

CENTRAL BANK SEMINAR

OCTOBER 2024

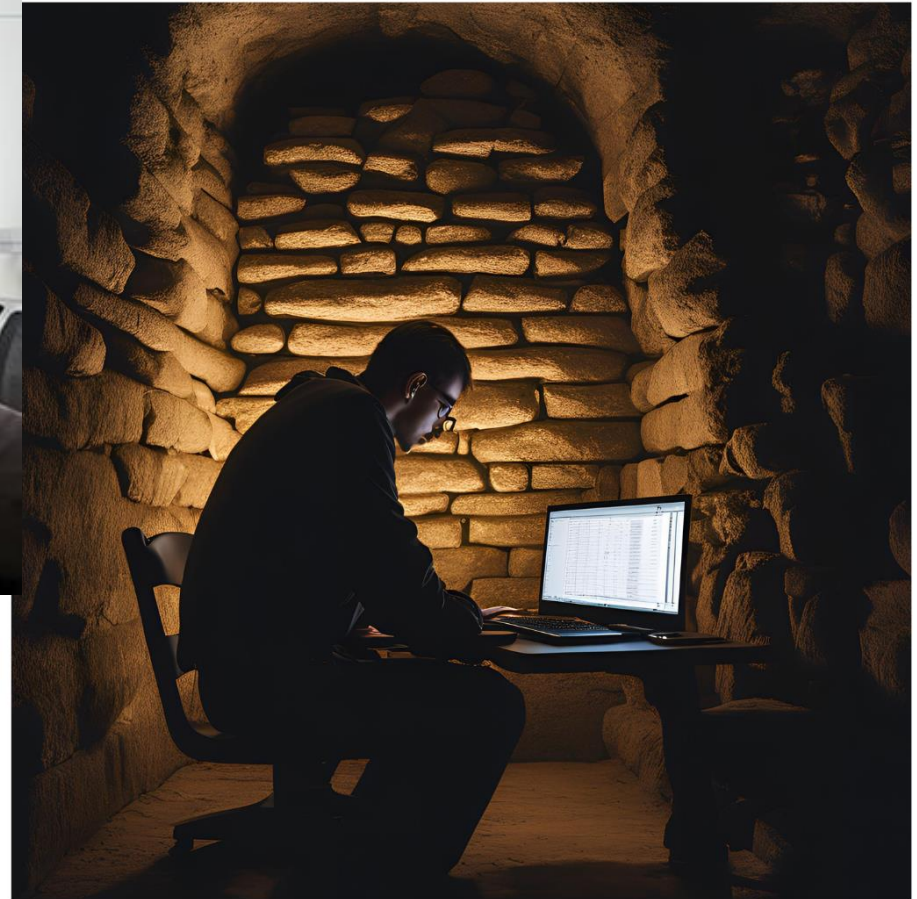
CAIM CENTRAL BANK SEMINAR

No death by PowerPoint (but torture by Excel)



Learning **about** something vs.
learning **to do** something

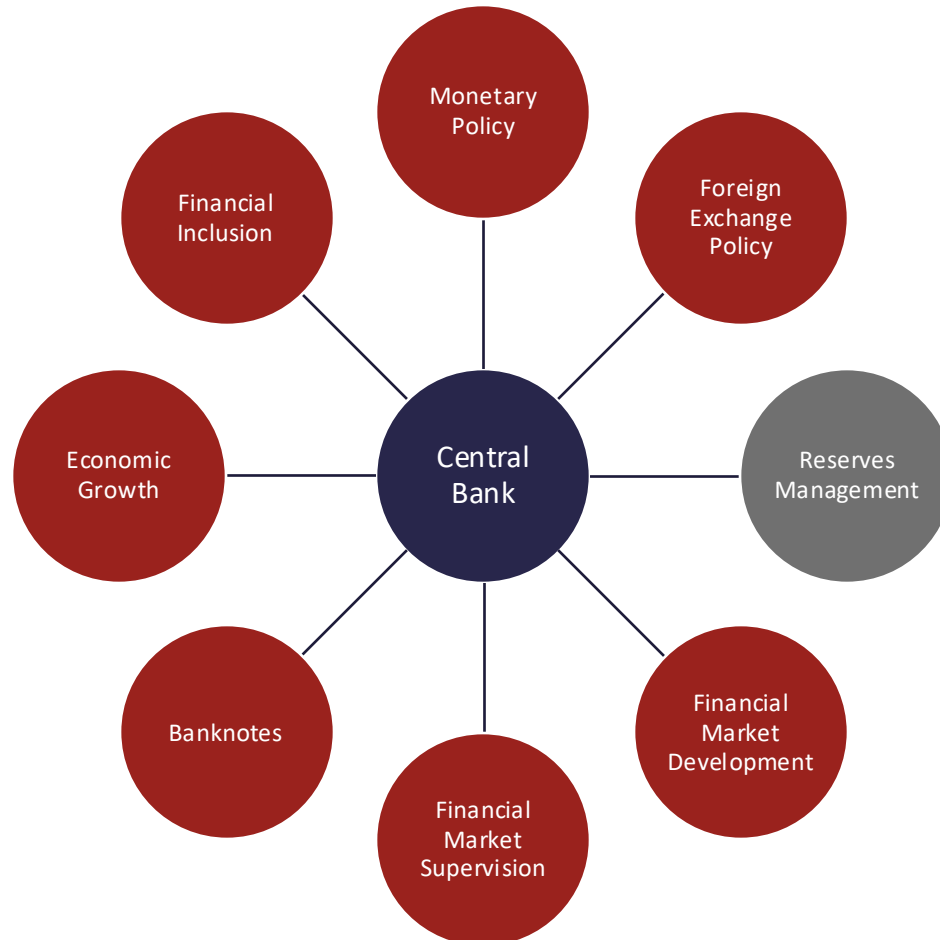
Images: LinkedIn (Jenny Jay Pollock via www.prdaily.com), canva.com



RESERVES MANAGEMENT

WHY TALK ABOUT RESERVES MANAGEMENT?

Balancing profitability and access to finance



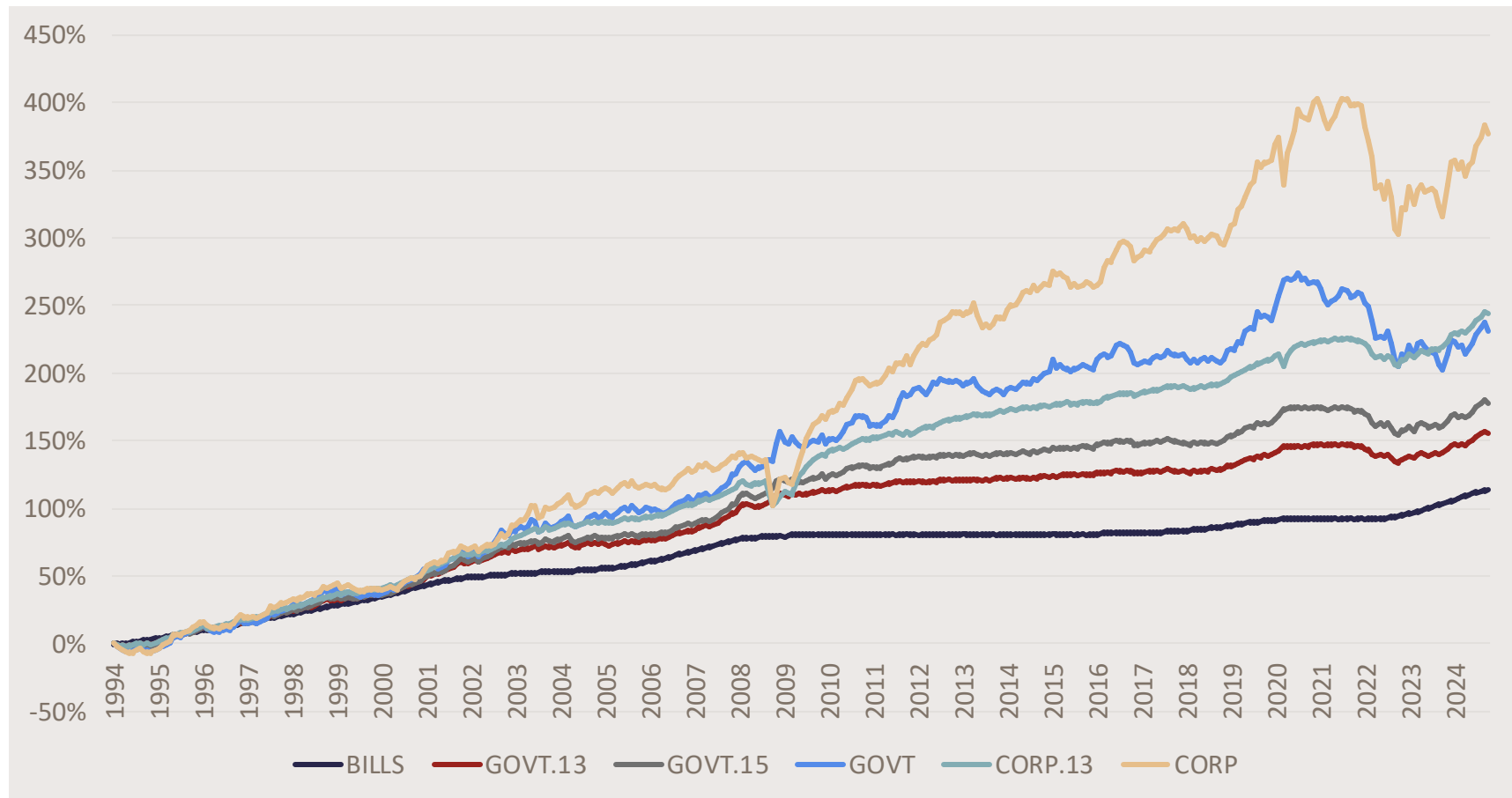
IMF Guidelines for Foreign Reserves Management:

- support and maintain confidence in the policies for monetary and exchange rate management including the capacity to intervene in support of the national or union currency;
- limit external vulnerability by maintaining foreign currency liquidity to absorb shocks during times of crisis or when access to borrowing is curtailed and in doing so;
- provide a level of confidence to markets that a country can meet its external obligations;
- demonstrate the backing of domestic currency by external assets;
- assist the government in meeting its foreign exchange needs and external debt obligations; and
- maintain a reserve for national disasters or emergencies.

Source: IMF, 2001

MORE RESERVES = MORE BETTER

Investing only in the most “conservative” assets hurts income and balance sheet growth



Source: CAIM, Bloomberg, October 2024

RESERVES MANAGEMENT OBJECTIVES

The traditional trinity is always subject to interpretation, dependent on institutional objectives

- **SAFETY**

- Capital preservation has traditionally been an important objective for strategic reserves management policies
 - *How to measure “safety”?*

- **LIQUIDITY**

- Central banks like to own freely marketable securities that can be liquidated quickly with minimal transaction costs if necessary
 - Central bank reserves assets are generally liquid – public market investment grade securities
 - Liquidity can degrade rapidly in times of market stress
 - Deposits are relatively illiquid instruments

