

The Investment Properties of Real Asset Funds: A Survey of Prior Work and New Findings

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- **Goal 1: Construct economically meaningful quarterly return series for real assets**
 - **Reported private real-asset returns are driven by appraisal-based NAVs.** Valuations reflect periodic reappraisals that rely on lagged comparables, not continuous market prices.
 - **This makes the series look stable even when underlying market conditions change abruptly.** Standard deviations, betas, and correlations with public benchmarks are mechanically understated. Portfolio optimization and risk budgeting built on these inputs can therefore be distorted.
- **Goal 2: Understand historical risk and return**
 - Collect and analyze data from various types of funds and benchmark to public-market comparables

Raw Time Series Data (Quarterly Returns)

Series	Source
Closed Ended Funds	MSCI Private Capital Universe data. Capitalization-weighted aggregate of funds (real estate, infrastructure, and natural resources). Returns are quarterly time-weighted (TWRR)
Open Ended Funds	Open-end diversified core equity index of inst. U.S. property funds (gross, unlevered). (ODCE) MSCI-PREA U.S. Core Open-End Property Fund Index. (ACOE) MSCI-PREA U.S. All Open-End Property Fund Index (core plus and opportunistic). (AFOE)
Global Public Equities	Developed markets value-weighted market return from the Fama–French data library.
S&P GSCI (Commodities)	Broad commodity price index (S&P Goldman Sachs Commodity Index, total return). BB:SPGSCI
Public Natural Resources	Equal-weighted average of Agriculture, Gold, Mines, Coal, and Oil industries from Ken French 48-industry returns
Global Public Bonds	Bloomberg Global Aggregate Bond Index, total return USD. Ticker: LEGATRUU
Global Public Infrastructure	MSCI World Infrastructure Gross Total Return USD Index (listed equities). BB: M2WO0INF
Global Public Real Estate	FTSE EPRA NAREIT Developed Total Return USD Index (listed REITs). BB: RUGL
Global Public Real Assets	Combined real asset proxy: Global Real Estate Index through 1998, 50/50 RE–Infra blend through 2005, and S&P Global Real Assets thereafter.

Raw Time Series Data (Quarterly Returns)

Series	Quarters	Mean	Std Dev	25%	75%
Real Assets	141	1.8%	3.7%	0.6%	3.2%
Real Estate	141	1.6%	4.3%	0.7%	3.6%
Core	141	1.4%	3.9%	0.4%	3.2%
VA/Opp	141	1.9%	4.6%	0.7%	3.6%
Infrastructure	100	1.9%	3.9%	0.5%	3.5%
Core	82	2.3%	4.7%	0.8%	3.9%
VA/Opp	90	2.1%	2.9%	0.8%	3.5%
Natural Resources	141	2.5%	4.8%	0.1%	5.1%
NFI-ODCE	141	1.4%	3.0%	0.5%	3.2%
MSCI-ACOE	69	1.0%	3.8%	0.2%	3.0%
MSCI-AFOE	69	1.0%	4.0%	0.4%	3.1%

Why ARMA Models Behave Strangely

- Private returns are appraisal-based, not market-priced
- Smoothing spreads shocks across quarters → high AR(1)
- Partial updates create strong MA terms
- ARMA fits capture valuation conventions, not fundamentals
- Leads to persistence, catch-up effects, spurious mean-reversion

ARMA Models

Series	AR(1)	MA(1)
Real Assets	0.564	0.346
Real Estate	0.624	0.364
Core	0.587	0.318
VA/Opp	0.592	0.366
Infrastructure	0.290	0.295
Core	0.215	0.249
VA/Opp	0.062	0.050
Natural Resources	0.297	0.236
NFI-ODCE	0.857	0.750
MSCI-ACOE	0.850	0.797
MSCI-AFOE	0.843	0.801

Unsmoothing Model

- **Develop a framework for jointly recovering “unsmoothed” private return series using:**
 - **Dimson multi-lag model** to capture delayed benchmark pass-through, and
 - **An ARMA** model for serial dependence from smoothing. Inverting this filter yields a more realistic economic return series
- **Our approach preserves long-run performance while correcting intra-period distortions**
 - The unsmoothed series matches the cumulative total return of the reported index, ensuring that we only re-time shocks rather than artificially enhancing/degrading holding-period performance.
- **The resulting unsmoothed series materially increases volatility and contemporaneous public correlations**
 - These revised estimates provide a more credible basis for portfolio construction, factor attribution, and strategic allocation across private and public real assets

