



Investment Advisory Committee (IAC) Meeting

[VRS Board Room](#)
[Pavilion Bldg - 3rd Floor](#)

Wednesday, 4/13/2022
9:00 - 11:30 AM ET

1. Approval of Minutes (November 10, 2021 Meeting)

IAC Meeting Minutes 11102021 - Final - Page 2

2. CIO Report

Asset Allocation Report 02-28-2022 - Page 5

Daily Asset Allocation Report 04-07-2022 - Page 6

Performance Summary 02-28-2022 - Page 7

Plan Tracking Error - Page 8

New Investments and Terminations 04-13-2022 - Page 9

3. Public Markets Program Reviews

a. Overview

b. Public Equity

c. Internal Equity Management

d. Fixed Income

4. Portfolio Solutions Group (PSG) Functional Reviews

a. Overview

b. Strategy

c. Research

d. Risk

e. Portfolio Integration

5. Meeting Materials

a. Reading Deck (Includes Both Public Markets & Portfolio Solutions Group)

Reading Deck IAC Apr 13 2022 Final - Page 11

b. Presentation Deck (Includes Both Public Markets & Portfolio Solutions Group)

Presentation Deck IAC Apr 13 2022 Final - Page 123

Minutes

A meeting of the Investment Advisory Committee of the Virginia Retirement System was held on November 10, 2021 with the following members present:

Larry Kochard, Chairperson
Michael Beasley
Theodore Economou
Deborah Allen Hewitt
Nancy Leake
Bryan Lewis
Rod Smyth

The following Board members were present:

O'Kelly E. McWilliams, III
Brandon Bell
John Bennett
Michael Disharoon
Brett Hayes
Joseph Montgomery
Troilen Seward

The following staff members were in attendance:

Trish Bishop, Ron Schmitz, Jennifer Schreck, Stephen Adelaar, John Alouf, Rory Badura, Parham Behrooz, Tom Coleman, Ryan Carlson, Warren Chang, Jeanne Chenault, Michael Cooper, Sara Denson, Jon Farmer, Laurie Fennell, Josh Fox, Katherine Grawe, JT Grier, Greg Hines, Dane Honrado, K.C. Howell, Robert Irving, Kristina Koutrakos, Matt Lacy, Chung Ma, Curt Mattson, Jennifer MacKnight, Moses Maxfield, Steve McClelland, Walker Noland, Tom Mulvin, Greg Oliff, Steven Peterson, Vera Pleasants, Mark Rein, Tyler Sanders, Jummai Sarki-Hurd, Dan Schlusser, Kristy Scott, Jillian Sherman, Larry Tentor, Korey Turner, Lisa Turner, Daniel Whitlock, Cindy Wilkinson, Steve Woodall, Nick Zizzo, and Olga Zozulya.

Also in attendance was Lauren Albanese of Financial Investment News; Jamie Bitz of the Virginia Joint Legislative Audit and Review Commission; Steff Chavez of Mandate Wire; Andrea Cinkovic of Goldman Sachs; Brian Deveney of the Virginia Auditor of Public Accounts; Alex Meyer of Goldman Sachs; Oscar Sheehan of Pageant Media; and Carolyn Weimer of Carlyle.

Mr. Kochard called the meeting to order at 10:05 a.m. Mr. Kochard indicated that this IAC meeting has been designated as the annual non-remote meeting (in which no members attend via electronic means). With the exception of Tom Gayner and Hance West, all other Committee members were present.

Minutes

A motion was made by Mr. Beasley and seconded by Dr. Hewitt to approve the minutes for the August 26, 2021 Committee meeting. The motion was unanimously approved.

CIO Report

Mr. Schmitz opened his CIO report commenting on market trends. Then Mr. Schmitz presented the Asset Allocation Report, Performance Summary, and Total Fund Tracking Error as of September 30, 2021. During the review of the Total Fund Tracking Error, Mr. Schmitz provided insight into the contributing factors to the Total Fund Tracking Error. Last, Mr. Schmitz reviewed the New Investments and Terminations Report.

Private Market Asset Program Reviews

Mr. Howell provided a brief overview of the Private Market Asset Programs, provided a preview of the agenda items, and introduced the following Program reviews: Credit Strategies, Real Assets, Private Equity, and Private Investment Partnerships (PIP).

Mr. Woodall provided an annual review of the Credit Strategies program. Annual review topics included: an overview of team members, asset allocation, market updates, exposures, results, top 10 managers, and a look ahead. Mr. Woodall concluded his review with a discussion regarding opportunities in private credit.

Mr. Noland provided an annual review of the Real Assets program. Annual review topics included: an overview of team members, exposures, results, top 10 managers, diverse investment management engagement, and a look forward. Mr. Noland concluded his review with a discussion regarding program asset allocation and market fundamentals.

Mr. Lewis stepped out of the meeting at 11:00 a.m and rejoined the meeting at 11:25 a.m.

Mr. Alouf provided an annual review of the Private Equity program. Annual review topics included: an overview of team members, exposures, results, top 10 investment managers, diverse investment management engagement, and a look forward. Mr. Alouf concluded his review with a discussion regarding current dynamics in his program

including the private equity pacing model, the fund life cycle, and trends in extending hold periods.

During the Private Equity program review, the Committee expressed support for exceeding the policy target if market movements raise the Private Equity allocation above the maximum allowable range.

Mr. Beasley exited the meeting at 12:00 p.m.

Mr. McClelland provided an annual review of the Private Investment Partnerships (PIP). Annual review topics included: an overview of team members, allocation, benchmark, portfolio growth, results, and a look forward. Mr. McClelland concluded his review with a discussion of lessons learned from establishing this program.

During the PIP program review, the Committee expressed support for staff to continue focusing on 10- and 20-year returns as part of their strategy.

Long Term Investment Themes

Mr. Schmitz introduced two long term investment themes (board policy and staff implementation) as well as several broad themes currently monitored by staff for the Committee's consideration at the next Investment Advisory Committee meeting.

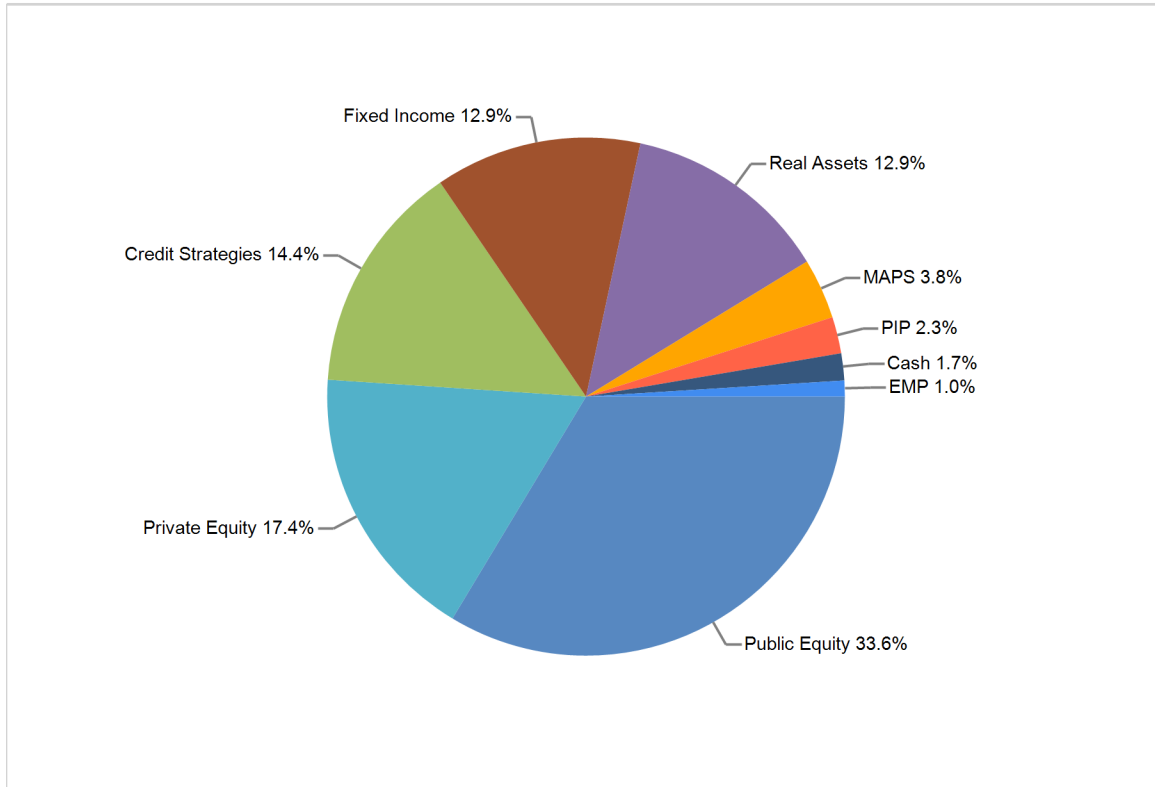
The Committee members engaged in general discussion throughout all of the reviews provided.

Adjournment

Ms. Leake made a motion to adjourn the meeting. Mr. Beasley seconded the motion. Mr. Kochard asked for the Committee members to vote on the motion, and the motion passed unanimously.

The meeting was adjourned at 12:34 p.m.

Larry Kochard, Chairperson



	<u>Current \$Bil</u>	<u>Current Weight</u>	<u>Policy Weight</u>	<u>Variance</u>	<u>Allowable Range</u>		<u>Internal %</u>
Total Fund	104.3						26.7%
Public Equity	35.1	33.6%	36.0%	-2.4%	-5%	+5%	38.7%
Fixed Income	13.5	12.9%	15.0%	-2.1%	-3%	+5%	96.0%
Credit Strategies	15.0	14.4%	14.0%	0.4%	-5%	+5%	
RS Credit	5.0	4.8%	5.6%	-0.8%			
NRS Credit	10.1	9.7%	8.4%	1.3%			
Real Assets	13.5	12.9%	14.0%	-1.1%	-5%	+5%	9.7%
Public RE	1.3	1.2%					99.9%
Private RE	8.0	7.7%					
Other RA	4.1	4.0%					
Private Equity	18.2	17.4%	14.0%	3.4%	-5%	+5%	
MAPS	3.9	3.8%	4.0%	-0.2%	-2%	+2%	
DSTRAT	2.2	2.1%					
RBI	1.7	1.6%					1.4%
PIP	2.4	2.3%	2.0%	0.3%	-2%	+2%	
EMP	1.0	1.0%	0.0%	1.0%		+3%	
Cash	1.8	1.7%	1.0%	0.7%	-1%	+4%	

	<u>Current \$Bil</u>	<u>Current Weight</u>	<u>Policy Limit</u>
Hedge Funds	11.0	10.5%	15.0%

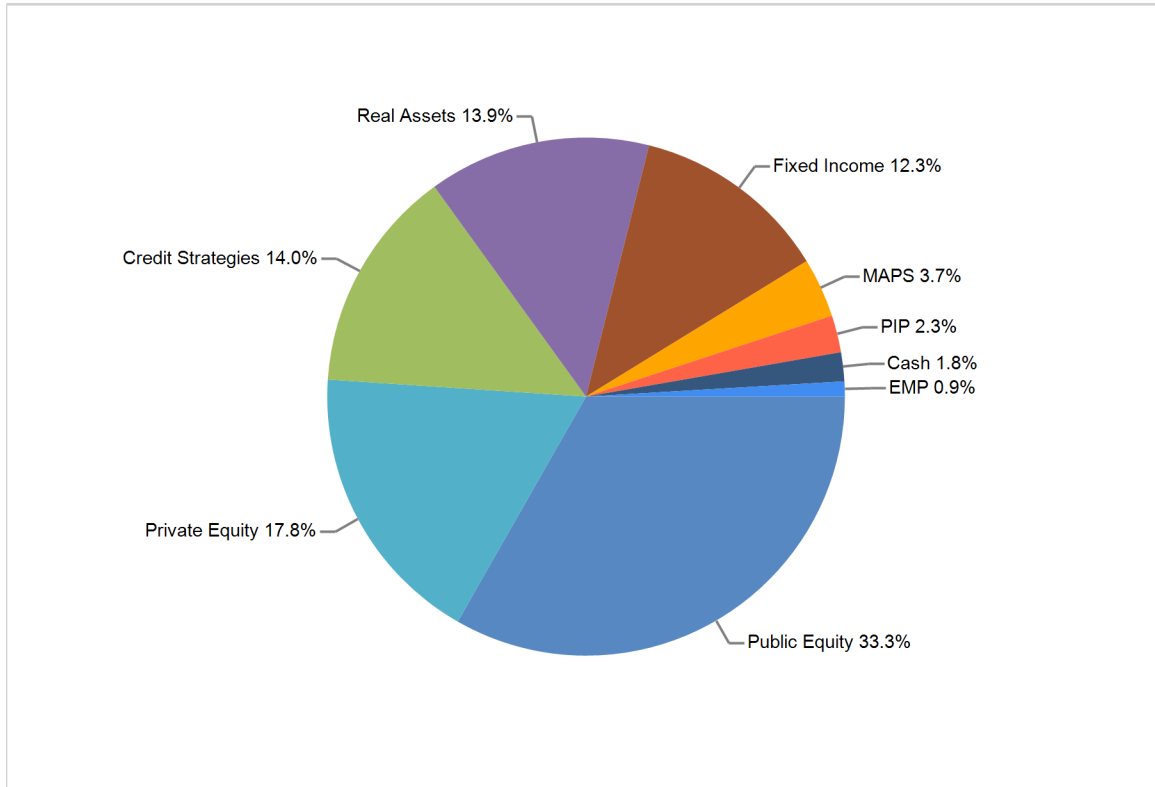
<u>Tracking Error</u>	
3Yr-Total Fund:	1.69%
3Yr-Total Public:	1.48%
5Yr-Total Fund:	1.35%
5Yr-Total Public:	1.16%

*Total Fund includes the following amt held by the Treasurer of VA: \$ 400 million

• The values shown for each asset class on this report may differ from the VRS Monthly Performance Report due to adjustments related to derivative positions in the Rebalance Account, pending transactions, and certain accruals. The values on this report are a more descriptive representation of the Virginia Retirement System's true economic exposure to each asset class.(4 adjustments applied)

*Total Fund and Total Public annualized tracking error is calculated using compounded quarterly returns as of 12/31/2021

* Differences in totals are due to rounding.



	Current \$Bil	Current Weight	Policy Weight	Variance	Allowable Range		Internal %
Total Fund	105.0						26.6%
Public Equity	34.9	33.3%	36.0%	-2.7%	-5%	+5%	40.3%
Fixed Income	12.9	12.3%	15.0%	-2.7%	-3%	+5%	95.9%
Credit Strategies	14.7	14.0%	14.0%	0.0%	-5%	+5%	
RS Credit	4.7	4.5%	5.6%	-1.1%			
NRS Credit	9.9	9.5%	8.4%	1.1%			
Real Assets	14.6	13.9%	14.0%	-0.1%	-5%	+5%	9.3%
Public RE	1.4	1.4%					95.0%
Private RE	8.8	8.3%					
Other RA	4.4	4.2%					
Private Equity	18.7	17.8%	14.0%	3.8%	-5%	+5%	
MAPS	3.9	3.7%	4.0%	-0.3%	-2%	+2%	
DSTRAT	2.2	2.0%					4.9%
RBI	1.7	1.7%					1.0%
PIP	2.4	2.3%	2.0%	0.3%	-2%	+2%	
EMP	1.0	0.9%	0.0%	0.9%		+3%	
Cash	1.9	1.8%	1.0%	0.8%	-1%	+4%	

	Current \$Bil	Current Weight	Policy Limit
Hedge Funds	10.4	9.9%	15.0%

Tracking Error	
3Yr-Total Fund:	1.74%
3Yr-Total Public:	1.54%
5Yr-Total Fund:	1.38%
5Yr-Total Public:	1.19%

*Total Fund includes the following amt held by the Treasurer of VA: \$ 107 million

• The values shown for each asset class on this report may reflect adjustments related to derivative positions in the Rebalance Account, pending transactions and certain accruals, in order to provide a more descriptive representation of the true economic exposure to each asset class (5 adjustments applied)

*Total Fund and Total Public annualized tracking error is calculated using compounded quarterly returns as of 3/31/2022

* Differences in totals are due to rounding.

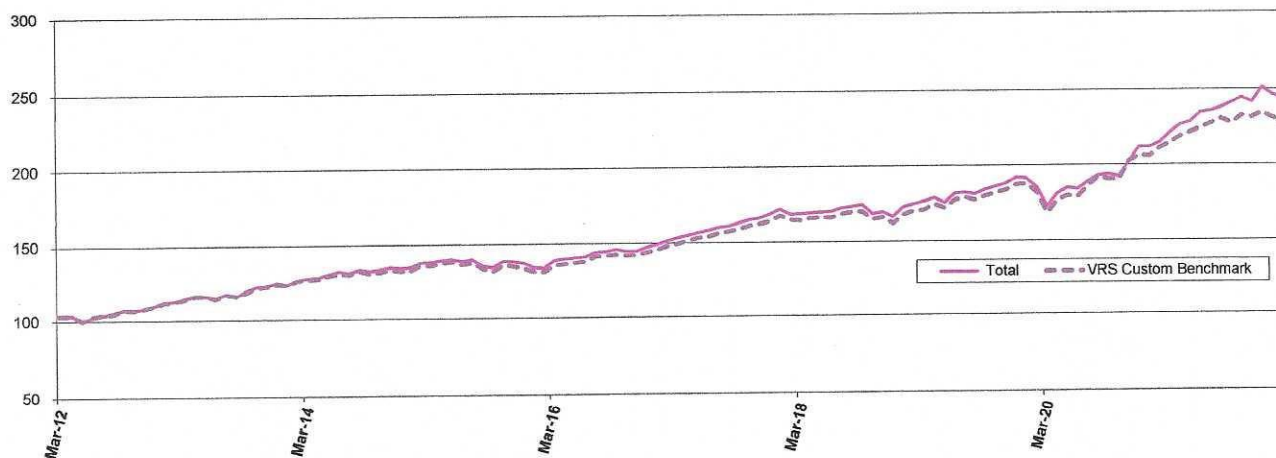
PERFORMANCE SUMMARY
Rolling Periods Ending
February 28, 2022



TOTAL FUND PERFORMANCE

	10 Yr	5 Yr	3 Yr	1 Yr	Qtr	Month	Fiscal YTD	Cal YTD	Market Value (\$MM)
Total Public Equity Strategies	10.0	10.3	12.2	7.6	-2.5	-2.1	-2.4	-6.6	35,073
<i>Benchmark</i>	10.1	11.2	13.3	7.3	-3.6	-2.3	-2.6	-7.3	
Total Fixed Income	3.2	3.7	4.7	-2.1	-3.5	-1.4	-3.4	-3.6	13,121
<i>Benchmark</i>	2.5	2.7	3.3	-2.7	-3.6	-1.4	-3.5	-3.6	
Total Credit Strategies	6.8	7.1	8.3	8.7	0.4	-0.5	3.1	-1.1	15,049
<i>Benchmark</i>	5.5	5.2	5.3	1.8	-0.7	-0.7	0.1	-1.6	
Total Real Assets	10.3	9.0	8.2	16.1	5.2	-0.2	9.2	-0.8	13,453
<i>Benchmark</i>	8.9	7.5	7.5	15.7	4.8	1.5	11.7	2.7	
Total Private Equity	18.0	22.6	25.4	49.7	7.8	0.0	21.0	-0.1	18,158
<i>Benchmark</i>	15.4	17.0	18.6	20.5	-1.9	-2.7	8.4	2.1	
Total Private Investment Partnerships	n/a	10.9	11.5	29.6	4.6	0.0	11.6	0.0	2,378
<i>Benchmark</i>	n/a	10.1	10.9	13.2	1.1	-0.5	7.2	1.4	
Total Multi-Asset Public Strategies	n/a	n/a	6.5	5.6	1.1	-1.0	0.8	-1.9	3,932
<i>Benchmark</i>	n/a	n/a	8.2	3.8	-1.9	-1.2	-0.9	-3.7	
Total Fund	9.0	10.0	11.7	13.5	1.1	-1.0	3.9	-2.9	104,265
<i>VRS Custom Benchmark</i>	8.3	9.0	10.2	7.9	-1.5	-1.3	1.5	-2.8	

10-Year Performance Indexed to 100



Effective July 2013, the VRS Custom Benchmark is a blend of the Asset Class Benchmarks at policy weights.

The VRS Cash Account, the Treasurer Short-Term Investment Account, the VRS Rebalancing Account, transition activity and accounts with market values of less than \$1 million are included in the Total Fund's market value. Differences in market value totals are due to rounding.

Total Fund Tracking Error

Figure 1: Policy Tracking Error Rolling Three Year - Plan (as of 12/31/2021)

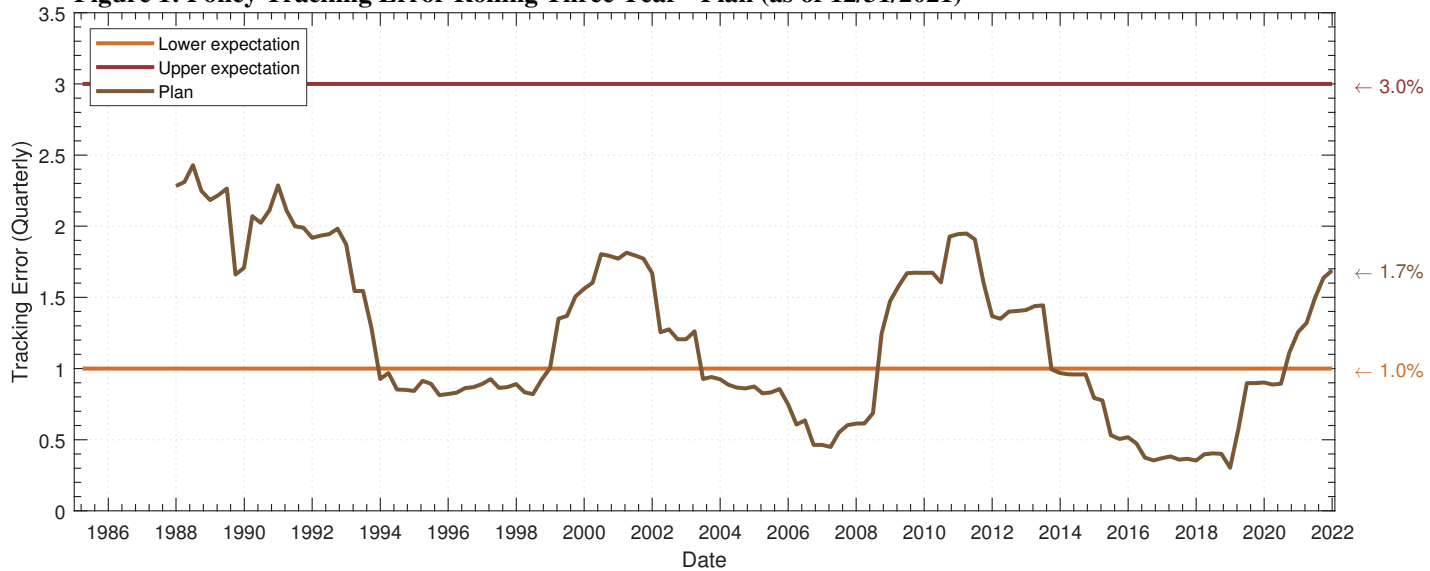
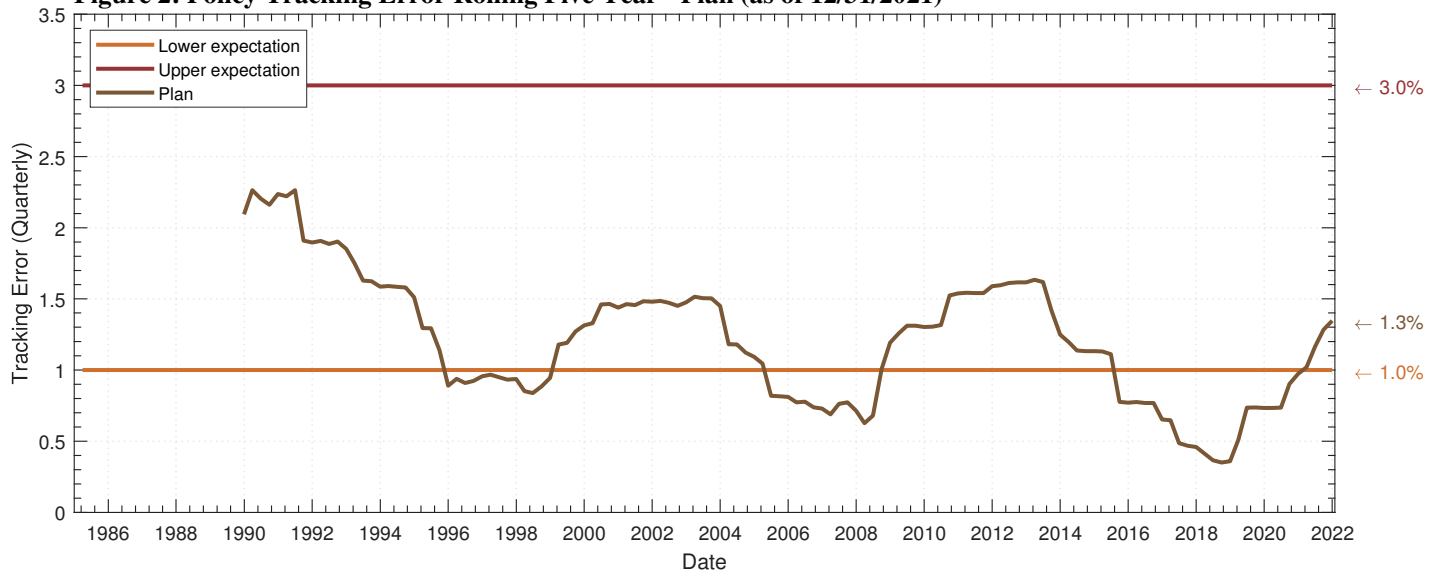


Figure 2: Policy Tracking Error Rolling Five Year - Plan (as of 12/31/2021)



The VRS Defined Benefit Plan Investment Policy Statement established the total fund tracking error range as the allowable observed tracking error calculated quarterly using 5 years of history.

VRS Investment Department
 Recap of New Investments/Terminations
 Time Period: 11/10/2021 – 04/13/2022



Program	Action	Effective Date	Commitment/ Current Value	Funding/ Defunding Period	Description
Public Equity	Closed	02/28/2022	\$200 Million	< 1 Month	* Kylin Management, LLC – A China, Korea, and Japan oriented equity hedge fund.
Fixed Income	Terminated	11/12/2021	\$166 Million	Immediate	AQR Systematic High Yield – AQR shut down their long-only fixed income business.
Credit Strategies	Hired	11/04/2021	\$215 Million	4 Years	Sixth Street Opportunities Partners V – A control-oriented distressed and opportunistic credit fund.
Credit Strategies	Hired	12/15/2021	\$350 Million	4 Years	HPS Strategic Investment Partners V – A private credit fund focused primarily on subordinated debt investments in larger companies.
Credit Strategies	Hired	12/21/2021	\$325 Million	4 Years	Ares SSG Capital Partners VI – A private credit fund targeting special situation and distressed debt investments in Asia.
Credit Strategies	Terminated	03/07/2022	\$148 Million	< 1 Month	Allianz Global Investors – A separate account investing in convertible bonds.
Real Assets	Hired	12/07/2021	\$200 Million	3 Years	QuadCP Fund I – Closed-end fund focused on opportunistic real estate in U.S.
Real Assets	Hired	12/21/2021	\$200 Million	5 Years	Blackstone Real Estate Partners Asia III L.P. – Pan-Asia focused closed-end fund focused on opportunistic real estate.
Real Assets	Hired	12/31/2021	\$125 Million	4 Years	* Artemis Real Estate Partners Fund IV, L.P. – A closed-end fund investing in value-add/opportunistic U.S. real estate.
Private Equity	Hired	11/12/2021	\$40 Million	6 Years	GTCR Strategic Growth Fund I – A U.S. middle market buyout fund targeting growth companies in four core domains: financial services & technology; healthcare; growth business services; and, technology, media & telecommunications.

* The manager is considered DIME under the Commonwealth of Virginia definition, which defines ownership threshold of 51% or more.

** The manager is considered DIME under the definition that considers industry best practices and defines an ownership threshold of greater than or equal to 33% and less than 51% of firm ownership or carry.

Program	Action	Effective Date	Commitment/Current Value	Funding/Defunding Period	Description
Private Equity	Hired	11/16/2021	\$200 Million	6 Years	** TSG 9 – A large market fund targeting consumer-branded growth companies.
Dynamic Strategies	Hired	03/31/2022	\$80 Million	Immediate	MetLife Climate Aware Fixed Income – A long-only, multi-asset fixed income strategy emphasizing climate-readiness.

* The manager is considered DIME under the Commonwealth of Virginia definition, which defines ownership threshold of 51% or more.

** The manager is considered DIME under the definition that considers industry best practices and defines an ownership threshold of greater than or equal to 33% and less than 51% of firm ownership or carry.

Investment Advisory Committee

Public Market Assets

Program Reviews

Reading Deck

April 13, 2022



Overview

(J.T. Grier, Managing Director)

Program Reviews

- **Public Equity**

(Dan Whitlock, Program Director)

- **Internal Equity Management**

(Dan Schlussler, Program Director)

- **Fixed Income**

(Parham Behrooz & Greg Oliff, Co-Directors)

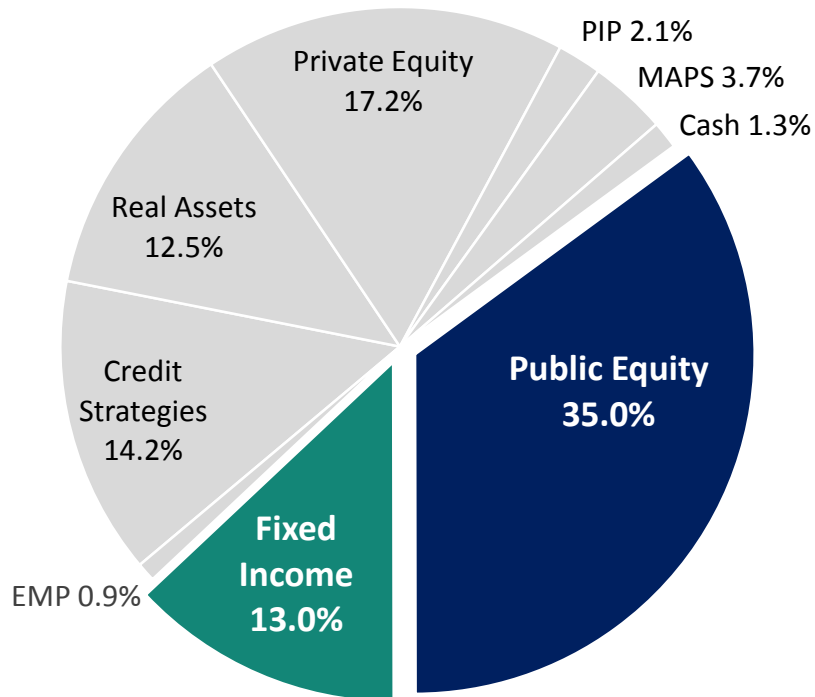
Public Market Program Overview

J.T. Grier
Managing Director, Public Markets



Overview: Public Market Assets

Public Market Assets: 48.0%



Public Equity

- 23 Developed Mkts
- 25 Emerging Mkts

Internal Equity Management

- ≈39% of Public Equity
- Invested in 48 Global Mkts

Fixed Income

- U.S. Core Focus
- USD EMD
- High Yield

Market values as of 12/31/2021; source: BNY Mellon data

Overview: Preview Of Agenda Items





Virginia Retirement System

Public Equity

Dan Whitlock
Program Director



Agenda: Public Equity Annual Review Topics



- Overview
- Markets
- Exposures
- Results
- Mandates
- Looking Forward

Overview: Team Members



Professional	Position	Highest Degree	Professional Certifications	Investment Experience	VRS Tenure
Dan Whitlock	Director	MBA	CFA, CAIA	20	20
Stephen Adelaar	Portfolio Manager	MS	CFA	22	15
Holly Glass	Portfolio Manager	MA	CFA	21	21
Olga Zozulya	Investment Officer	MBA*	CFA	9	9
Korey Turner	Senior Investment Analyst	MS*		2	2
Kelly Baker	Portfolio Assistant	AAS		12	7
Additional Resources	The entire Internal Equity Team, Portfolio Solutions Group, Governance Team, Management Committee, Operations Team, Compliance Team, and Legal/Regulatory Team.				

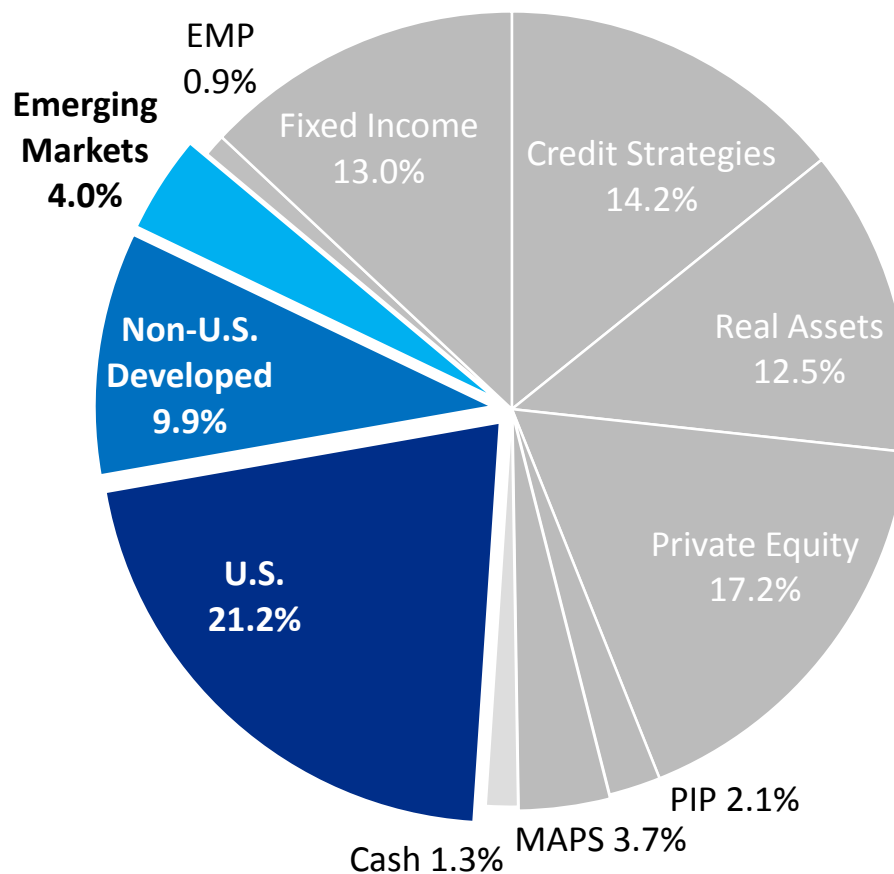
*Coursework completed, but degrees not yet received

Overview: Team & Process



	Stephen Adelaar	Holly Glass	Korey Turner	Olga Zozulya	Dan Whitlock
Strategy Lead	Defined Contribution Emerging Markets Hedge Funds	<i>IEM Group Markets (Ital)</i> Risk Management Transition Management United States	Tilt Monitoring	Global Equity Int'l Developed	Total Public Equity
Analyst	<i>Afton (IEM)</i> Arisaig Global EM Cons Baillie Gifford Global Baillie Gifford EM Kylin LSV Global LSV Non-U.S. Small Cap LSV U.S. SC <i>Matoaka (IEM)</i> Select – SEG Select – Cooper Square	Acadian EM Acadian Small Cap Advent Convertibles Arrowstreet Global Cevian Eminence Hedge fund Overlay <i>Mobjack (IEM)</i> <i>Piedmont (IEM)</i> Taiyo	Coatue <i>Potomac (IEM)</i> Ariel Global J.P. Morgan LS	<i>Internal EM (IEM)</i> Jackson Square Lansdowne Global Maverick Nitorum Thelme	Farallon Farallon Healthcare ValueAct Capital Nordea EM Nordea Global

Overview: Asset Allocation as of 12/31/21



U.S. Equity	21.2%
Non-U.S. Developed	9.9%
Emerging Market	4.0%
Total Public Equity	35.0%

Overview: Philosophy



- **Primary Objective**
Gain exposure to global economic growth & the global equity risk premium
- **Specific Return Objective**
Outperform the strategic benchmark over three to five years
- **Approach**
Risk-adjusted, using both equity hedge funds & low-volatility equity mandates
- **Strategic Benchmark**
MSCI All-Country World Index Investible Markets Index (MSCI ACWI IMI)

Overview: Manager Evaluation Framework



Sustainable Risk-Adjusted Returns

- Long history, repeatable process, consistent philosophy
- Sustainable team and firm
- Outperformed in a consistently diversified manner
- Outperformed when considering risk profile
- Sizeable allocations will not impact performance

Doing Things Differently

- Low correlations to existing book (quantitative & qualitative)
- Something VRS cannot produce internally
- Something one of VRS' existing external managers cannot provide
- Employ a different way of thinking or different strategies

Terms & Back Office

- Favorable fees, liquidity, etc.
- Robust back office
- Partnership mentality
- Resources to manage sizeable allocations

Markets: 1 Year Ending 12/31/21



MSCI Standard Indices
1-yr return ending 12/31/2021

	Global	Developed	Dev ex US	US	EMEA	Pacific	Emerging	EM ASIA	EM LatAm	EM EMEA
All Sectors	18.5%	21.8%	12.6%	26.5%	16.3%	2.6%	-2.5%	-5.1%	-8.1%	18.0%
Energy	36.0%	40.1%	28.8%	51.0%	25.7%	7.8%	21.0%	15.9%	7.8%	32.6%
Information Technology	27.4%	29.9%	20.9%	31.3%	24.6%	9.1%	9.9%	9.8%	7.8%	n/a
Financials	24.4%	27.9%	20.1%	35.0%	20.3%	7.7%	8.2%	5.5%	-22.9%	30.1%
Real Estate	22.8%	28.7%	4.9%	42.1%	1.7%	-5.3%	-21.8%	-27.1%	-11.1%	22.6%
Health Care	17.5%	19.8%	8.5%	24.8%	16.3%	-15.8%	-19.8%	-20.7%	-30.5%	37.1%
Industrials	16.1%	16.6%	13.5%	19.4%	19.8%	4.8%	8.4%	10.7%	-10.5%	17.0%
Materials	14.8%	16.3%	10.1%	26.5%	16.3%	-0.4%	9.3%	10.9%	0.0%	13.7%
Consumer Staples	11.1%	13.1%	8.0%	17.2%	12.0%	-10.5%	-4.9%	-7.8%	6.1%	-3.1%
Communication Services	10.5%	14.4%	-4.3%	18.7%	5.1%	-15.5%	-9.1%	-14.2%	32.3%	15.9%
Utilities	10.1%	9.8%	1.0%	16.3%	0.7%	5.2%	12.4%	19.5%	-17.5%	18.1%
Consumer Discretionary	9.0%	17.9%	10.9%	21.3%	14.2%	-16.8%	-29.1%	-29.0%	-52.3%	-20.9%

Unhedged Total Returns

Sources: MSCI and Bloomberg

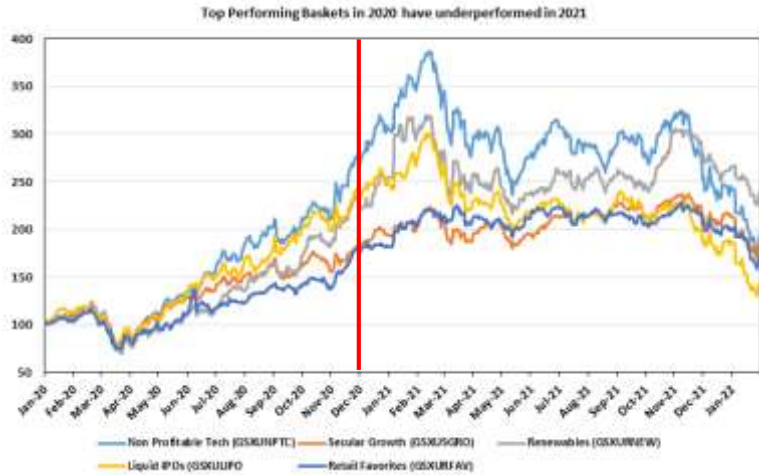
Markets: 5 Years Ending 12/31/21

Percentage Appreciation of Price and Earnings



Source: Bloomberg

Markets: Update from 2020 Graphs; Unusual Times



Source: Goldman Sachs Global Markets Division, as of Feb-2022. Past performance is not indicative of forward returns.

