

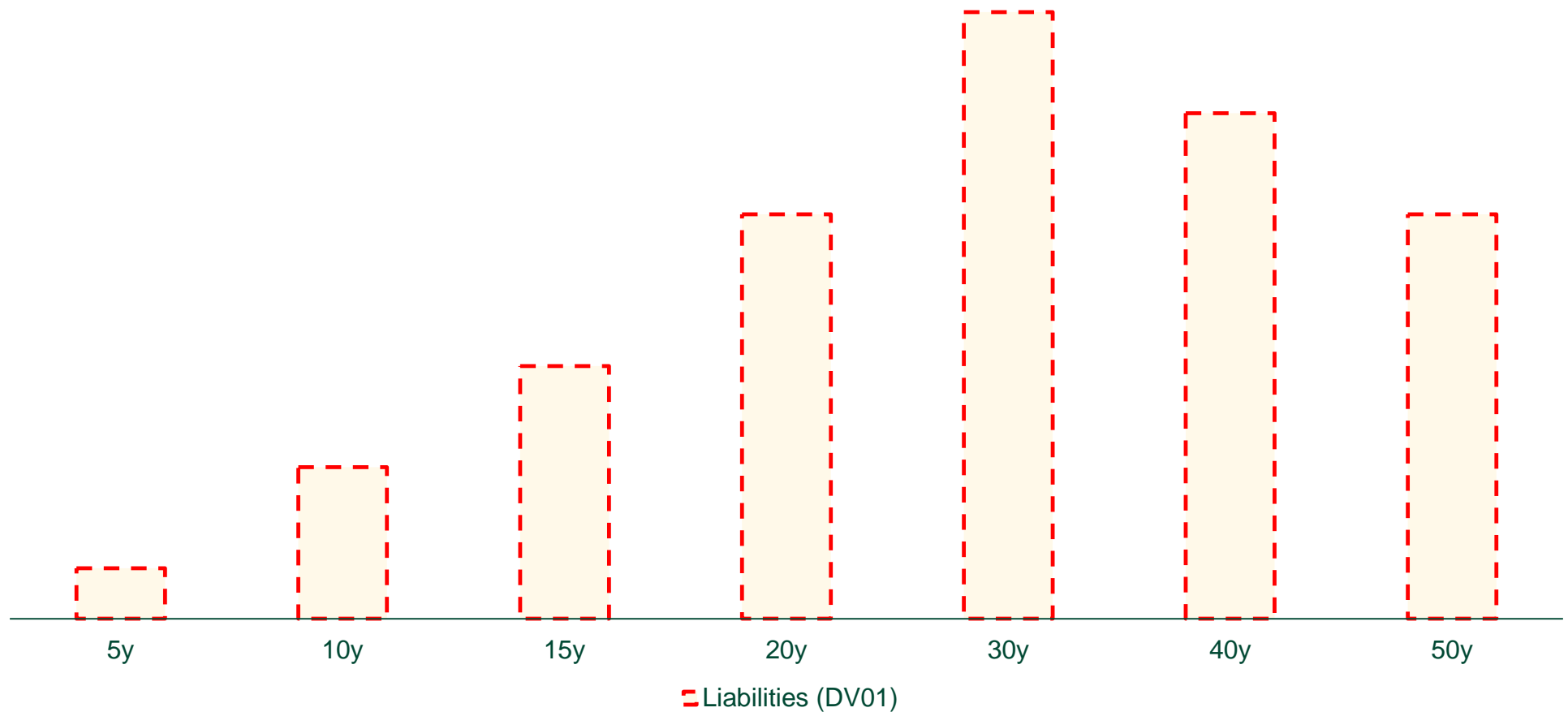
Applications of Scenario-based Robust Optimisation

