The Future of Portfolio Construction:

Portfolio optimisation using liquid public and illiquid private assets

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- **Bridging top-down strategic (SAA) and tactical (TAA) asset allocation with bottom-up tactical instrument selection** for portfolios with public and private assets

- **New approach for factor-based covariance estimation spanning liquid and illiquid instruments**

- Sepp A., Ossa I., and Kastenholz M. (2025) *Robust Optimization of Strategic and Tactical Asset Allocation for Multi-Asset Portfolios*, Accepted to Journal of Portfolio Management

  `https://ssrn.com/abstract=5250221`

2

Mean-Variance Approach to SAA and TAA

- **Capital Market Assumptions** (CMAs): estimates of expected returns μ for core asset classes

- **Covariance matrix** Σ: estimated using returns

- **Optimal/Markovitz SAA portfolio weights**:
$$w \propto \Sigma^{-1}\mu$$

- **Problem with Markowitz portfolio: it overweights noisy factors** with small eigen-values λ:
$$w = O(\lambda^{-1})$$

- **Problem with private assets:** infrequent reporting with NAV smoothing and asymmetric returns

Blackrock's 5 year USD CMAs in 2025

- CMAs are weak predictors of future returns

- SAA optimiser with CMAs will overweight assets with higher relative expected returns (Private equity and debt, hedge funds)
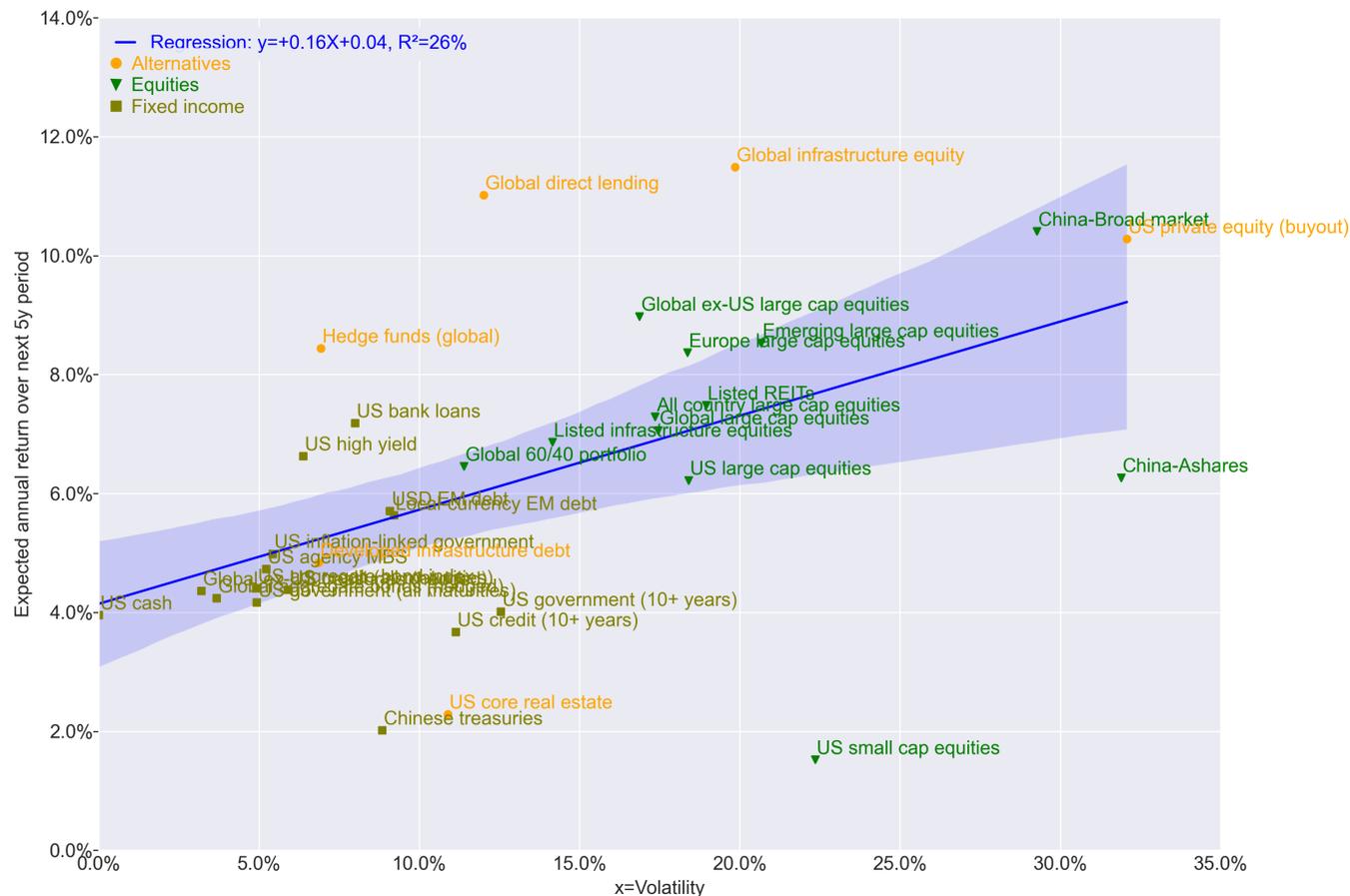
Real-World Private Wealth Portfolios

• **Top-down assets allocation** based on long-term strategic weights

    1) **Public Markets:** Fixed-income & Equities

    2) **Private Markets:** Private Equity & Debt, RE

    3) **Liquid Alts:** Hedge Funds, Commodities

• **Bottom-up instrument & funds & manager selection** to fill-in strategic buckets

• **Quant / philosophical challenge**: what matters most - asset allocation or instrument selection?