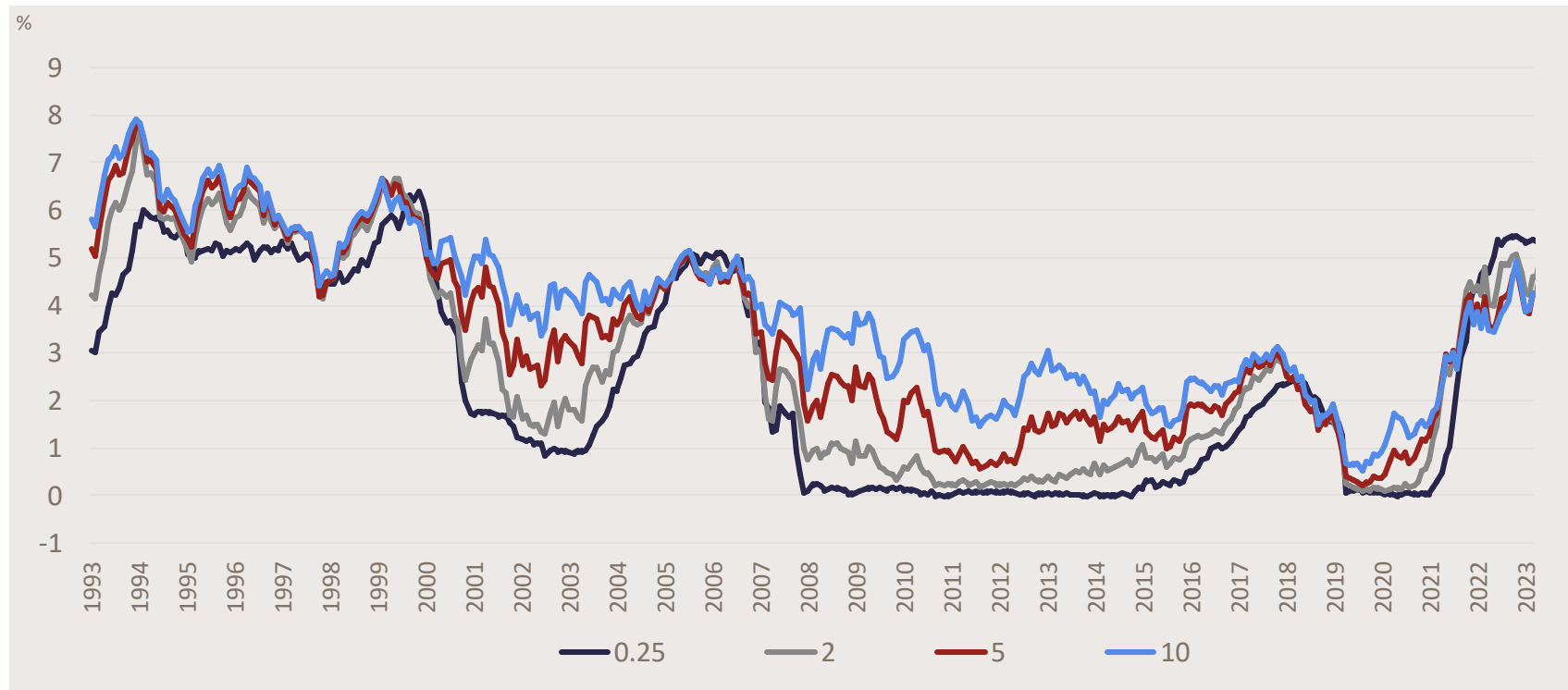
- **RETURN**

- Often cited as only the third priority (after safety and liquidity), many central banks nonetheless rely on income from reserves management to support budgets

A WILD RIDE AFTER POST-GFC DOLDRUMS

Yields have returned to levels not seen since before the Great Financial Crisis

Fed Funds rate and selected US Treasury yields



Source: Bloomberg, October 2024

FROM THE ARCHIVES: SUMMER 2021

Capital preservation had not been available since the global pandemic started

RESERVES MANAGEMENT OBJECTIVES

Historical objectives are no longer attainable in the current market environment, but ample opportunities exist to improve reserves management outcomes

- **SAFETY**

- Capital preservation has traditionally been an important objective for strategic reserves management policies

- *Capital preservation is not available in current market conditions*

- **LIQUIDITY**

- Central banks like to own freely marketable securities that can be liquidated quickly with minimal transaction costs if necessary
 - Central bank reserves assets are generally liquid – public market investment grade securities
 - Shrinking broker balance sheets can impede (and have impeded) liquidity in times of market stress
 - Deposits are relatively illiquid instruments

- **RETURN**

- Often cited as only the third priority (after safety and liquidity), many central banks nonetheless rely on income from reserves management to support budgets
 - Expected returns are materially lower than historical averages in the current market environment

Options exist to improve reserves portfolio outcomes, subject to current market realities

FROM THE ARCHIVES: JANUARY 2023

Expected positive outlooks for bond markets materialised

AFTER THE STORM

CAIM | CROWN AGENTS
INVESTMENT
MANAGEMENT

The sky begins to clear - 2023 should bring interesting investment opportunities



PRIVATE & CONFIDENTIAL

2

NUMBERS FOR RESERVES MANAGERS TO REMEMBER

"Traditional" reserves portfolio assets have return potential not seen since the Global Financial Crisis

1.07%

Annualised return of ICE US 1-3 year Treasury Index, 2009-2020

[CAIM: Capital protection unavailable]

-0.55%

Return of ICE US 1-3 year Treasury Index, 2021

-3.65%

Return of ICE US 1-3 year Treasury Index, 2022

4.26%

Return of ICE US 1-3 year Treasury Index, 2023

[CAIM: Sunny skies ahead]

3.71%

Return of ICE US 1-3 year Treasury Index, YTD October 2024

3.95%

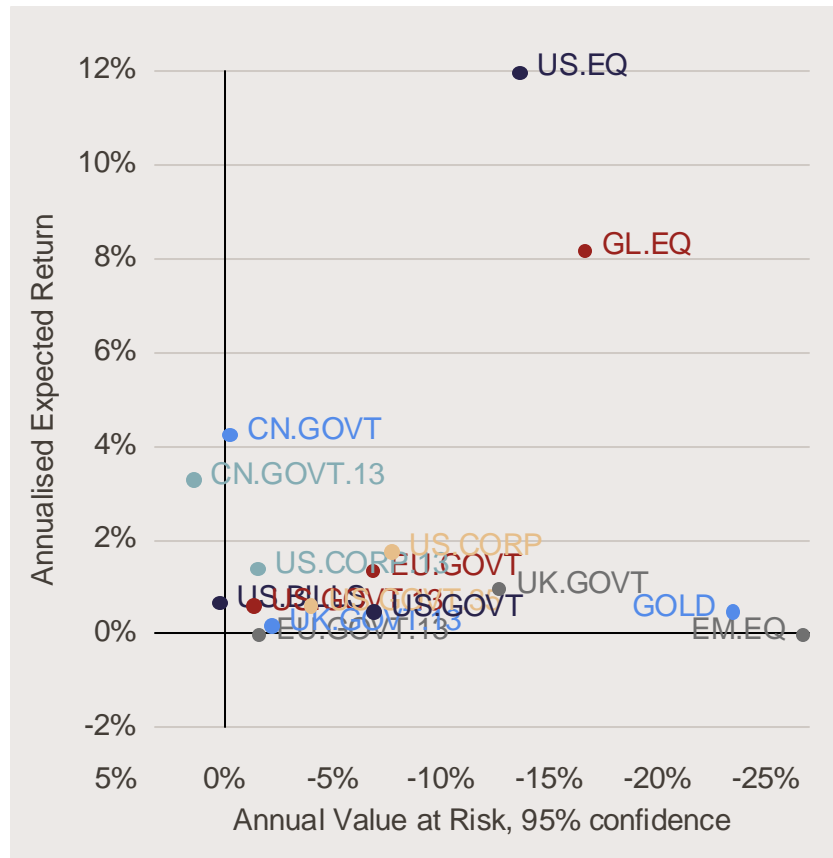
US 2-year Treasury yield, October 11, 2024

Source: CAIM, October 2024

THEN VS. NOW

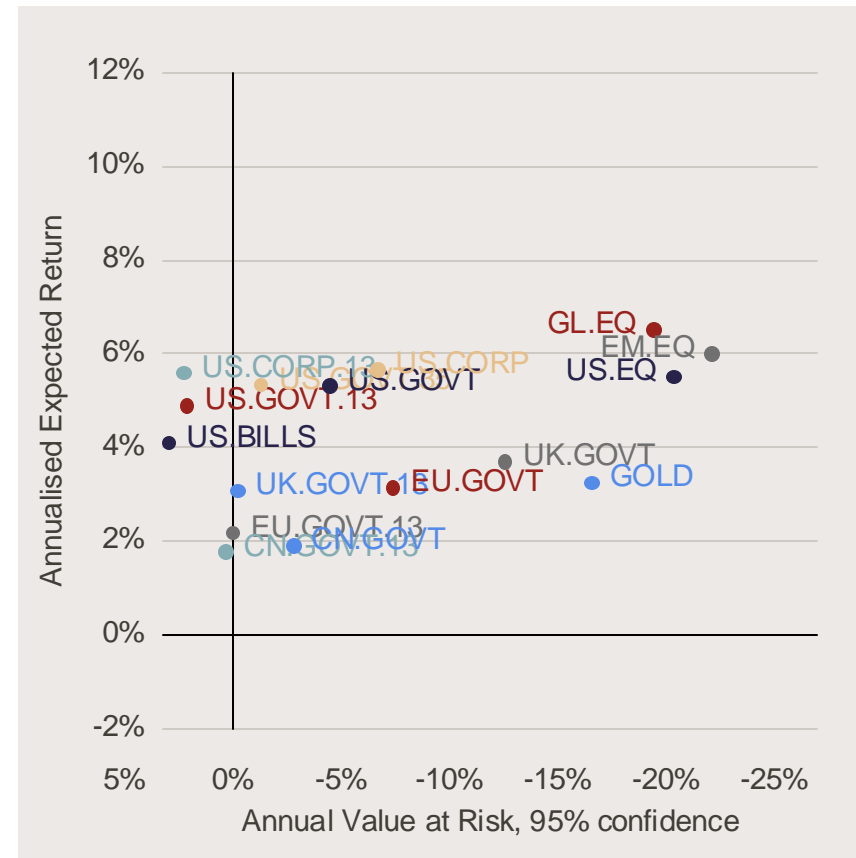
**Expectations for income and capital preservation – unavailable in 2021,
now returned since 2023**

Historical local annualised return and risk (2012 - 2023)



Source: CAIM, January 2023. Please see appendix for asset class abbreviations

Forward-looking local annualised return and risk from 2023

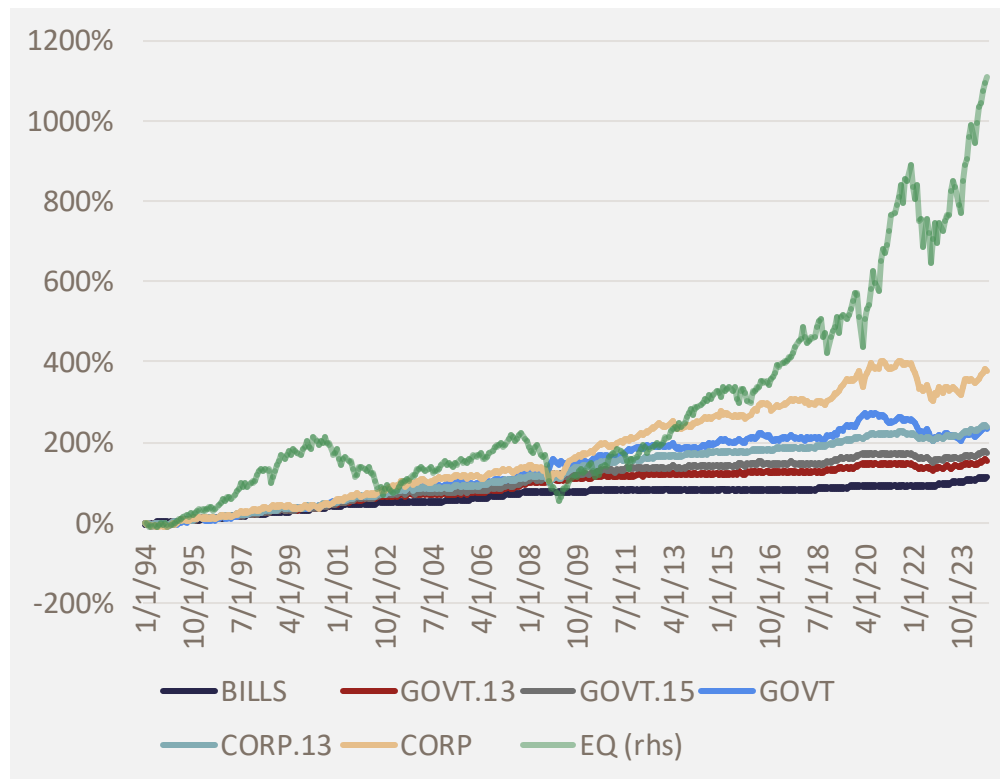


Source: CAIM, January 2023. Calculated using 5000 simulations based on current market conditions and forward-looking expectations. Please see appendix for asset class abbreviations.

