

# PORTFOLIO CONSTRUCTION FOR ROBO-ADVISORY WITH ACTIVE AND PASSIVE FUND

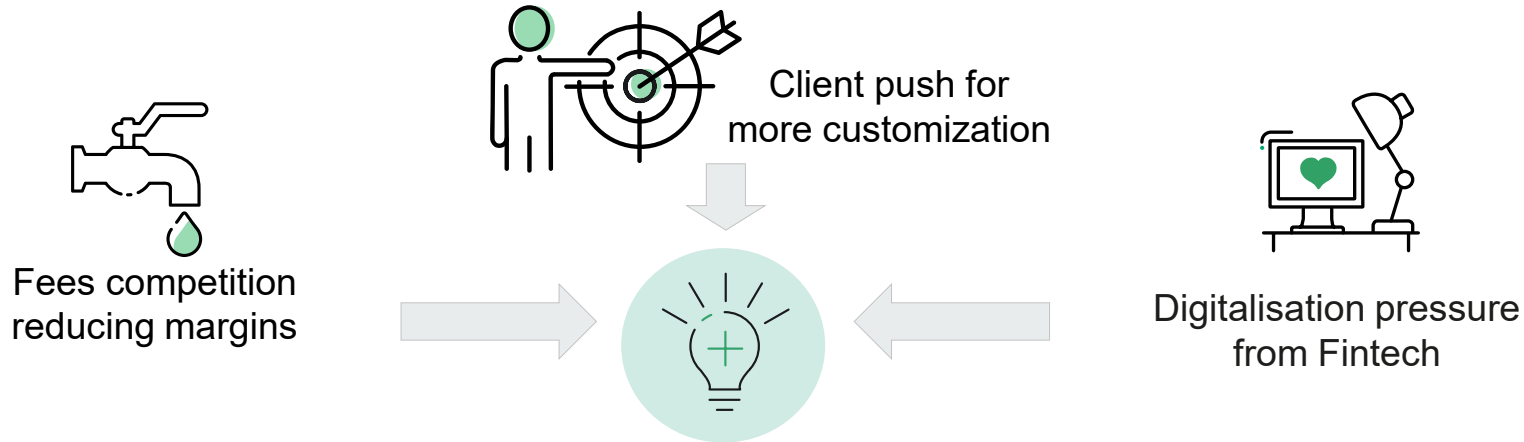
RAUL LEOTE DE CARVALHO  
JUNE 2026



**BNP PARIBAS**  
**ASSET MANAGEMENT**

The sustainable investor for a changing world

# Asset allocation challenge for asset managers



**Solution:** industrialization of customised asset allocations

Robo-Advisor  
(Retail clients)

Tactical Asset Allocation  
(Institutional clients)



## Robust

Reasonable and intuitive  
Low sensitivity to inputs

## Systematic

Efficient  
Flexible

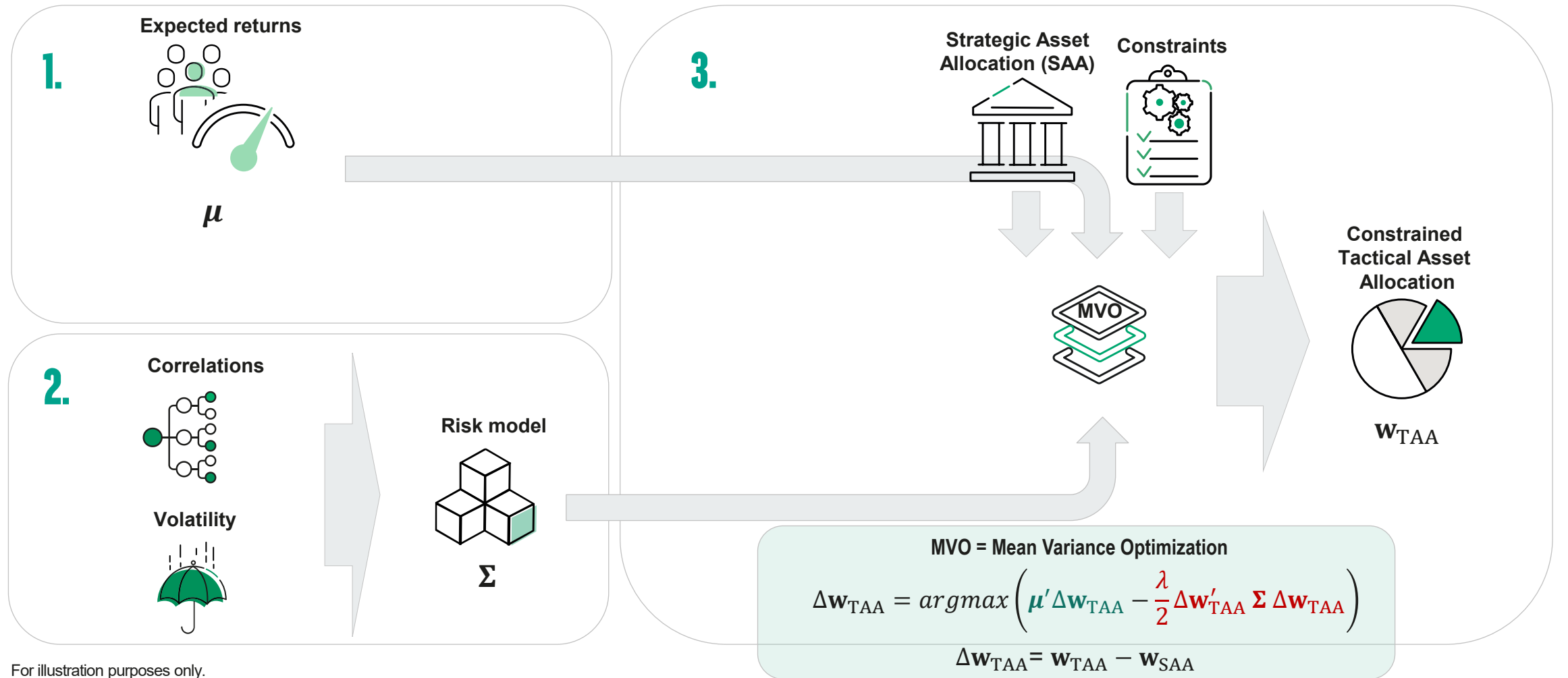
## Transparent

Be able to explain portfolio

A framework to implement Tactical Asset Allocation (TAA) in a **robust, systematic and transparent**

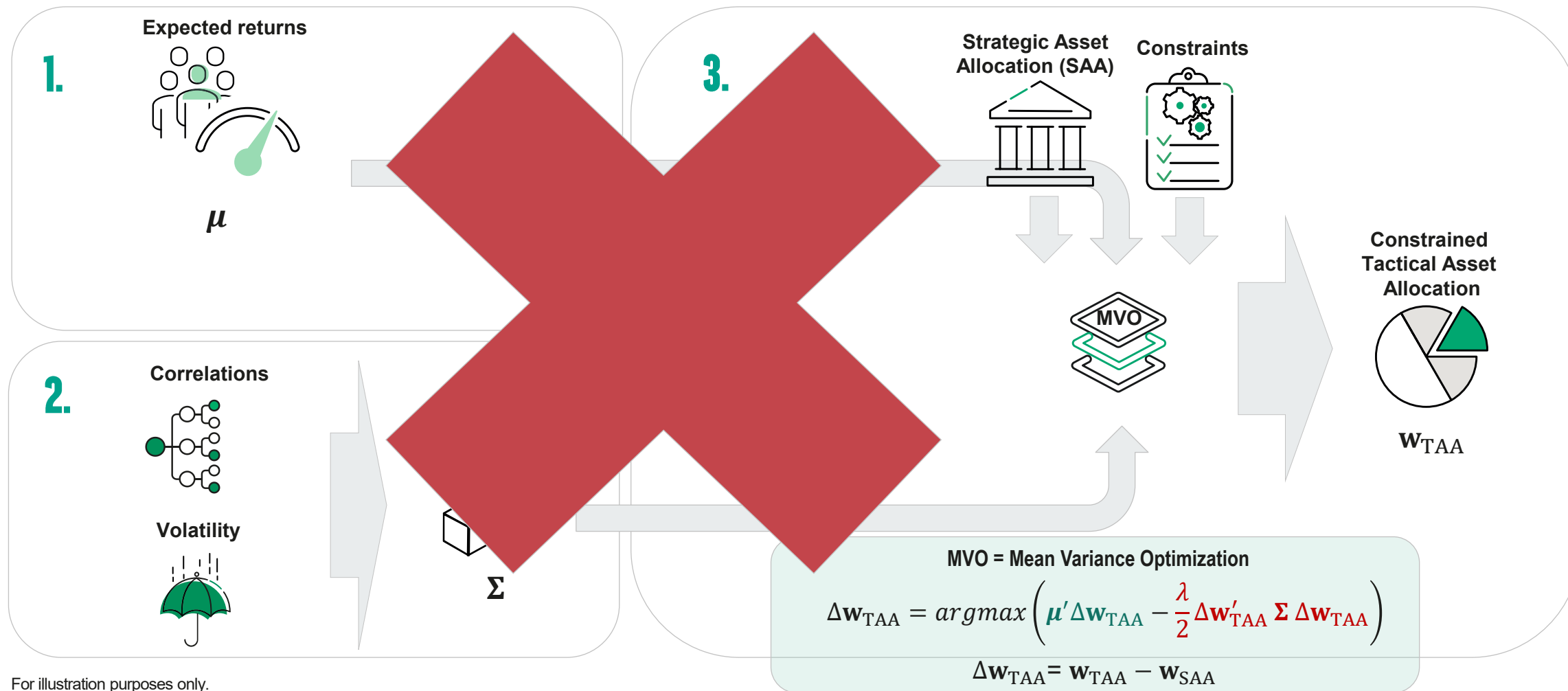
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# The Tactical Asset Allocation (TAA) problem **in theory**