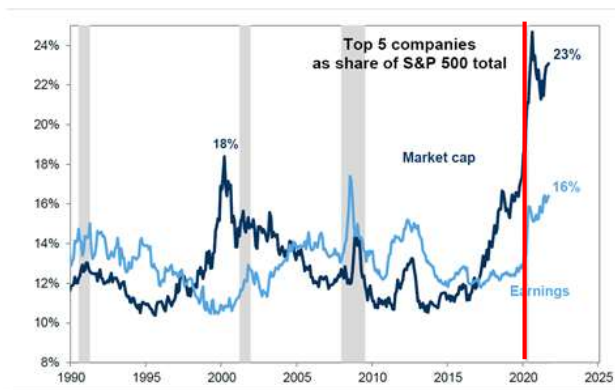
U.S. GROWTH PRICE/SALES



As of 1/31/22 | Sources: GMO, Worldscope, Compustat, MSCI
Note: Valuation ratios calculated using a weighted median

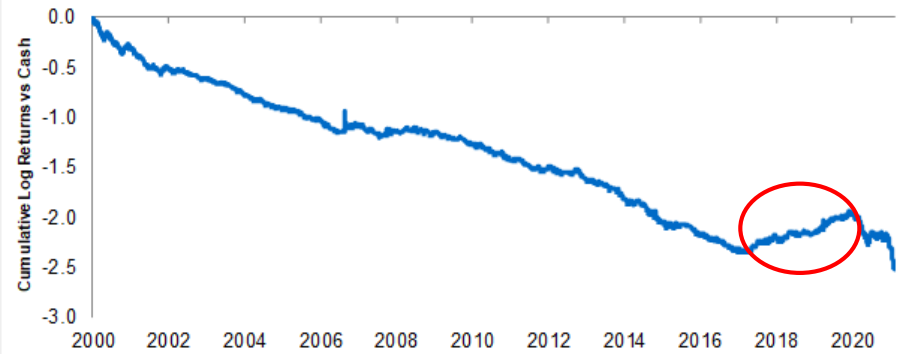
Goldman Sachs Top 5 stocks as a share of S&P 500

Top 5 stocks contribute 23% to S&P 500 market cap and 16% to earnings



Source: FactSet, Goldman Sachs Global Investment Research, as of September 17, 2021. Global Investment Research

Hypothetical Opposite Stock Selection (SSP) Illustration



Source: AQR. For illustrative purposes only. Hypothetical data has inherent limitations, some of which are described in the disclosures. See detailed explanation in the body of this article, and additional disclosures at the end of this article. This hypothetical performance does not reflect the deduction of any management fees, which as mentioned, would further reduce the actual return. It should not be assumed that the inversion of these charts is illustrative of actual portfolio performance.

Exposures: Portfolio Positioning as of 12/31/21

\$37.6 Billion
35.0% of Plan Assets

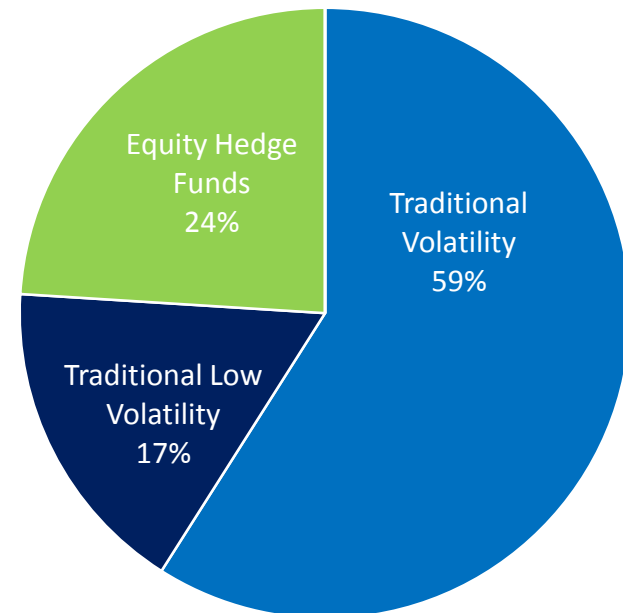
57% Traditional Domestic (-2.8% vs. bmk)
31% Traditional Non-US Developed (+2.3% vs. bmk)
12% Traditional Emerging Markets (+0.5% vs. bmk)

100% Active
0% Passive

39% Internal
61% External

59% Traditional Volatility
17% Traditional Low Volatility
24% Equity Hedge Funds

0.96 Beta
1.40% Forecasted Active Risk (Barra)



27 External Mandates (14 Traditional & 13 HFs)
21 External Managers (9 Traditional & 12 HFs)

Exposures: Portfolio Characteristics as of 12/31/21



Portfolio Characteristics	Program	Benchmark	
Dividend Yield	2.4%	2.2%	●
Price to Book	2.4	2.4	●
Price to Earnings (F12)	15.6	18.1	●
Price to Earnings (T12)	20.0	22.5	●
Return on Equity	14.3%	13.5%	●
Debt to Assets	21.3%	23.0%	●
Sales Growth	19.8%	14.9%	●
Cash Flow Growth	25.6%	13.1%	●
Profit Margin	7.7%	9.4%	●

Great Value, Better Quality, and Attractive Growth Profiles

Results: As of 12/31/21



	10 Year	5 Year	3 Year	1 Year
Total Public Equity	11.85	12.89	18.53	19.27
Strategic Benchmark	12.01	13.97	19.91	18.65
Excess Return	-0.16	-1.07	-1.38	0.62
Beta vs. Strategic Benchmark*	0.97	0.97	0.96	
Beta vs. Respective Beta 1 Market Cap Benchmarks*	0.92	0.94	0.94	
Active Risk vs. Strategic Benchmark**	1.19	1.48	1.85	
Information Ratio vs. Strategic Benchmark***	-0.14	-0.73	-0.73	

*Measure of volatility, or systematic risk, of a portfolio in comparison to a benchmark

**Otherwise known as tracking error, this is the standard deviation of returns relative to a benchmark

*** $(\text{Portfolio Returns} - \text{Benchmark Returns}) / \text{Active Risk}$

VRS Public Equity has outperformed in seven of the last ten calendar years, underperforming in only 2018 - 2020

Please see endnotes in appendix

Results: As of 12/31/21



	10 Year	5 Year	3 Year	1 Year	MV (\$M)
Total Public Equity	11.85	12.89	18.53	19.27	37,568
Strategic Benchmark ¹	12.01	13.97	19.91	18.65	
Excess Return	-0.16	-1.07	-1.38	0.62	
U.S. Program	15.50	17.14	24.31	26.83	12,097
U.S. Benchmark ²	16.14	17.94	25.89	25.84	
Excess Return	-0.64	-0.81	-1.58	0.98	
Non-U.S. Developed Program	9.98	8.78	12.40	14.38	5,252
Non-U.S. Developed Benchmark ³	10.01	10.51	15.38	12.85	
Excess Return	-0.03	-1.73	-2.98	1.54	
Emerging Market Program	5.50	8.59	10.21	4.52	1,997
Emerging Market Benchmark ⁴	5.75	10.12	11.63	-0.24	
Excess Return	-0.26	-1.54	-1.42	4.76	
Global Program	13.25	14.09	19.45	21.14	9,190
Global Benchmark ⁵	12.92	14.97	21.08	18.97	
Excess Return	0.33	-0.88	-1.63	2.16	
Equity Hedge Fund Program	9.44	10.25	16.93	14.70	9,032
Equity Hedge Fund Program Benchmark ⁶	8.23	11.02	15.96	18.65	
Excess Return	1.21	-0.78	0.97	-3.95	

Please see endnotes in appendix

IAC Meeting – April 13, 2022

Results: As of 12/31/21

	1 Year
Total Public Equity	19.27
Strategic Benchmark ¹	18.65
Excess Return	0.62

Largest One Year Absolute Return Contributors:

Positive: U.S. program was up 26.8% with a 27% weight

Negative: Non-U.S. Program was up 11.4% with a 19% weight

Largest One Year Relative Return Contributors:

Positive: Value exposure and Quantitatively implemented managers

Negative: Growth exposure, Low Volatility Managers, HF Managers, and Qualitatively implemented managers

Please see endnotes in appendix

Results: CY 2021 Attribution Deeper Dive



2021 Performance Factor Attribution

Note: Attribution an estimate and does not contain fees, intra-month trading, t-costs, etc.; some categories that are not material were left off.

Factor Impact Summary:

- An overweight to U.S. Value and Quality were the largest contributors to Style.
- A smaller U.S. Size was the largest detractor to Style.
- The low beta approach was a headwind in strong markets.
- Stock Selection was positive, particularly within the U.S. and China.

Attribution	Value (%)
Portfolio Base Return	19.5
Benchmark Base Return	18.7
Excess Return	+0.8
Currency	-0.2
Market Timing	-0.7
Country Allocation	-0.2
Selection	+1.8
Industry	+0.5
Style	+1.0
Stock Specific Return	+0.3

Results: 2022 Update: Continued Outperformance



2021/2022 Performance Factor Attribution*

Factor Impact Summary:

- Lower beta that was a headwind in 2021 helped protect capital in the drawdown in 2022.
- U.S. Value continued to contribute.
- Stock Selection outperformance was widespread while some energy underweights detracted.

Attribution	2021	2022 (through Feb)
Portfolio Base Return	19.5	-6.5
Benchmark Base Return	18.7	-7.3
Excess Return	+0.8	+0.8
Currency	-0.2	+0.1
Market Timing	-0.7	+0.4
Country Allocation	-0.2	-0.1
Selection	+1.8	+0.5
Industry	+0.5	+0.1
Style	+1.0	+0.7
Stock Specific Return	+0.3	-0.3

*Attribution is an estimate and does not contain fees, intra-month trading, t-costs, etc.; some categories that are not material were left off.

Managers: Top 5



Name	Mandates	# of Mandates	% of Program
VRS Internal Equity	U.S., Non-U.S., Emerging	6	39%
LSV	Global, Non-U.S. Small, U.S. Small	3	8%
Arrowstreet	Global	1	8%
Nordea	Global, Emerging	2	6%
Baillie Gifford	Global, Emerging	2	5%
Total			65%

Managers: Hires & Terminations – 1 Year



Action	Effective Date	Commitment/ Current Value	Funding/ Defunding Period	Description
Hired	1/4/2021	\$400 Million	2 Years	Coatue A long/short equity hedge fund
Hired	7/1/2021	\$250 Million	< 1 Year	Farallon Healthcare Partners, L.P. A long/short equity fund

Managers: Diverse Investment Management Engagement (DIME)



Women & Minority Owned Management Firms Currently In The Lineup

- Ariel managing VRS assets since 2014
African-American, Asian-American & women-owned global equity manager
- Kylin managing VRS assets since 2014
Asian-American owned hedge fund
- Advent managing VRS assets since 2011, Public Equity assets since 2020
African-American owned convertible manager

Continue To Meet With New Prospects & Consider New Investments

- 97 meetings with minority managers or consultants in last 5 years
- 209 meetings since we started tracking this in late 2009

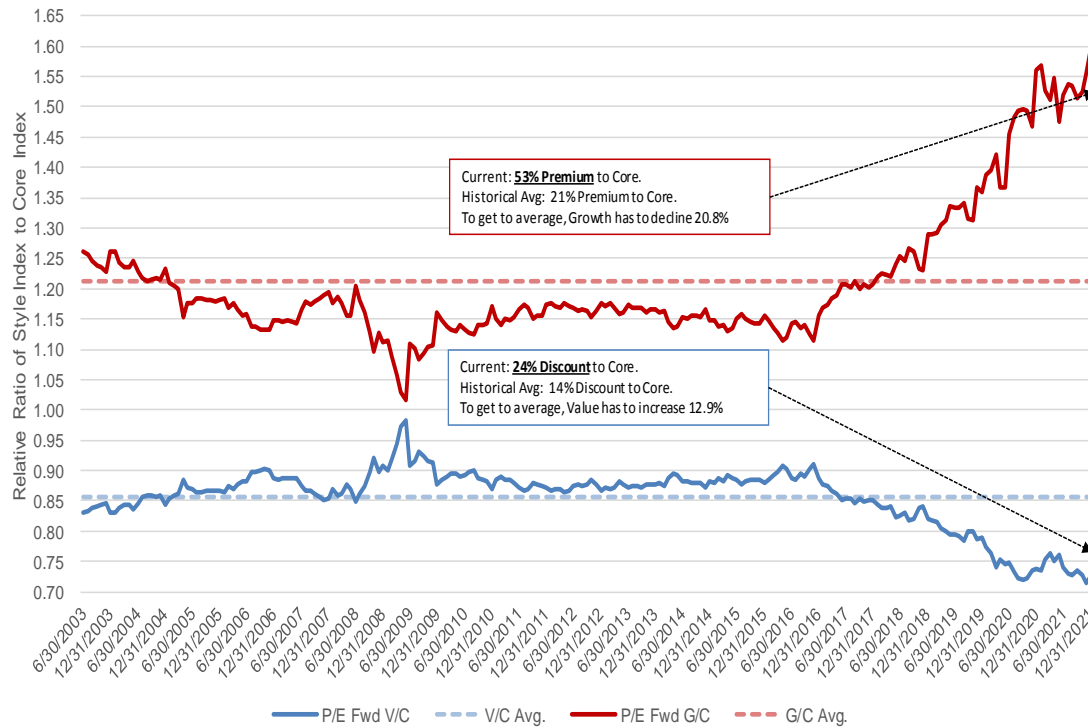
Looking Forward: Remain Opportunistic



- Opportunistic Manager Selection
- Monitor Tilt Opportunities
- Continue To Work Closely With Internal Equity & Portfolio Solutions Group
- Continue Women & Minority Manager Outreach

Discussion Topic: Opportunity Still In Value

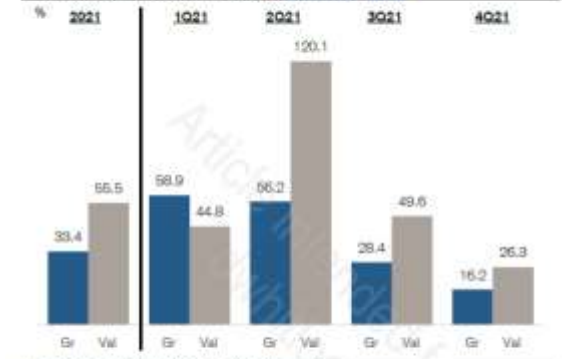
Forward PE Ratio for MSCI World Value and Growth Index Relative to MSCI World Core (Jan-2022)



Source: LSV Asset Management

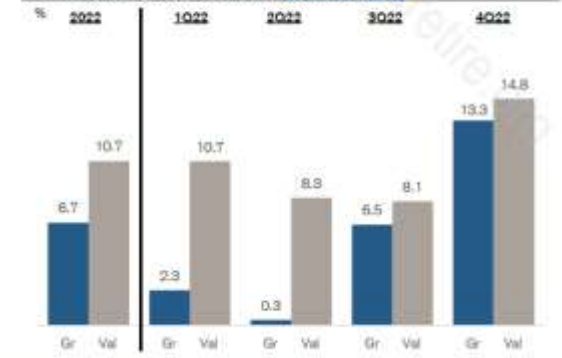
2021 vs. 2022

Figure 22: 2021 Consensus EPS Growth: GROWTH vs. VALUE



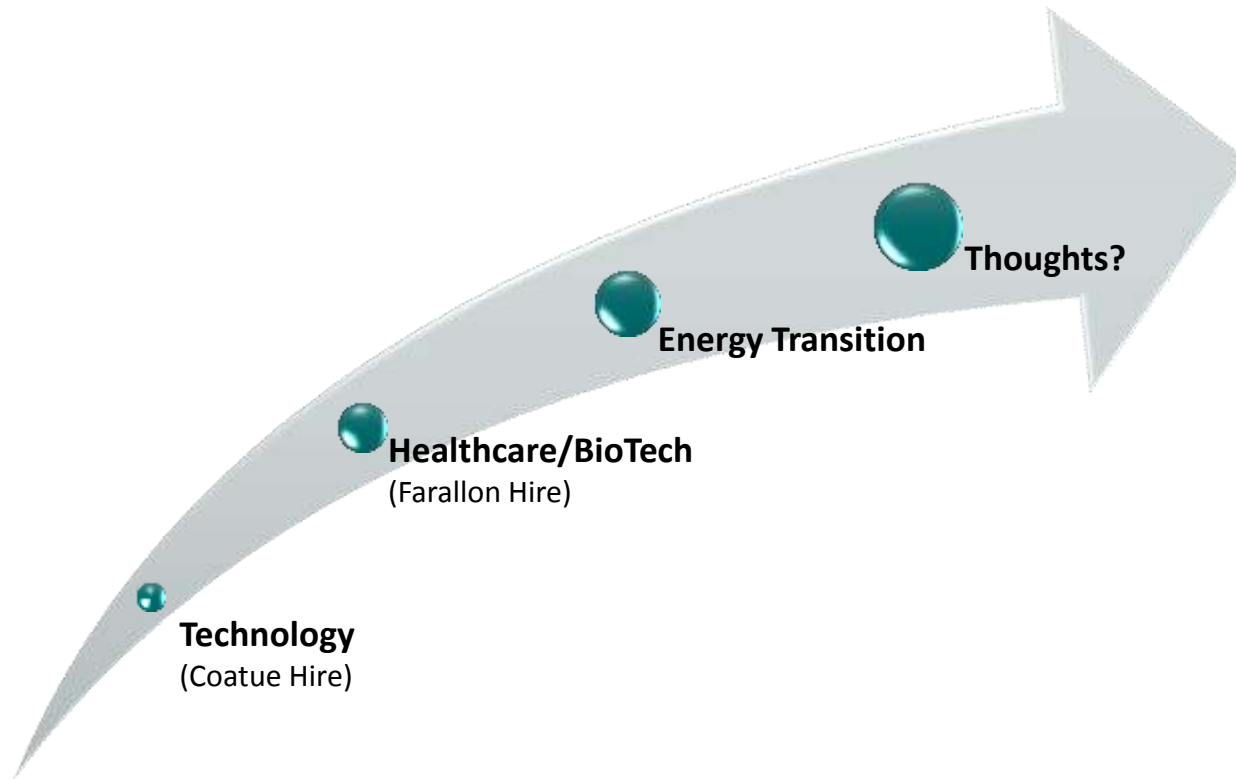
Note: Growth rates for S&P 500 Growth and Value benchmarks
Source: Standard & Poor's, Refinitiv, FactSet, Credit Suisse

Figure 23: 2022 Consensus EPS Growth: GROWTH vs. VALUE



Note: Growth rates for S&P 500 Growth and Value benchmarks
Source: Standard & Poor's, Refinitiv, FactSet and Credit Suisse

Discussion Topic: Active Management in Areas of Secular Growth



Appendix

Due Diligence: Constant Re-Underwriting

Existing Portfolio

- **Qualitative:** long-term relationships, frequent communication, monitor organizations & personnel
- **Quantitative:** monitor exposures & performance & risk, risk budget drives allocation, identify new strategic & tactical tilts

Assess Opportunity

- **Qualitative:** identify attractive investments, identify talented managers, utilize network of contacts
- **Quantitative:** multiple data sources/screen universe, identify potential manager, evaluate performance & risk of prospects

Manager Due Diligence

- **Qualitative:** face to face manager meetings, review firm strategy & process, detailed portfolio reviews, reference checks
- **Quantitative:** due diligence of existing managers, attribution, verify performance, assess risk

Portfolio Construction & Risk Management

- **Qualitative:** bottom-up portfolio construction, look for organizational “cracks” & process changes
- **Quantitative:** review targeted policy allocation & portfolio tilts, determine benchmark & manager allocations, perform risk analysis, monitor exposures



¹Effective February 2020, this is the MSCI ACWI IMI (net VRS tax rates) index; prior periods included several other representative benchmarks.

²Effective March 2017, this is a weighted average of MSCI U.S. Standard and MSCI U.S. Small Cap indices; prior periods are other representative benchmarks

³Effective February 2020, this is a weighted average of MSCI World ex U.S. Standard (net VRS tax rates) and MSCI World ex U.S. Small Cap (net of VRS tax rates) indices; prior periods are other representative benchmarks

⁴Effective April 2009, this is the MSCI Emerging IMI (net of VRS tax rates); prior periods are other representative benchmarks

⁵Effective February 2020, this is the MSCI ACWI Standard (net of VRS tax rates) index; prior periods are other representative benchmarks

⁶Effective February 2020, this is the MSCI ACWI IMI (net of VRS tax rates) index; prior periods are other representative benchmarks



Virginia
Retirement
System

Internal Equity Management (IEM)

Dan Schlussler
Program Director



Agenda: IEM Annual Review Topics



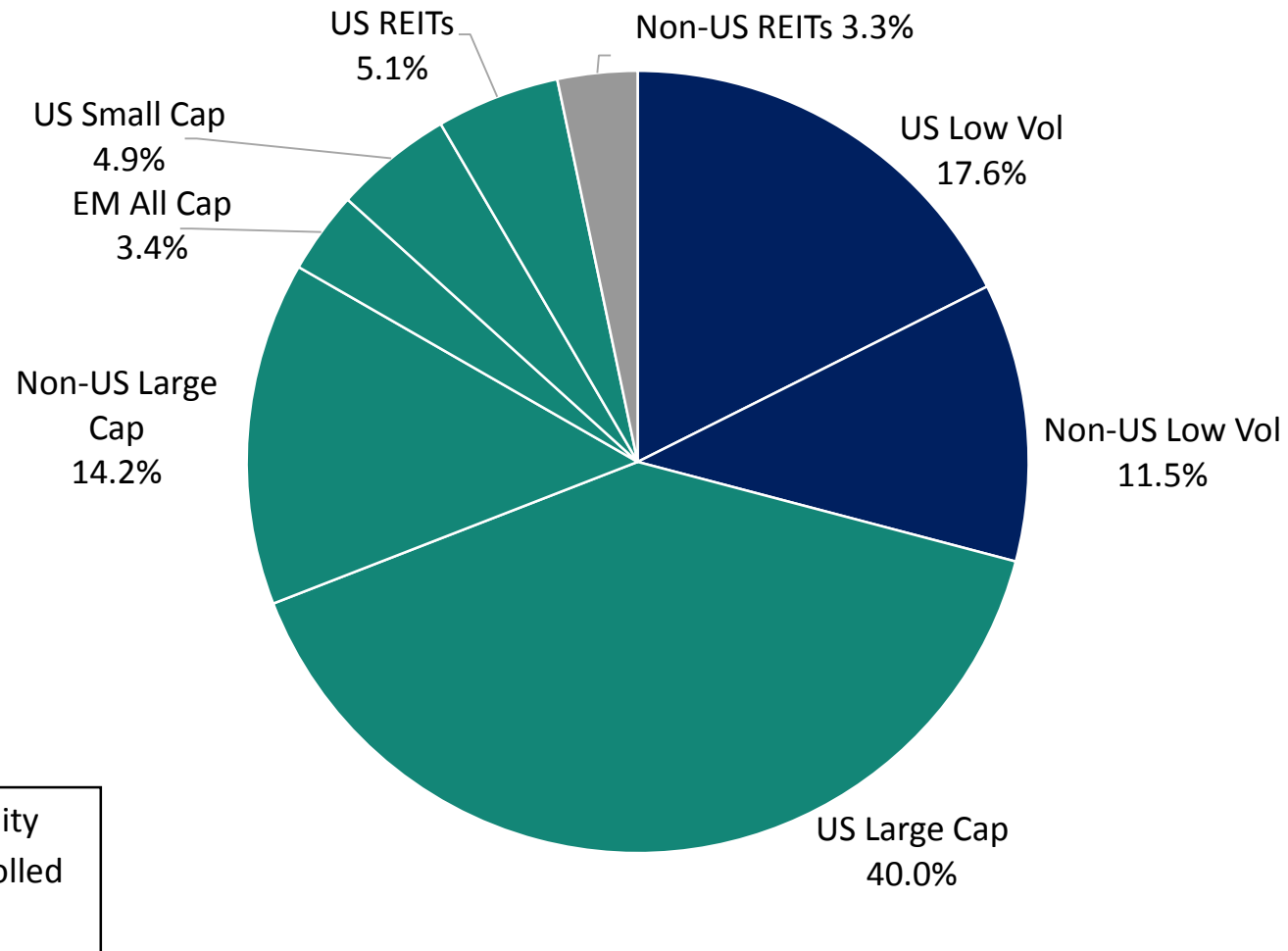
- Overview
- Markets
- Exposures
- Results
- Looking Forward

Overview: Team Members



Professional	Position	Area(s) of Focus	Highest Degree	Professional Certifications	Investment Experience	VRS Tenure
Dan Schlussler	Program Director	Non-U.S. Dev Low Vol, Research	MBA	CFA	26	9
Joe Kennebeck	Sr. Investment Officer	Head Trader	BA		29	15
Ryan Carlson	Portfolio Manager	U.S. REIT, Investment Tools	BS	CFA	19	2
Aaron Lazar	Investment Officer	Currency Hedge, Non-U.S. Large Cap, Swaps Trading	MA	Passed CFA Level 1	8	8
Vu Le	Portfolio Manager	U.S. Small Cap, Research, Currency Hedge	PhD	CFA	11	10
Alex Muniz	Sr. Portfolio Manager	U.S. Low Volatility, Research	MA	CFA	21	21
Garret Rhodes	Senior Analyst	Non-U.S. REIT Passive, Currency Hedge	MS	CFA	3	3
Larry Tentor	Portfolio Manager	Non-U.S. Large Cap, Data Infrastructure	PhD	FRM	20	14
Weldon Wirick	Portfolio Manager	Emerging Markets, Trading	MA	CFA	20	16
Matthew Lacy	Director of Portfolio Integration (PSG)	U.S. Large Cap	MA	CFA	23	23
Additional Resources	Investment Operations Department Portfolio Solutions Group Investment Decision Support					

Overview: Asset Allocation



Overview: Philosophy

Provide Cost Effective Access To The Equity Risk Premium



Provide Risk-Controlled Value Added



Provide Insights Into The Capital Markets



Complement The Total Public Equity Program

Philosophy – Risk Controlled Relative Value

- Markets are relatively efficient
- Behavioral biases create exploitable opportunities
- Systematic strategies are effective at capitalizing on these opportunities

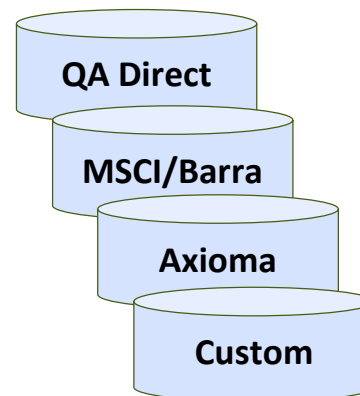


Overview: Research Process

Investment Ideas



Data Collection



Proprietary Research



Overview: Factor Selection & Alpha Score

Valuation
Discounted Cash Flow
Relative Valuations



Quality
Prudent Accounting
Return on Equity



Market Sentiment
Momentum
Analyst Revisions



**Composite
Score**

- DCF models provide robust estimates of intrinsic value
- RV models compare stocks within cohorts using accounting metrics
- Valuation models identify stocks trading at a discount or premium

- Cash based earnings are preferred to accrual-based earnings
- High & stable profitability help to avoid value traps
- Quality captures accounting strength & management efficiency

- Stock price movements show persistence in the intermediate term
- Analyst revisions have a predictable impact on stock prices
- Market sentiment indicates potential investment opportunities

Composite score identifies stocks that are trading at a discount, have superior management & positive market recognition

Overview: Portfolio & Risk Management

Quantitative

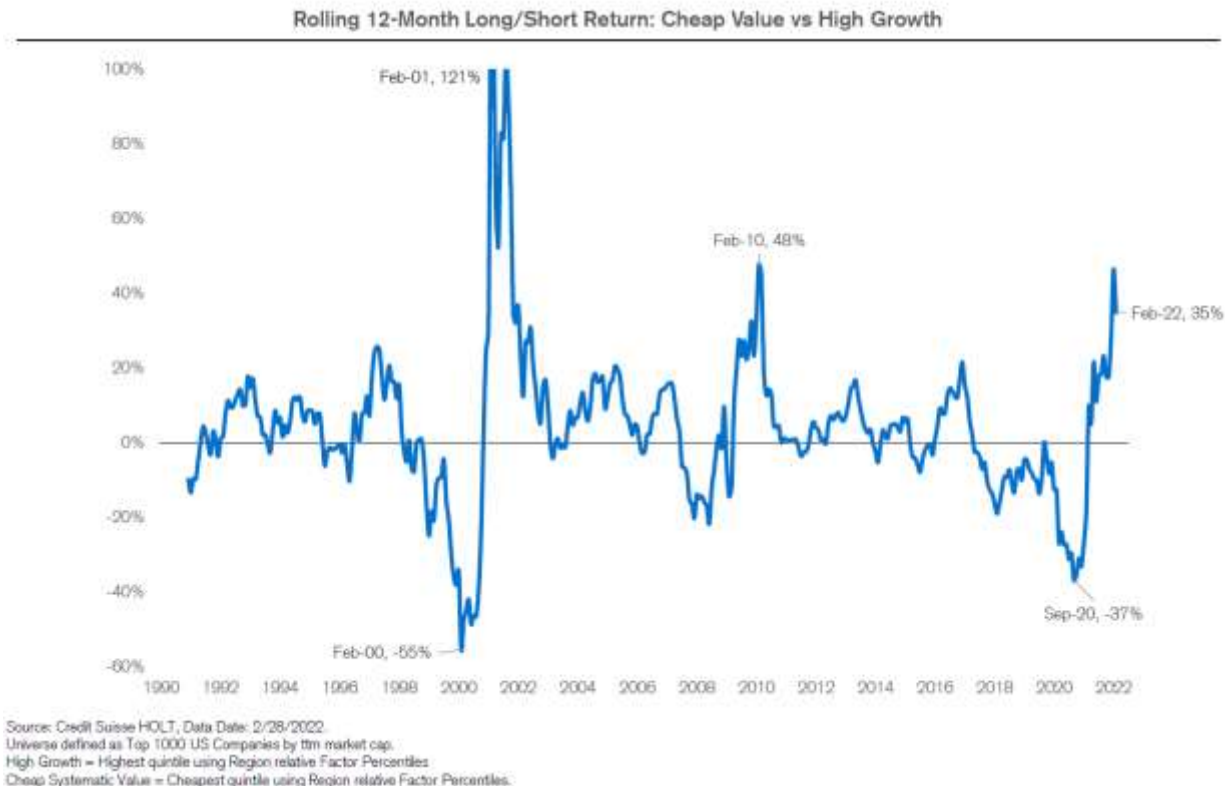
Statistical Risk	<ul style="list-style-type: none">• Fundamental Multifactor Risk Models• PCA Risk Models
Factor Constraints	<ul style="list-style-type: none">• Relative or Total Risk• Return & Risk Factors• Industries, Sectors, Countries, Regions, etc.

Qualitative

Fundamental & Non-Modeled Risks	<ul style="list-style-type: none">• Forensic Accounting, Shorting Activity, etc.• Individual Stock Modeling Tools
Expert Assessment	<ul style="list-style-type: none">• Continuous Monitoring• Thematic Trend Analysis• Proprietary Research

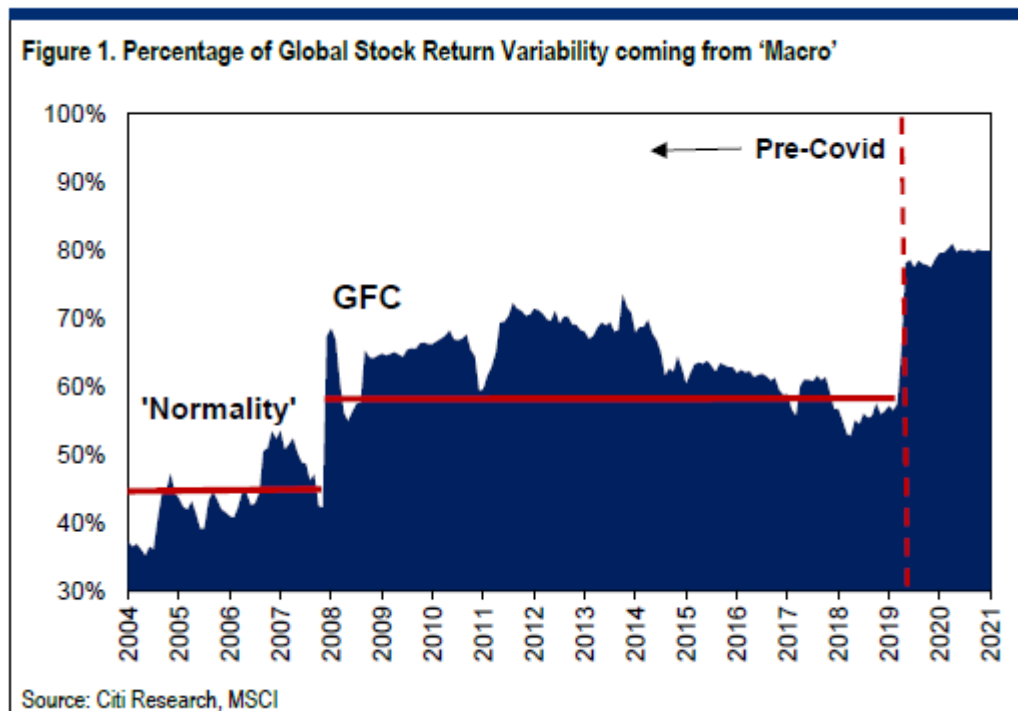
Markets: Big Reversal in Value vs. Growth

- After a painful drawdown Value has recovered relative to High Growth stocks
- One of the strongest rallies since the unwinding of the Tech Bubble



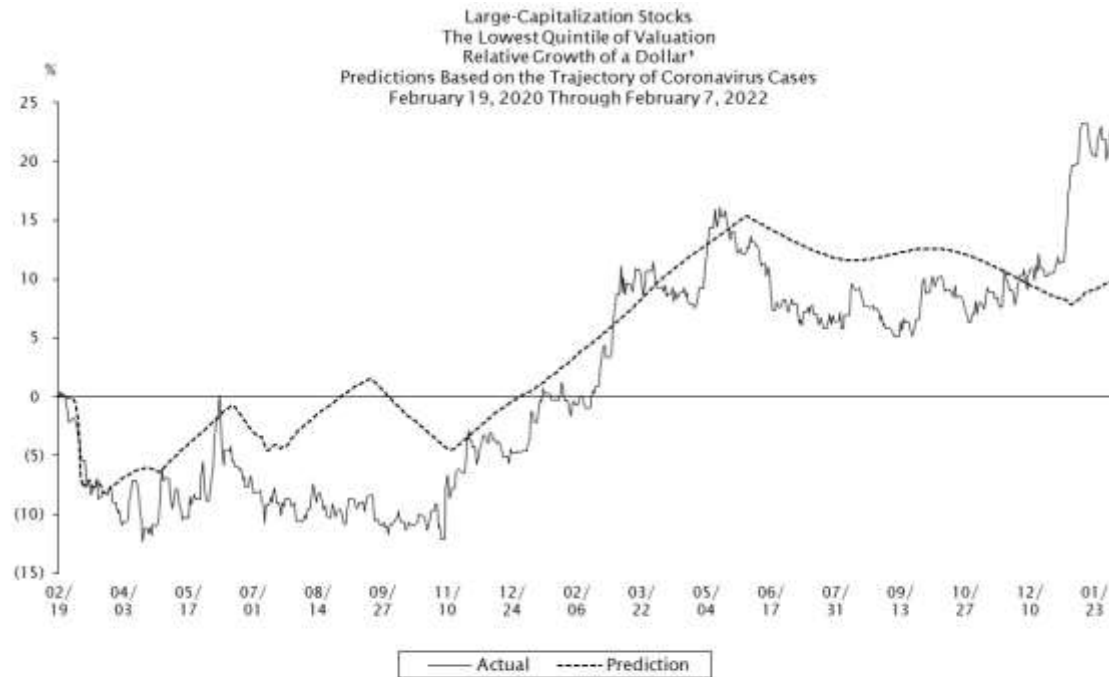
Markets: Macro Factors Continue to Drive Markets

- Post-GFC period has seen macro drivers explain more of equity return variability
- The COVID crisis has resulted in an even greater increase from normal levels and remains elevated



Markets: Value Benefitting from COVID Trends...

- COVID trends have been one factor affecting Value stock performance
- Improving case counts have given support to the Value trade



Source: Empirical Research Partners Analysis.
*Equally-weighted data.

Markets: ...As Well as the Yield Curve

- Yield curve steepening has also been a positive for Value



Source: Federal Reserve Bank of New York, Empirical Research Partners' Analysis.

