GLASS PRISM
Portfolio Optimization

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Introduction

Introduction to PRISM

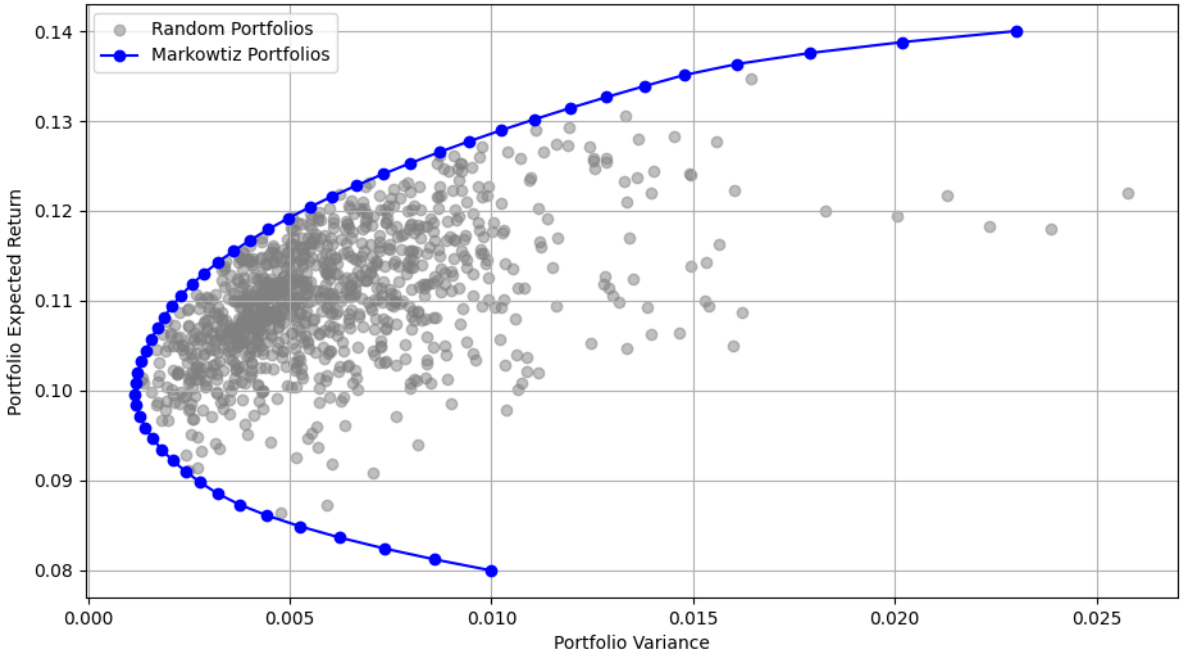
- Investing for instutional investors has become more complex
  - Economic uncertainty
  - Geo-political risks
  - Investment universe expanding
  - Access to private assets
  - Evolving regulations

» Requires a sophisticated approach to developing a Strategic Asset Allocation

Markowitz Optimization

Minimize the variance (risk) and maximize the expectation of portfolio return (return)

- Uses diversification benefits
- Includes allocation constraints
- Formulaic approach → Linear



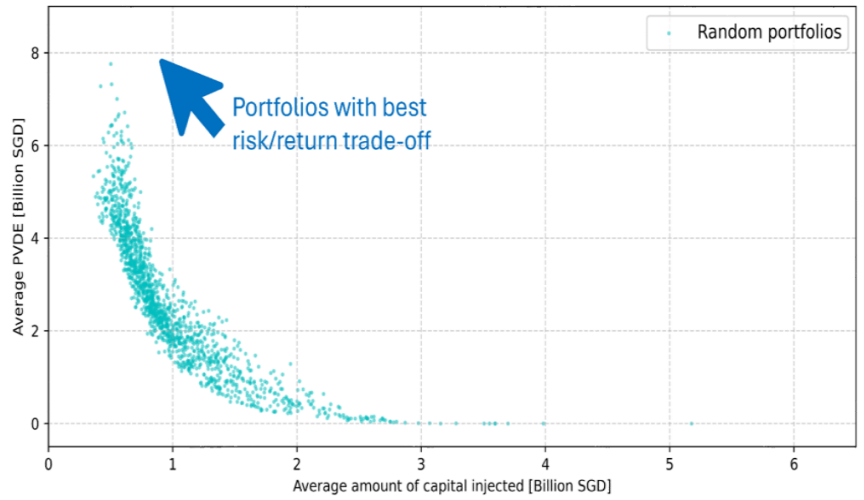
Closed form solution

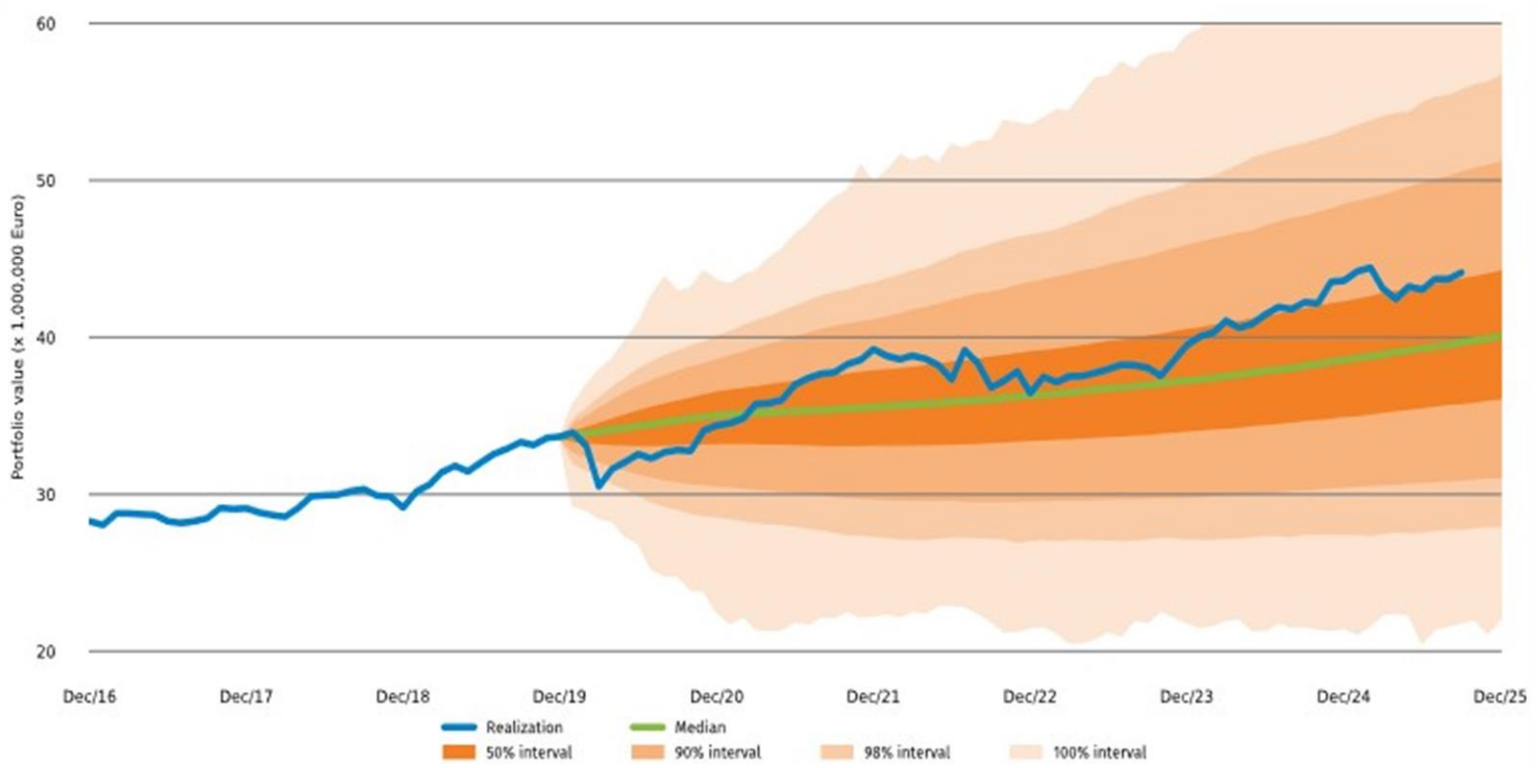
Stochastic scenario approach

Evaluate portfolio performance on ‘any’ set of investor specific risk and return measures

Non-linear Objectives

e.g solvency capital charge, liquidity, dividends, surplus, capital injection, deficit contribution, etc





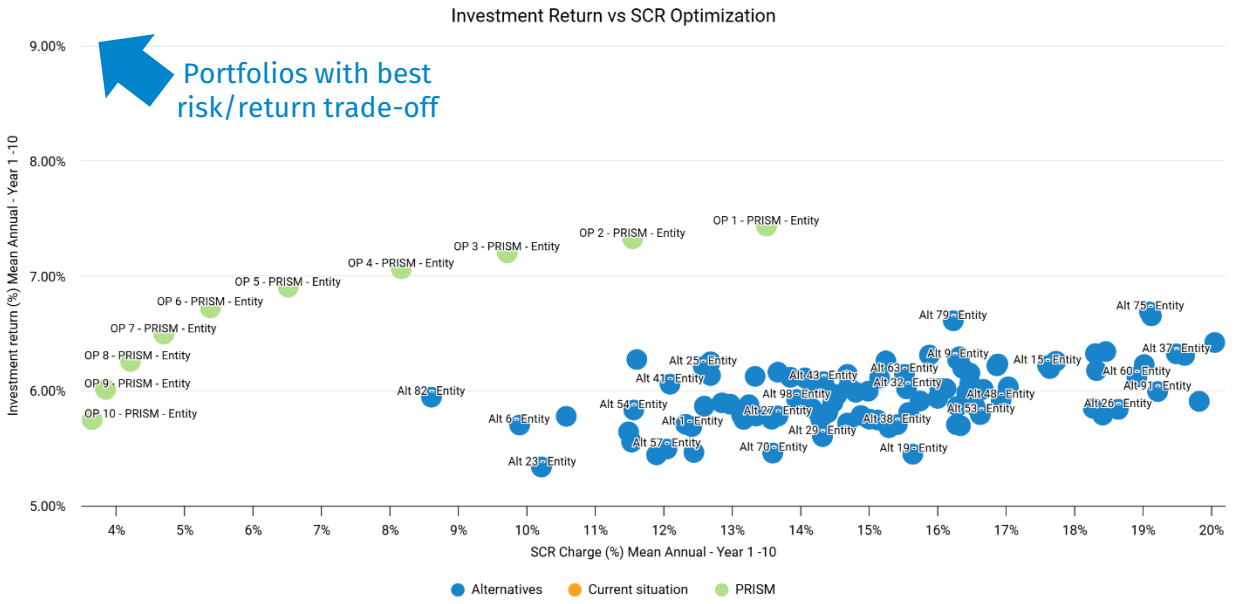
‘Trial and error’

GLASS PRISM: Scenario-Based Machine Learning (SBML)

01 **Flexibility** and **accuracy** of a stochastic scenario approach, **efficiency** of closed-form optimizers

02 **Trains Machine Learning** algorithms on stochastic scenarios data

03 **Generic approach** to optimize on any combination of risk-return measures

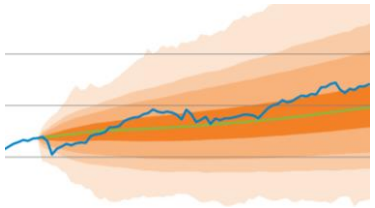


Targeted SAA

PRISM Workflow

Three-step approach

1. Scenarios Capital Market Assumptions



Risk-return measures

GLASS

Portfolio Weights

2.

ML-based Surrogate model

3.