ASSET ALLOCATION CONSIDERATIONS

“Riskier” assets have provided compelling returns over the long term

Cumulative total return, 1992 – 2023. The ICE 1-3 year US investment grade corporate index has performed as well as the *full duration* ICE US government bond index over this time period



Source: Bloomberg Finance LP. October 2024. ICE fixed income indices and US.EQ = S&P500 total return index.

Dimensions to increase central bank reserves portfolio returns (and ideally to diversify risk):

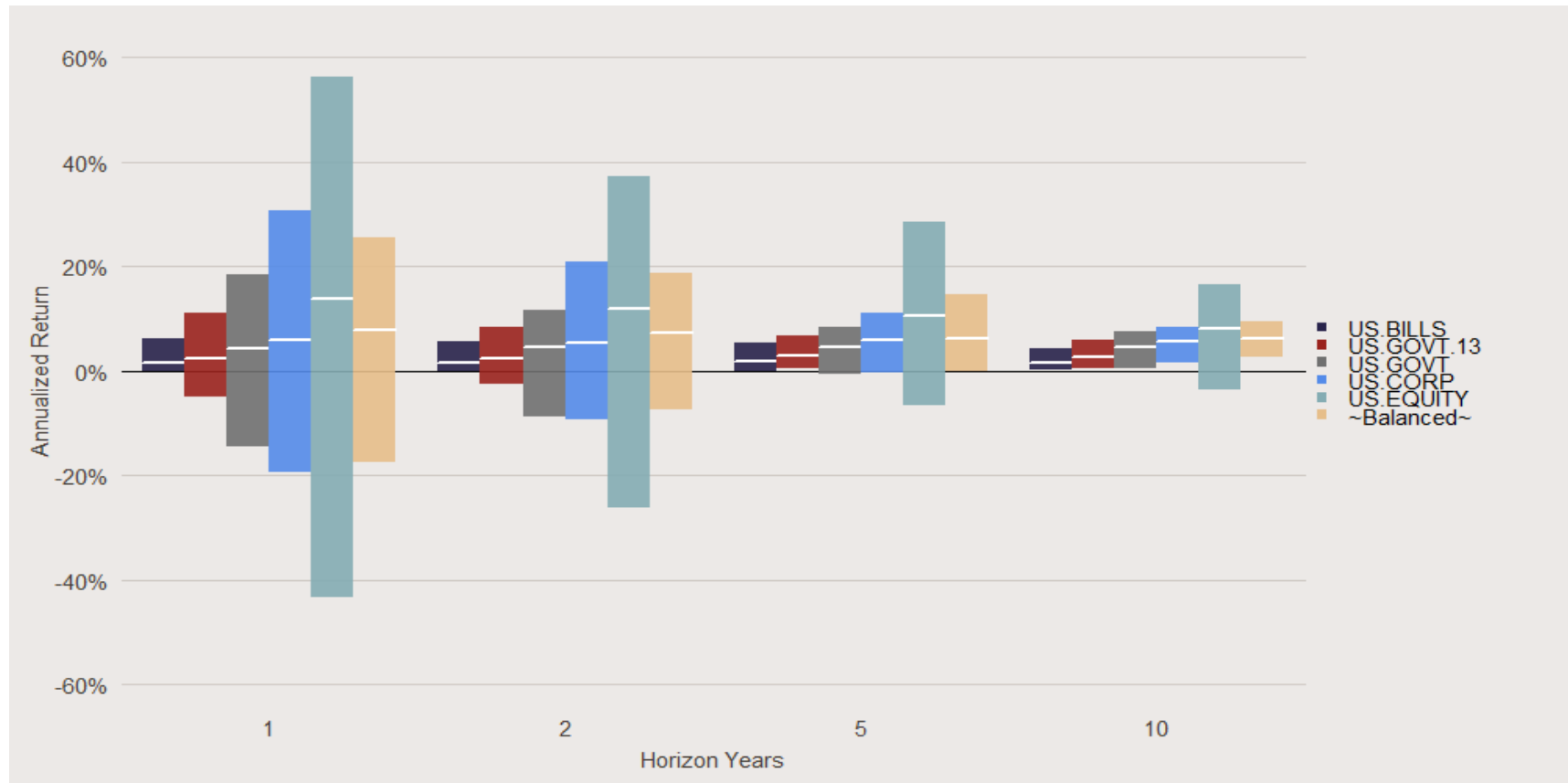
- **Duration:** increase interest rate risk
- **Credit:** Agencies, Supras, Corporates, High Yield
- **Market:** International diversification, EMD
- **Equities:** Developed markets, EM
- **Alternatives:** Real estate, hedge funds, private markets

It's important for a central bank to define its income objectives and risk tolerance

"RISKIER" ASSETS CAN PROVIDE BETTER INVESTMENT OUTCOMES

A diversified portfolio of "risky" assets has had more attractive return and risk properties than a "typical" 1-3 year US government bond reserves portfolio over a 10-year horizon

Historical return and risk over various rolling horizons, 1993 - 2024



Source: Bloomberg Finance LP, ICE, CAIM, September 2024. Bars depict range of historical annualized returns over each rolling horizon. Lines represent median annualized returns. ICE fixed income indices, US.EQUITY = S&P500 total return index. ~Balanced~ portfolio has equal weights of full duration US.GOV'T, full duration US.CORP and US.EQUITY.

NEW RESERVES MANAGEMENT OBJECTIVES?

Generate Income for the
Central Bank

Manage Investments
Efficiently

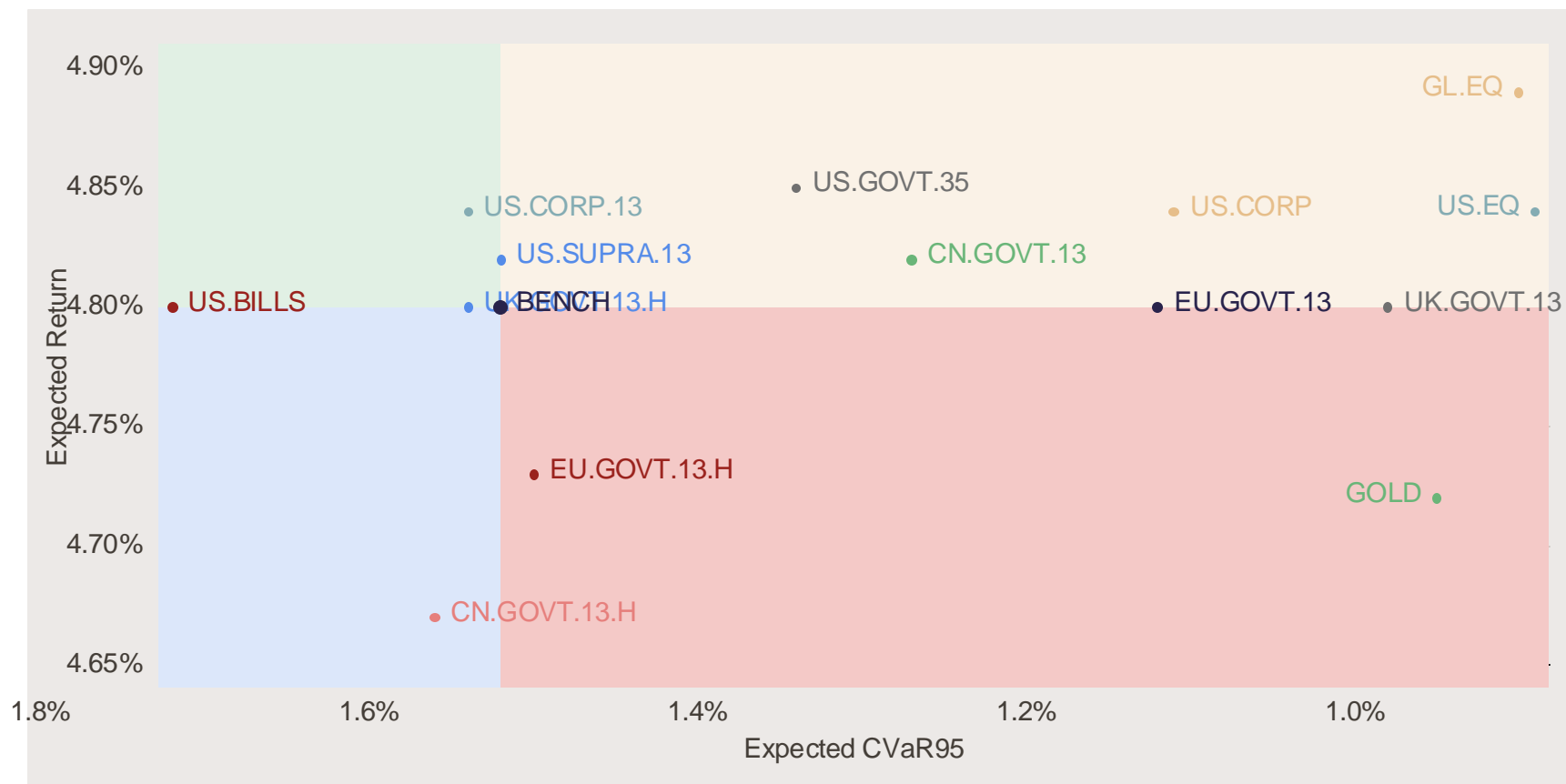
Manage Investments
Prudently

Ensure well-qualified
staff

MARGINAL RISK AND RETURN CONTRIBUTION OF ASSET CLASSES

It's possible to find asset classes for various portfolio design goals

5% allocations to individual asset classes included with benchmark in portfolio, USD base currency

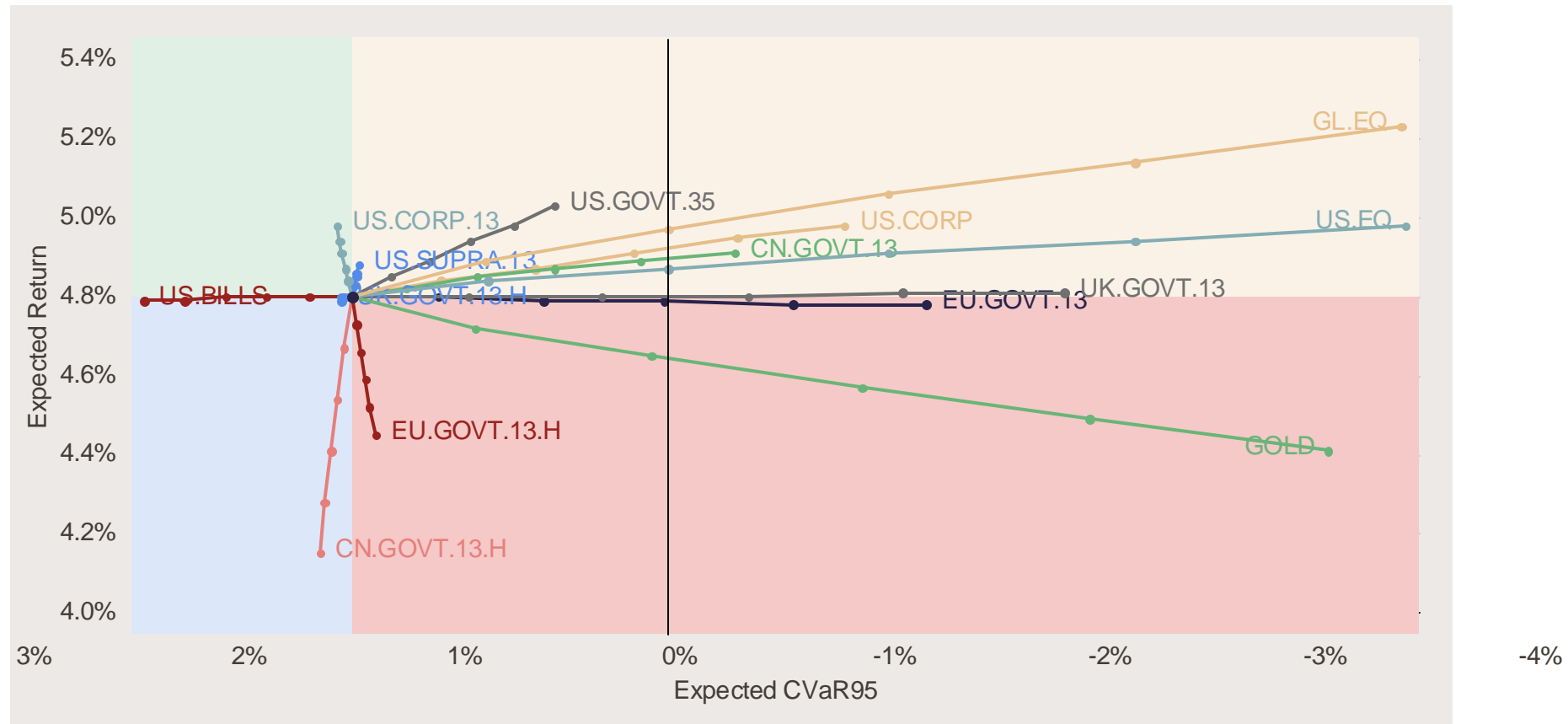


Source: CAIM, May 2023. Please see appendix for asset class abbreviations

MARGINAL RISK AND RETURN CONTRIBUTION OF ASSET CLASSES

Plenty of leeway to add diversifying assets *and* achieve expectations of capital preservation

