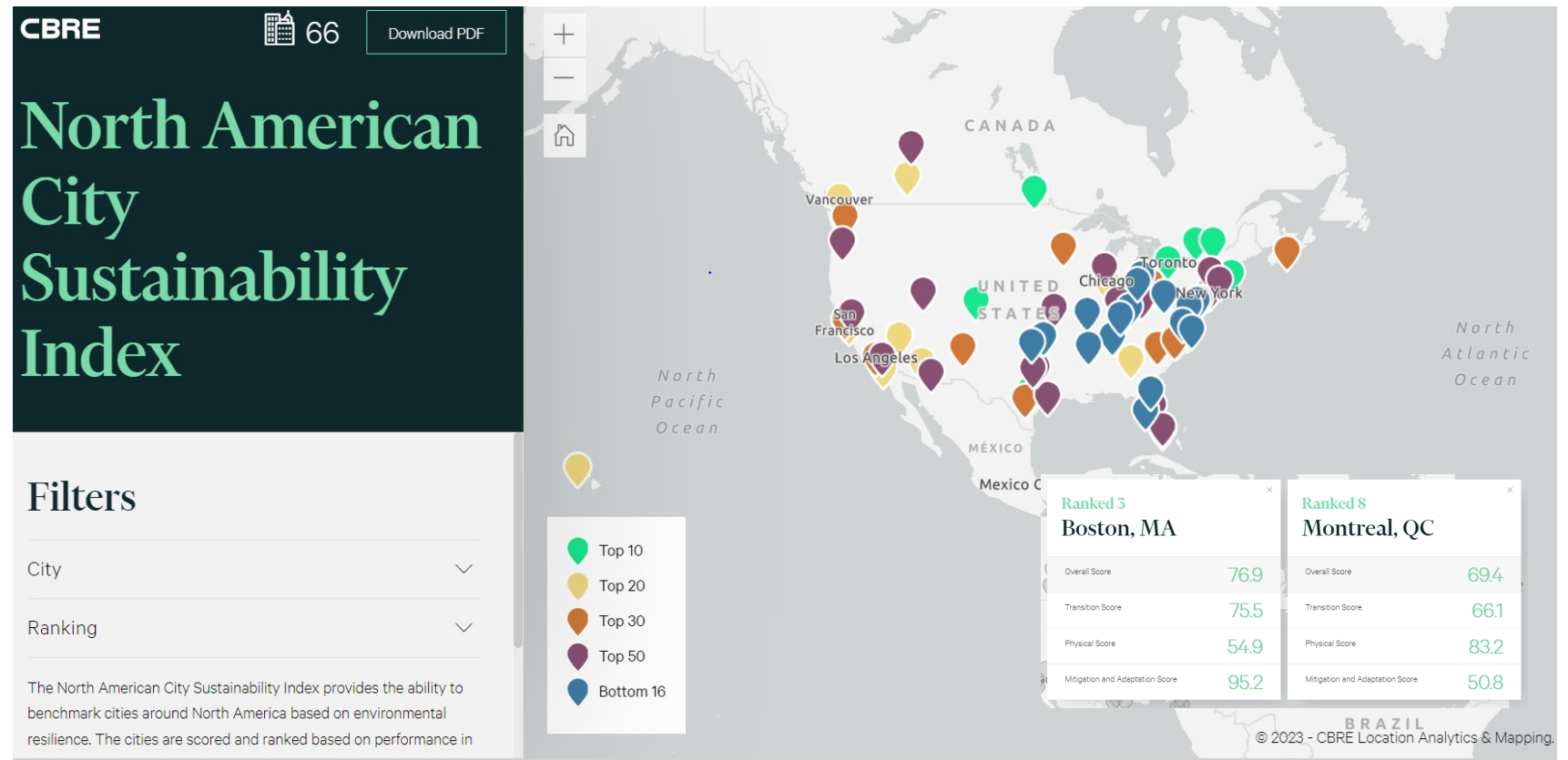
Scan the QR code to access the 2023 North American City Sustainability Study report published in August.

Coffee
Break

What's New at EA?

Stefan Weiss

Sr. Managing Economist

stefan.weiss@cbre.com

Christina Tong

Economist

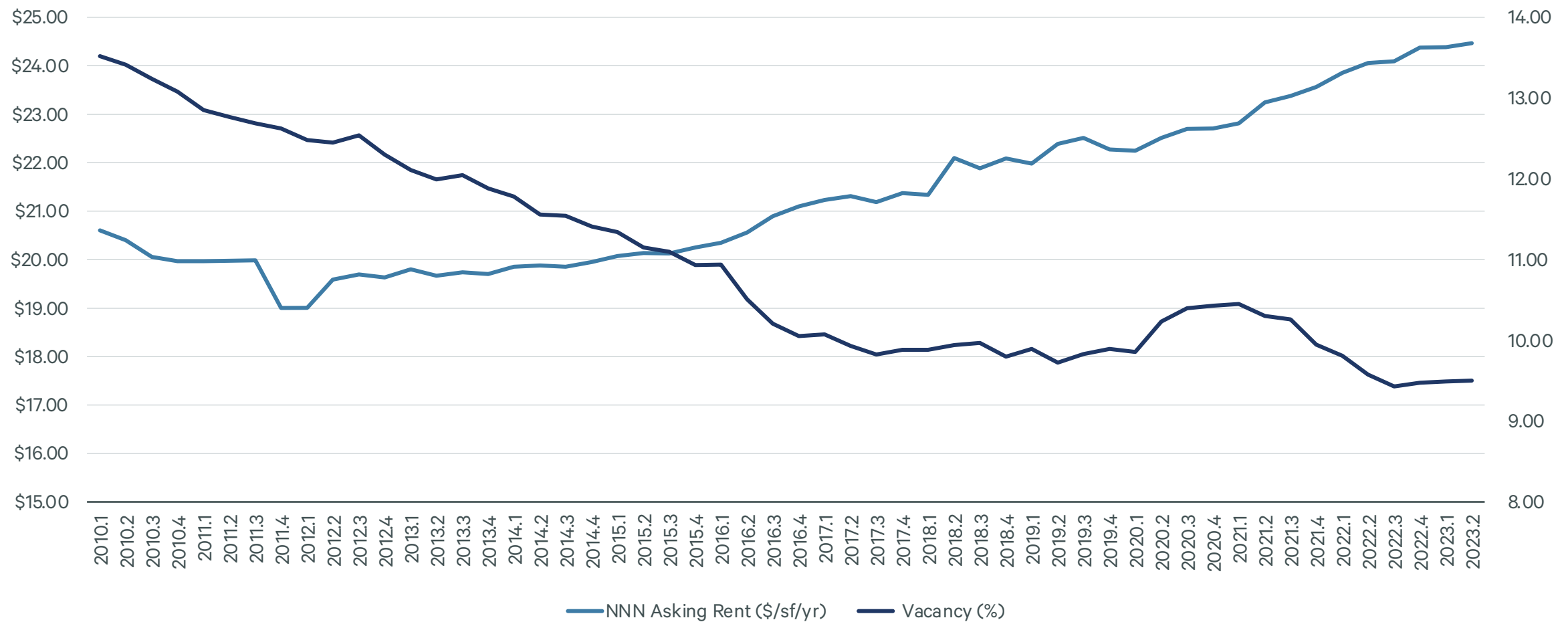christina.tong@cbre.com

Michael Leahy

Sr. Analyst

michael.leahy1@cbre.com

1

Medical Office Coverage

EA now offers medical office rent & vacancy historicals

Sum of 60 Medical Office Stats

Legend: NNN Asking Rent ($/sf/yr) — Vacancy (%)

Source: CBRE Econometric Advisors.

Institutional investment has doubled during the past 5 years

Representing a 44% Increase in Market Share

Institutional Acquisitions of Medical
Office Property ($ Billions)

Share of Medical Office Volume

Source: MSCI, CBRE Econometric Advisors.
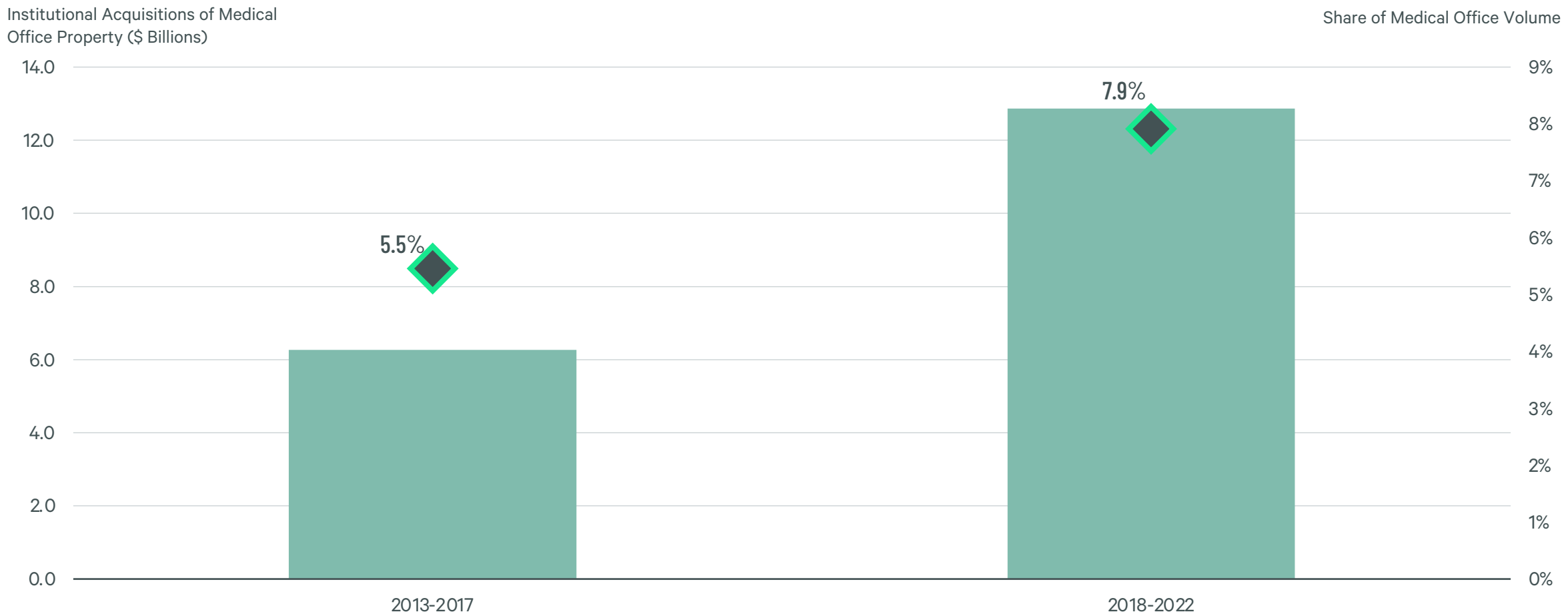
Medical office proves consistent while traditional office treads water