Optimizer

Insurance Case Study

Optimization for an insurer under Solvency UK

Objective:

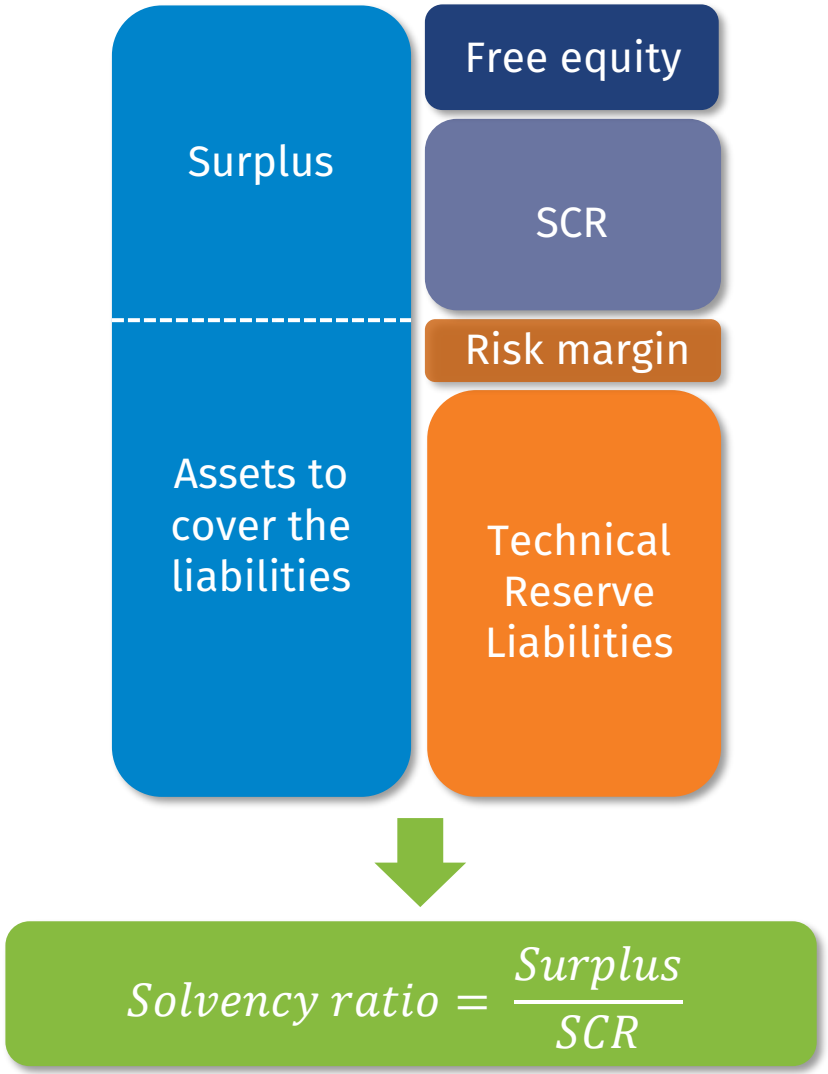
Maximize Solvency Ratio +
Maximize Asset Return

Complex Constraints:

Cash Flow Match

Minimal Solvency Ratio

Solvency ratio

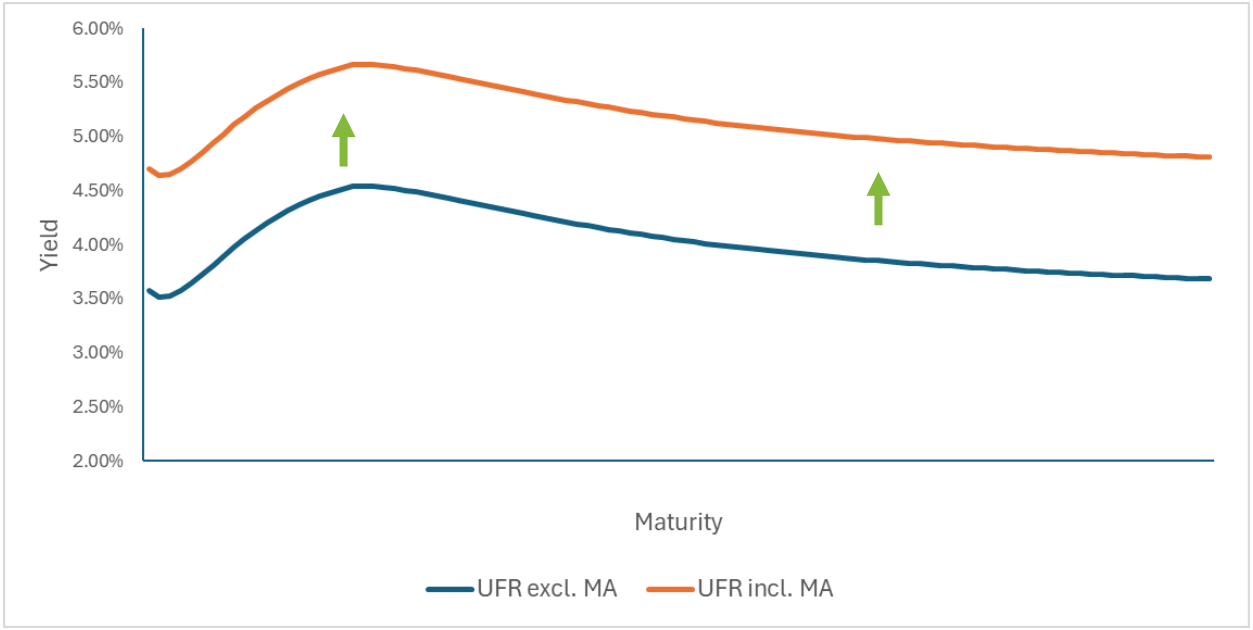


$$Solvency\ ratio = \frac{Surplus}{SCR}$$

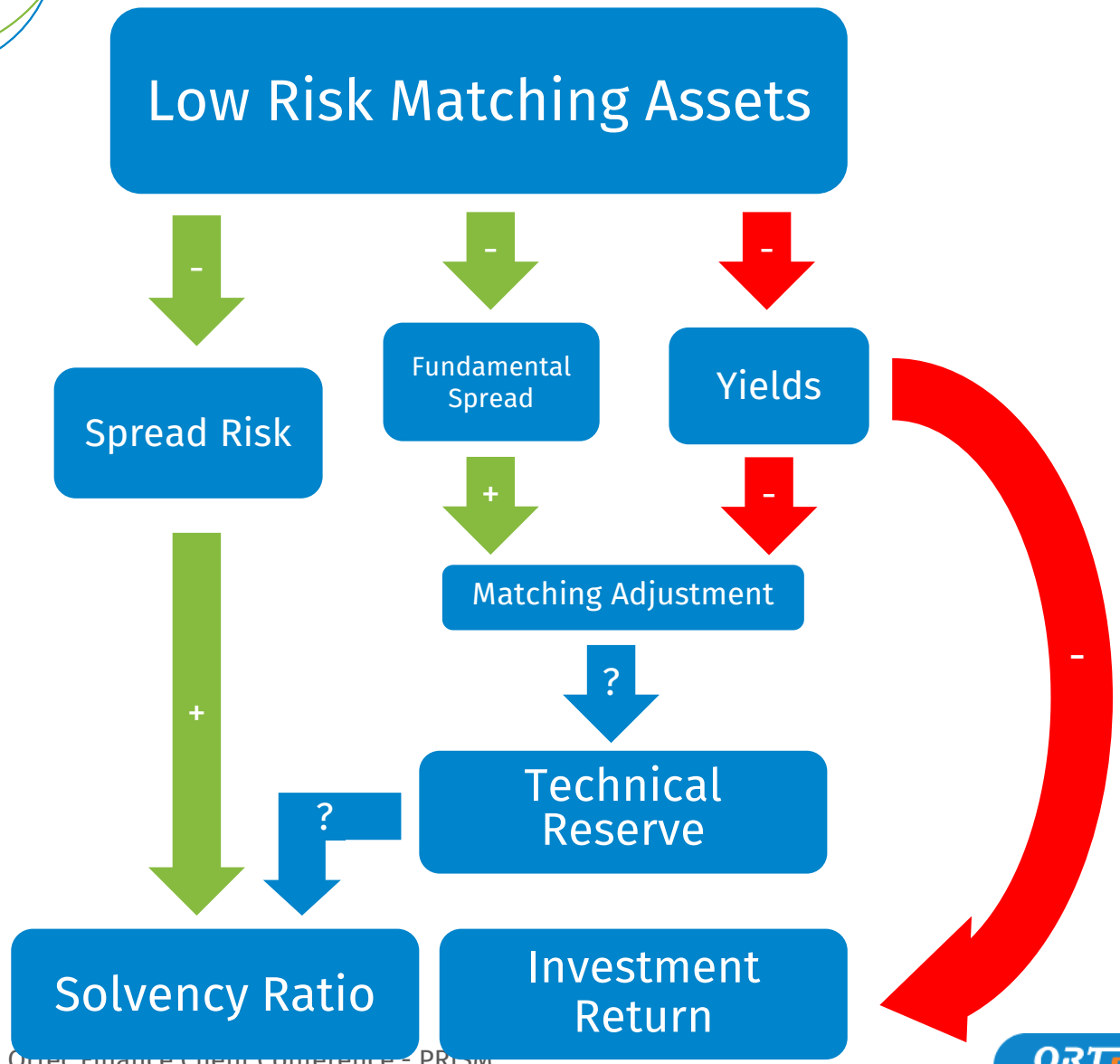
Matching Adjustment

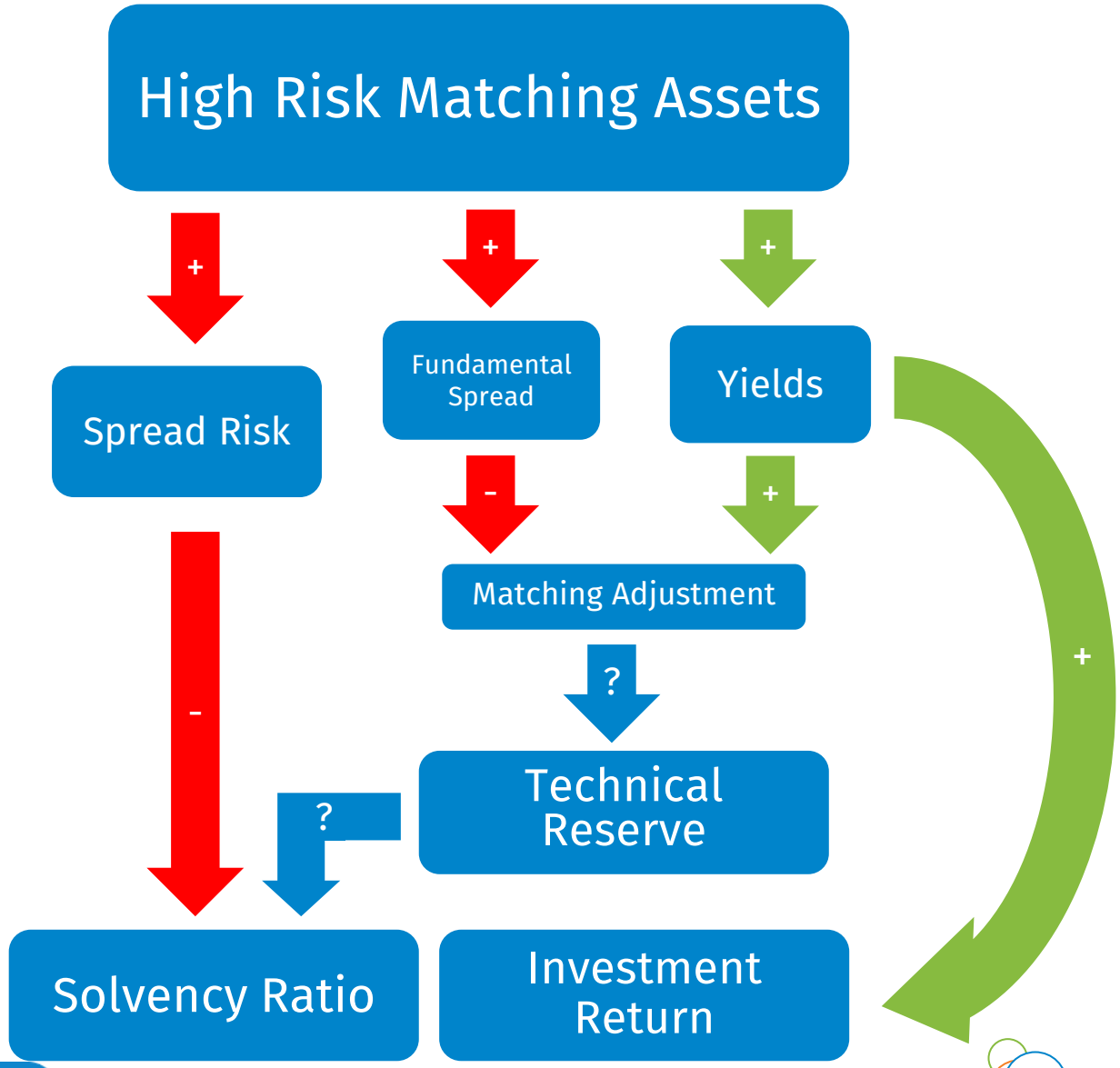
- Solvency UK allows for a Matching Adjustment (MA) to the Insurance UFR (discount curve) → **similar to Dynamic Discount Rate**
- If liabilities sufficiently matched, parallel shift to discount curve can be applied
- Strict constraints, among others:
  - Eligibility of asset classes
  - Aggregated periodic CF shortfall max 3% of BEL (discounted with RFR)
- $MV_{Assets} = \sum_{t=0} \frac{CF_{Liabilities,t}}{(1+IRR_{Assets})}$, $MV_{BEL} = \sum_{t=0} \frac{CF_{Liabilities,t}}{(1+IRR_{Liabilities})}$