Thema conferentie Netspar

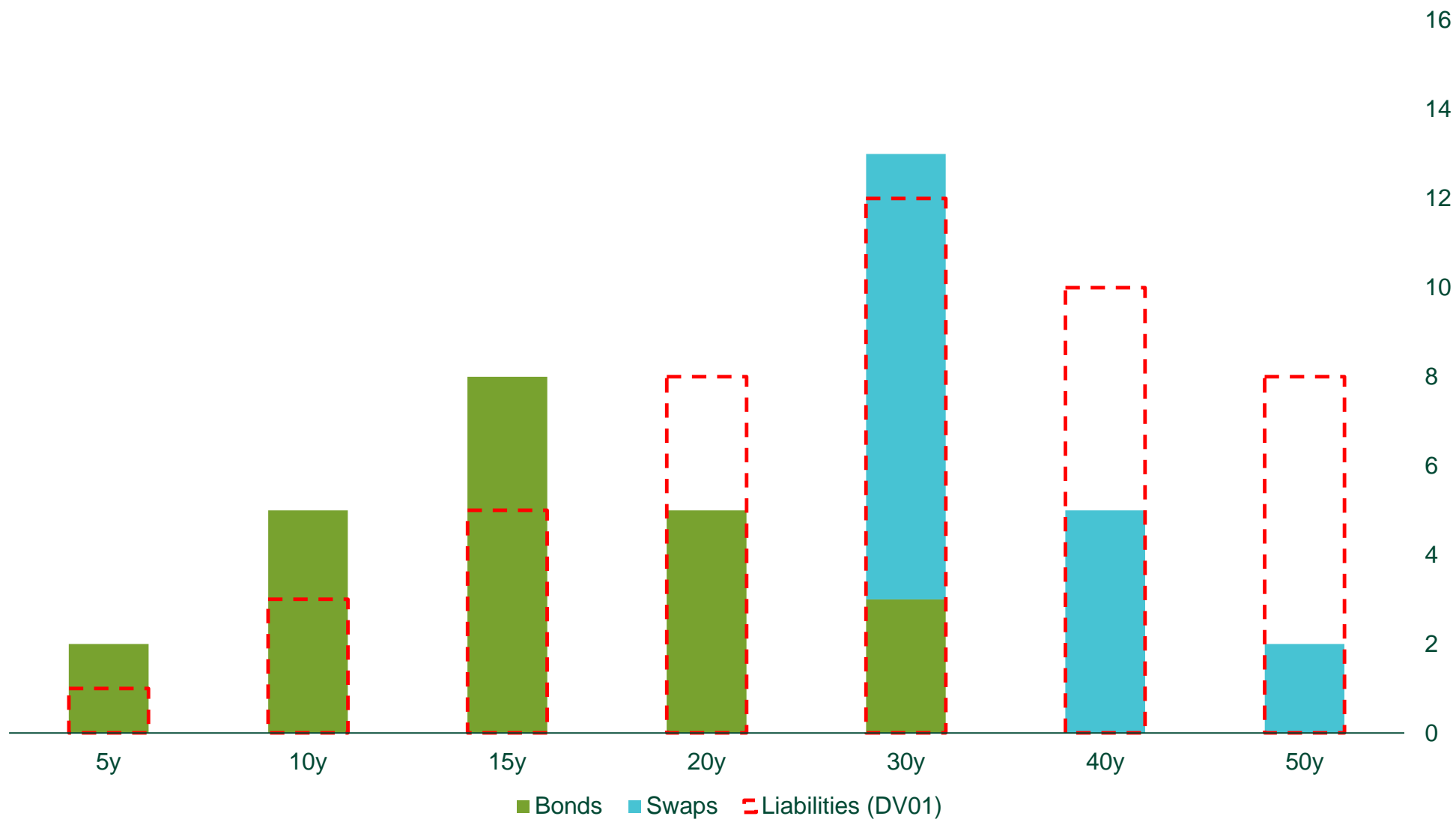
5th of July 2018

Challenges of the LDI manager...

Liabilities



... often leads to imperfect hedges



Current approaches not ideal

Debt weights



Equal weights



Mean variance?