Asking Rent Indexed

National Rent Index CAGR Since Q1 2020

Traditional Office	0.0%
Medical Office	3.0%

Legend: Medical Office, Traditional Office

Source: CBRE Econometric Advisors.
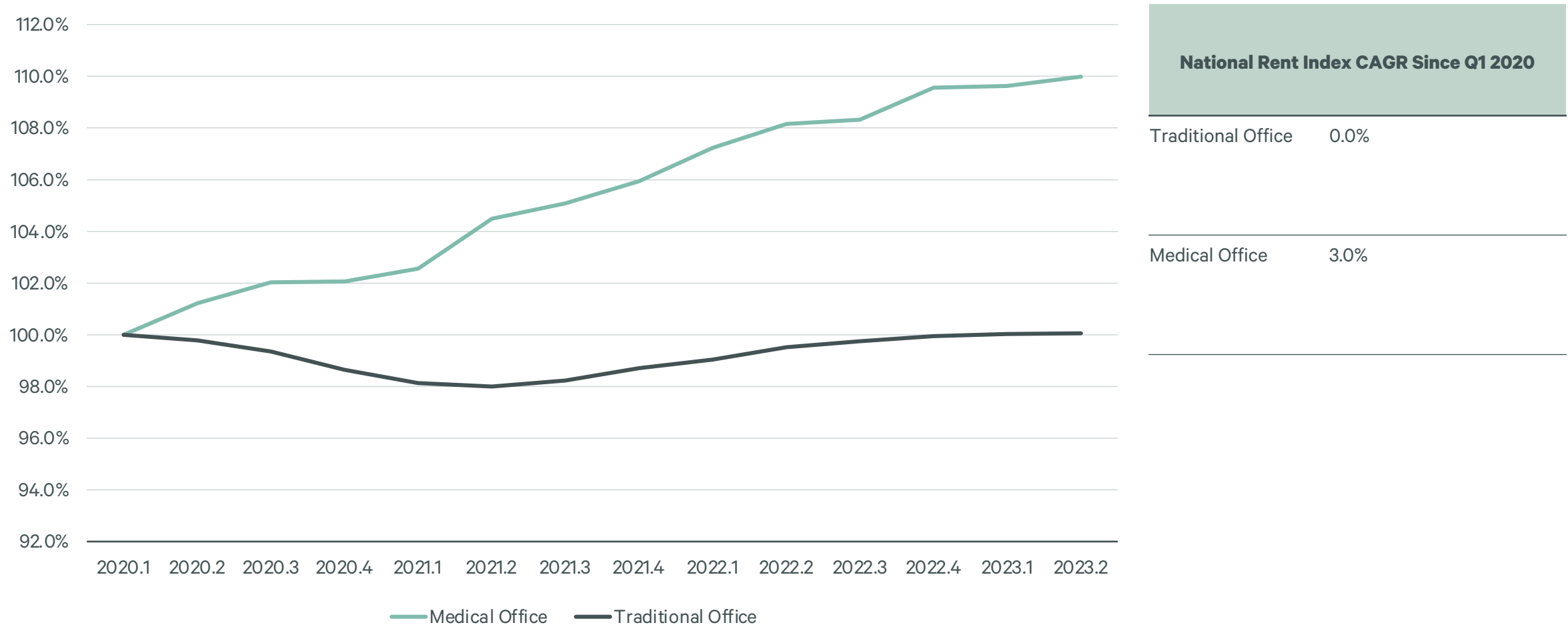
Medical office proves consistent while traditional office treads water ... at best

Asking & Economic Rent Indexed
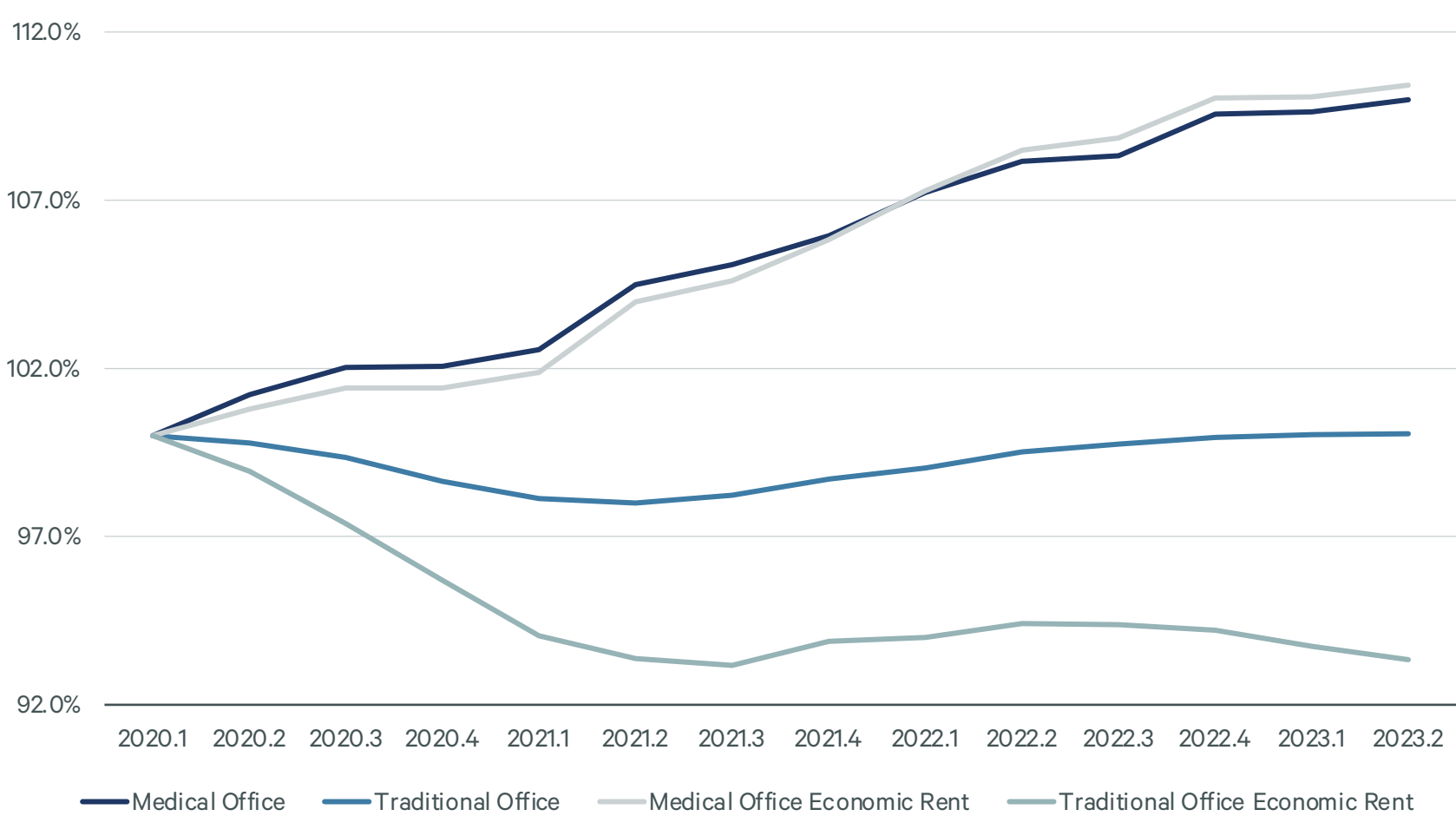
National Rent Index CAGR Since Q1 2020		
	Asking Rent	Economic Rent
Traditional Office	0.0%	-2.1%
Medical Office	3.0%	3.1%

Legend: Medical Office, Traditional Office, Medical Office Economic Rent, Traditional Office Economic Rent

Source: CBRE Econometric Advisors.

The Sun Belt has outperformed as population shifts accelerated

Medical Office NNN Rent CAGR Since Q4 2019
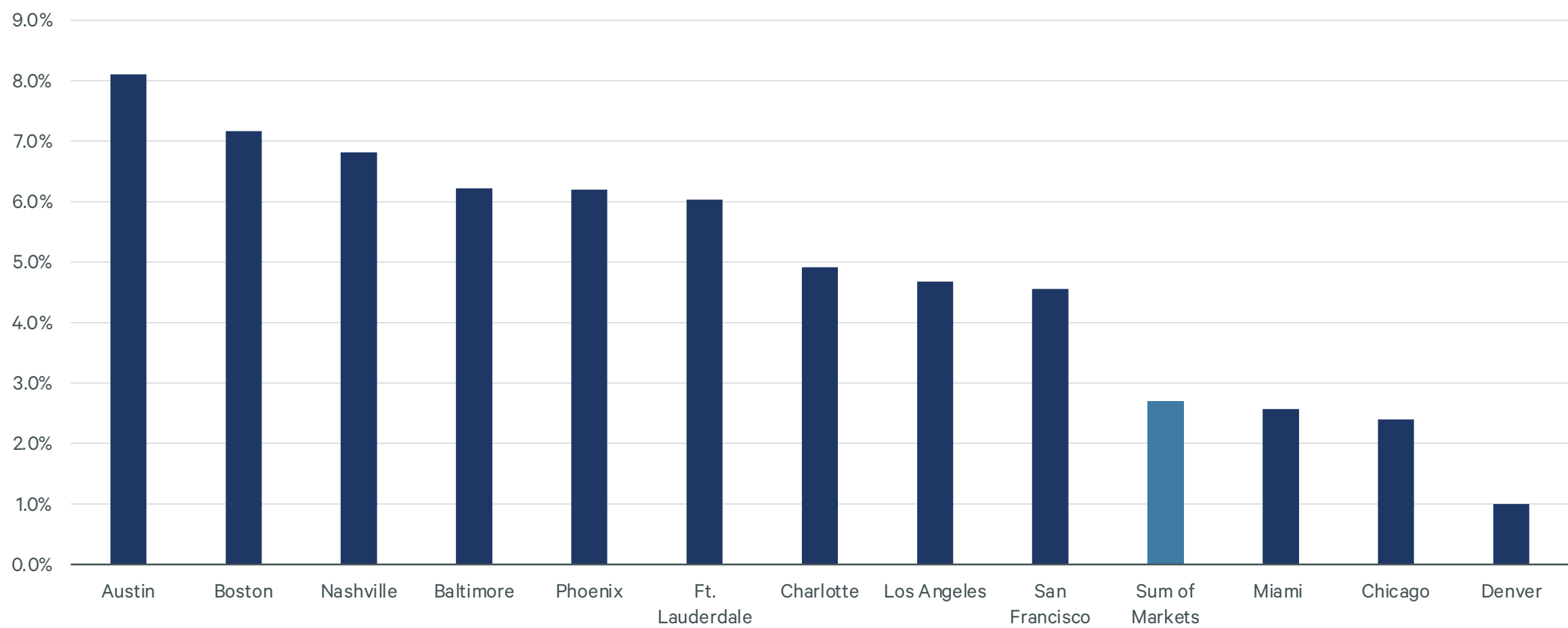
What is driving the trend in medical office rents?

$/sf

NNN Medical Asking Rent

Source: CBRE Econometric Advisors.

What is driving the trend in medical office rents?

$/sf

Correlation Coefficient: .98

Legend: ▬ NNN Medical Asking Rent ▬ NNN Rent Predict ▬ 75+ population

What is driving the trend in medical office rents?