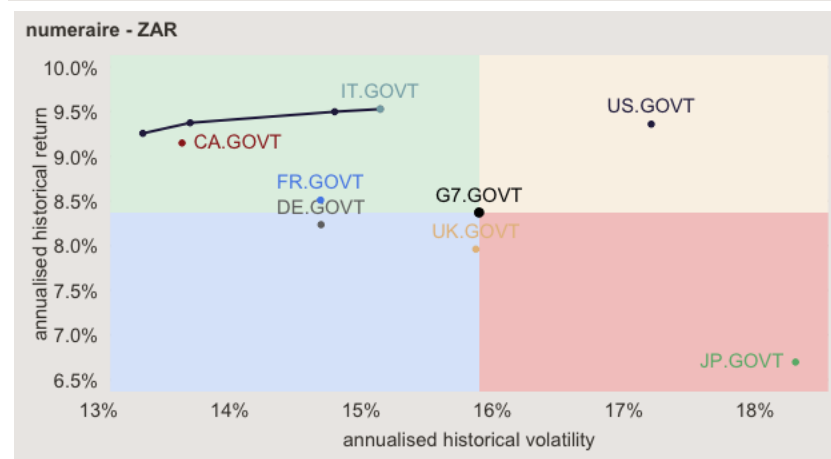
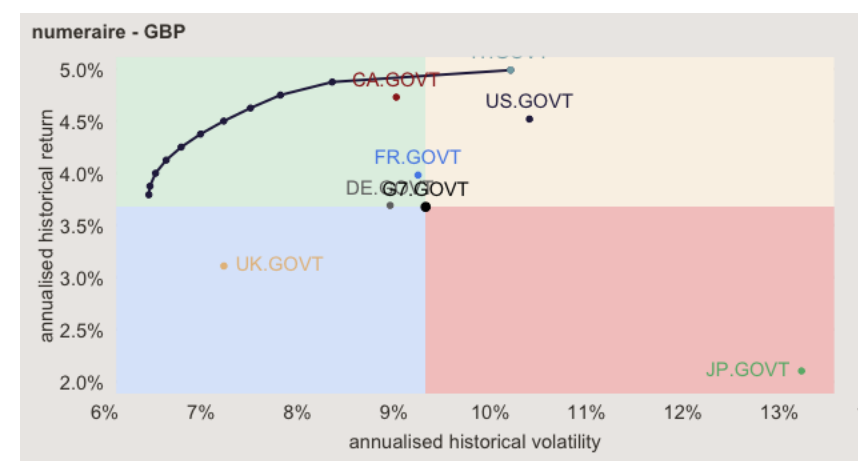
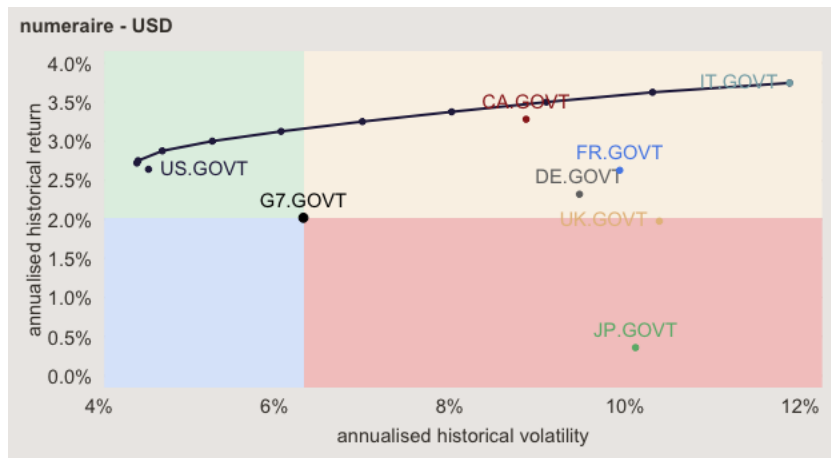
Adding up to 25% of individual asset classes to benchmark portfolio, in 5% increments



Source: CAIM, May 2023. Please see appendix for asset class abbreviations

ONE SIZE DOES NOT FIT ALL

An investor's base currency influences the attractiveness of individual markets and portfolios



- There's no reason to consider a "global market cap" portfolio as a benchmark if more customised market mixes make better sense

Source: CAIM, September 2023. Annualised historical return data from September 2004 – September 2023

VARIOUS INTERNAL STAKEHOLDERS



THERE IS A DIRECT TRADE-OFF BETWEEN RISK AND RETURN

Diversification improves the trade-off at the portfolio level

The level of expected return is driven by an institution's **ability** and **willingness** to accept risks

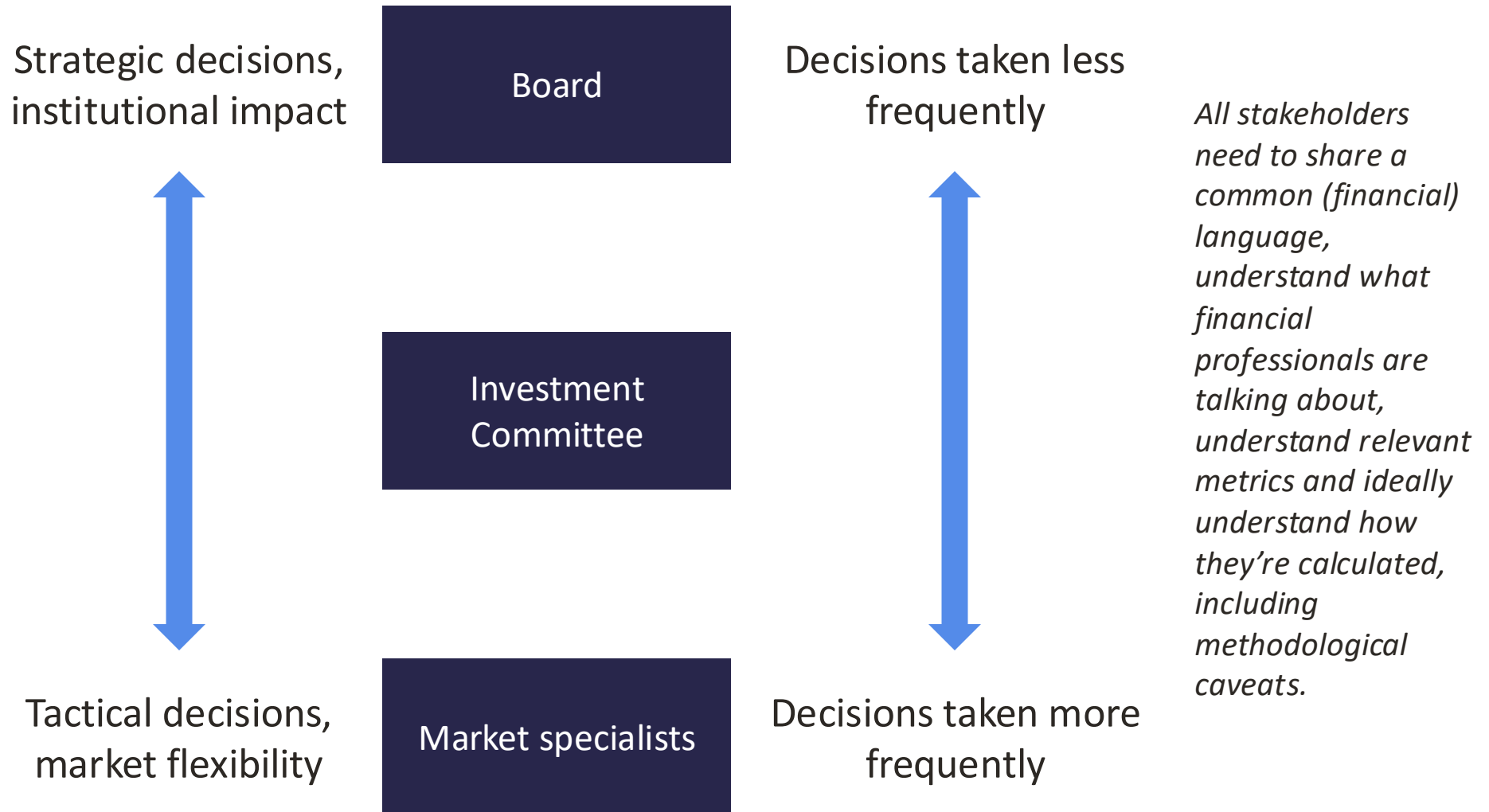
- **Ability to accept risk** is a function of reserves adequacy (central banks) or funded ratio (national pension funds)
- **Willingness to accept risk** is a function of internal technical/operational capacity and corporate culture

DEFINING RISK

Institutional culture informs investment policy decisions

- What are bad outcomes?
 - Exposure to an issuer or counterparty named in the press
 - Low returns in a low-yield environment
 - Reporting a mark-to-market loss
 - Asking parliament/finance ministry for operational budget, due to low investment returns

GOVERNANCE: WHO MAKES WHICH DECISION?



MY SYSTEM CAN'T CALCULATE X

- Do it yourself!
- Raw data + knowledge = power / insight

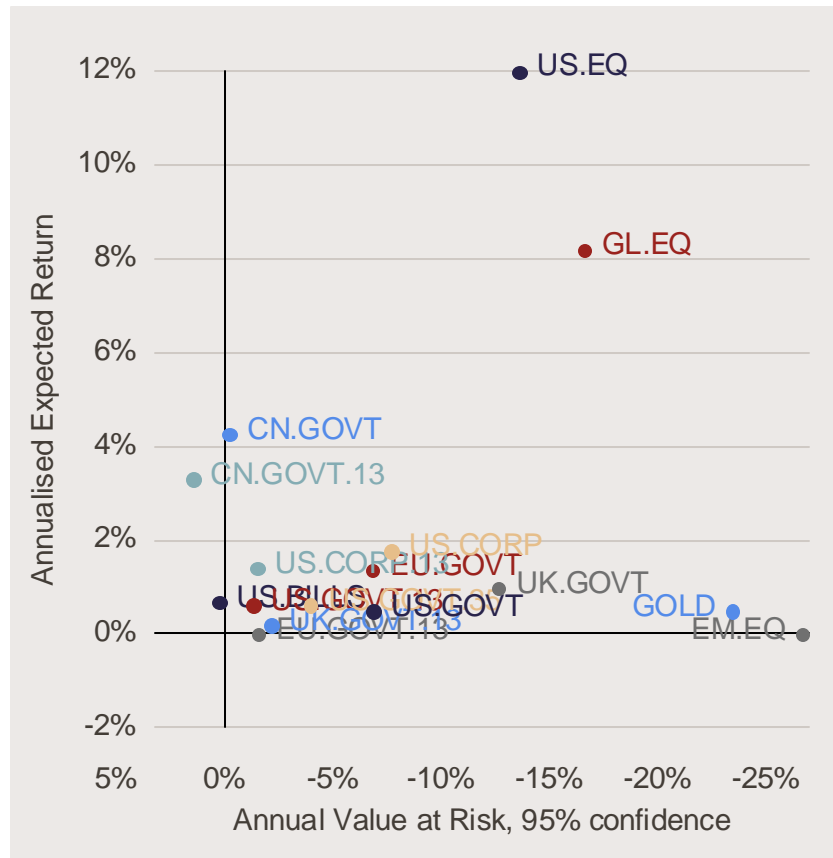
The background of the slide features a dark blue gradient with a pattern of white binary code (0s and 1s) scattered across it. Overlaid on this is a faint, light blue bar chart with several vertical bars of varying heights, suggesting data analysis or financial trends.