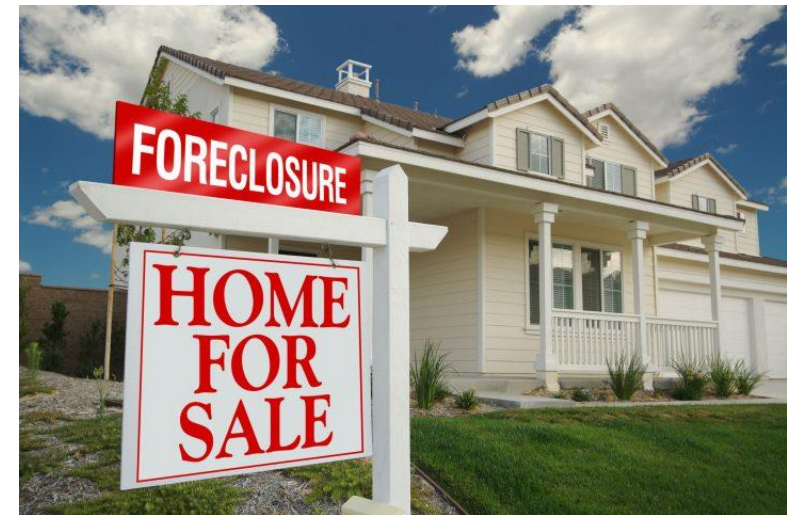
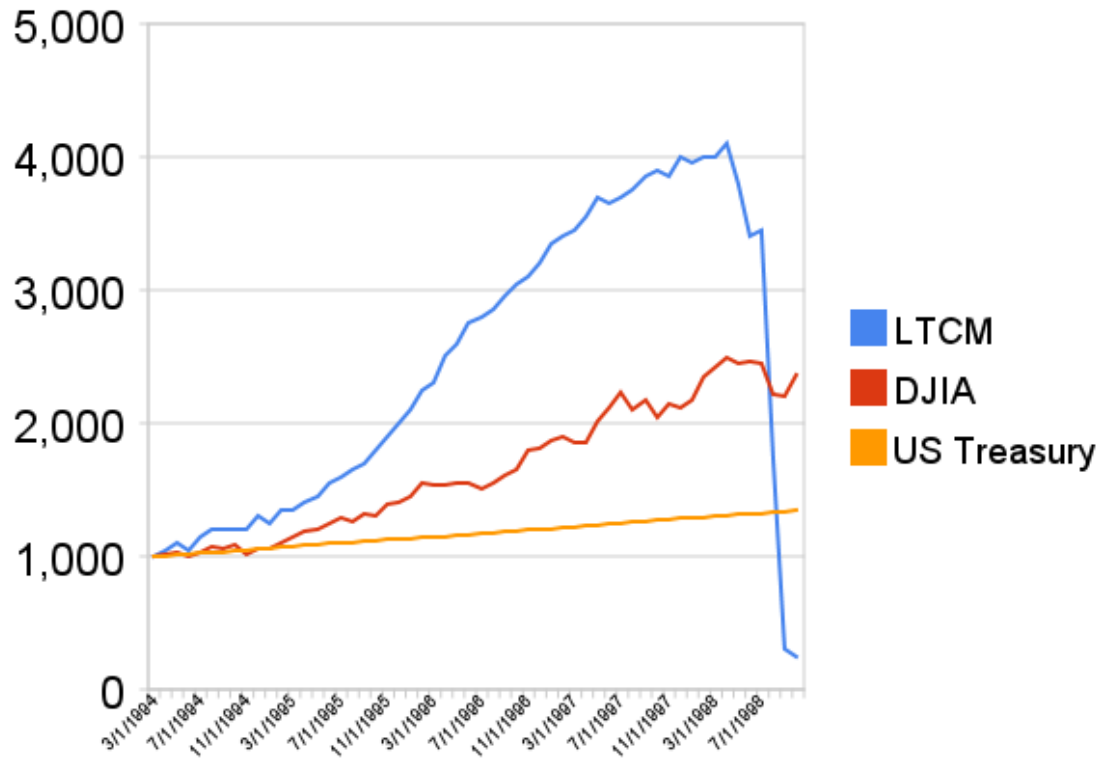
- Italy
- France
- Germany
- Netherlands
- Spain
- Belgium
- Austria
- Portugal
- Finland

Fixed Income is notoriously non-normally distributed...