Adaptive Markets Hypothesis of Andrew Lo

- **Non-stationarity inherent**: prices reflect evolving conditions and behavior of market participants

- **Behavioral biases abound**: momentum, low beta, value etc characteristics can be profitable

- Bernstein (2003) portfolio construction:

i) Long-run assumptions of the future are doubtful

ii) Portfolios must adopt to shorter-term outlook

Our Adaptive Portfolio Construction

- **Top-down SAA using risk-budgeting**

- **Bottom-up instrument selection** using alphas

Top-Down SAA:
Risk budget-based allocation to core asset classes (AC indices)

- Risk contribution of n-th asset:
$$RC_n(w) = \frac{w_n(\Sigma w)_n}{\sqrt{w^\mathsf{T}\Sigma w}}$$

- Risk budgeting problem with budgets b_n
$$RC_n(w) = b_n R(w), \quad n = 1, ..., N$$

SAA allocation -> tracking error constraint for AC allocation

Portfolio alpha maximization for instruments with SAA tracking error and liquidity constraints

Optimal allocation for investable asset universe

- Maximize portfolio alpha characteristics:
$$\max_{w^{(taa)}} \left\{ \alpha^\mathsf{T} w^{(taa)} \right\}$$

- Subject to **i) tracking error constraint** to SAA portfolio $w^{(saa)}$ by G asset classes:
$$\Delta_g^\mathsf{T} \Sigma \Delta_g \leq \sigma_{g, \text{ target}}^2, \quad g = 1, ..., G$$
where $\Delta_g = \text{diag}(1_g)\left(w^{(saa)} - w^{(taa)}\right)$

Bottom-up instrument selection ->
Tactical alphas: momentum & low beta for passive funds, Jensen alpha for active funds

Estimation of Covariance Matrix

• **Traditional methods (in-sample, shrinkage) are ill-suited for multi-asset universes**:

i. How to extrapolate returns?

ii. Target covariance matrix for shrinkage?

• **Standard industry risk-models are dubious for multi-asset portfolios**:

i. Selection of factors' base?

ii. Optimal estimation of assets' factor loadings?

Our Set of Tradable Risk Factors

- Set of risk-premia source:

1. Equity
2. Rates
3. Credit (CDX IG and HY)
4. Private Equity (Growth + Carry)
5. Carry (FX)
6. Inflation (break-even swaps)

- These **factors are implemented using futures and QIS trackers** with volatility targeting to 15%

- **Portfolio exposures can be hedged**

PE factor premia explains PE out-performance

- PE ex-equity = quarterly return of MSCI PE Index - MSCI World Equity

(A) Performances

— PE ex-equity: P.a. return=3.9%, Vol=15.8%, Sharpe (rf=0)=0.24
— PE factor premia: P.a. return=4.4%, Vol=15.8%, Sharpe (rf=0)=0.28

(B) PE ex-equity beta to PE factor premia

— beta: avg=0.84, last=0.92

(C) Total return attribution

— PE factor premia = 105%
— residual = -2%
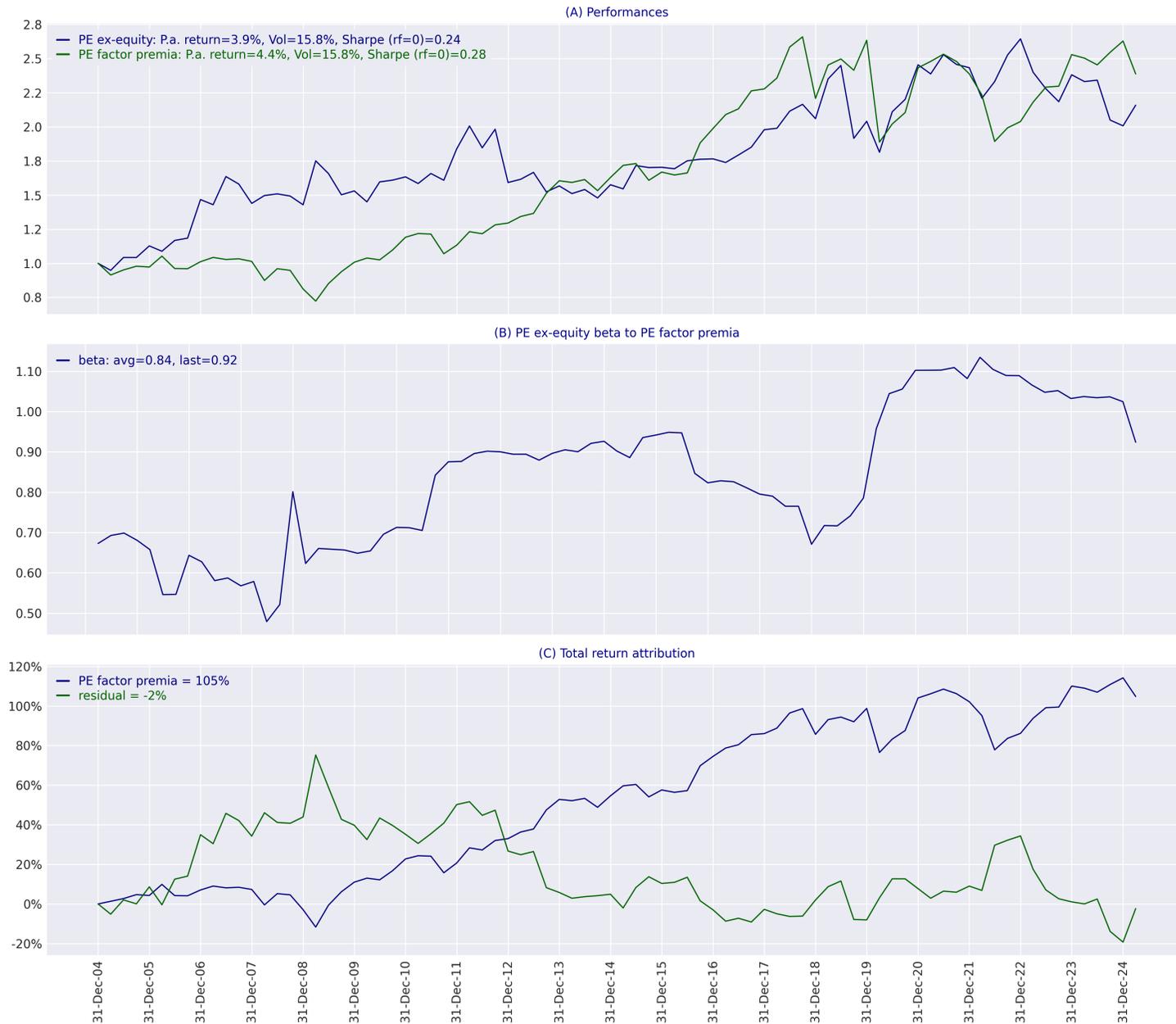
Factor Risk Model