- Dimson multi-lag regression: $r_t^P - \bar{r}^P = \alpha + \sum_{k=0}^K \beta_k (r_{t-k}^B - \bar{r}^B) + u_t,$
- $\beta_{\text{Dimson}} = \sum \beta_k$ captures long-run benchmark sensitivity correcting for reporting lag.
- Residual u_t modeled as ARMA(p,q): $u_t = \sum_{i=1}^p \phi_i u_{t-i} + \sum_{j=1}^q \theta_j \varepsilon_{t-j} + \varepsilon_t,$
- Long-run gain indicates smoothing severity. $g = \frac{1 + \sum_j \theta_j}{1 - \sum_i \phi_i},$
- Unsmoothing = invert appraisal filter $\rightarrow$ restore contemporaneous economic shocks.
- Final series re-scaled so cumulative return matches reported private index.

$$\bar{U}_t := R_0 \left[\frac{U_t}{U_0} \right] \left[\frac{R_T / R_0}{U_T / U_0} \right]^{\frac{t}{T}}$$

Model Selection Criteria

- Estimate ARMA(p,q) jointly with Dimson regression
- Inspect coefficient signs & significance (AR & MA terms + p-values)
 - Discount models with negative AR coefficients and fighting AR & MA terms
- Inspect AIC & BIC to judge relative merit of candidate models
 - In many cases competing models would have similar AICs & BICs
- Among candidates, preference given to the model with the smallest difference between unsmoothed volatility and the public benchmark's volatility