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# The Tactical Asset Allocation (TAA) problem **in practice**



# The Tactical Asset Allocation (TAA) problem **in practice**

## **Expected Returns**

not known with certainty  
not consistent with the risk model



## **Mean Variance Portfolios**

create positions to exploit return-risk inconsistencies  
lead to extreme and concentrated allocations

MVO portfolios are hard to implement in practice  
Often under-diversified and unstable

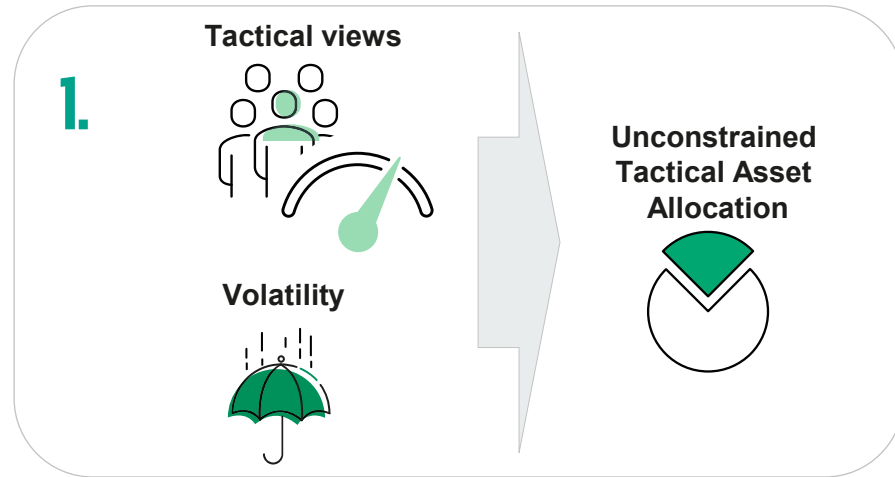
**In practice** robust approaches must be used to ensure feasibility

# The Tactical Asset Allocation (TAA) problem in practice

|                        | <b>Core Assets: Investment Views</b>   | <b>SAA Assets: SAA Portfolio</b>   | <b>Pre-selected Funds: TAA Portfolio</b>  |
|------------------------|--|--|---|
| <b>Equities</b>        | Europe EMU<br>Europe EMU SC<br>Europe UK<br>USA<br>USA SC<br>Japan<br>Emerging Global  | Europe<br>USA<br>Japan<br>Emerging Global                                | Europe Active<br>USA Active<br>Japan Active<br>Emerging Active<br>World Active<br>Europe Passive<br>USA Passive<br>Japan Passive<br>Emerging Passive<br>World Passive   |
| <b>Bonds</b>           | EUR Sovereign<br>EUR Investment Grade<br>EUR High Yield<br>USD Sovereign<br>USD Investment Grade<br>USD High Yield<br>EMD HC Sov Global<br>EMD LC Sov Global | EUR Aggregate<br>USD Aggregate<br>High Yield Global<br>EMD HC Sov Global | EUR Sovereign Active<br>EUR Investment Grade Active<br>EUR Aggregate Active<br>EUR High Yield Active<br>USA Investment Grade Active<br>USA High Yield Active<br>Global Aggregate Active<br>Emerging HC Active<br>EUR Sovereign Passive<br>EUR Investment Grade Passive<br>USA Investment Grade Passive<br>Emerging HC Passive |
| <b>Diversification</b> | Commodities Global<br><br>Real Estate Pan-Europe   | Commodities Global<br><br>Real Estate Pan-Europe                         | Commodities Active<br>Commodities Passive<br>Real Estate Europe Active<br>Real Estate Europe Passive  |

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# Expressing Tactical Asset Allocation (TAA) views in practice



## Common practice by Asset Managers

### Risk budgeting translates TAA views into tactical target deviations

#### Views

Independent directional tilt consuming Active Risk Budget  
Expressed as **Scores**: expected direction & conviction

#### Scores

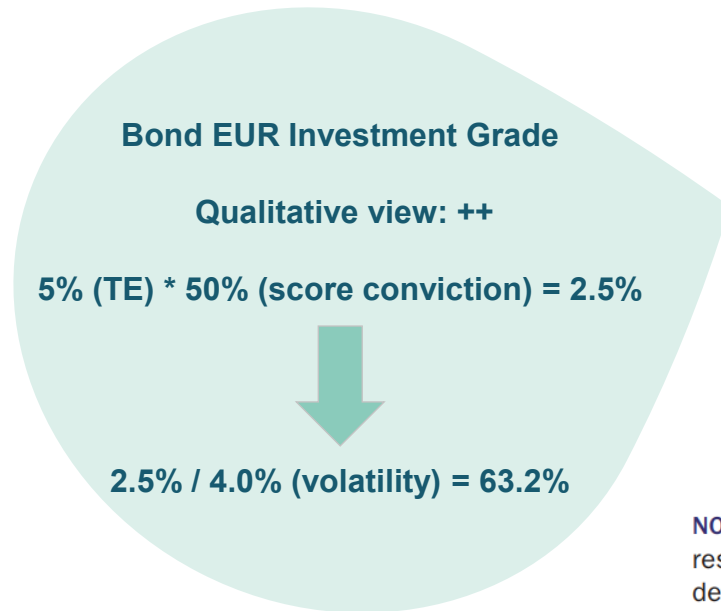
Share of Active Risk Budget consumed by Portfolio Tilt, e.g.:  
100% Score => portfolio tilt = 100% x Active Risk Budget  
50% Score => portfolio tilt = 50% x Active Risk Budget

Source: Issaoui, T., R. Perchet, O. Retière, F. Soupé, C. Yin, and R. Leote de Carvalho (2022) Mass Customization of Asset Allocation *The Journal of Investing* 31(3) 73-97; DOI: 10.3905/joi.2021.1.217

# Expressing Tactical Asset Allocation (TAA) views in practice

- Active Risk Budget = 5% (TE)