• Select a factor model with base set X_t for **dimensionality reduction**

• Vector Y_t of asset returns:

$$Y_t = \beta X_t + \text{diag}(\vartheta)\epsilon_t \tag{1}$$

• Factor model 1 is estimated for asset sets split by assets liquidity profiles (daily, monthly, quarterly)

• **Avoid extrapolation of returns: instead use extrapolation of beta loadings and residual vols**

New Hierarchical Clustering Group Lasso, HCGL

- Apply statistical clustering in each asset set for **sparsity and consistency** of estimated loadings β

- Group Lasso estimator of β-s for G clusters:

$$\min_{\beta=\beta(\lambda)} \left\{ \frac{1}{T} \sum_{t'=t-T}^{t} w_{t',t} \|Y_{t'} - \beta X_{t'}\|_2^2 + \lambda \sum_{g=1}^{G} \sqrt{s_g} \|\beta_{\mathcal{I}_g}\|_2 \right\}$$

- λ is the regularization parameter, $\|x\|_2$ is l_2 norm
- $\beta_{\mathcal{I}_g}$ is subset of β in cluster g with size s_g
- $w_{t',t} = \nu^{t'-t}$ is EWMA weight with $0 < \nu < 1$
- T is sample size

Specification of Factor Covariance Matrix

● Factor covariance matrix is estimated using EWMA filter of monthly returns with span of 3 years

(A) 31Dec2015

	Equity	Bond	Credit	PE premia	Carry premia	Inflation premia
Equity	1.00	-0.24	0.87	0.69	0.75	0.42
Bond	-0.24	1.00	-0.11	-0.07	-0.34	-0.35
Credit	0.87	-0.11	1.00	0.82	0.66	0.39
PE premia	0.69	-0.07	0.82	1.00	0.48	0.34
Carry premia	0.75	-0.34	0.66	0.48	1.00	0.28
Inflation premia	0.42	-0.35	0.39	0.34	0.28	1.00

(B) 31Dec2020

	Equity	Bond	Credit	PE premia	Carry premia	Inflation premia
Equity	1.00	-0.53	0.83	0.80	0.78	0.77
Bond	-0.53	1.00	-0.44	-0.44	-0.63	-0.60
Credit	0.83	-0.44	1.00	0.93	0.64	0.89
PE premia	0.80	-0.44	0.93	1.00	0.65	0.89
Carry premia	0.78	-0.63	0.64	0.65	1.00	0.66
Inflation premia	0.77	-0.60	0.89	0.89	0.66	1.00

(C) 31Dec2024

	Equity	Bond	Credit	PE premia	Carry premia	Inflation premia
Equity	1.00	0.58	0.83	0.69	0.23	0.11
Bond	0.58	1.00	0.40	0.42	-0.25	-0.39
Credit	0.83	0.40	1.00	0.79	0.13	0.23
PE premia	0.69	0.42	0.79	1.00	-0.13	0.08
Carry premia	0.23	-0.25	0.13	-0.13	1.00	0.40
Inflation premia	0.11	-0.39	0.23	0.08	0.40	1.00

Clusters Dendrogram for SAA&TAA Universe, 31Dec2024

● Clusters are estimated with Wards clustering method
using EWMA correlations with span of 3 years

(A) Quarterly

(B) Monthly

(C) Cluster IDs

Instrument	Cluster ID
HF Macro/CTA	QE-3
Insurance-Linked *	QE-2
Private Assets *	QE-1
Private Debt *	QE-1
HF Equity Hedge	QE-1
HF Event driven	QE-1
HF Relative Value	QE-1
Private Equity	QE-1
EM IG Bonds	ME-4
Credit *	ME-4
Rates *	ME-4
EM Bonds *	ME-4
Other Fixed Income *	ME-4
Global IG Bonds	ME-4
US Treasuries	ME-4
US TIPs	ME-4
Global Capital Debt	ME-4
Securitized Debt	ME-4
Structured Credit	ME-4
EM HY Bonds	ME-3
MSCI EM ex-Asia	ME-3
MSCI Asia Ex-Japan	ME-3
MSCI Japan	ME-3
MSCI Europe	ME-3
MSCI US	ME-3
Global Convertibles	ME-3
HY Credit *	ME-3
Global HY Bonds	ME-3
Equity *	ME-3
Hedge Funds *	ME-3
Real Assets *	ME-3
EM Local Currency Bonds	ME-3
REITs	ME-3
Commodities Precious	ME-2
Commodities EX-Precious	ME-2
EU Leveraged Loans	ME-1
US Leveraged Loans	ME-1

