Tracking Error as a Risk Management Tool at CalPERS

Investment Committee

November 16, 2020

CalPERS

Executive Summary

- Tracking Error (TE) is a metric that attempts to measure the difference between the portfolio and the benchmark, also known as “active risk”
- TE is only one of many risk management tools in use at CalPERS
- In theory TE can be useful for monitoring and constraining the degree to which staff-driven portfolio implementation decisions and tactical bets diverge from the Strategic Asset Allocation (embodied by the policy benchmark)
- In practice there are limits to TE’s effectiveness, as it relies heavily on modeling assumptions and precise data. In particular for private asset classes, TE is a flawed – even meaningless – metric
- TE as currently implemented at CalPERS is dominated by “noise” from private asset modeling and benchmark issues, limiting its potential as a monitoring and portfolio oversight tool
- We have started reporting an additional TE measure we label “Actionable TE” that excludes private assets to focus exclusively on the areas where TE works well, i.e. public asset classes and asset allocation
- We suggest some related enhancements to the Total Fund Investment Policy on TE that could improve portfolio governance

Tracking Error in Context of Total Fund Investment Policy

Motivation

Risk management is central to managing the assets of CalPERS and to achieving the strategic objectives. A framework for investment risk management is established through (a) the adoption of investment policies for total fund strategic asset allocation, (b) individual asset classes and portfolios with appropriate benchmarks and ***(c) reasonable risk limits****.* (p. 11)

Reporting Requirement

Quantitative Risk Metrics – Staff will report appropriate risk metrics, including volatility, for both forecasted total ***and forecasted active risk*** *… In addition, staff will provide commentary and analysis as appropriate on the interpretation and relative reliability of the provided metrics.* (p. 30, Reporting Responsibilities)

Constraint

The Asset Allocation Program will be managed within a target forecast annual tracking error to the Policy benchmark of 0.75% using the CalPERS Total Fund Risk Management System … ***The CalPERS Total Fund shall be managed with a target forecast annual tracking error of 1.5%,*** *inclusive of active asset allocation and other active management decisions, using the CalPERS Total Fund Risk Management System.* (p. 50, Investment Constraints and Limitations)

Tracking Error in Context of Other Risk Tools

TE is only one of many risk metrics and constraints in use at CalPERS

"Risk to CalPERS is multi-faceted and not fully captured through measures such as volatility or tracking error"

Investment Belief 9

Focus today

POLICY (TRUST LEVEL)*

LIMITS AND CONSTRAINTS

- Asset Allocation (targets and allocation ranges)
- Tracking error (150 bps total / 75 bps allocation)
- Leverage limit (20%)

REPORTING / DISCLOSURE

- Currency
- Counterparty exposure
- Liquidity
- Stress testing / Scenario Analysis

POLICY (PROGRAM LEVEL)*

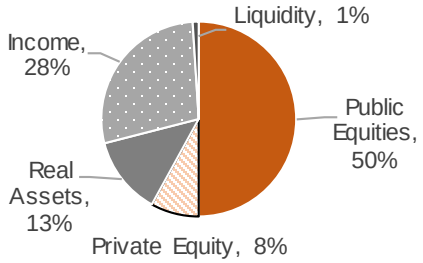
Global Equity	• Strategy categories (Index-oriented or Active) • Segment Active risk TE (0-50 bps forecast TE)
Global Fixed Income	• Segment limitations: - Long Treasury: Duration +/- 10% of BM - Long Spread: Sector ranges per strategy +/-10% of BM wgt (min wgt 0%) • External manager constraints
Private Equity	• External manager selection criteria • Staff authority limits • Strategy targets and ranges • Commitment limits • GP exposure limits (<10% in one GP w/o IC approval)
Real Assets	• Limitations by sub-program risk classification (Core, Value-add, Opportunistic) • Limitation on ownership of public securities (<10%) • Staff authority limits • Partner relationship exposure limits (<20%)
Opportunistic Strategies	• Max 5% exposure limit by market value • Allocation ranges by strategy • Staff authority limits
Securities Lending	• Liquidity constraint (min. 20% of cash collateral pool exercisable within 7 BDs) • Maintenance margin (102%/105% for securities with initial margin of 102%/105%) • Margin call constraints • Cash collateral re-investment
Low Liquidity Enhanced Return	• Duration limits • Maturity and rating constraints
Liquidity	• Maturity constraints (max. 15 months for internal STIF) • Minimum credit quality