Markets: High Growth Stocks Retreat

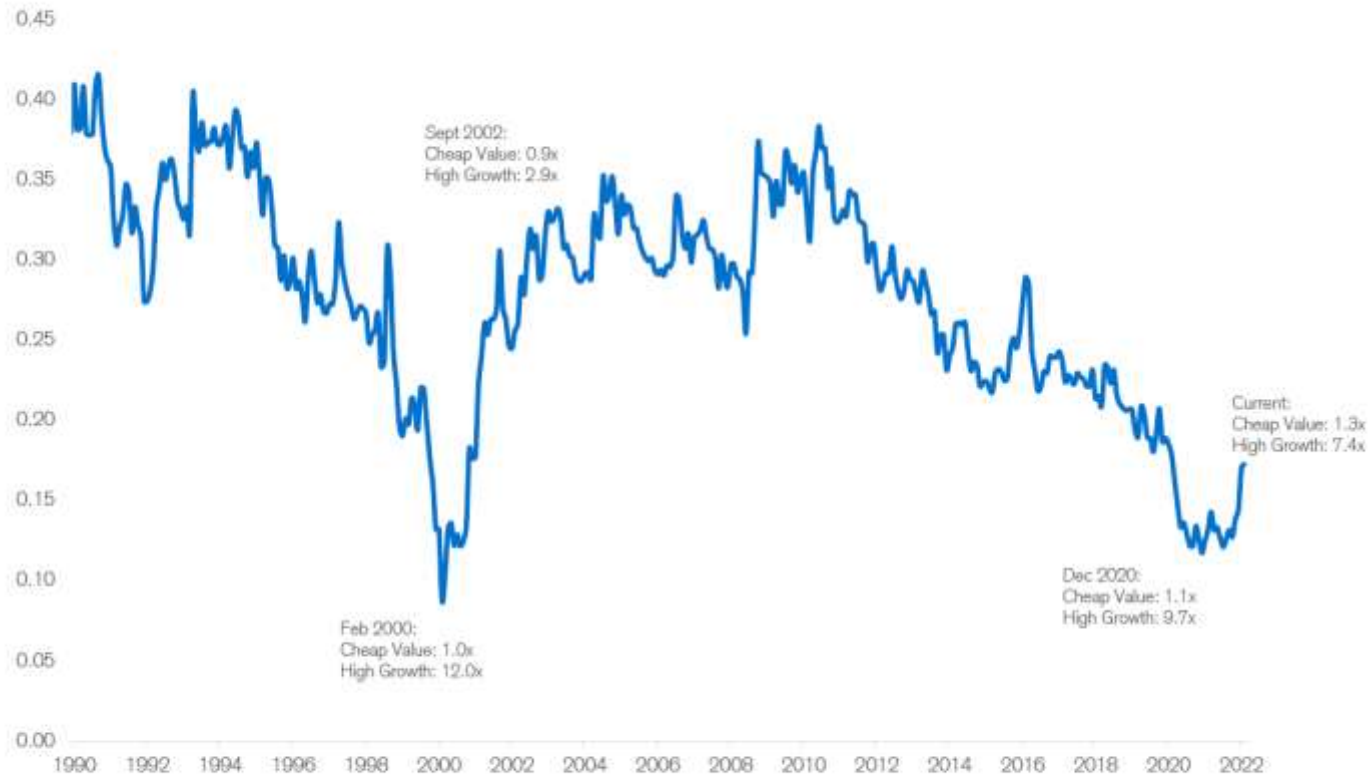
- High Growth stocks were early beneficiaries at the onset of the Pandemic
- Currently they have given up most of their gains



Source: Credit Suisse HOLT, the BLOOMBERG PROFESSIONAL™ service, Data Date: 3/10/2022. Universe defined as largest 1000 companies by ttm market cap. Returns equally weighted.

Markets: Value Still Cheap Relative to High Growth

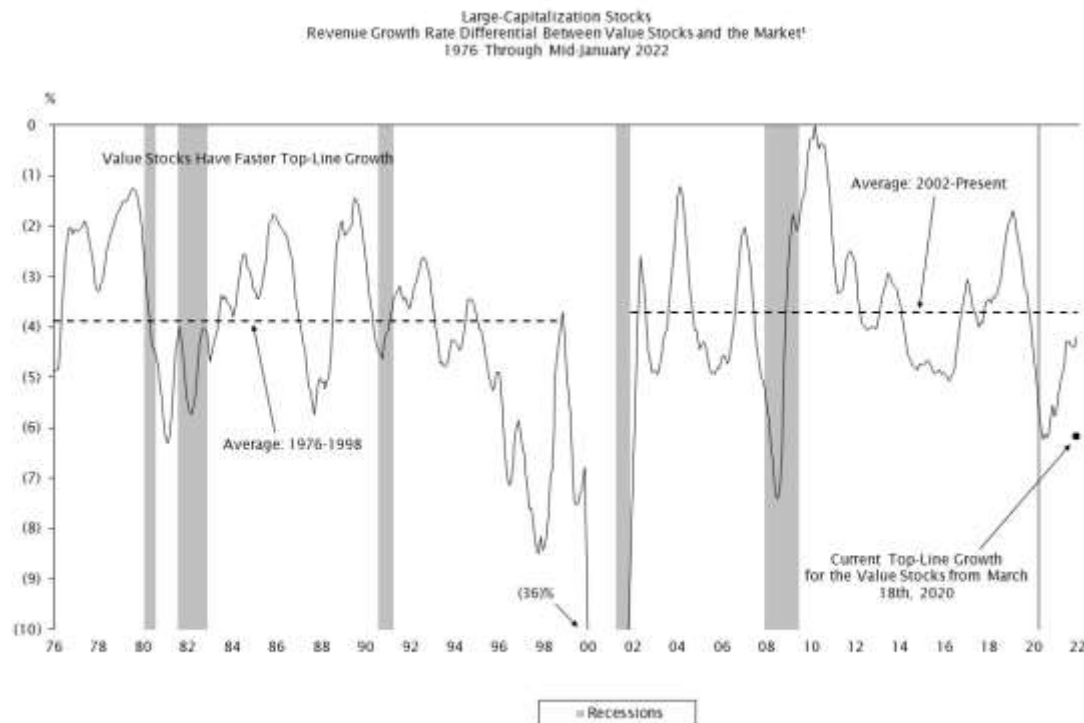
Ratio of Median HOLT Price to Book: Cheap Value vs High Growth



Source: Credit Suisse HOLT, Data Date: 2/28/2022.
 Universe defined as Top 1000 US Companies by ttm market cap.
 High Growth = Highest quintile using Region relative Factor Percentiles. Long-term median HOLT P/B = 3.8x
 Cheap Systematic Value = Cheapest quintile using Region relative Factor Percentiles. Long-term median HOLT P/B = 1.1x

Markets: Fundamentals Behind Value Have Improved

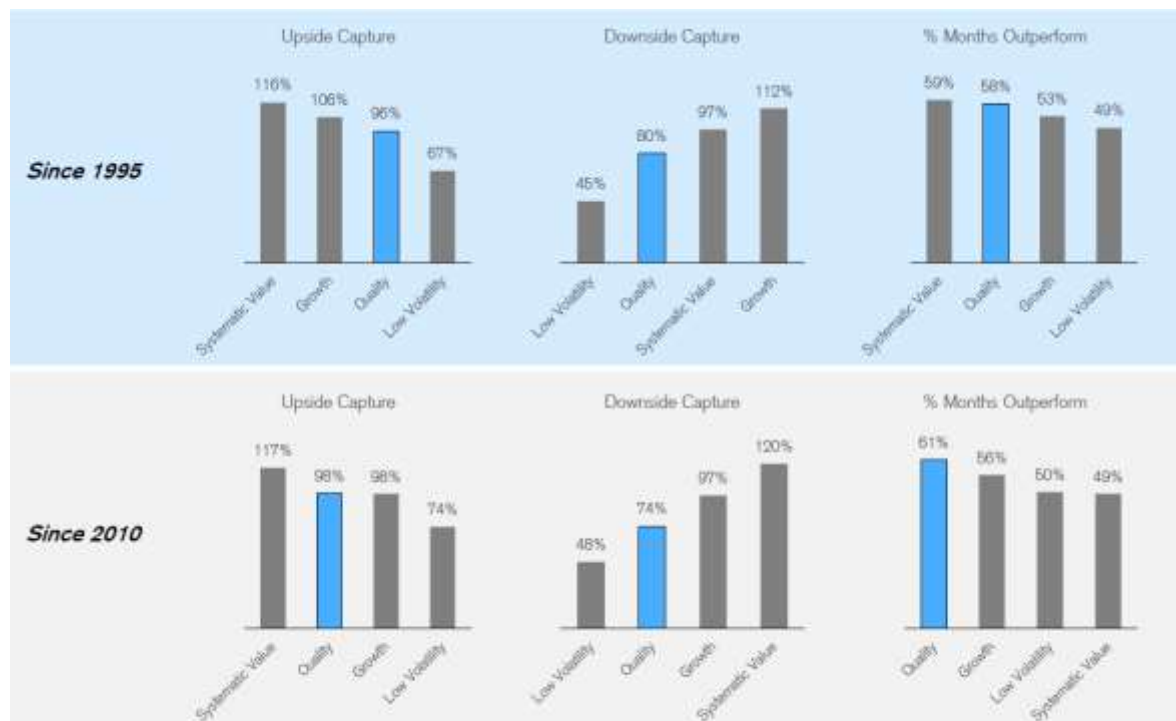
- Revenue growth rate differentials for Value versus Growth stocks have returned to more normal levels
- Other measures of market sentiment have also improved from 2020 lows



Source: Empirical Research Partners Analysis.
¹ Equally-weighted data smoothed on a trailing six-month basis.

Markets: Continued Focus on Value with Quality

- Quality stocks remain attractive in the current market
- Paired with Value, Quality provides the benefit of tilting towards stocks with better upside and downside characteristics and helps avoid the risk of value traps



Source: Credit Suisse HOLT, Data Date: 1/31/2022.
Universe: Top 2000 Global Companies by ttm market cap. Returns equally weighted, rebalanced monthly. Factors defined as Top Quintile using the Regional relative Factor Percentiles.

Exposures: Risk & Positions



Risk Summary*	Strategy	Mkt Val (\$MM)	Weight	Tracking	CF Risk	Specific	Risk Attrib	% of TE
Program	Composite	15,285	100.0	0.98	0.64	0.36	0.98	100.0
Potomac	US Large Cap	6,333	41.4	0.81	0.26	0.74	0.20	21.0
Afton	US Small Cap	772	5.1	1.20	0.51	0.49	0.02	2.4
Monroe	US REIT	802	5.2	0.95	0.07	0.93	0.00	0.4
Mobjack	US Low Vol	2,767	18.1	2.30	0.33	0.67	0.25	26.1
Matoaka	Non-US Dev. Large Cap	2,242	14.7	1.88	0.72	0.28	0.21	21.3
Tuckahoe	Emerging Markets	542	3.5	2.11	0.59	0.41	0.02	2.2
Piedmont	Non-US Dev. Low Vol	1,826	11.9	2.86	0.59	0.41	0.26	26.7

Top 10 Industry Group	Act Wgt
Diversified Financials	1.45
Food, Beverage, Tobacco	1.31
Food & Staples Retailing	0.83
Utilities	0.81
Insurance	0.74
Household & Personal Products	-0.82
Consumer Services	-0.83
Healthcare Equipment/Srvcs.	-1.01
Banks	-1.02
Materials	-1.10

Top 10 Country	Act Wgt
Australia	0.39
Norway	0.34
Sweden	0.27
Israel	0.20
Canada	0.12
Germany	-0.15
France	-0.21
United States	-0.25
Japan	-0.45
Switzerland	-0.54

Sectors	Act Wgt
Consumer Staples	1.32
Financials	1.17
Utilities	0.81
Real Estate	0.66
Communication Services	0.53
Information Technology	-0.78
Healthcare	-0.87
Consumer Discretionary	-0.91
Industrials	-1.09
Materials	-1.10

Factor	Act Wgt
Value	0.17
Profitability	0.12
Dividend Yield	0.09
Earnings Var.	0.07
Momentum	0.07
Size	0.00
Growth	-0.01
Trade Activity	-0.01
Volatility	-0.03
Leverage	-0.08

#Market Value Data as of 12/31/2021. Risk summary data as of 1/17/2022.
Industry Group, Country, Sector, and Factor data as of 12/31/2021.

Results: Program Performance (as of 12/31/21)



	IEM Active				IEM Low Volatility				IEM Enhanced Index			
	1 Yr	3 Yr	5 Yr	Incep	1 Yr	3 Yr	5 Yr	Incep	1 Yr	3 Yr	5 Yr	Incep
Total Active Internal Equity	24.00	19.10	13.51	8.33	19.30	14.90	10.78	12.86	26.01	20.97	14.61	8.03
IEM Benchmark	20.95	20.25	14.43	7.82	17.87	17.12	13.10	11.15	22.29	21.63	14.99	7.80
<i>Excess Returns</i>	3.05	-1.15	-0.92	0.51	1.43	-2.21	-2.32	1.71	3.72	-0.66	-0.38	0.24
<i>Realized Tracking Error</i>	1.22	1.20	1.02	1.04	1.64	1.69	1.58	2.73	1.19	1.13	0.96	0.81
<i>Realized Information Ratio</i>	2.50	-0.96	-0.90	0.49	0.87	-1.31	-1.47	0.62	3.13	-0.58	-0.40	0.29

Results: Strategy Performance (as of 12/31/21)



	Inception Date	Mkt Value (\$MM)	1-Year Return	1-Year Excess	Since Inc. Excess	Since Inc. Tracking
Risk Controlled Strategies		10,692	26.01	3.72	0.24	0.81
U.S. Large Cap (Potomac)	Apr-01	6,333	31.21	4.24	0.32	0.97
Non-U.S. Large Cap (Matoaka)	Sep-10	2,242	15.24	2.14	-0.07	1.17
EM All Cap (Tuckahoe)	Sep-15	542	2.10	2.34	-0.68	1.72
U.S. Small Cap (Afton)	Jun-05	772	27.75	8.19	0.31	1.94
U.S. REITs (Monroe)	Dec-05	802	44.61	1.78	1.13	1.12
Less Constrained (Low Vol) Strategies		4,593	19.30	1.43	1.71	2.73
U.S. Large Cap (Mobjack)	Jun-10	2,767	24.61	1.20	1.67	3.17
Non-U.S. Large (Piedmont)	Dec-12	1,826	12.04	1.72	0.68	2.56
Passive Strategies		519	8.43	-0.33	0.12	0.28
Non-U.S. Developed REIT	Jul-20	518	8.47	-0.28	-0.52	0.26
Other Mandates						
Currency Hedging	Apr-09	2,260	n.a.	n.a.	n.a.	n.a.

Results: Performance Factors



Potomac*: US Enhanced Index

- Potomac had a strong year in 2021, adding over 400 bps over its benchmark.
- Increased value exposure along with a large underweight to high volatility technology stocks contributed to performance.

*Largest strategy by assets

Afton: US Small Cap Enhanced Index

- Afton delivered over 800 bps in outperformance, driven mainly by Value factors but also with our Quality and Sentiment models contributing.
- Good stock selection, particularly in Consumer Discretionary and Technology.

Piedmont: Non-US Low Volatility Strategies

- Quality stocks with good valuation added meaningfully to performance.
- Good stock selection in transportation and capital goods stocks as well as within the insurance industry.

Tuckahoe: Emerging Markets Enhanced Index

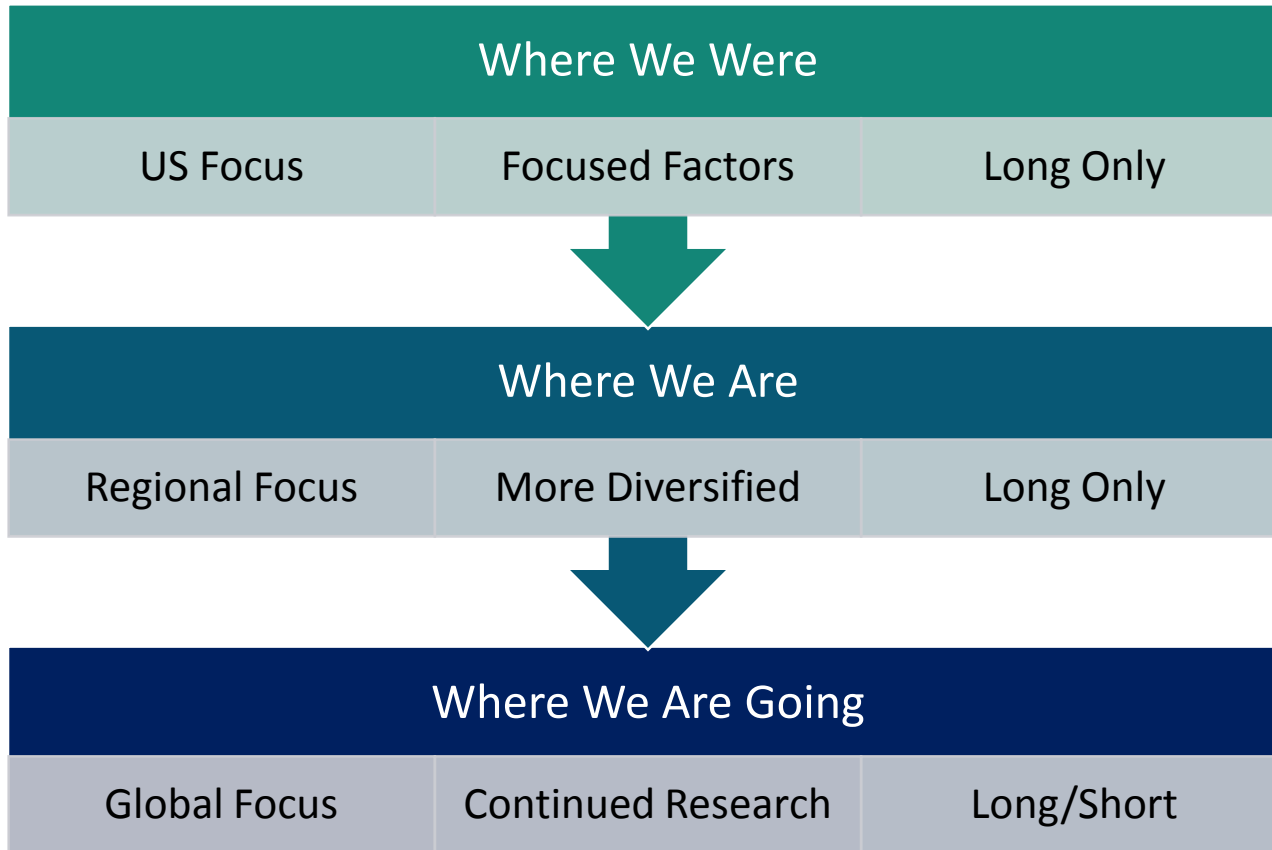
- Strong performance was driven by Value exposure as well as our positioning within the small cap universe.
- Overweights in India Technology and China Energy also contributed.

Looking Forward: Focus on Research, Process and Tools



- We have maintained conviction in our strategies and are delivering strong excess returns after a period of difficult performance
- Continue research focused on enhancing existing return factors in our models as well as looking for new sources of alpha
- Nearing completion of our Global Enhanced Index Strategy. Look to complete Long/Short as well
- Major projects to enhance our research infrastructure and investment tools

Discussion Topic: Where We Are Focused



Fixed Income

Parham Behrooz & Greg Oliff
Co-Directors



Agenda: Fixed Income Annual Review Topics



- Overview
- Markets
- Exposures
- Results
- Mandates
- Looking Forward

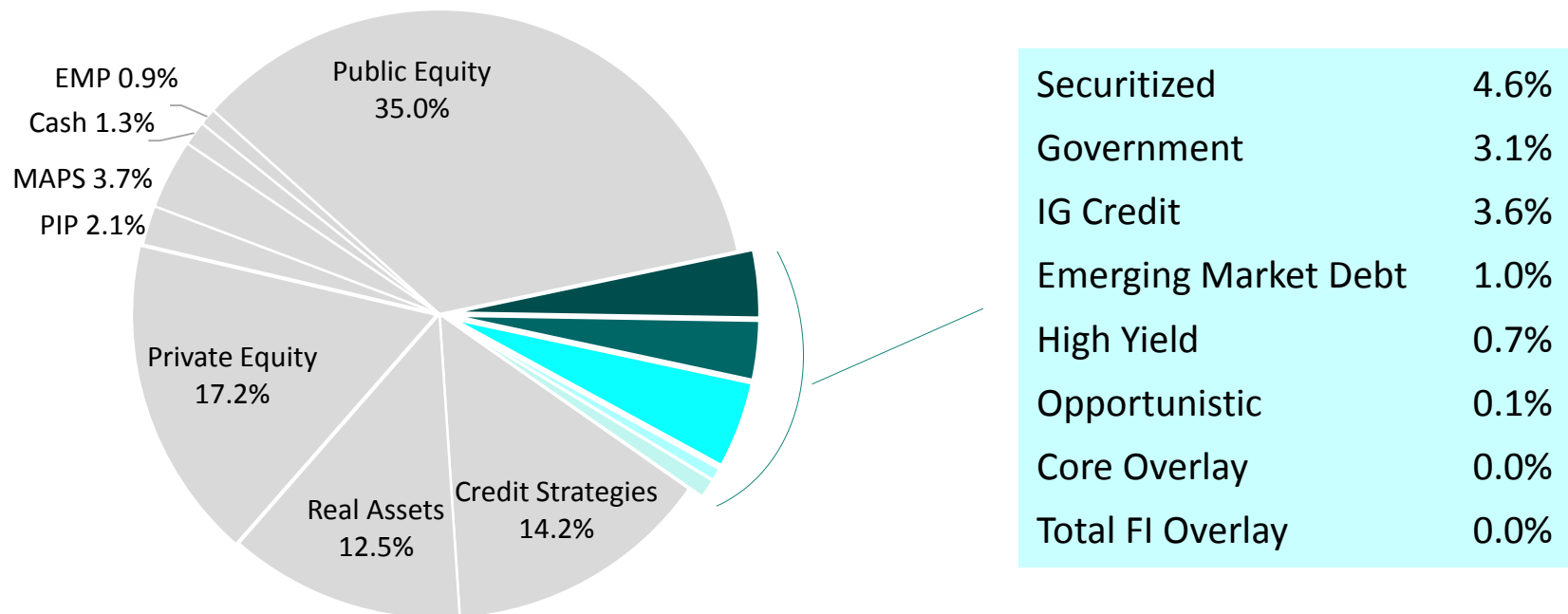
Overview: Team Members



Professional	Position	Highest Degree	Professional Certifications	Investment Experience	VRS Tenure
Parham Behrooz	Co-Director	BS	CFA	25	9
Greg Oliff	Co-Director	MBA	CFA	14	11
Mehtab Haleem	Portfolio Manager	MS		13	1
Teresa Nguyen	Portfolio Manager	BA	CFA	20	5
Michael Desai	Investment Officer	MS		5	1
Kidus Molla	Investment Analyst	BS		<1	<1
Additional Resources	Investment Operations Department & Portfolio Intelligence Team				

Overview: Asset Allocation as of 12/31/21

Total Fixed Income = 13.0%

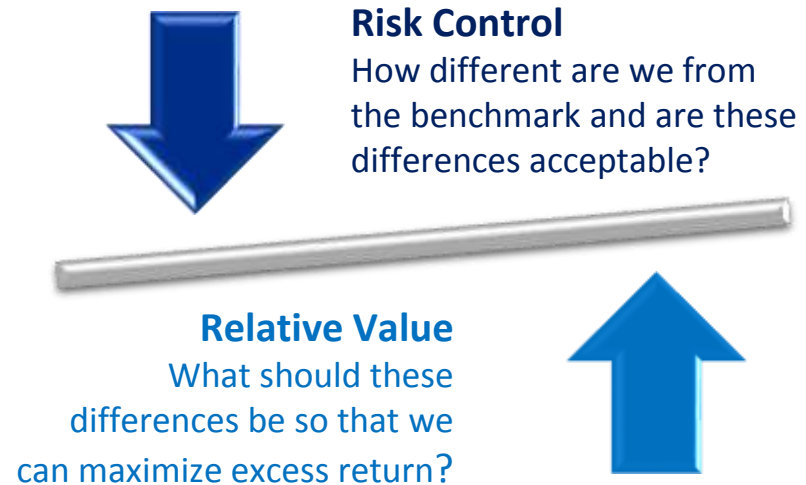


Market values as of 12/31/2021; Source: BNY Mellon data

Overview: Philosophy

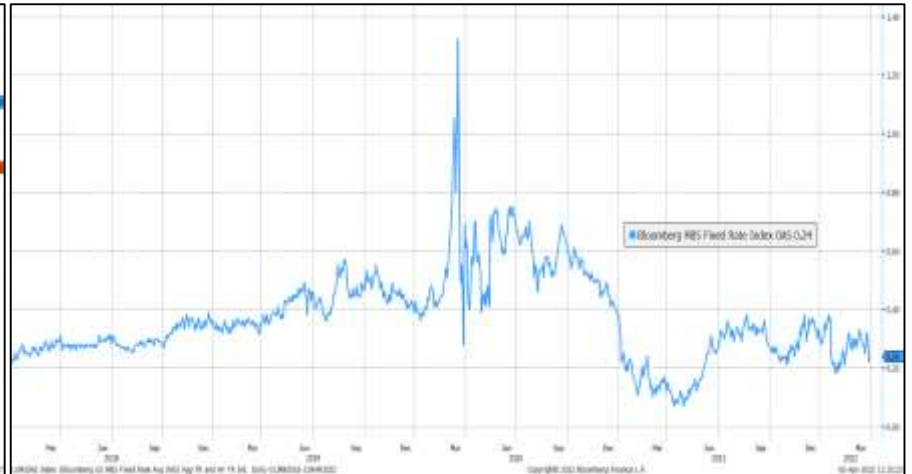
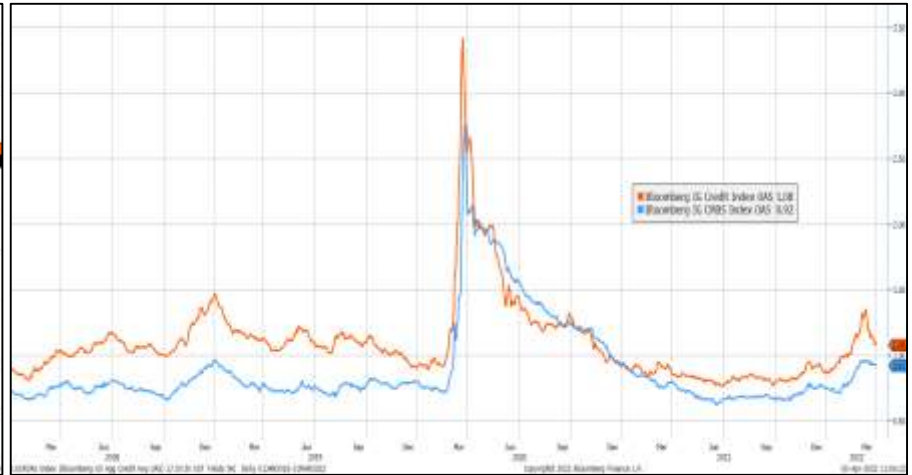
Risk Controlled Relative Value

Market factors provide opportunities to add value through optimal sector allocation and security selection, while managing risk exposures to the benchmark within controlled parameters

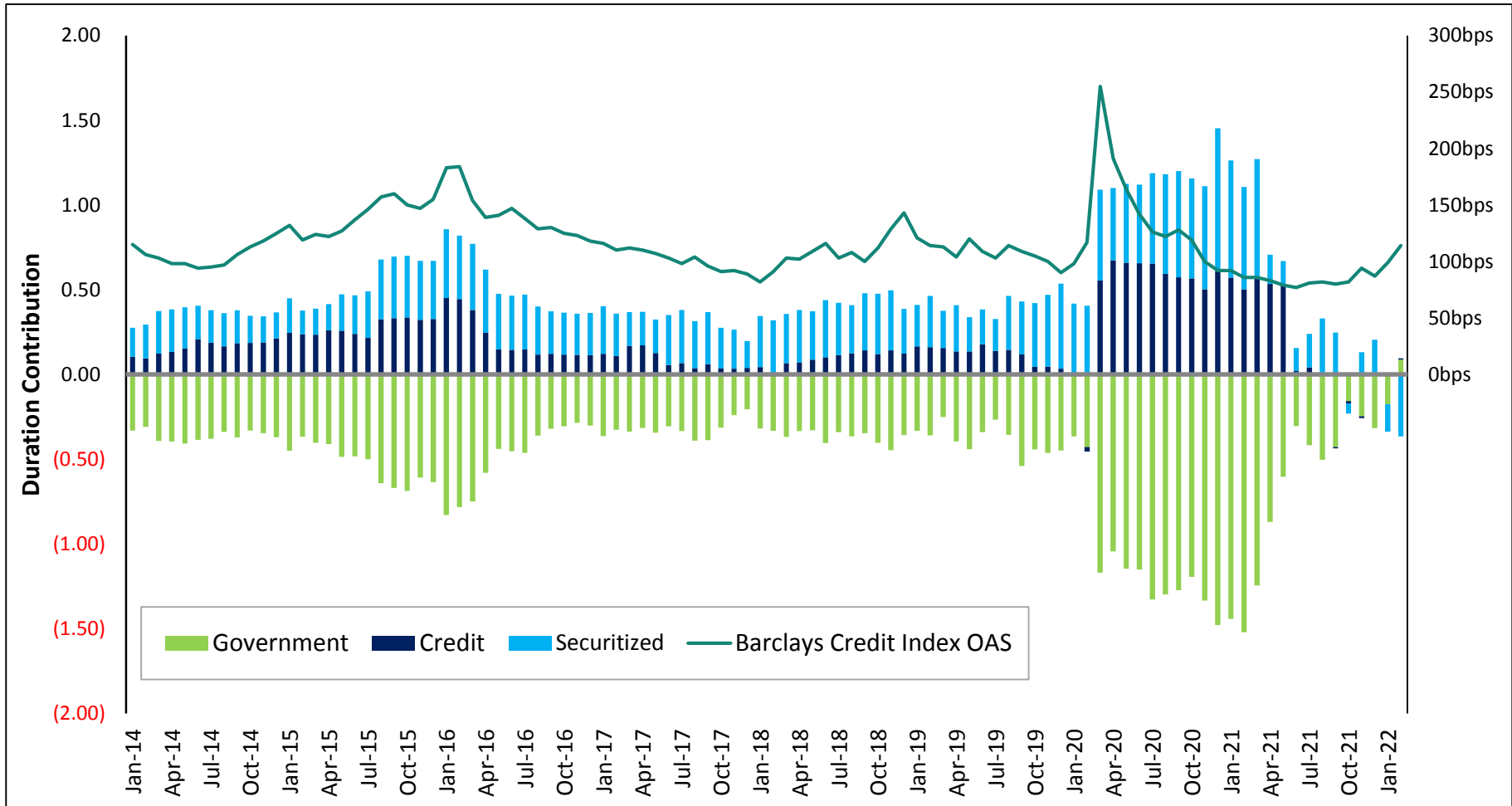


The Fixed Income Program serves as a diversifying asset class, historically providing a hedge against a deflationary economic environment.

Markets: Data: Jan 2018 - Feb 2022

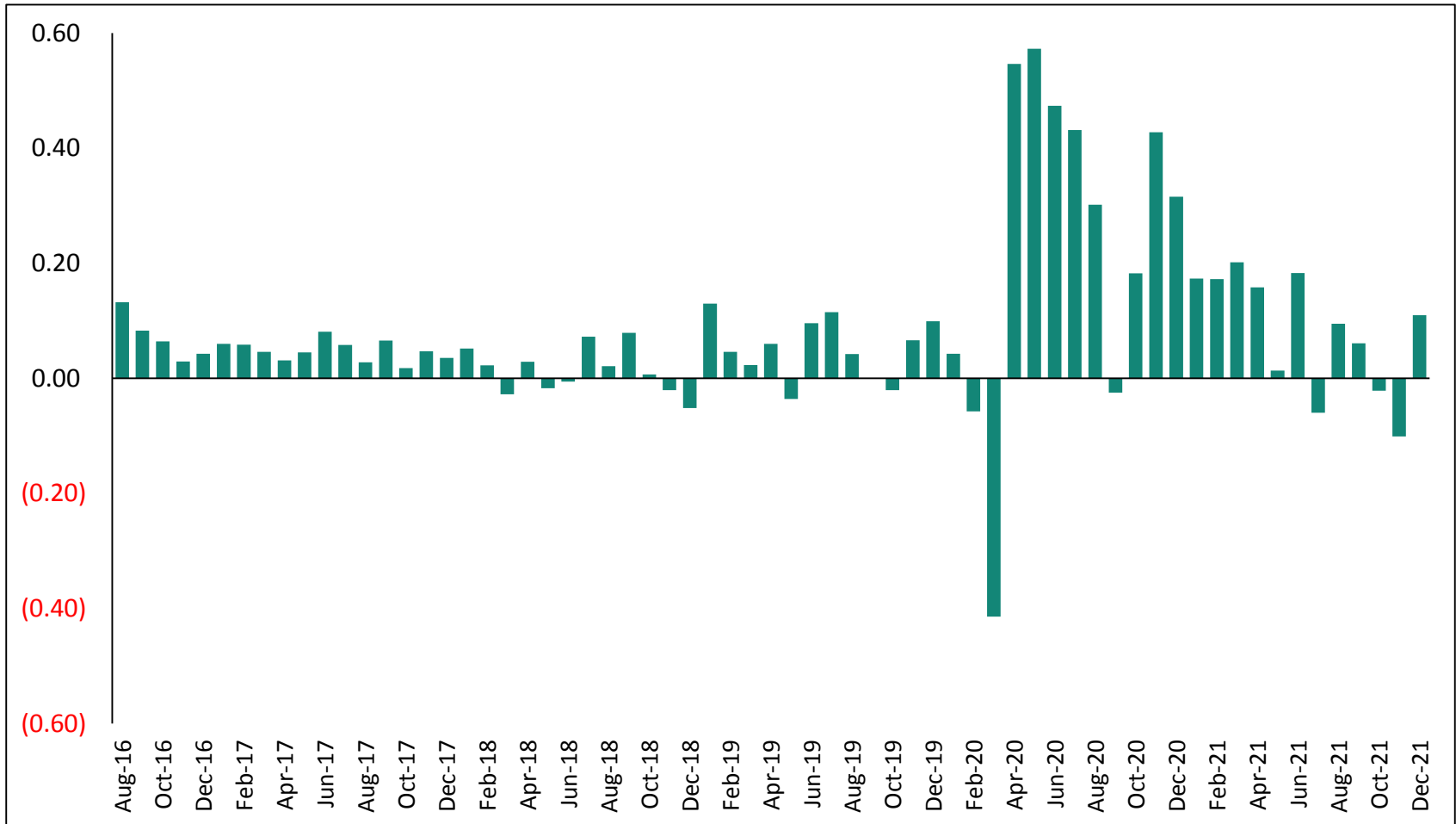


Markets: History of Core Sector Tilts



Source: Aladdin, Bloomberg

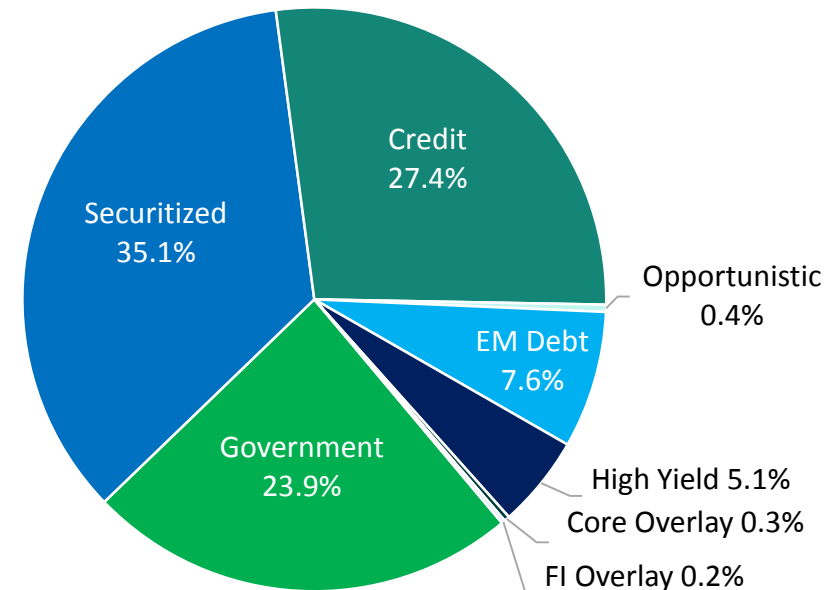
Markets: Program Monthly Excess Returns



Source: BNY Mellon, VRS

Exposures: Fixed Income Snapshot as of 12/31/21

VRS Internal Fixed Income Portfolios		
Strategy	Market Value (\$MM)	Market Value (%)
Government	3,253.2	23.9
Securitized	4,776.4	35.1
Credit	3,730.7	27.4
Opportunistic	50.1	0.4
EM Debt	1,028.4	7.6
High Yield	688.8	5.1
Core Overlay	42.7	0.3
FI Overlay	34.5	0.2
Total	13,604.8	100.0



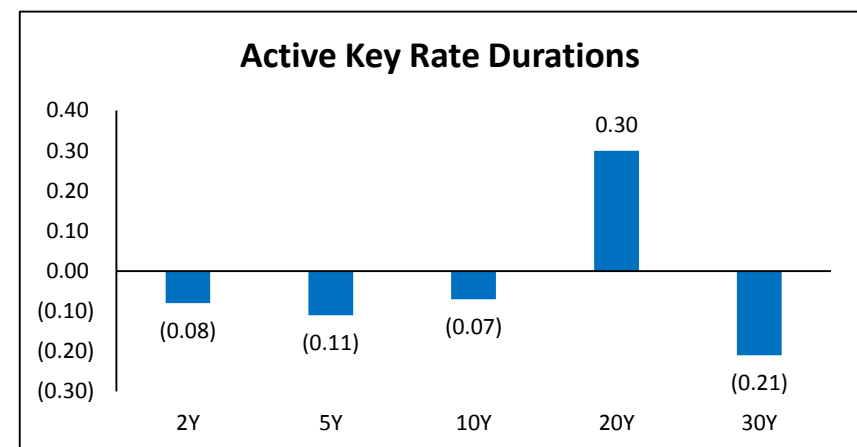
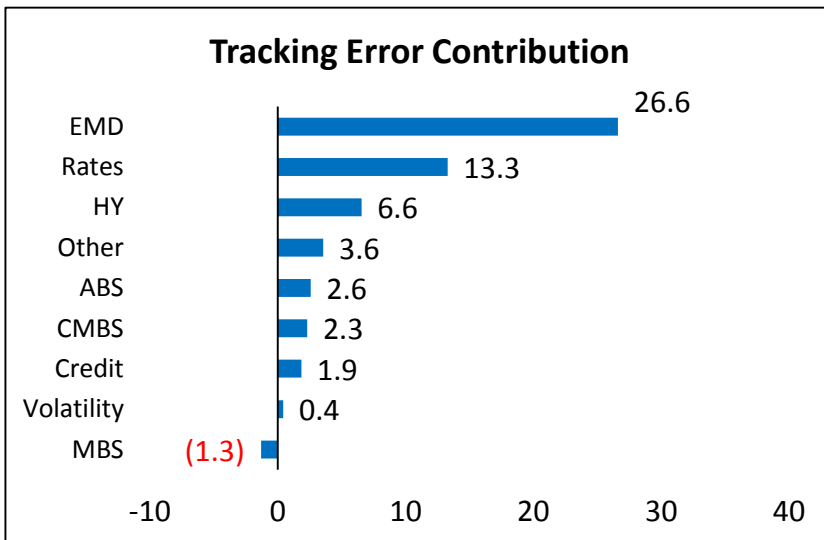
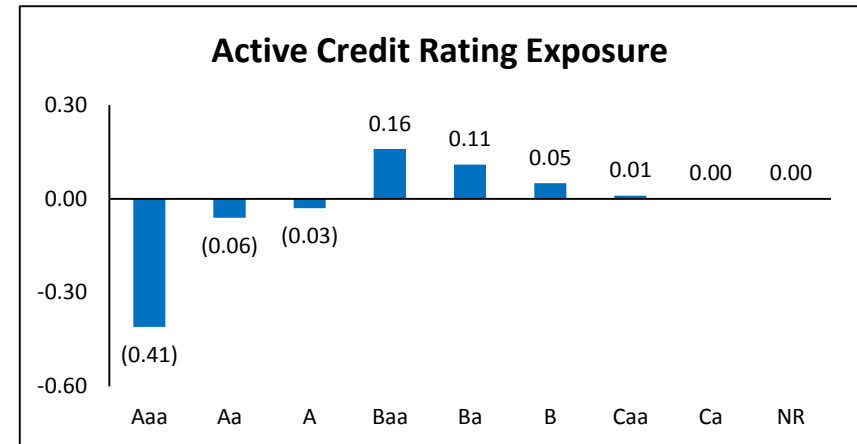
Highlights From Past Year

- Took advantage of rally in spread sectors to reduce exposure and reposition the portfolio more defensively
- Robust processes and market knowledge helped team realize strong outperformance
- Furthered long-term plan of deeper sector specialization coupled with cross training
- Onboarded a new team member virtually

Exposures: Portfolio Characteristics as of 12/31/21

Total Fixed Income Program Market Value: \$13,604,843,659

Portfolio Characteristics			
	Port	Bench	Diff
Effective Duration	6.52	6.69	(0.17)
Yield to Maturity	2.56	2.23	0.33
Option Adj. Spread	88	56	32



Results: Core Portfolio Attribution Factors For CY'21



Program Level

- Fiscal and monetary stimulus resulted in spreads back near pre-pandemic tight
- Closed the year with increased rate volatility resulting from Fed speculation
- Sector allocation decisions added 38 basis points to excess return

Portfolio Level

- Fixed income portfolio opportunistically reallocated to a more defensive position
- Team continued to build deeper expertise in EMD and High Yield, while enhancing existing processes for a likely regime shift
- Security selection added 70 basis points to the Program's excess return

Results: Risk/Return Characteristics as of 12/31/21



Program Excess Return and Statistics				
	Since July 2012*	5 Year	3 Year	1 Year
Core FI Program	0.43	1.04	1.50	1.08
Tracking Error	0.42	0.51	0.62	0.34
Information Ratio	1.02	2.05	2.41	3.21
Total FI Program	0.56	1.06	1.53	0.98
Tracking Error	0.93	0.55	0.68	0.36
Information Ratio	0.60	1.93	2.26	2.74

Batting Average

Monthly Excess Returns*		
Core FI Program	85/114	75%

*Beginning July 2012, FI transitioned all assets internally and implemented our enhanced investment approach.