$/sf

R-squared: .97

Adjusted R-squared: .96

Legend: NNN Medical Asking Rent — NNN Rent Predict — 75+ population
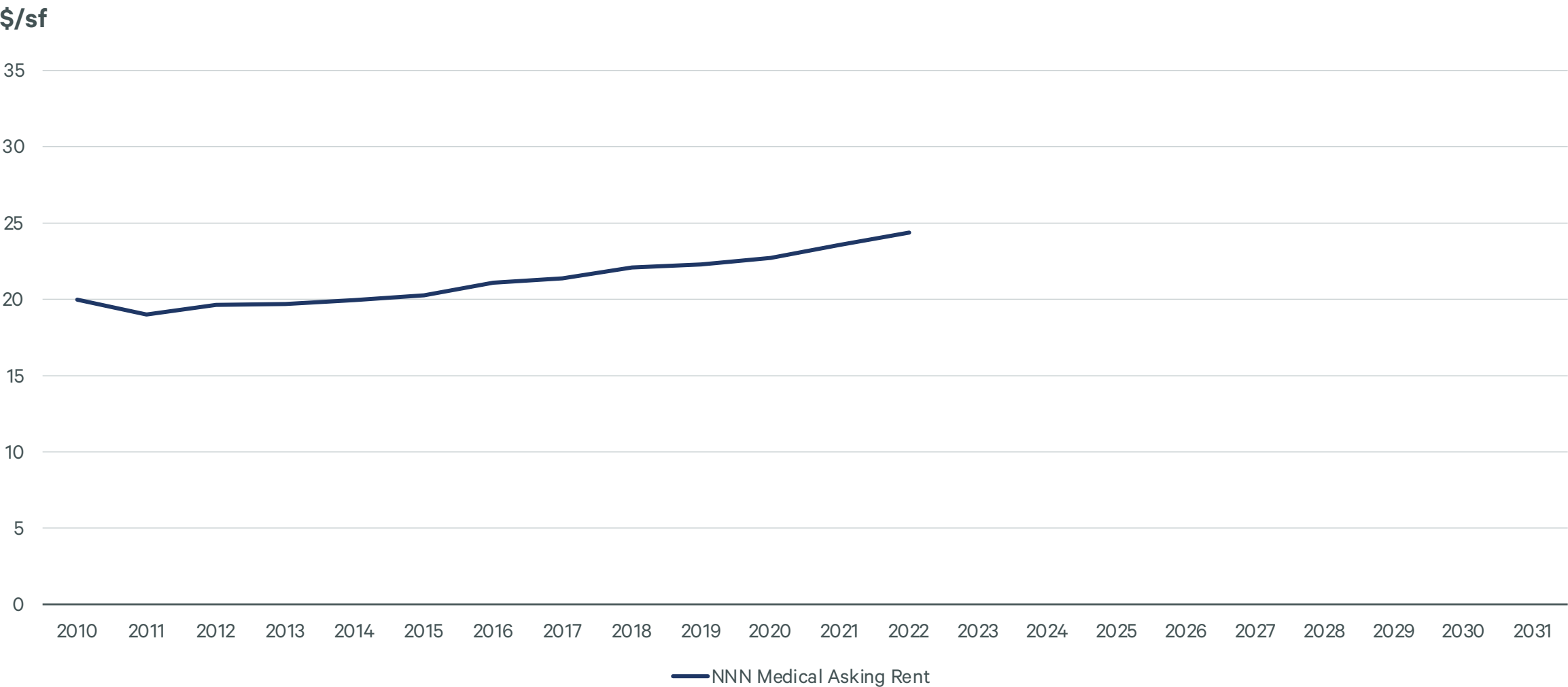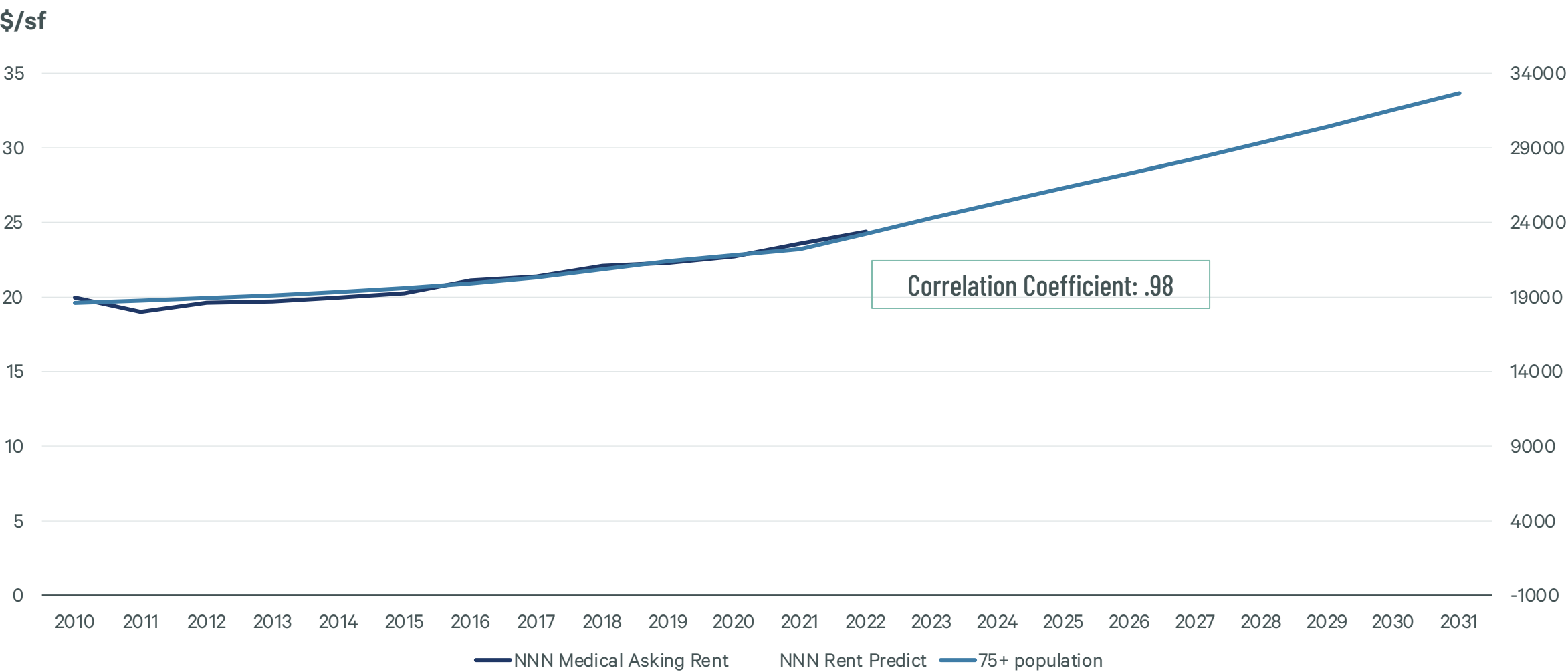
Source: CBRE Econometric Advisors.
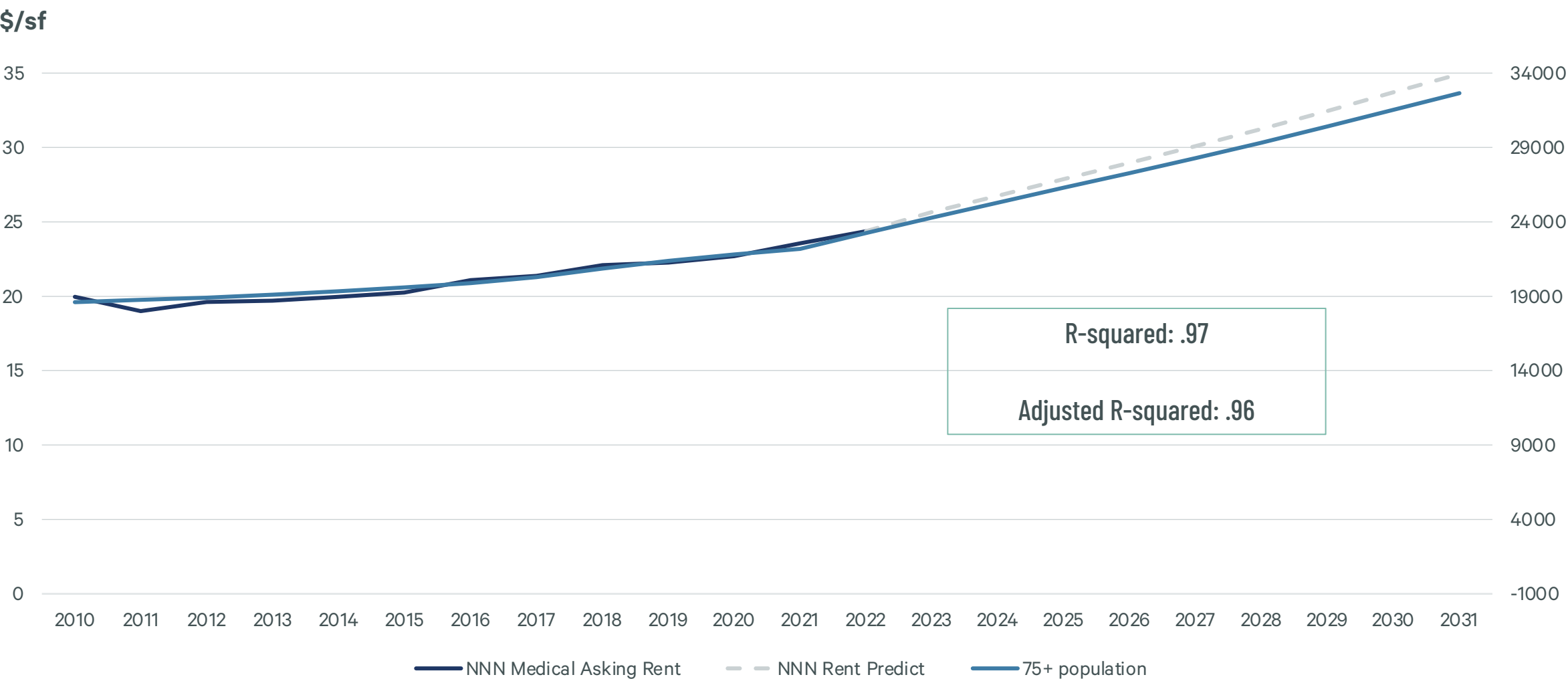
2

Introducing EA Effective Rent

Recap on EA Taking Rent methodology

Leveraging CBRE proprietary voucher data, we used a panel model to predict the gap between Asking Rent and Taking Rent using deal-level data.

– Deal-level lease size/lease term

– Market vacancy rate/ Market Asking Rent

– Suite-level matched-deal Asking Rent* (not just building average)

– We back cast EA Taking Rent by modeling the relationship between total consideration and a list of available variables.

EA Taking Rent and Discount Rate Between Taking and Asking

Discount Rate (%, RHS) EA Taking Rent

Free rent per year

- Voucher data input starting from 2010

- Free rent per year, on average, is comparably stable over the years

- Filtering:

  - First remove very long/short leases

  - Remove extreme free rent occurrences that are not representative

  - Free rent per year is then filtered based on three standard deviations

- We modeled free rent per year using a set of fixed effect on both year and market

Sum of Market: Modeled Free Rent Month for 7-Year Term

Source: CBRE Econometric Advisors.
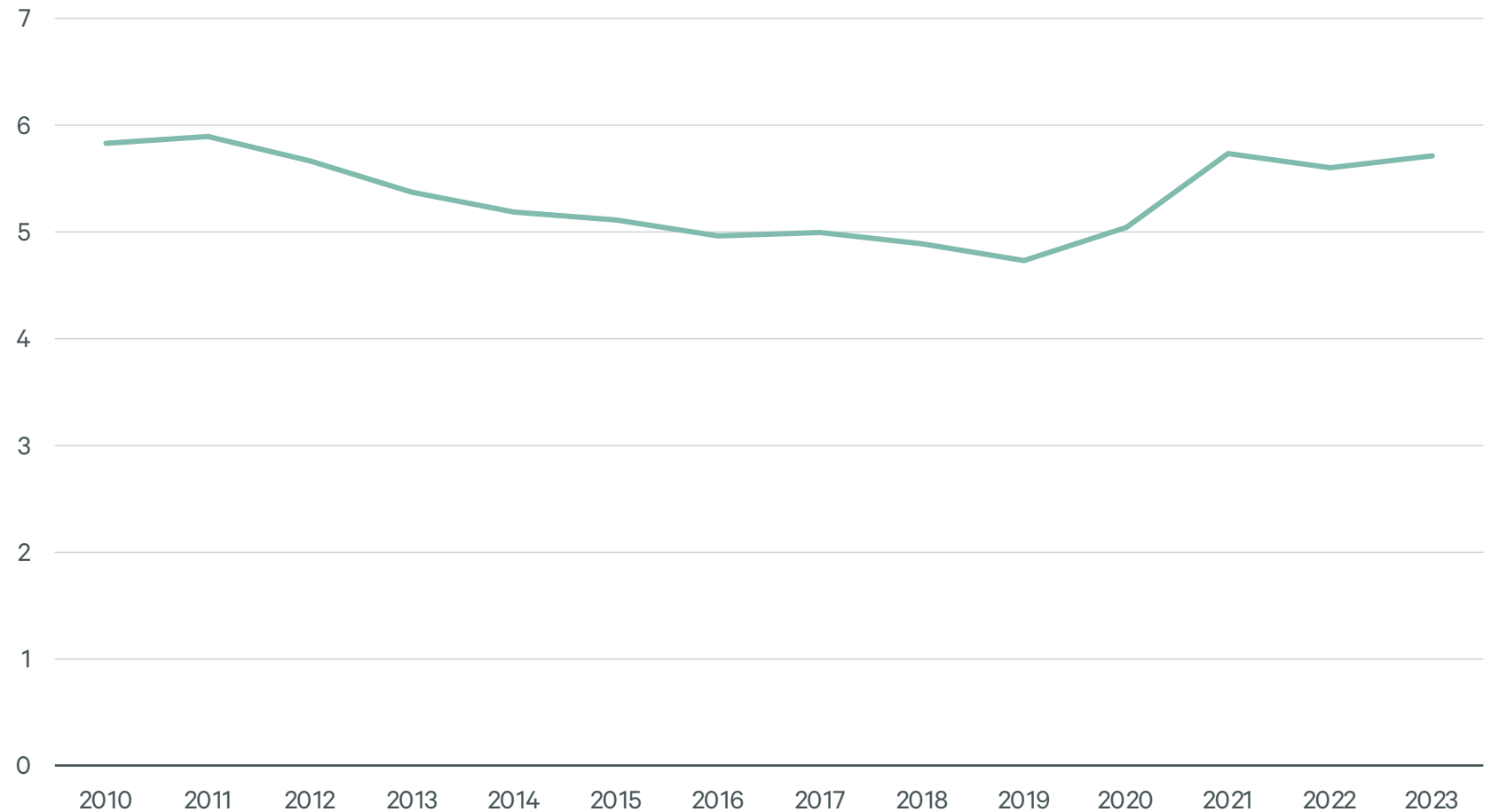
Rent escalation per year