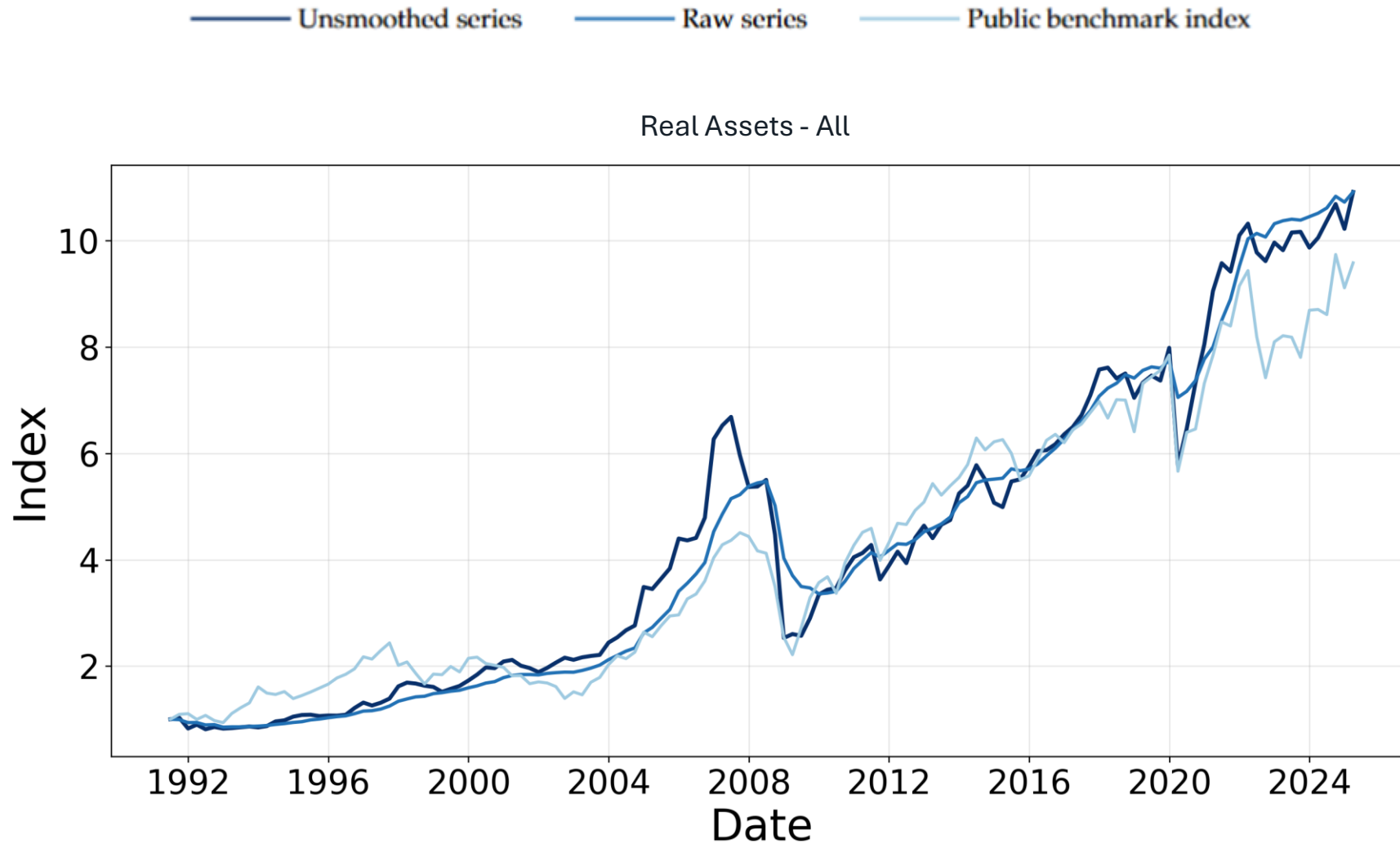
Key Results

- Unsmoothed volatility is higher and closer to public-market comparators
- Mean returns remain unchanged, by construction
- Dimson betas reveal meaningful systematic exposure once lags are included
- Open-end core strategies are smoothest, but unsmoothing corrects this

Unsmoothing Models

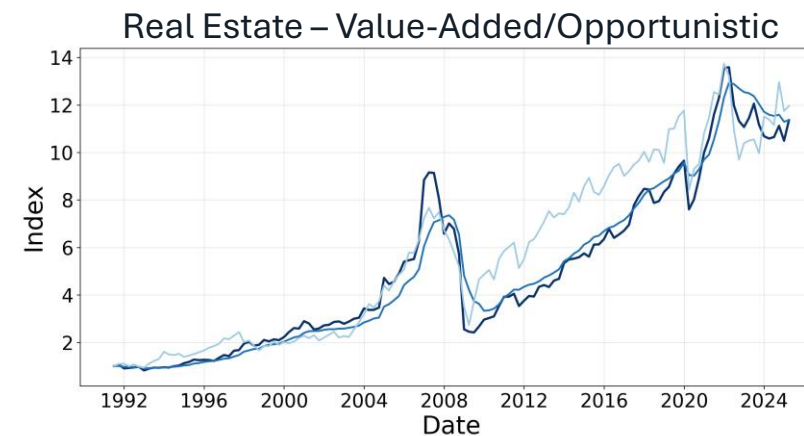
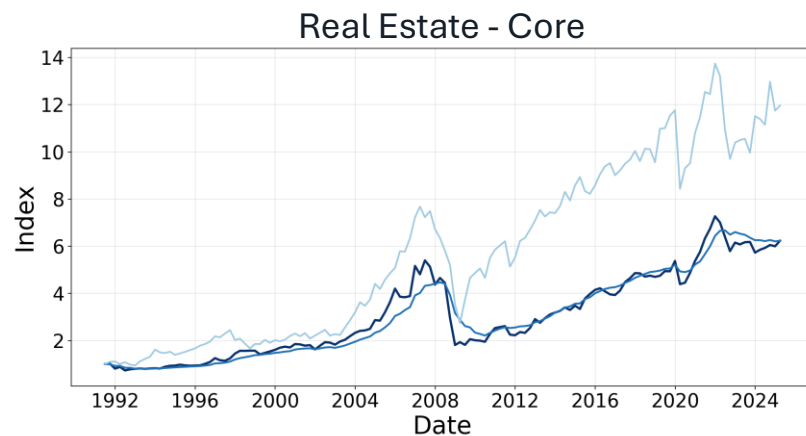
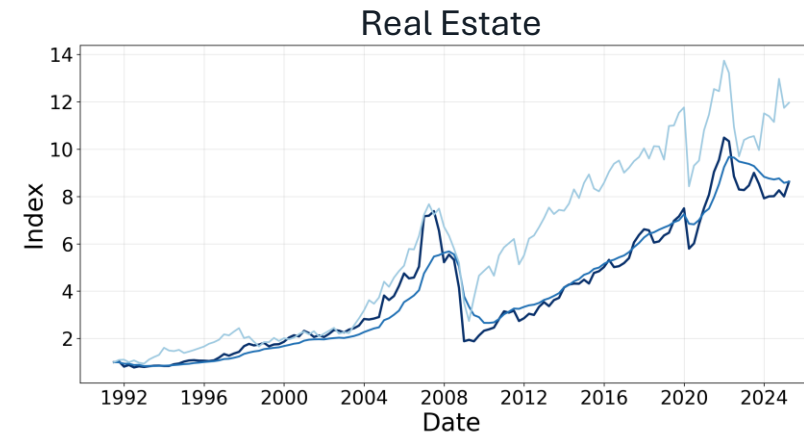
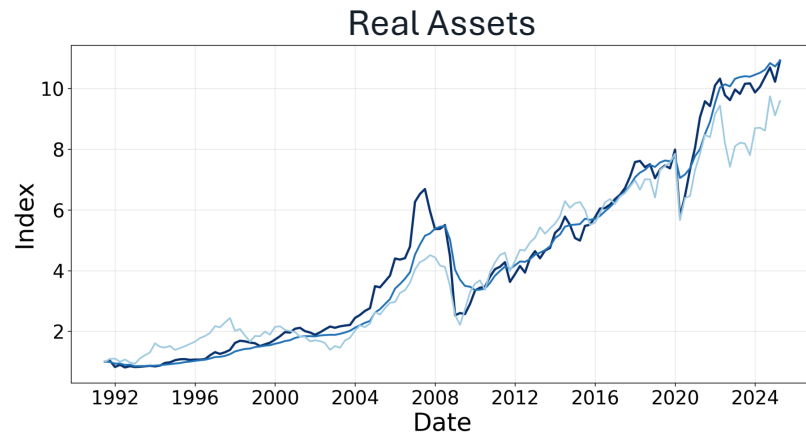
Series	Best AMRA	Benchmark		Raw Reported		Unsmoothed (model-implied)		Dimson β
	(p,q)	Mean (%)	Std Dev (%)	Mean (%)	Std Dev (%)	Mean (%)	Std Dev (%)	
Real Assets	(1,5)	6.98	17.20	7.40	7.40	7.40	16.50	0.377
Real Estate	(1,4)	7.40	19.20	6.56	8.80	6.56	19.40	0.369
Core	(1,4)	7.40	19.20	5.30	7.90	5.30	17.50	0.271
VA/Opp	(1,4)	7.40	19.20	7.40	9.20	7.40	19.00	0.454
Infrastructure	(0,5)	5.72	14.90	7.82	7.40	7.82	11.90	0.536
Core	(0,4)	5.56	13.50	9.09	9.20	9.09	13.30	0.714
VA/Opp	(0,5)	7.82	13.60	8.67	5.90	8.67	11.00	0.413
Natural Resources	(0,4)	10.38	22.80	9.09	9.50	9.09	16.20	0.598
NFI-ODCE	(1,1)	7.40	19.20	5.72	6.10	5.72	15.00	0.260
MSCI-ACOE	(1,0)	2.42	21.20	3.65	7.40	3.65	17.70	0.420
MSCI-AFOE	(1,0)	2.42	21.20	4.06	7.90	4.06	19.20	0.445