Results: Portfolio as of 12/31/21



Portfolio Excess Return and Statistics

	Since July 2012*	5 Year	3 Year	1 Year
Government	0.32	0.35	0.37	0.28
Tracking Error	0.17	0.20	0.25	0.26
Information Ratio	1.90	1.76	1.45	1.07
Securitized	0.64	0.77	1.10	1.28
Tracking Error	0.47	0.56	0.70	0.45
Information Ratio	1.36	1.37	1.56	2.84
Credit	0.71	0.86	1.09	0.63
Tracking Error	0.34	0.25	0.28	0.20
Information Ratio	2.12	3.50	3.87	3.14
Opportunistic*	–	0.92	0.99	0.87
Tracking Error	–	0.81	0.94	0.79
Information Ratio	–	1.13	1.06	1.10

*Beginning July 2012, FI transitioned all assets internally and implemented our enhanced investment approach.

Results: Portfolio as of 12/31/21



Portfolio Excess Return and Statistics				
	Since Inception*	1 Year	Fiscal YTD	3 Months
Internal EMD	0.29	0.36	(0.13)	(0.32)
Tracking Error	0.67	0.49	–	–
Information Ratio	0.43	0.75	–	–
Payden & Rygel EMD	0.82	0.03	(0.70)	(0.96)
PIMCO EMD	0.61	0.21	(0.64)	(0.85)
Internal High Yield	(0.43)	(0.33)	(0.13)	(0.05)
Tracking Error	0.98	0.45	–	–
Information Ratio	(0.44)	(0.73)	–	–
Man Numeric High Yield	1.27	0.87	0.19	0.08

**Inception dates: Internal EMD Portfolio 11/2018, Internal HY Portfolio 7/2019, External EMD Portfolio 1/2020, Man Numeric HY 7/2020*

Looking Forward: Where Are We focusing?

Continue To Implement Long Term Vision For The Program

Continue to Find Ways To Collaborate in Efforts To Add Value To VRS

On The Radar

- Enhancements to portfolio processes and program cross training
- Explore quantitative tools/enhancements to fundamental processes
- Expand into more value-adding ideas in the Opportunistic Portfolio
- Cross-asset class working groups to enhance expertise

People: Collaboration Across Programs



Portfolios

- IEM: Systematic High Yield & Total Fund Rebalance Portfolio
- RBI: RBI Risk Hedging Portfolio
- Operations: Collateral Management Portfolio

People

- Intentional Touch Points Across Programs
- External Manager Partnership Sessions
- Factor Based Investing Work
- Individual Team Member Collaboration



Virginia
Retirement
System

Investment Advisory Committee Portfolio Solutions Group Functional Review Reading & Presentation Deck

April 13, 2022



Overview

(Chung Ma, Managing Director)

Functional Reviews



Risk

(Greg Hines, Investment Officer)



Strategy

(Kristina Koutrakos, Director)



Research

(Steve Peterson, Program Director)



Portfolio Integration

(Matt Lacy, Program Director)

Overview: Team Members Portfolio Solutions Group



Professional	Position	Highest Degree	Professional Certifications	Investment Experience	VRS Tenure
Chung Ma	Managing Director	MA	CFA	26	8
Matt Lacy	Program Director, Port. Integration	MA	CFA	23	23
Kristina Koutrakos	Director, Portfolio Strategy	MBA	CAIA	23	6
Katie Grawe	Sr. Investment Officer	MBA		23	4
Steven Peterson	Program Director, Research	PhD		40	15
Dane Honrado	Research Director, IDS	MS/MBA	FRM	18	6
Advait Apte	Investment Officer	MA/PhD	CFA	10	4
Lisa Davis	Decisions Systems Analyst III	BS	PMP, CSM	5	5
Quynh Phuong	Decision Systems Principal	BS		2	2
Quentin Jefferies	Decision Data Analyst I	BA		2	2
Demory Williamson	Decision Data Analyst I	BS		<1	<1
Ross Kasarda	Director, Risk Management	MA	CFA	17	17
Moses Maxfield	Investment Officer	MBA	CFA, CAIA	15	15
Greg Hines	Investment Officer	MA	CFA	10	8

Risk Management

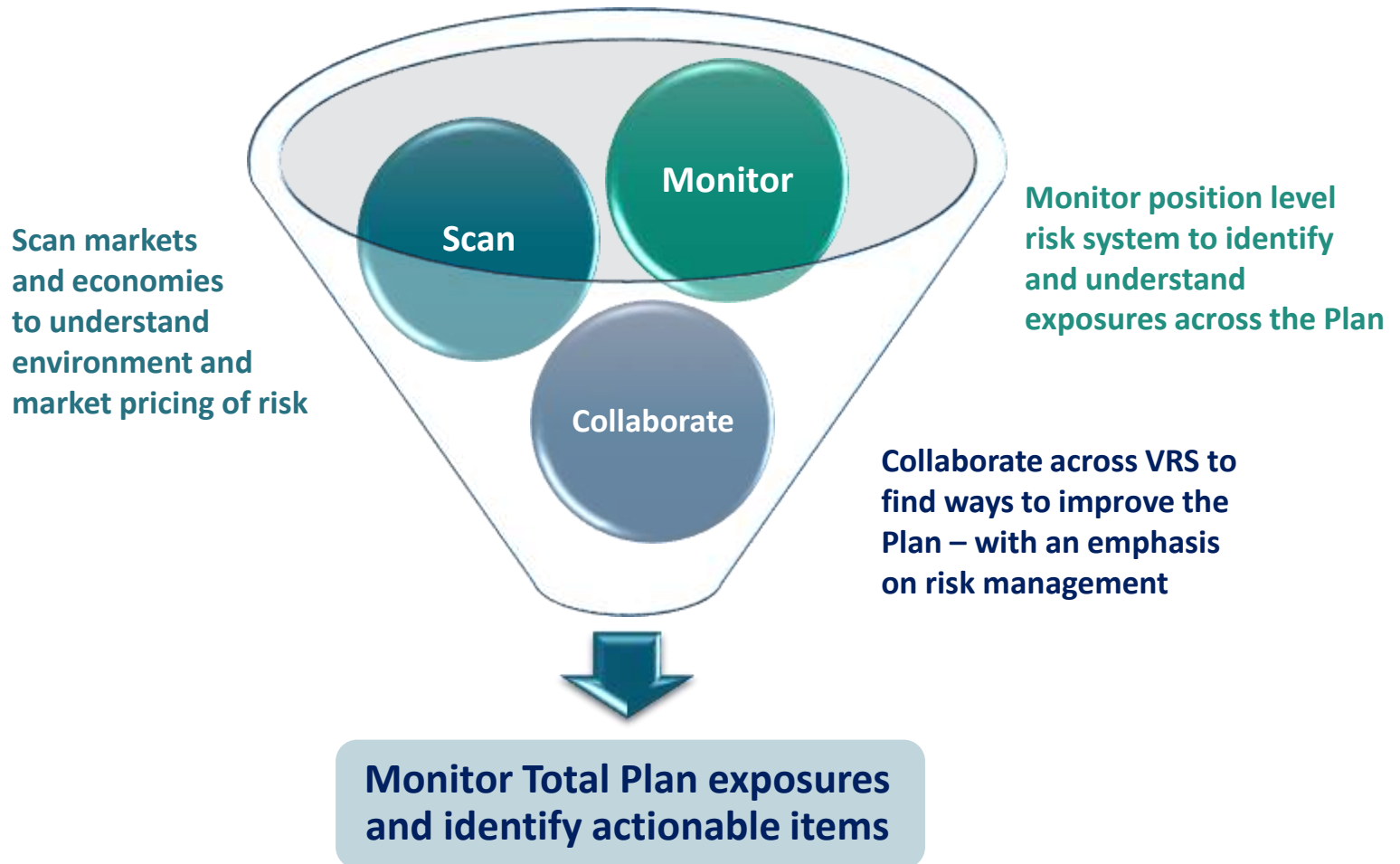
Greg Hines

Investment Officer



Team Members

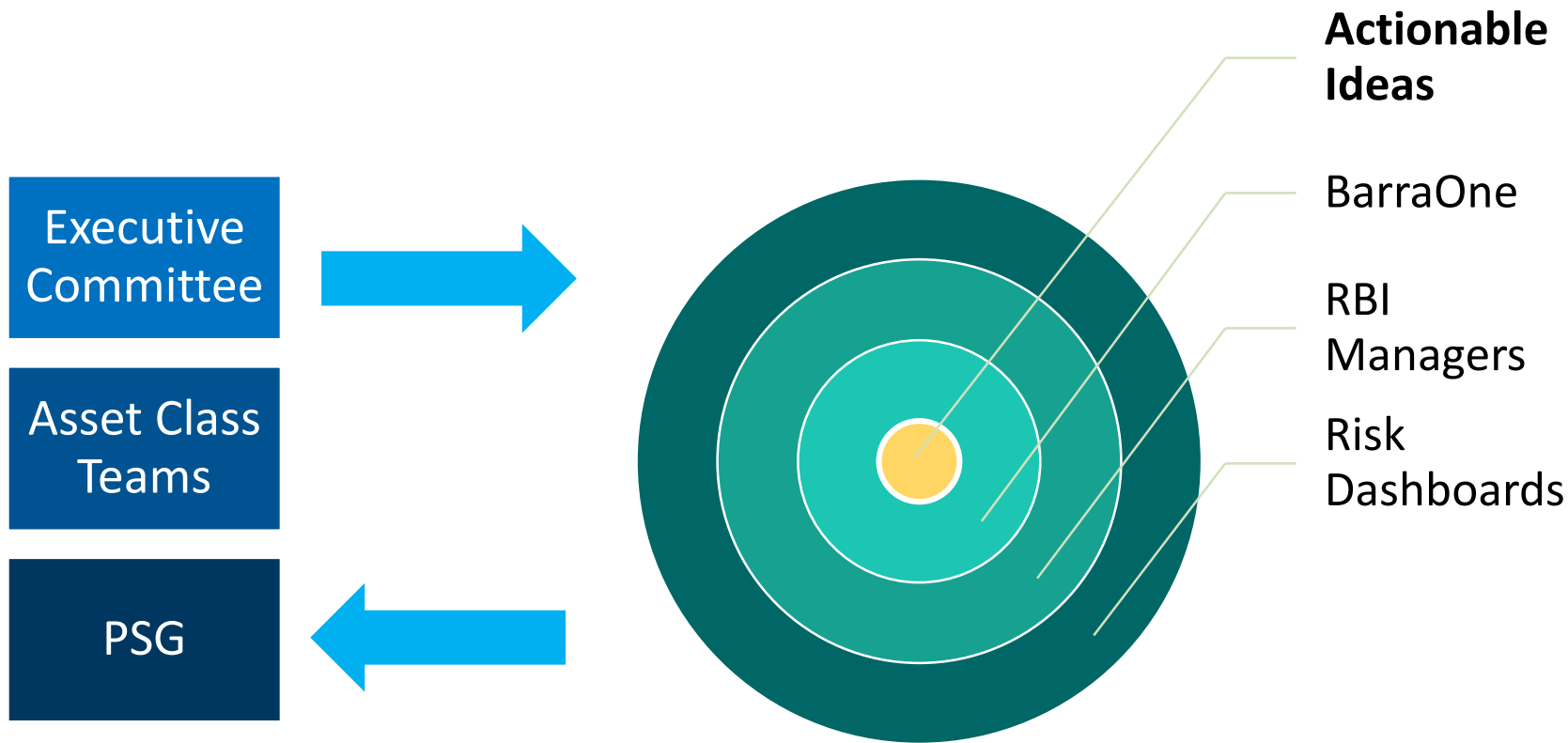
Professional	Position	Highest Degree	Professional Certifications	Investment Experience	VRS Tenure
Ross Kasarda	Director	MA	CFA	17	17
Moses Maxfield	Investment Officer	MBA	CFA, CAIA	15	15
Greg Hines	Investment Officer	MA	CFA	10	8



Risk Management Deliverables

- ✓ Build and monitor Plan-level position risk management system; generate reports to ensure risk controls are in place
 - Key metrics: tracking error, volatility, sectors, country, currency, factor exposures
 - Stress testing and scenario analysis
 - Monitoring changes and trends over time
- ✓ Produce a monthly risk report for the Management Committee identifying key Plan risks and exposures
- ✓ Support Executive Committee and asset class teams with risk and portfolio analytics
- ✓ Work with PSG on portfolio analysis, trade ideas and implementation
- ✓ Manage the Rebalance Account to help facilitate cash flows between asset classes

Risk Team Synergies



- ✓ Deploy Interactive Exposure and Risk Decomposition Reporting in Tableau to each asset class team with a demo and working sessions
- ✓ Continue to use Risk Tools and RBI relationships to identify actionable items for Plan
- ✓ Work with the asset class teams to identify customized reporting tools if desired
- ✓ Expand derivatives understanding in credit, fixed income, and FX asset classes

Risk Management Monthly Update - Excerpts



● All World Systemic Risk ● All World Turbulence ...

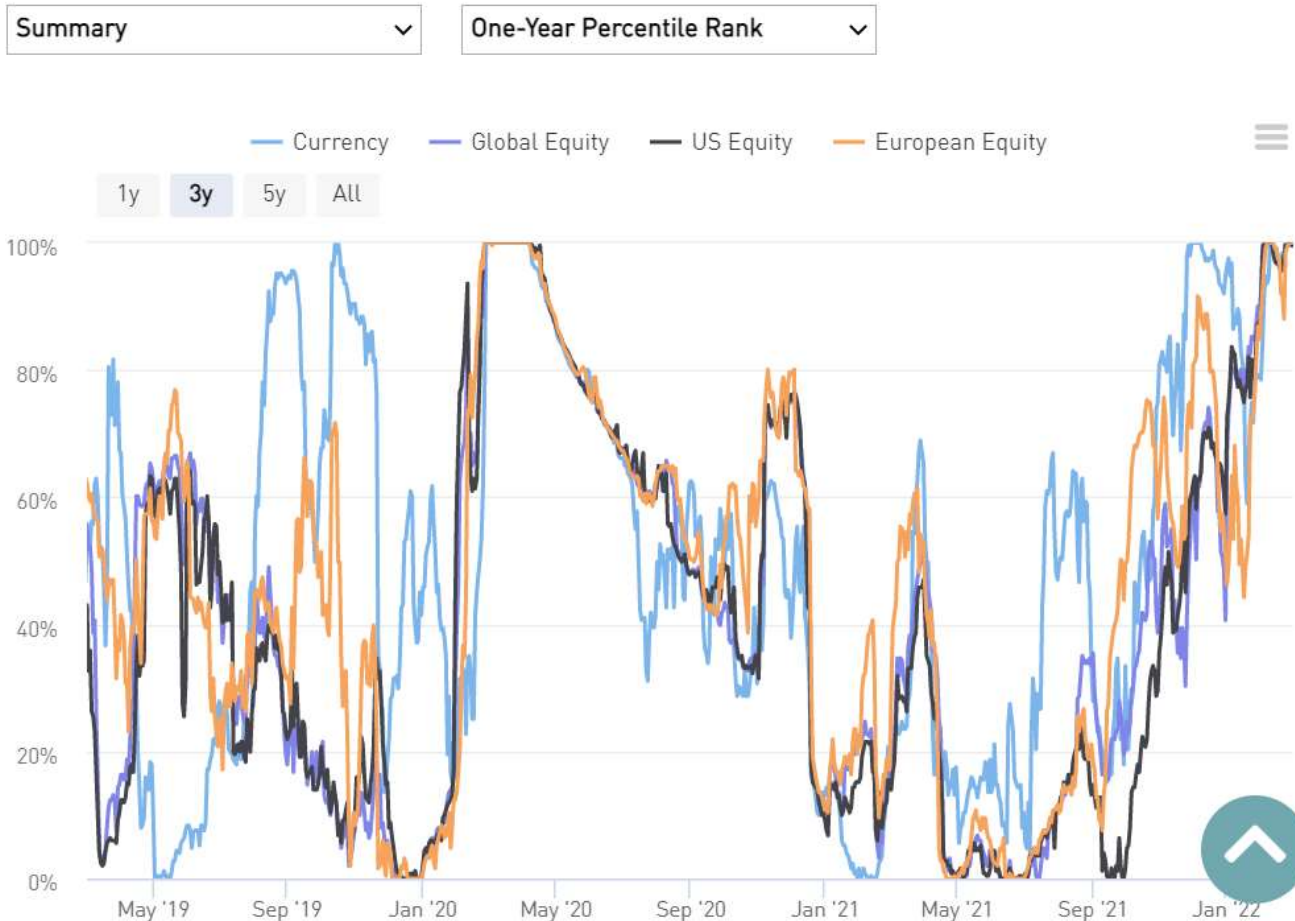
From: 3/2/2021  To: 3/2/2022 
Quick View: 6m YTD 1y 3y 5y All



Each State Street Turbulence Index provides a daily measure of market turbulence based on the collective unusualness of global equity sector returns. Thus, the relative turbulence of a given day can stem from the returns of unusual magnitude, or from the unusual interaction of a combination of assets, none of which is necessarily unusual in isolation. The more abnormal the returns, the higher the Turbulence Index value will be.

The systemic risk indices measure the fragility of global equity markets. High levels of systemic risk indicate that unexpected shocks are likely to propagate quickly and broadly through equity markets, potentially leading to significant drawdowns. Low levels of systemic risk indicate that markets are loosely linked and may be more robust to shocks.

Turbulence Indices



Each State Street Turbulence Index provides a daily measure of market turbulence based on the collective unusualness of global equity sector returns. Thus, the relative turbulence of a given day can stem from the returns of unusual magnitude, or from the unusual interaction of a combination of assets, none of which is necessarily unusual in isolation. The more abnormal the returns, the higher the Turbulence Index value will be.

IAC Meeting – April 13, 2022

Factor Risk Positioning

Barra Risk Decomposition Drill-down by Portfolio and Model

Specify Portfolio
VRS Total Plan_HF

Specify Effective Date
December 2021

Specify Model
MAC.L Tier 2 Global

Expand Hierarchy to Level
4

Risk Details as of December 2021

Risk Source	Factor Risk	Portfolio Risk	Portfolio Risk Contribution	Portfolio Risk Contribution %	Benchmark Risk	Benchmark Risk Contribution	Benchmark Risk Contribution %	Active Risk	Active Portfolio Risk Contribution	Active Portfolio Risk Contribution..	Portfolio Exposure	Active Exposure
Total Risk		12.11	12.11	100.00%	10.53	10.53	100.00%	2.98	2.98	100.00%		
Local Market Risk		11.69	11.65	96.26%	10.15	10.12	96.06%	2.96	2.95	99.05%		
Common Factor Risk		11.68	11.63	96.07%	10.12	10.07	95.63%	2.90	2.83	95.04%		
Industry		0.12	-0.05	-0.40%	0.06	-0.02	-0.23%	0.06	-0.01	-0.46%		
Style		0.60	0.39	3.19%	0.08	0.03	0.33%	0.58	0.23	7.80%		
Term Structure		0.65	-0.16	-1.35%	0.77	-0.17	-1.64%	0.11	0.03	0.87%		
Inflation		0.00	0.00	0.01%	0.00	0.00	0.00%	0.00	0.00	0.01%		
Spread		0.97	0.70	5.77%	1.02	0.73	6.95%	0.05	-0.01	-0.41%		
Commodity		0.01	0.00	0.02%	0.00	0.00	0.00%	0.01	0.00	0.05%		
Equity Implied Vol		0.00	0.00	0.01%	0.00	0.00	0.00%	0.00	0.00	0.02%		
Private Real Estate		0.81	0.61	5.05%	0.90	0.71	6.75%	0.10	-0.03	-0.99%		
Hedge Fund		0.02	0.00	0.00%	0.00	0.00	0.00%	0.02	0.00	0.01%		
Country		0.12	0.05	0.42%	0.01	0.00	0.05%	0.11	0.03	1.02%		
Market		9.87	9.31	76.93%	8.80	8.43	80.08%	1.08	0.48	16.00%		
Private Equity		2.75	0.54	4.44%	0.00	0.00	0.00%	2.75	2.18	73.10%		
Private Infrastructure		0.00	0.00	0.00%	0.00	0.00	0.00%	0.00	0.00	0.00%		
Factor Residual Risk		2.76	0.24	1.99%	2.33	0.35	3.34%	1.03	-0.06	-1.97%		
Specific Risk		0.53	0.02	0.19%	0.69	0.05	0.43%	0.60	0.12	4.01%		
Currency Risk		1.00	0.45	3.74%	0.89	0.41	3.94%	0.15	0.03	0.95%		

Portfolio Strategy

Kristina Koutrakos
Director, Portfolio Strategy



Team Members

Professional	Position	Investment Experience	VRS Tenure
Kristina Koutrakos, CAIA	Director, Portfolio Strategy	23	6
Industry Experience	Kyria Capital, co-Founder, Managing Partner Multi-family office, Managing Director, Investment Strategy BlackRock, Director, Fixed Income & Credit Portfolio Manager Western Asset, Fixed Income Portfolio Manager		
Education	Cornell University, MBA University of Virginia, BA, Economics		
Katherine Grawe	Portfolio Manager	23	4
Industry Experience	Corestone Investment Managers, Co-Director of Research Rocaton Investment Advisors, Manager Research Cambridge Associates, Manager Research		
Education	University of Edinburgh, MBA Colgate University, BA, Anthropology		

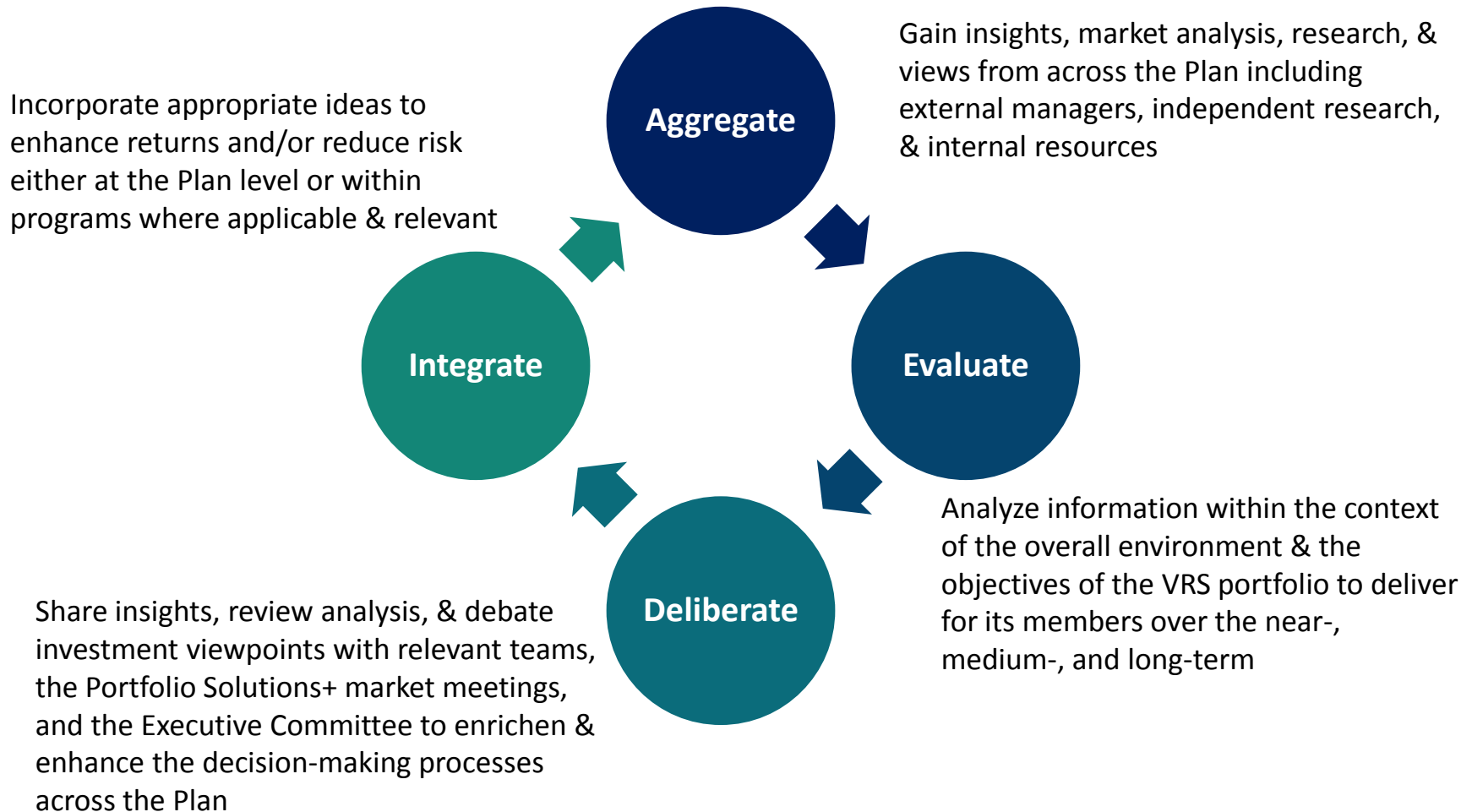
VRS Strategic Advantages

- Access to a broad and flexible set of **investment insights** across asset classes, geographies, and time frames
- **Long-term** time horizon

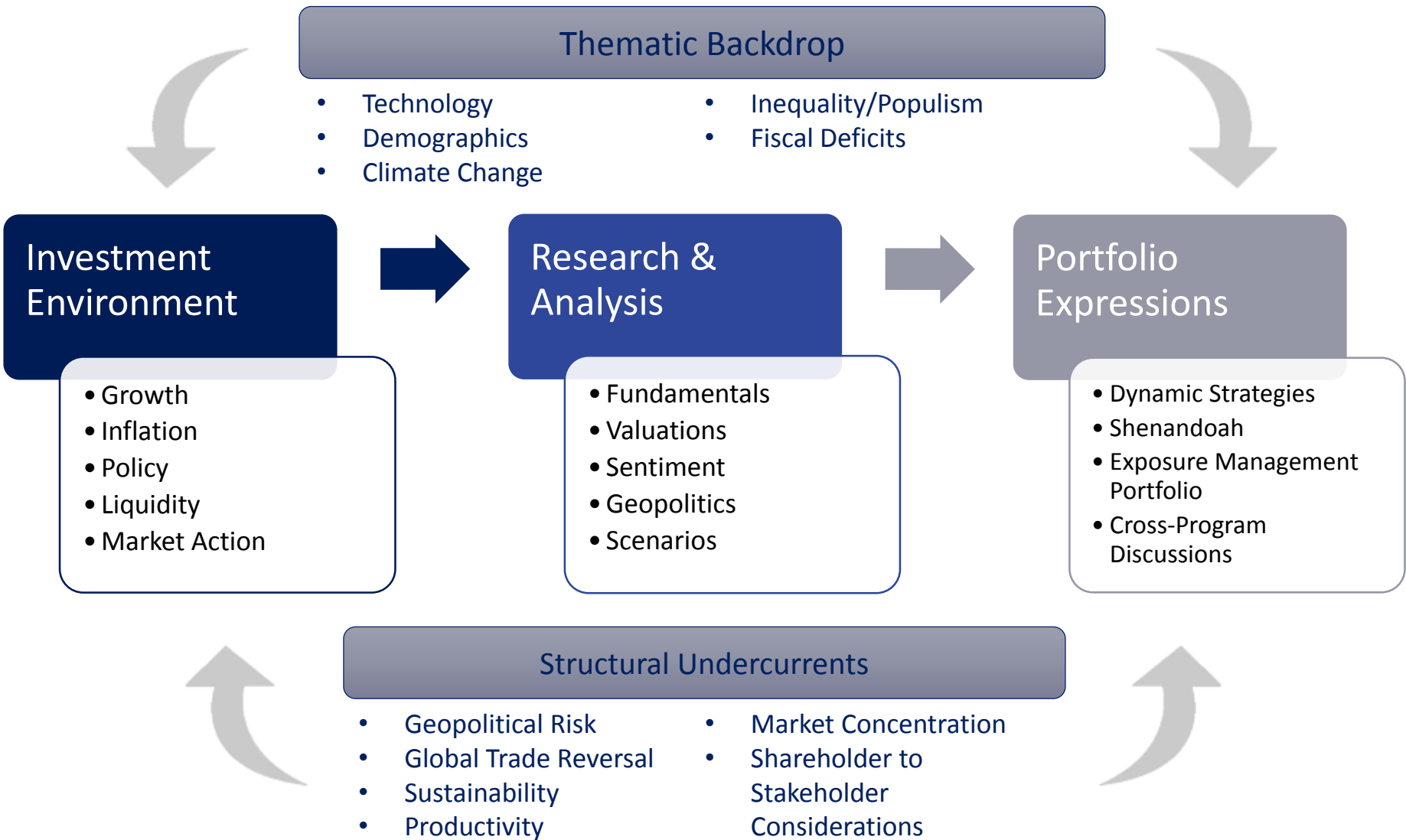
Strategy Team Investment Objective

- Add **asset allocation alpha** and **diversify excess return** sources
- Identify long-term **thematic drivers** and consider ways to incorporate **structural change** into the portfolio
- Invest over **multiple time horizons**

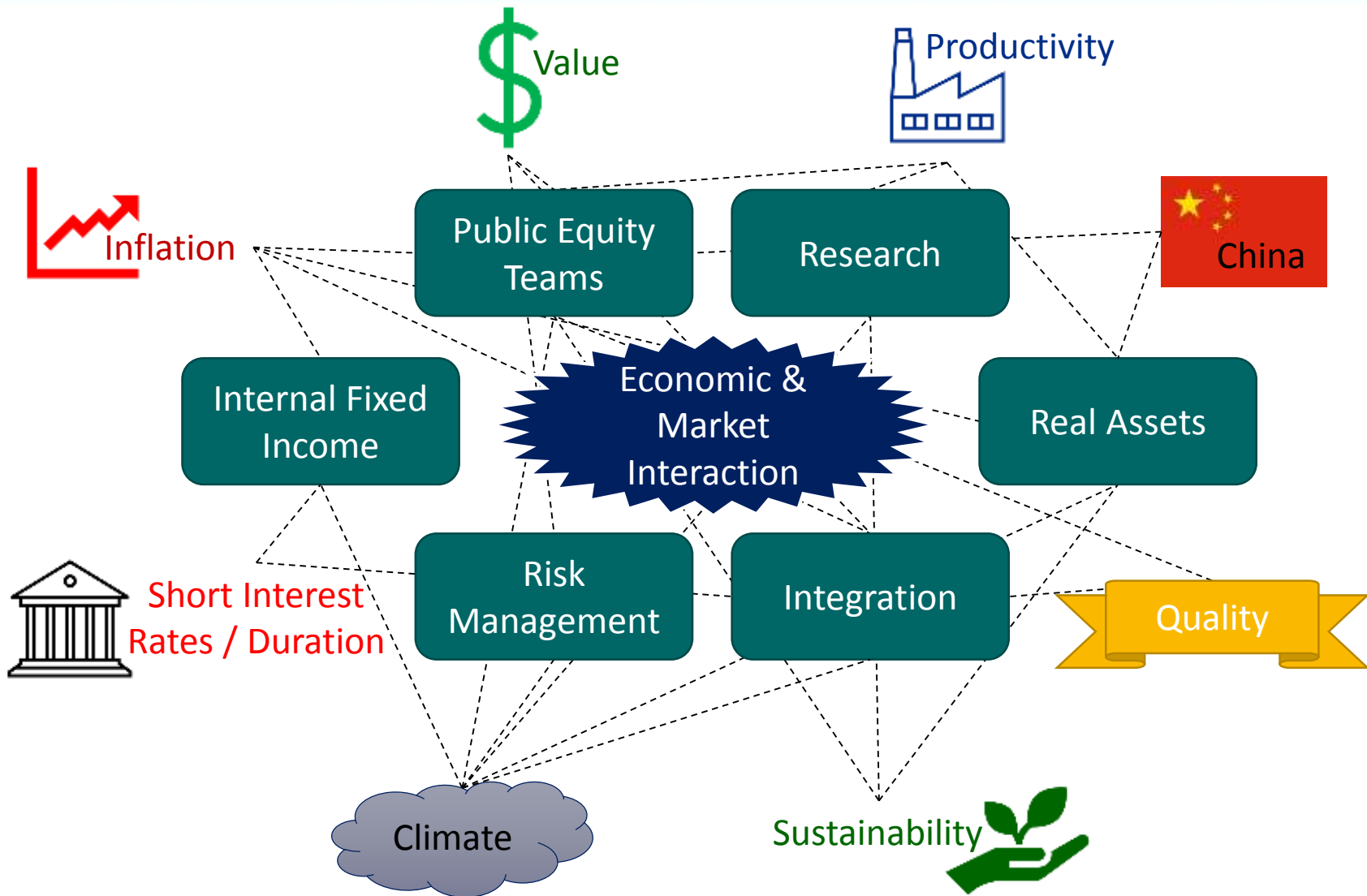
The Strategy team seeks to add value through active asset allocation management and the identification of opportunities across the investment landscape.