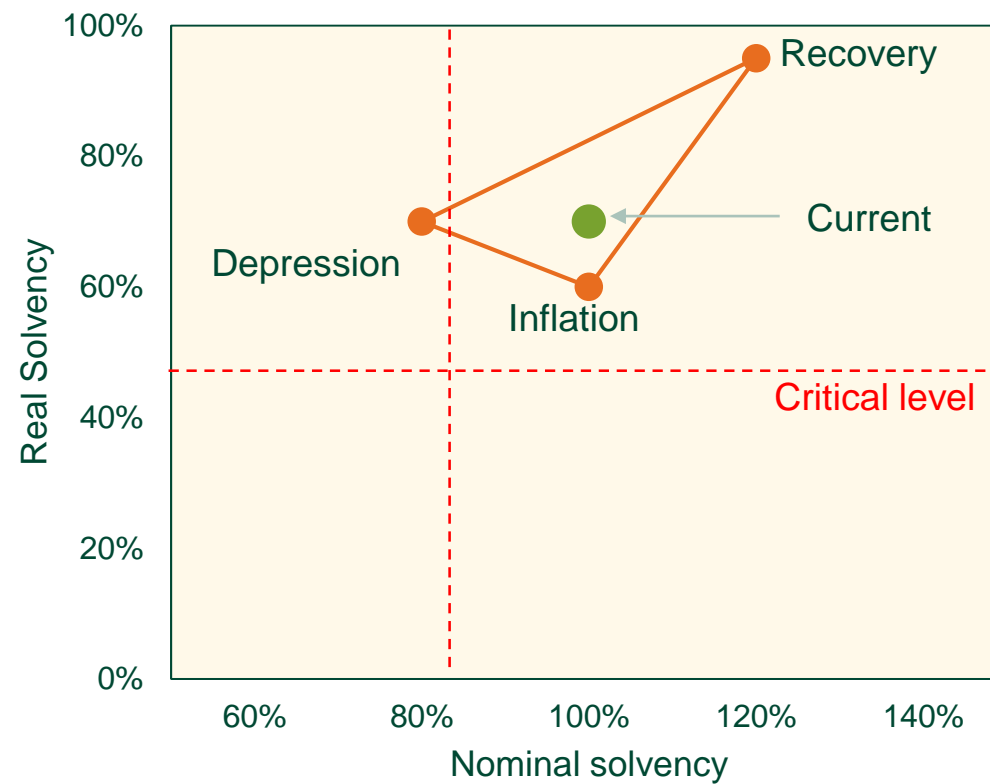


Source: Bloomberg

... which with leverage can lead to disasters



Helpful tool: scenarios for stress tests

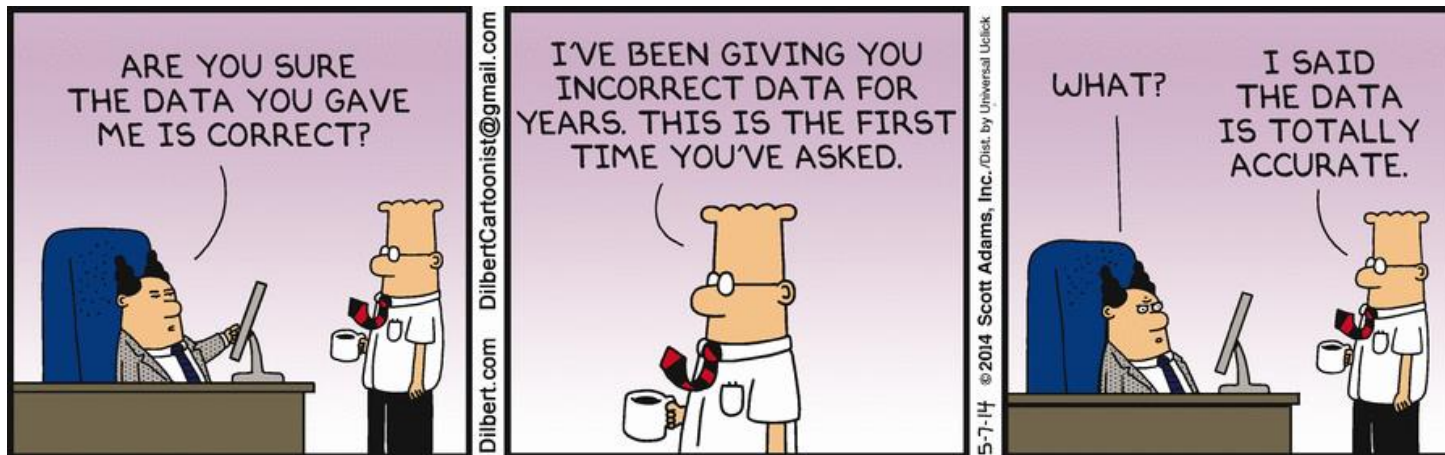




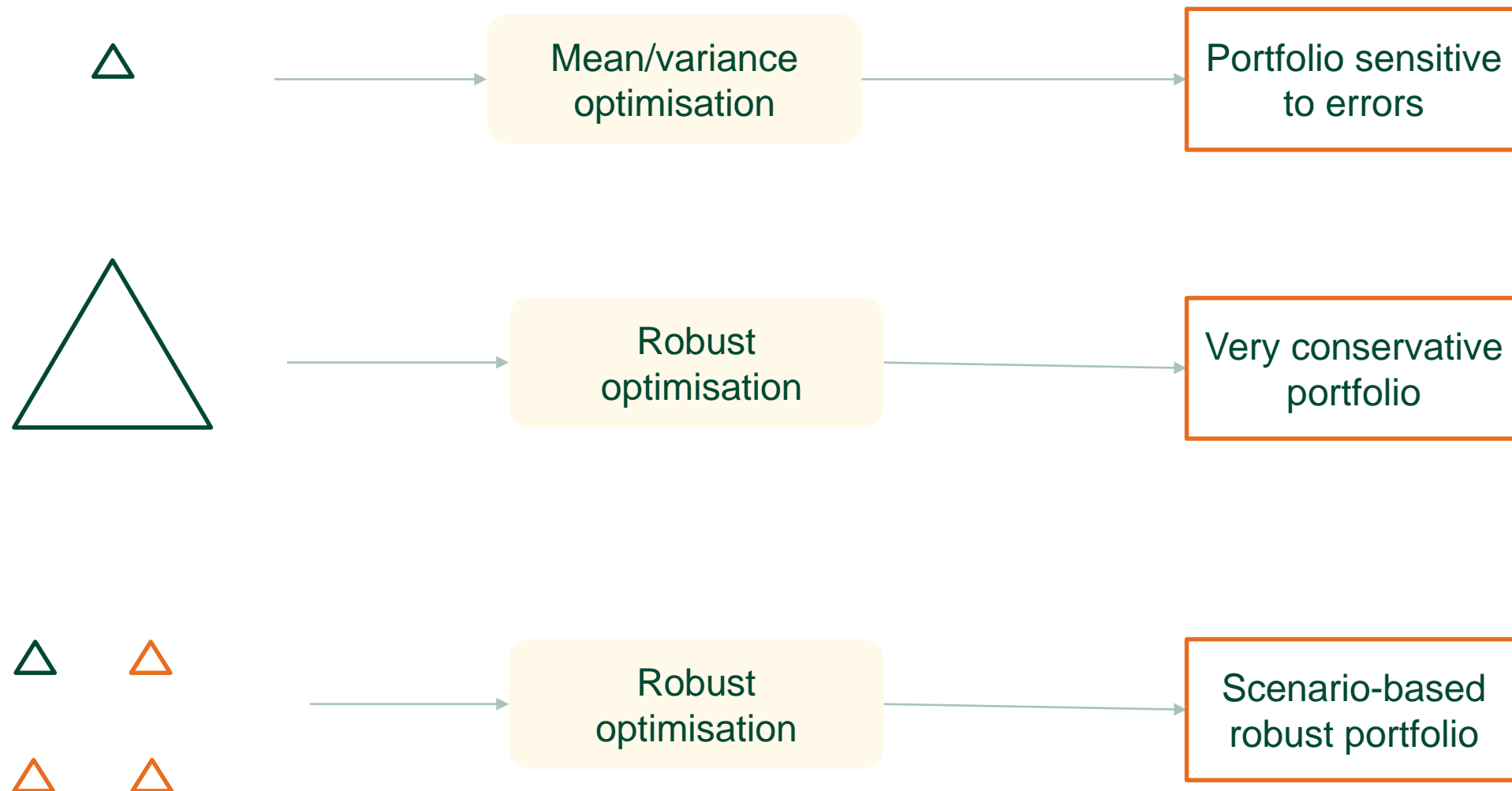
But thus far limited use for portfolio construction

		Growth	Inflation
MARKET EXPECTATIONS	Rising	25% OF RISK Equities Commodities Corporate Credit EM Credit	25% OF RISK IL Bonds Commodities EM Credit
	Falling	25% OF RISK Nominal Bonds IL Bonds	25% OF RISK Equities Nominal Bonds

New approach: robust optimisation



Specification of uncertainty set with scenarios



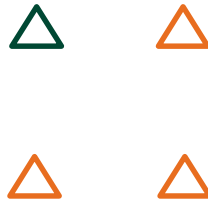
Any number of scenarios, any distribution