14

Estimated Betas Loadings on 31Dec2024

- Different sparsity and regularization profiles

(A) Multivariate Regression

	Equity	Bond	Credit	PE premia	Carry premia	Inflation premia
HF Macro/CTA	0.24	-0.15	-0.07	-0.08	-0.02	-0.10
Insurance-Linked *	0.30	0.04	0.10	-0.25	-0.11	-0.02
Private Assets *	0.47	0.17	-0.29	0.55	0.07	0.17
Private Debt *	0.15	0.04	0.11	0.11	0.14	0.10
HF Equity Hedge	0.41	-0.06	-0.08	0.08	0.01	0.04
HF Event driven	0.28	-0.05	-0.16	0.18	-0.05	-0.00
HF Relative Value	0.29	-0.02	-0.05	0.11	-0.03	-0.07
Private Equity	0.47	0.17	-0.29	0.55	0.07	0.17
EM IG Bonds	0.13	0.25	0.17	-0.02	-0.00	-0.08
Credit *	0.04	0.27	0.19	0.01	-0.00	-0.04
Rates *	0.09	0.28	-0.03	0.01	-0.02	-0.08
EM Bonds *	0.16	0.18	0.26	-0.03	-0.00	-0.07
Other Fixed Income *	0.13	0.14	0.07	0.11	0.01	-0.00
Global IG Bonds	0.04	0.27	0.19	0.01	-0.00	-0.04
US Treasuries	0.09	0.28	-0.03	0.01	-0.02	-0.08
US TIPs	0.09	0.33	-0.02	-0.00	-0.02	0.16
Global Capital Debt	0.03	0.20	0.23	0.01	-0.01	-0.01
Securitized Debt	0.15	0.28	0.01	0.04	-0.01	-0.11
Structured Credit	0.01	0.17	0.11	0.05	-0.02	-0.02
EM HY Bonds	0.22	0.05	0.43	-0.03	-0.01	-0.03
MSCI EM ex-Asia	0.42	0.03	0.62	-0.07	0.03	0.03
MSCI Asia Ex-Japan	0.48	0.32	-0.05	0.09	0.27	-0.02
MSCI Japan	0.67	0.08	0.17	0.02	-0.14	-0.11
MSCI Europe	0.55	0.25	0.51	-0.22	0.11	-0.04
MSCI US	0.99	0.11	-0.00	0.06	0.06	0.05
Global Convertibles	0.45	0.05	-0.13	0.39	0.06	0.03
HY Credit *	0.07	0.12	0.38	-0.01	-0.00	0.03
Global HY Bonds	0.07	0.12	0.38	-0.01	-0.00	0.03
Equity *	0.84	0.15	0.10	0.02	0.07	0.01
Hedge Funds *	0.16	-0.03	0.01	0.04	-0.01	-0.01
Real Assets *	0.44	0.23	0.26	-0.12	0.03	0.25
EM Local Currency Bonds	0.14	0.20	0.20	-0.09	-0.01	-0.06
REITs	0.78	0.36	0.17	0.11	-0.03	0.04
Commodities Precious	-0.01	0.35	0.39	-0.46	-0.04	0.22
Commodities EX-Precious	0.15	0.03	0.31	-0.33	0.14	0.53
EU Leveraged Loans	-0.06	0.03	0.23	0.02	-0.01	0.14
US Leveraged Loans	-0.01	-0.00	0.15	0.05	0.01	0.10

(B) Independent Lasso

	Equity	Bond	Credit	PE premia	Carry premia	Inflation premia
HF Macro/CTA	0.16	-0.12	-0.05	-0.05	-0.00	-0.08
Insurance-Linked *	0.27	0.05	0.08	-0.21	-0.10	-0.01
Private Assets *	0.46	0.16	-0.25	0.52	0.07	0.16
Private Debt *	0.17	0.03	0.11	0.10	0.13	0.09
HF Equity Hedge	0.38	-0.05	-0.04	0.06	0.01	0.03
HF Event driven	0.23	-0.03	-0.11	0.16	-0.02	
HF Relative Value	0.23		-0.00	0.10	-0.01	-0.05
Private Equity	0.46	0.16	-0.25	0.52	0.07	0.16
EM IG Bonds	0.10	0.28	0.08			
Credit *	0.02	0.27	0.14	0.01		
Rates *		0.31				-0.01
EM Bonds *	0.13	0.20	0.18			
Other Fixed Income *	0.13	0.13	0.03	0.10		
Global IG Bonds	0.02	0.27	0.14	0.01		
US Treasuries		0.31				-0.01
US TIPs	0.05	0.29				0.07
Global Capital Debt	0.01	0.20	0.19	0.01		
Securitized Debt	0.07	0.32		0.03		-0.03
Structured Credit		0.17	0.05	0.06		
EM HY Bonds	0.19	0.05	0.35			
MSCI EM ex-Asia	0.42		0.53		0.02	
MSCI Asia Ex-Japan	0.49	0.29		0.02	0.21	
MSCI Japan	0.59	0.12	0.10	0.06	-0.09	-0.03
MSCI Europe	0.51	0.24	0.28		0.12	
MSCI US	1.05	0.05		0.01	0.00	
Global Convertibles	0.42	0.01		0.29	0.01	
HY Credit *	0.07	0.09	0.34			
Global HY Bonds	0.07	0.09	0.34			
Equity *	0.89	0.10	0.06		0.02	
Hedge Funds *	0.10			0.03		
Real Assets *	0.45	0.17	0.14		0.03	0.19
EM Local Currency Bonds	0.10	0.22	0.06			
REITs	0.75	0.34	0.14	0.12		
Commodities Precious		0.29	0.13	-0.21		0.15
Commodities EX-Precious	0.10		0.10	-0.09	0.17	0.47
EU Leveraged Loans			0.16	0.01		0.07
US Leveraged Loans			0.11	0.02		0.06