YIELD CURVE MODELING AND SCENARIO ANALYSIS

THEN VS. NOW

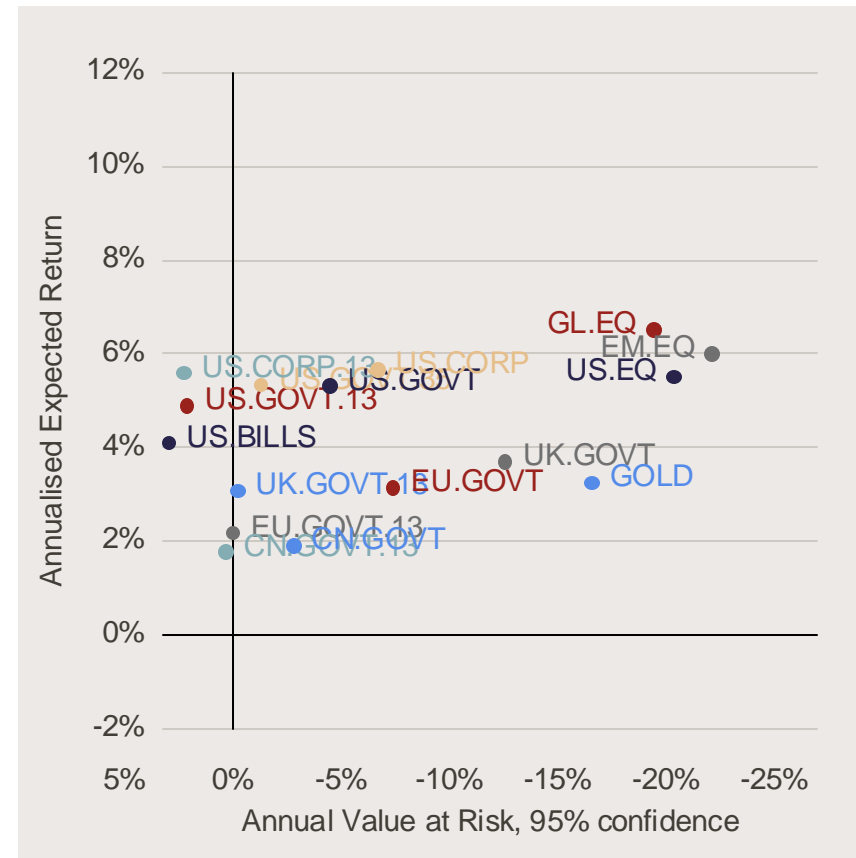
Expected returns and risk look materially better now

Historical local annualised return and risk (2012 - 2023)



Source: CAIM, January 2023. Please see appendix for asset class abbreviations

Forward-looking local annualised return and risk

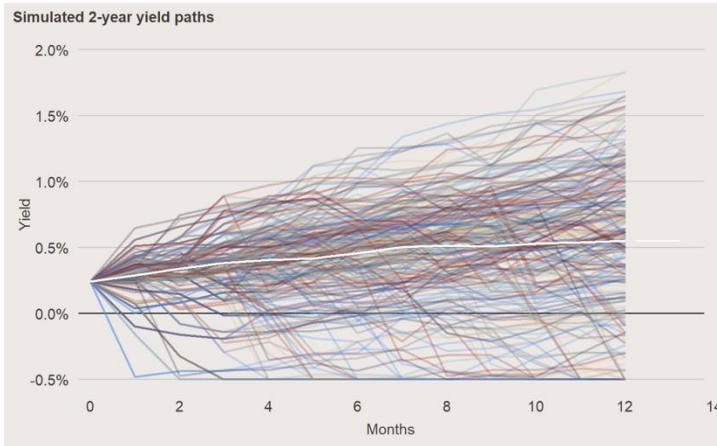


Source: CAIM, January 2023. Calculated using 5000 simulations based on current market conditions and forward-looking expectations. Please see appendix for asset class abbreviations.

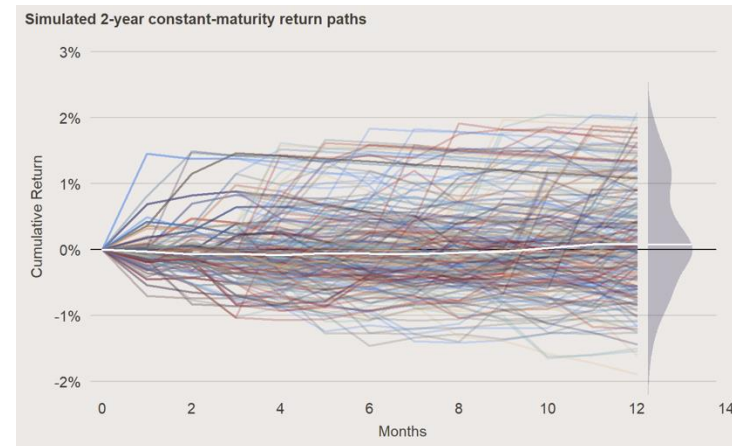
WHY IS IT IMPORTANT TO LOOK AT YIELDS, NOT HISTORICAL RETURNS, IN FIXED INCOME?

Higher current yields lead to increased forward-looking return expectations in fixed income

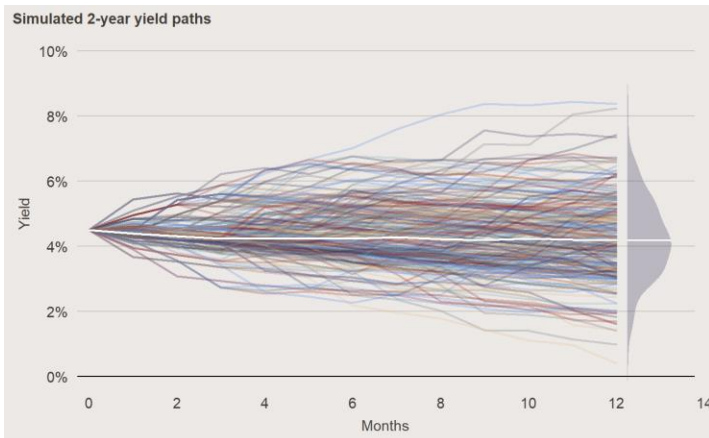
Mid-2021



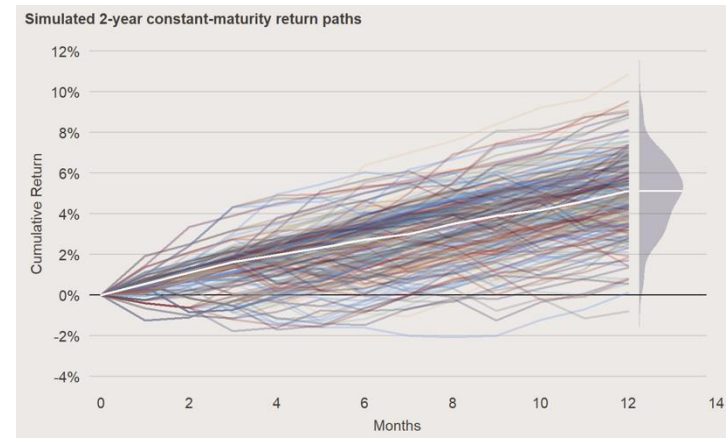
Mid-2021



Early 2023



Early 2023



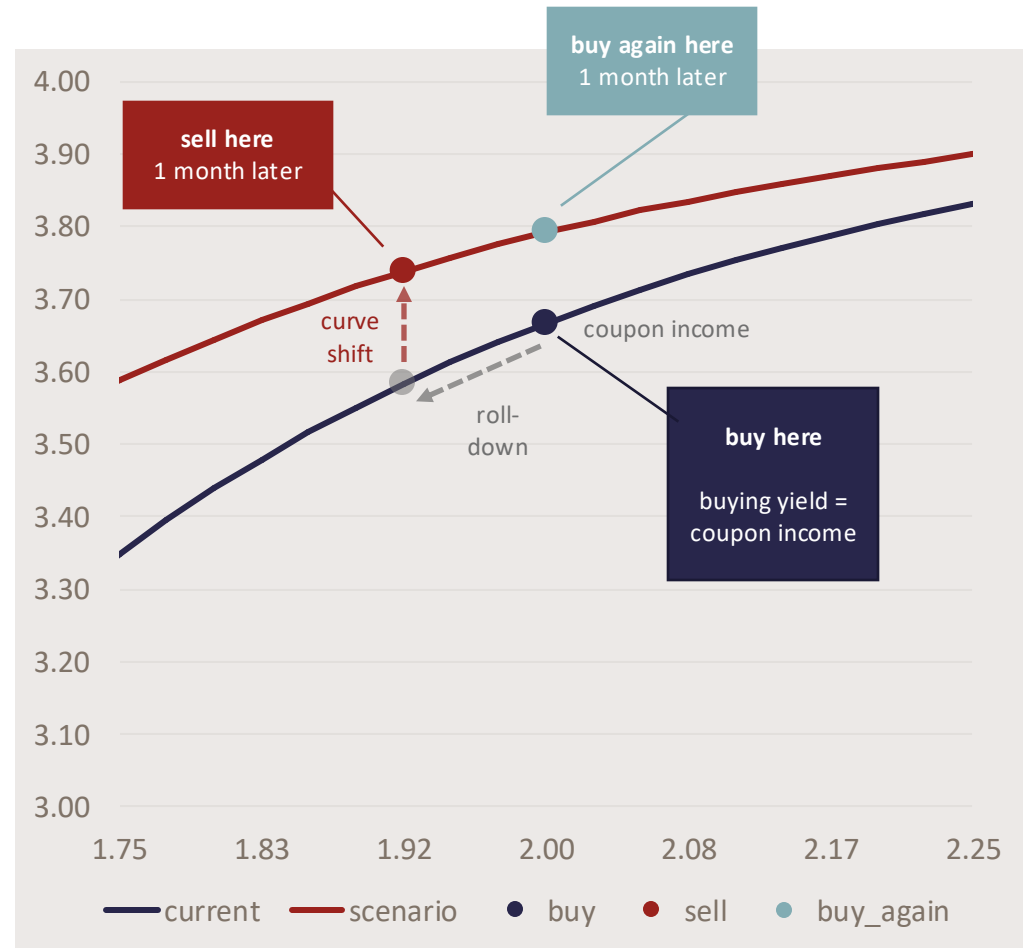
Source: CAIM, January 2023

CONSTANT MATURITY FIXED INCOME RETURN MODELING

Scenario analysis, carry and roll

For constant-maturity strategies (e.g. managing against a 1-3 year benchmark):

- **Fixed income invariants:** yield, coupon, maturity, spread (if applicable)
- Buy a 2-year maturity note at par
- 1 month later:
 - Earn 1 month of coupon income at purchase yield
 - Sell a 1-year 11-month note at the relevant yield
 - Calculate the price, which includes roll-down and curve shift.
- Repeat for your n-month horizon
- Repeat 1,000, 5,000, 1 million times (e.g.) with simulated curves for asset allocation analysis
- **You do not need individual curve points at every maturity! Calculate using a yield curve model**

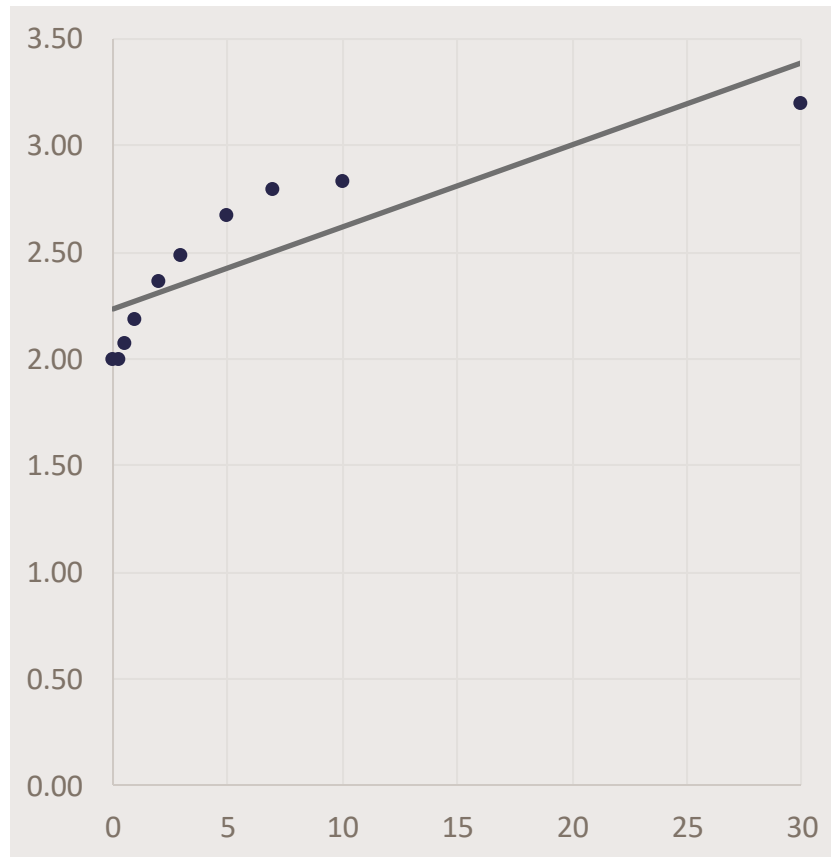


Hypothetical example, CAIM, April 2023

WHAT ARE WE TRYING TO DO HERE?