* Not a complete list of limits and constraints

TE in Context of Two Categories of Portfolio Risk

Strategic Asset Allocation (SAA)

11.5% Volatility



- Risk is that SAA does not achieve goals defined in Asset Liability Management (ALM) process
- Dominating driver of portfolio outcomes
- Driven by fundamental nature of assets we invest in
- Risk determined by Board (ALM process)

Active Risk

1.05% Volatility ("Tracking Error")

Security	*Benchmark*	*Held*
….		
Stock A	*0.90%*	*1.19%*
Stock B	*1.04%*	*0.79%*
Stock C	*0.66%*	*0.87%*
Stock D	*0.41%*	*0.43%*
Stock E	*0.31%*	*0.32%*
…		

- Risk is that implemented portfolio deviates from characteristics of SAA without corresponding return
- Critical to manage, but less significant driver
- Driven by portfolio implementation frictions and intentional tactical bets
- Risk determined by staff (implementation)

How Tracking Error is Calculated

Portfolio Positions

….	
Stock A	1.19%
Stock B	0.79%
Stock C	0.87%
Stock D	0.43%
Stock E	0.32%
…	

\- *(minus)*

Benchmark Positions

….	
Stock A	0.91%
Stock B	1.04%
Stock C	0.66%
Stock D	0.41%
Stock E	0.31%
…	

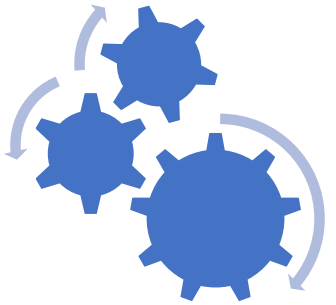
=

Active Exposures

….	
Stock A	+0.29%
Stock B	-0.25%
Stock C	+0.21%
Stock D	-0.02%
Stock E	+0.01%
…	

Historical Market Data

Risk Model



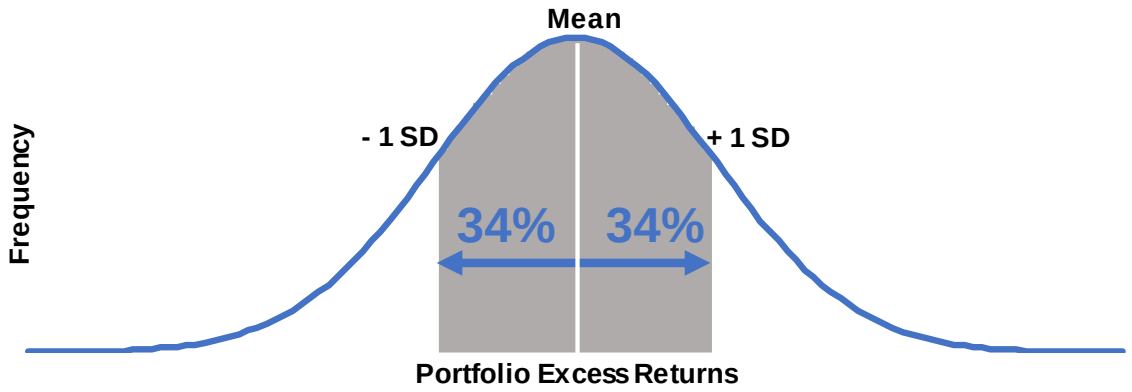
Tracking Error

"105 bps"

- Estimated from current positions, TE is typically intended to be forward looking ("*forecasted*")
- Note we also calculate and report a separate *realized* TE based on historical performance (not shown here)

Formal Definition and Interpretation of Tracking Error

- TE is defined as the *expected standard deviation of excess (relative) returns of the portfolio versus benchmark*
- TE can be interpreted as the range in which excess returns are expected to fall 68% of the time



- However, there are multiple issues with this interpretation as a predictor of risk
  - Real world outcomes are not normally distributed, and worse outcomes occur more frequently than implied by the models (”tail risk”)
  - Models are calibrated with historical data, so they are prone to biases e.g. choice of historical period, data availability limitations
  - These issues are further exacerbated for private assets with data limitations and benchmarking challenges

Practical Uses of Tracking Error in Risk Management

Risk Target or Limit:

- TE can serve as a guidance and control metric on desired extent of leeway to take active risk
  - Assumes that the metric is aligned with actual investment decisions ("actionable" TE)

Monitoring Tool:

- Enables insights regarding portfolio/strategy changes over time and could indicate an increase or decrease in active risk posture

Problems With Using Tracking Error for Private Assets

Private Equity

- Private Equity's benchmark is the *public equity* index, so *any* private equity portfolio will exhibit a large TE*
- Private equity models do not capture investment specific risk as limited granular data is available for private companies

Real Assets

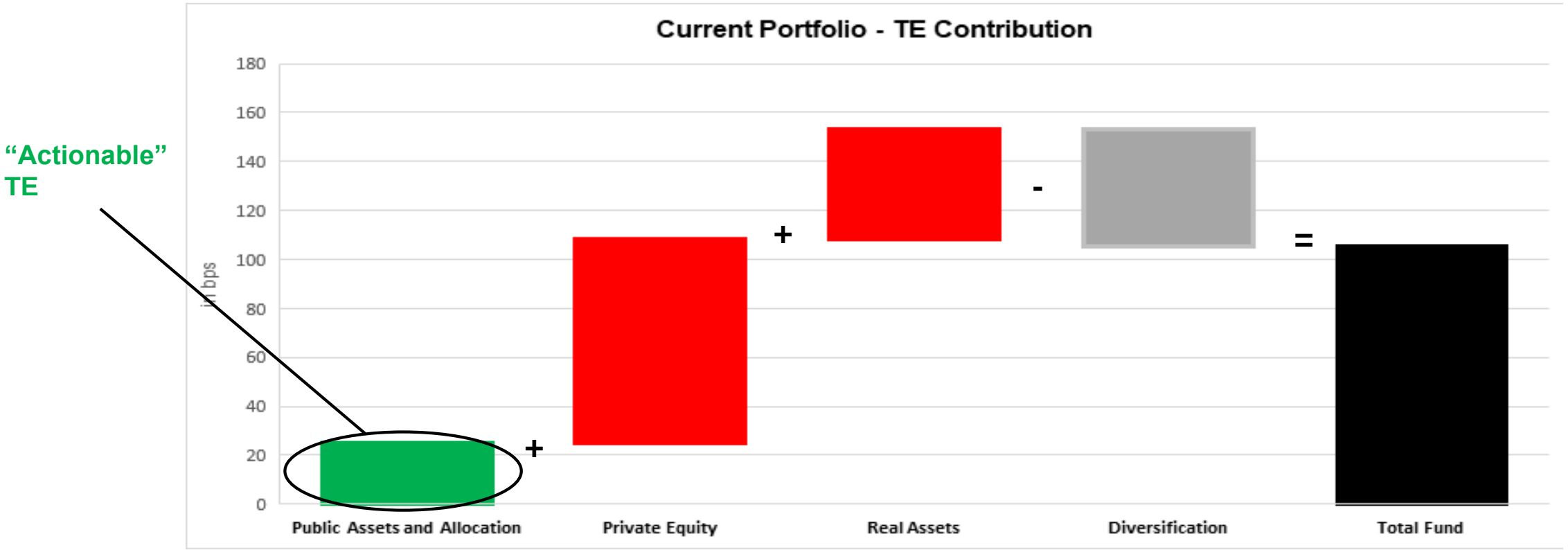
- Real Asset benchmark is not investable
- TE is clouded by a number of measurement limitations, such as low level of precision for models, lack of data/models e.g. international real estate
  - Stale pricing i.e. values are determined via appraisal, so statistical techniques are used to derive "economic" returns
  - Lack or very limited historical data for non-core real estate

TE provides little or no useful information about private asset risks and is rarely used for risk management of these assets

*Represents difference between the PE portfolio modeled with Barra's private equity model and the FTSE public equity index

Current PERF Tracking Error Breakdown

- TE from private assets dominates the current official PERF TE, obscuring the useful portion of TE that could be helpful in tracking the impact of staff's risk taking and implementation decisions



Two Implications of Current TE Methodology

	Hypothetical Portfolio Scenario	Tracking Error (Current Methodology**)
Implication 1: Little differentiation between vastly different risk-taking scenarios	Current Portfolio	105
	Doubling of Public Market Risks	116
	Theoretical Perfect Implementation* (No deliberate active risk in publics or privates)	102
Implication 2: De-facto constraint on increased asset allocation to privates	Current Portfolio with Private Equity Policy Allocation = 12%	177 (Would exceed 150 bps limit)