Cumulative Returns of Private Funds and Public Benchmarks

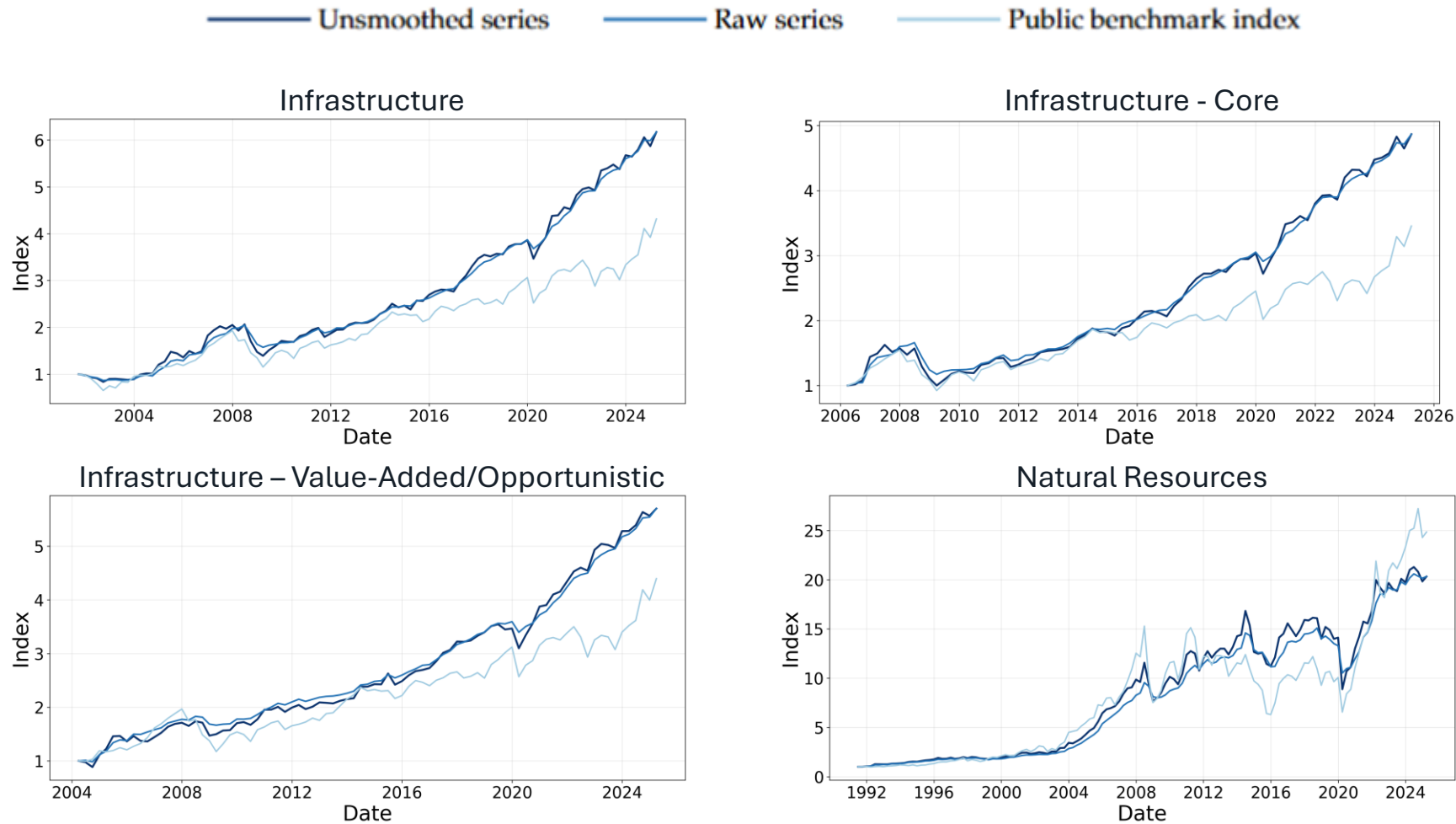


Cumulative Returns of Private Funds and Public Benchmarks

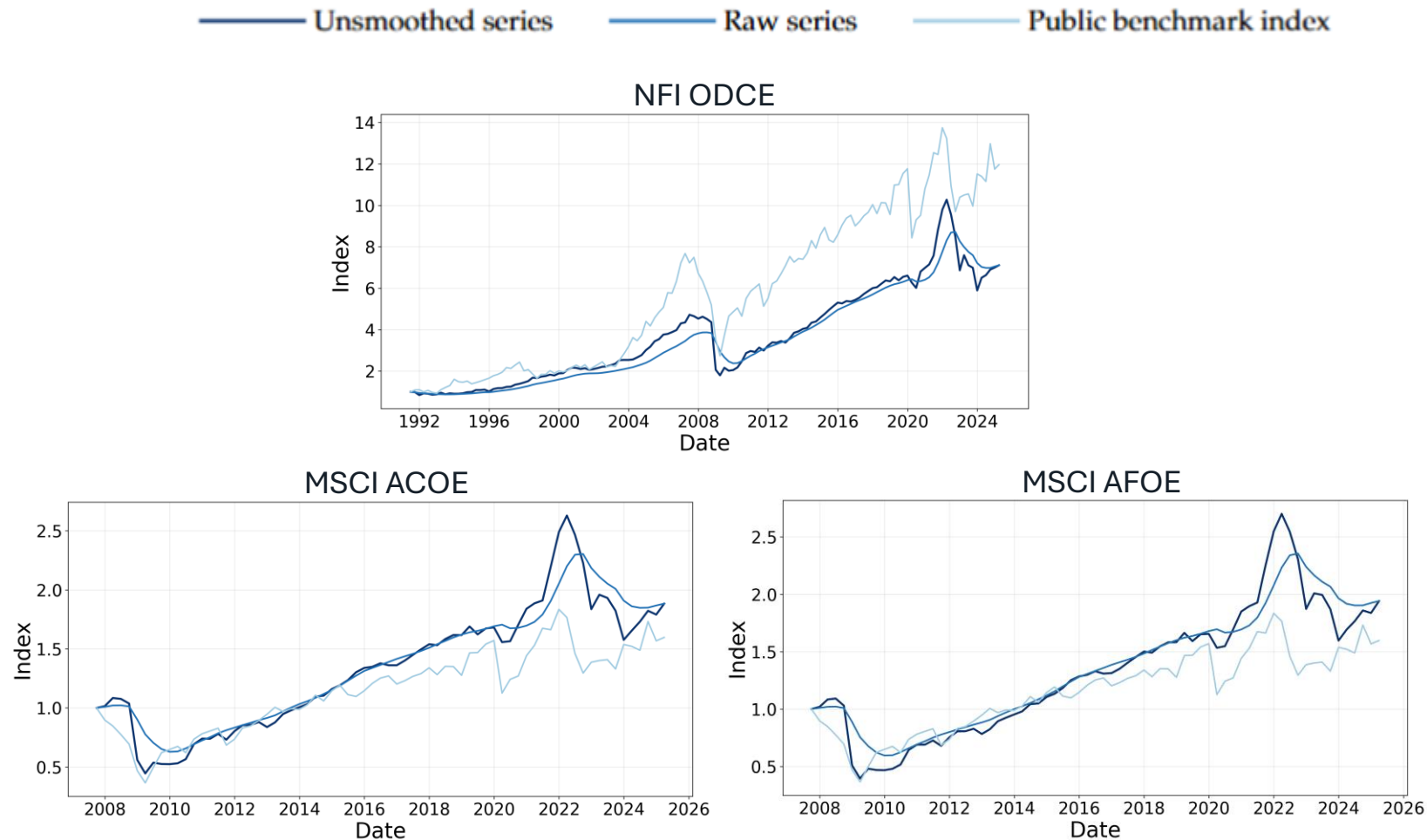
— Unsmoothed series — Raw series — Public benchmark index