$$MA = IRR_{Assets} - IRR_{Liabilities} - FS$$

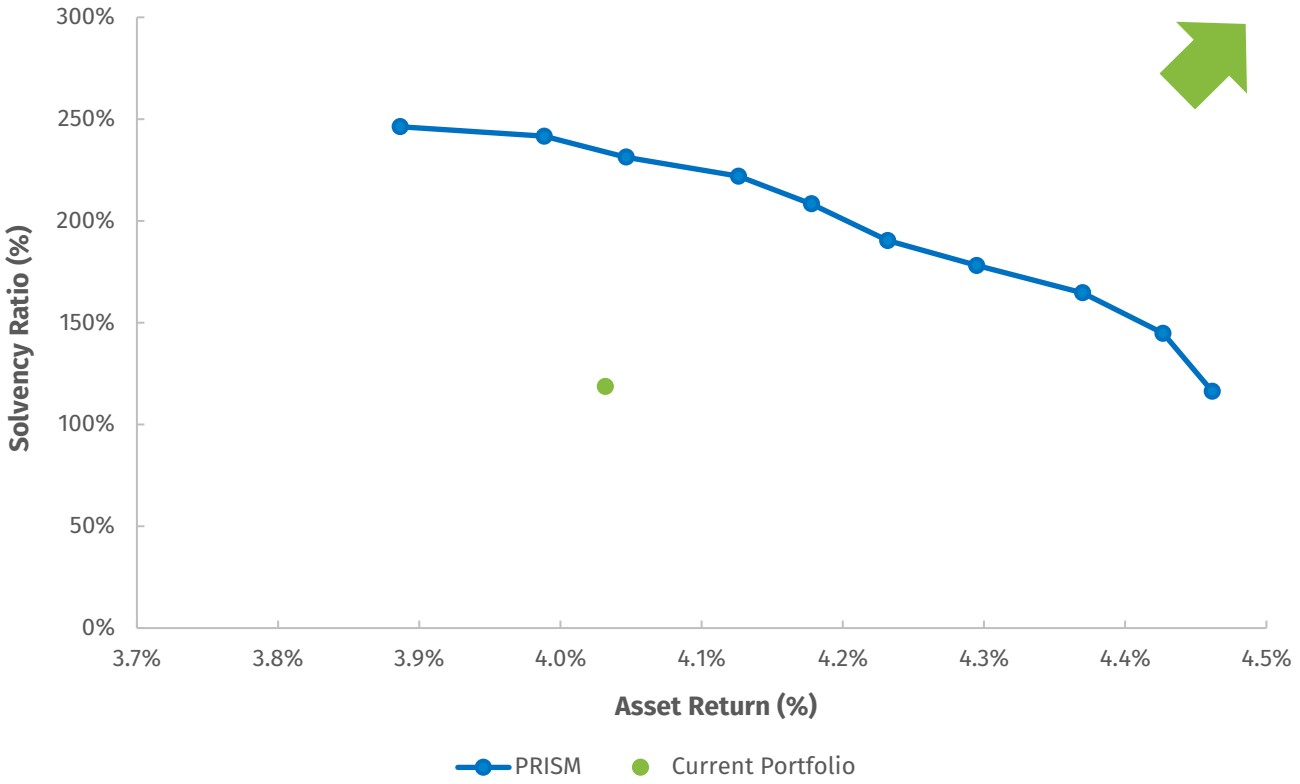


Non-linear problem

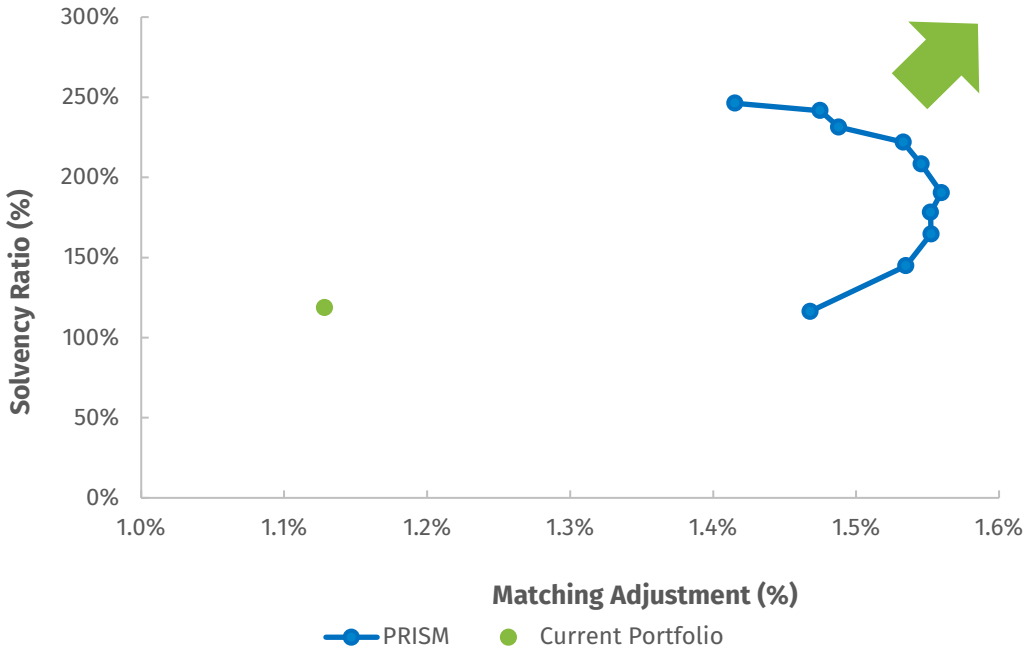


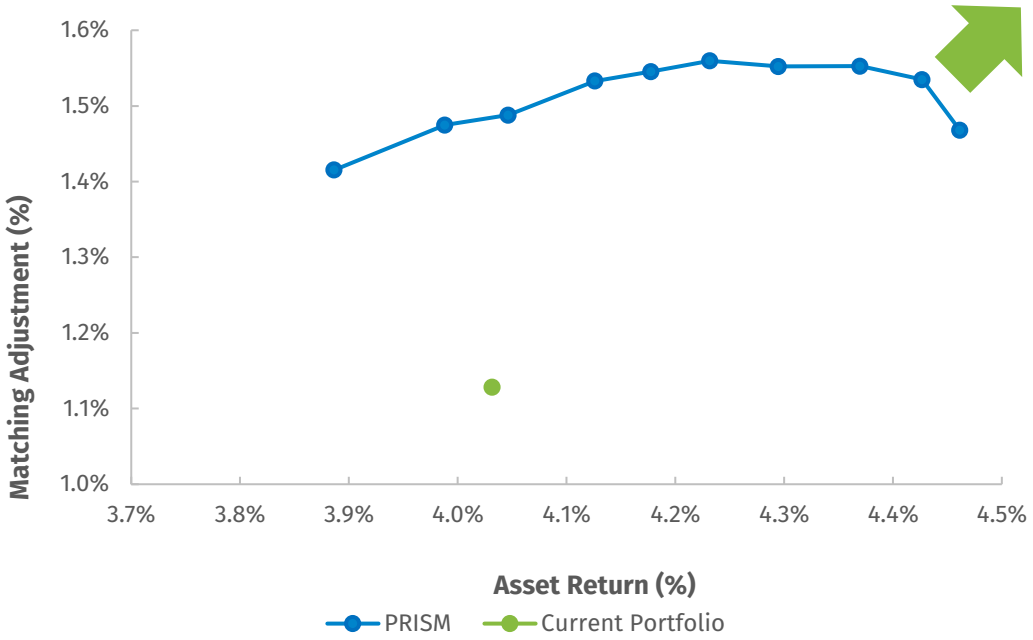


PRISM Optimization with MA



PRISM Optimization with MA





Pensions Case Study

Optimization for a US Pension Fund

Objective:

Maximize Investment Return vs Minimize Investment Risk

Complex Constraints:

Liquidity

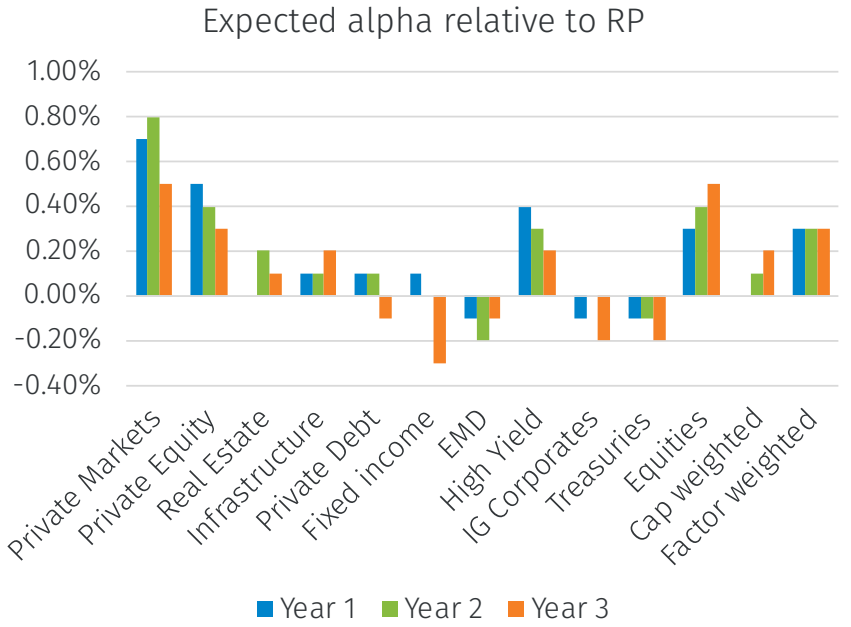
Active Risk

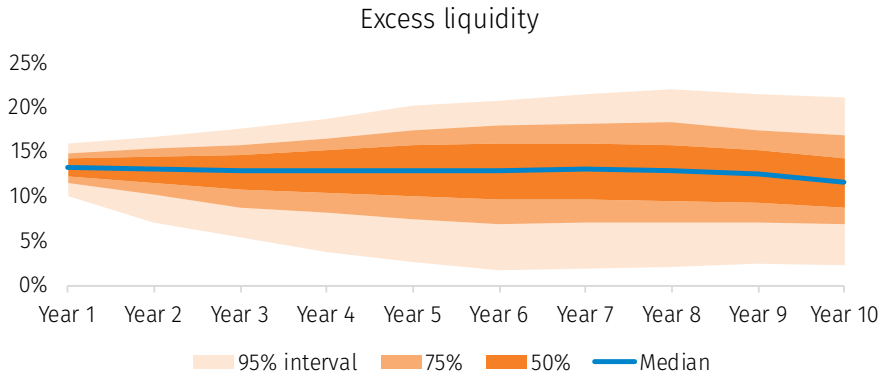
Leverage

Portfolio Reachability

TPA Approach

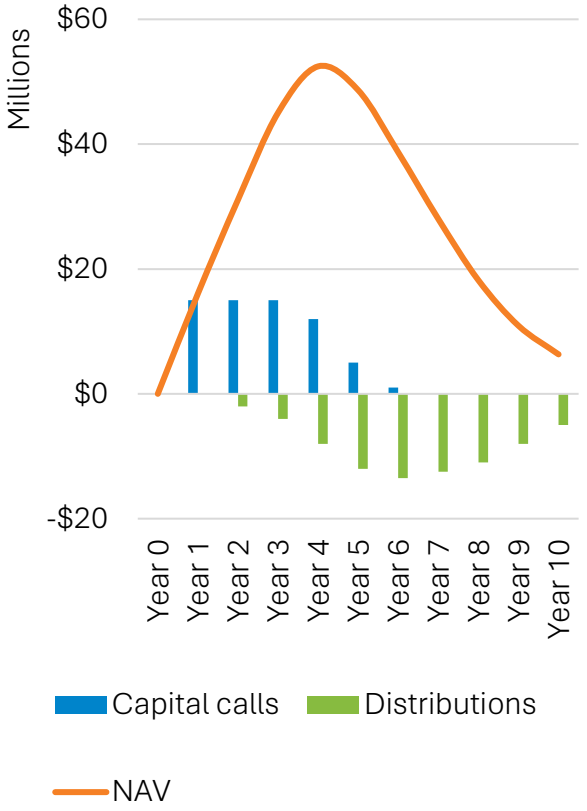
- Construct the reference portfolio (beta).
- Set an active risk limit.
- Compare expected alpha for different investment opportunities.
- Portfolios are constrained by liquidity, leverage, the active risk limit, and portfolio reachability.