- Voucher data input starting from 2010

- Rent escalation is calculated using base rent, end rent and lease term

- Filtering:
  - Remove extreme escalations that are not representative
  - Escalations are then filtered based on standard deviation

- We modeled rent escalation per year using fixed effect on year and market

Sum of Markets: Rent Escalation Per Year (%)
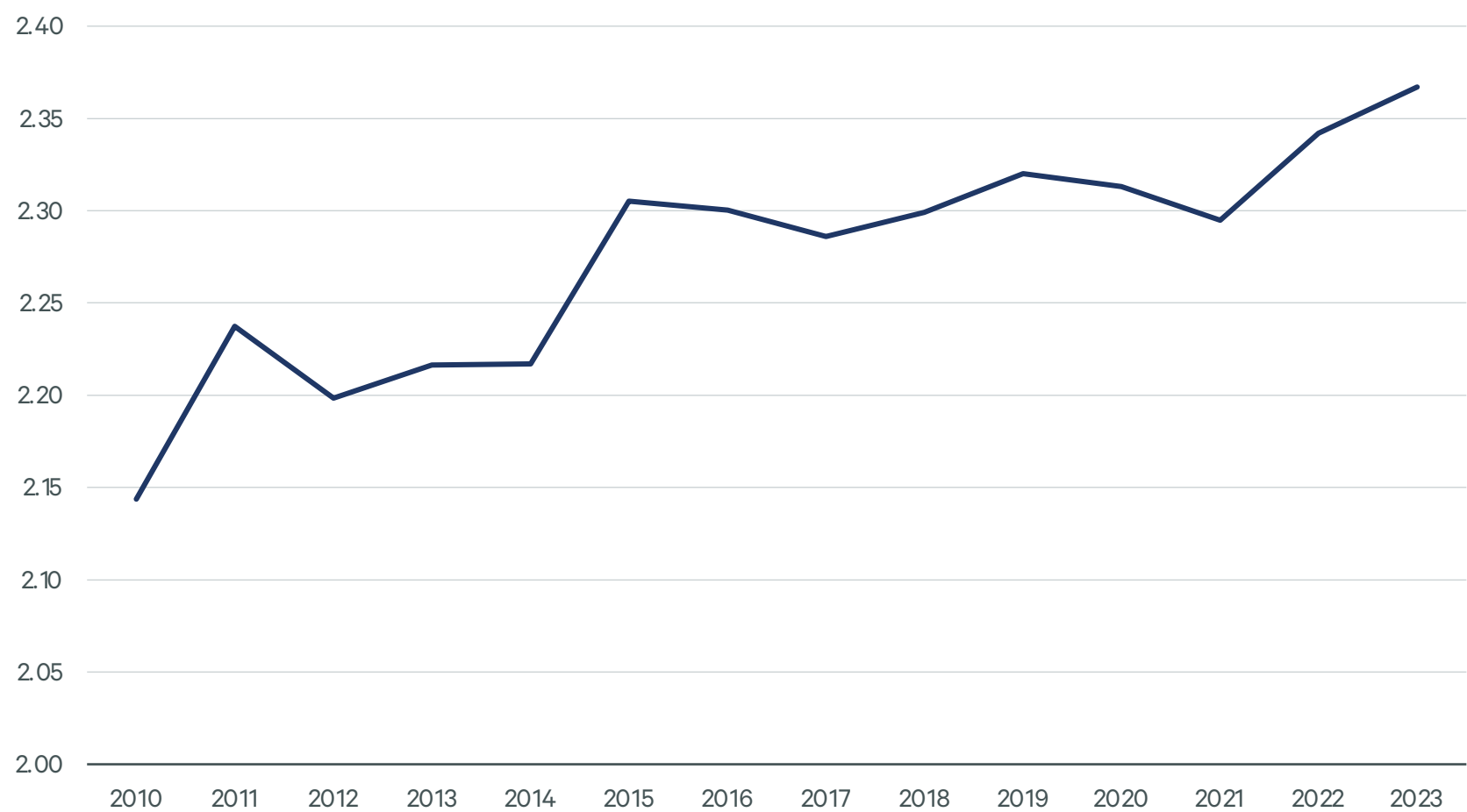
Source: CBRE Econometric Advisors.

Tenant improvement per square foot

Sum of Market

- Data input: CBRE Lease Comp data and VTS

- A generalized linear model (GLM) with a Poisson distribution and log link function

- log(tipersf)~

  leasingsf+leaseterm+baserent+lag.realtbond + realrentgr +lead.inflation+ marketcode6

- And we use the coefficient and feed it market-level Taking Rent, setting the leasing sq. ft. to 20,000 sq. ft. and 7-year lease term

- Different inputs will produce different results

Legend: Model TI per SF — Taking Rent

Source: CBRE Econometric Advisors.
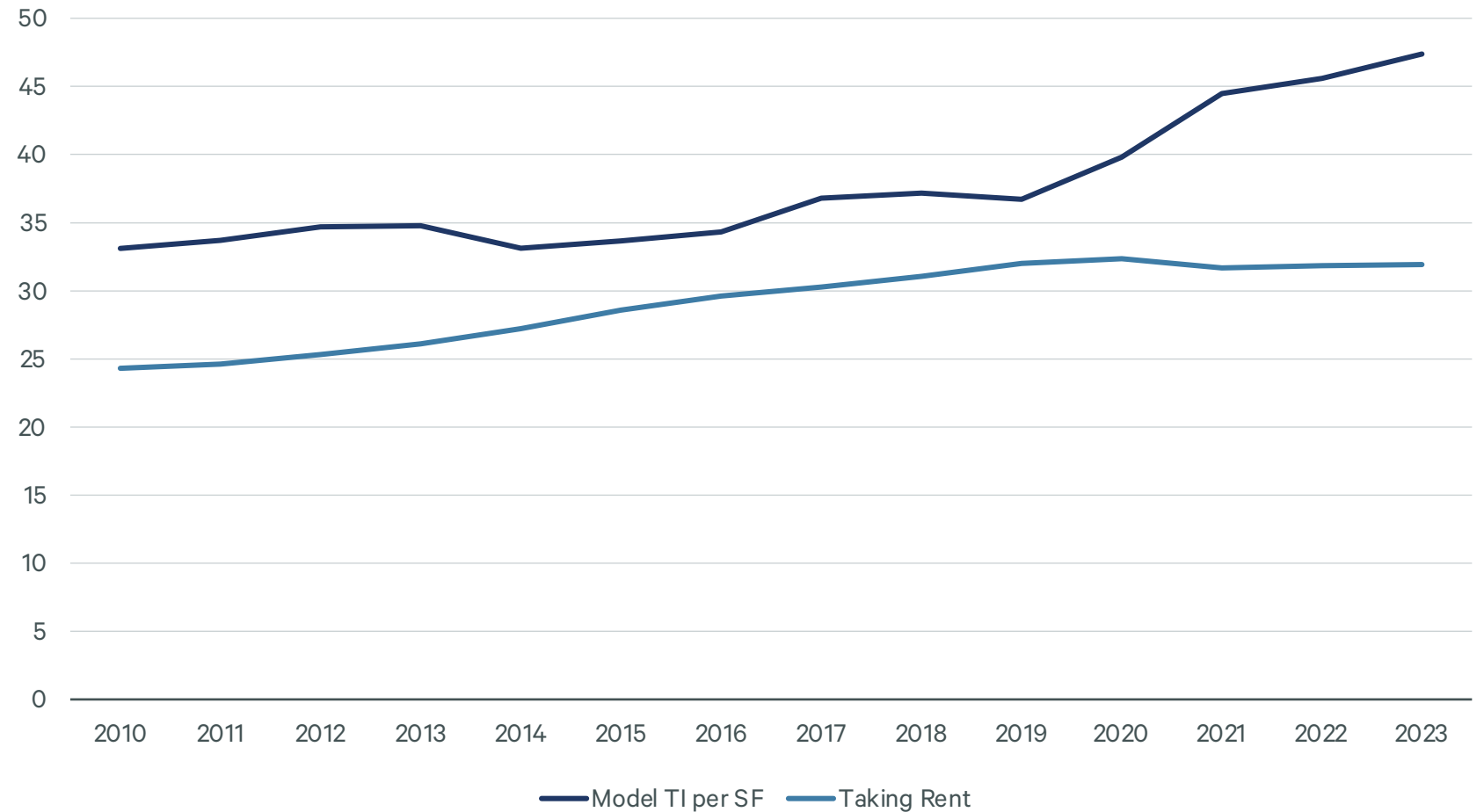
Put these components together– EA Effective Rent

- Assumptions for market-level Effective Rent:
  - 7-year lease term
  - Discount rate of 8.2% (the long-term office NCRIEF total return, 1978 to current quarter)
- Calculate cash flows
  - TI in cashflow 0
  - Deduct free rent periods' rental income from cashflow 1
  - Rent growth using predicted rent escalation
- Calculate the NPV of those cashflows using discount ratio
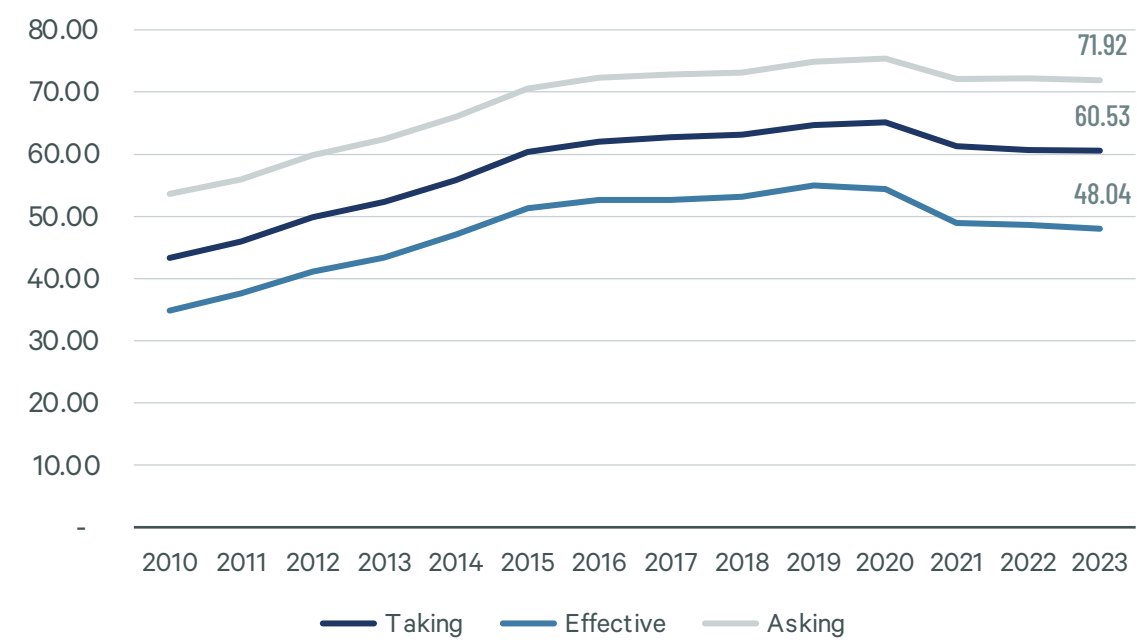- Calculate a PMT term which is the Effective Rent