Cumulative Returns of Private Funds and Public Benchmarks



Cumulative Returns of Private Funds and Public Benchmarks



Benchmark Choices & Private/Public Composition Differences

Benchmark choices in this paper

- We rely on widely-used public market indices to benchmark private real-asset returns
- However, these indices are not perfect proxies for private fund portfolios: differences in liquidity, valuation smoothing, leverage, hold-period, and exit discipline mean that the comparators are approximate at best

Private vs. public real-asset investment vehicles [Brown, Lundblad & Volckmann (2025)]

- **Geography:** Private funds have greater geographic diversification (non-US Europe/Asia/emerging exposure) compared to many U.S.-centric listed indices
- **Sector:** Private funds invest heavily in industrial/logistics, core transport, renewables; public indices remain heavily weighted to office, shopping centers, utilities/towers

➔ Meaningful Juice to Squeeze out of Benchmark Construction

From Indices to Funds

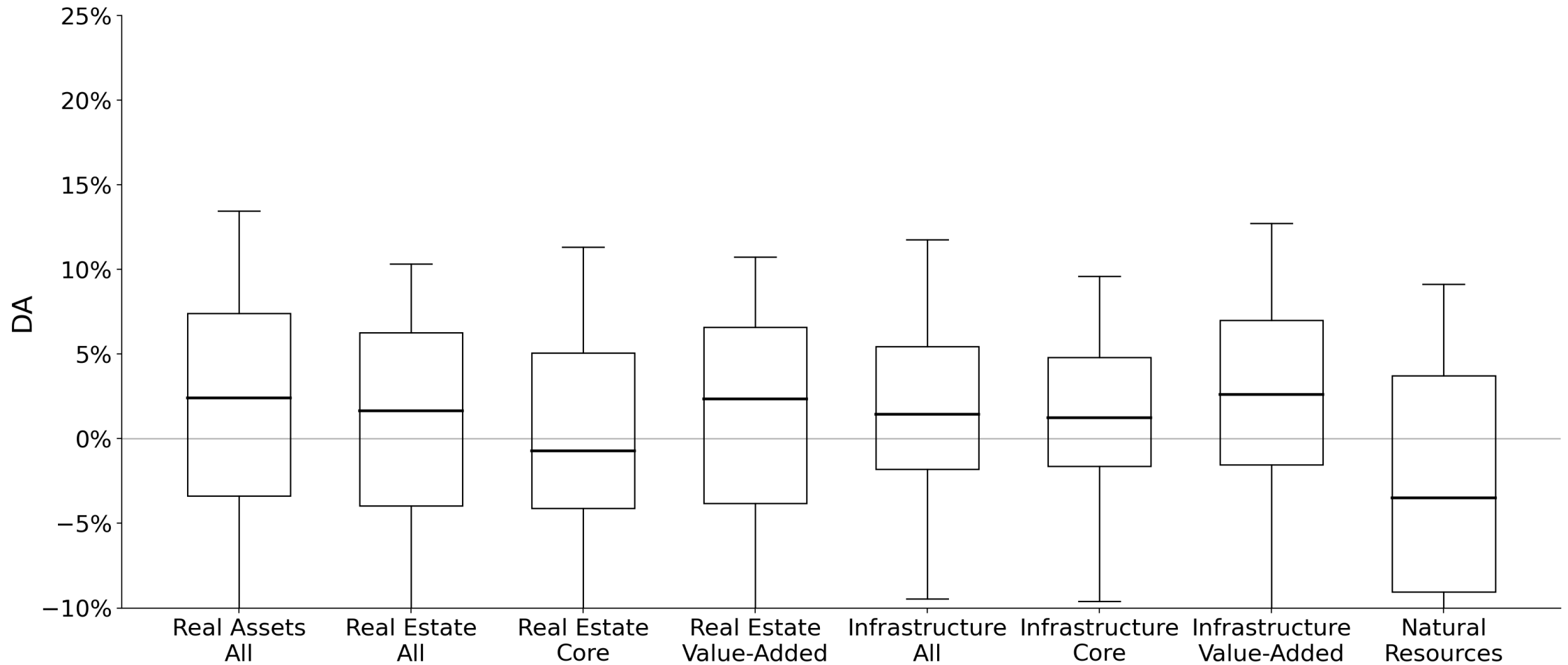
- Index-level results show that private real assets behave more like public assets once smoothing is removed
- The natural next question is whether investors have been rewarded for bearing this risk
- We turn to fund-level outcomes: market-adjusted PME and Direct Alpha
- We examine how performance varies across strategies and vintages using the same public benchmarks that anchor the unsmoothing exercise