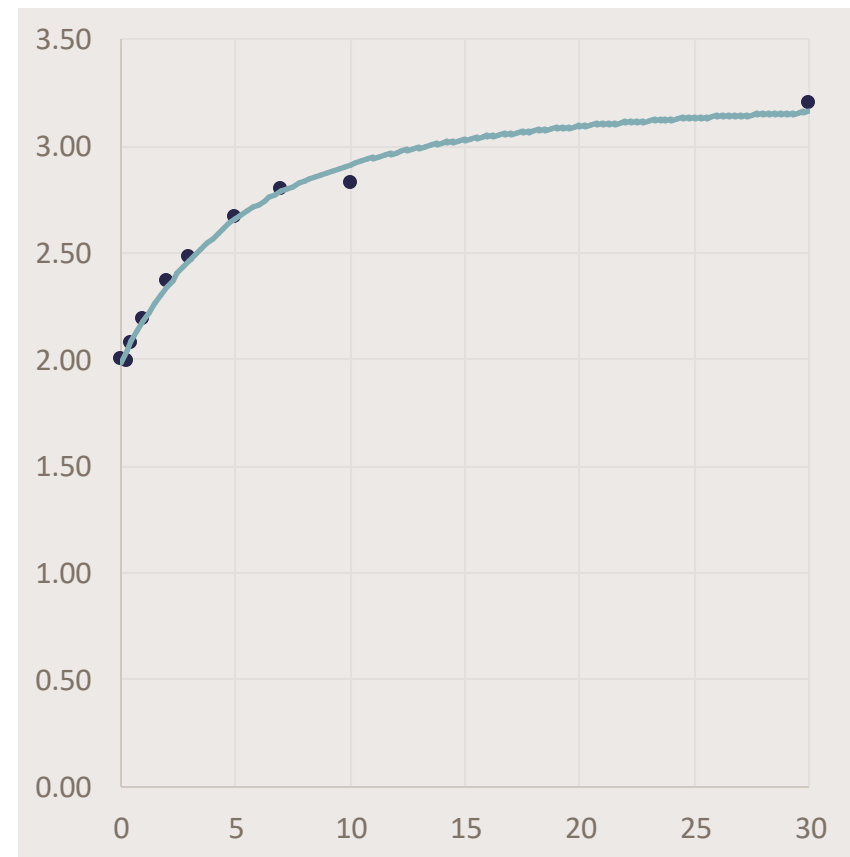
Describe an entire yield curve parametrically, with as few parameters as possible

Clearly a linear model is not ideal/appropriate



Source: Bloomberg, CAIM, CNY generic government curve, April 2023. Linear trendline from PowerPoint

This seems better,
and only needs 3 coefficients and 1 constant



Source: Bloomberg, CAIM, CNY generic government curve, April 2023 . Nelson-Siegel model.

INTRODUCING THE (PARSIMONIOUS) NELSON-SIEGEL YIELD CURVE MODEL

Just three coefficients (and a lambda constant) can describe an entire yield curve

Nelson-Siegel model:

$$y(\tau) = \beta_0 + \beta_1 \left(\frac{1 - e^{-\lambda\tau}}{\lambda\tau} \right) + \beta_2 \left(\frac{1 - e^{-\lambda\tau}}{\lambda\tau} - e^{-\lambda\tau} \right) + \epsilon_\tau$$

y : yield to be forecasted

τ : time (maturity) in years

β_0 : level factor

β_1 : slope factor

β_2 : curvature factor

λ : decay factor, directly related to location of curve's "hump"

ϵ_τ : error term at given maturity

Restated slightly:

$$yield_{mat} = \beta_{level} + \beta_{slope} \times loading_{slope_{mat}} + \beta_{curvature} \times loading_{curvature_{mat}}$$

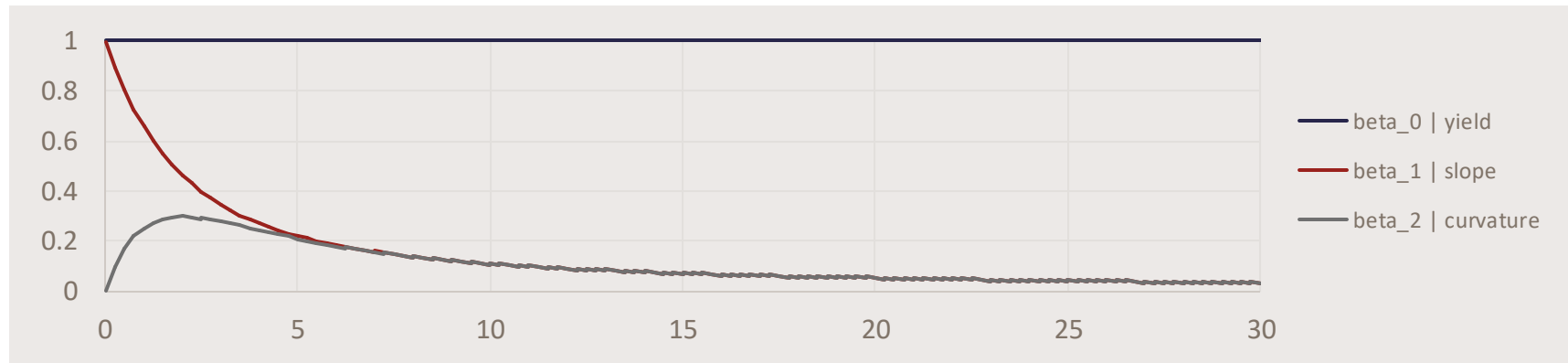
Excel formula:

$$\begin{aligned} &= \text{beta_0} + \text{beta_1} * ((1 - \text{EXP}(-\text{lambda} * \text{maturity})) / (\text{lambda} * \text{maturity})) \\ &+ \text{beta_2} * ((1 - \text{EXP}(-\text{lambda} * \text{maturity})) / (\text{lambda} * \text{maturity}) - \text{EXP}(-\text{lambda} * \text{maturity})) \end{aligned}$$

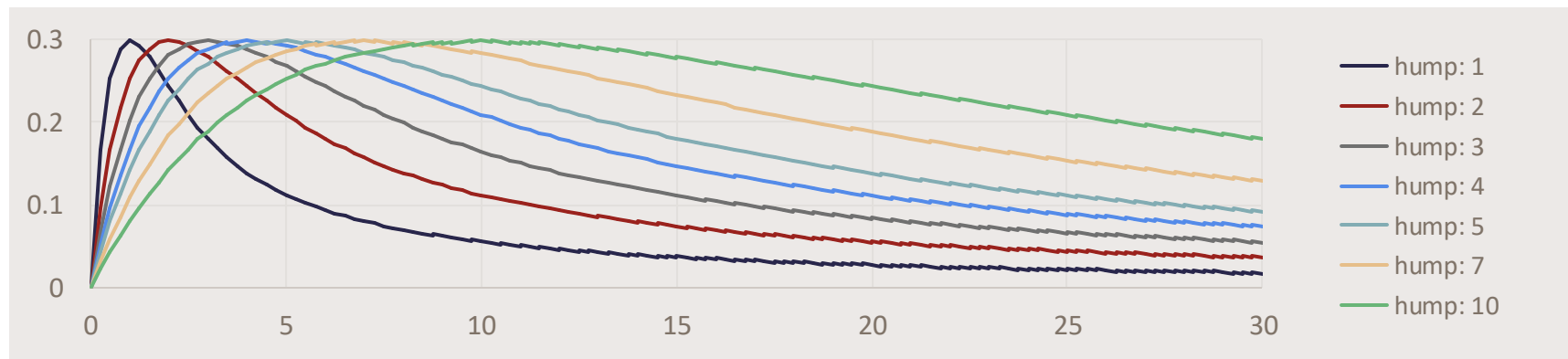
WHAT IS FACTOR LOADING?

Different Nelson-Siegel factors will have varying influence at different maturities

Factor loading: "hump location" = 2 years, lambda = 0.8966



Different lambdas will affect factor loading across maturities



Source: CAIM, April 2023

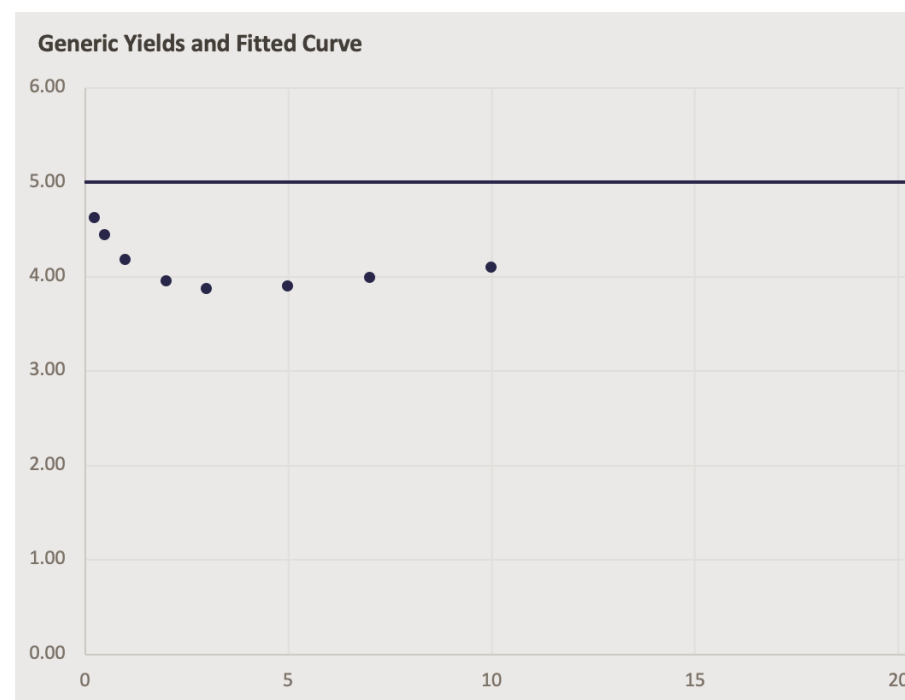
EXCEL EXAMPLE

market	obs_date
US	2024-10-11

maturity	yield	ns	err	use [1 or 0]
0.25	4.63	5.00	0.38	●
0.5	4.44	5.00	0.56	●
1	4.18	5.00	0.82	●
2	3.96	5.00	1.04	●
3	3.88	5.00	1.13	●
5	3.90	5.00	1.10	●
7	3.99	5.00	1.01	●
10	4.10	5.00	0.90	●
30	4.41	5.00	0.59	●

maturity	ns	factor loadings		
		beta_0	beta_1	beta_2
0.00	5.00	1	0.9995	0.0005
0.25	5.00	1	0.9565	0.0422
0.50	5.00	1	0.9155	0.0796
0.75	5.00	1	0.8768	0.1127
1.00	5.00	1	0.8403	0.1417
1.25	5.00	1	0.8059	0.1672
1.50	5.00	1	0.7734	0.1895
1.75	5.00	1	0.7427	0.2089
2.00	5.00	1	0.7137	0.2256
2.25	5.00	1	0.6862	0.2401