Base scenario

Historical data, multivariate normal distribution

Scenario A

Multivariate normal distribution with user input specification

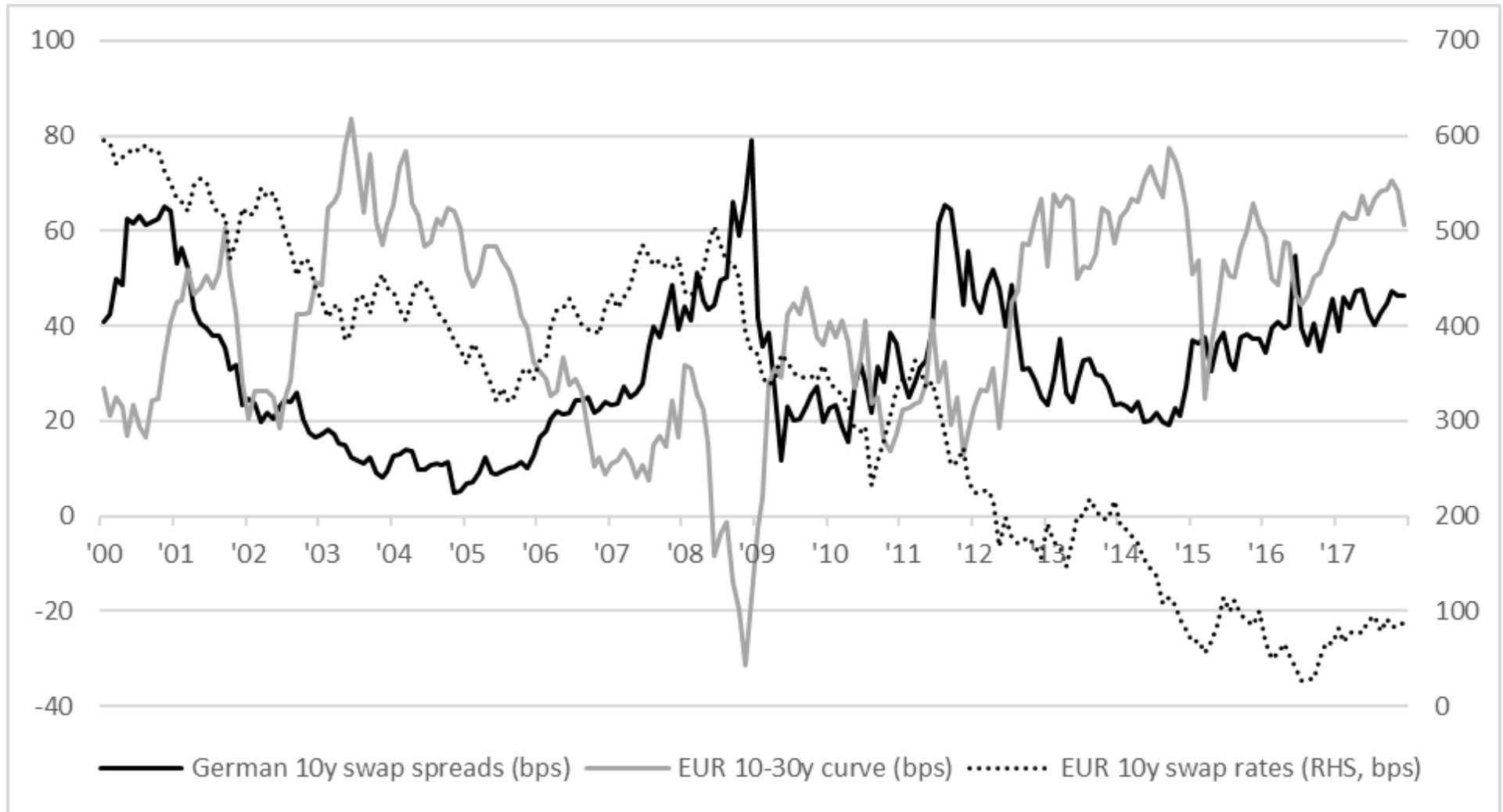
**Scenario B**

Mean reverting model?

Scenario C

Fatter tailed distribution?