(C) Hierarchical Group Lasso

	Equity	Bond	Credit	PE premia	Carry premia	Inflation premia
HF Macro/CTA	0.20	-0.13	-0.06	-0.06	-0.01	-0.09
Insurance-Linked *	0.28	0.05	0.09	-0.23	-0.11	-0.01
Private Assets *	0.46	0.16	-0.26	0.52	0.07	0.16
Private Debt *	0.16	0.03	0.11	0.11	0.13	0.10
HF Equity Hedge	0.39	-0.05	-0.07	0.08	0.01	0.04
HF Event driven	0.26	-0.04	-0.14	0.17	-0.04	-0.00
HF Relative Value	0.27	-0.02	-0.04	0.11	-0.03	-0.06
Private Equity	0.46	0.16	-0.26	0.52	0.07	0.16
EM IG Bonds	0.09	0.27	0.12	0.01		-0.04
Credit *	0.06	0.26	0.13	0.02		-0.02
Rates *	0.04	0.29	0.00	0.01		-0.05
EM Bonds *	0.12	0.21	0.18	0.02		-0.02
Other Fixed Income *	0.09	0.15	0.12	0.05		0.00
Global IG Bonds	0.06	0.26	0.13	0.02		-0.02
US Treasuries	0.04	0.29	0.00	0.01		-0.05
US TIPs	0.06	0.29	0.03	0.01		0.07
Global Capital Debt	0.06	0.20	0.15	0.03		-0.00
Securitized Debt	0.07	0.31	0.05	0.03		-0.06
Structured Credit	0.03	0.17	0.09	0.03		-0.01
EM HY Bonds	0.26	0.05	0.29	0.02	-0.00	-0.01
MSCI EM ex-Asia	0.47	0.03	0.44	0.02	0.04	0.03
MSCI Asia Ex-Japan	0.51	0.27	0.02	0.03	0.19	-0.01
MSCI Japan	0.57	0.13	0.17	0.05	-0.09	-0.05
MSCI Europe	0.57	0.23	0.32	-0.08	0.11	-0.01
MSCI US	0.86	0.13	0.10	0.05	0.06	0.03
Global Convertibles	0.43	0.05	0.05	0.21	0.02	0.02
HY Credit *	0.15	0.09	0.26	-0.00	-0.00	0.02
Global HY Bonds	0.15	0.09	0.26	-0.00	-0.00	0.02
Equity *	0.75	0.15	0.15	0.03	0.07	0.01
Hedge Funds *	0.14	-0.02	0.03	0.03	-0.00	-0.00
Real Assets *	0.45	0.17	0.21	-0.04	0.06	0.13
EM Local Currency Bonds	0.16	0.19	0.11	-0.03	-0.01	-0.04
REITs	0.74	0.34	0.21	0.09	-0.02	0.01
Commodities Precious	0.02	0.31	0.23	-0.32	-0.02	0.19
Commodities EX-Precious	0.07	0.04	0.25	-0.22	0.16	0.50
EU Leveraged Loans			0.16	0.02		0.08
US Leveraged Loans			0.14	0.03		0.08