## Unconstrained Active Portfolio Representing Qualitative Views

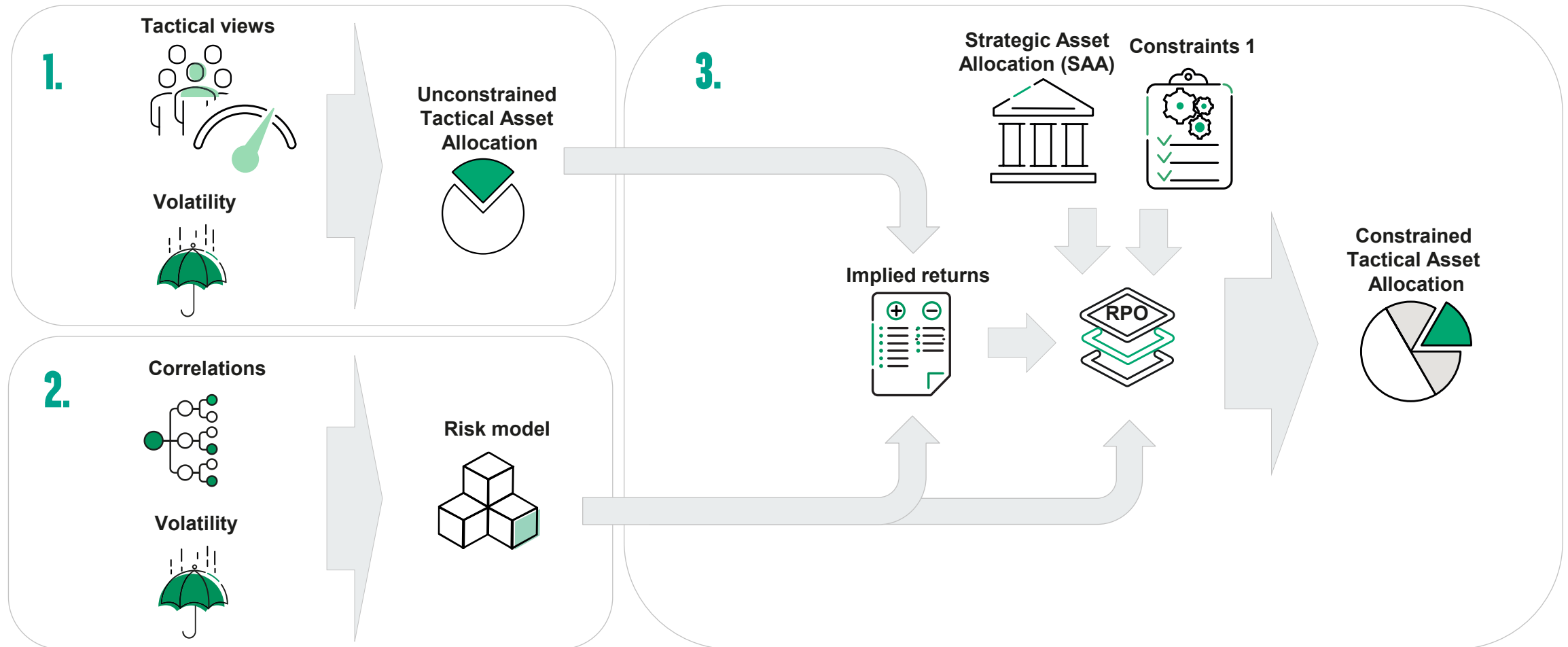


|  | Qualitative View | Score: % of TE Consumption | TE Allocated Based on Conviction and Direction | Volatility of Asset Returns | Unconstrained Active Portfolio |
|--|------------------|----------------------------|--|-----------------------------|--------------------------------|
| Bond EUR Sovereign                     | ----             | -100%                      | -5.0%  | 4.0%                        | -124.8%                        |
| Bond EUR Investment Grade              | ++               | 50%                        | 2.5%   | 4.0%                        | 63.2%                          |
| Bond USD Investment Grade              | =                | 0%                         | 0.0%   | 5.9%                        | 0.0%                           |
| Bond USD High Yield                    | ++               | 50%                        | 2.5%   | 9.2%                        | 27.2%                          |
| Bond EMD HC Sov. Global                | -                | -25%                       | -1.3%  | 8.7%                        | -14.4%                         |
| Equity Europe EMU                      | --               | -50%                       | -2.5%  | 16.4%                       | -15.2%                         |
| Equity Europe EMU SC                   | ++               | 50%                        | 2.5%   | 18.2%                       | 13.8%                          |
| <b>Portfolio Sum of Active Weights</b> |                  |                            |  |                             | <b>-50.3%</b>                  |

**NOTES:** + + + + represents a positive directional view (against cash) with full conviction; = represents a neutral view; and - - - - represents a negative directional view with full conviction. Investment grade and high yield refer to corporate bonds and their common definitions using agency ratings and standard indices. This example is for illustration purposes only and does not reflect any current or past or expected views. The choice of abstract scores to express full conviction is arbitrary and, in practice, can be more granular.

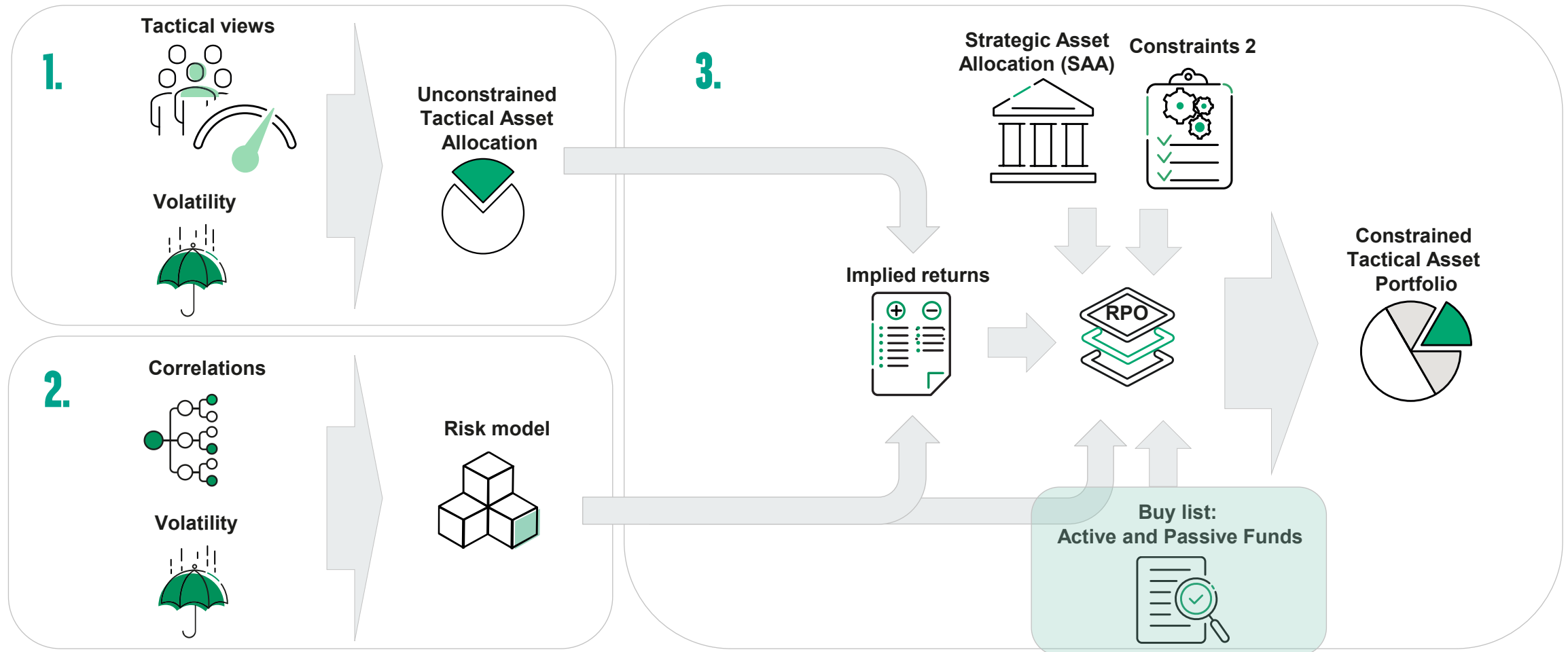
Source: Issaoui, T., R. Perchet, O. Retière, F. Soupé, C. Yin, and R. Leote de Carvalho (2022) Mass Customization of Asset Allocation *The Journal of Investing* 31(3) 73-97; DOI: 10.3905/joi.2021.1.217

# Optimization used to implement constraints while remaining faithful to views



Source: Issaoui, T., R. Perchet, O. Retière, F. Soupé, C. Yin, and R. Leote de Carvalho (2022) Mass Customization of Asset Allocation *The Journal of Investing* 31(3) 73-97; DOI: 10.3905/joi.2021.1.217