Sum of Markets

Legend: Taking — Effective — Asking

Values labeled on chart: 35.48, 31.93, 22.18
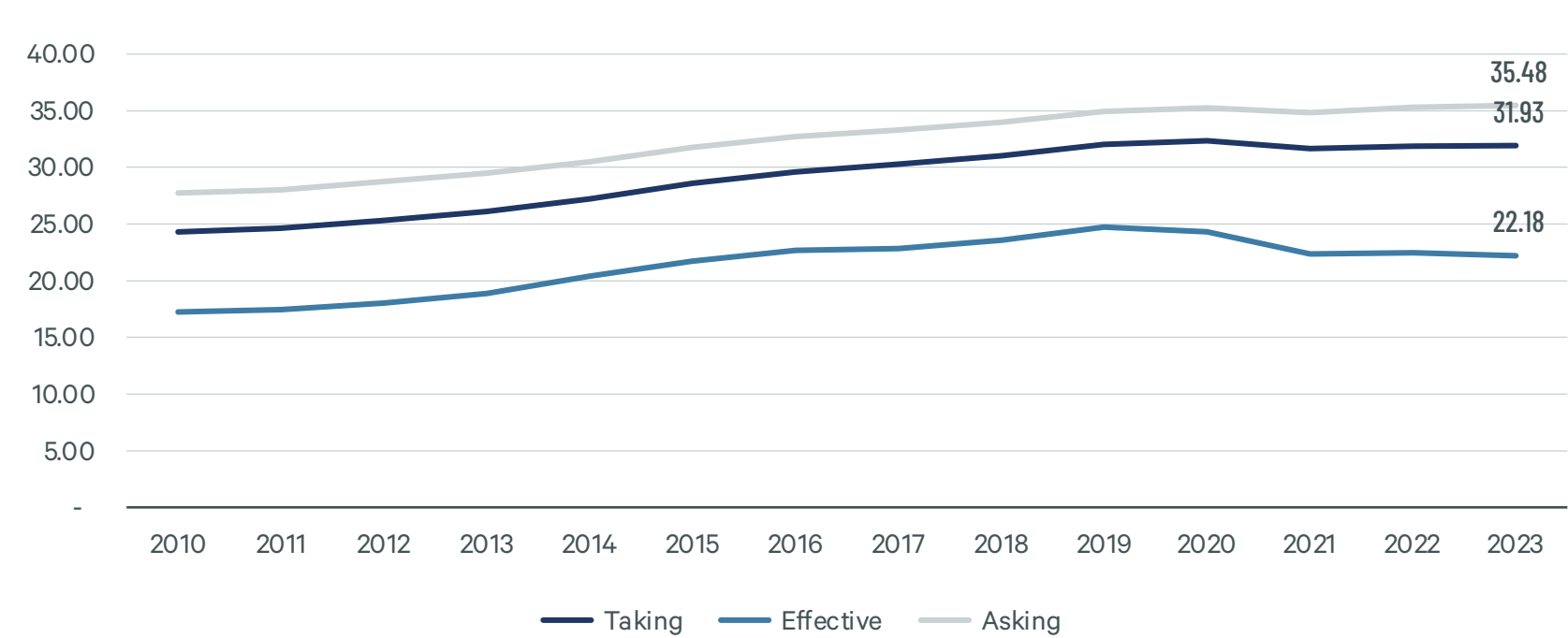
	Decline since Pre-pandemic	Current Gap between Asking
Asking Rent	1.6%	n/a
Taking Rent	-0.3%	10%
Effective Rent	-10.3%	37%

Source: CBRE Econometric Advisors.

Example markets' rents performance

Manhattan

Legend: Taking — Effective — Asking

	Decline since Pre-pandemic	Current Gap between Asking
Asking Rent	-3.9%	n/a
Taking Rent	-6.4%	16%
Effective Rent	-12.6%	33%

Source: CBRE Econometric Advisors.

San Francisco

Legend: Taking — Effective — Asking
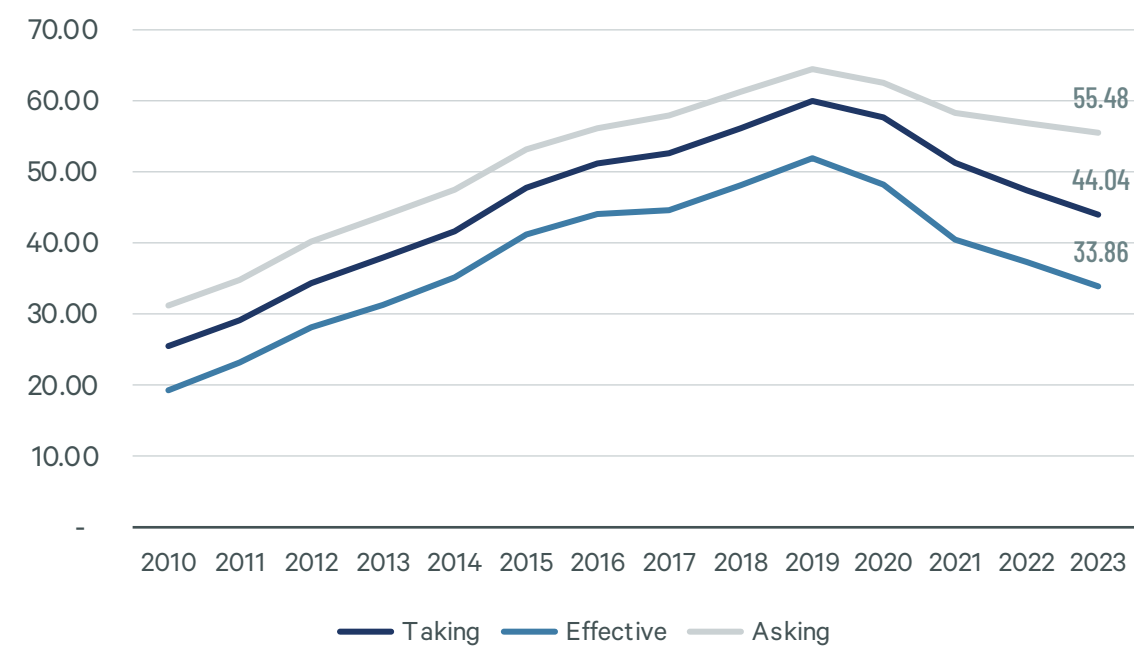
	Decline since Pre-pandemic	Current Gap between Asking
Asking Rent	-14%	n/a
Taking Rent	-26.6%	21%
Effective Rent	-34.8%	39%

Source: CBRE Econometric Advisors.

Final Product

- EA Effective Rent on quarterly basis

  - Interpolated using cubic spline method (used to interpolate data points and create a smooth curve that passes through the data points).

- 61 Tier 1 markets

- Starting point from Q4 2010 (some a bit later)

- Next steps:

  - Back cast to early 1990s

  - Share down the market-level Taking Rent and Effective Rent to submarket level

  - Incorporate OPEX data and create EA Net Effective Rent

EA Effective Rent

Sum of Markets
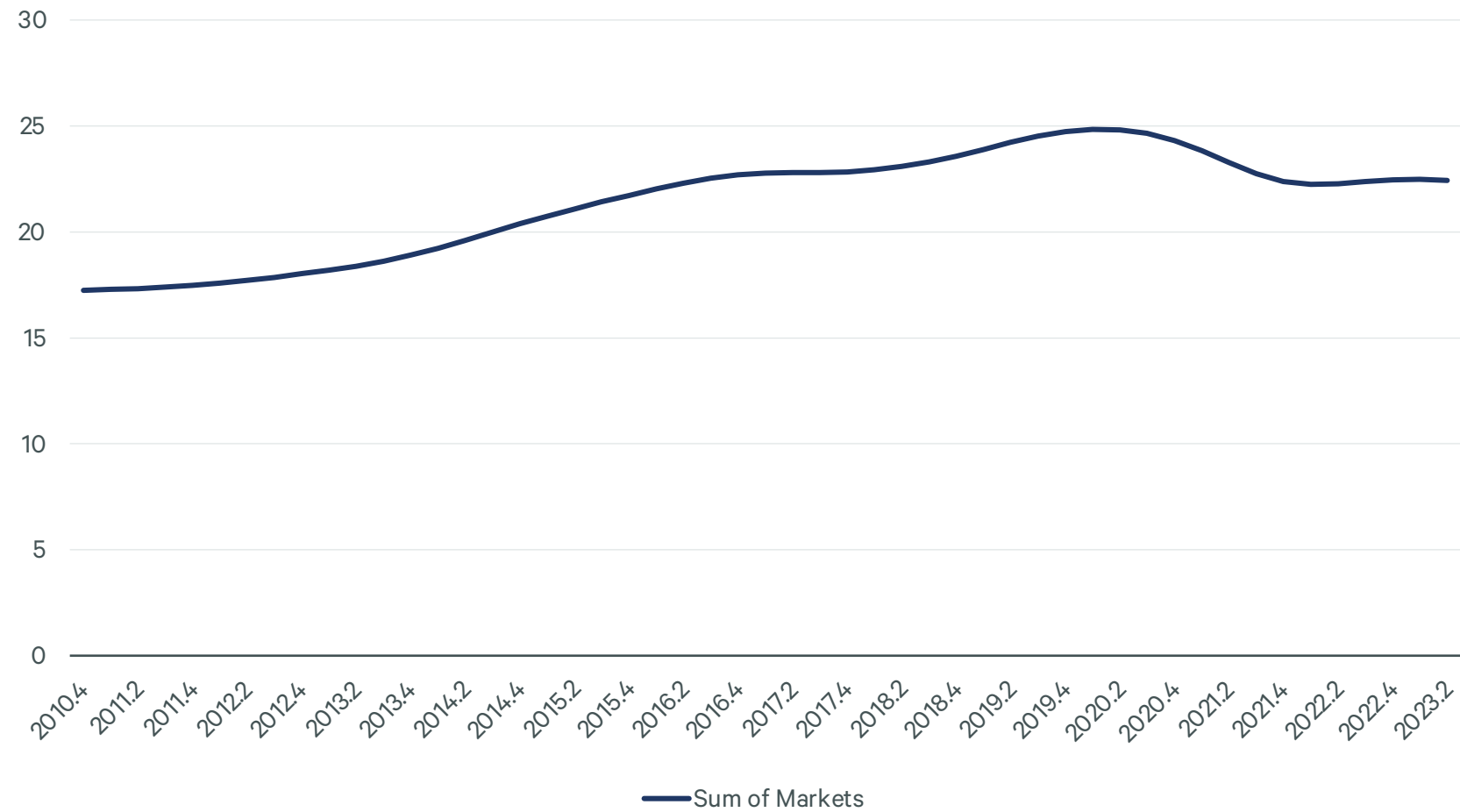
3

Hurdle Rates for Evaluating Long-term Commercial Real Estate Investment Opportunities
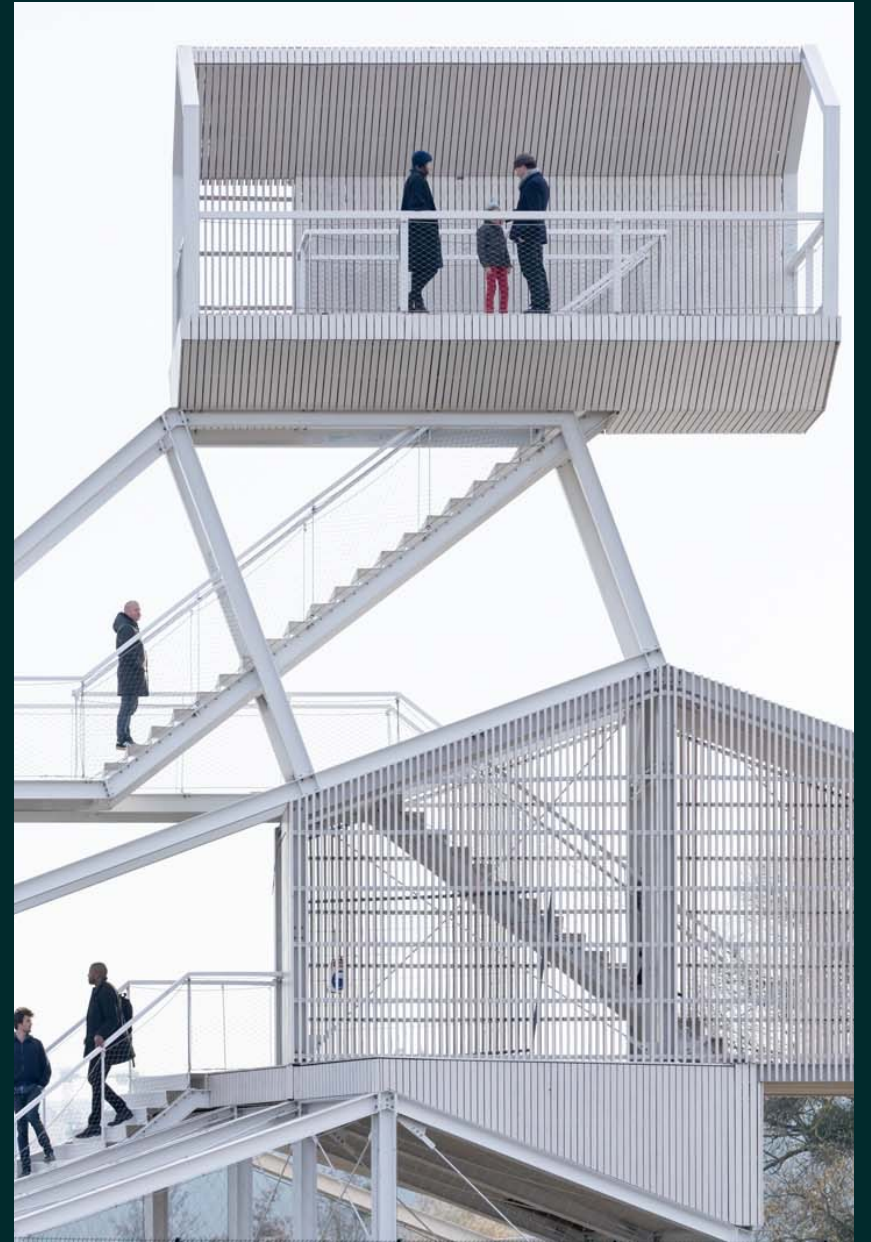
Towards a Hurdle Rate Model

Why?

EA has a long history of forecasting CRE fundamentals that drive absolute returns. We need to compare these against objective measures of risk.

What?

A model that assigns each EA market a required rate of return in each quarter to compare against your expected returns.
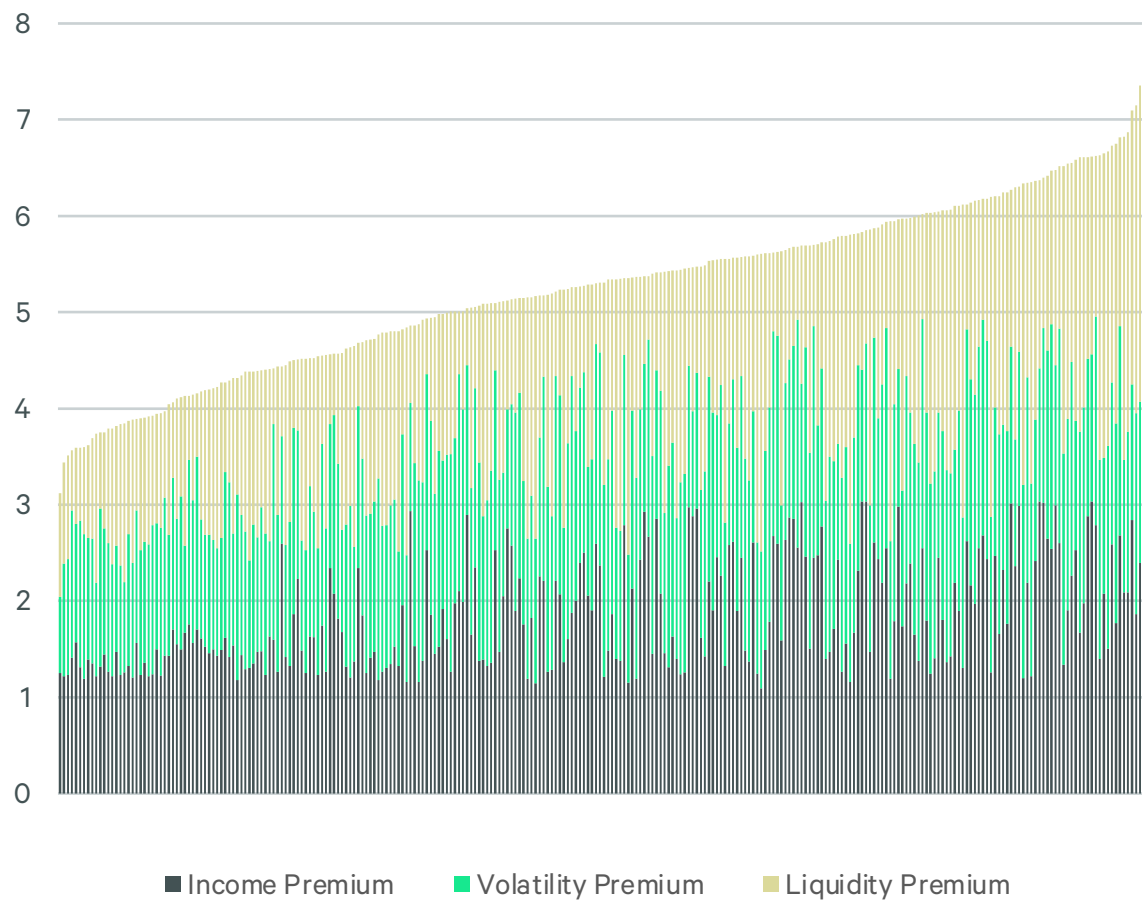
So What?

The output of this model can help suggest markets to make core equity investments with the greatest risk-adjusted returns.

The Hurdle Rate framework in a nutshell

– This framework is appropriate for core investors and assumes no leverage.

– To reflect long-term returns, our expected return is the sum of Capex adjusted income yield and annualized 10-year NOI growth.

– It reflects market average returns and does NOT rule out particular deals in un-investable markets as each property is unique.
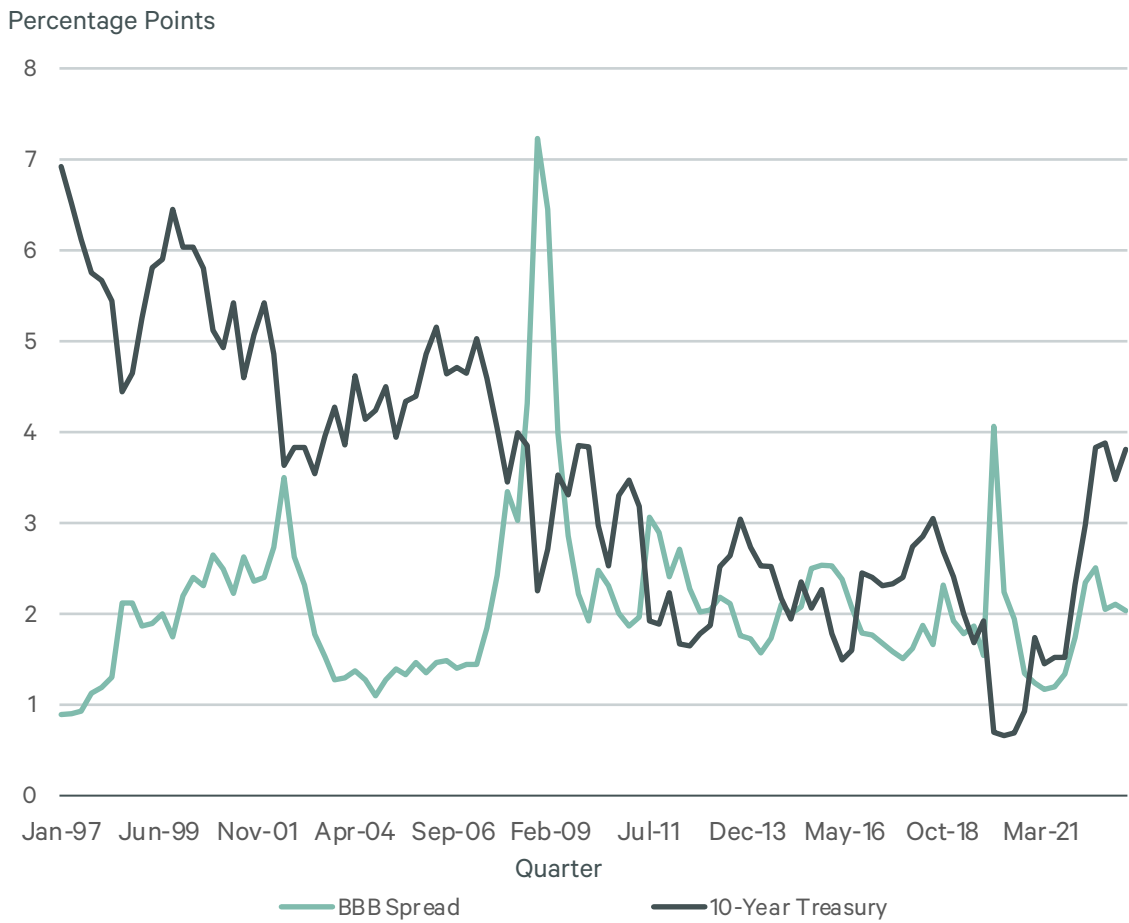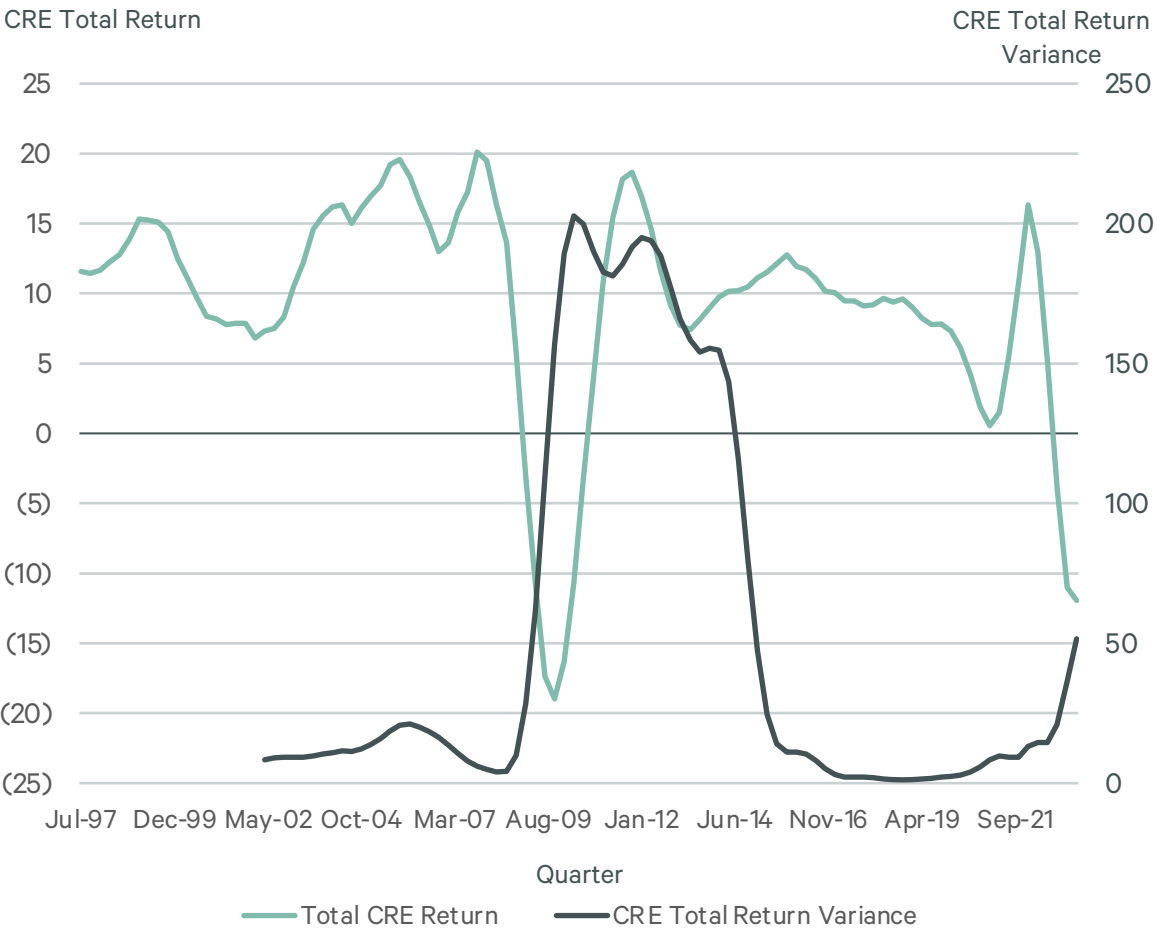