* Private assets are included at exact SAA targets; 0 active risk in public assets; Real Assets invested only in US core real estate; Private Equity invested at policy target weights to each strategy

** The estimates are for current market conditions and might increase during extended market dislocations due to risk model changes

Reporting Now Includes Actionable TE as a Distinct Metric

Excerpt from Trust Level Quarterly Update – Performance & Risk

Total PERF Risk

Risk Measure	7/1/2020	3/31/2020	Explanation of Risk Measures:
Forecasted Volatility[1]			The total (absolute) volatility is the annualized standard deviation of the Portfolio total return distribution and is indicative of the plan's dispersion given the current environment. The metric is model-based and could underestimate potential drawdowns.
Portfolio	11.5%	11.1%	
Benchmark	11.1%	10.9%	
Forecasted Tracking Error[1]			Forecasted tracking error is the annualized standard deviation of the differential return between the portfolio and an equal investment in the benchmark.
Portfolio	1.05%	1.05%	
Forecasted Tracking Error (Actionable)[1]			Excludes from the above measure the effect of active exposure from private asset classes (Private Equity and Real Assets) arising from the modeling challenges and the non-investible nature of their benchmarks. This metric focuses on controllable and measurable active exposures and captures all public markets strategies and asset allocation management.
Portfolio	0.24%	0.19%	

Potential Policy Improvements

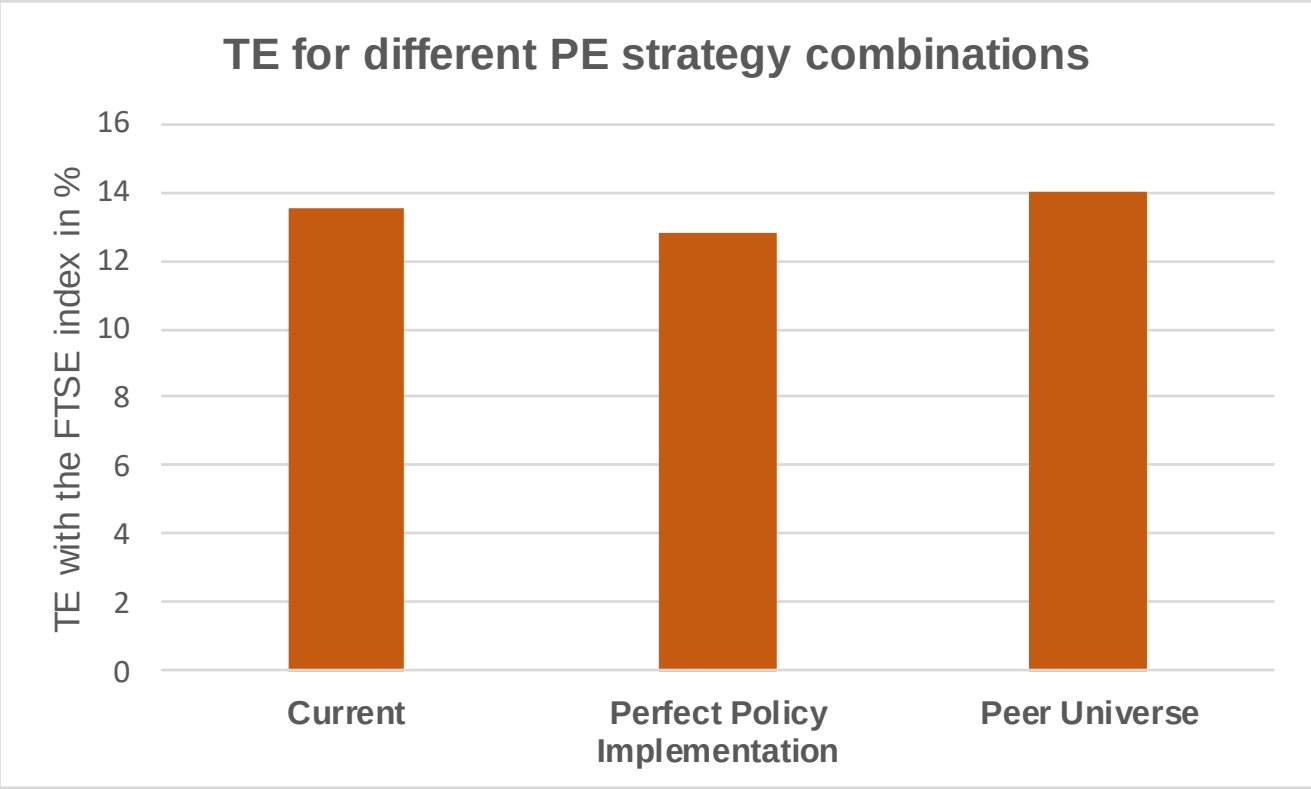
- Consider applying policy constraint to Actionable TE only
  - A risk-equivalent limit on Actionable TE comparable to today's 150 bps constraint on Total TE would be around 100 bps
  - Would want to retain reporting requirement for Total TE (as rough indicator of potential variance from benchmark, whether or not controlled by staff)
- Introduce language around what happens when limit is breached and any allowable short-term departures from limit
  - Analogous to existing language for allocation ranges and leverage limit
- Consider dropping the separate 75 bps constraint on allocation in favor of one single limit
  - This constraint is less relevant in context of today's total fund management approach
  - This constraint is not aligned with existing policy bands, (e.g. implies max Growth overweight of approximately 3% vs. 7% allowable under policy band)