# Optimization used to create TAA portfolio with only active and passive funds



Source: Mallouli, M. A., Perchet, R., Soupé, F. and Leote de Carvalho, R., (2026) Multi-Asset Portfolios with Active and Passive Funds: A Robust Optimization Framework, SSRN

# RPO\* from implied returns derived from active views



$$\Delta \mathbf{w}_{TAA} = \underset{\text{portfolio expected return}}{\operatorname{argmax}} \left( \bar{\boldsymbol{\mu}}' \Delta \mathbf{w}_{TAA} - \frac{\lambda}{2} \Delta \mathbf{w}'_{TAA} \boldsymbol{\Sigma} \Delta \mathbf{w}_{TAA} - \kappa \sqrt{\Delta \mathbf{w}'_{TAA} \boldsymbol{\Omega} \Delta \mathbf{w}_{TAA}} \right)$$

portfolio expected return     
 portfolio variance from the risk model     
 portfolio exposure to estimation uncertainty in expected returns

$\boldsymbol{\Omega}$  uncertainty matrix capturing confidence and co-dependence of views in the optimization

$\lambda$  aversion to risk

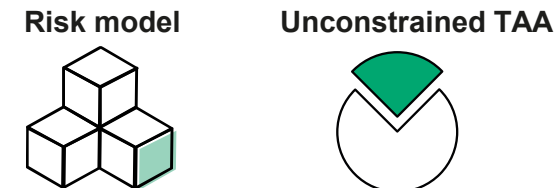
$\kappa$  aversion to uncertainty

Expected return inputs  $\bar{\boldsymbol{\mu}}$

unconstrained active portfolio  $\mathbf{w}_{active}$  with target active tilts is assumed efficient

$$\bar{\boldsymbol{\mu}} = \frac{\kappa \boldsymbol{\Omega} \mathbf{w}_{active}}{\sqrt{\mathbf{w}_{active}^T \boldsymbol{\Omega} \mathbf{w}_{active}}} + 2\lambda \boldsymbol{\Sigma} \mathbf{w}_{active}$$

$\bar{\boldsymbol{\mu}}$  translate at individual asset class level the information in the qualitative views



Implied returns with uncertainty



Source: Mallouli, M. A., Perchet, R., Soupé, F. and Leote de Carvalho, R., (2026) Multi-Asset Portfolios with Active and Passive Funds: A Robust Optimization Framework, SSRN

\* Robust Portfolio Optimization  
For illustration purposes only.

# RPO\* from implied returns derived from active views, including active fund alpha



$$\Delta \mathbf{w}_{TAA} = \underset{\text{portfolio expected return}}{\operatorname{argmax}} \left( \bar{\boldsymbol{\mu}}' \Delta \mathbf{w}_{TAA} - \frac{\lambda}{2} \Delta \mathbf{w}_{TAA}' \boldsymbol{\Sigma} \Delta \mathbf{w}_{TAA} - \kappa \sqrt{\Delta \mathbf{w}_{TAA}' \boldsymbol{\Omega} \Delta \mathbf{w}_{TAA}} \right)$$

portfolio expected return     
 portfolio variance from the risk model     
 portfolio exposure to estimation uncertainty in expected returns

$\boldsymbol{\Omega}$  uncertainty matrix capturing confidence and co-dependence of views in the optimization

$\lambda$  aversion to risk

$\kappa$  aversion to uncertainty

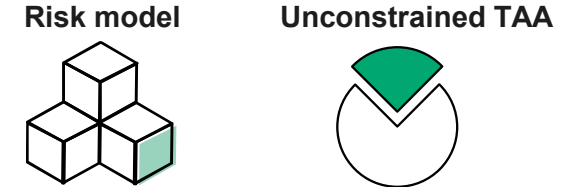
Expected return inputs  $\bar{\boldsymbol{\mu}}$

unconstrained active portfolio  $\mathbf{w}_{active}$  with target active tilts is assumed efficient

$$\bar{\boldsymbol{\mu}} = \frac{\kappa \boldsymbol{\Omega} \mathbf{w}_{active}}{\sqrt{\mathbf{w}_{active}' \boldsymbol{\Omega} \mathbf{w}_{active}}} + 2\lambda \boldsymbol{\Sigma} \mathbf{w}_{active} + \frac{1}{\gamma} \boldsymbol{\alpha}_{fb}$$

$\gamma$  is an aversion to active fund alpha: higher  $\gamma$  more passive funds

$\bar{\boldsymbol{\mu}}$  translate at individual asset class level the information in the qualitative views



Implied returns with uncertainty



Source: Mallouli, M. A., Perchet, R., Soupé, F. and Leote de Carvalho, R., (2026) Multi-Asset Portfolios with Active and Passive Funds: A Robust Optimization Framework, SSRN

\* Robust Portfolio Optimization  
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# Optimization used to implement constraints while remaining faithful to views

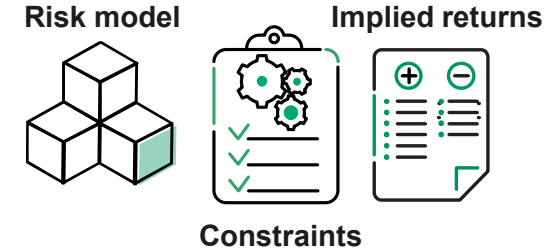


$$\Delta \mathbf{w}_{TAA} = \underset{\text{portfolio expected return}}{\operatorname{argmax}} \left( \bar{\boldsymbol{\mu}}' \Delta \mathbf{w}_{TAA} - \frac{\lambda}{2} \Delta \mathbf{w}'_{TAA} \boldsymbol{\Sigma} \Delta \mathbf{w}_{TAA} - \kappa \sqrt{\Delta \mathbf{w}'_{TAA} \boldsymbol{\Omega} \Delta \mathbf{w}_{TAA}} \right)$$

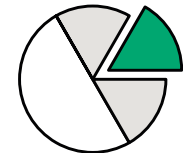
portfolio expected return     
 portfolio variance from the risk model     
 portfolio exposure to estimation uncertainty in expected returns

Optimise from implied returns  $\bar{\boldsymbol{\mu}}$  subject to constraints:

- zero sum active weights
- long only constraint
- no leverage
- etc.



**Constrained TAA**

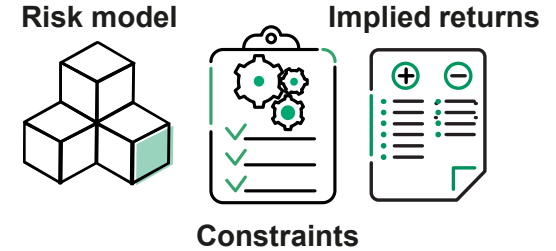


# Constructing the TAA portfolio with only funds is just about adding constraints



$$\Delta \mathbf{w}_{TAA} = \underset{\text{portfolio expected return}}{\operatorname{argmax}} \left( \bar{\boldsymbol{\mu}}' \Delta \mathbf{w}_{TAA} - \frac{\lambda}{2} \Delta \mathbf{w}'_{TAA} \boldsymbol{\Sigma} \Delta \mathbf{w}_{TAA} - \kappa \sqrt{\Delta \mathbf{w}'_{TAA} \boldsymbol{\Omega} \Delta \mathbf{w}_{TAA}} \right)$$

portfolio expected return     
 portfolio variance from the risk model     
 portfolio exposure to estimation uncertainty in expected returns



Optimise from implied returns  $\bar{\boldsymbol{\mu}}$  subject to constraints

zero sum active weights

long only constraint

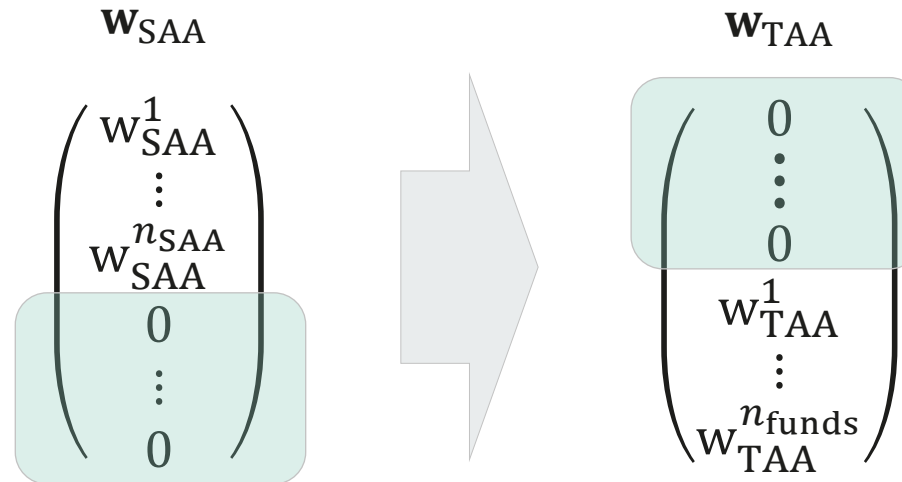
no leverage

$\mathbf{w}_{TAA}$  can only invest in funds

etc.