Expected Return: 10-Year NOI Growth, Income Yield

Hurdle Rate: Volatility Premium, Illiquidity Premium, Income Insecurity Premium, 10-Year Treasury
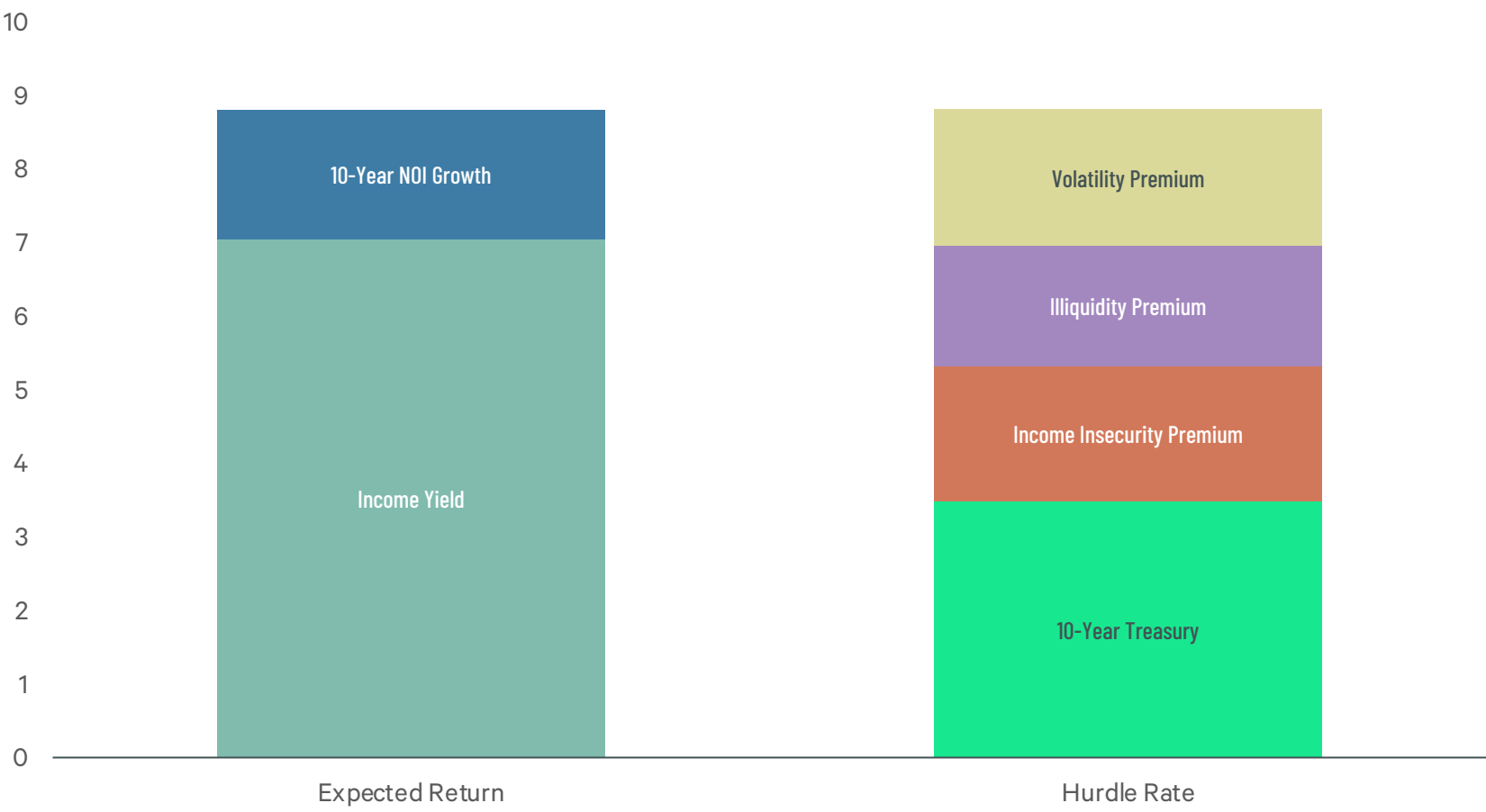
What do current hurdle rates tell us?

Q2 2023 Hurdle Rates by Sector

Legend: ■ Income Premium ■ Volatility Premium ■ Liquidity Premium

What is driving our CRE premia?

Percentage Points

Left chart legend: BBB Spread, 10-Year Treasury
X-axis: Jan-97, Jun-99, Nov-01, Apr-04, Sep-06, Feb-09, Jul-11, Dec-13, May-16, Oct-18, Mar-21 (Quarter)

Source: Macrobond.

CRE Total Return | CRE Total Return Variance

Right chart legend: Total CRE Return, CRE Total Return Variance
X-axis: Jul-97, Dec-99, May-02, Oct-04, Mar-07, Aug-09, Jan-12, Jun-14, Nov-16, Apr-19, Sep-21 (Quarter)

Source: Macrobond.

Historical analysis confirms Hurdle Rates approach

Average Hurdle Rate by Component

Legend: 10-Year Treasury · Volatility Premium · Income Premium · Liquidity Premium
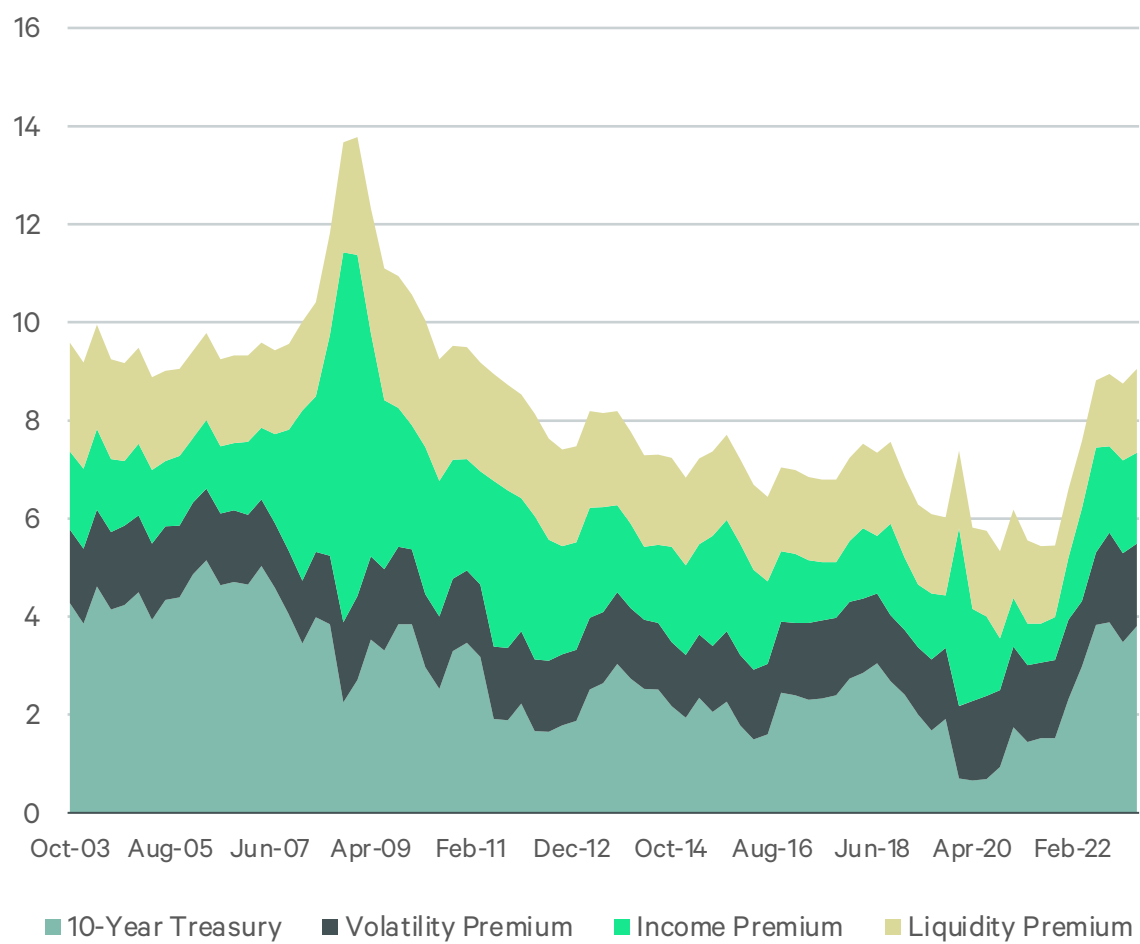
Average Hurdle Rate by Sector