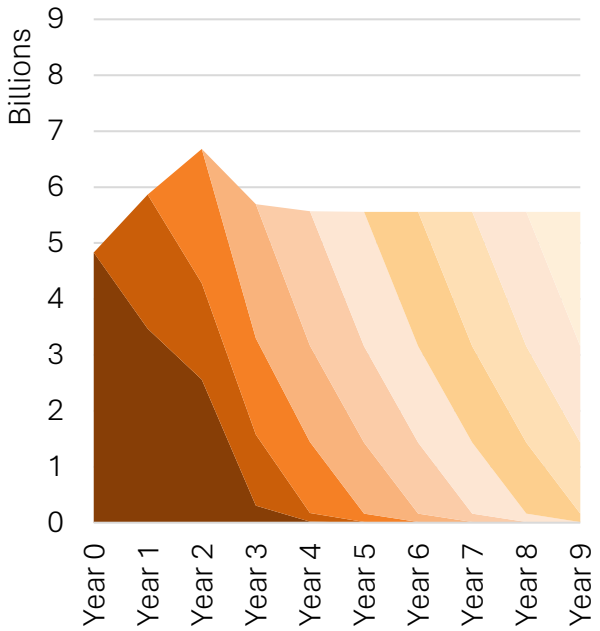


Modeling Approach

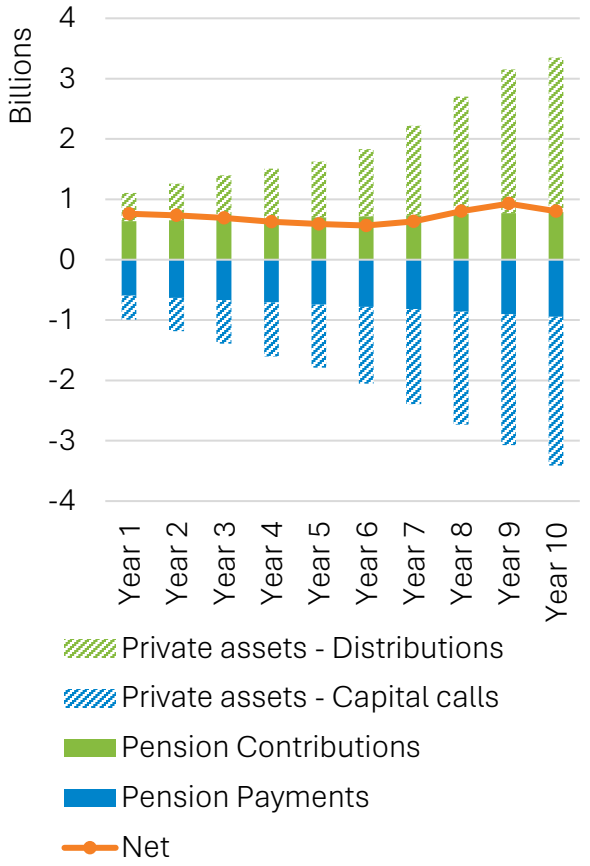
1 vintage year



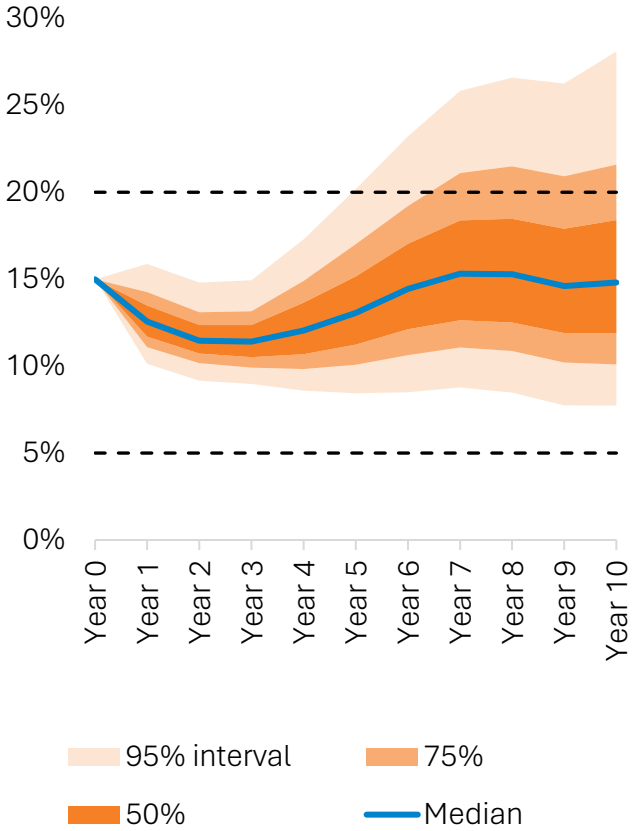
Adding vintages together



Simulating total balance sheet

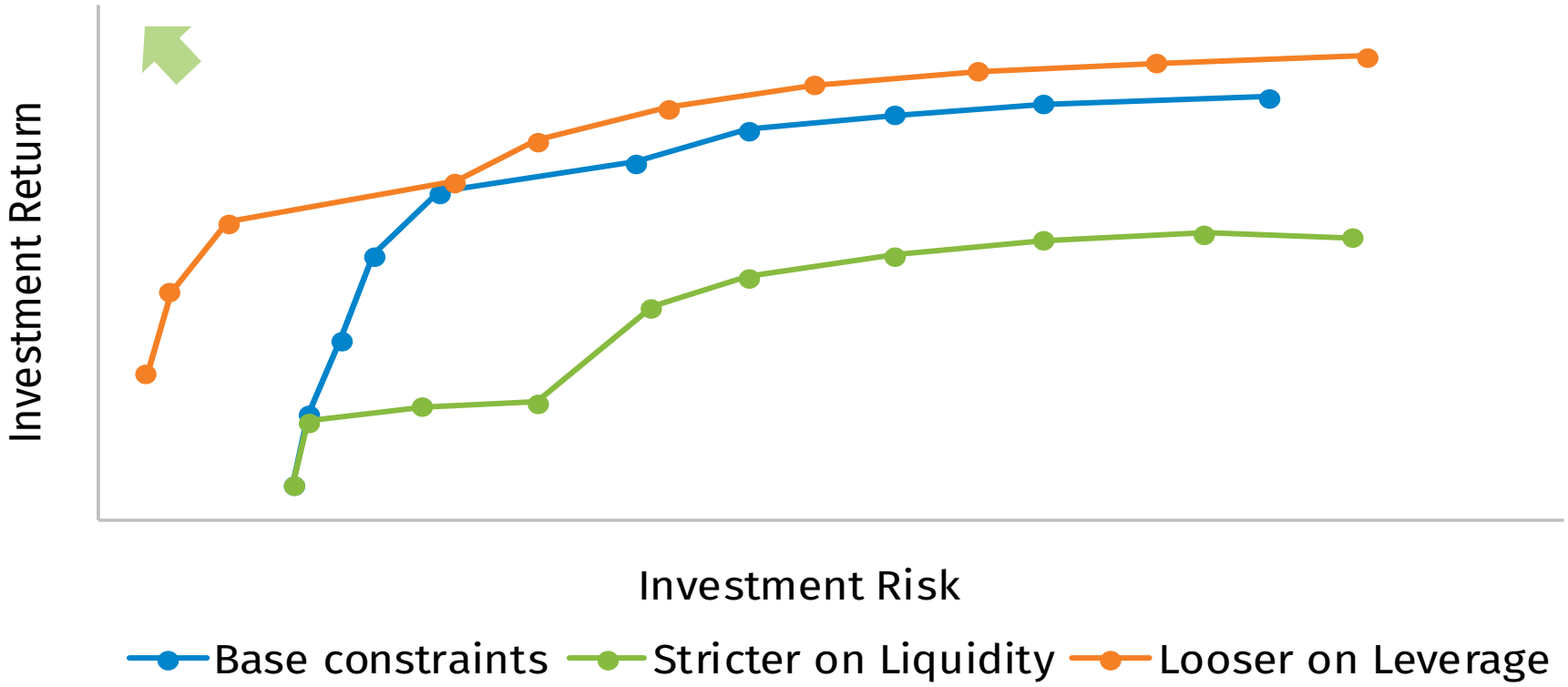


Combining with scenarios



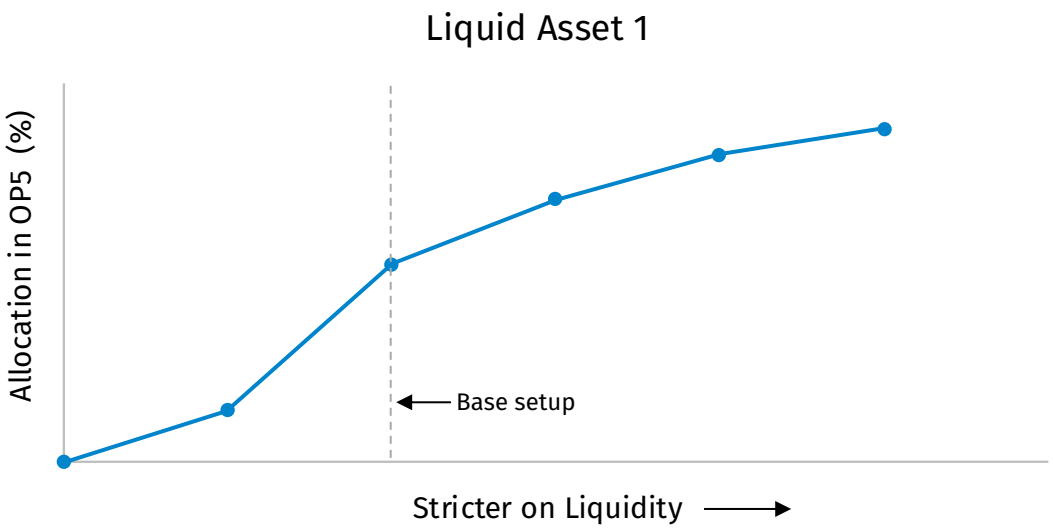
Constraint Sensitivity

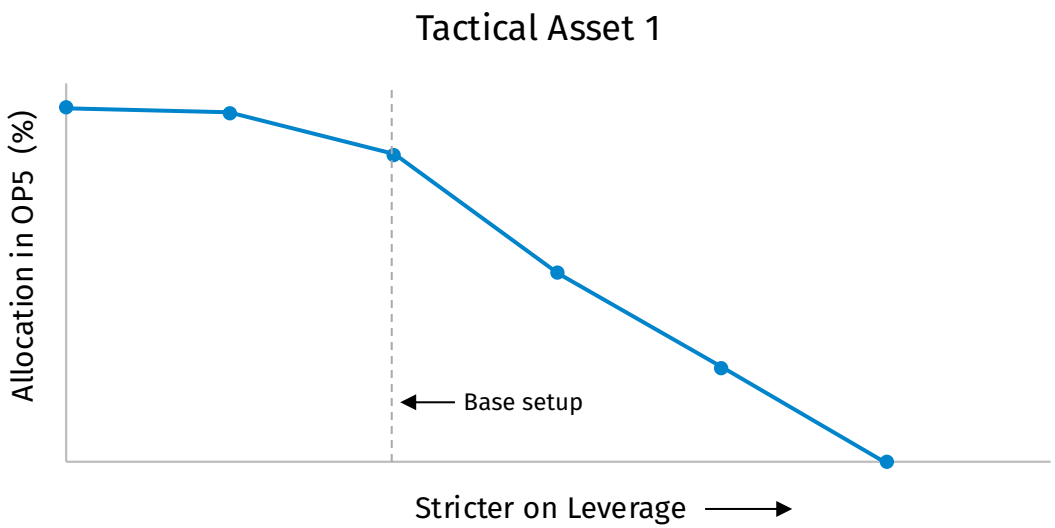
Total Portfolio Level



Constraint Sensitivity

Asset Class Level





- How does the optimal allocation to an asset class in interesting optimal portfolios change when narrowing or loosening constraints?

Takeaway

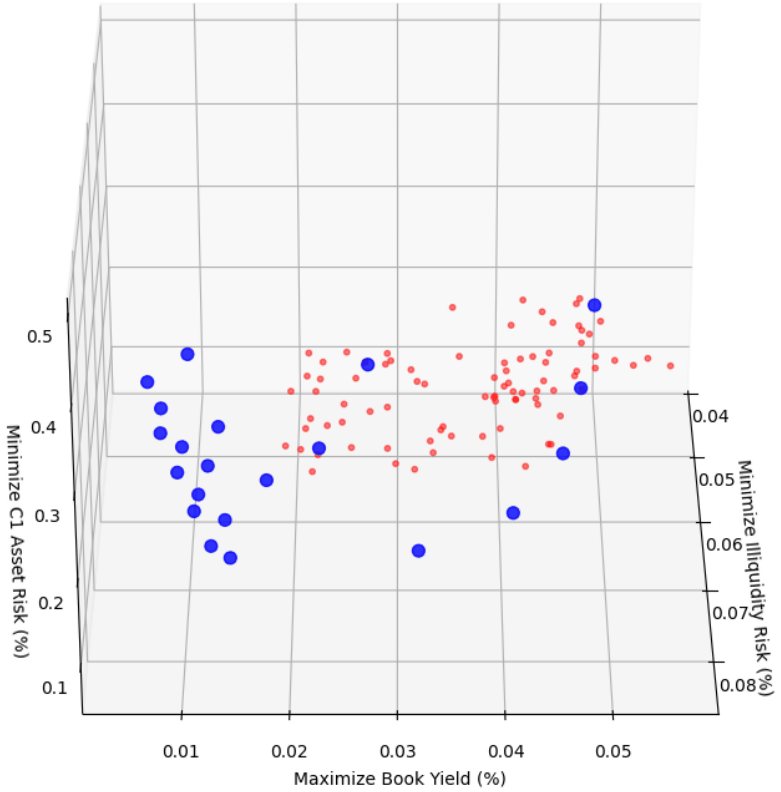
- 2-Dimensional optimization combined with complex constraints can be very effective:

  - Time-efficient way of obtaining optimal portfolios within a (non-linear) feasible space.
  - Informs which constraints are binding, and which are less restrictive.
  - Optimal performance and allocation sensitivity to constraints can easily be tested.