Process Integration

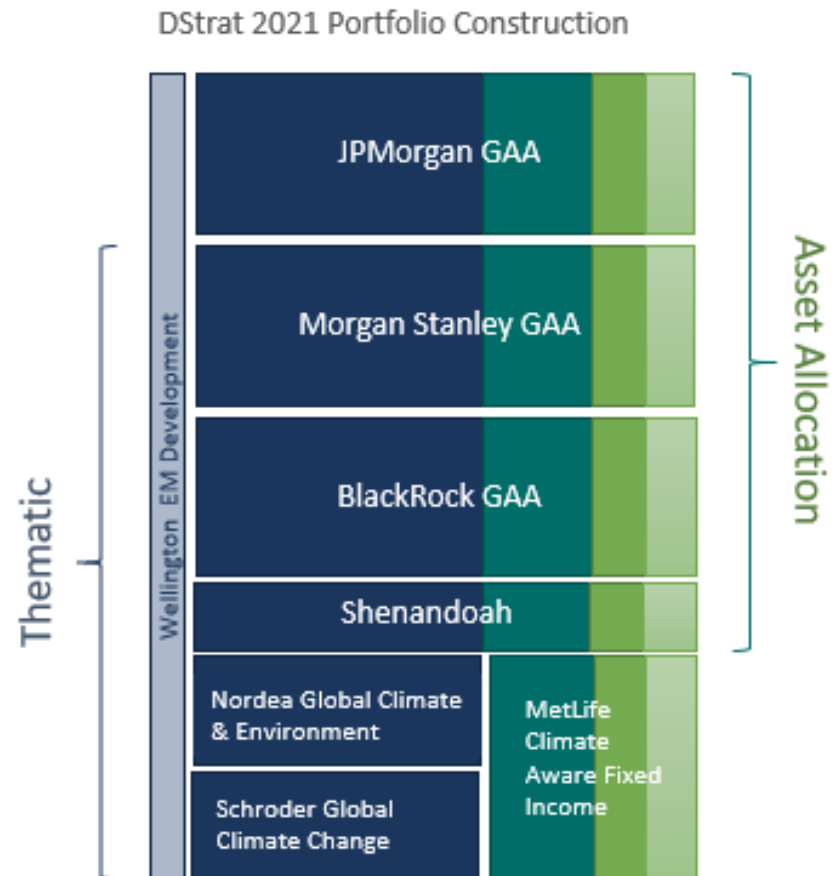


2021 Engagement Examples



FY2022 Plans & Priorities

- Strategic partnerships and asset allocation mandates continue to strengthen
- Ongoing focus on Shenandoah and internal active asset allocation efforts
- Continued collaboration across the Plan
- Continued thematic development and incorporation into the investment portfolio where appropriate and impactful





Virginia
Retirement
System

Research

Steven Peterson

Program Director – Research & IDS



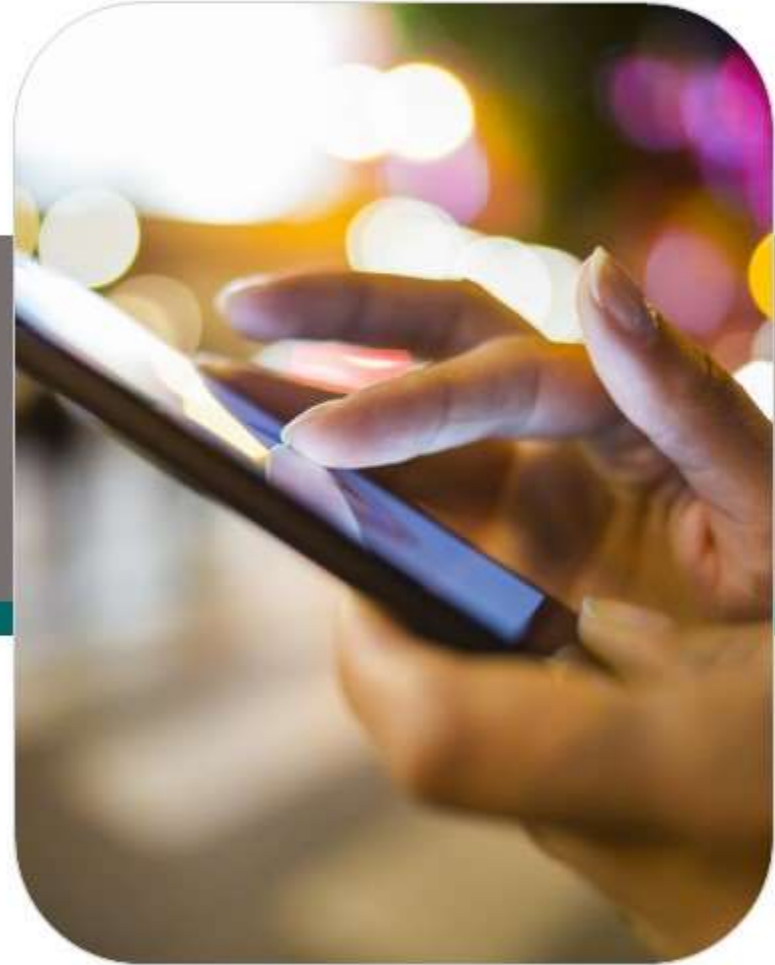
Research Team



Professional	Position	Highest Degree	Professional Certifications	Investment Experience	VRS Tenure
Steve Peterson	Director	MA, PhD		40	15
Advait Apte	Sr. Investment Officer	MA, PhD	CFA	10	4
Dane Honrado	Research Director	MS, MBA	FRM	18	6
Lisa Davis	Decision System Analyst III	BS	PMP, CSM, Investment Foundations	5	5
Quynh Phuong	Decision Systems Principal	BS	Investment Foundations	2	2
Demory Williamson	Decision Data Analyst I	BS		<1	<1
Quentin Jefferies	Decision Data Analyst I	BA		2	2
Contractors/ Consultants	Additional Support		Skills vary based on current needs. Examples include data modeling, report building and project management	Mid to senior level as require by specific project(s)	

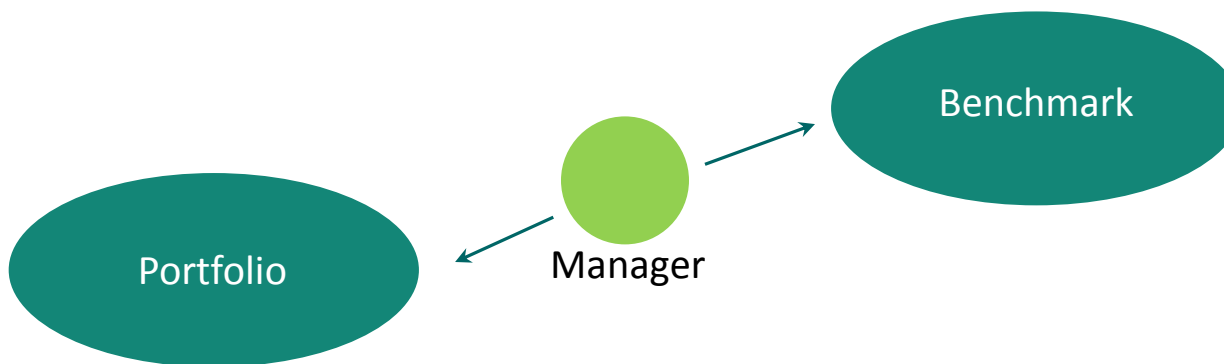
Investment Foundations: CFA Institute® Investment Foundations Certificate

Case 1: Do Prospective Managers Improve Diversification?



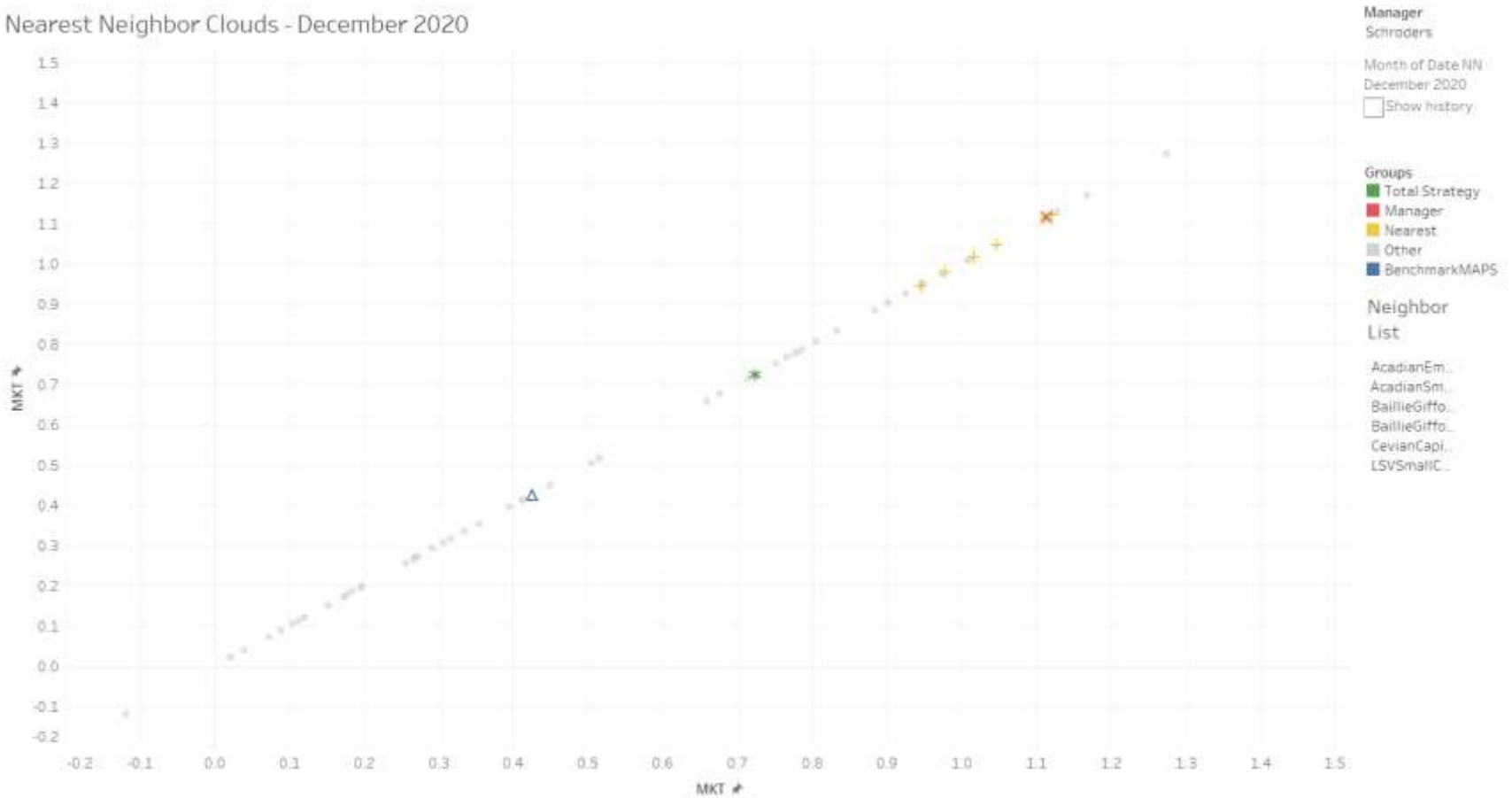
Complements the manager due diligence process

- In which direction, w.r.t the benchmark, does the manager under consideration move the portfolio?
- Does the new manager diversify the VRS portfolio?
- Does the new manager duplicate existing exposures?



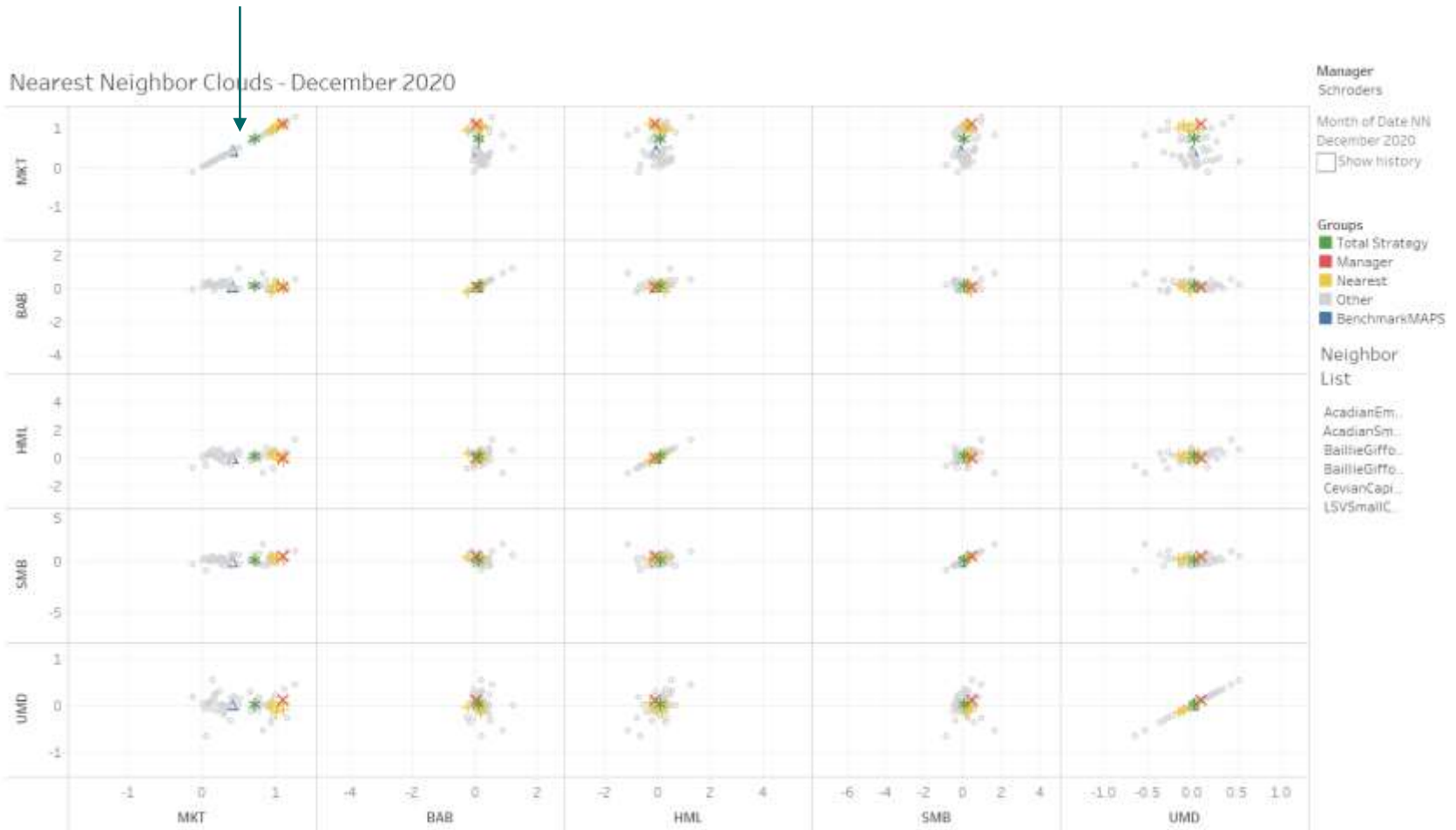
Nearest Neighbor Clouds

Nearest Neighbor Clouds - December 2020



Nearest Neighbor Clouds

Just looked at this one



MKT: Equity market, BAB: low volatility, HML: value v. growth, SMB: small v. large cap, UMD: momentum

Nearest Neighbors

Word Cloud

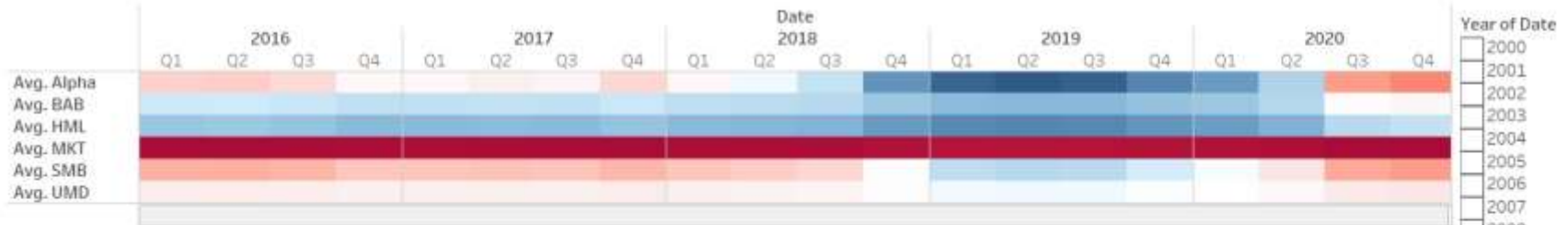
Center Mgr
 Nordea
 Schroders

Year of Date NN
2008 to 2020



Schroders Heat Map (Beta & Return Attribution)

AQR Beta



Measure Values



AQR Return Attribution



Measure Values



Case 2: Natural Language Processing





Portfolio Integration

Matt Lacy

Director, Portfolio Integration



- Provide uncorrelated returns from an absolute and excess return perspective
 - Risk Based Strategies
 - Tactical Asset Allocation
 - Macro and multi-asset strategies
 - Internally managed strategies and hedges
- Provide consulting services to the Plan
 - Risk management
 - Research
 - Strategy
 - Systems and data delivery
 - Implementation
 - Currency

Identify resources and expertise across the Plan and bring that to bear to provide investment solutions and exploit opportunities

Integrate all the components of an investment or trading strategy

- Establish objectives
- Idea generation and research
- Data and systems
- Portfolio construction and risk management
- Trading and implementation
- Monitoring trades and existing positions

Transfer knowledge and skills across the organization

Make sure all the parts fit together!



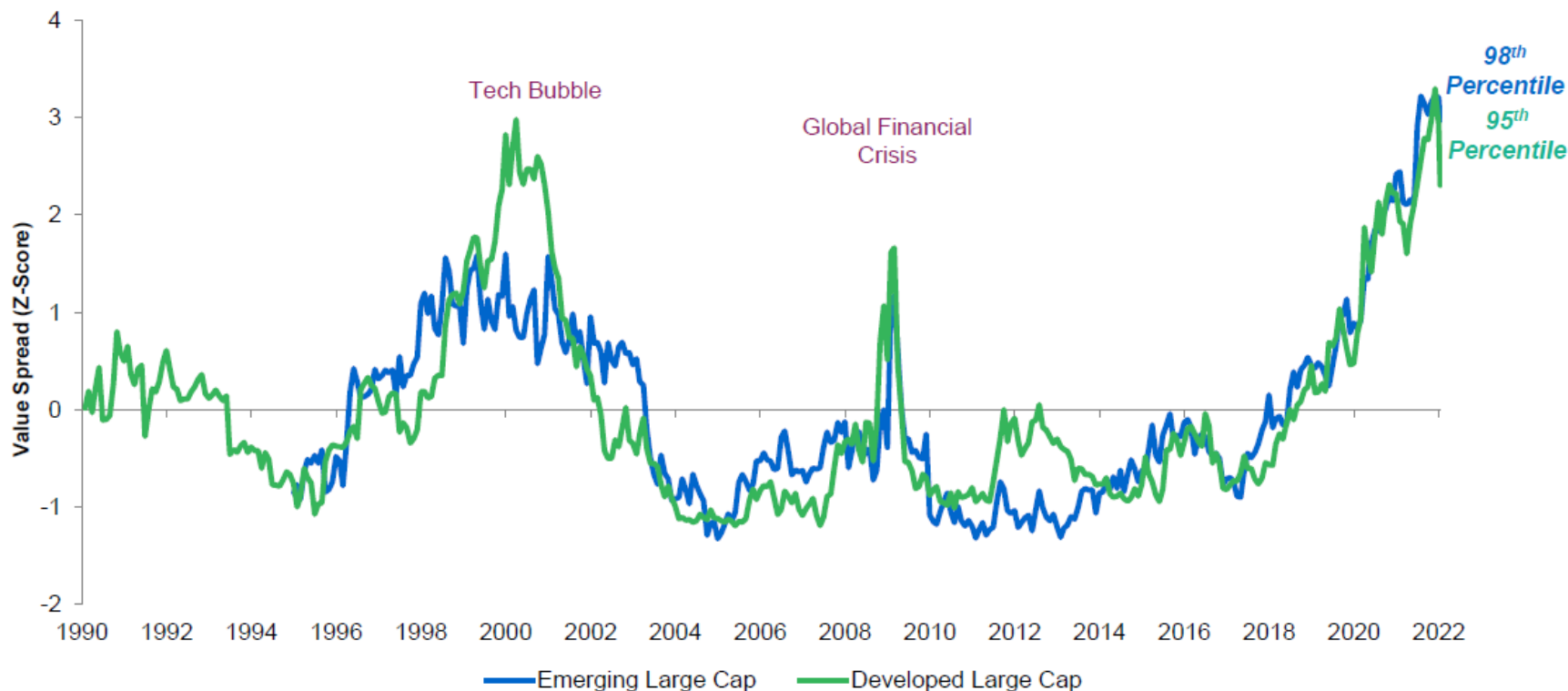
Case Study: AQR Value Trade

- Sought to take advantage of historically wide discounts between value and growth equities
- Identified as most attractive expression among other Value opportunities
- Account Structure
 - Long/Short Market Neutral
 - Targets 10 – 15% annual volatility
 - Seeks to maintain sector and country neutrality
 - Investment Universe: MSCI ACWI Standard (All Country World Index)

Factor Spreads are Attractive

Value Spreads for Hypothetical AQR Industry-and-Dollar-Neutral Value Portfolios*

January 1, 1990 – January 14, 2022

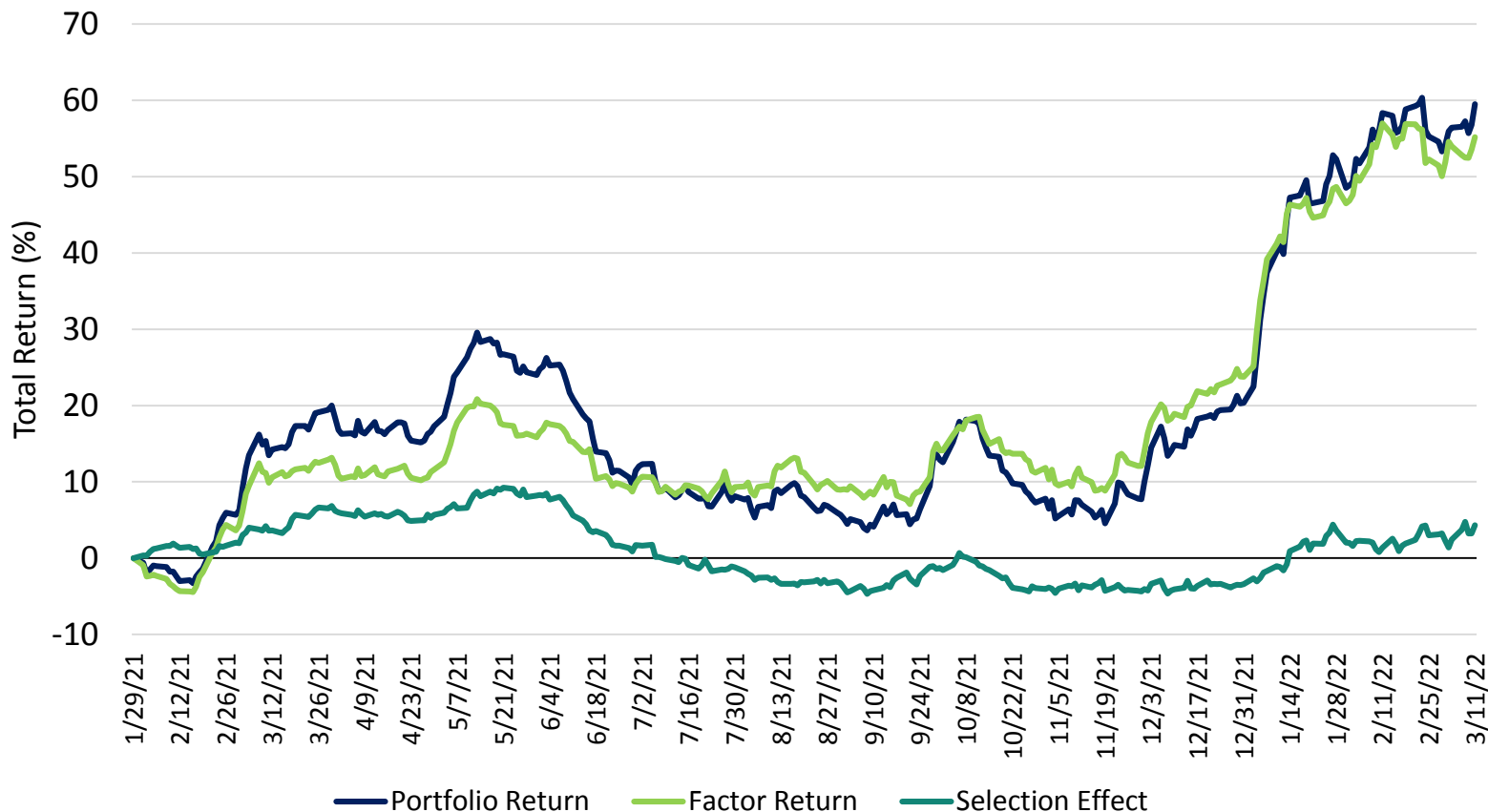


*Spreads are constructed using the Hypothetical AQR Value portfolio as described below, and are adjusted to be dollar-neutral, but not necessarily beta-neutral through time.

Source: AQR. Hypothetical value composite includes five value measures: book-to-price, earnings-to-price, forecast earnings-to-price, sales-to-enterprise value, and cash flow-to-enterprise value; spreads are measured based on ratios. To construct industry-neutrality, the value spreads are constructed by comparing the aforementioned value measures within each industry, which are then aggregated up to represent an entire portfolio. Hypothetical data has inherent limitations, some of which are disclosed in the Appendix. Please see the Hypothetical AQR Developed and Emerging Value Model Descriptions in the Appendix. For illustrative purposes only and not representative of an actual portfolio AQR currently manages. Please read the Appendix for important disclosures.



AQR Value Trade



* Performance is approximated using lagged holdings and does not include management fees or transaction costs

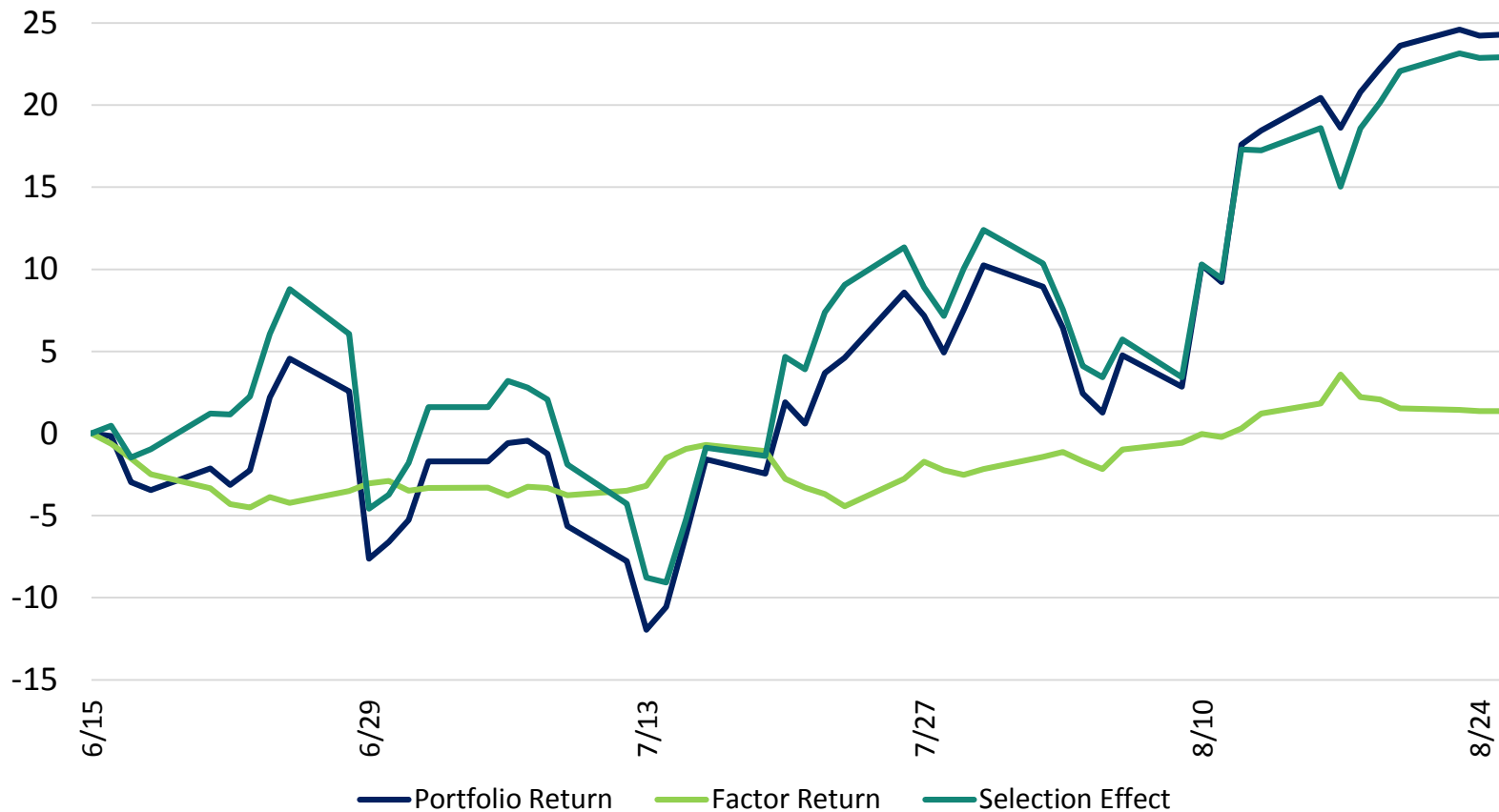
Single Name Equity Hedge Trade

- Sizeable position in a recent IPO (under lockup)
- Desire to reduce risk on this position
- Key challenges:
 - Liquidity
 - Specific risk - Stock is modeled at 46 vol (76% is specific risk)
 - Are we eligible to hedge the position?
 - Can we source the shares to borrow?
 - Can we find a dealer that can act as principal?

Hedge Structure and Timeline

- PSG and X-team worked together to structure the hedge
- Long S&P500, Short the stock, both on swap
- Worked with Legal team to ensure eligibility
- IEM traders executed the trade over 9 days
- Maintaining the borrow was a challenge. Financing rates were close to 20% per annum at the end.
- Carried hedge position for approximately 3 months until underlying stock came out of lockup
- Trade generated \$30mm of profit (21% of notional) that can be used to offset losses on the underlying stock. Note that the stock was still a gain for the Public Equity portfolio. The hedging trade helped to preserve the gains on the position.

Hedge Performance (Excluding Financing Costs)



- Transition management of Potomac, our Large Cap US Enhanced Index Strategy, to the IEM team.
- Work with the FI team to expand risk management and portfolio construction tools for internally managed systematic High Yield strategy.
- Continue working with D-Strat and RBI teams to evaluate managers and new strategies.
- Continue research on developing an internally managed systematic macro strategy.
- Evaluate external systematic macro strategies. Look to form partnerships to help with our internal efforts.



Virginia
Retirement
System

Investment Advisory Committee Public Market Assets Program Reviews Presentation Deck

April 13, 2022



Overview

(J.T. Grier, Managing Director)

Program Reviews

- **Public Equity**

(Dan Whitlock, Program Director)

- **Internal Equity Management**

(Dan Schlussler, Program Director)

- **Fixed Income**

(Parham Behrooz & Greg Oliff, Co-Directors)

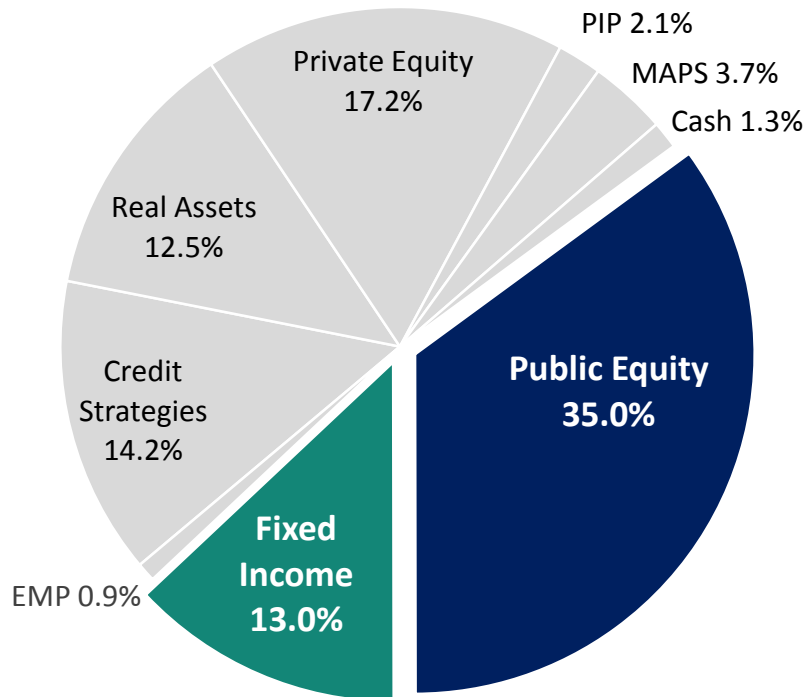
Public Market Program Overview

J.T. Grier
Managing Director, Public Markets



Overview: Public Market Assets

Public Market Assets: 48.0%



Public Equity

- 23 Developed Mkts
- 25 Emerging Mkts

Internal Equity Management

- ≈39% of Public Equity
- Invested in 48 Global Mkts

Fixed Income

- U.S. Core Focus
- USD EMD
- High Yield

Market values as of 12/31/2021; source: BNY Mellon data

Overview: Preview Of Agenda Items



Public Equity

Dan Whitlock
Program Director



Agenda: Public Equity Annual Review Topics



- Overview
- Markets
- Exposures
- Results
- Mandates
- Looking Forward

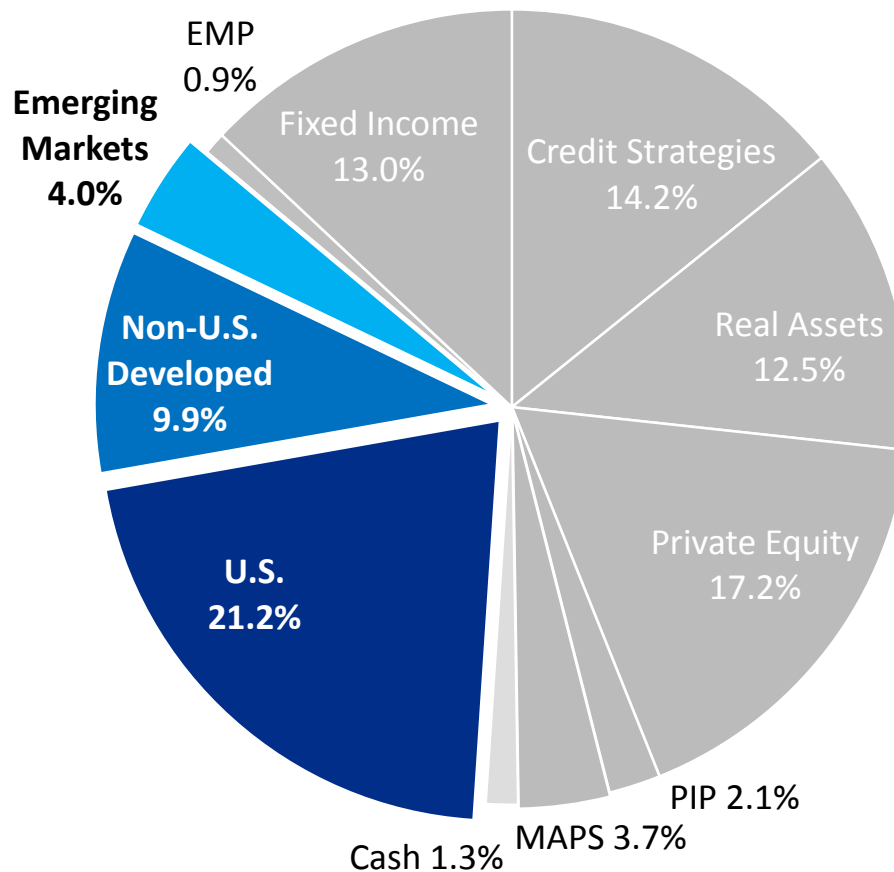
Overview: Team Members



Professional	Position	Highest Degree	Professional Certifications	Investment Experience	VRS Tenure
Dan Whitlock	Director	MBA	CFA, CAIA	20	20
Stephen Adelaar	Portfolio Manager	MS	CFA	22	15
Holly Glass	Portfolio Manager	MA	CFA	21	21
Olga Zozulya	Investment Officer	MBA*	CFA	9	9
Korey Turner	Senior Investment Analyst	MS*		2	2
Kelly Baker	Portfolio Assistant	AAS		12	7
Additional Resources	The entire Internal Equity Team, Portfolio Solutions Group, Governance Team, Management Committee, Operations Team, Compliance Team, and Legal/Regulatory Team.				

*Coursework completed, but degrees not yet received

Overview: Asset Allocation as of 12/31/21



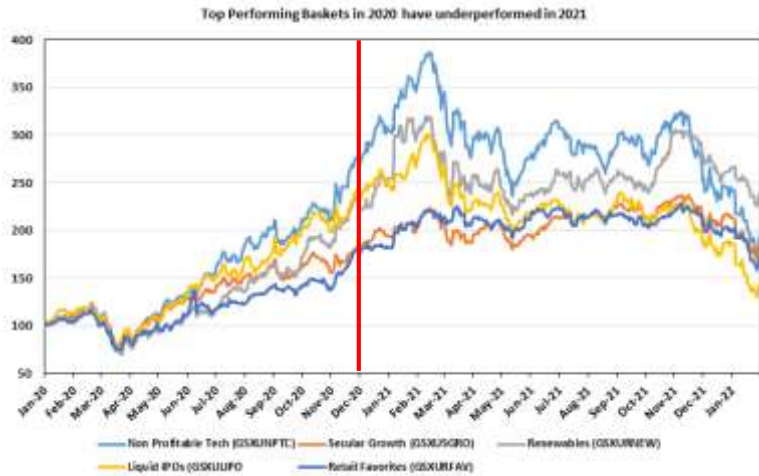
U.S. Equity	21.2%
Non-U.S. Developed	9.9%
Emerging Market	4.0%
Total Public Equity	35.0%

Overview: Philosophy



- **Primary Objective**
Gain exposure to global economic growth & the global equity risk premium
- **Specific Return Objective**
Outperform the strategic benchmark over three to five years
- **Approach**
Risk-adjusted, using both equity hedge funds & low-volatility equity mandates
- **Strategic Benchmark**
MSCI All-Country World Index Investible Markets Index (MSCI ACWI IMI)

Markets: Update from 2020 Graphs; Unusual Times



Source: Goldman Sachs Global Markets Division, as of Feb-2022. Past performance is not indicative of forward returns.

U.S. GROWTH PRICE/SALES



As of 1/31/22 | Sources: GMO, Worldscope, Compustat, MSCI
Note: Valuation ratios calculated using a weighted median

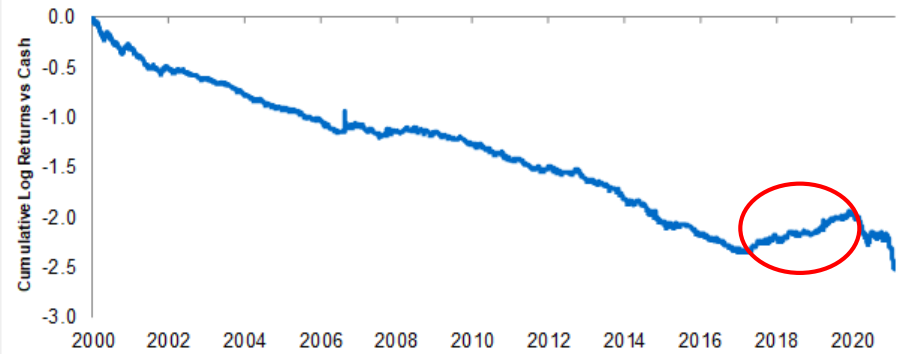
Goldman Sachs Top 5 stocks as a share of S&P 500

Top 5 stocks contribute 23% to S&P 500 market cap and 16% to earnings



Source: FactSet, Goldman Sachs Global Investment Research, as of September 17, 2021. Global Investment Research

Hypothetical Opposite Stock Selection (SSP) Illustration



Source: AQR. For illustrative purposes only. Hypothetical data has inherent limitations, some of which are described in the disclosures. See detailed explanation in the body of this article, and additional disclosures at the end of this article. This hypothetical performance does not reflect the deduction of any management fees, which as mentioned, would further reduce the actual return. It should not be assumed that the inversion of these charts is illustrative of actual portfolio performance.