Asset Correlation Matrix

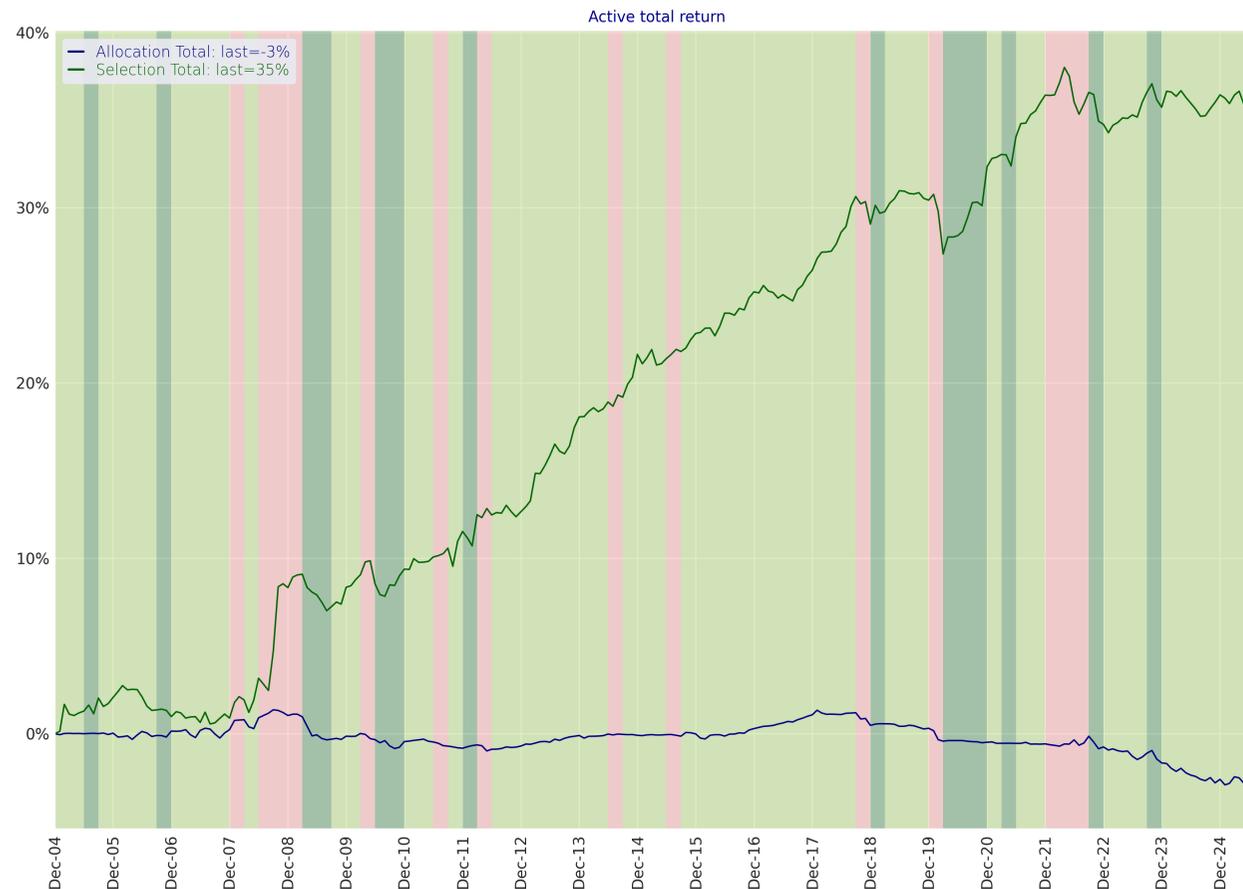|	Global IG Bonds	US Treasuries	US TIPs	Global HY Bonds	EM IG Bonds	EM HY Bonds	EM Local Currency Bonds	Securitized Debt	US Leveraged Loans	EU Leveraged Loans	Global Capital Debt	Global Convertibles	Structured Credit	MSCI US	MSCI Europe	MSCI Japan	MSCI Asia Ex-Japan	MSCI EM ex-Asia	HF Equity Hedge	HF Event driven	HF Macro/CTA	HF Relative Value	Private Equity	Private Debt	Commodities EX-Precious	Commodities Precious	REITs	Insurance-Linked
Global IG Bonds	1.00	0.84	0.82	0.83	0.92	0.82	0.69	0.86	0.49	0.47	0.92	0.74	0.72	0.75	0.73	0.65	0.69	0.61	0.75	0.54	-0.14	0.79	0.50	0.63	0.14	0.24	0.86	0.50
US Treasuries	0.84	1.00	0.85	0.62	0.83	0.62	0.53	0.93	0.33	0.32	0.79	0.52	0.75	0.50	0.53	0.47	0.51	0.45	0.48	0.38	-0.27	0.55	0.32	0.39	-0.02	0.26	0.69	0.34
US TIPs	0.82	0.85	1.00	0.66	0.81	0.66	0.56	0.85	0.36	0.35	0.78	0.57	0.70	0.56	0.58	0.50	0.55	0.50	0.56	0.44	-0.20	0.61	0.38	0.46	0.12	0.27	0.73	0.36
Global HY Bonds	0.83	0.62	0.66	1.00	0.80	0.83	0.68	0.66	0.51	0.48	0.83	0.80	0.58	0.85	0.77	0.69	0.71	0.64	0.85	0.56	0.03	0.80	0.59	0.74	0.27	0.19	0.84	0.51
EM IG Bonds	0.92	0.83	0.81	0.80	1.00	0.80	0.67	0.84	0.48	0.46	0.90	0.71	0.71	0.72	0.70	0.63	0.66	0.59	0.72	0.53	-0.15	0.77	0.47	0.60	0.14	0.24	0.83	0.48
EM HY Bonds	0.82	0.62	0.66	0.83	0.80	1.00	0.67	0.66	0.49	0.47	0.82	0.77	0.58	0.80	0.74	0.66	0.68	0.62	0.81	0.55	0.01	0.78	0.55	0.70	0.26	0.20	0.82	0.49
EM Local Currency Bonds	0.69	0.53	0.56	0.68	0.67	0.67	1.00	0.56	0.41	0.39	0.69	0.63	0.49	0.65	0.61	0.55	0.57	0.51	0.66	0.46	-0.01	0.65	0.45	0.57	0.21	0.17	0.68	0.41
Securitized Debt	0.86	0.93	0.85	0.66	0.84	0.66	0.56	1.00	0.36	0.34	0.81	0.56	0.74	0.55	0.57	0.50	0.55	0.49	0.54	0.42	-0.23	0.60	0.36	0.44	0.04	0.26	0.73	0.36
US Leveraged Loans	0.49	0.33	0.36	0.51	0.48	0.49	0.41	0.36	1.00	0.32	0.50	0.47	0.32	0.49	0.45	0.41	0.42	0.37	0.51	0.35	0.01	0.53	0.33	0.43	0.16	0.11	0.49	0.34
EU Leveraged Loans	0.47	0.32	0.35	0.48	0.46	0.47	0.39	0.34	0.32	1.00	0.48	0.44	0.31	0.47	0.43	0.39	0.40	0.36	0.48	0.34	0.01	0.51	0.31	0.41	0.15	0.10	0.47	0.32
Global Capital Debt	0.92	0.79	0.78	0.83	0.90	0.82	0.69	0.81	0.50	0.48	1.00	0.75	0.69	0.77	0.73	0.66	0.69	0.62	0.77	0.55	-0.10	0.80	0.51	0.65	0.18	0.24	0.85	0.50
Global Convertibles	0.74	0.52	0.57	0.80	0.71	0.77	0.63	0.56	0.47	0.44	0.75	1.00	0.50	0.85	0.73	0.68	0.66	0.59	0.83	0.50	0.10	0.73	0.59	0.74	0.22	0.13	0.77	0.47