Fund-level Performance Data (Quartile Breakpoints)

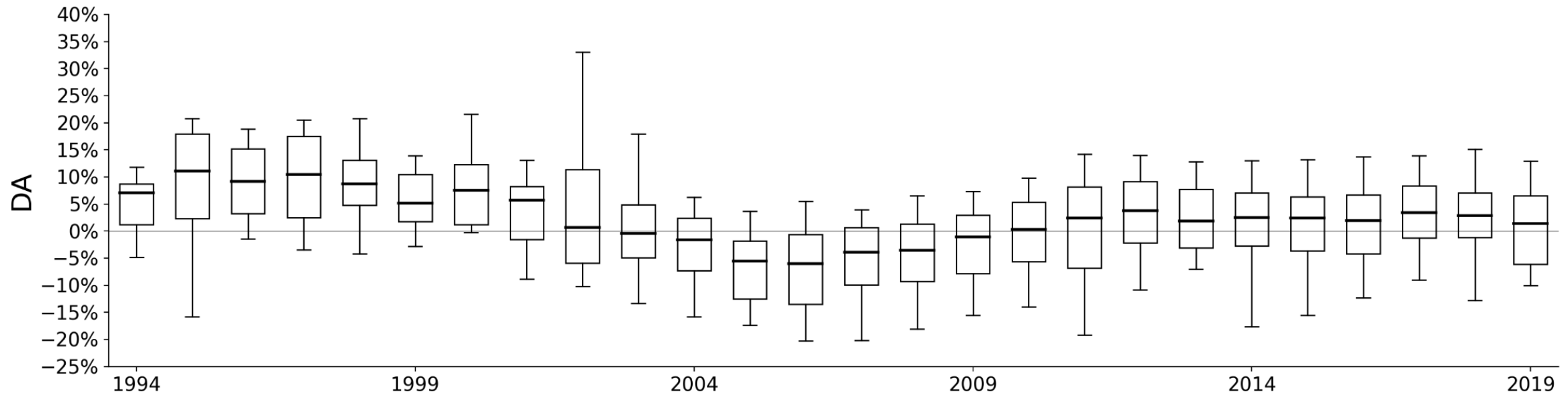
Fund-level Performance Data (Quartile Breakpoints)

Series	#funds	TVPI			IRR			PME			Direct Alpha		
		25%	50%	75%	25%	50%	75%	25%	50%	75%	25%	50%	75%
Real Assets	1,877	1.01	1.31	1.60	0.4%	7.2%	12.9%	0.76	1.03	1.24	-5.8%	0.9%	6.4%
Real Estate	1,210	0.98	1.29	1.56	-0.2%	7.2%	13.4%	0.76	1.01	1.22	-5.8%	0.5%	6.0%
Core	334	1.02	1.29	1.57	0.5%	7.2%	13.5%	0.81	1.01	1.22	-5.3%	0.2%	5.9%
VA/Opp	876	0.97	1.29	1.55	-0.5%	7.3%	13.4%	0.76	1.02	1.23	-6.1%	0.6%	6.1%
Infrastructure	255	1.17	1.38	1.63	4.1%	8.6%	12.7%	0.90	1.06	1.22	-2.4%	1.4%	5.7%
Core	150	1.20	1.37	1.66	4.4%	8.5%	12.1%	0.91	1.04	1.20	-2.1%	1.1%	5.0%
VA/Opp	105	1.08	1.38	1.57	2.3%	8.8%	13.6%	0.86	1.07	1.24	-3.6%	1.8%	6.8%
Nat. Resources	357	1.00	1.37	1.73	0.2%	5.9%	12.1%	0.59	0.81	1.13	-9.7%	-3.9%	2.9%