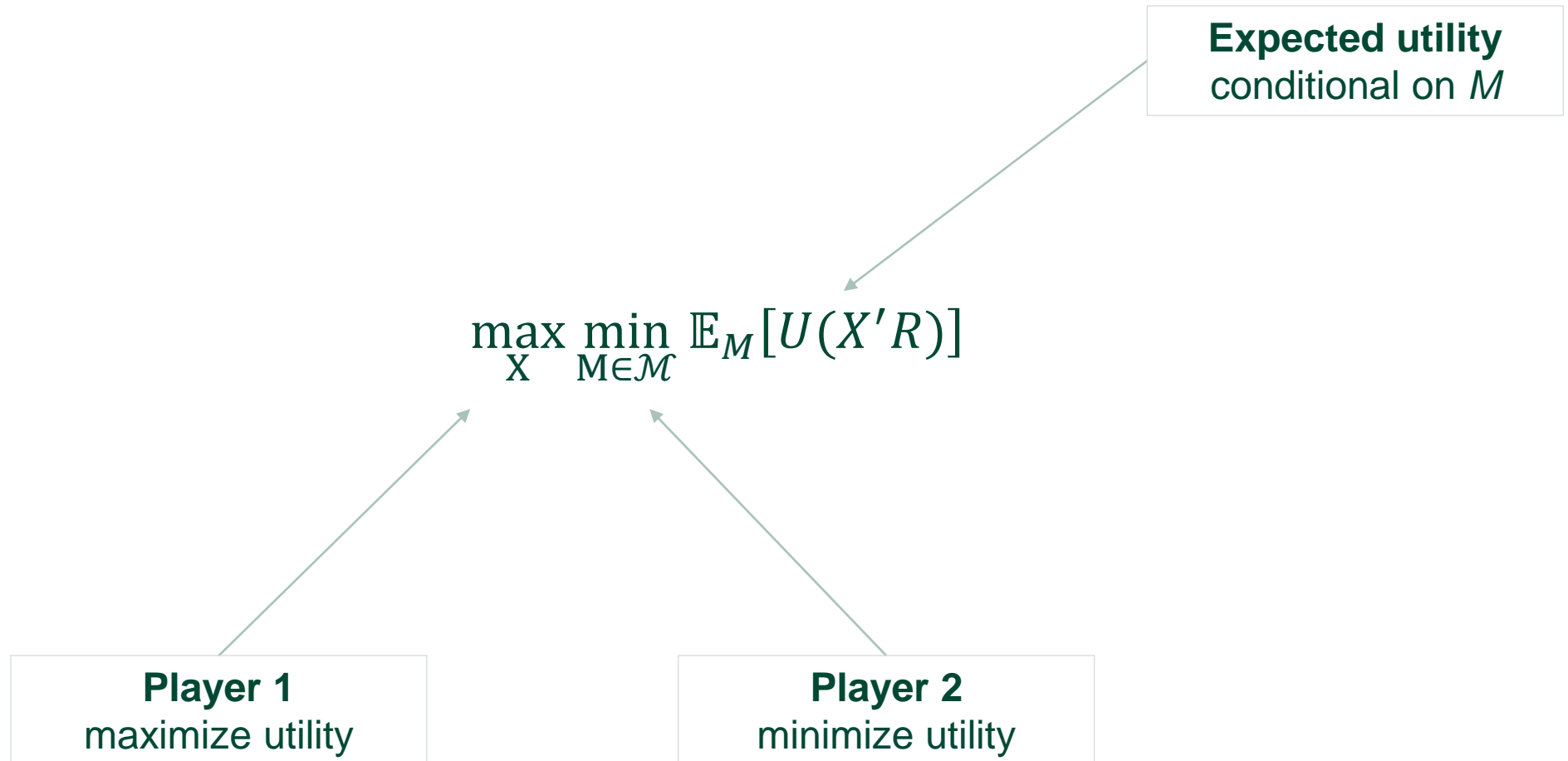
Base scenario



Expert judgement scenarios

Scenario	μ (MoM changes, bps)	Σ
Base	(-2.59 -0.02 0.18)	$\begin{pmatrix} 315 & -15.9 & -20.9 \\ .. & 33.8 & -2.36 \\ .. & .. & 52.1 \end{pmatrix}$
Recovery	(1.00 -0.50 0.00)	$\begin{pmatrix} 300 & -30 & 0.00 \\ .. & 30.0 & 0.00 \\ .. & .. & 50 \end{pmatrix}$
Lower for longer	(0.00 0.50 -1.00)	$\begin{pmatrix} 150 & 10.0 & 20.0 \\ .. & 20.0 & 5.00 \\ .. & ... & 25.0 \end{pmatrix}$
Stagflation	(2.00 -1.00 2.00)	$\begin{pmatrix} 450 & -15.0 & 0.00 \\ .. & 60.0 & 0.00 \\ .. & .. & 75.0 \end{pmatrix}$