$n_{SAA}$  SAA core indices

$n_{funds}$  Investable Funds



Source: Mallouli, M. A., Perchet, R., Soupé, F. and Leote de Carvalho, R., (2026) Multi-Asset Portfolios with Active and Passive Funds: A Robust Optimization Framework, SSRN

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# Mapping of SAA Assets on Core Assets

|  |                |                          |                                  | Beta of SAA assets to Core Assets |                      |                  |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  |              |              |              |      |
|--|----------------|--------------------------|----------------------------------|-----------------------------------|----------------------|------------------|------------|---------------|--------------|------------------------|--------------------|---------------------------|---------------------|--------------------|---------------------------|---------------------|------------------------|------------------------|--|----------------------------------|--------------|--------------|--------------|------|
| SAA Assets                             | Tickers        | SAA portfolio allocation | Thematic Volatility of Benchmark | Equity Europe EMU                 | Equity Europe EMU SC | Equity Europe UK | Equity USA | Equity USA SC | Equity Japan | Equity Emerging Global | Bond EUR Sovereign | Bond EUR Investment Grade | Bond EUR High Yield | Bond USD Sovereign | Bond USD Investment Grade | Bond USD High Yield | Bond EMD HC Sov Global | Bond EMD LC Sov Global | Diversification Real Estate Pan-Europe | Diversification Commodity Global | Currency USD | Currency GBP | Currency JPY |      |
| Equity Europe                          | M7EU Index     | 16%                      | 1.8%                             | 0.49                              | 0.09                 | 0.37             |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  |              |              |              | 0.37 |
| Equity USA                             | NDDUUS Index   | 12%                      | 0.0%                             |                                   |                      |                  | 1.00       |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  |              | 1.00         |              |      |
| Equity Japan                           | NDDLJN Index   | 7%                       | 0.0%                             |                                   |                      |                  |            |               | 1.00         |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  |              |              |              | 1.00 |
| Equity Emerging Global                 | NDUEEGF Index  | 6%                       | 0.0%                             |                                   |                      |                  |            |               |              | 1.00                   |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  |              | 1.00         |              |      |
| Bond EUR Aggregate                     | LBEATREU Index | 20%                      | 0.3%                             |                                   |                      |                  |            |               |              |                        | 0.65               | 0.27                      |                     | 0.03               |                           |                     |                        |                        |  |                                  |              |              |              |      |
| Bond USD Aggregate                     | LBUSTRUU Index | 20%                      | 0.9%                             |                                   |                      |                  |            |               |              |                        |                    |                           |                     | 0.61               | 0.24                      |                     | 0.06                   |                        |  |                                  |              |              |              |      |
| Bond High Yield Global                 | LG30TREH Index | 6%                       | 1.0%                             |                                   |                      |                  |            |               |              |                        |                    |                           | 0.21                |                    |                           | 0.60                | 0.24                   |                        |  |                                  |              |              |              |      |
| Bond EMD HC Sov Global                 | JPGCCOMP Index | 4%                       | 0.0%                             |                                   |                      |                  |            |               |              |                        |                    |                           |                     |                    |                           |                     | 1.00                   |                        |  |                                  |              |              |              |      |
| Diversification Real Estate Pan-Europe | TRNHUE Index   | 4%                       | 0.0%                             |                                   |                      |                  |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        | 1.00                                   |                                  |              |              |              |      |
| Diversification Commodity Global       | BCOMXALT Index | 5%                       | 0.0%                             |                                   |                      |                  |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  | 1.00                             |              |              |              |      |

Source: Mallouli, M. A., Perchet, R., Soupé, F. and Leote de Carvalho, R., (2026) Multi-Asset Portfolios with Active and Passive Funds: A Robust Optimization Framework, SSRN

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# Mapping Benchmarks on Core Assets

| Benchmarks                                | Thematic Volatility of Benchmark | Beta of Benchmarks to Core Assets |                      |                  |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  |              |              |              |
|---|----------------------------------|-----------------------------------|----------------------|------------------|------------|---------------|--------------|------------------------|--------------------|---------------------------|---------------------|--------------------|---------------------------|---------------------|------------------------|------------------------|--|----------------------------------|--------------|--------------|--------------|
|   |                                  | Equity Europe EMU                 | Equity Europe EMU SC | Equity Europe UK | Equity USA | Equity USA SC | Equity Japan | Equity Emerging Global | Bond EUR Sovereign | Bond EUR Investment Grade | Bond EUR High Yield | Bond USD Sovereign | Bond USD Investment Grade | Bond USD High Yield | Bond EMD HC Sov Global | Bond EMD LC Sov Global | Diversification Real Estate Pan-Europe | Diversification Commodity Global | Currency USD | Currency GBP | Currency JPY |
| Equity Europe                             | 1.8%                             | 0.49                              | 0.09                 | 0.37             |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  |              | 0.37         |              |
| Equity Europe ESG                         | 2.0%                             | 0.49                              | 0.10                 | 0.36             |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  |              | 0.36         |              |
| Equity USA S&P500                         | 0.6%                             |                                   |                      |                  | 0.99       |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  | 0.99         |              |              |
| Equity USA Value                          | 5.1%                             |                                   |                      |                  | 0.78       | 0.13          |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  | 0.91         |              |              |
| (...)                                     |                                  |                                   |                      |                  |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  |              |              |              |
| Equity Global All Countries Water         | 6.3%                             | 0.01                              | 0.12                 | 0.17             | 0.26       | 0.20          | 0.12         | 0.06                   |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  | 0.51         | 0.17         | 0.12         |
| Bond EUR Sovereign                        | 0.0%                             |                                   |                      |                  |            |               |              |                        | 1.00               |                           |                     |                    |                           |                     |                        |                        |  |                                  |              |              |              |
| Bond EUR Sovereign ESG                    | 0.2%                             |                                   |                      |                  |            |               |              |                        | 0.99               |                           |                     |                    |                           |                     |                        |                        |  |                                  |              |              |              |
| Bond EUR Investment Grade                 | 0.0%                             |                                   |                      |                  |            |               |              |                        |                    | 1.00                      |                     |                    |                           |                     |                        |                        |  |                                  |              |              |              |
| Bond EUR Investment Grade SRI             | 0.3%                             |                                   |                      |                  |            |               |              |                        | 0.01               | 1.04                      |                     | 0.01               |                           |                     |                        |                        |  |                                  |              |              |              |
| (...)                                     |                                  |                                   |                      |                  |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  |              |              |              |
| Bond Global Aggregate Green               | 0.9%                             |                                   |                      |                  |            |               |              |                        | 0.30               | 0.49                      | 0.28                | 0.06               |                           |                     |                        |                        |  |                                  |              |              |              |
| Diversification Commodity Energy & Metals | 4.7%                             |                                   |                      |                  |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  | 0.79                             |              |              |              |
| (...)                                     |                                  |                                   |                      |                  |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  |              |              |              |

Source: Yin, C., R. Perchet, and F. Soupé (2021) A Practical Guide To Robust Portfolio Optimization *Quantitative Finance*; DOI: 10.1080/14697688.2020.1849780