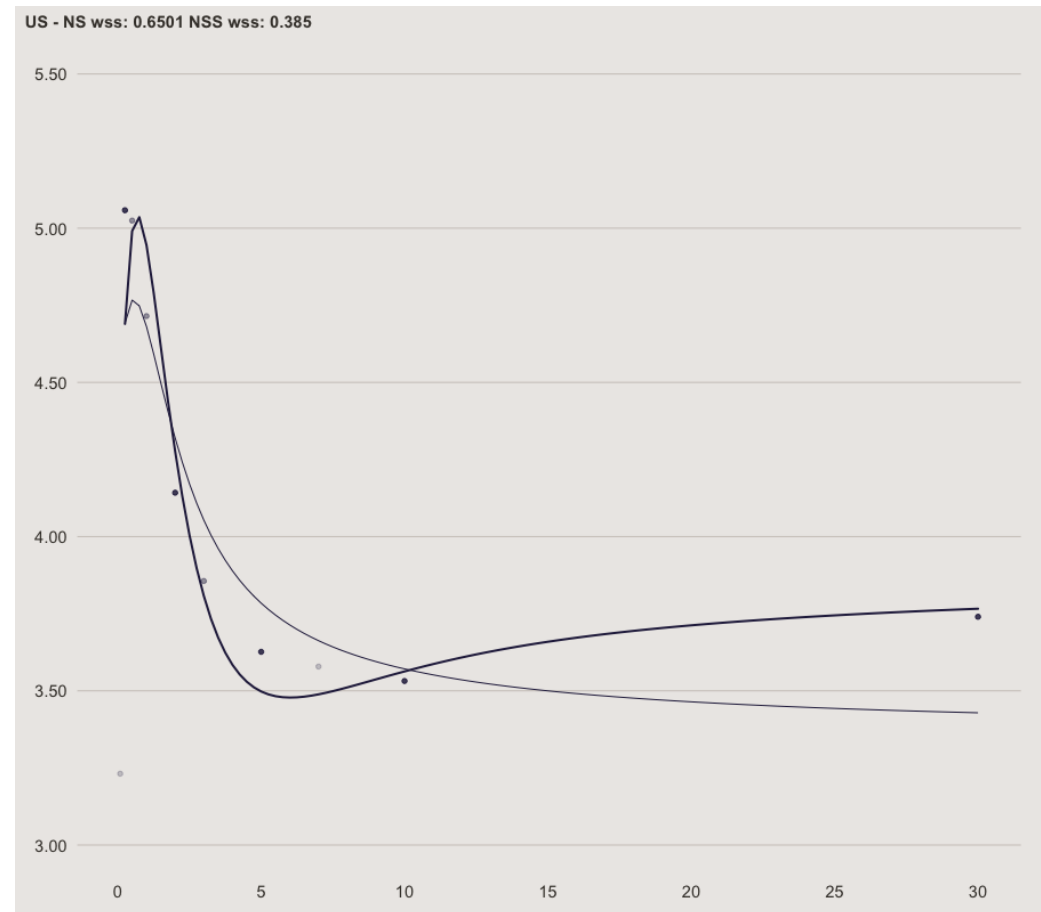
nelson-siegel coefficients			
beta_0	5.0000	level	hump_location
beta_1	0.0000	slope	5
beta_2	0.0000	curvature	
lambda	0.3587	lambda	



NELSON-SIEGEL SHORTCOMINGS

The Nelson-Siegel model is sometimes too simple, especially when faced with relatively complicated yield curves

- At times, market transition or dislocation results in a set of yields that are difficult to fit with only a NS model
- Sometimes two humps are better than one – consider the Nelson-Siegel-Svensson model!
 - one extra beta and one extra lambda parameter allow the fitted curve to have “humps” at two locations
- Similar practical applications and uses to NS curves, with only marginally more calculations
- Different yields can be weighted differently during the curve fitting process (a 2 year yield may be more relevant than a 1 year yield...)

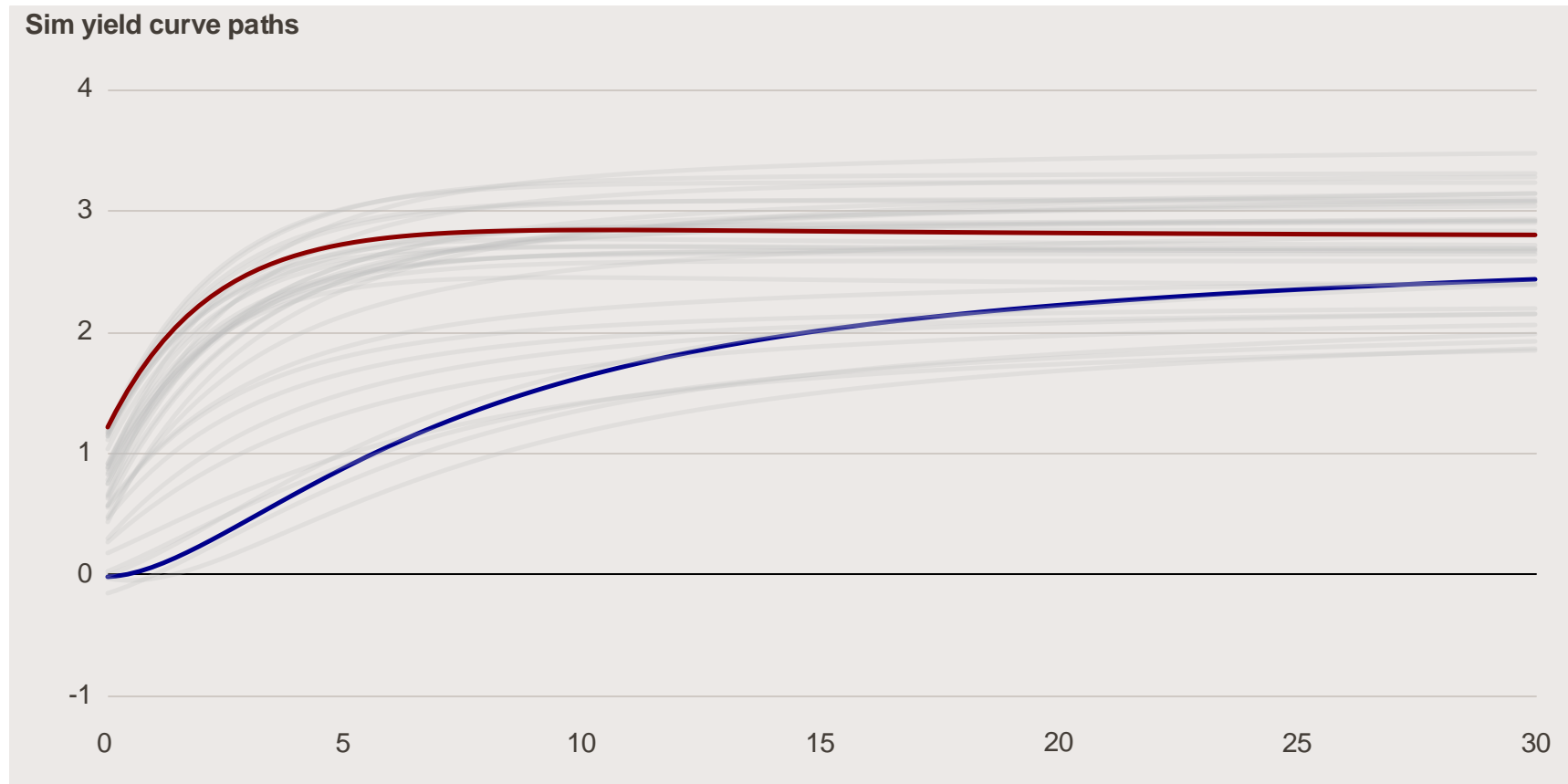


Source: CAIM, April 2023

CURVE HORIZON SIMULATION EXAMPLE

Curve development over 1 simulation over 36 month horizon

Blue = current curve, red = horizon curve



Source: CAIM, April 2021

APPENDIX

RESERVES MANAGEMENT GOVERNANCE

VARIOUS INTERNAL STAKEHOLDERS



THERE IS A DIRECT TRADE-OFF BETWEEN RISK AND RETURN

Diversification improves the trade-off at the portfolio level

The level of expected return is driven by an institution's **ability** and **willingness** to accept risks

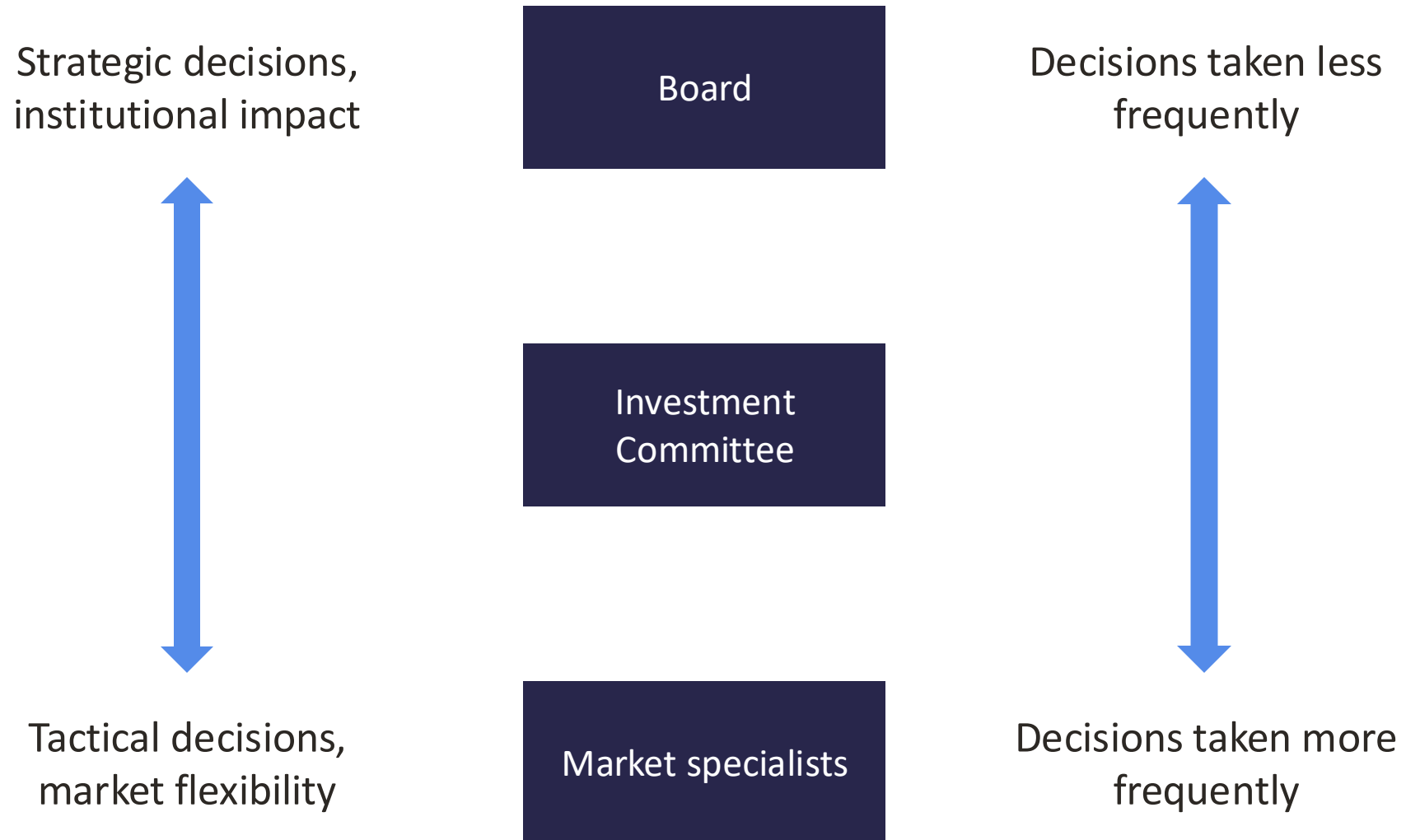
- **Ability to accept risk** is a function of reserves adequacy (central banks) or funded ratio (national pension funds)
- **Willingness to accept risk** is a function of internal technical/operational capacity and corporate culture

DEFINING RISK

Institutional culture informs investment policy decisions

- What are bad outcomes?
 - Exposure to an issuer or counterparty named in the press
 - Low returns in a low-yield environment
 - Reporting a mark-to-market loss
 - Asking parliament/finance ministry for operational budget, due to low investment returns

GOVERNANCE: WHO MAKES WHICH DECISION?