Structured Credit	0.72	0.75	0.70	0.58	0.71	0.58	0.49	0.74	0.32	0.31	0.69	0.50	1.00	0.49	0.51	0.44	0.48	0.44	0.49	0.38	-0.17	0.53	0.33	0.40	0.09	0.23	0.63	0.32
MSCI US	0.75	0.50	0.56	0.85	0.72	0.80	0.65	0.55	0.49	0.47	0.77	0.85	0.49	1.00	0.77	0.74	0.70	0.61	0.91	0.50	0.15	0.76	0.66	0.82	0.18	0.10	0.80	0.50
MSCI Europe	0.73	0.53	0.58	0.77	0.70	0.74	0.61	0.57	0.45	0.43	0.73	0.73	0.51	0.77	1.00	0.62	0.64	0.58	0.78	0.51	0.05	0.72	0.54	0.68	0.28	0.18	0.76	0.45
MSCI Japan	0.65	0.47	0.50	0.69	0.63	0.66	0.55	0.50	0.41	0.39	0.66	0.68	0.44	0.74	0.62	1.00	0.57	0.50	0.72	0.41	0.08	0.63	0.50	0.64	0.12	0.10	0.66	0.42
MSCI Asia Ex-Japan	0.69	0.51	0.55	0.71	0.66	0.68	0.57	0.55	0.42	0.40	0.69	0.66	0.48	0.70	0.64	0.57	1.00	0.53	0.70	0.47	0.02	0.67	0.49	0.61	0.24	0.17	0.70	0.42
MSCI EM ex-Asia	0.61	0.45	0.50	0.64	0.59	0.62	0.51	0.49	0.37	0.36	0.62	0.59	0.44	0.61	0.58	0.50	0.53	1.00	0.63	0.45	0.02	0.61	0.44	0.54	0.30	0.18	0.64	0.37
HF Equity Hedge	0.75	0.48	0.56	0.85	0.72	0.81	0.66	0.54	0.51	0.48	0.77	0.83	0.49	0.91	0.78	0.72	0.70	0.63	1.00	0.56	0.13	0.79	0.64	0.80	0.29	0.14	0.81	0.51
HF Event driven	0.54	0.38	0.44	0.56	0.53	0.55	0.46	0.42	0.35	0.34	0.55	0.50	0.38	0.50	0.51	0.41	0.47	0.45	0.56	1.00	-0.01	0.58	0.36	0.45	0.34	0.19	0.58	0.34
HF Macro/CTA	-0.14	-0.27	-0.20	0.03	-0.15	0.01	-0.01	-0.23	0.01	0.01	-0.10	0.10	-0.17	0.15	0.05	0.08	0.02	0.02	0.13	-0.01	1.00	-0.01	0.13	0.16	0.05	-0.10	-0.03	0.01
HF Relative Value	0.79	0.55	0.61	0.80	0.77	0.78	0.65	0.60	0.53	0.51	0.80	0.73	0.53	0.76	0.72	0.63	0.67	0.61	0.79	0.58	-0.01	1.00	0.51	0.66	0.32	0.20	0.80	0.52
Private Equity	0.50	0.32	0.38	0.59	0.47	0.55	0.45	0.36	0.33	0.31	0.51	0.59	0.33	0.66	0.54	0.50	0.49	0.44	0.64	0.36	0.13	0.51	1.00	0.58	0.21	0.08	0.56	0.33
Private Debt	0.63	0.39	0.46	0.74	0.60	0.70	0.57	0.44	0.43	0.41	0.65	0.74	0.40	0.82	0.68	0.64	0.61	0.54	0.80	0.45	0.16	0.66	0.58	1.00	0.22	0.09	0.69	0.43
Commodities EX-Precious	0.14	-0.02	0.12	0.27	0.14	0.26	0.21	0.04	0.16	0.15	0.18	0.22	0.09	0.18	0.28	0.12	0.24	0.30	0.29	0.34	0.05	0.32	0.21	0.22	1.00	0.21	0.31	0.13
Commodities Precious	0.24	0.26	0.27	0.19	0.24	0.20	0.17	0.26	0.11	0.10	0.24	0.13	0.23	0.10	0.18	0.10	0.17	0.18	0.14	0.19	-0.10	0.20	0.08	0.09	0.21	1.00	0.24	0.09
REITs	0.86	0.69	0.73	0.84	0.83	0.82	0.68	0.73	0.49	0.47	0.85	0.77	0.63	0.80	0.76	0.66	0.70	0.64	0.81	0.58	-0.03	0.80	0.56	0.69	0.31	0.24	1.00	0.49
Insurance-Linked	0.50	0.34	0.36	0.51	0.48	0.49	0.41	0.36	0.34	0.32	0.50	0.47	0.32	0.50	0.45	0.42	0.42	0.37	0.51	0.34	0.01	0.52	0.33	0.43	0.13	0.09	0.49	1.00