Two player game



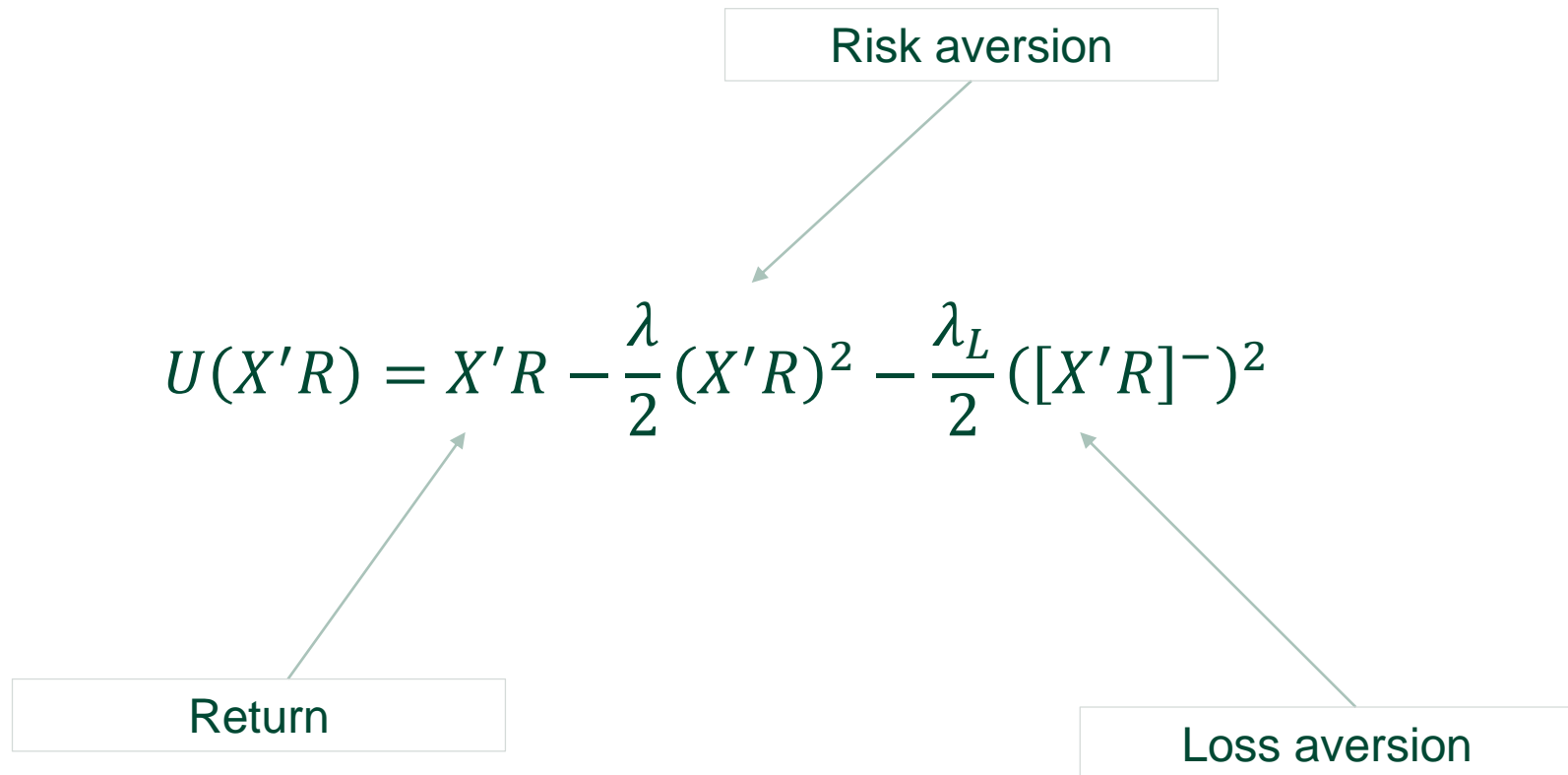
Limiting second player's freedom

Player 2 chooses
scenario weights...

$$\mathcal{M} = \left\{ \sum_{j=1}^m \phi_j M_j \mid \phi_j \geq L \wedge \sum_{j=1}^m \phi_j = 1 \right\}$$

...but weights have
lower bound

Loss aversion in goal function



Results

	Test A	Test B
Experiment settings		
Loss aversion	0.01	0.01
Risk aversion	0.01	0.01
Lower bound on scenario weights	0.10	0.15

Scenario weights (player 2 optimum)		
Base scenario	0.10	0.15
Recovery	0.70	0.55
Lower for longer	0.10	0.15
Stagflation	0.10	0.15

Portfolio (player 1 optimum)		
Interest rate risk	0.35	0.37
Spread risk	-1.95	-2.39
Curve risk	0.24	0.58

	Test A	Test B
Monte Carlo		
Return	1.1	1.2
Variance	81.5	87.8
Loss variance	27.1	28.3
Utility	0.5	0.6

Out of Sample		
Return	-0.6	-0.8
Variance	187.6	285.0
Loss variance	95.0	152.3
Utility	-2.1	-3.0

Conclusion

- More freedom: inputs, utility function
- Narratives describe uncertainty
- Better out of sample performance
- Less conservative portfolio's

Next steps

- Apply to more asset classes
- Closed-form?
- Further develop narratives, regimes
- Non-boundary player 2 solutions