WHO MAKES WHICH DECISION?

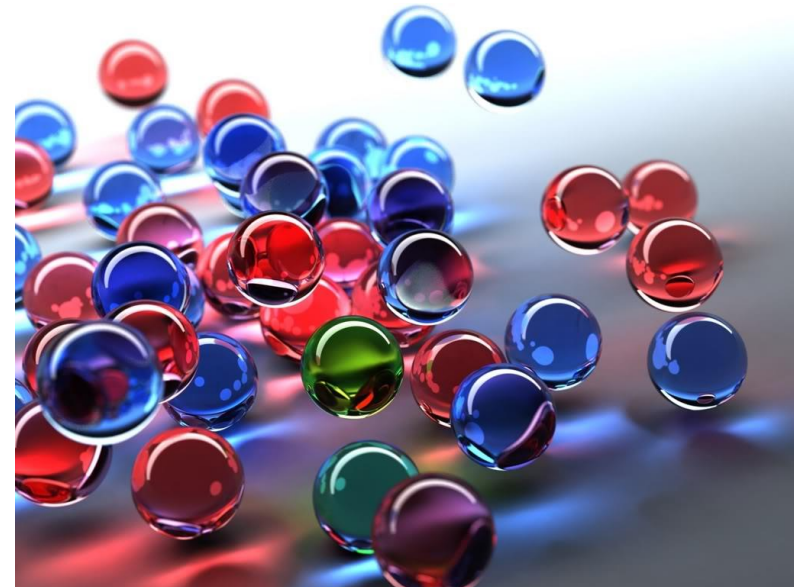


FOCUS ON THE RIGHT INFORMATION



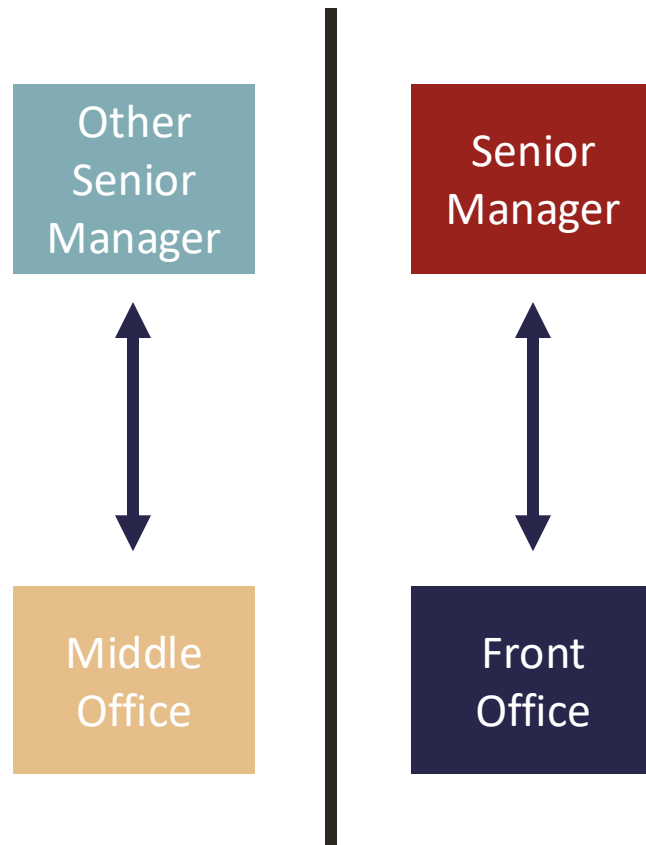
INFORMATION TO MANAGEMENT SHOULD BE AT A PORTFOLIO LEVEL, NOT AT A SECURITY LEVEL

Management should not focus on the performance of individual securities in isolation, but in the context of a well diversified portfolio with a risk and return objective suitable to meet its strategic objectives. (*Prudent investor rule*)

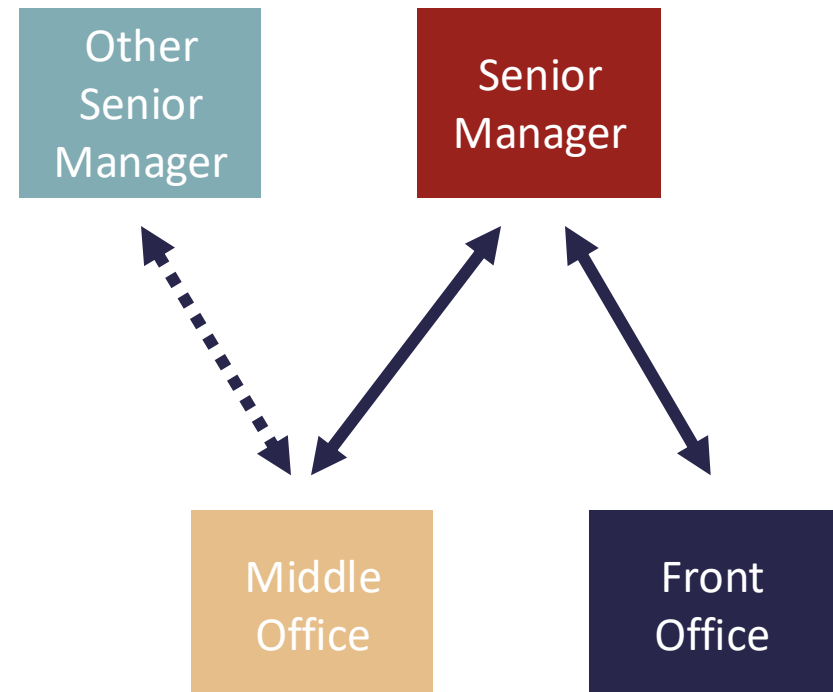


RISK MANAGEMENT ORGANIZATIONAL FRAMEWORKS

Independent, inefficient



Independent, efficient



WHAT ROLE FOR RISK MANAGERS?

**Institutional outcomes are often better when
risk managers work collaboratively with portfolio managers**



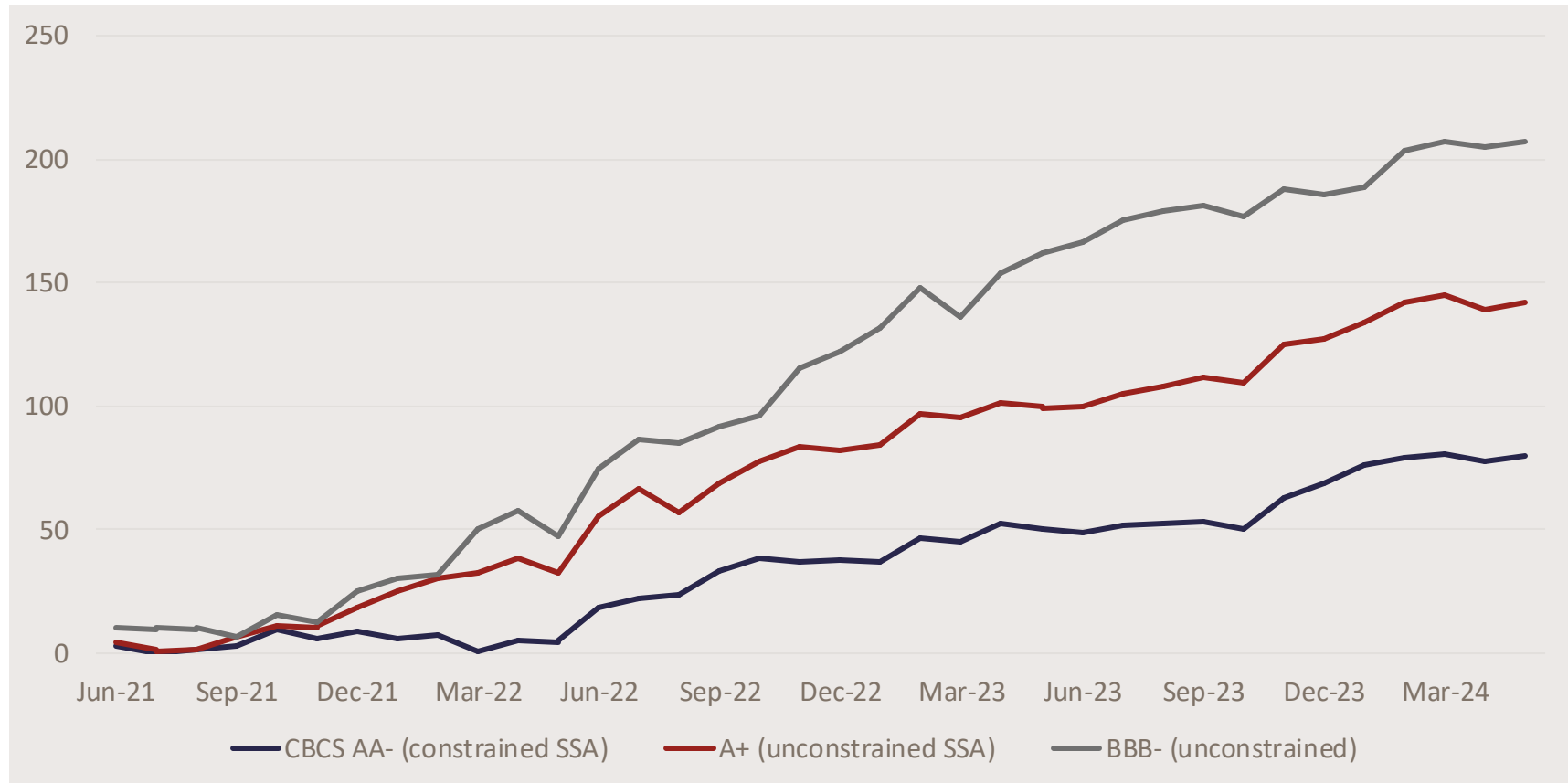
or



COMPARING SIMILAR BENCHMARK FUNDS

Accounts with greater active investing leeway have delivered higher alpha

Three-year cumulative alpha for similar central bank portfolios managed by CAIM



Source: CAIM, to 31st May 2024

RISK MANAGEMENT

- Risk management
 - Is vital to navigating increasingly complex and challenging markets
 - Is not risk avoidance
 - Is not forecasting
 - Should focus on relevant metrics
 - Should facilitate efficient investment management
 - Should be independent of, but collaborate with, front office

DISCLAIMER

This communication is intended for professional clients and eligible counterparties only. Past performance is not a reliable indicator of future results. Performance results are calculated before management fees and after trading expenses. Information contained in this publication is compiled from industry sources which we consider to be accurate and reliable.

There is no representation or warranty of any kind, whether express or implied, regarding the accuracy or completeness of the information given. The information provided does not constitute advice and it should not be relied on as such.

Any views or opinions expressed are those of Crown Agents Investment Management Ltd and are subject to change due to market and other conditions and should not be taken as statements of policy or intent.

CAIM (Company Registration No. 02169973) has its registered office at The Rex Building, 62 Queen Street, London EC4R 1EB. CAIM is authorised and regulated by the Financial Conduct Authority. ©CAIM 2023.

Vat Reg No: GB 377 614565.

Authorised and regulated by the Financial Conduct Authority (Financial Services Register number: 119207)

www.caiml.com
CAIMLenquiries@caiml.com

The Rex Building
62 Queen Street
London EC4R 1EB
United Kingdom

T: +44 (0)20 3903 2500
F: +44 (0)20 7248 0730