The Future of PRISM

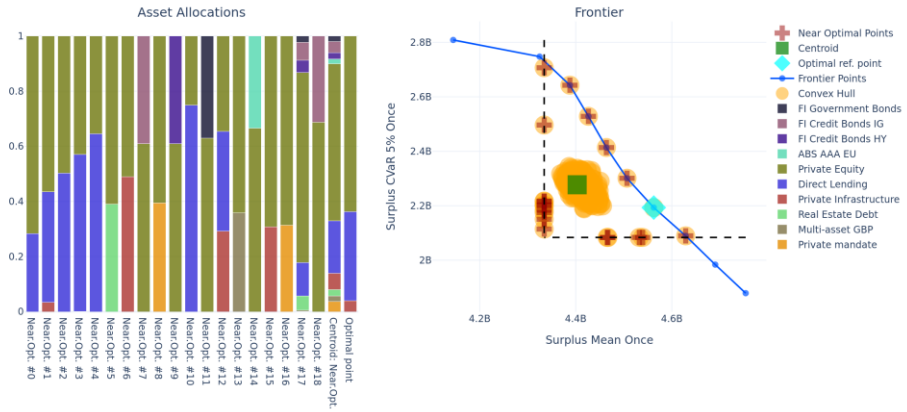
Three-Dimensional Portfolio Optimization

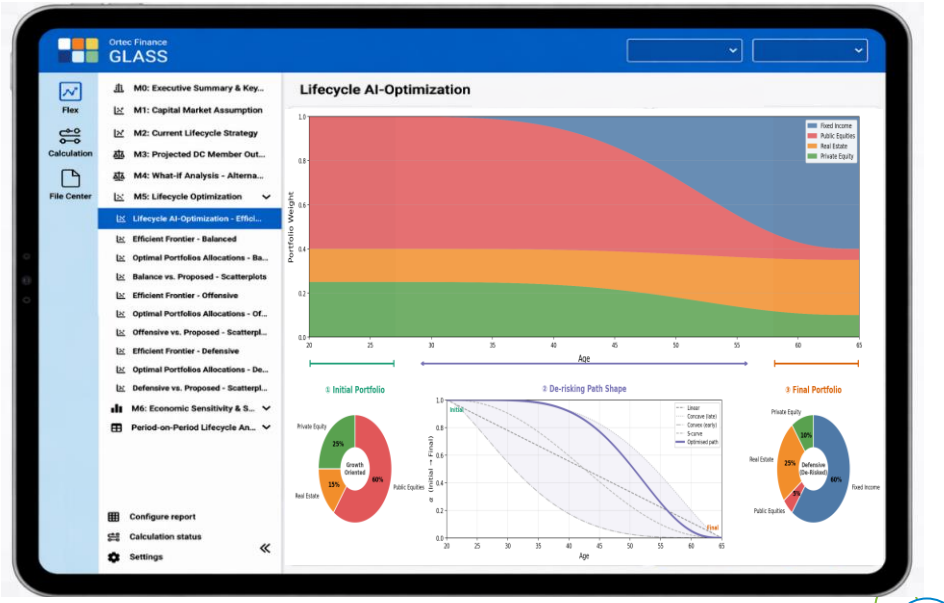
Maximize Book Yield vs Minimize Asset Risk vs Minimize Illiquidity Risk



The future of PRISM

- Three (or higher) Dimensional Optimization
- Near Optimal
- Multiple complex constraints
- Pensions DC: Glidepath
- Pensions DC: Retirement decumulation (research phase)
- Multi-fund Optimization
- Robust Optimization (research phase)
- And more….

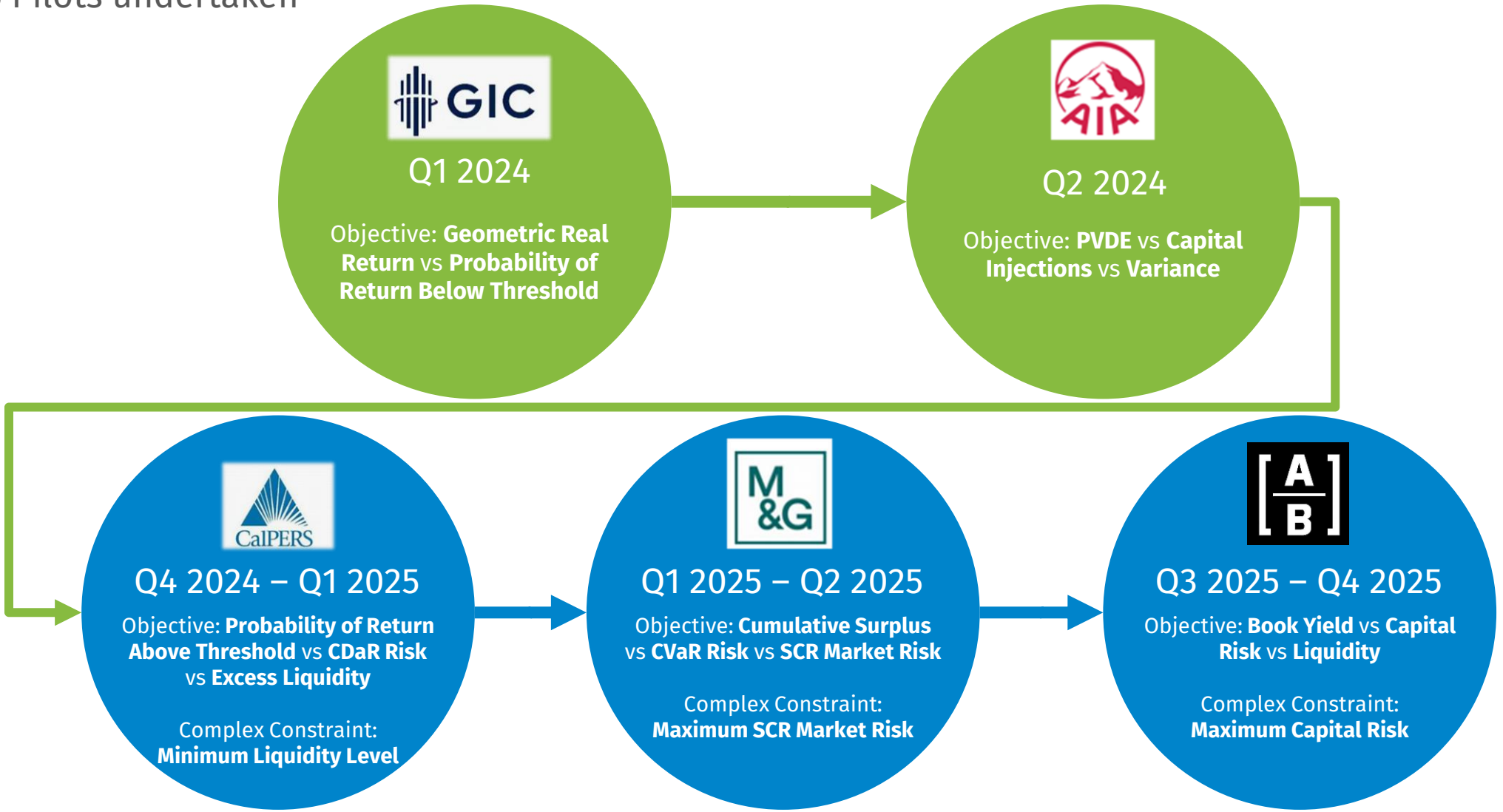




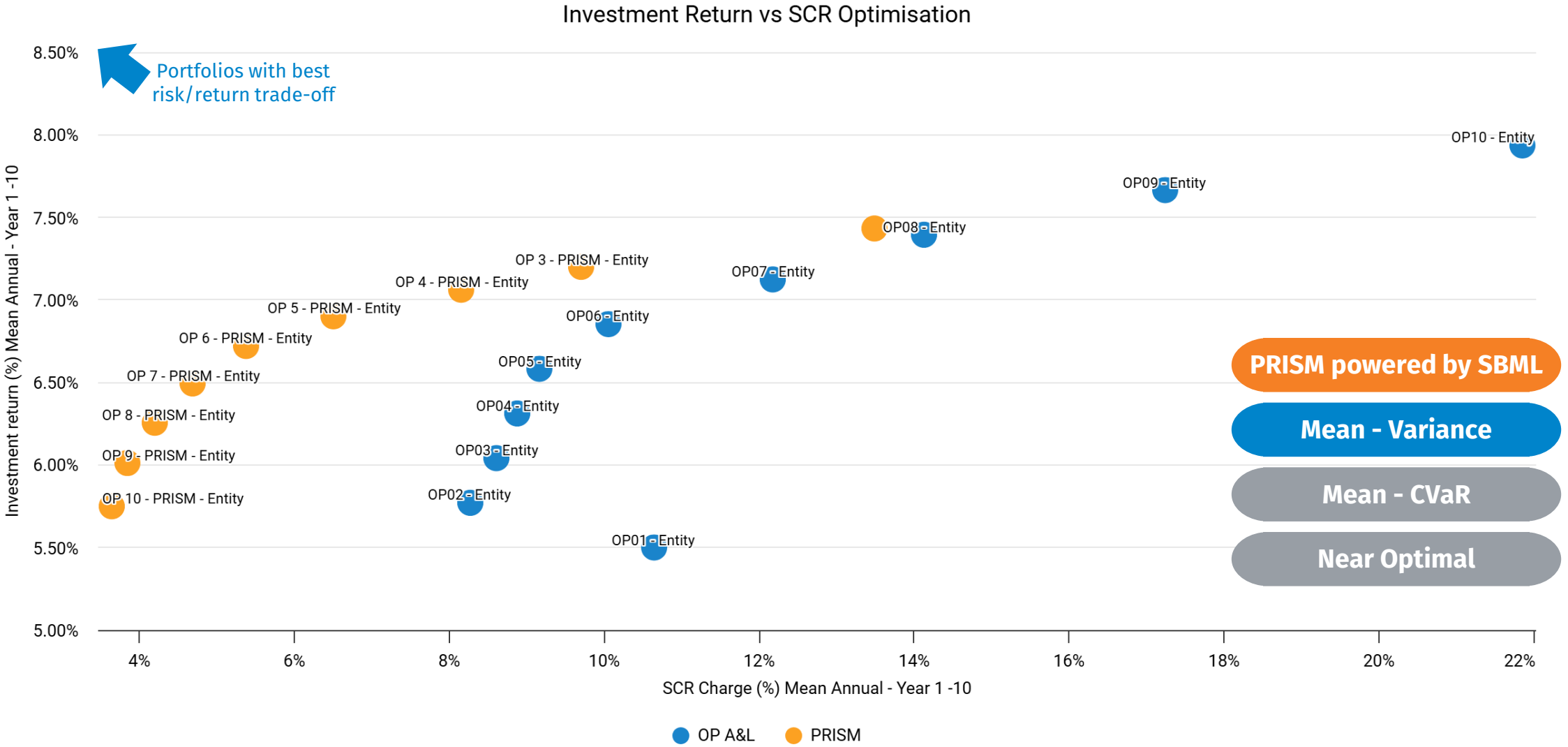
Appendix

Scenario-Based Machine Learning

5 Pilots undertaken



Portfolio Optimization



MA Optimisation Set-up

- Matching portfolio:
  - Matching government bond portfolio (20-70yr)
  - Matching AA UK corporate bond portfolio (1-20yr)

- Surplus portfolio:
  - Equities
  - Government bonds
  - Corporate bonds
  - Cash
  - Direct lending

- Investable universe consist of MA-eligible 1-20yr assets of different ratings and asset features:
  - Government bonds (US & UK)
  - Corporate bonds IG + HY (US & UK)
  - Private RE
  - Private Infra

Optimization for an insurer under US RBC

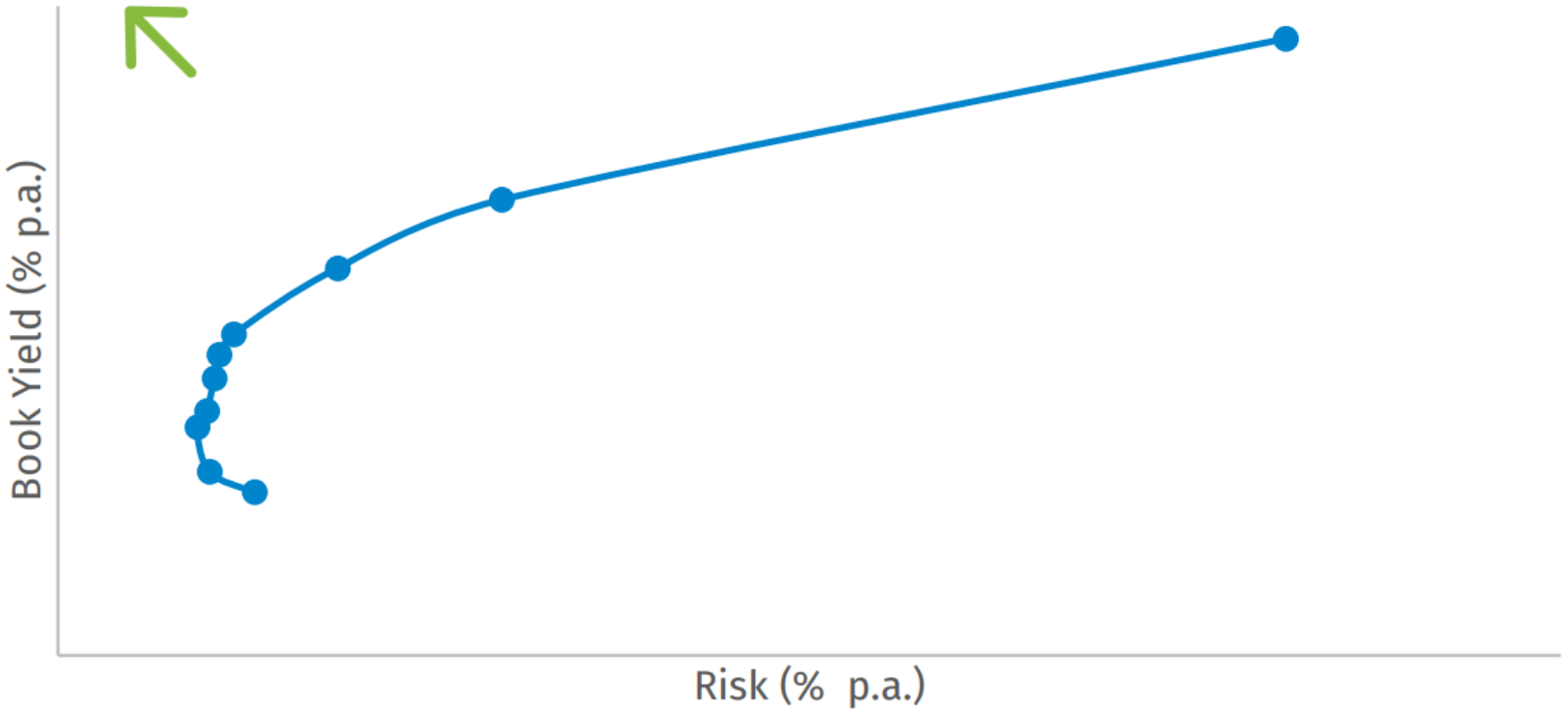
Objective:

Maximize Book Yield vs Minimize Capital Risk

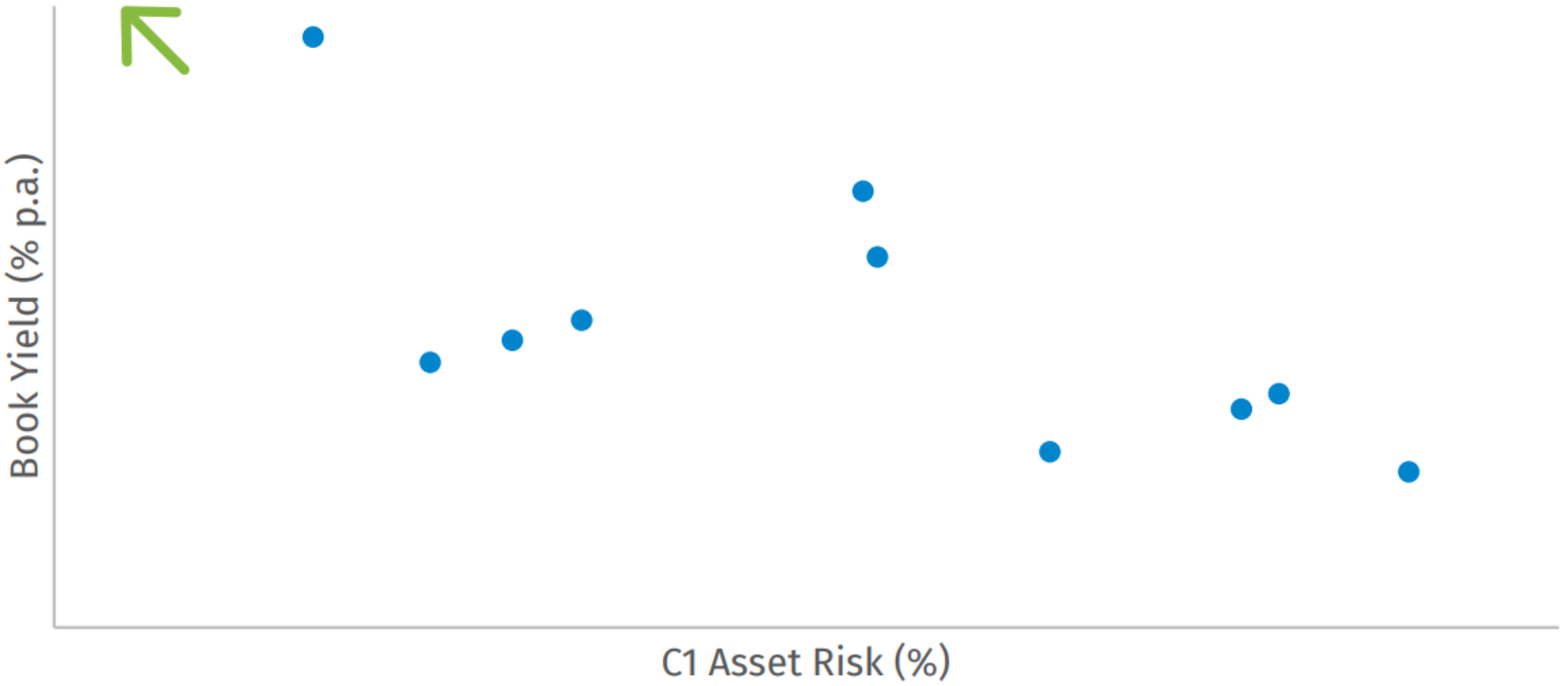
Complex Constraint:

Cap Capital Risk

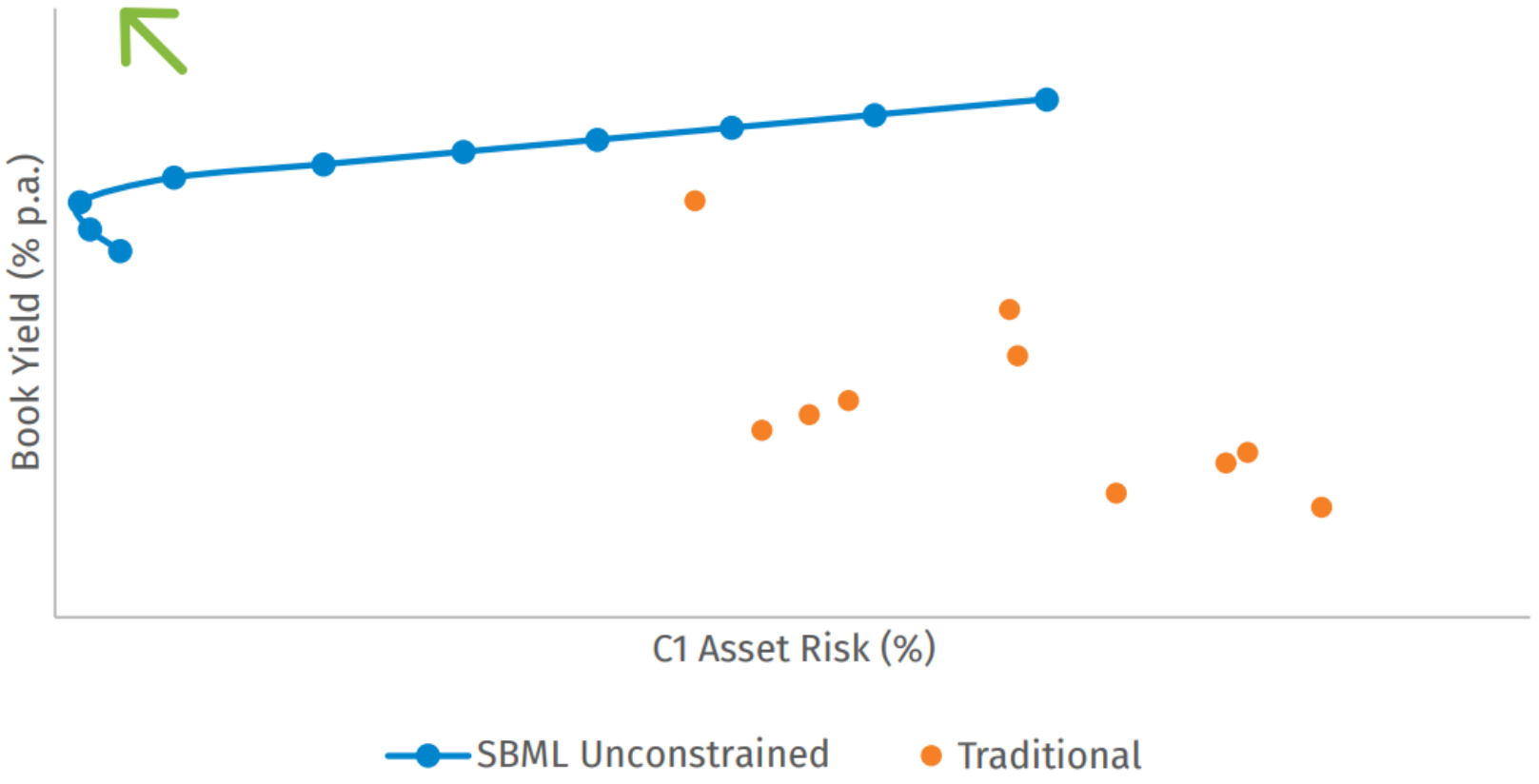
Traditional book yield optimization



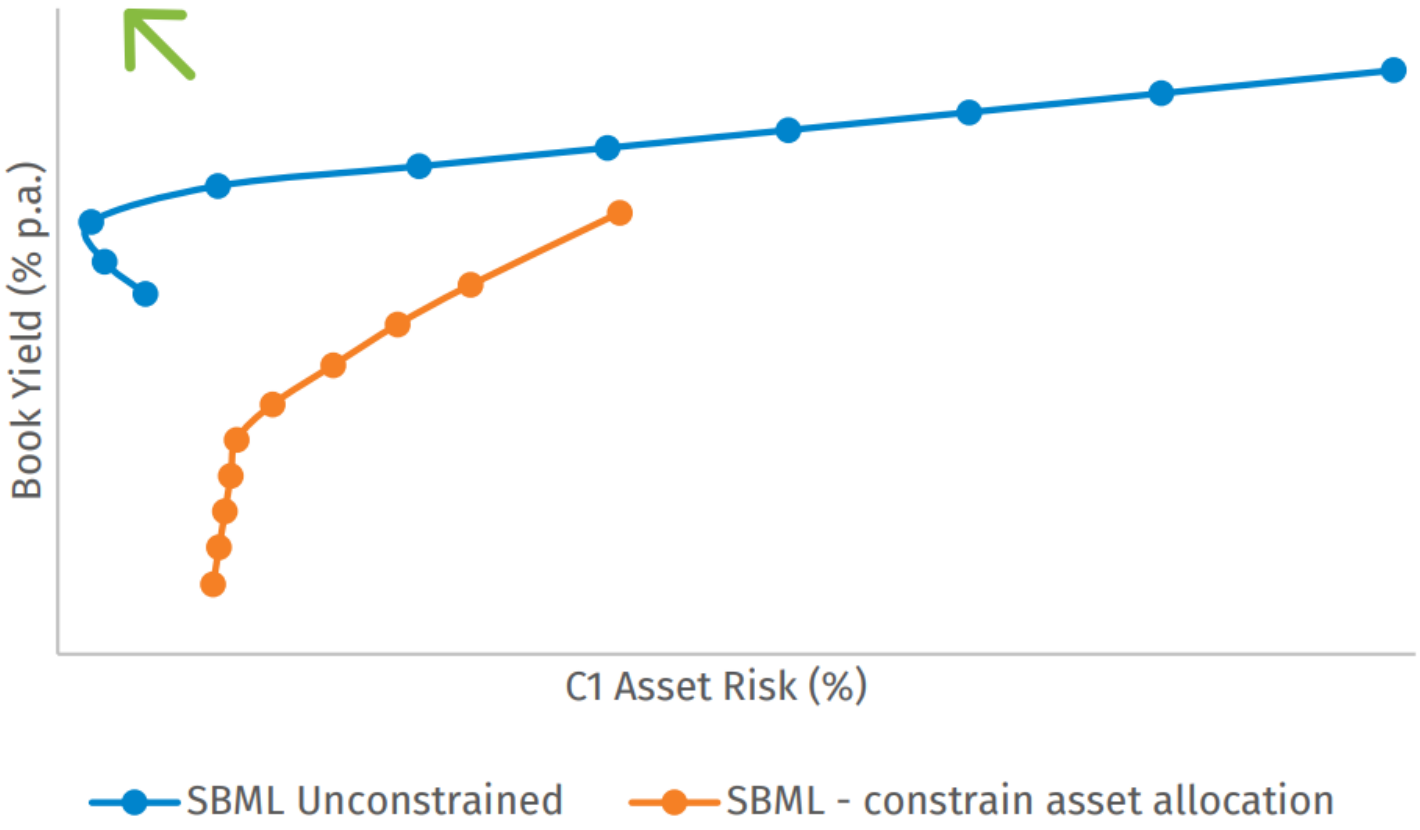
Traditional book yield optimization



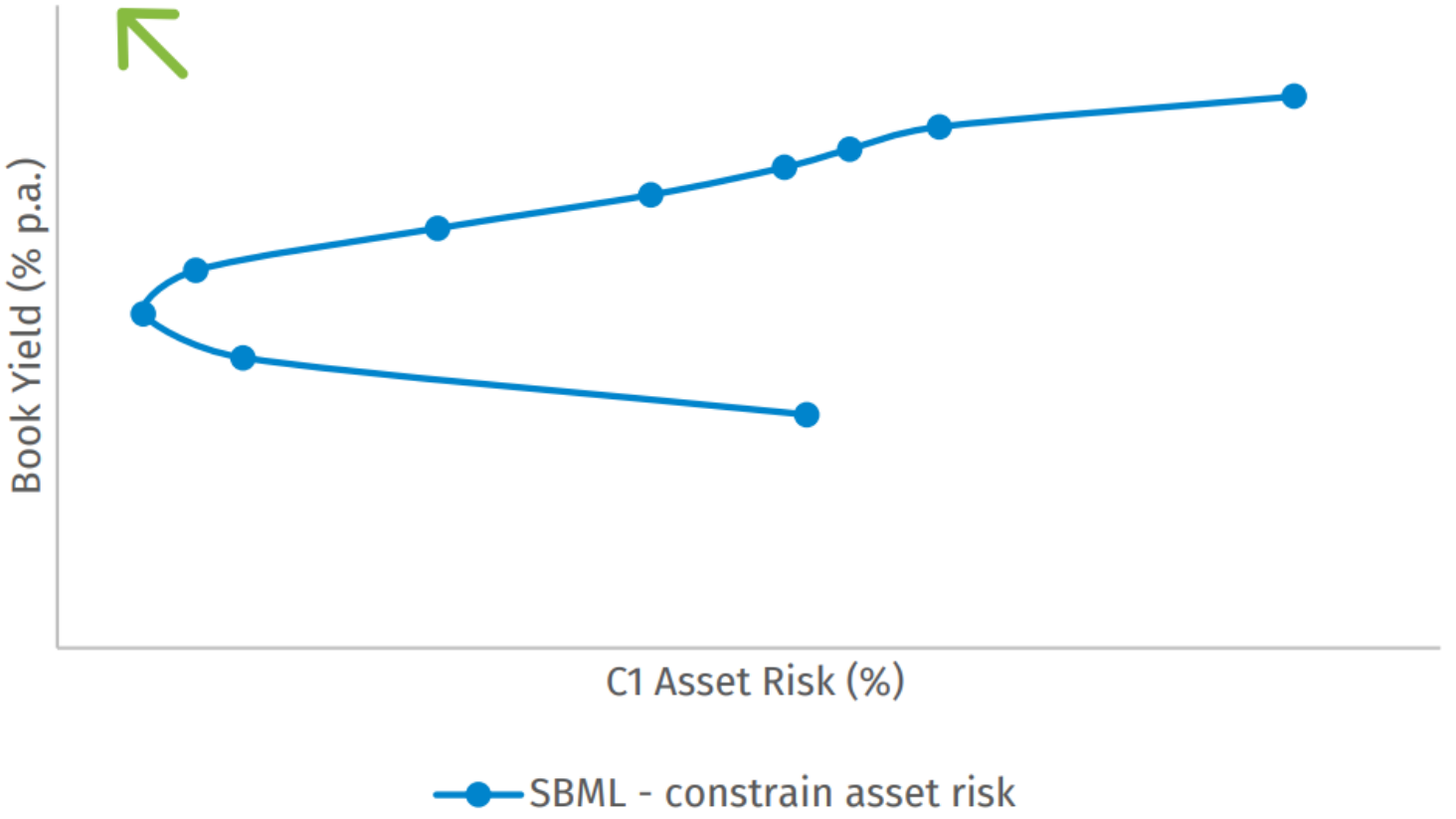
PRISM optimization – unconstrained



PRISM optimization – linear constraints

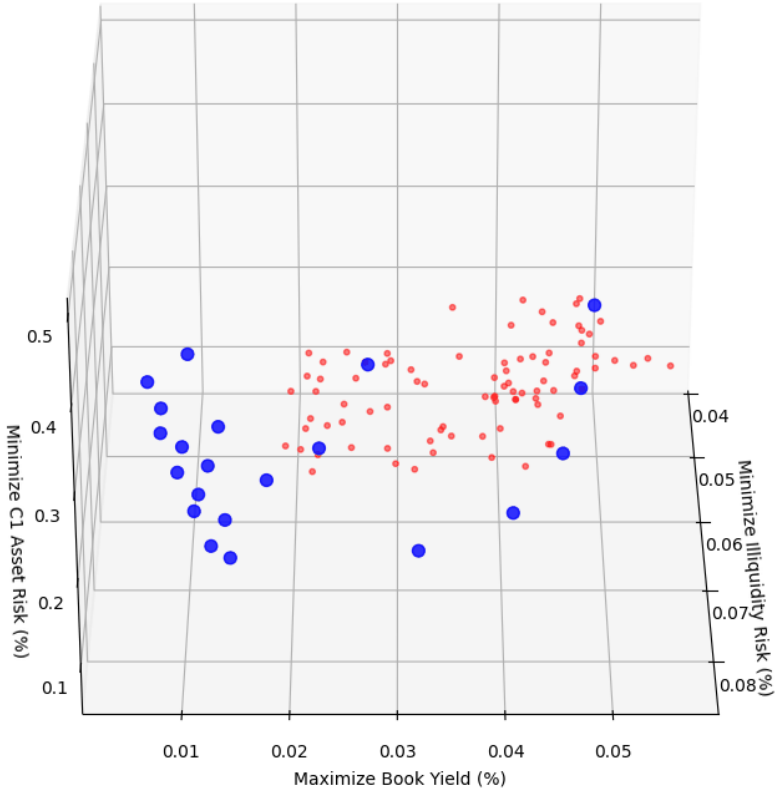


PRISM optimization – complex constraint (asset risk)



Three-Dimensional Portfolio Optimization

Maximize Book Yield vs Minimize Asset Risk vs Minimize Illiquidity Risk

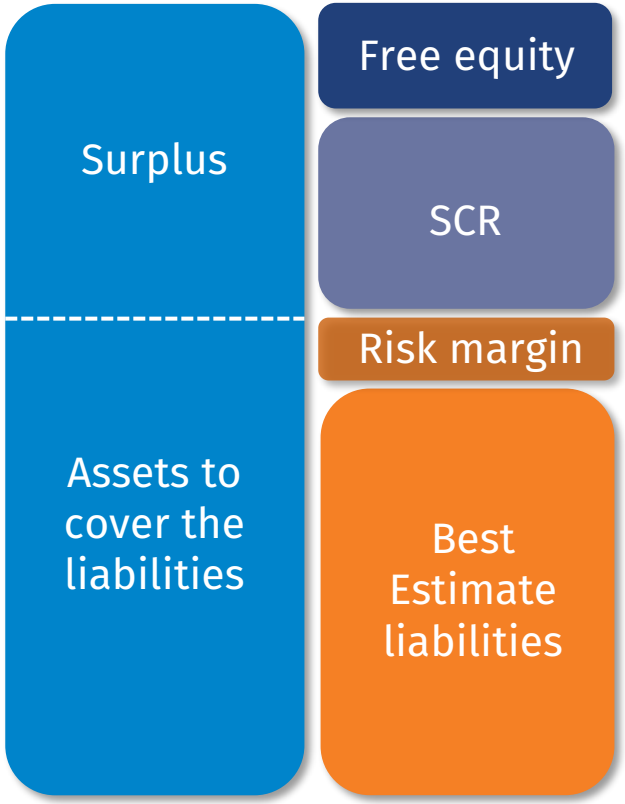


Optimizations M&G Pilot

M&G Investments

1. Optimizing Cumulative Surplus Mean vs Tail Risk, with SCR Market Risk constraints

2. Optimizing Solvency II Ratio Mean vs St.Dev.



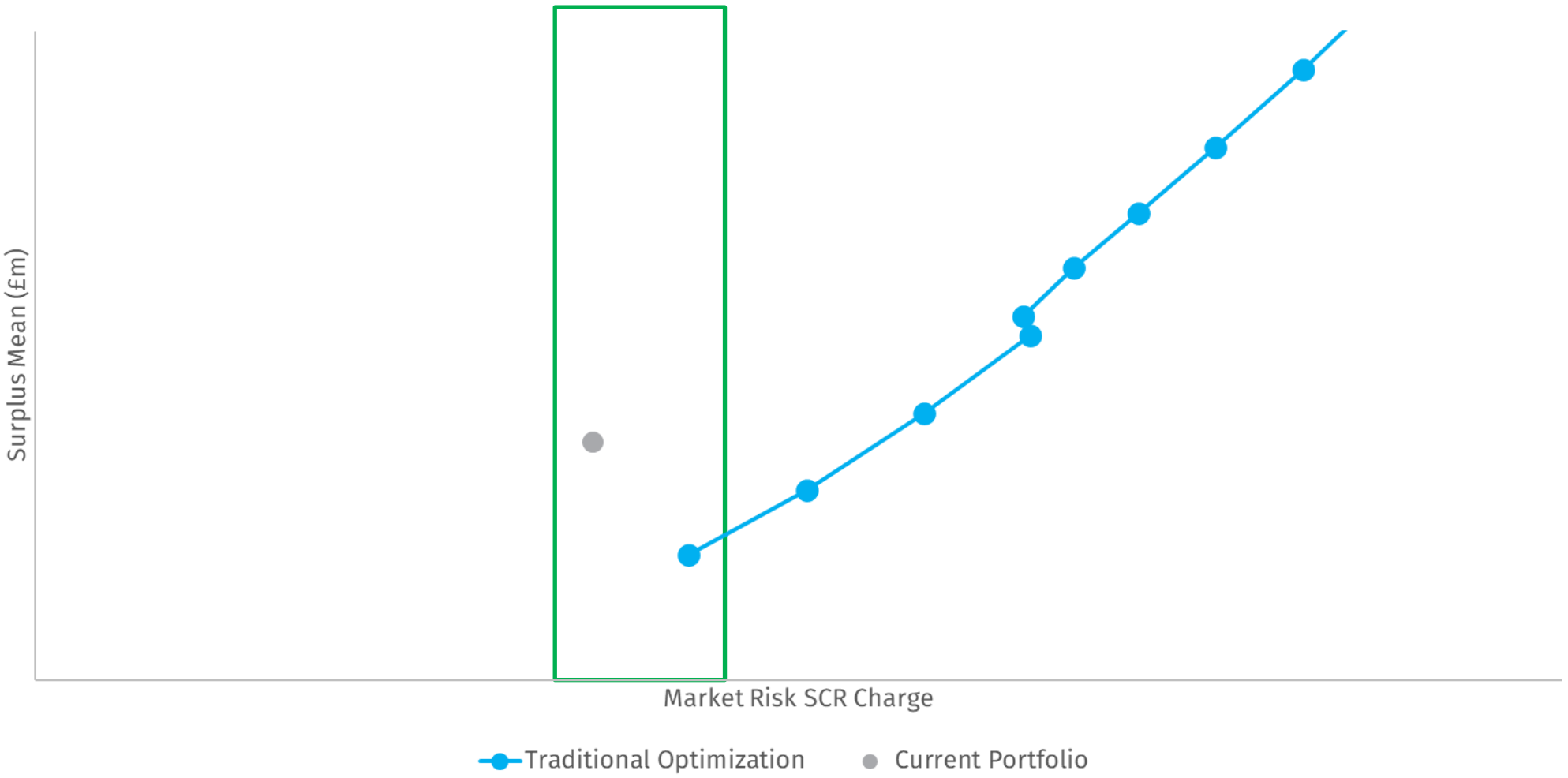
$$Solvency\ II\ ratio = \frac{Surplus}{SCR}$$