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# Mapping Funds on Core Assets

| Fund Designation                                      | Beta of fund relative to its benchmark | Specific Volatility of fund relative to exposure to its benchmark | Expected information ratio before costs | OCR   | Expected alpha | Beta of Funds to Core Assets |                      |                  |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  |              |              |
|---|--|---|---|-------|----------------|------------------------------|----------------------|------------------|------------|---------------|--------------|------------------------|--------------------|---------------------------|---------------------|--------------------|---------------------------|---------------------|------------------------|------------------------|--|----------------------------------|--------------|--------------|
|   |  |   |   |       |                | Equity Europe EMU            | Equity Europe EMU SC | Equity Europe UK | Equity USA | Equity USA SC | Equity Japan | Equity Emerging Global | Bond EUR Sovereign | Bond EUR Investment Grade | Bond EUR High Yield | Bond USD Sovereign | Bond USD Investment Grade | Bond USD High Yield | Bond EMD HC Sov Global | Bond EMD LC Sov Global | Diversification Real Estate Pan-Europe | Diversification Commodity Global | Currency USD | Currency GBP |
| Equity Europe Mid-large Active Fundamental Art 8      | 1.01                                   | 3.5%  | 0.5                                     | 0.96% | 0.8%           | 0.50                         | 0.09                 | 0.37             |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  | 0.37                             |              |              |
| Equity Europe Mid-large Active Quant Art 8            | 0.93                                   | 3.4%  | 0.5                                     | 0.61% | 1.1%           | 0.46                         | 0.09                 | 0.34             |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  | 0.34                             |              |              |
| Equity Europe Mid-large Passive Index Art 8           | 1.00                                   | 0.5%  | 0.0                                     | 0.15% | -0.2%          | 0.49                         | 0.10                 | 0.36             |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  | 0.36                             |              |              |
| (...)   |  |   |   |       |                |                              |                      |                  |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  |              |              |
| Equity World Disruptive Tech Active Fundamental Art 8 | 1.14                                   | 6.1%  | 0.5                                     | 0.96% | 2.1%           |                              | 0.09                 |                  | 1.01       |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  | 1.13                             |              |              |
| Equity World Mid-large Passive Index Art 8            | 1.00                                   | 0.1%  | 0.0                                     | 0.16% | -0.2%          | 0.11                         | 0.04                 | 0.10             | 0.58       | 0.01          | 0.11         | 0.05                   |                    |                           |                     |                    |                           |                     |                        |                        |  | 0.64                             | 0.10         | 0.11         |
| Bonds EUR Sovereign Active Fundamental Art 8          | 0.97                                   | 0.8%  | 0.5                                     | 0.43% | 0.0%           |                              |                      |                  |            |               |              |                        | 0.97               |                           |                     |                    |                           |                     |                        |                        |  |                                  |              |              |
| Bonds EUR Sovereign Passive Index Art 8               | 1.00                                   | 0.2%  | 0.0                                     | 0.15% | -0.2%          |                              |                      |                  |            |               |              |                        | 0.99               |                           |                     |                    |                           |                     |                        |                        |  |                                  |              |              |
| (...)   |  |   |   |       |                |                              |                      |                  |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  |              |              |
| Bonds Global Green Active Fundamental Art 9           | 0.96                                   | 0.7%  | 0.5                                     | 0.43% | -0.1%          |                              |                      |                  |            |               |              |                        | 0.29               | 0.47                      |                     | 0.27               | 0.06                      |                     |                        |                        |  |                                  |              |              |
| Commodities Global All Passive Index Art 6            | 1.00                                   | 0.1%  | 0.0                                     | 0.39% | -0.4%          |                              |                      |                  |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        | 0.79                   |  |                                  |              |              |
| (...)   |  |   |   |       |                |                              |                      |                  |            |               |              |                        |                    |                           |                     |                    |                           |                     |                        |                        |  |                                  |              |              |

Source: Yin, C., R. Perchet, and F. Soupé (2021) A Practical Guide To Robust Portfolio Optimization *Quantitative Finance*; DOI: 10.1080/14697688.2020.1849780

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# Examples and Results

**NO TACTICAL VIEW**  
**NO THEMATIC VIEW**

Confidence in active alpha increases:

- Tracking Error increases
- Portfolio favors high-alpha active funds

| <i>RB</i> / $\gamma$                       | <b>Optimal Tactical Portfolios as a function of <i>RB</i> / <math>\gamma</math></b> |       |       |       |       |
|--|---|-------|-------|-------|-------|
|  | 2.00%   | 0.40% | 0.13% | 0.04% | 0.00% |
| Portfolio Active Fund Net Alpha            | 1.41%   | 0.95% | 0.47% | 0.18% | 0.05% |
| Tactical & Thematic Implied Excess Returns | -   | -     | -     | -     | -     |
| Information ratio                          | 0.80  | 0.99  | 0.77  | 0.35  | 0.11  |
| Portfolio Volatility                       | 7.73%   | 7.42% | 7.36% | 7.35% | 7.35% |
| Portfolio Tracking Error                   | 1.76%   | 0.97% | 0.61% | 0.50% | 0.49% |
| Active Fundamental                         | 72.2%   | 67.0% | 58.1% | 50.2% | 48.0% |
| Active Quant                               | 27.8%   | 32.3% | 20.9% | 12.7% | 7.1%  |
| Passive Index                              | 0.0%  | 0.7%  | 21.0% | 37.1% | 44.8% |
| Equity                                     | 50.8%   | 44.0% | 42.2% | 41.4% | 41.1% |
| Fixed Income                               | 39.5%   | 45.8% | 47.8% | 48.6% | 48.9% |
| Commodities                                | 7.8%  | 6.3%  | 6.1%  | 6.1%  | 6.1%  |
| Real Estate                                | 1.9%  | 3.9%  | 3.9%  | 3.8%  | 3.8%  |

Source: Table 1 from the article Mallouli, M. A., Perchet, R., Soupé, F. and Leote de Carvalho, R., Multi-Asset Portfolios with Active and Passive Funds: A Robust Optimization Framework

# Examples and Results

**NO TACTICAL VIEW**  
**NO THEMATIC VIEW**

Beta exposures to core assets:

- Remain aligned with those in SAA

Increase in Tracking Error:

- From uncorrelated active fund alpha

| <i>RB</i> / $\gamma$                   | Portfolio Beta exposures of to Core Assets                        |       |       |       |       | SAA Portfolio |
|--|---|-------|-------|-------|-------|---------------|
|  | Optimal Tactical Portfolios as a function of <i>RB</i> / $\gamma$ |       |       |       |       |               |
|  | 2.00%   | 0.40% | 0.13% | 0.04% | 0.00% |               |
| Equity Europe EMU                      | 0.05  | 0.07  | 0.08  | 0.08  | 0.08  | 0.08          |
| Equity Europe EMU SC                   | 0.01  | 0.02  | 0.02  | 0.02  | 0.02  | 0.01          |
| Equity Europe UK                       | 0.04  | 0.06  | 0.06  | 0.06  | 0.06  | 0.06          |
| Equity USA                             | 0.14  | 0.12  | 0.12  | 0.12  | 0.12  | 0.12          |
| Equity USA SC                          | -   | 0.01  | -     | -     | -     | -             |
| Equity Pacific Japan                   | 0.12  | 0.08  | 0.07  | 0.07  | 0.07  | 0.07          |
| Equity Emerging Global                 | 0.09  | 0.05  | 0.06  | 0.06  | 0.06  | 0.06          |
| Bond EUR Sovereign                     | 0.07  | 0.14  | 0.16  | 0.17  | 0.17  | 0.13          |
| Bond EUR Investment Grade              | 0.05  | 0.08  | 0.09  | 0.09  | 0.09  | 0.05          |
| Bond EUR High Yield                    | -   | -     | -     | -     | -     | 0.01          |
| Bond USD Sovereign                     | 0.14  | 0.07  | 0.06  | 0.05  | 0.05  | 0.13          |
| Bond USD Investment Grade              | 0.03  | 0.08  | 0.07  | 0.07  | 0.06  | 0.05          |
| Bond USD High Yield                    | -   | 0.02  | 0.03  | 0.03  | 0.03  | 0.04          |
| Bond EMD HC Sov Global                 | 0.11  | 0.08  | 0.07  | 0.07  | 0.07  | 0.07          |
| Bond EMD LC Sov Global                 | -   | -     | -     | -     | -     | -             |
| Diversification Real Estate Pan-Europe | 0.02  | 0.04  | 0.04  | 0.04  | 0.04  | 0.04          |
| Diversification Commodity Global       | 0.07  | 0.05  | 0.05  | 0.05  | 0.05  | 0.05          |
| Currency USD                           | 0.23  | 0.18  | 0.18  | 0.18  | 0.18  | 0.18          |
| Currency GBP                           | 0.04  | 0.06  | 0.06  | 0.06  | 0.06  | 0.06          |
| Currency JPY                           | 0.12  | 0.08  | 0.07  | 0.07  | 0.07  | 0.07          |