Legend: Risk-Free Rate · Industrial · Multifamily · Office · Retail
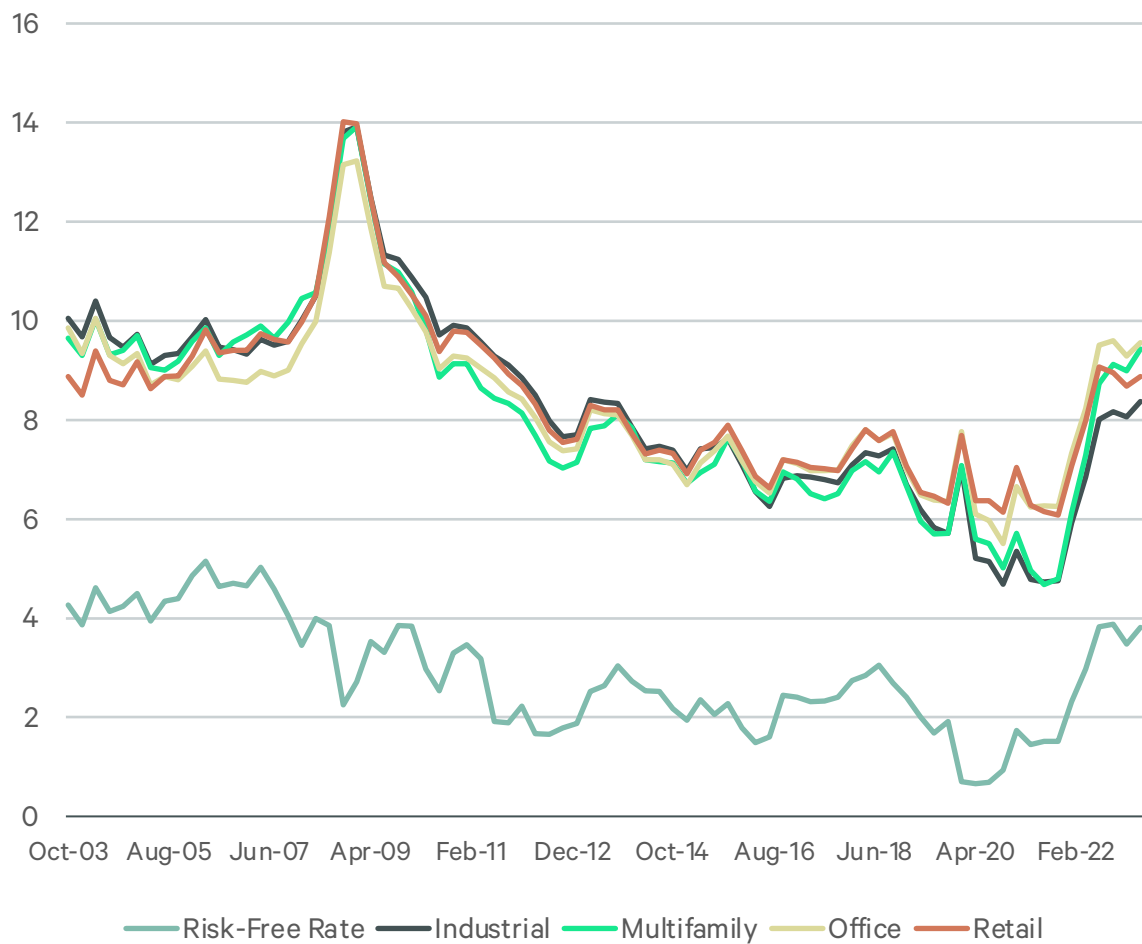
Bringing this all together

Relative attractiveness mainly concentrated in industrial

Baseline Expected Return vs. Required Rate of Return Q2 2023

Sector	Attractive Markets	Less Attractive Markets
Industrial	36	32
Multifamily	7	62
Office	0	64
Retail	7	61

Source: CBRE Econometric Advisors.

Severe Downside shows implications for attractiveness

Severe Downside Expected Return vs. Required Rate of Return Q2 2023

Upside Expected Return vs. Required Rate of Return Q2 2023

Legend: ■ Industrial ■ Multifamily ■ Office ■ Retail ── Required Return Threshold
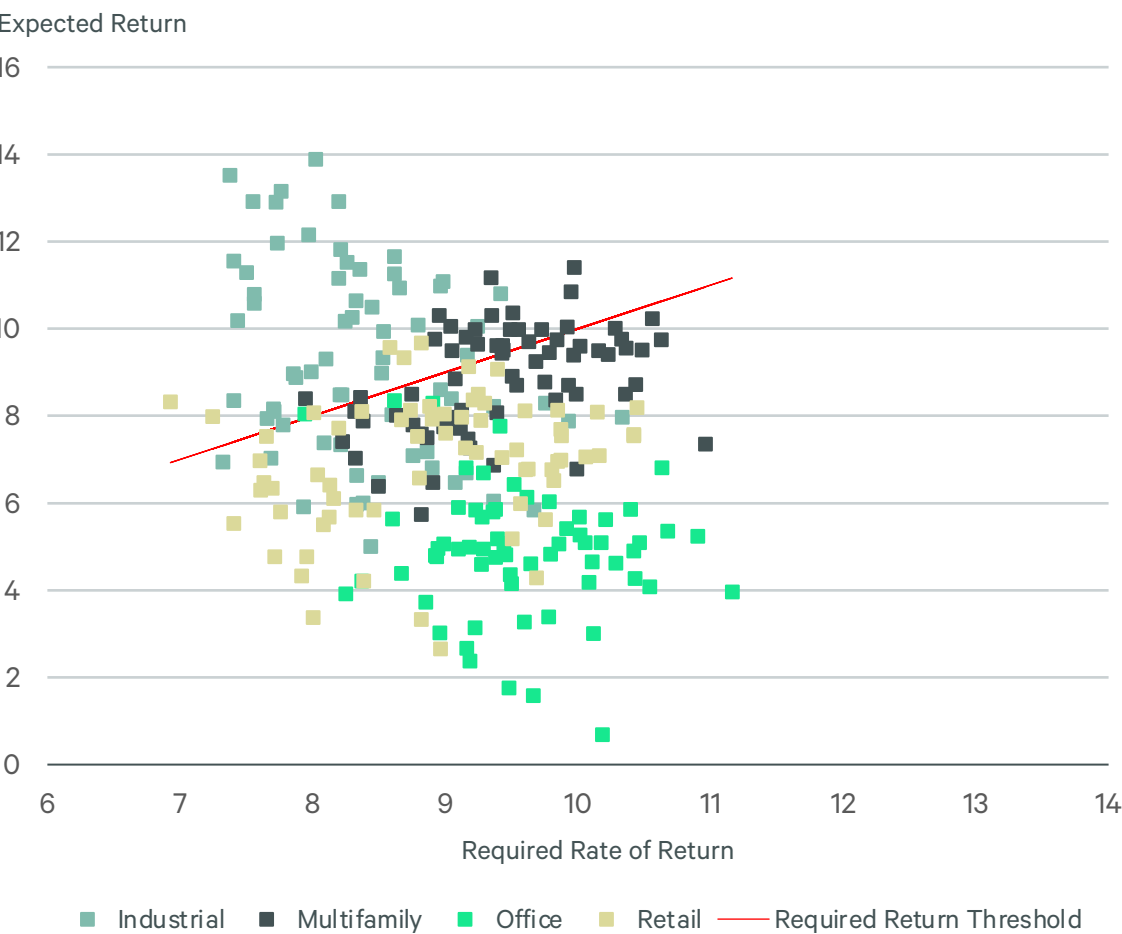
Which markets show attractiveness?

Industrial

- Salt Lake City
- Los Angeles
- Charlotte
- Tampa
- Miami

Retail

- Nashville
- Atlanta
- Phoenix
- Tampa
- Orlando

Office

- Las Vegas
- Norfolk
- Albuquerque
- West Palm Beach
- Miami

Multifamily

- Detroit
- Columbus
- Kansas City
- Cincinnati
- Norfolk
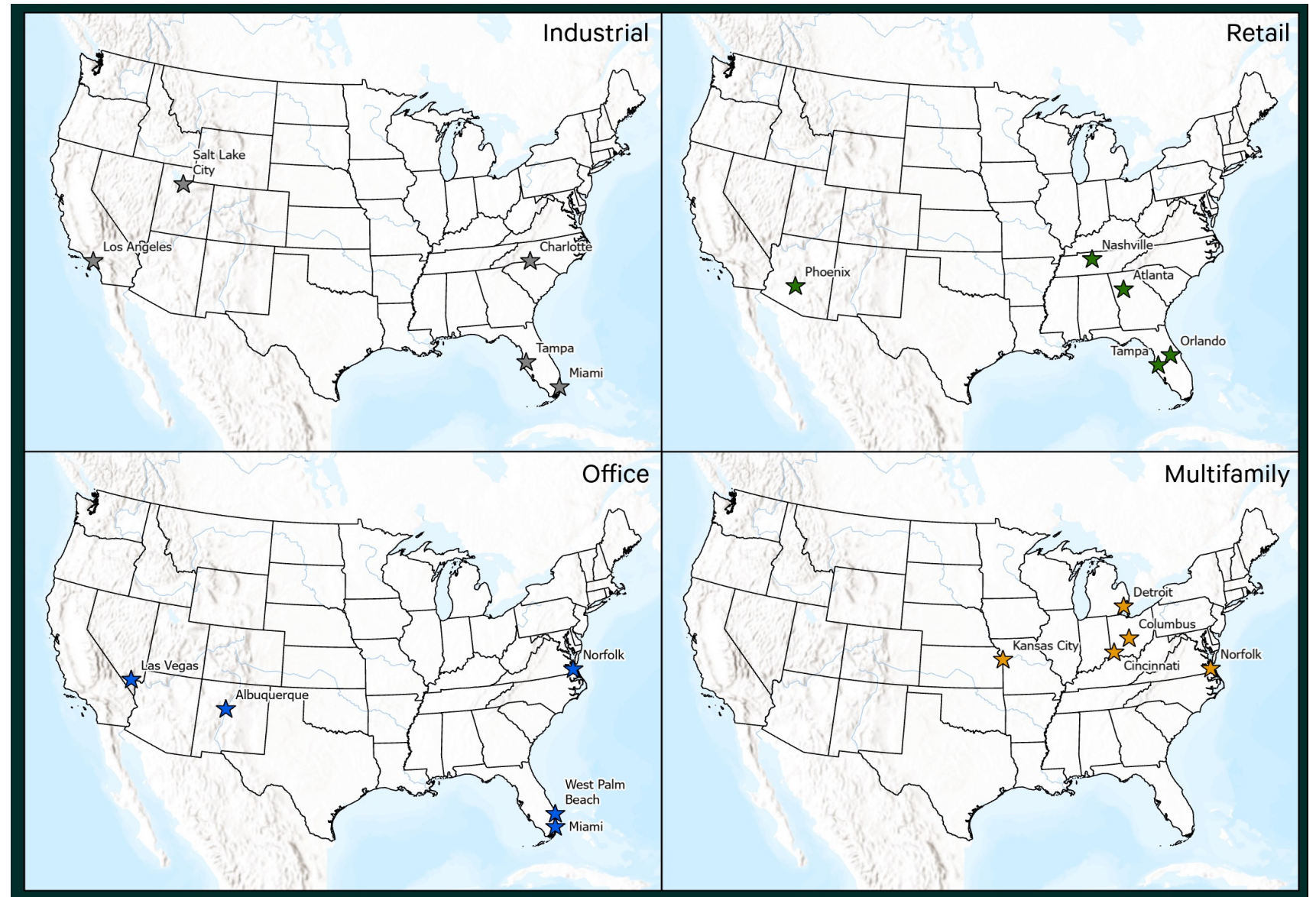
Closing Remarks

ECONOMETRIC ADVISORS
Dennis Schoenmaker, Ph.D.

Principal Economist
Executive Director
dennis.schoenmaker@cbre.com

Thank you

<div align="right">CBRE</div>

Gracias   ধন্যবাদ   Salamat   Asante   धन्यवाद   Obrigado   Tack   謝謝   O Se   Спасибо   감사합니다

Bedankt   Grazi   ਪੰਨਵਾਦ   Merci   תודהشكريه   Teşekkürler   Danke   ありがとう   Dziękuję   Terima Kasih   شكرا

FOR MORE INFORMATION

Dennis Schoenmaker, Ph.D.

Principal Economist
Econometric Advisors
dennis.schoenmaker@cbre.om

Kasia Dziewulska, MSc

Executive Director
Econometric Advisors
kasia.dziewulska@cbre.com

Matt Mowell

Sr. Managing Economist
Econometric Advisors
matt.mowell@cbre.com

Stefan Weiss

Sr. Managing Economist
Econometric Advisors
stefan.weiss@cbre.com

CBRE Group, Inc 2100 McKinney Ave Suite 700, Dallas, TX 75201