Traditional Optimization

Mean versus 5% CVaR of cumulative surplus

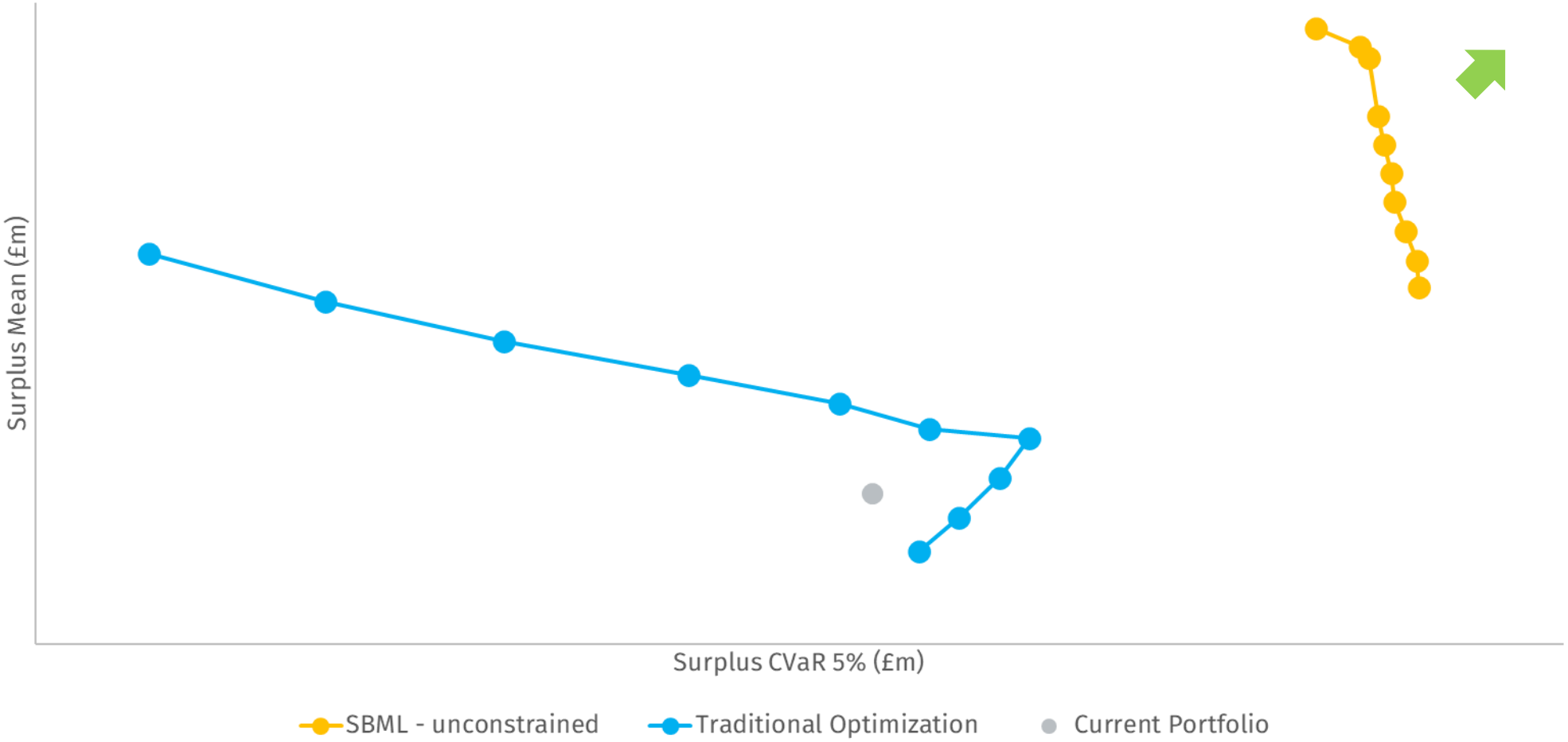
Constraining Market Risk

Between 5% and 6%



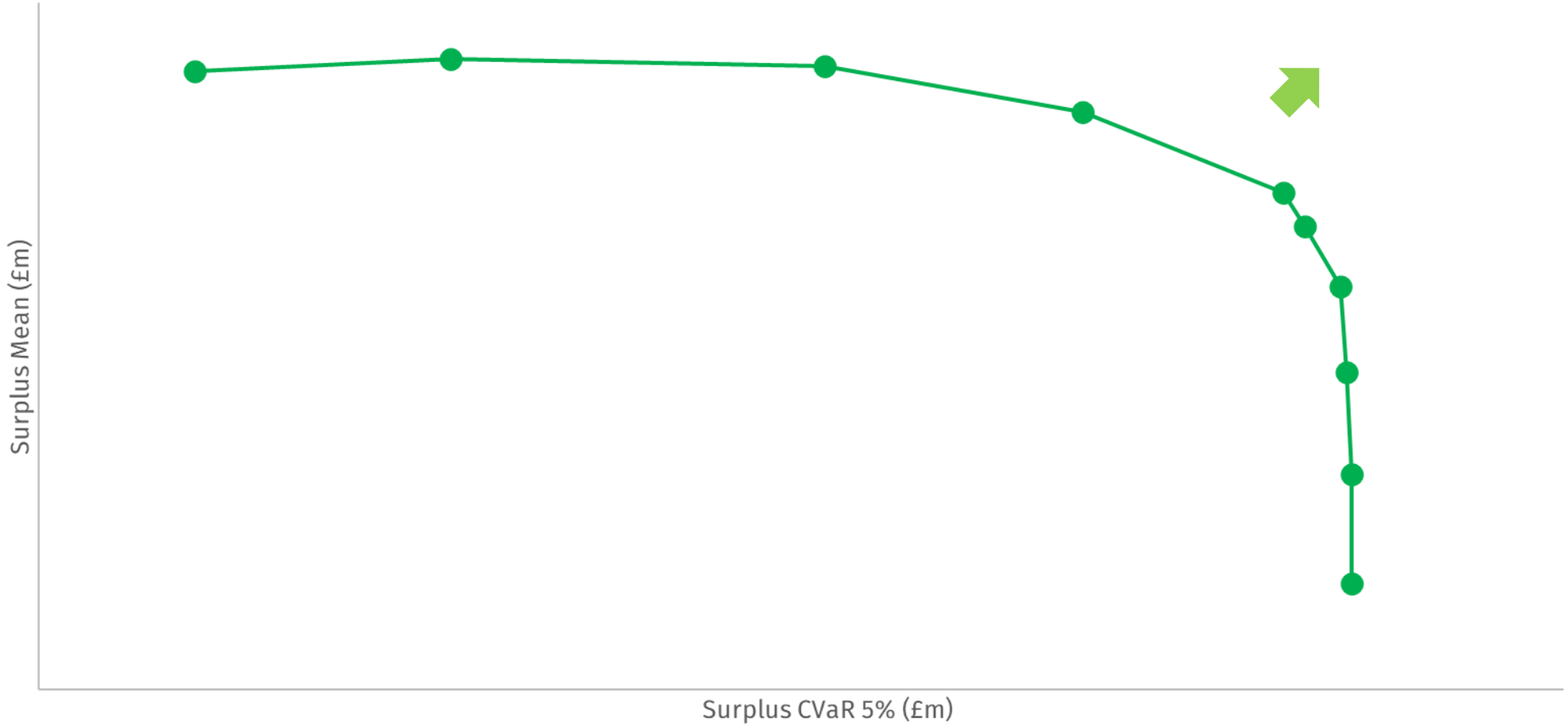
Scenario Based Machine Learning

Mean versus 5% CVaR of cumulative surplus



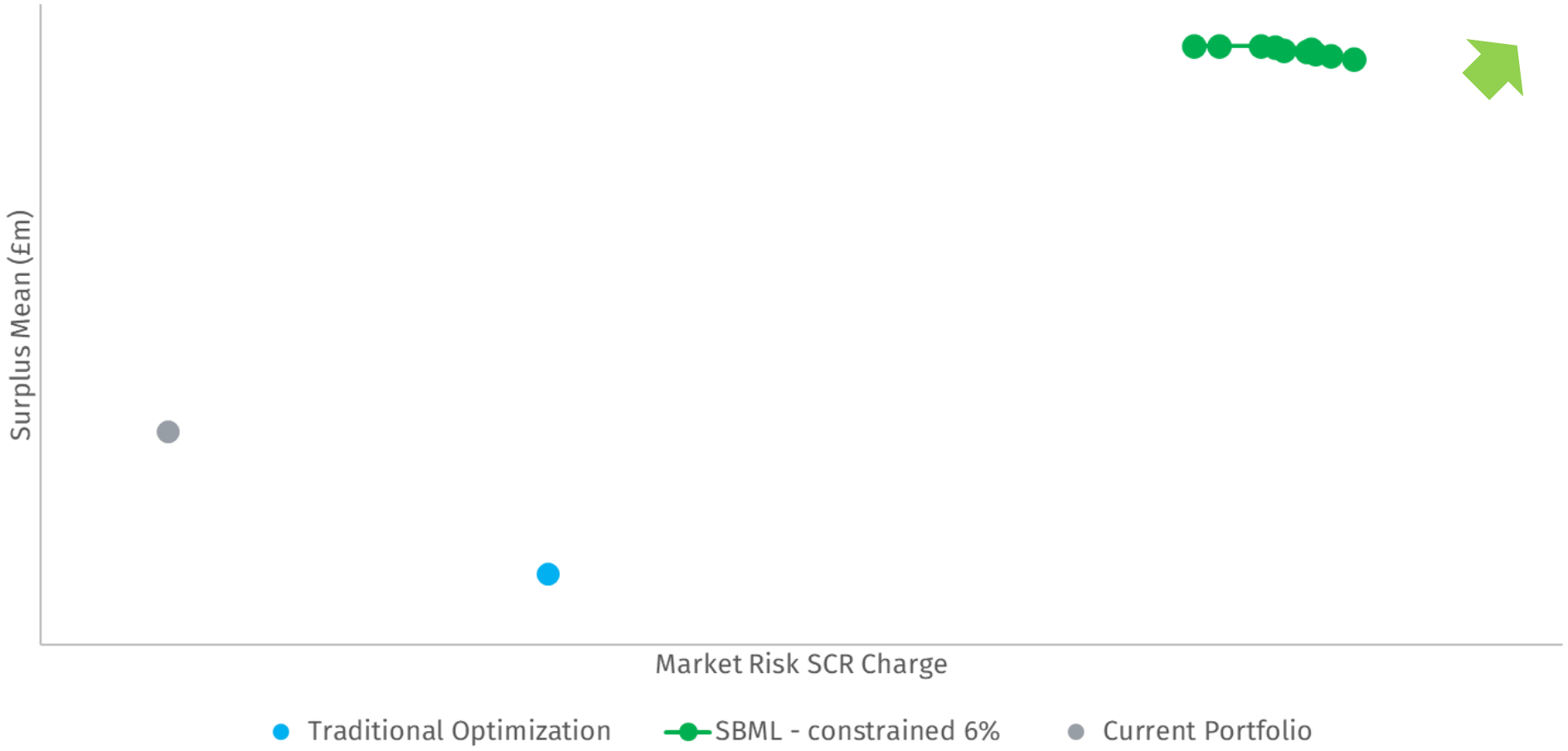
Scenario-Based Machine Learning

Mean versus 5% CVaR of cumulative surplus – complex constraint; market risk between 5%-6%



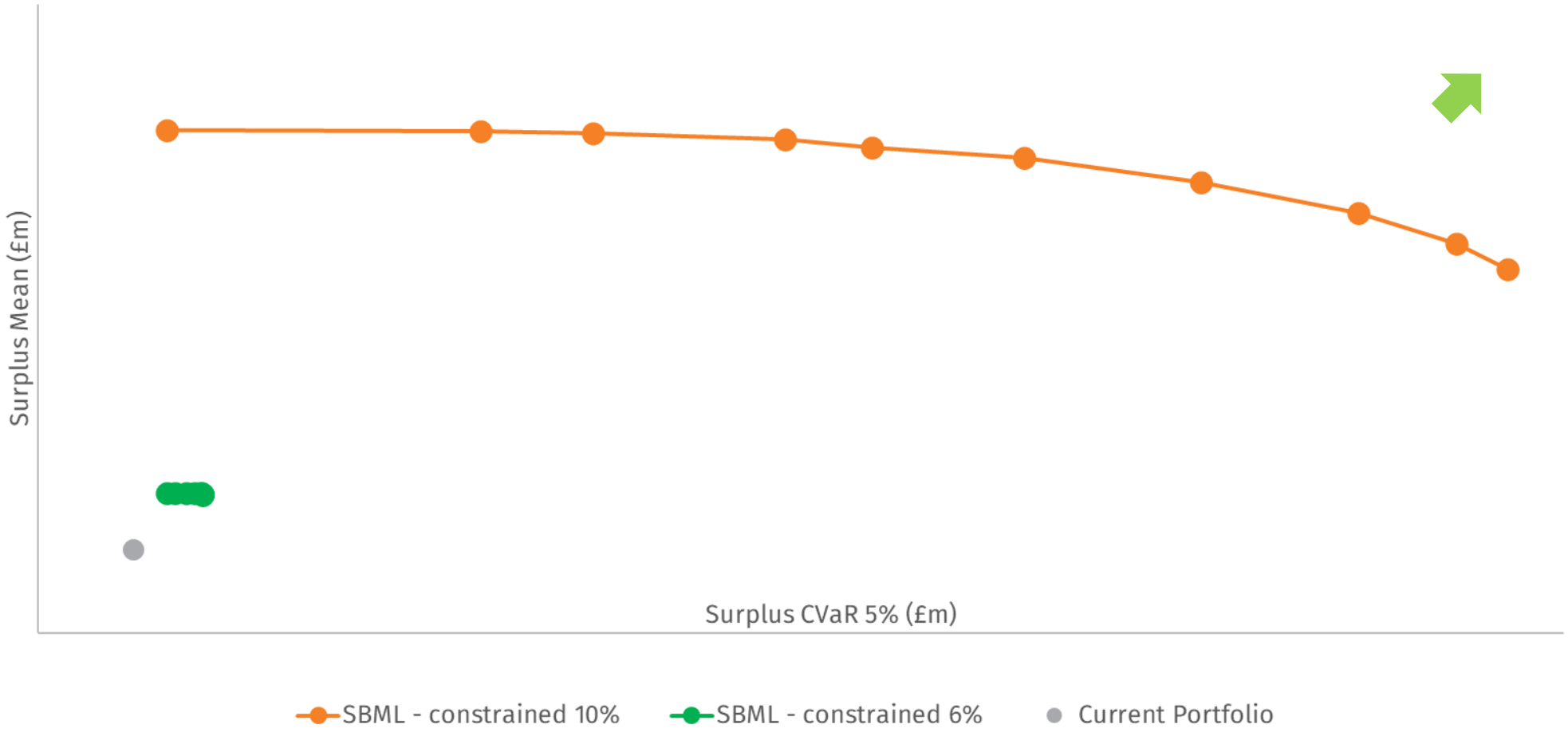
Compare against traditional optimization

Constrain Market Risk SCR Charge between 5%-6%



Scenario-Based Machine Learning

Increase Market Risk SCR Charge up to 10%



Objectives

Linear relationship

Investment Return

Maximum Tail Risk

Investment Risk

Objectives

Non-linear relationship

Capital Charge

Dividends / Surplus

Liquidity

Solvency Ratio

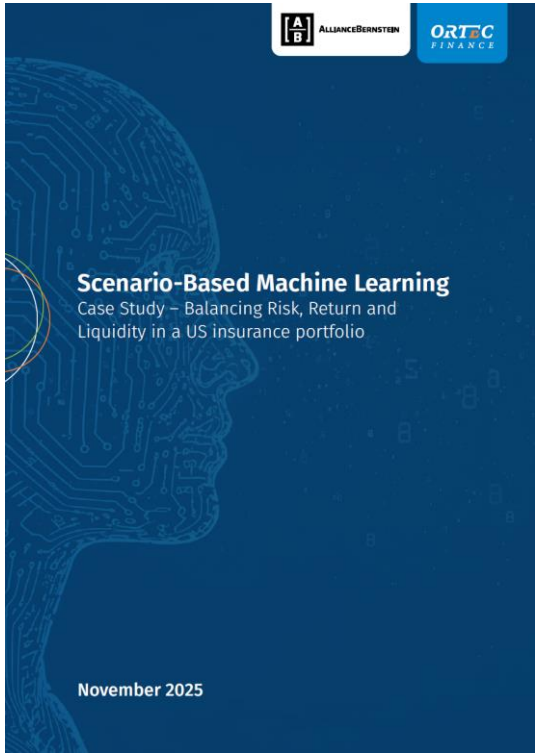
Capital Injection / Contributions

Cashflow Match

Etc...

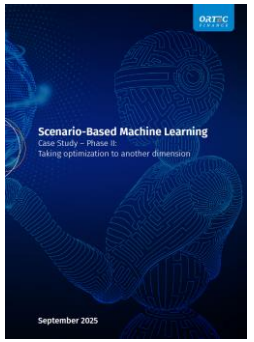
More Information

Use this QR code to access all our PRISM case studies and whitepaper



Balancing Risk, Return and Liquidity in a US insurance portfolio

Optimizing Insurance Portfolios with SBML



Unlock the Next Dimension of Portfolio Optimization

How AI Can Help Manage Insurance Portfolios

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