**Note:** We choose to work with *RB* /  $\gamma$  = 0.13%, for the remainder of the experiments.

Source: Table 1 from the article Mallouli, M. A., Perchet, R., Soupé, F. and Leote de Carvalho, R., Multi-Asset Portfolios with Active and Passive Funds: A Robust Optimization Framework

# Examples and Results

NO TACTICAL VIEW

NO THEMATIC VIEW

CONSTRAINT ON SUSTAINABILITY

Beyond min allocation to SI = 40%:

- Funds with large exposures to SI preferred
- Portfolio concentrates on these few funds

|                                   | Optimal Tactical Portfolios with Minimum allocation to Sustainable Investments |       |       |       |       |
|-----------------------------------|--|-------|-------|-------|-------|
| Minimum SI                        | 0%   | 30%   | 40%   | 50%   | 75%   |
| Equity Europe Active              | 14%  | 14%   | 14%   | 15%   | 16%   |
| Equity USA Active                 | 5.4%   | 5.4%  | 7.0%  | 7.7%  | -     |
| Equity Japan Active               | 4.6%   | 4.6%  | 4.6%  | 4.6%  | -     |
| Equity Emerging Active            | 1.7%   | 1.7%  | 1.7%  | 1.7%  | -     |
| Equity World Active               | 2.7%   | 2.7%  | 3.5%  | 4.5%  | 24.4% |
| Bond EUR Sovereign Active         | 7.5%   | 7.5%  | 7.1%  | -     | -     |
| Bond EUR Investment Grade Active  | 3.1%   | 3.1%  | 0.8%  | -     | -     |
| Bond EUR Aggregate Active         | 5.0%   | 5.0%  | -     | -     | -     |
| Bond EUR High Yield Active        | -  | -     | 0.3%  | 0.4%  | -     |
| Bond USA Investment Grade Active  | 5.8%   | 5.8%  | 4.7%  | 2.8%  | -     |
| Bond USA High Yield Active        | 3.2%   | 3.2%  | 2.8%  | 1.5%  | -     |
| Bond Global Aggregate Active      | 15.5%  | 15.5% | 26.6% | 37.9% | 54.9% |
| Bond Emerging HC Active           | 2.7%   | 2.7%  | 3.0%  | 3.9%  | -     |
| Commodities Active                | 3.9%   | 3.9%  | 3.9%  | 3.9%  | -     |
| Real Estate Europe Active         | 3.8%   | 3.8%  | 3.9%  | 4.0%  | 5.2%  |
| Equity Europe Passive             | 1.9%   | 1.9%  | 1.5%  | 1.3%  | -     |
| Equity USA Passive                | 4.5%   | 4.5%  | 1.2%  | -     | -     |
| Equity Japan Passive              | 2.2%   | 2.2%  | 1.8%  | 1.6%  | -     |
| Equity Emerging Passive           | 4.3%   | 4.3%  | 4.1%  | 4.0%  | -     |
| Equity World Passive              | 0.9%   | 0.9%  | 2.9%  | 2.7%  | -     |
| Bond EUR Sovereign Passive        | 1.7%   | 1.7%  | -     | -     | -     |
| Bond EUR Investment Grade Passive | -  | -     | -     | -     | -     |
| Bond USA Investment Grade Passive | -  | -     | -     | -     | -     |
| Bond Emerging HC Passive          | 3.1%   | 3.1%  | 2.1%  | -     | -     |
| Commodities Passive               | 2.3%   | 2.3%  | 2.2%  | 2.2%  | -     |
| Real Estate Europe Passive        | 0.1%   | 0.1%  | -     | -     | -     |

Source: Table 5 from the article Mallouli, M. A., Perchet, R., Soupé, F. and Leote de Carvalho, R., Multi-Asset Portfolios with Active and Passive Funds: A Robust Optimization Framework

For illustration purposes only.

# Examples and Results

NO TACTICAL VIEW

NO THEMATIC VIEW

CONSTRAINT ON SUSTAINABILITY

Despite reduction in fund diversification:

- Similar exposures to core asset class as in SAA

|  | Portfolio Beta exposures to Core Assets |  |      |      |      |      |
|--|---|--|------|------|------|------|
|  | SAA Portfolio                           | Optimal Tactical Portfolios with Minimum allocation to Sustainable Investments |      |      |      |      |
| Minimum SI                             |   | 0%   | 30%  | 40%  | 50%  | 75%  |
| Equity Europe EMU                      | 0.08                                    | 0.08   | 0.08 | 0.08 | 0.08 | 0.07 |
| Equity Europe EMU SC                   | 0.01                                    | 0.02   | 0.02 | 0.02 | 0.02 | 0.04 |
| Equity Europe UK                       | 0.06                                    | 0.06   | 0.06 | 0.06 | 0.07 | 0.09 |
| Equity North America USA               | 0.12                                    | 0.12   | 0.12 | 0.11 | 0.11 | 0.06 |
| Equity North America USA SC            | -                                       | -  | -    | -    | -    | 0.05 |
| Equity Pacific Japan                   | 0.07                                    | 0.07   | 0.07 | 0.07 | 0.07 | 0.03 |
| Equity Emerging Global                 | 0.06                                    | 0.06   | 0.06 | 0.06 | 0.06 | 0.01 |
| Bond EUR Sovereign                     | 0.13                                    | 0.16   | 0.16 | 0.14 | 0.11 | 0.16 |
| Bond EUR Investment Grade              | 0.05                                    | 0.09   | 0.09 | 0.11 | 0.17 | 0.26 |
| Bond EUR High Yield                    | 0.01                                    | -  | -    | -    | -    | -    |
| Bond USD Sovereign                     | 0.13                                    | 0.06   | 0.06 | 0.08 | 0.10 | 0.15 |
| Bond USD Investment Grade              | 0.05                                    | 0.07   | 0.07 | 0.06 | 0.05 | 0.03 |
| Bond USD High Yield                    | 0.04                                    | 0.03   | 0.03 | 0.03 | 0.01 | -    |
| Bond EMD HC Sov Global                 | 0.07                                    | 0.07   | 0.07 | 0.06 | 0.05 | -    |
| Bond EMD LC Sov Global                 | -                                       | -  | -    | -    | -    | -    |
| Diversification Real Estate Pan-Europe | 0.04                                    | 0.04   | 0.04 | 0.04 | 0.04 | 0.05 |
| Diversification Commodity Global       | 0.05                                    | 0.05   | 0.05 | 0.05 | 0.05 | -    |
| Currency USD                           | 0.18                                    | 0.18   | 0.18 | 0.18 | 0.17 | 0.12 |
| Currency GBP                           | 0.06                                    | 0.06   | 0.06 | 0.06 | 0.07 | 0.09 |
| Currency JPY                           | 0.07                                    | 0.07   | 0.07 | 0.07 | 0.07 | 0.03 |

Source: Table 6 from the article Mallouli, M. A., Perchet, R., Soupé, F. and Leote de Carvalho, R., Multi-Asset Portfolios with Active and Passive Funds: A Robust Optimization Framework

For illustration purposes only.