Exposures: Portfolio Positioning as of 12/31/21

\$37.6 Billion
35.0% of Plan Assets

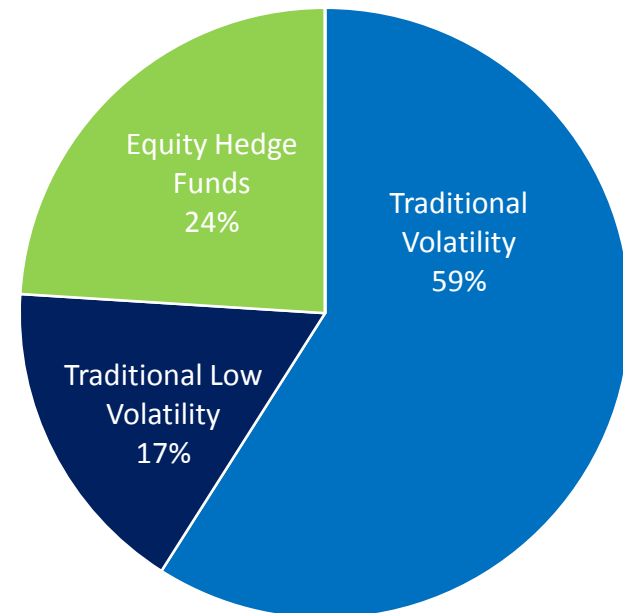
- 57% Traditional Domestic (-2.8% vs. bmk)
- 31% Traditional Non-US Developed (+2.3% vs. bmk)
- 12% Traditional Emerging Markets (+0.5% vs. bmk)

100% Active
0% Passive

39% Internal
61% External

59% Traditional Volatility
17% Traditional Low Volatility
24% Equity Hedge Funds

0.96 Beta
1.40% Forecasted Active Risk (Barra)



27 External Mandates (14 Traditional & 13 HFs)
21 External Managers (9 Traditional & 12 HFs)

Results: As of 12/31/21



	10 Year	5 Year	3 Year	1 Year
Total Public Equity	11.85	12.89	18.53	19.27
Strategic Benchmark	12.01	13.97	19.91	18.65
Excess Return	-0.16	-1.07	-1.38	0.62
Beta vs. Strategic Benchmark*	0.97	0.97	0.96	
Beta vs. Respective Beta 1 Market Cap Benchmarks*	0.92	0.94	0.94	
Active Risk vs. Strategic Benchmark**	1.19	1.48	1.85	
Information Ratio vs. Strategic Benchmark***	-0.14	-0.73	-0.73	

*Measure of volatility, or systematic risk, of a portfolio in comparison to a benchmark

**Otherwise known as tracking error, this is the standard deviation of returns relative to a benchmark

*** $(\text{Portfolio Returns} - \text{Benchmark Returns}) / \text{Active Risk}$

VRS Public Equity has outperformed in seven of the last ten calendar years, underperforming in only 2018 - 2020

Please see endnotes in appendix

Results: As of 12/31/21



	10 Year	5 Year	3 Year	1 Year	MV (\$M)
Total Public Equity	11.85	12.89	18.53	19.27	37,568
Strategic Benchmark ¹	12.01	13.97	19.91	18.65	
Excess Return	-0.16	-1.07	-1.38	0.62	
U.S. Program	15.50	17.14	24.31	26.83	12,097
U.S. Benchmark ²	16.14	17.94	25.89	25.84	
Excess Return	-0.64	-0.81	-1.58	0.98	
Non-U.S. Developed Program	9.98	8.78	12.40	14.38	5,252
Non-U.S. Developed Benchmark ³	10.01	10.51	15.38	12.85	
Excess Return	-0.03	-1.73	-2.98	1.54	
Emerging Market Program	5.50	8.59	10.21	4.52	1,997
Emerging Market Benchmark ⁴	5.75	10.12	11.63	-0.24	
Excess Return	-0.26	-1.54	-1.42	4.76	
Global Program	13.25	14.09	19.45	21.14	9,190
Global Benchmark ⁵	12.92	14.97	21.08	18.97	
Excess Return	0.33	-0.88	-1.63	2.16	
Equity Hedge Fund Program	9.44	10.25	16.93	14.70	9,032
Equity Hedge Fund Program Benchmark ⁶	8.23	11.02	15.96	18.65	
Excess Return	1.21	-0.78	0.97	-3.95	

Results: CY 2021 Attribution Deeper Dive



2021 Performance Factor Attribution

Note: Attribution an estimate and does not contain fees, intra-month trading, t-costs, etc.; some categories that are not material were left off.

Factor Impact Summary:

- An overweight to U.S. Value and Quality were the largest contributors to Style.
- A smaller U.S. Size was the largest detractor to Style.
- The low beta approach was a headwind in strong markets.
- Stock Selection was positive, particularly within the U.S. and China.

Attribution	Value (%)
Portfolio Base Return	19.5
Benchmark Base Return	18.7
Excess Return	+0.8
Currency	-0.2
Market Timing	-0.7
Country Allocation	-0.2
Selection	+1.8
Industry	+0.5
Style	+1.0
Stock Specific Return	+0.3

Results: 2022 Update: Continued Outperformance



2021/2022 Performance Factor Attribution*

Factor Impact Summary:

- Lower beta that was a headwind in 2021 helped protect capital in the drawdown in 2022.
- U.S. Value continued to contribute.
- Stock Selection outperformance was widespread while some energy underweights detracted.

Attribution	2021	2022 (through Feb)
Portfolio Base Return	19.5	-6.5
Benchmark Base Return	18.7	-7.3
Excess Return	+0.8	+0.8
Currency	-0.2	+0.1
Market Timing	-0.7	+0.4
Country Allocation	-0.2	-0.1
Selection	+1.8	+0.5
Industry	+0.5	+0.1
Style	+1.0	+0.7
Stock Specific Return	+0.3	-0.3

*Attribution is an estimate and does not contain fees, intra-month trading, t-costs, etc.; some categories that are not material were left off.

Managers: Top 5



Name	Mandates	# of Mandates	% of Program
VRS Internal Equity	U.S., Non-U.S., Emerging	6	39%
LSV	Global, Non-U.S. Small, U.S. Small	3	8%
Arrowstreet	Global	1	8%
Nordea	Global, Emerging	2	6%
Baillie Gifford	Global, Emerging	2	5%
Total			65%

Managers: Hires & Terminations – 1 Year



Action	Effective Date	Commitment/ Current Value	Funding/ Defunding Period	Description
Hired	1/4/2021	\$400 Million	2 Years	Coatue A long/short equity hedge fund
Hired	7/1/2021	\$250 Million	< 1 Year	Farallon Healthcare Partners, L.P. A long/short equity fund

Managers: Diverse Investment Management Engagement (DIME)



Women & Minority Owned Management Firms Currently In The Lineup

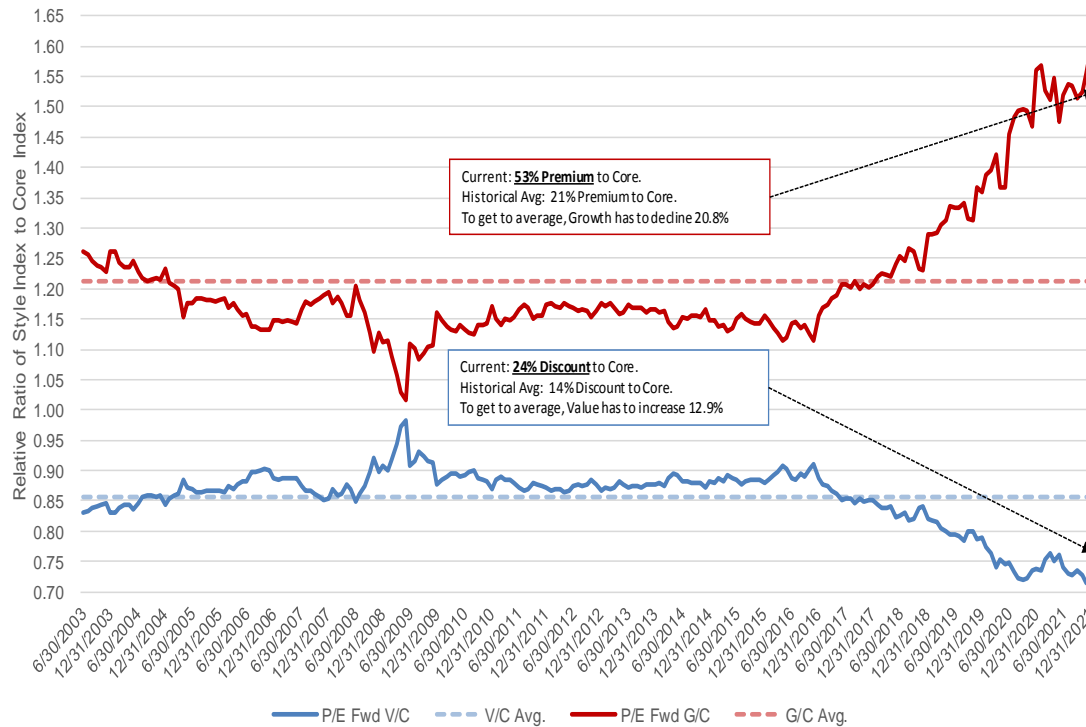
- Ariel managing VRS assets since 2014
African-American, Asian-American & women-owned global equity manager
- Kylin managing VRS assets since 2014
Asian-American owned hedge fund
- Advent managing VRS assets since 2011, Public Equity assets since 2020
African-American owned convertible manager

Continue To Meet With New Prospects & Consider New Investments

- 97 meetings with minority managers or consultants in last 5 years
- 209 meetings since we started tracking this in late 2009

Discussion Topic: Opportunity Still In Value

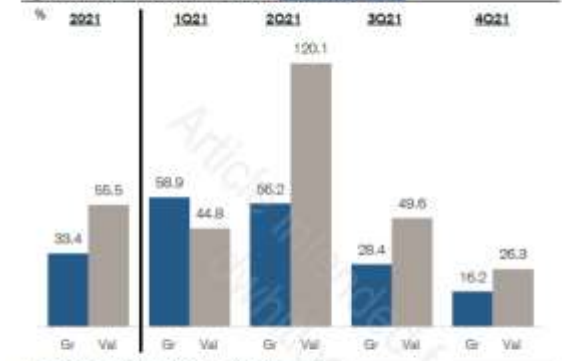
Forward PE Ratio for MSCI World Value and Growth Index Relative to MSCI World Core (Jan-2022)



Source: LSV Asset Management

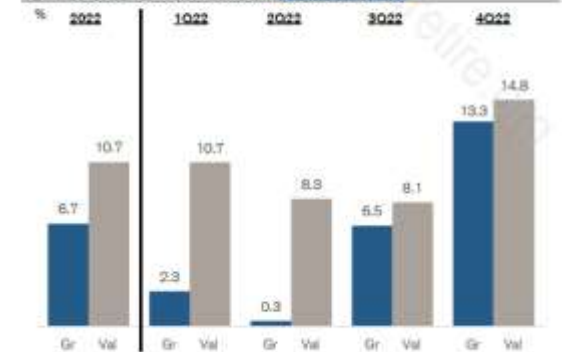
2021 vs. 2022

Figure 22: 2021 Consensus EPS Growth: GROWTH vs. VALUE



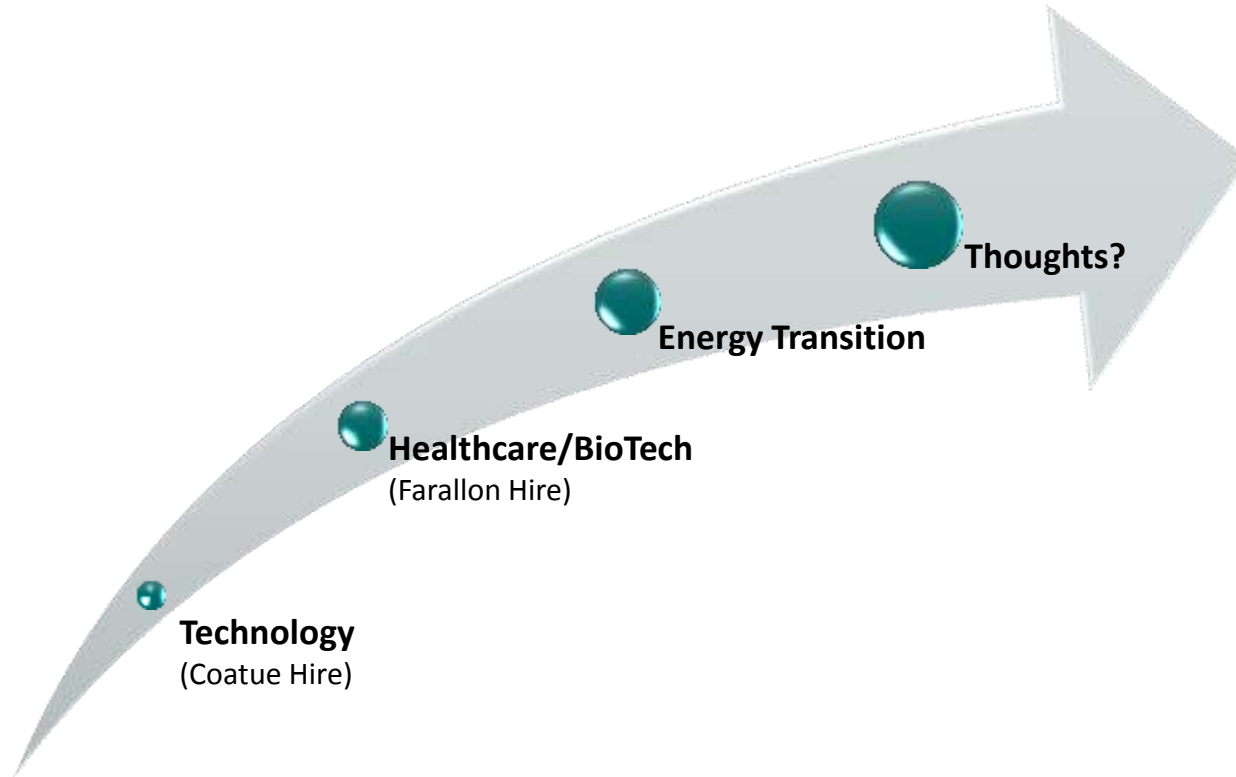
Note: Growth rates for S&P 500 Growth and Value benchmarks
Source: Standard & Poor's, Refinitiv, FactSet, Credit Suisse

Figure 23: 2022 Consensus EPS Growth: GROWTH vs. VALUE



Note: Growth rates for S&P 500 Growth and Value benchmarks
Source: Standard & Poor's, Refinitiv, FactSet and Credit Suisse

Discussion Topic: Active Management in Areas of Secular Growth



Internal Equity Management (IEM)

Dan Schlussler
Program Director



Agenda: IEM Annual Review Topics



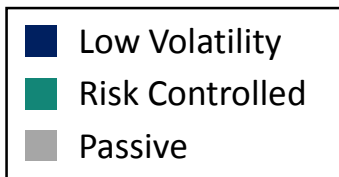
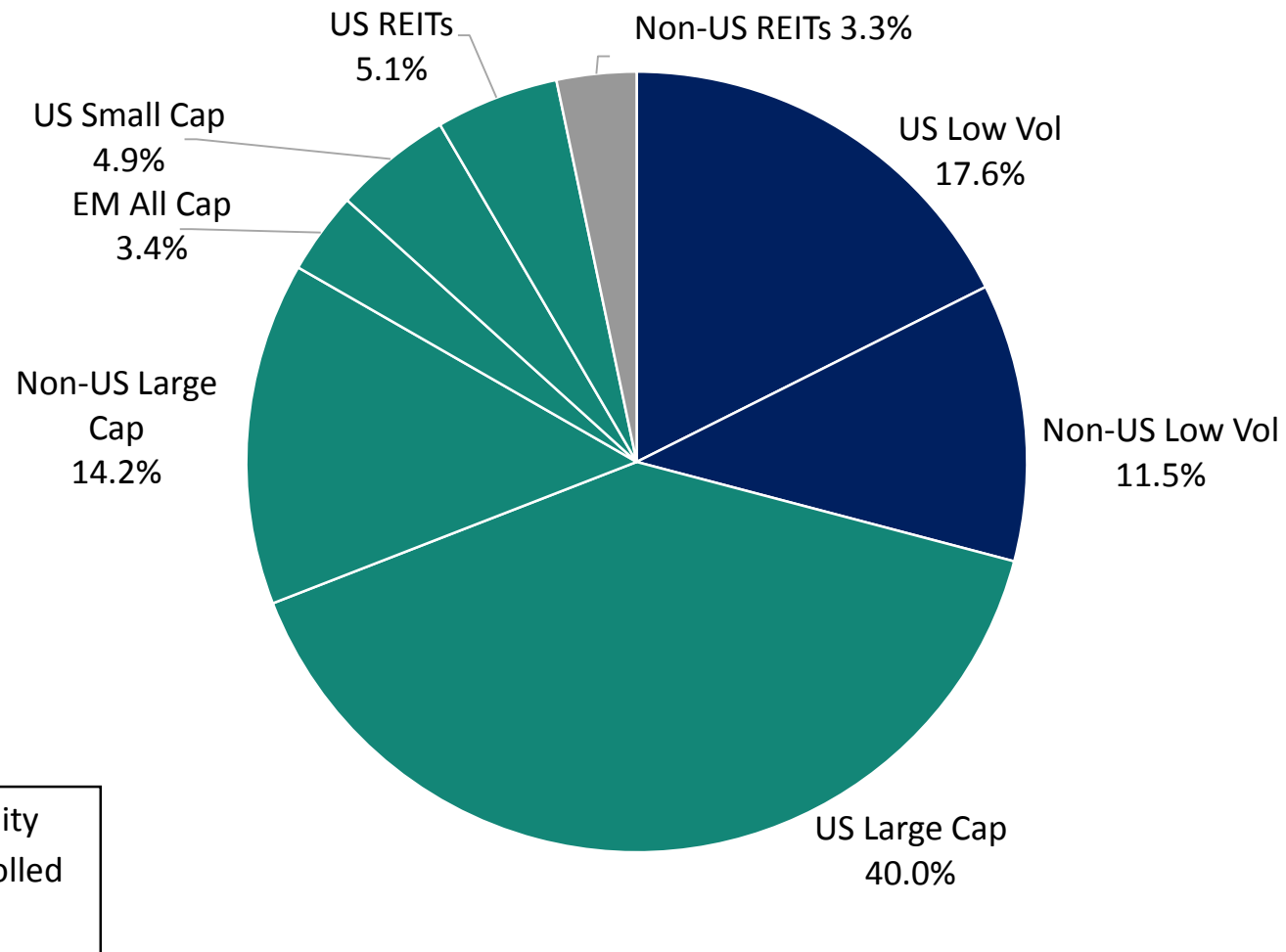
- Overview
- Markets
- Exposures
- Results
- Looking Forward

Overview: Team Members



Professional	Position	Area(s) of Focus	Highest Degree	Professional Certifications	Investment Experience	VRS Tenure
Dan Schlussler	Program Director	Non-U.S. Dev Low Vol, Research	MBA	CFA	26	9
Joe Kennebeck	Sr. Investment Officer	Head Trader	BA		29	15
Ryan Carlson	Portfolio Manager	U.S. REIT, Investment Tools	BS	CFA	19	2
Aaron Lazar	Investment Officer	Currency Hedge, Non-U.S. Large Cap, Swaps Trading	MA	Passed CFA Level 1	8	8
Vu Le	Portfolio Manager	U.S. Small Cap, Research, Currency Hedge	PhD	CFA	11	10
Alex Muniz	Sr. Portfolio Manager	U.S. Low Volatility, Research	MA	CFA	21	21
Garret Rhodes	Senior Analyst	Non-U.S. REIT Passive, Currency Hedge	MS	CFA	3	3
Larry Tentor	Portfolio Manager	Non-U.S. Large Cap, Data Infrastructure	PhD	FRM	20	14
Weldon Wirick	Portfolio Manager	Emerging Markets, Trading	MA	CFA	20	16
Matthew Lacy	Director of Portfolio Integration (PSG)	U.S. Large Cap	MA	CFA	23	23
Additional Resources	Investment Operations Department Portfolio Solutions Group Investment Decision Support					

Overview: Asset Allocation

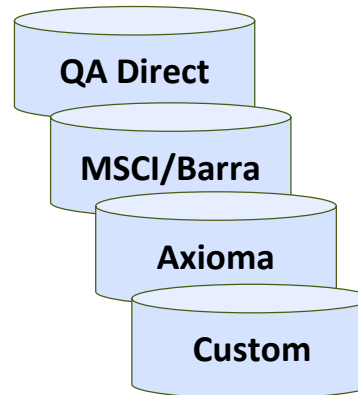


Overview: Research Process

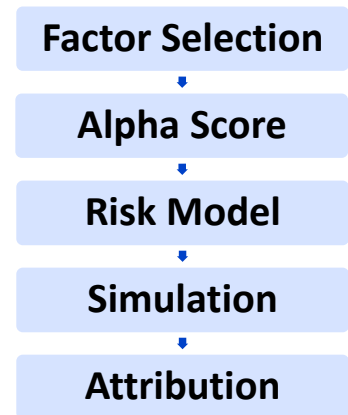
Investment Ideas



Data Collection



Proprietary Research



Markets: Big Reversal in Value vs. Growth

Rolling 12-Month Long/Short Return: Cheap Value vs High Growth

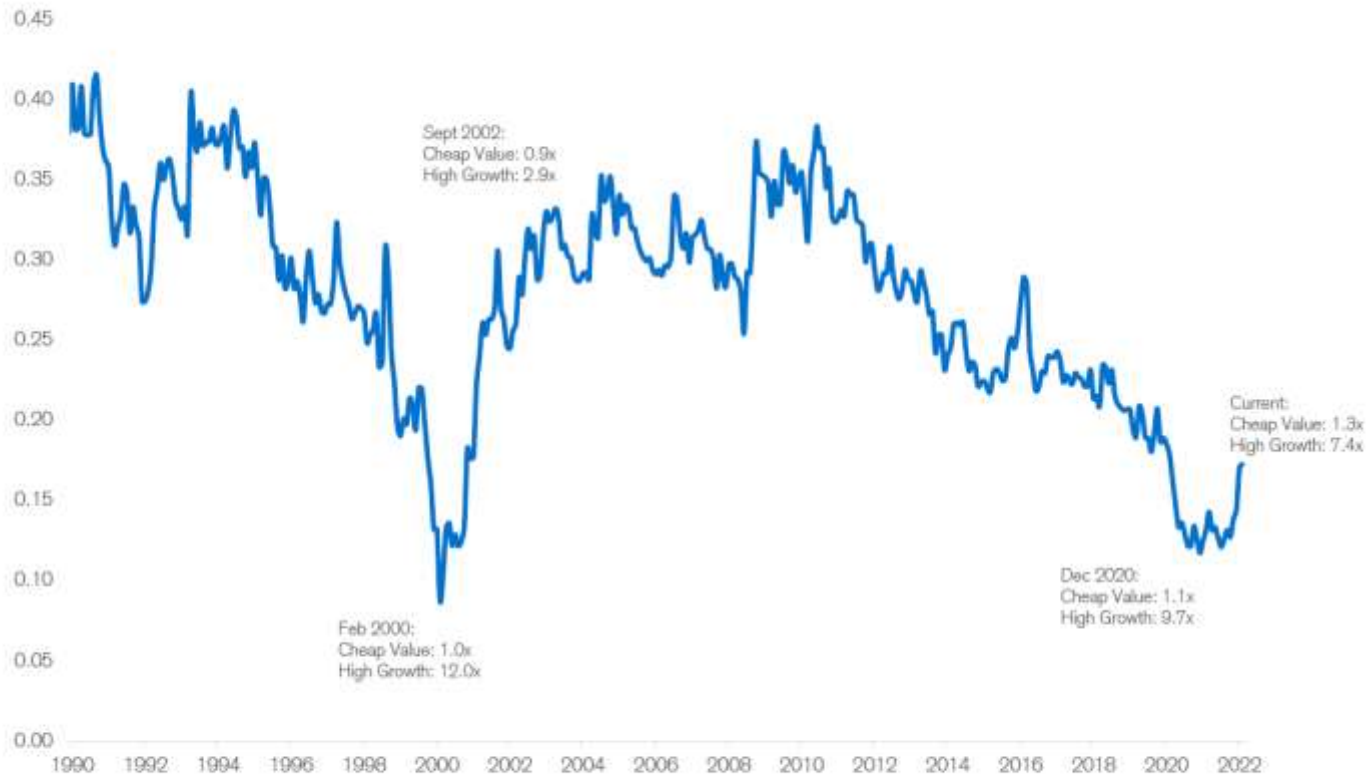


Source: Credit Suisse HOLT, Data Date: 2/28/2022.
Universe defined as Top 1000 US Companies by tm market cap.
High Growth = Highest quintile using Region relative Factor Percentiles
Cheap Systematic Value = Cheapest quintile using Region relative Factor Percentiles.

Markets: Value Still Cheap Relative to High Growth



Ratio of Median HOLT Price to Book: Cheap Value vs High Growth



Source: Credit Suisse HOLT, Data Date: 2/28/2022.
 Universe defined as Top 1000 US Companies by ttm market cap.
 High Growth = Highest quintile using Region relative Factor Percentiles. Long-term median HOLT P/B = 3.8x
 Cheap Systematic Value = Cheapest quintile using Region relative Factor Percentiles. Long-term median HOLT P/B = 1.1x

Exposures: Risk & Positions



Risk Summary*	Strategy	Mkt Val (\$MM)	Weight	Tracking	CF Risk	Specific	Risk Attrib	% of TE
Program	Composite	15,285	100.0	0.98	0.64	0.36	0.98	100.0
Potomac	US Large Cap	6,333	41.4	0.81	0.26	0.74	0.20	21.0
Afton	US Small Cap	772	5.1	1.20	0.51	0.49	0.02	2.4
Monroe	US REIT	802	5.2	0.95	0.07	0.93	0.00	0.4
Mobjack	US Low Vol	2,767	18.1	2.30	0.33	0.67	0.25	26.1
Matoaka	Non-US Dev. Large Cap	2,242	14.7	1.88	0.72	0.28	0.21	21.3
Tuckahoe	Emerging Markets	542	3.5	2.11	0.59	0.41	0.02	2.2
Piedmont	Non-US Dev. Low Vol	1,826	11.9	2.86	0.59	0.41	0.26	26.7

Top 10 Industry Group	Act Wgt
Diversified Financials	1.45
Food, Beverage, Tobacco	1.31
Food & Staples Retailing	0.83
Utilities	0.81
Insurance	0.74
Household & Personal Products	-0.82
Consumer Services	-0.83
Healthcare Equipment/Srvcs.	-1.01
Banks	-1.02
Materials	-1.10

Top 10 Country	Act Wgt
Australia	0.39
Norway	0.34
Sweden	0.27
Israel	0.20
Canada	0.12
Germany	-0.15
France	-0.21
United States	-0.25
Japan	-0.45
Switzerland	-0.54

Sectors	Act Wgt
Consumer Staples	1.32
Financials	1.17
Utilities	0.81
Real Estate	0.66
Communication Services	0.53
Information Technology	-0.78
Healthcare	-0.87
Consumer Discretionary	-0.91
Industrials	-1.09
Materials	-1.10

Factor	Act Wgt
Value	0.17
Profitability	0.12
Dividend Yield	0.09
Earnings Var.	0.07
Momentum	0.07
Size	0.00
Growth	-0.01
Trade Activity	-0.01
Volatility	-0.03
Leverage	-0.08

#Market Value Data as of 12/31/2021. Risk summary data as of 1/17/2022.
Industry Group, Country, Sector, and Factor data as of 12/31/2021.

Results: Program Performance (as of 12/31/21)



	IEM Active				IEM Low Volatility				IEM Enhanced Index			
	1 Yr	3 Yr	5 Yr	Incep	1 Yr	3 Yr	5 Yr	Incep	1 Yr	3 Yr	5 Yr	Incep
Total Active Internal Equity	24.00	19.10	13.51	8.33	19.30	14.90	10.78	12.86	26.01	20.97	14.61	8.03
IEM Benchmark	20.95	20.25	14.43	7.82	17.87	17.12	13.10	11.15	22.29	21.63	14.99	7.80
<i>Excess Returns</i>	3.05	-1.15	-0.92	0.51	1.43	-2.21	-2.32	1.71	3.72	-0.66	-0.38	0.24
<i>Realized Tracking Error</i>	1.22	1.20	1.02	1.04	1.64	1.69	1.58	2.73	1.19	1.13	0.96	0.81
<i>Realized Information Ratio</i>	2.50	-0.96	-0.90	0.49	0.87	-1.31	-1.47	0.62	3.13	-0.58	-0.40	0.29

Results: Strategy Performance (as of 12/31/21)



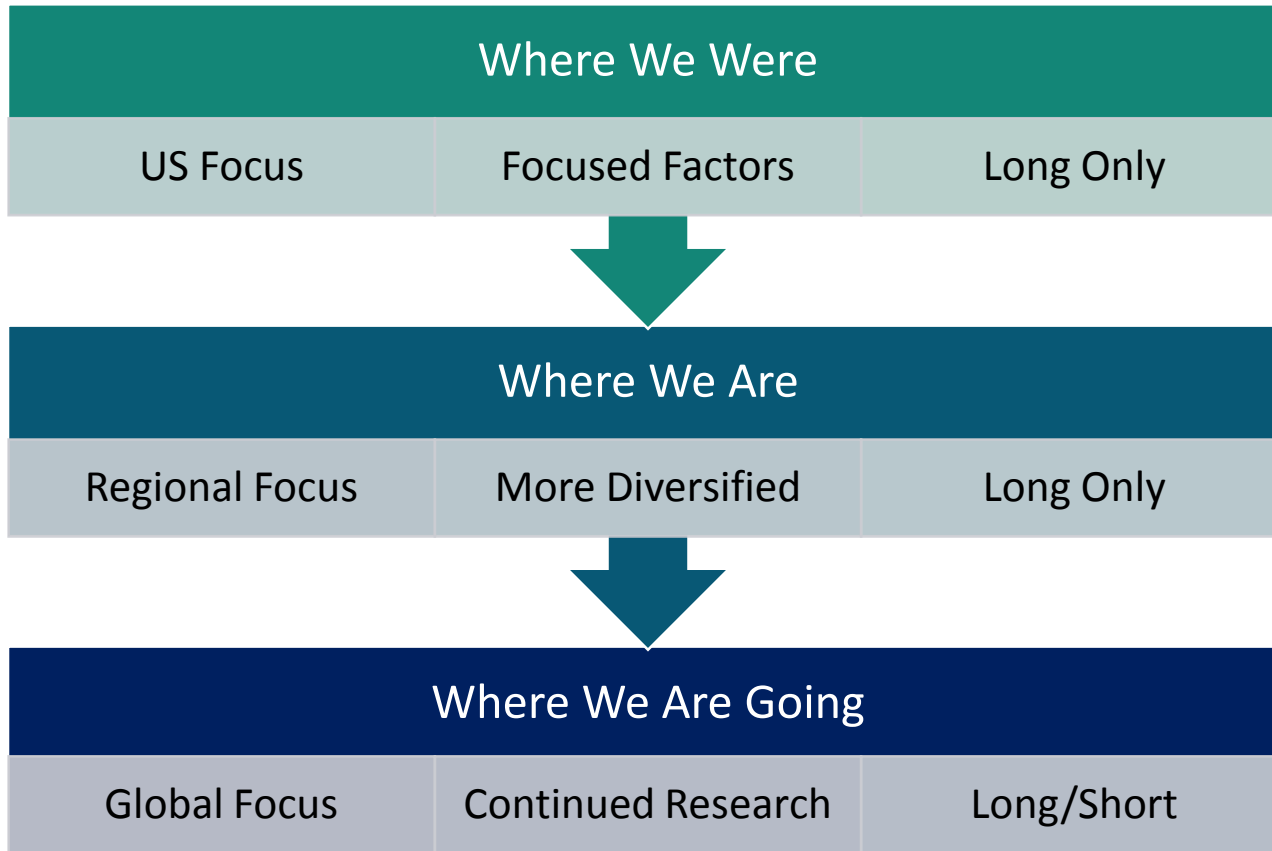
	Inception Date	Mkt Value (\$MM)	1-Year Return	1-Year Excess	Since Inc. Excess	Since Inc. Tracking
Risk Controlled Strategies		10,692	26.01	3.72	0.24	0.81
U.S. Large Cap (Potomac)	Apr-01	6,333	31.21	4.24	0.32	0.97
Non-U.S. Large Cap (Matoaka)	Sep-10	2,242	15.24	2.14	-0.07	1.17
EM All Cap (Tuckahoe)	Sep-15	542	2.10	2.34	-0.68	1.72
U.S. Small Cap (Afton)	Jun-05	772	27.75	8.19	0.31	1.94
U.S. REITs (Monroe)	Dec-05	802	44.61	1.78	1.13	1.12
Less Constrained (Low Vol) Strategies		4,593	19.30	1.43	1.71	2.73
U.S. Large Cap (Mobjack)	Jun-10	2,767	24.61	1.20	1.67	3.17
Non-U.S. Large (Piedmont)	Dec-12	1,826	12.04	1.72	0.68	2.56
Passive Strategies		519	8.43	-0.33	0.12	0.28
Non-U.S. Developed REIT	Jul-20	518	8.47	-0.28	-0.52	0.26
Other Mandates						
Currency Hedging	Apr-09	2,260	n.a.	n.a.	n.a.	n.a.