Tactical Alphas of TAA Universe

- Passive funds: grouped momentum & low beta

- Active funds: risk–adjusted (Jensen) alpha
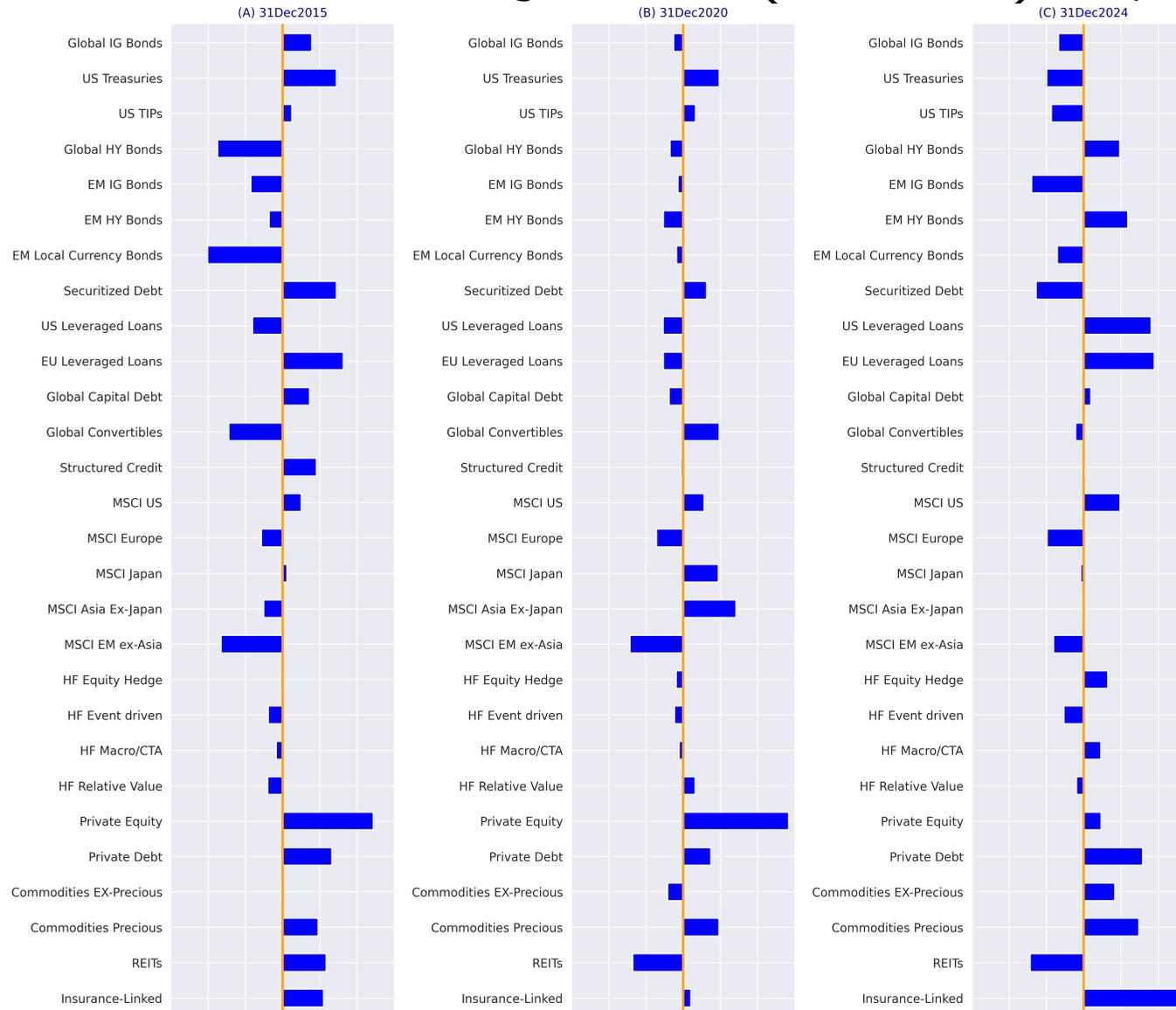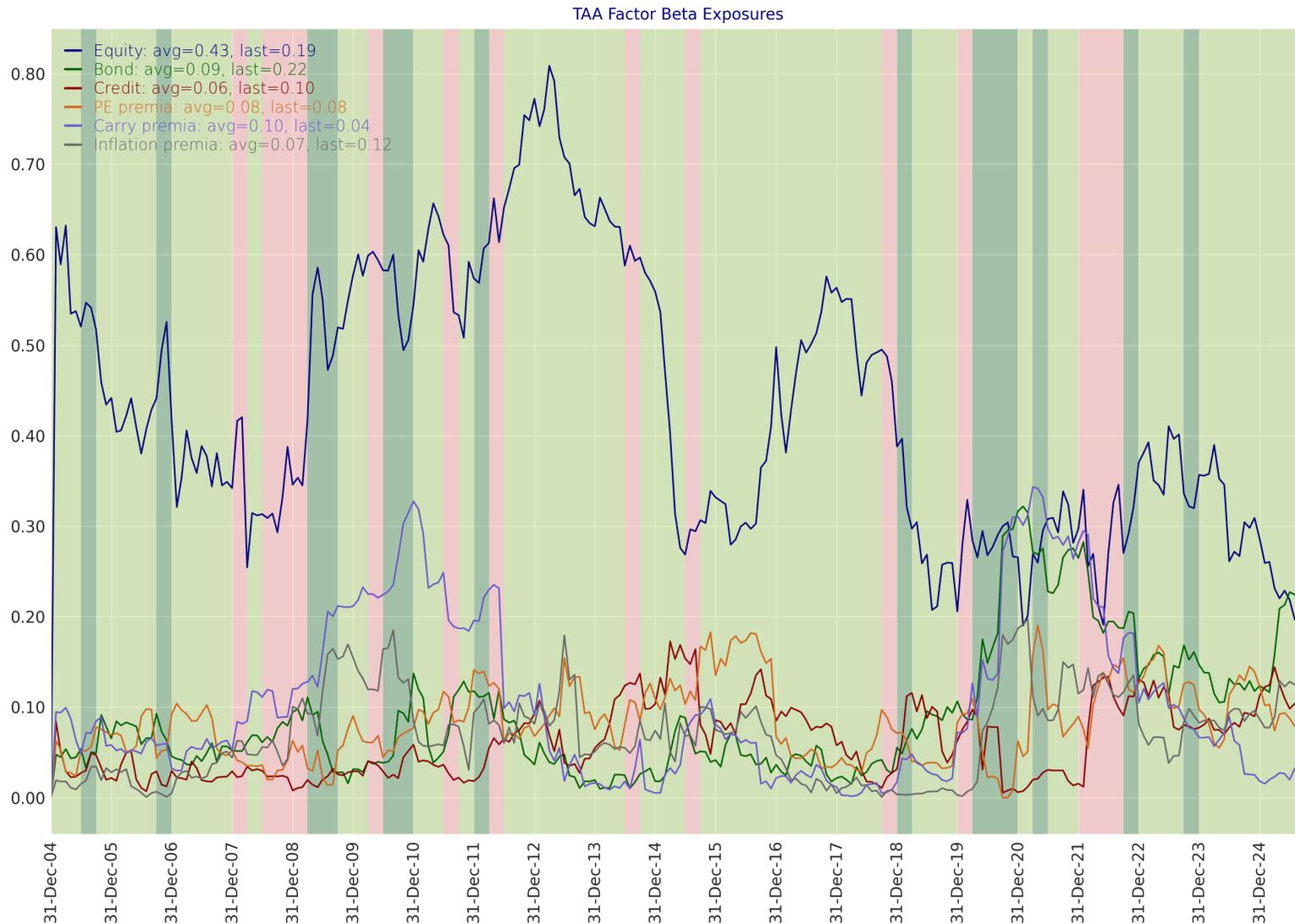
Brinson-Style Allocation and Selection

● Performance of implementation TAA portfolio vs benchmark SAA is due to instrument selection

	TAA Weight Avg	SAA Weight Avg	TAA Return Sum	SAA Return Sum	Asset Allocation	Instrument Selection	Total Active
Fixed Income	24%	27%	28%	22%	-1%	7%	6%
Equity	36%	35%	74%	63%	-2%	13%	11%
Alternatives	39%	38%	81%	62%	1%	19%	19%
Total Sum	100%	100%	184%	148%	-2%	38%	36%

Active total return

Implementation Portfolio Factor Betas

- Portfolio weighted ex-anti factor betas

TAA Factor Beta Exposures

Equity: avg=0.43, last=0.19
Bond: avg=0.09, last=0.22
Credit: avg=0.06, last=0.10
PE premia: avg=0.08, last=0.08
Carry premia: avg=0.10, last=0.04
Inflation premia: avg=0.07, last=0.12

Summary

- Bridge top-down asset allocation (SAA) with bottom up-instrument selection (TAA)

- No requirements to estimate expected returns of asset classes and instruments

- New Hierarchical Clustering Group Lasso (HCGL) method for factor-based regularised estimation of covariance matrix

- Stronger capital efficiency across liquid and illiquid buckets for portfolios with public and private assets

Disclosure

These slides and discussion represent my personal views.

These views and discussion are not an investment advice in any possible form.