# Examples and Results

## TACTICAL VIEWS: DIRECTIONAL VIEW ON EQUITY USA

| S  | Optimal Tactical Portfolios with views |       |       |       |       |
|--|--|-------|-------|-------|-------|
|  | Equity USA view ( $S_{directional}$ )  |       |       |       |       |
|  | -100%                                  | -50%  | 0%    | 50%   | 100%  |
| Portfolio Active Fund Net Alpha            | 0.29%                                  | 0.37% | 0.47% | 0.35% | 0.31% |
| Tactical & Thematic Implied Excess Returns | 0.72%                                  | 0.20% | -     | 0.21% | 0.78% |
| Total Excess Return                        | 1.01%                                  | 0.56% | 0.47% | 0.56% | 1.10% |
| Information ratio                          | 0.52                                   | 0.48  | 0.77  | 0.47  | 0.53  |
| Portfolio Volatility                       | 6.19%                                  | 6.71% | 7.36% | 8.11% | 8.85% |
| Portfolio Tracking Error                   | 1.94%                                  | 1.18% | 0.61% | 1.19% | 2.05% |
| Active Fundamental                         | 68.9%                                  | 65.8% | 58.1% | 51.8% | 46.2% |
| Active Quant                               | 10.7%                                  | 13.9% | 20.9% | 13.4% | 12.1% |
| Passive Index                              | 20.4%                                  | 20.3% | 21.0% | 34.7% | 41.7% |
| Equity                                     | 29.8%                                  | 35.6% | 42.2% | 48.2% | 53.8% |
| Fixed Income                               | 60.0%                                  | 54.2% | 47.8% | 42.0% | 36.4% |
| Commodities                                | 6.7%                                   | 6.3%  | 6.1%  | 5.7%  | 5.4%  |
| Real Estate                                | 3.5%                                   | 3.8%  | 3.9%  | 4.1%  | 4.4%  |

Stronger directional views increase in tracking error

Allocation to passive increases as positive tactical view increases

| S                                 | Optimal Tactical Portfolios with views |       |       |       |       |
|-----------------------------------|--|-------|-------|-------|-------|
|                                   | Equity US view ( $S_{directional}$ )   |       |       |       |       |
|                                   | -100%                                  | -50%  | 0%    | 50%   | 100%  |
| Equity Europe Active              | 14%                                    | 14%   | 14%   | 13%   | 12%   |
| Equity USA Active                 | -                                      | 3.7%  | 5.5%  | 3.7%  | 3.4%  |
| Equity Japan Active               | 3.6%                                   | 3.6%  | 4.6%  | 3.0%  | 2.6%  |
| Equity Emerging Active            | 1.5%                                   | 1.4%  | 1.7%  | 1.1%  | 0.9%  |
| Equity World Active               | 0.3%                                   | 2.0%  | 2.7%  | 1.7%  | 1.6%  |
| Bond EUR Sovereign Active         | 1.7%                                   | 3.7%  | 7.4%  | 3.8%  | 1.6%  |
| Bond EUR Investment Grade Active  | -                                      | -     | 3.1%  | -     | -     |
| Bond EUR Aggregate Active         | 18.1%                                  | 13.1% | 5.0%  | -     | -     |
| Bond EUR High Yield Active        | 1.0%                                   | 1.0%  | 0.1%  | 0.6%  | 0.6%  |
| Bond USA Investment Grade Active  | 3.8%                                   | 3.8%  | 5.8%  | 4.9%  | 4.6%  |
| Bond USA High Yield Active        | 4.1%                                   | 4.0%  | 3.2%  | 3.1%  | 2.8%  |
| Bond Global Aggregate Active      | 25.0%                                  | 22.4% | 15.5% | 19.4% | 15.4% |
| Bond Emerging HC Active           | -                                      | -     | 2.7%  | 4.0%  | 5.4%  |
| Commodities Active                | 3.5%                                   | 3.5%  | 3.9%  | 3.4%  | 3.3%  |
| Real Estate Europe Active         | 3.3%                                   | 3.6%  | 3.8%  | 3.9%  | 4.1%  |
| Equity Europe Passive             | 2.7%                                   | 2.9%  | 1.9%  | 2.2%  | 2.3%  |
| Equity USA Passive                | -                                      | -     | 4.5%  | 13.1% | 18.5% |
| Equity Japan Passive              | 3.4%                                   | 3.4%  | 2.2%  | 3.7%  | 4.1%  |
| Equity Emerging Passive           | 4.4%                                   | 4.6%  | 4.3%  | 4.8%  | 5.0%  |
| Equity World Passive              | -                                      | -     | 0.9%  | 2.1%  | 3.3%  |
| Bond EUR Sovereign Passive        | -                                      | -     | 1.8%  | 4.5%  | 5.7%  |
| Bond EUR Investment Grade Passive | -                                      | -     | -     | -     | -     |
| Bond USA Investment Grade Passive | -                                      | -     | -     | -     | 0.4%  |
| Bond Emerging HC Passive          | 6.3%                                   | 6.2%  | 3.1%  | 1.6%  | -     |
| Commodities Passive               | 3.3%                                   | 2.8%  | 2.3%  | 2.4%  | 2.1%  |
| Real Estate Europe Passive        | 0.2%                                   | 0.2%  | 0.1%  | 0.3%  | 0.3%  |

Source: Tables 7 and 8 from the article Mallouli, M. A., Perchet, R., Soupé, F. and Leote de Carvalho, R., Multi-Asset Portfolios with Active and Passive Funds: A Robust Optimization Framework

For illustration purposes only.

# Examples and Results

## THEMATIC VIEWS: VIEW ON DISRUPTIVE TECHNOLOGY

A positive view on Disruptive Tech:

- increases allocation to funds exposed to theme
- is funded by other equity themes and styles

|                        | Optimal Tactical Portfolios with views                           |       |       |       |       |
|------------------------|--|-------|-------|-------|-------|
|                        | <b>Disruptive Tech Thematic view (<math>S_{thematic}</math>)</b> |       |       |       |       |
| $S_{thematic}$         | -100%  | -50%  | 0%    | 50%   | 100%  |
| Equity Mid-large       | 35%  | 34%   | 32%   | 24%   | 22%   |
| Equity Dividend        | 5.6%   | 5.4%  | 5.1%  | 5.4%  | 5.5%  |
| Equity Value           | 0.4%   | 0.6%  | 1.2%  | 0.7%  | -     |
| Equity Growth          | 0.4%   | 0.6%  | 1.0%  | 0.5%  | -     |
| Equity Water           | 0.2%   | 0.2%  | 0.6%  | 0.1%  | -     |
| Equity Disruptive Tech | -  | -     | 0.9%  | 8.5%  | 12.3% |
| Equity Low Risk        | 0.5%   | 0.7%  | 1.2%  | 0.8%  | -     |
| Bonds Sovereign        | 7.6%   | 7.1%  | 9.2%  | 5.8%  | 5.8%  |
| Bonds Investment Grade | 3.9%   | 4.1%  | 8.9%  | 4.2%  | 4.1%  |
| Bonds High Yield       | 4.9%   | 4.7%  | 3.3%  | 4.4%  | 4.5%  |
| Bonds Aggregate        | 10.5%  | 12.0% | 12.6% | 15.9% | 16.1% |
| Bonds HC               | 6.3%   | 6.2%  | 5.8%  | 6.1%  | 6.3%  |
| Bonds Green            | 15.0%  | 14.1% | 7.9%  | 13.3% | 14.0% |
| Commodities            | 6.0%   | 6.0%  | 6.1%  | 6.1%  | 6.1%  |
| Real Estate            | 4.0%   | 4.0%  | 3.9%  | 3.9%  | 3.8%  |

Source: Table 9 from the article Mallouli, M. A., Perchet, R., Soupé, F. and Leote de Carvalho, R., Multi-Asset Portfolios with Active and Passive Funds: A Robust Optimization Framework

For illustration purposes only.

# Takeaways

The framework turns qualitative views into robust, implementable portfolios that remain realistic under uncertainty.



- ✓ **Transparency**  
Risk decomposed into systematic and idiosyncratic components  
Enables clear attribution and stakeholder communication
- ✓ **Flexibility:**  
Integrates SAA, tactical views and active alpha in one framework  
Investor preferences explicitly controlled  
In absence of strong views, portfolio remains aligned with SAA
- ✓ **Scalability:**  
Suitable for large-scale and automated portfolio construction  
Applicable to institutional and digital advisory platforms
- ✓ **Balance:**  
Separates view generation (core assets) from implementation (funds)  
Trades off tactical views vs active alpha  
Passive vs active allocation adjusts endogenously with confidence

# Additional Information

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