Conclusion

- Tracking Error is a potentially useful tool to measure and constrain the degree to which a portfolio diverges from its benchmark
- Due to weaknesses in our current TE metric methodology related to inherent measurement limitations in private assets, we are now reporting an additional metric called “Actionable TE” that focuses only on public assets and asset allocation
- A review of policy language around TE including the approach to the TE limit could help further strengthen PERF’s governance and accountability

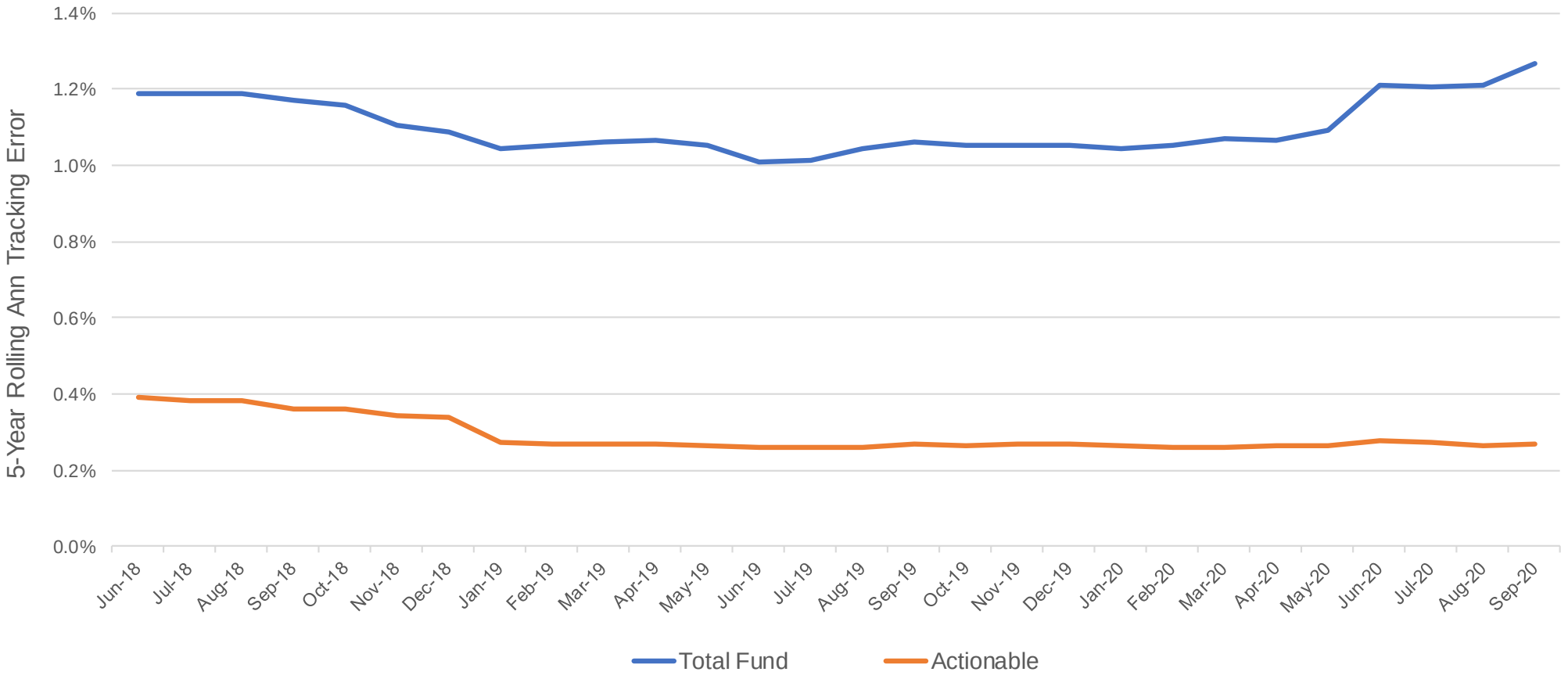
Appendix

Illustration: Tracking Error for Private Equity

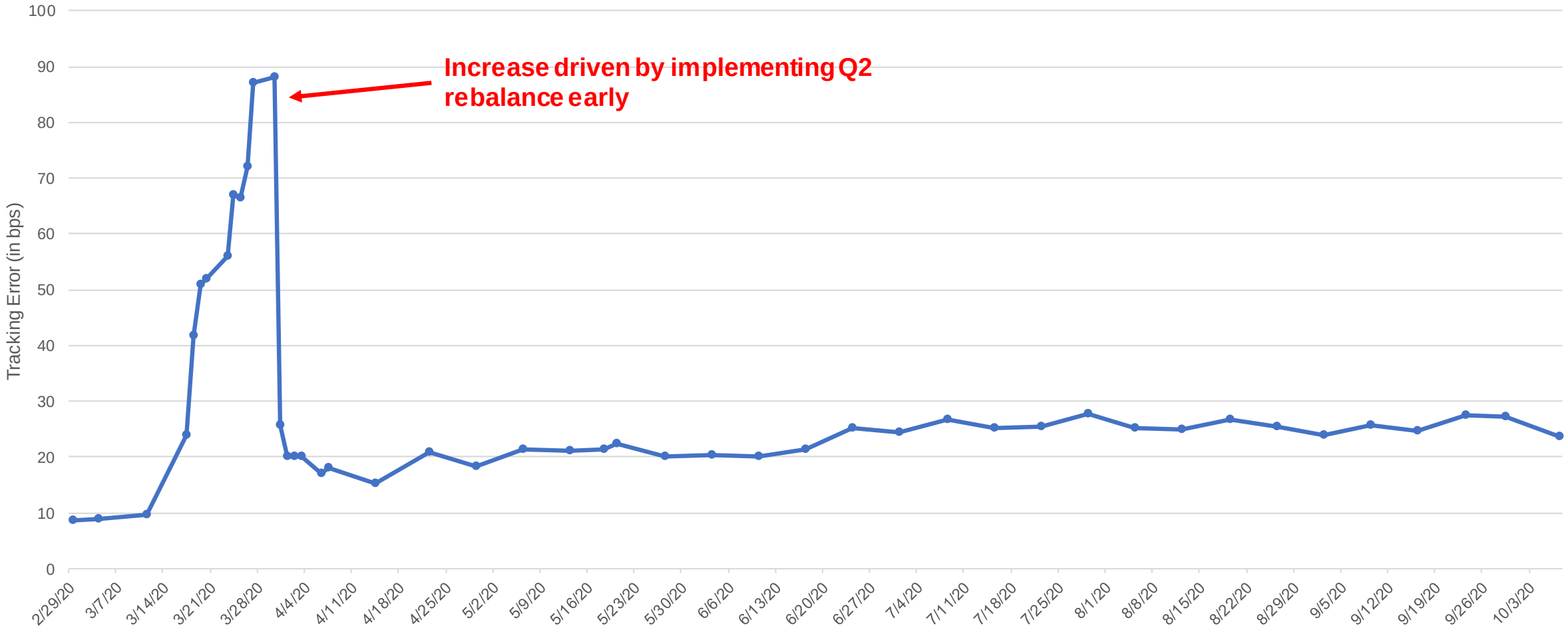


- Calculated tracking error of the PE portfolio barely changes no matter how we implement the portfolio
- The model is capturing the risk between private and public markets (the benchmark), not providing unique insights about our portfolio