Looking Forward: Focus on Research, Process and Tools



- We have maintained conviction in our strategies and are delivering strong excess returns after a period of difficult performance
- Continue research focused on enhancing existing return factors in our models as well as looking for new sources of alpha
- Nearing completion of our Global Enhanced Index Strategy. Look to complete Long/Short as well
- Major projects to enhance our research infrastructure and investment tools

Discussion Topic: Where We Are Focused



Fixed Income

Parham Behrooz & Greg Oliff
Co-Directors



Agenda: Fixed Income Annual Review Topics



- Overview
- Markets
- Exposures
- Results
- Mandates
- Looking Forward

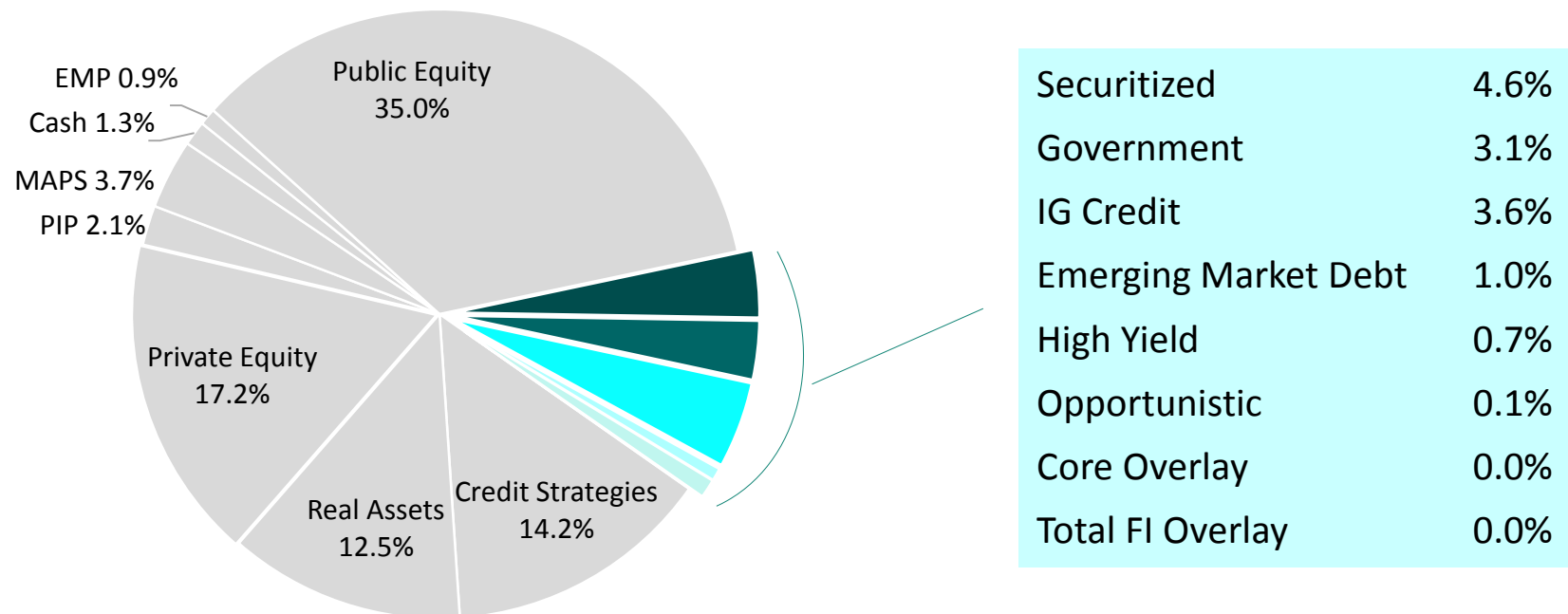
Overview: Team Members



Professional	Position	Highest Degree	Professional Certifications	Investment Experience	VRS Tenure
Parham Behrooz	Co-Director	BS	CFA	25	9
Greg Oliff	Co-Director	MBA	CFA	14	11
Mehtab Haleem	Portfolio Manager	MS		13	1
Teresa Nguyen	Portfolio Manager	BA	CFA	20	5
Michael Desai	Investment Officer	MS		5	1
Kidus Molla	Investment Analyst	BS		<1	<1
Additional Resources	Investment Operations Department & Portfolio Intelligence Team				

Overview: Asset Allocation as of 12/31/21

Total Fixed Income = 13.0%

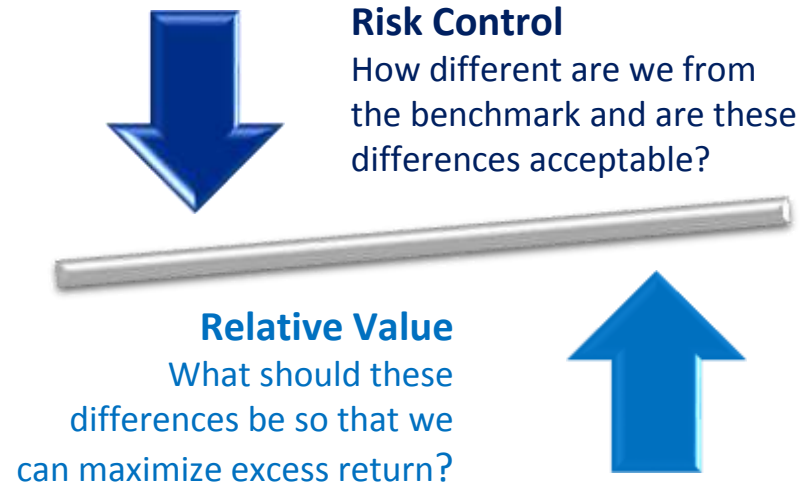


Market values as of 12/31/2021; Source: BNY Mellon data

Overview: Philosophy

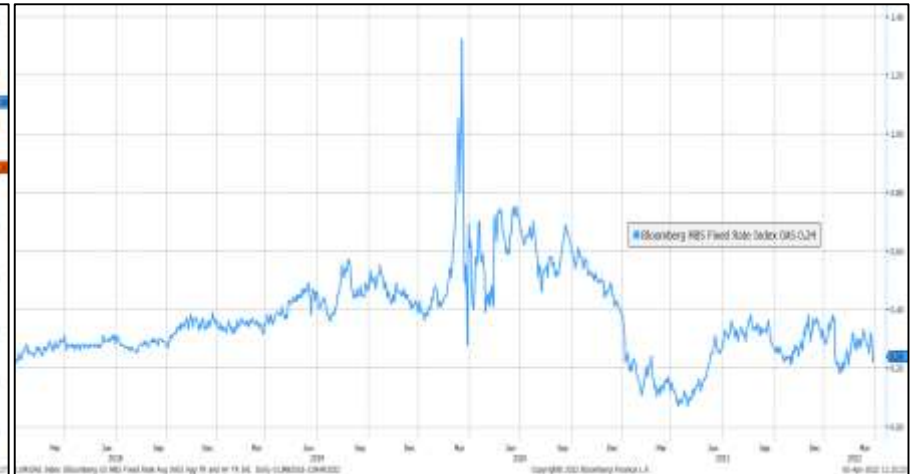
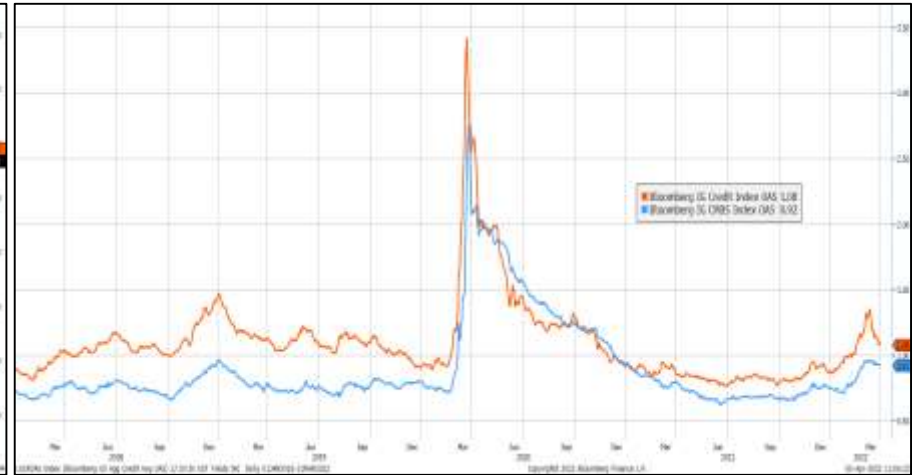
Risk Controlled Relative Value

Market factors provide opportunities to add value through optimal sector allocation and security selection, while managing risk exposures to the benchmark within controlled parameters

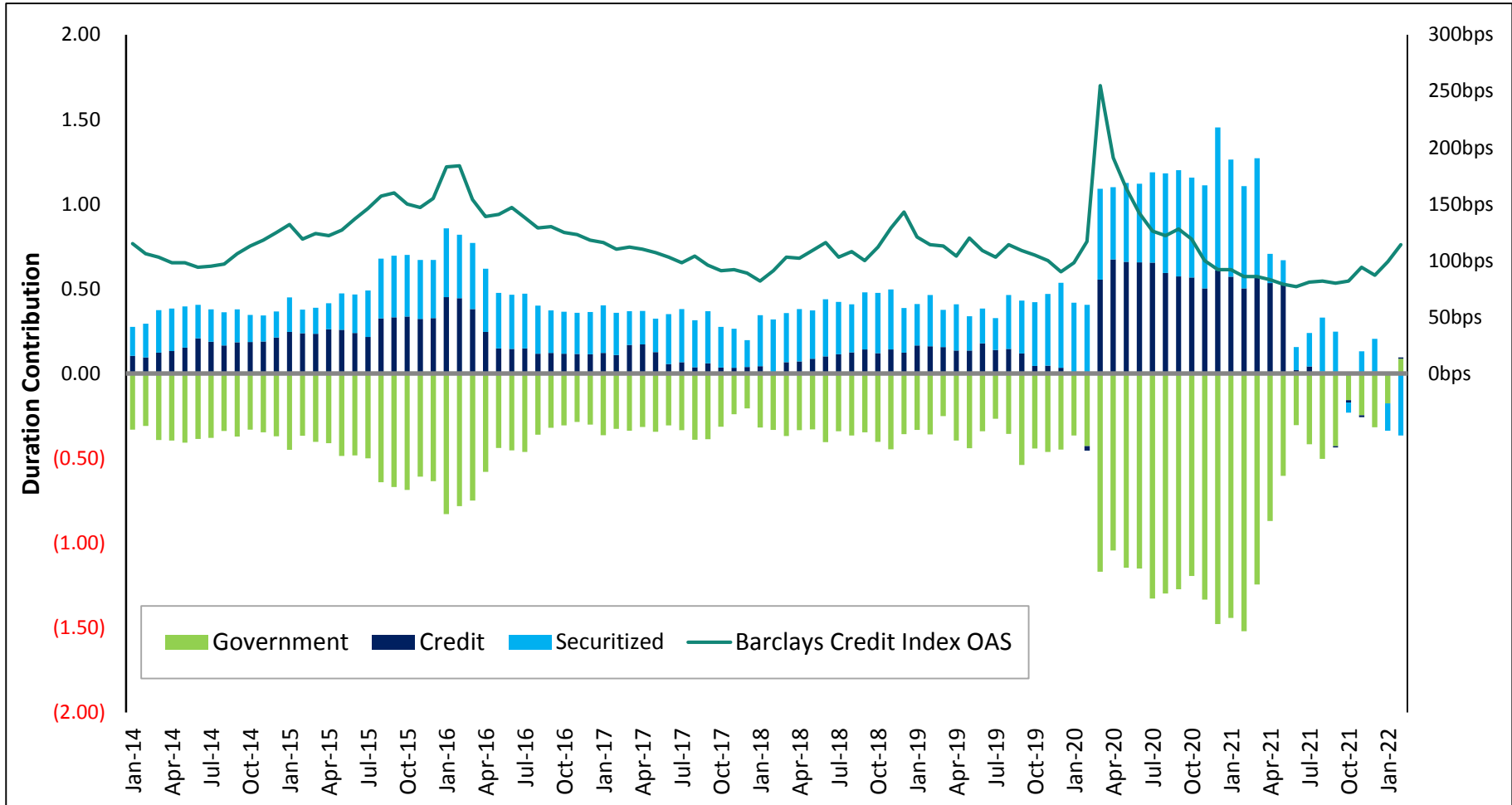


The Fixed Income Program serves as a diversifying asset class, historically providing a hedge against a deflationary economic environment.

Markets: Data: Jan 2018 - Mar 2022

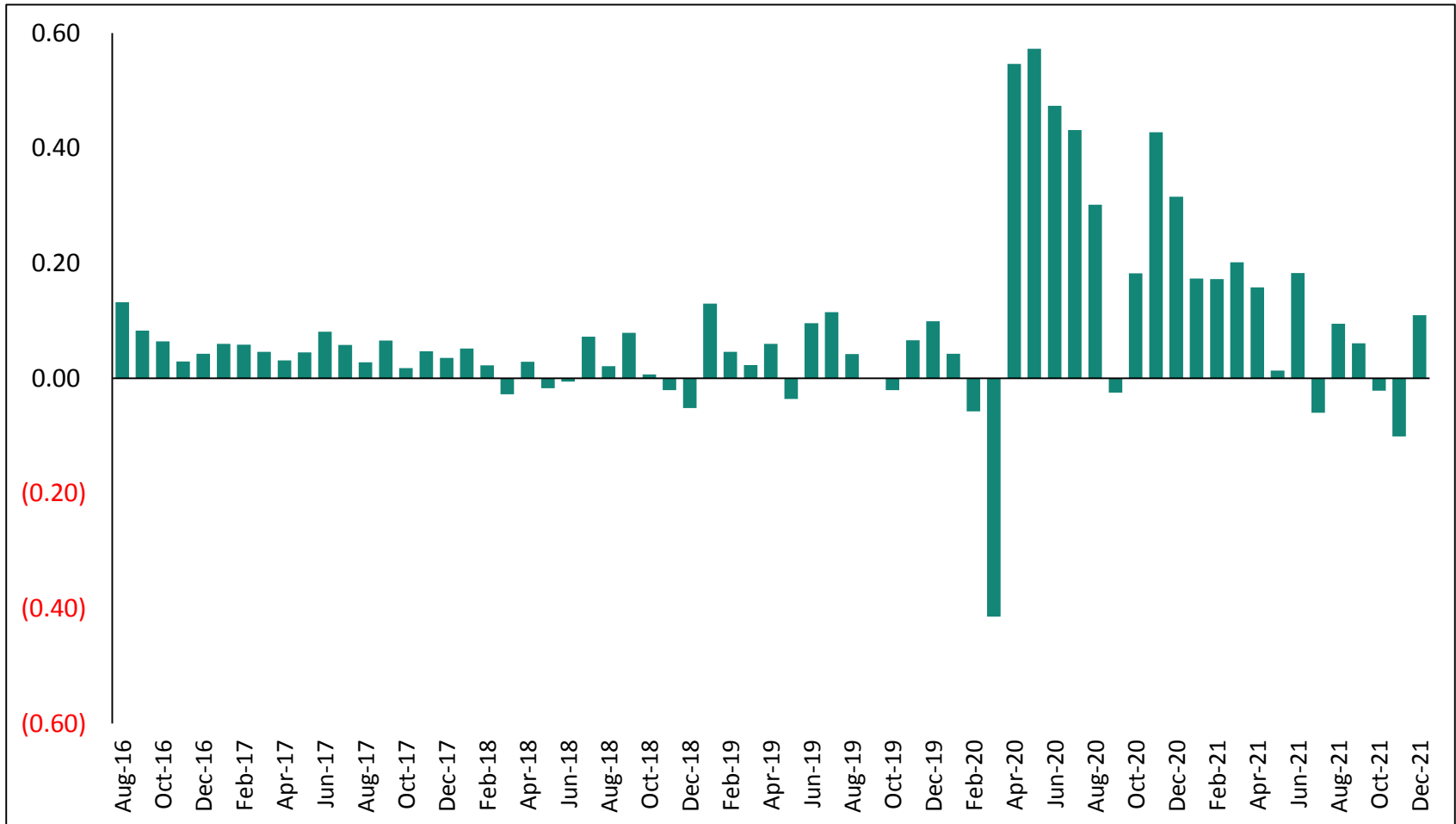


Markets: History of Core Sector Tilts



Source: Aladdin, Bloomberg

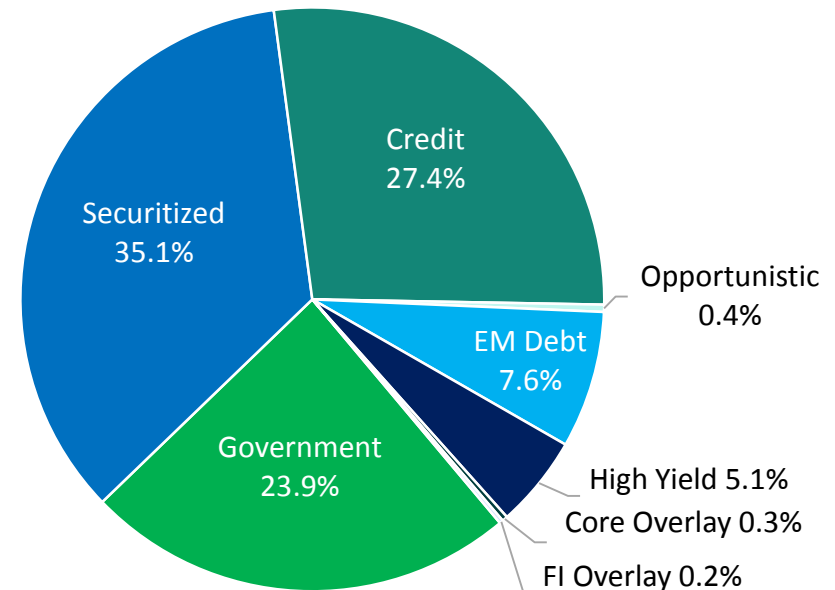
Markets: Program Monthly Excess Returns



Source: BNY Mellon, VRS

Exposures: Fixed Income Snapshot as of 12/31/21

VRS Internal Fixed Income Portfolios		
Strategy	Market Value (\$MM)	Market Value (%)
Government	3,253.2	23.9
Securitized	4,776.4	35.1
Credit	3,730.7	27.4
Opportunistic	50.1	0.4
EM Debt	1,028.4	7.6
High Yield	688.8	5.1
Core Overlay	42.7	0.3
FI Overlay	34.5	0.2
Total	13,604.8	100.0



Highlights From Past Year

- Took advantage of rally in spread sectors to reduce exposure and reposition the portfolio more defensively
- Robust processes and market knowledge helped team realize strong outperformance
- Furthered long-term plan of deeper sector specialization coupled with cross training
- Onboarded a new team member virtually

Results: Core Portfolio Attribution Factors For CY'21



Program Level

- Fiscal and monetary stimulus resulted in spreads back near pre-pandemic tight
- Closed the year with increased rate volatility resulting from Fed speculation
- Sector allocation decisions added 38 basis points to excess return

Portfolio Level

- Fixed income portfolio opportunistically reallocated to a more defensive position
- Team continued to build deeper expertise in EMD and High Yield, while enhancing existing processes for a likely regime shift
- Security selection added 70 basis points to the Program's excess return

Results: Risk/Return Characteristics as of 12/31/21



Program Excess Return and Statistics				
	Since July 2012*	5 Year	3 Year	1 Year
Core FI Program	0.43	1.04	1.50	1.08
Tracking Error	0.42	0.51	0.62	0.34
Information Ratio	1.02	2.05	2.41	3.21
Total FI Program	0.56	1.06	1.53	0.98
Tracking Error	0.93	0.55	0.68	0.36
Information Ratio	0.60	1.93	2.26	2.74

Batting Average

Monthly Excess Returns*		
Core FI Program	85/114	75%

*Beginning July 2012, FI transitioned all assets internally and implemented our enhanced investment approach.

Results: Portfolio as of 12/31/21



Portfolio Excess Return and Statistics

	Since July 2012*	5 Year	3 Year	1 Year
Government	0.32	0.35	0.37	0.28
Tracking Error	0.17	0.20	0.25	0.26
Information Ratio	1.90	1.76	1.45	1.07
Securitized	0.64	0.77	1.10	1.28
Tracking Error	0.47	0.56	0.70	0.45
Information Ratio	1.36	1.37	1.56	2.84
Credit	0.71	0.86	1.09	0.63
Tracking Error	0.34	0.25	0.28	0.20
Information Ratio	2.12	3.50	3.87	3.14
Opportunistic*	–	0.92	0.99	0.87
Tracking Error	–	0.81	0.94	0.79
Information Ratio	–	1.13	1.06	1.10

*Beginning July 2012, FI transitioned all assets internally and implemented our enhanced investment approach.

Results: Portfolio as of 12/31/21



Portfolio Excess Return and Statistics				
	Since Inception*	1 Year	Fiscal YTD	3 Months
Internal EMD	0.29	0.36	(0.13)	(0.32)
Tracking Error	0.67	0.49	–	–
Information Ratio	0.43	0.75	–	–
Payden & Rygel EMD	0.82	0.03	(0.70)	(0.96)
PIMCO EMD	0.61	0.21	(0.64)	(0.85)
Internal High Yield	(0.43)	(0.33)	(0.13)	(0.05)
Tracking Error	0.98	0.45	–	–
Information Ratio	(0.44)	(0.73)	–	–
Man Numeric High Yield	1.27	0.87	0.19	0.08

**Inception dates: Internal EMD Portfolio 11/2018, Internal HY Portfolio 7/2019, External EMD Portfolio 1/2020, Man Numeric HY 7/2020*

People: Collaboration Across Programs



Portfolios

- IEM: Systematic High Yield & Total Fund Rebalance Portfolio
- RBI: RBI Risk Hedging Portfolio
- Operations: Collateral Management Portfolio

People

- Intentional Touch Points Across Programs
- External Manager Partnership Sessions
- Factor Based Investing Work
- Individual Team Member Collaboration



Virginia
Retirement
System

Investment Advisory Committee Portfolio Solutions Group Functional Review Reading & Presentation Deck

April 13, 2022



Overview

(Chung Ma, Managing Director)

Functional Reviews



Risk

(Greg Hines, Investment Officer)



Strategy

(Kristina Koutrakos, Director)



Research

(Steve Peterson, Program Director)



Portfolio Integration

(Matt Lacy, Program Director)

Overview: Team Members Portfolio Solutions Group



Professional	Position	Highest Degree	Professional Certifications	Investment Experience	VRS Tenure
Chung Ma	Managing Director	MA	CFA	26	8
Matt Lacy	Program Director, Port. Integration	MA	CFA	23	23
Kristina Koutrakos	Director, Portfolio Strategy	MBA	CAIA	23	6
Katie Grawe	Sr. Investment Officer	MBA		23	4
Steven Peterson	Program Director, Research	PhD		40	15
Dane Honrado	Research Director, IDS	MS/MBA	FRM	18	6
Advait Apte	Investment Officer	MA/PhD	CFA	10	4
Lisa Davis	Decisions Systems Analyst III	BS	PMP, CSM	5	5
Quynh Phuong	Decision Systems Principal	BS		2	2
Quentin Jefferies	Decision Data Analyst I	BA		2	2
Demory Williamson	Decision Data Analyst I	BS		<1	<1
Ross Kasarda	Director, Risk Management	MA	CFA	17	17
Moses Maxfield	Investment Officer	MBA	CFA, CAIA	15	15
Greg Hines	Investment Officer	MA	CFA	10	8

Risk Management

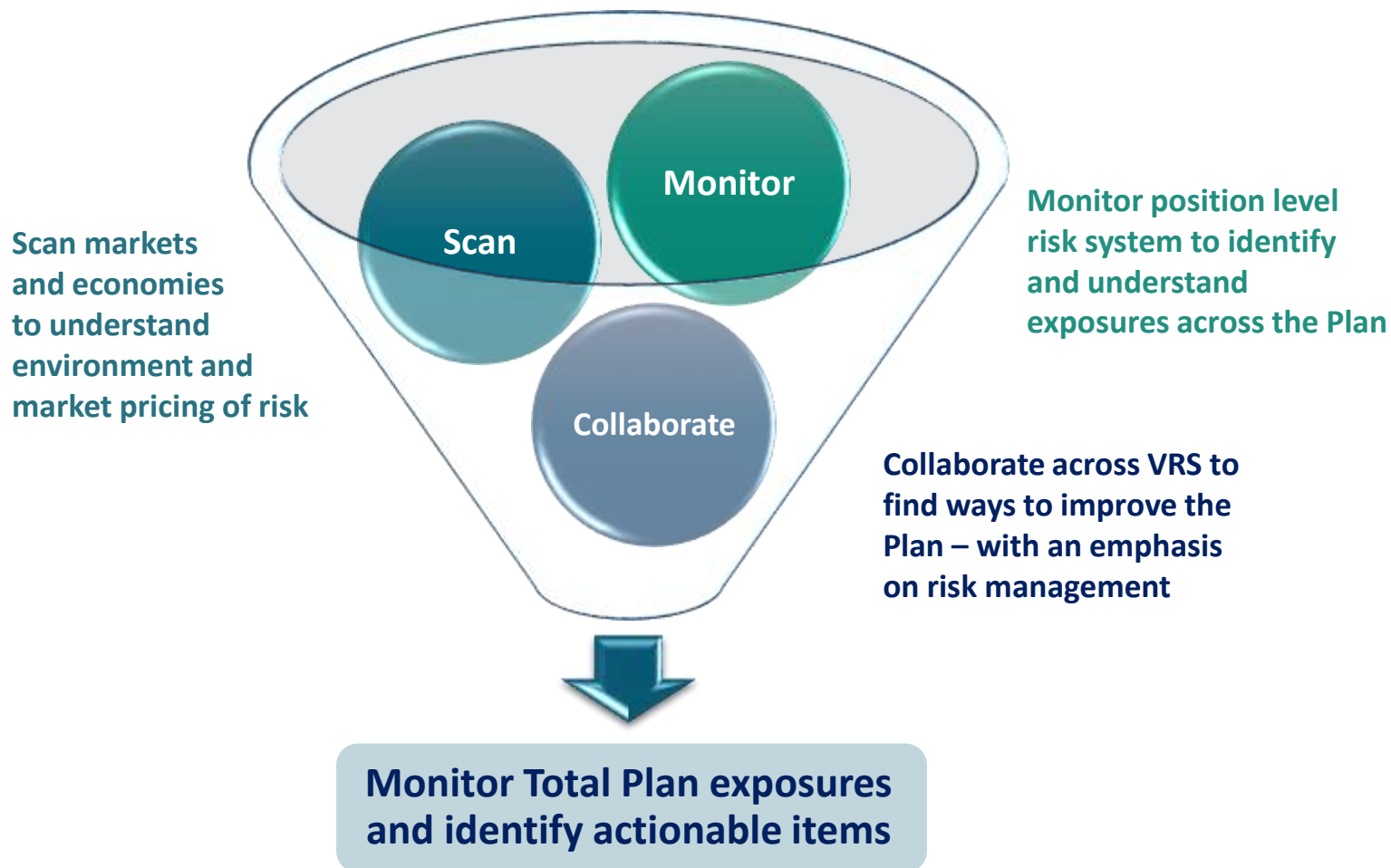
Greg Hines

Investment Officer



Team Members

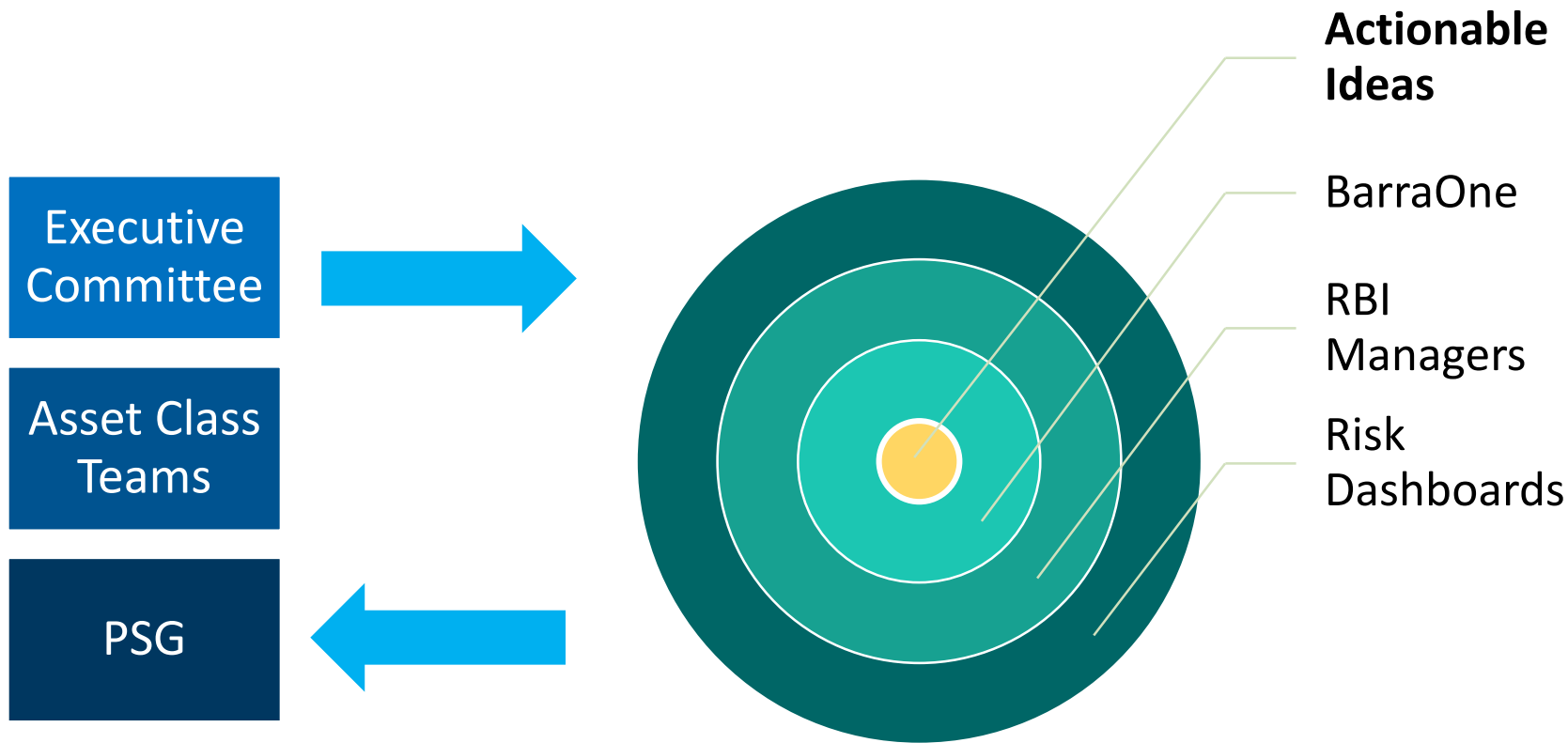
Professional	Position	Highest Degree	Professional Certifications	Investment Experience	VRS Tenure
Ross Kasarda	Director	MA	CFA	17	17
Moses Maxfield	Investment Officer	MBA	CFA, CAIA	15	15
Greg Hines	Investment Officer	MA	CFA	10	8



Risk Management Deliverables

- ✓ Build and monitor Plan-level position risk management system; generate reports to ensure risk controls are in place
 - Key metrics: tracking error, volatility, sectors, country, currency, factor exposures
 - Stress testing and scenario analysis
 - Monitoring changes and trends over time
- ✓ Produce a monthly risk report for the Management Committee identifying key Plan risks and exposures
- ✓ Support Executive Committee and asset class teams with risk and portfolio analytics
- ✓ Work with PSG on portfolio analysis, trade ideas and implementation
- ✓ Manage the Rebalance Account to help facilitate cash flows between asset classes

Risk Team Synergies



- ✓ Deploy Interactive Exposure and Risk Decomposition Reporting in Tableau to each asset class team with a demo and working sessions
- ✓ Continue to use Risk Tools and RBI relationships to identify actionable items for Plan
- ✓ Work with the asset class teams to identify customized reporting tools if desired
- ✓ Expand derivatives understanding in credit, fixed income, and FX asset classes

Risk Management Monthly Update - Excerpts



● All World Systemic Risk ● All World Turbulence ...

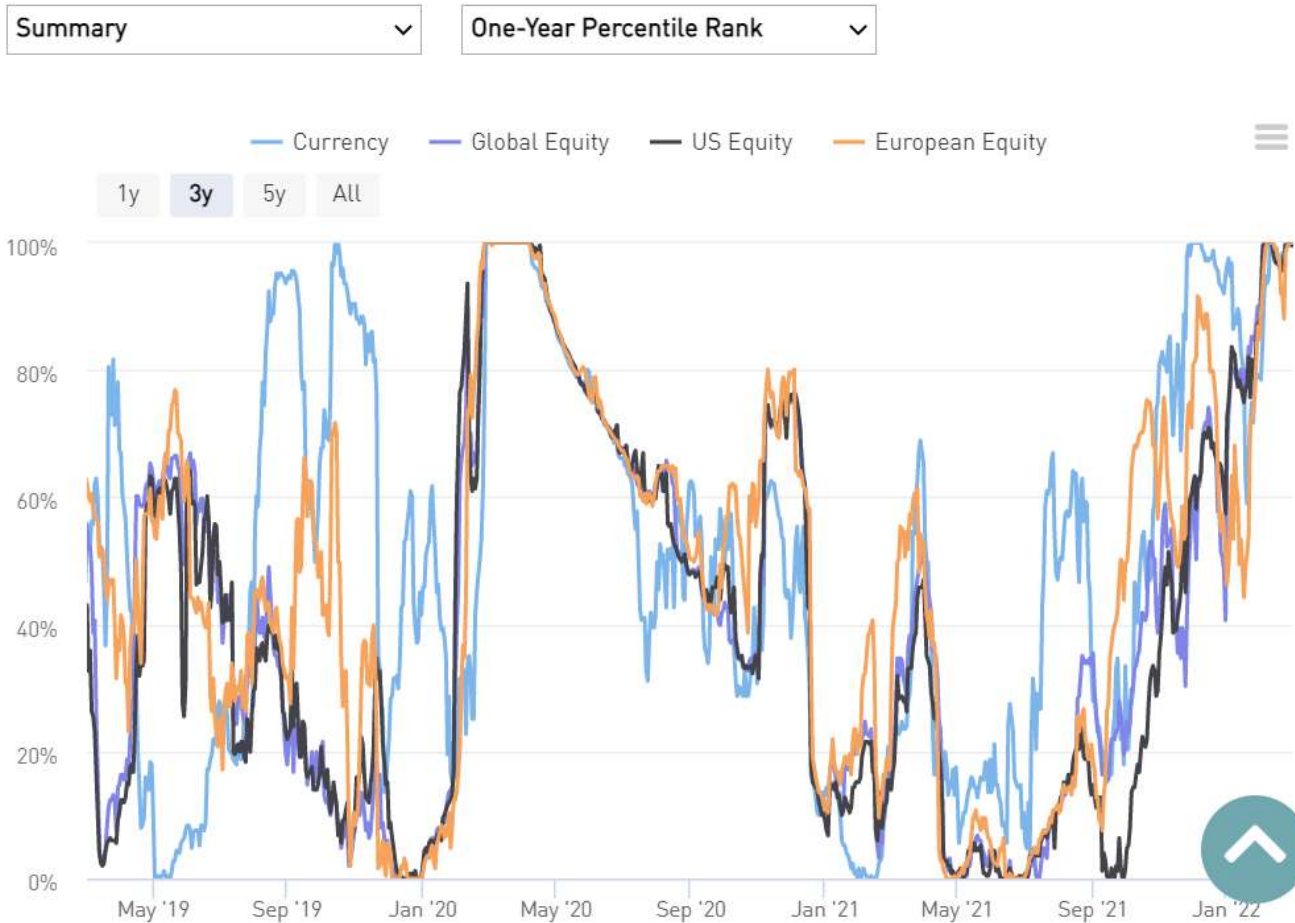
From: 3/2/2021  To: 3/2/2022 
Quick View: 6m YTD 1y 3y 5y All



Each State Street Turbulence Index provides a daily measure of market turbulence based on the collective unusualness of global equity sector returns. Thus, the relative turbulence of a given day can stem from the returns of unusual magnitude, or from the unusual interaction of a combination of assets, none of which is necessarily unusual in isolation. The more abnormal the returns, the higher the Turbulence Index value will be.

The systemic risk indices measure the fragility of global equity markets. High levels of systemic risk indicate that unexpected shocks are likely to propagate quickly and broadly through equity markets, potentially leading to significant drawdowns. Low levels of systemic risk indicate that markets are loosely linked and may be more robust to shocks.

Turbulence Indices



Each State Street Turbulence Index provides a daily measure of market turbulence based on the collective unusualness of global equity sector returns. Thus, the relative turbulence of a given day can stem from the returns of unusual magnitude, or from the unusual interaction of a combination of assets, none of which is necessarily unusual in isolation. The more abnormal the returns, the higher the Turbulence Index value will be.

IAC Meeting – April 13, 2022

Factor Risk Positioning

Barra Risk Decomposition Drill-down by Portfolio and Model

Specify Portfolio
VRS Total Plan_HF

Specify Effective Date
December 2021

Specify Model
MAC.L Tier 2 Global

Expand Hierarchy to Level
4

Risk Details as of December 2021

Risk Source	Factor Risk	Portfolio Risk	Portfolio Risk Contribution	Portfolio Risk Contribution %	Benchmark Risk	Benchmark Risk Contribution	Benchmark Risk Contribution %	Active Risk	Active Portfolio Risk Contribution	Active Portfolio Risk Contribution..	Portfolio Exposure	Active Exposure
Total Risk		12.11	12.11	100.00%	10.53	10.53	100.00%	2.98	2.98	100.00%		
Local Market Risk		11.69	11.65	96.26%	10.15	10.12	96.06%	2.96	2.95	99.05%		
Common Factor Risk		11.68	11.63	96.07%	10.12	10.07	95.63%	2.90	2.83	95.04%		
Industry		0.12	-0.05	-0.40%	0.06	-0.02	-0.23%	0.06	-0.01	-0.46%		
Style		0.60	0.39	3.19%	0.08	0.03	0.33%	0.58	0.23	7.80%		
Term Structure		0.65	-0.16	-1.35%	0.77	-0.17	-1.64%	0.11	0.03	0.87%		
Inflation		0.00	0.00	0.01%	0.00	0.00	0.00%	0.00	0.00	0.01%		
Spread		0.97	0.70	5.77%	1.02	0.73	6.95%	0.05	-0.01	-0.41%		
Commodity		0.01	0.00	0.02%	0.00	0.00	0.00%	0.01	0.00	0.05%		
Equity Implied Vol		0.00	0.00	0.01%	0.00	0.00	0.00%	0.00	0.00	0.02%		
Private Real Estate		0.81	0.61	5.05%	0.90	0.71	6.75%	0.10	-0.03	-0.99%		
Hedge Fund		0.02	0.00	0.00%	0.00	0.00	0.00%	0.02	0.00	0.01%		
Country		0.12	0.05	0.42%	0.01	0.00	0.05%	0.11	0.03	1.02%		
Market		9.87	9.31	76.93%	8.80	8.43	80.08%	1.08	0.48	16.00%		
Private Equity		2.75	0.54	4.44%	0.00	0.00	0.00%	2.75	2.18	73.10%		
Private Infrastructure		0.00	0.00	0.00%	0.00	0.00	0.00%	0.00	0.00	0.00%		
Factor Residual Risk		2.76	0.24	1.99%	2.33	0.35	3.34%	1.03	-0.06	-1.97%		
Specific Risk		0.53	0.02	0.19%	0.69	0.05	0.43%	0.60	0.12	4.01%		
Currency Risk		1.00	0.45	3.74%	0.89	0.41	3.94%	0.15	0.03	0.95%		



Virginia
Retirement
System

Portfolio Strategy

Kristina Koutrakos

Director, Portfolio Strategy



Team Members

Professional	Position	Investment Experience	VRS Tenure
Kristina Koutrakos, CAIA	Director, Portfolio Strategy	23	6
Industry Experience	Kyria Capital, co-Founder, Managing Partner Multi-family office, Managing Director, Investment Strategy BlackRock, Director, Fixed Income & Credit Portfolio Manager Western Asset, Fixed Income Portfolio Manager		
Education	Cornell University, MBA University of Virginia, BA, Economics		
Katherine Grawe	Portfolio Manager	23	4
Industry Experience	Corestone Investment Managers, Co-Director of Research Rocaton Investment Advisors, Manager Research Cambridge Associates, Manager Research		
Education	University of Edinburgh, MBA Colgate University, BA, Anthropology		

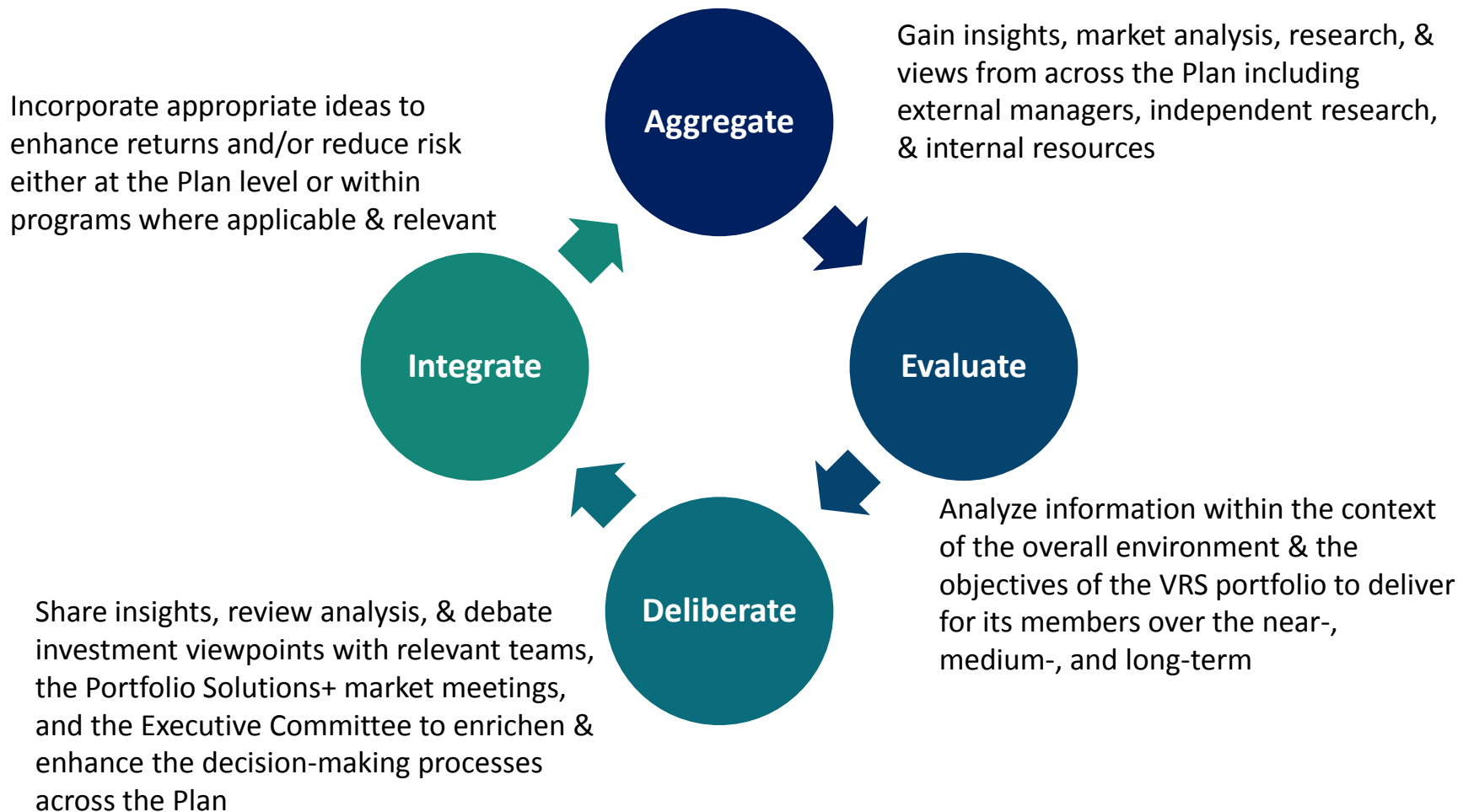
VRS Strategic Advantages

- Access to a broad and flexible set of **investment insights** across asset classes, geographies, and time frames
- **Long-term** time horizon