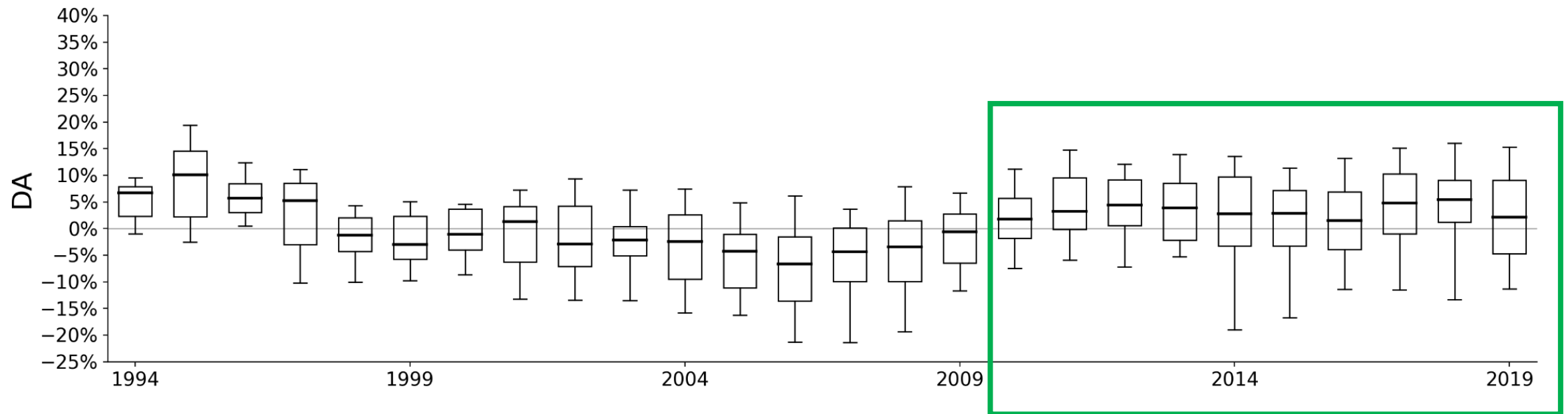
Real Asset Direct Alphas (all vintages)



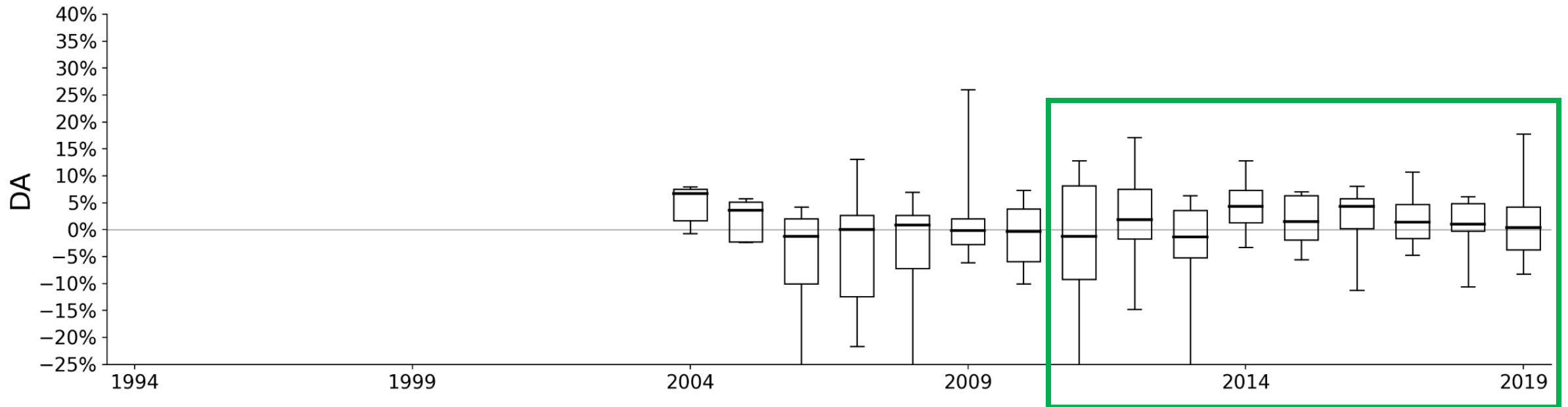
Real Assets Direct Alpha (by-vintage)



Real Estate Direct Alpha (by-vintage)



Infrastructure Direct Alpha (by-vintage)



Good performance, but maybe not quite as good as many think?

Conclusions

- A unified ARMA–Dimson framework successfully recovers economically meaningful unsmoothed returns.
 - Unsmoothed returns reveal substantially higher true volatility and market sensitivity
 - Real asset returns are highly cyclical after unsmoothing
 - Long-horizon cumulative performance aligns more closely with public-market counterparts
- Fund-level evidence suggests private real asset funds (as a whole) have performed well relative to appropriate public market benchmarks
 - Most surprising? Real estate funds have performed better than public REITs post-GFC



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Questions? Please get in touch:

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