PERF Realized Tracking Error

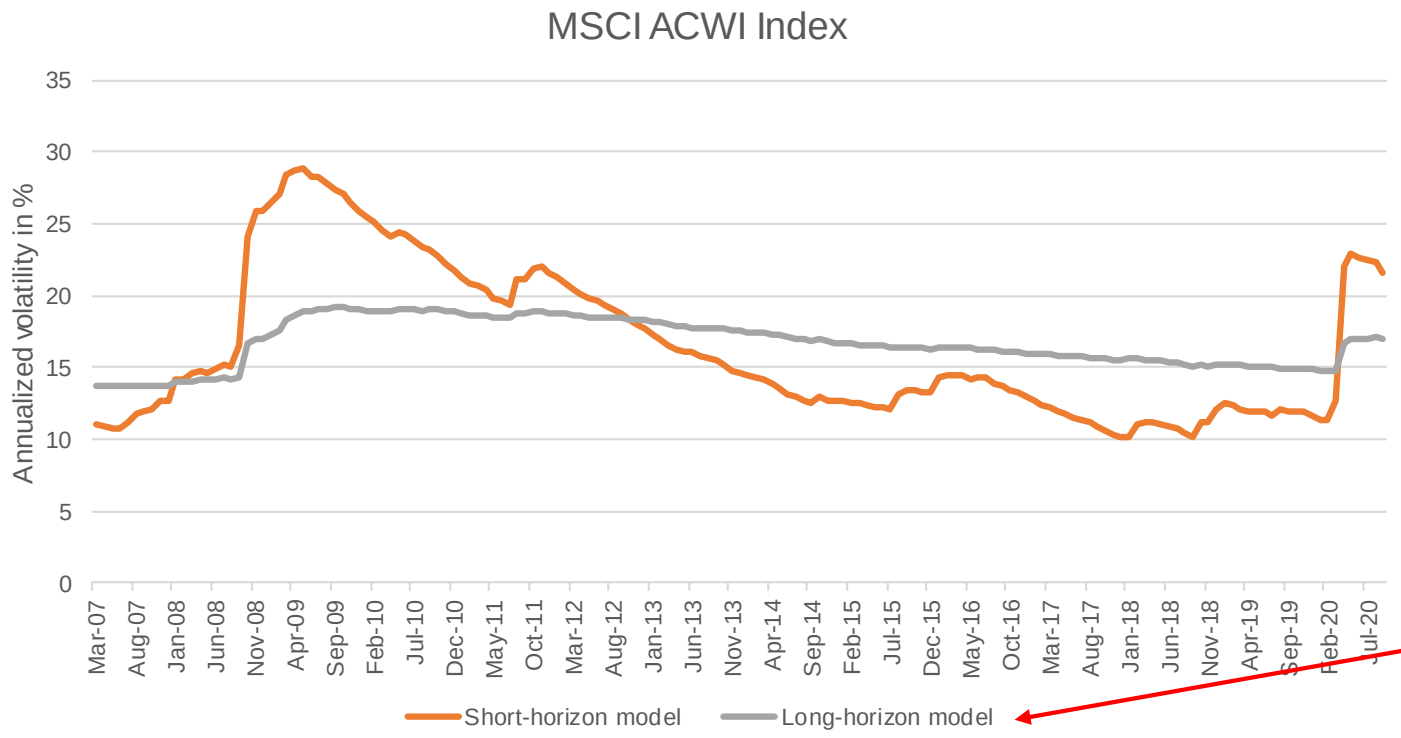


Actionable Tracking Error Over the Last Six Months



Why Do We Want Long-horizon Risk Models?

- Long-horizon risk models are calibrated with longer historical lookback, so they are less sensitive to short-term market movements; therefore, changes in risk estimates are driven more by changes in *positions* ie risk taking activities and less by changes in market volatility



Used for policy monitoring and reporting

Active Risk Limits and Targets for Selected Peers*

Institution	Active Risk Limit/Target	Comment
State of Wisconsin Investment Board (SWIB)	TE Target = 120 bps ± 60 bps (Core Fund)	Leverage (10%) incorporated in the SAA
Norway Government Pension Fund Global (GPFG)	TE Limit = 125 bps CVaR@97.5% (expected shortfall) = 375 bps	95%+ public assets Measured relative to all publics portfolio
Teacher Retirement System of Texas (TRS)	Neutral TE target = 100 bps Max=300 bps	Defined for Public portfolio
New Zealand 's Superannuation Fund	Active Risk ≤ 800 bps	Relative to Reference Portfolio (publics only)
CalSTRS	No Total Fund active risk limit 10-50 bps risk budget for Global Equity	

* Not a comprehensive list and includes peers that have relevant active risk metrics and disclose them externally; information is interpreted from publicly available documents