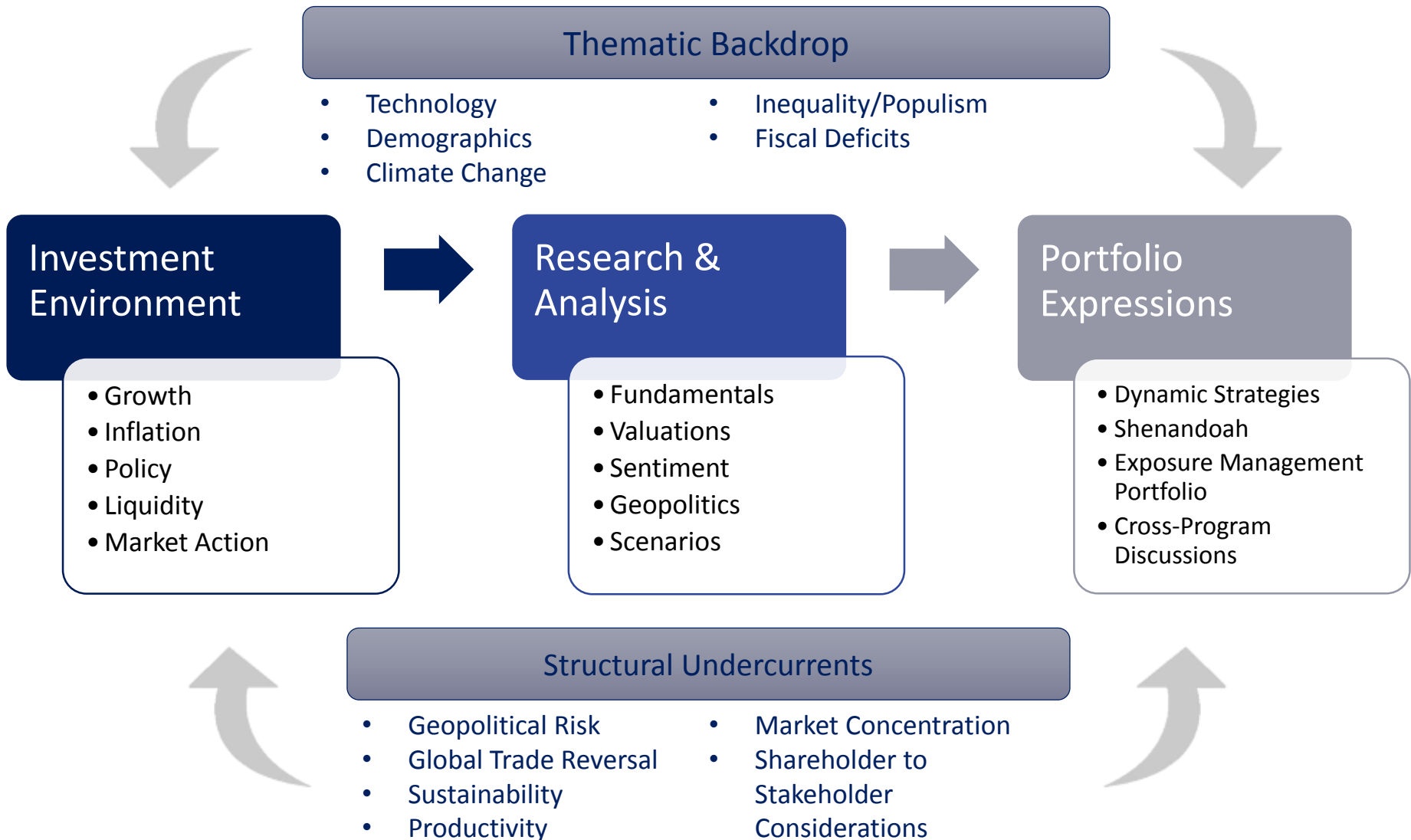
Strategy Team Investment Objective

- Add **asset allocation alpha** and **diversify excess return** sources
- Identify long-term **thematic drivers** and consider ways to incorporate **structural change** into the portfolio
- Invest over **multiple time horizons**

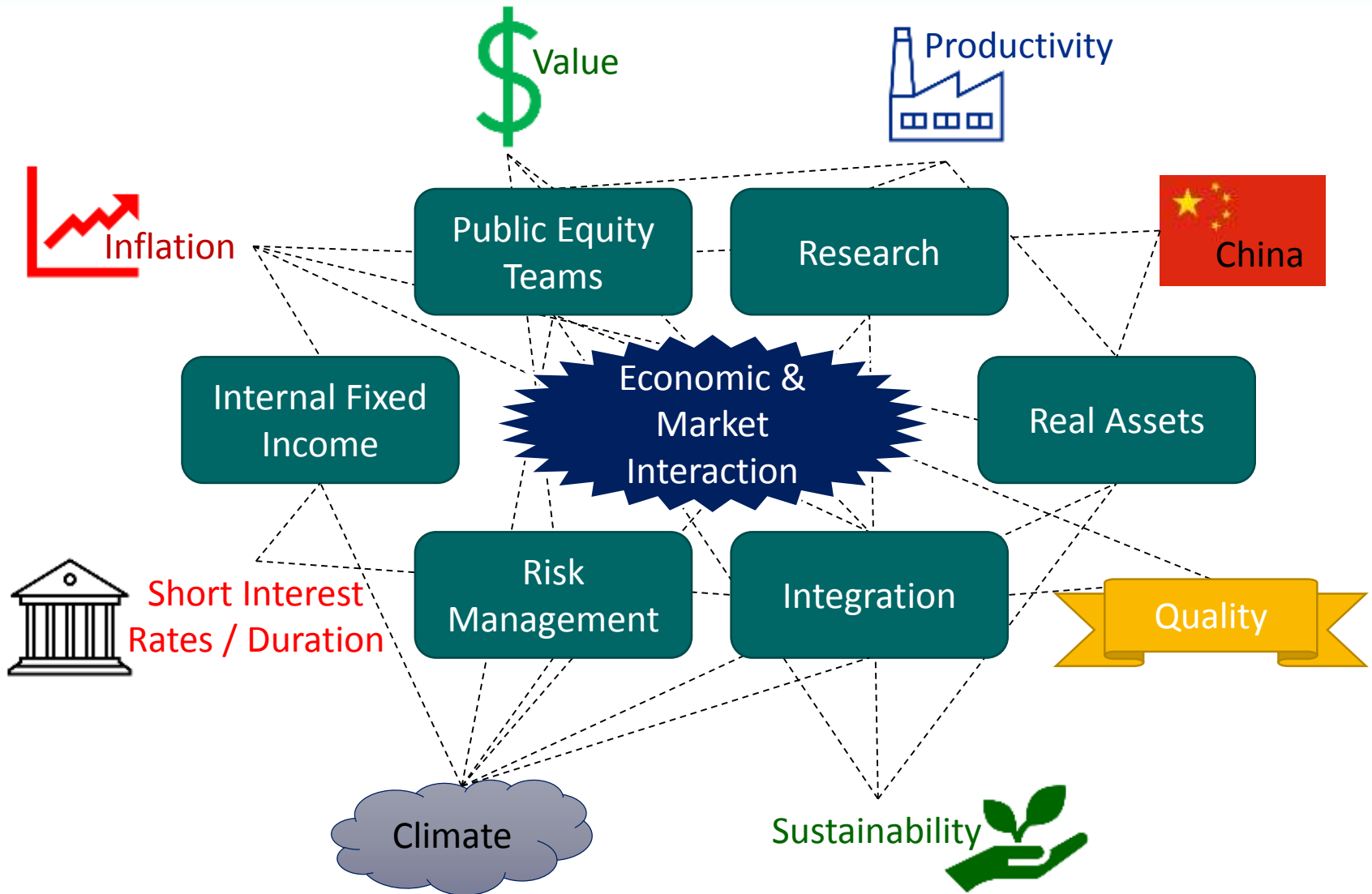
The Strategy team seeks to add value through active asset allocation management and the identification of opportunities across the investment landscape.



Process Integration

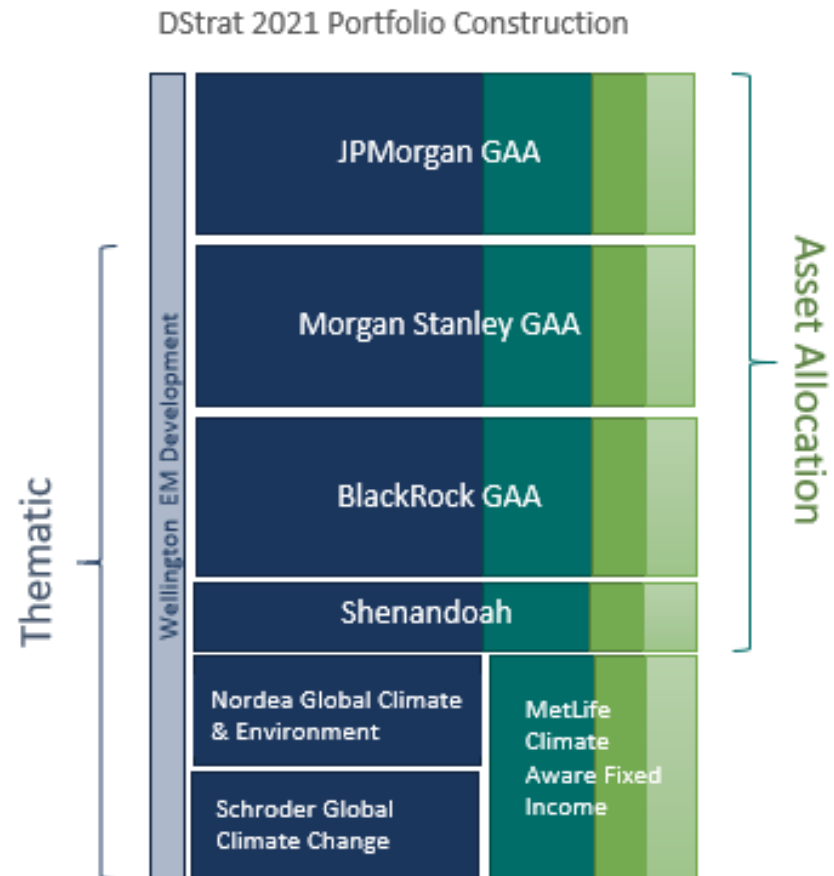


2021 Engagement Examples



FY2022 Plans & Priorities

- Strategic partnerships and asset allocation mandates continue to strengthen
- Ongoing focus on Shenandoah and internal active asset allocation efforts
- Continued collaboration across the Plan
- Continued thematic development and incorporation into the investment portfolio where appropriate and impactful





Virginia
Retirement
System

Research

Steven Peterson

Program Director – Research & IDS



Research Team

Professional	Position	Highest Degree	Professional Certifications	Investment Experience	VRS Tenure
Steve Peterson	Director	MA, PhD		40	15
Advait Apte	Sr. Investment Officer	MA, PhD	CFA	10	4
Dane Honrado	Research Director	MS, MBA	FRM	18	6
Lisa Davis	Decision System Analyst III	BS	PMP, CSM, Investment Foundations	5	5
Quynh Phuong	Decision Systems Principal	BS	Investment Foundations	2	2
Demory Williamson	Decision Data Analyst I	BS		<1	<1
Quentin Jefferies	Decision Data Analyst I	BA		2	2
Contractors/ Consultants	Additional Support		Skills vary based on current needs. Examples include data modeling, report building and project management	Mid to senior level as require by specific project(s)	

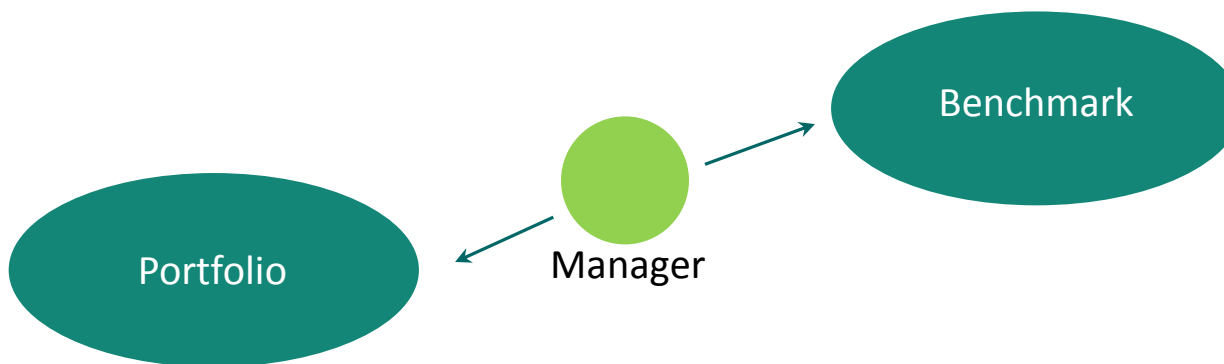
Investment Foundations: CFA Institute® Investment Foundations Certificate

Case 1: Do Prospective Managers Improve Diversification?



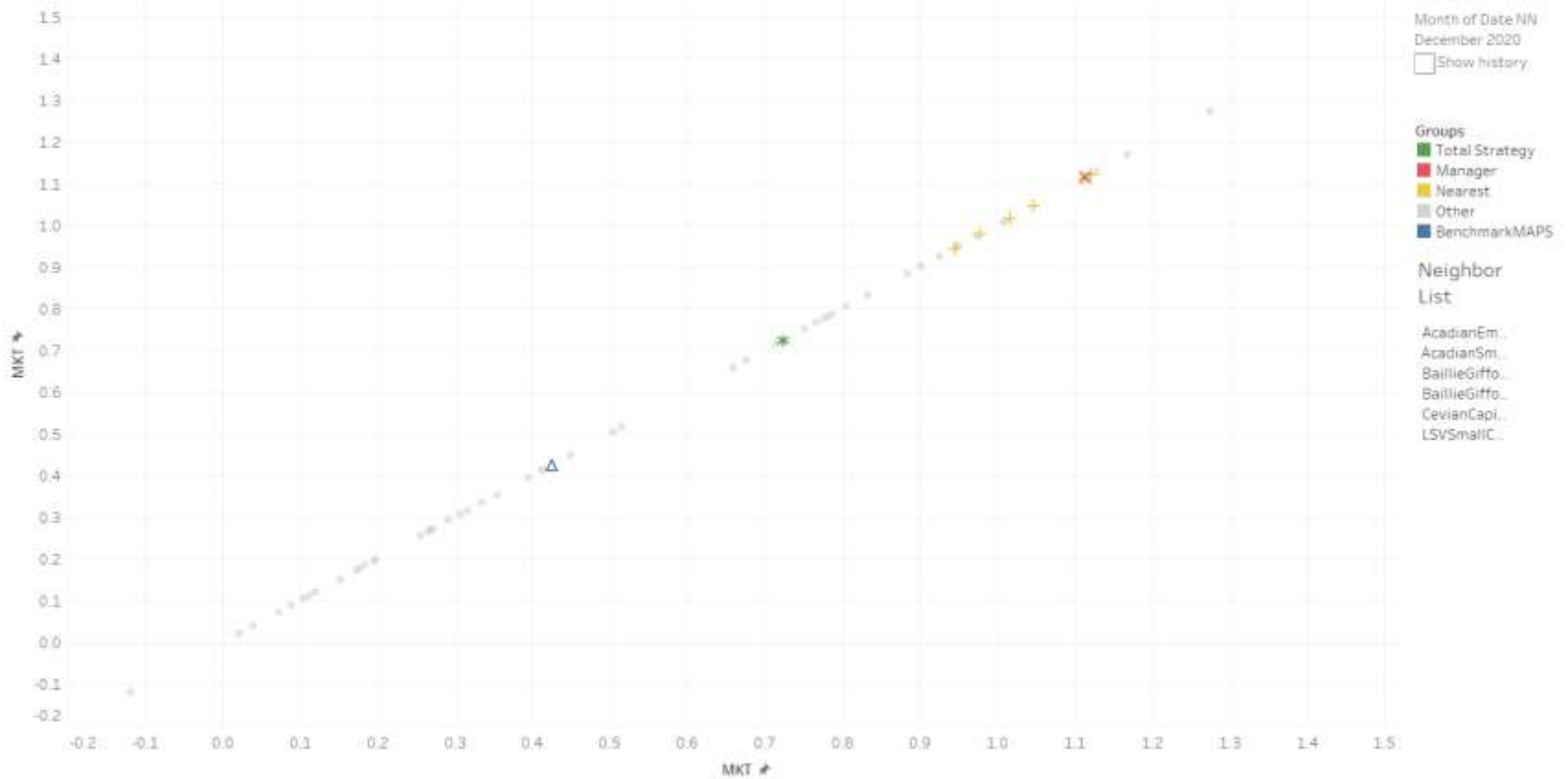
Complements the manager due diligence process

- In which direction, w.r.t the benchmark, does the manager under consideration move the portfolio?
- Does the new manager diversify the VRS portfolio?
- Does the new manager duplicate existing exposures?



Nearest Neighbor Clouds

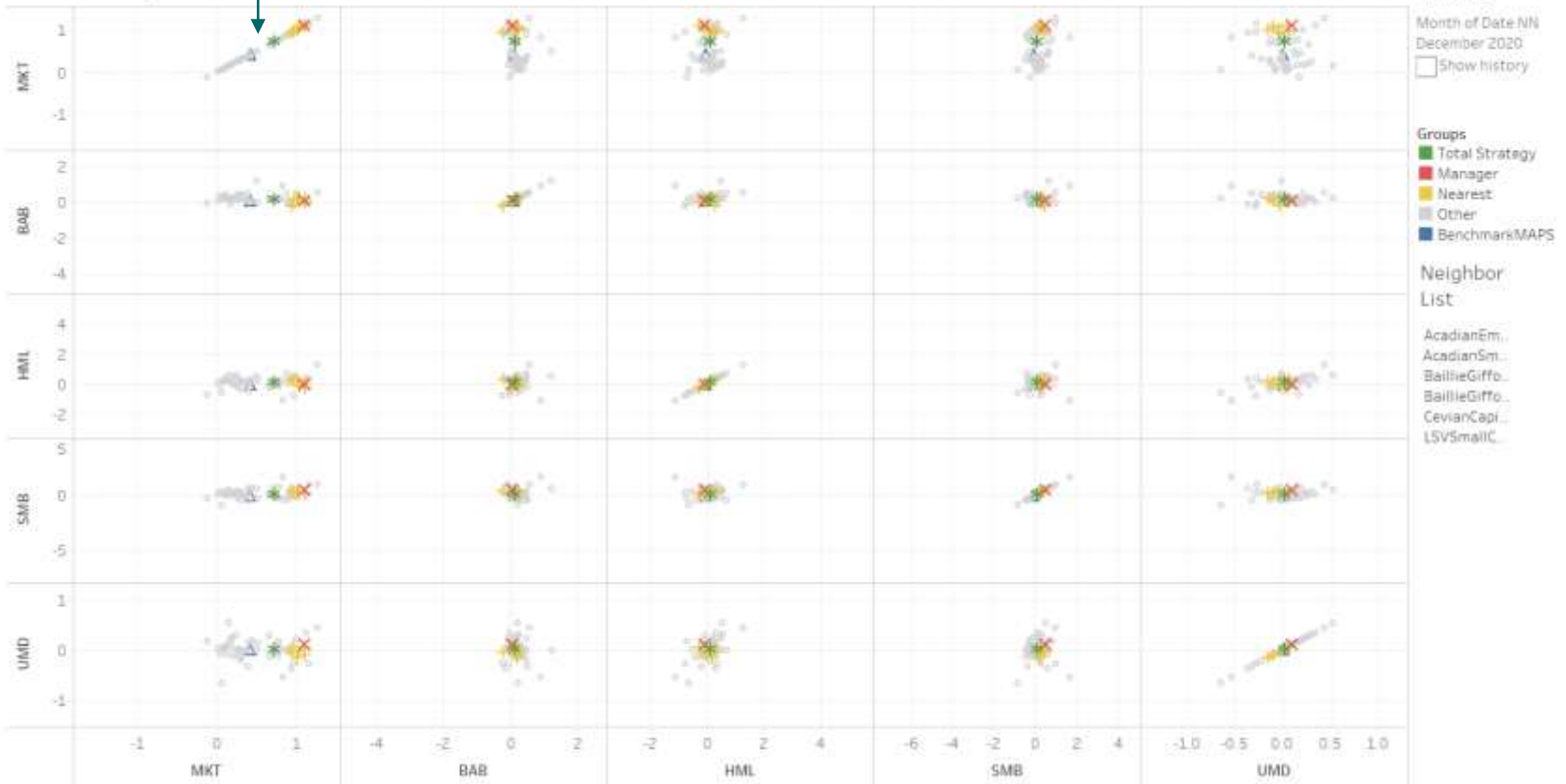
Nearest Neighbor Clouds - December 2020



Nearest Neighbor Clouds

Just looked at this one

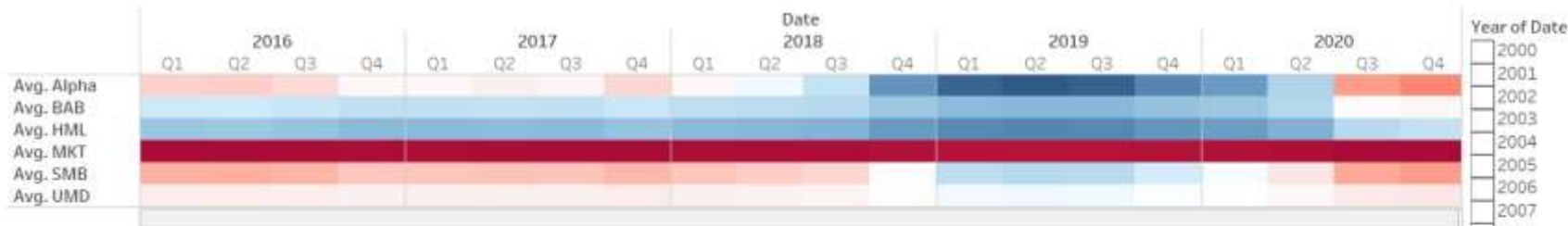
Nearest Neighbor Clouds - December 2020



MKT: Equity market, BAB: low volatility, HML: value v. growth, SMB: small v. large cap, UMD: momentum

Schroders Heat Map (Beta & Return Attribution)

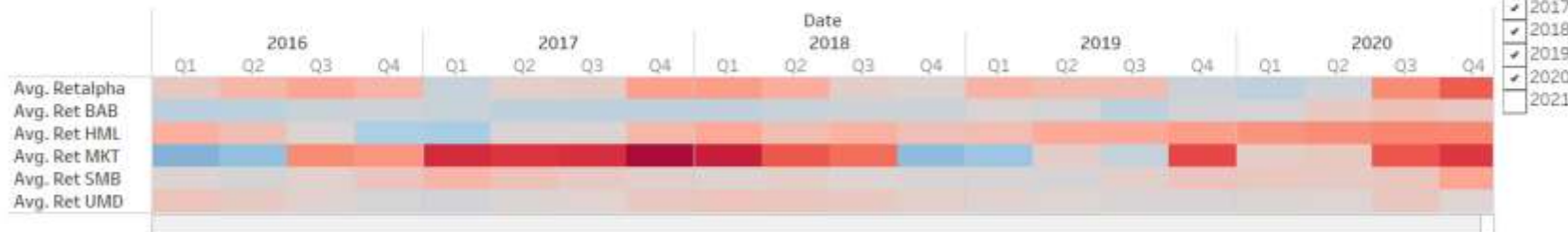
AQR Beta



Measure Values



AQR Return Attribution



Measure Values



Case 2: Natural Language Processing



Portfolio Integration

Matt Lacy

Director, Portfolio Integration



- Provide uncorrelated returns from an absolute and excess return perspective
 - Risk Based Strategies
 - Tactical Asset Allocation
 - Macro and multi-asset strategies
 - Internally managed strategies and hedges
- Provide consulting services to the Plan
 - Risk management
 - Research
 - Strategy
 - Systems and data delivery
 - Implementation
 - Currency

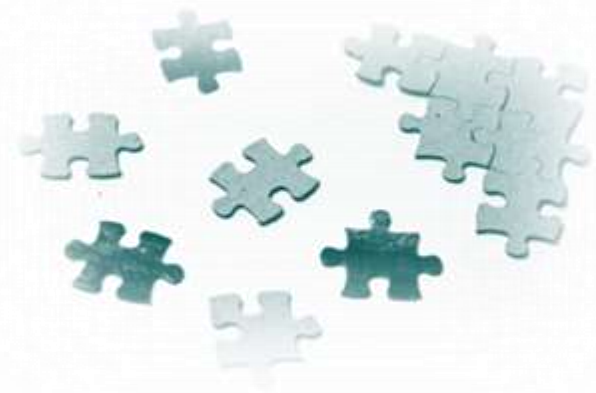
Identify resources and expertise across the Plan and bring that to bear to provide investment solutions and exploit opportunities

Integrate all the components of an investment or trading strategy

- Establish objectives
- Idea generation and research
- Data and systems
- Portfolio construction and risk management
- Trading and implementation
- Monitoring trades and existing positions

Transfer knowledge and skills across the organization

Make sure all the parts fit together!



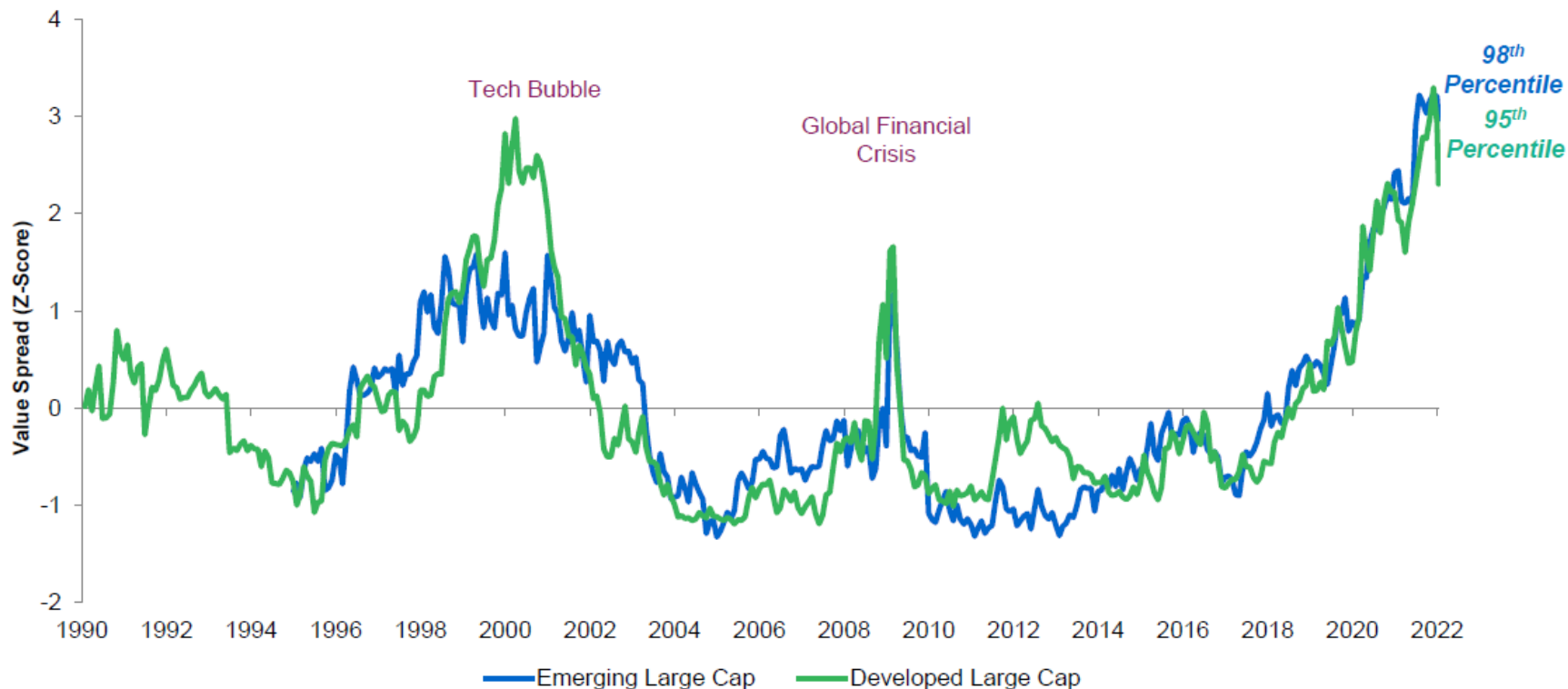
Case Study: AQR Value Trade

- Sought to take advantage of historically wide discounts between value and growth equities
- Identified as most attractive expression among other Value opportunities
- Account Structure
 - Long/Short Market Neutral
 - Targets 10 – 15% annual volatility
 - Seeks to maintain sector and country neutrality
 - Investment Universe: MSCI ACWI Standard (All Country World Index)

Factor Spreads are Attractive

Value Spreads for Hypothetical AQR Industry-and-Dollar-Neutral Value Portfolios*

January 1, 1990 – January 14, 2022

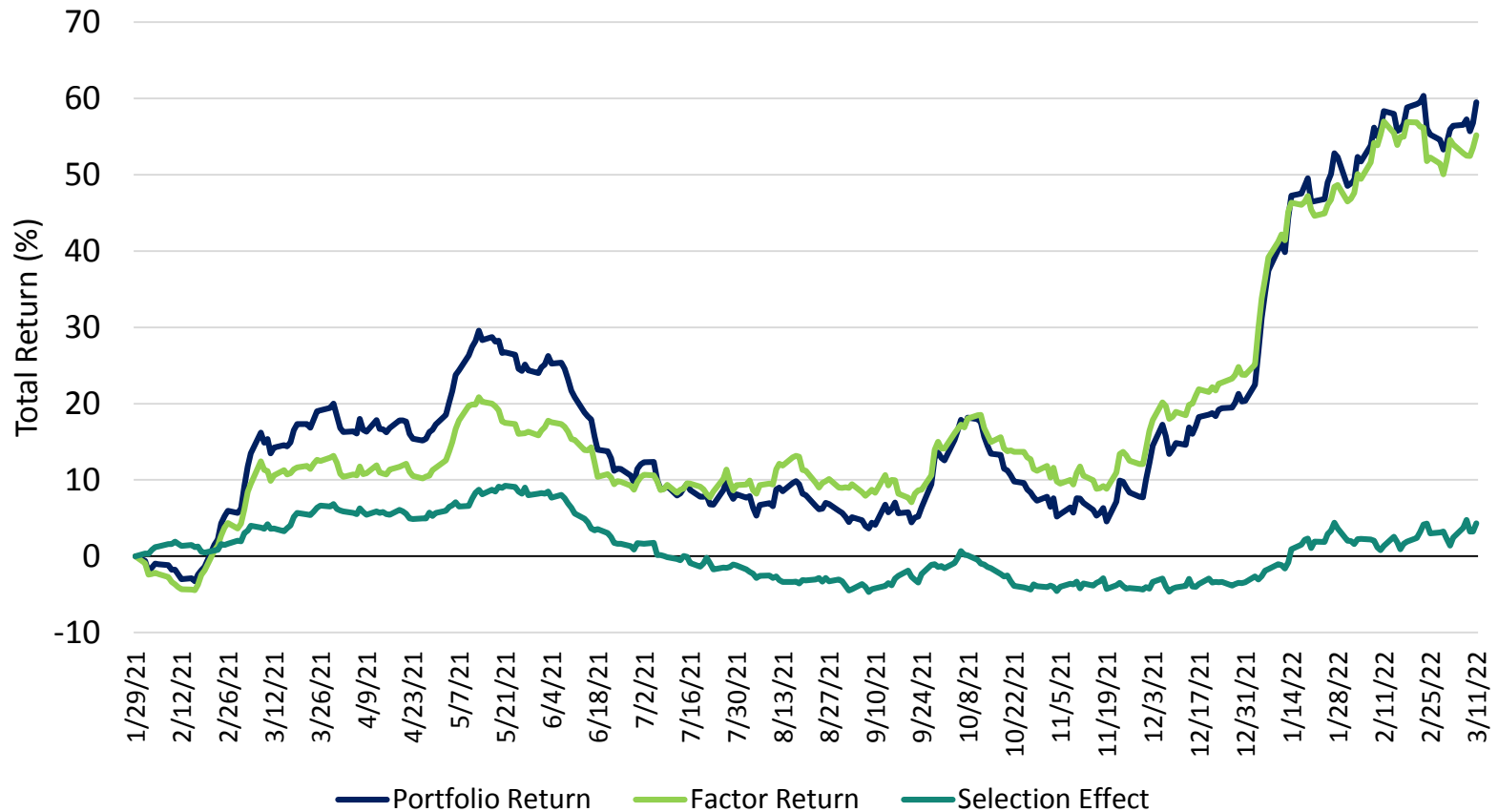


*Spreads are constructed using the Hypothetical AQR Value portfolio as described below, and are adjusted to be dollar-neutral, but not necessarily beta-neutral through time.

Source: AQR. Hypothetical value composite includes five value measures: book-to-price, earnings-to-price, forecast earnings-to-price, sales-to-enterprise value, and cash flow-to-enterprise value; spreads are measured based on ratios. To construct industry-neutrality, the value spreads are constructed by comparing the aforementioned value measures within each industry, which are then aggregated up to represent an entire portfolio. Hypothetical data has inherent limitations, some of which are disclosed in the Appendix. Please see the Hypothetical AQR Developed and Emerging Value Model Descriptions in the Appendix. For illustrative purposes only and not representative of an actual portfolio AQR currently manages. Please read the Appendix for important disclosures.



AQR Value Trade



* Performance is approximated using lagged holdings and does not include management fees or transaction costs

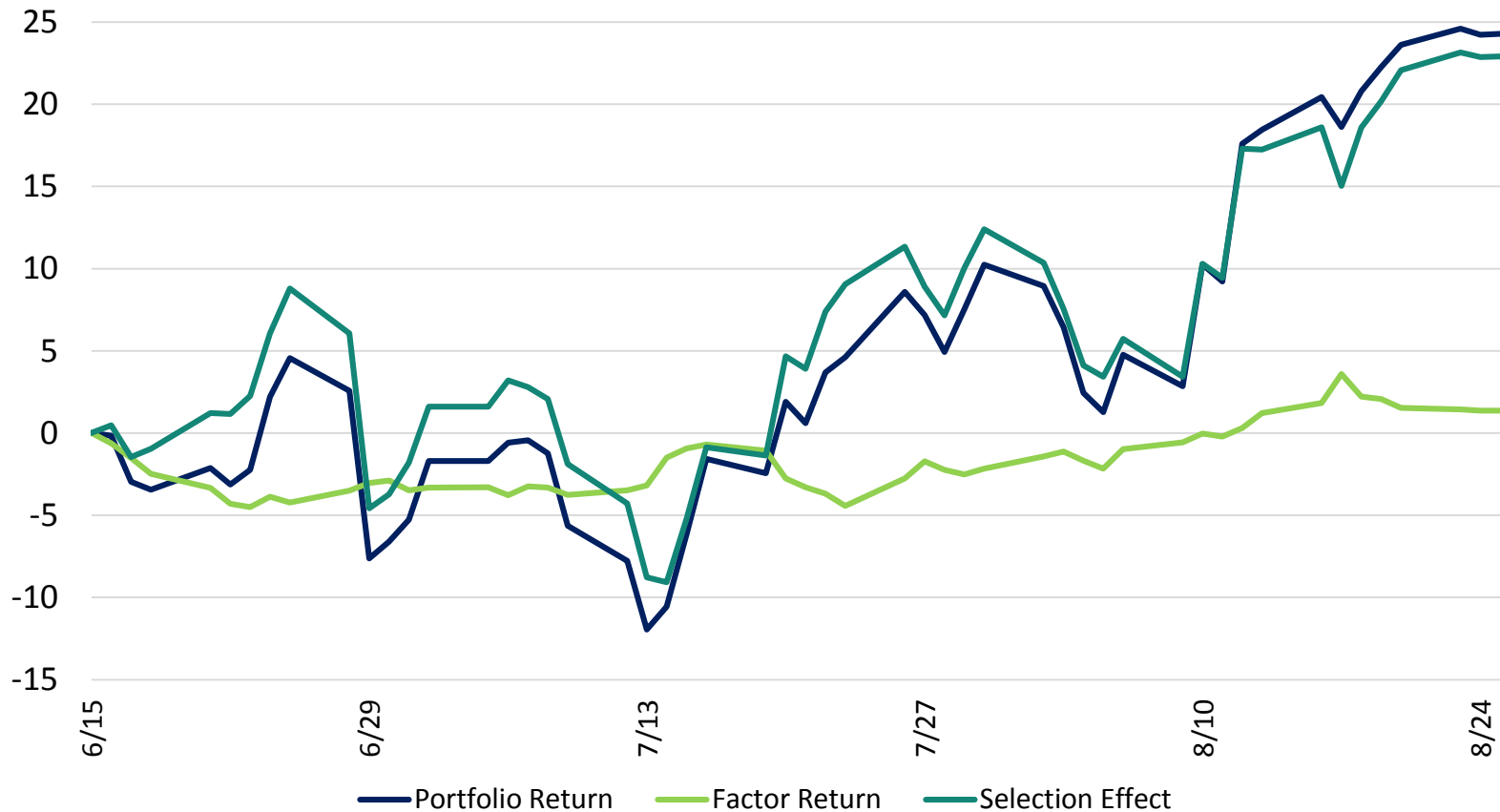
Single Name Equity Hedge Trade

- Sizeable position in a recent IPO (under lockup)
- Desire to reduce risk on this position
- Key challenges:
 - Liquidity
 - Specific risk - Stock is modeled at 46 vol (76% is specific risk)
 - Are we eligible to hedge the position?
 - Can we source the shares to borrow?
 - Can we find a dealer that can act as principal?

Hedge Structure and Timeline

- PSG and X-team worked together to structure the hedge
- Long S&P500, Short the stock, both on swap
- Worked with Legal team to ensure eligibility
- IEM traders executed the trade over 9 days
- Maintaining the borrow was a challenge. Financing rates were close to 20% per annum at the end.
- Carried hedge position for approximately 3 months until underlying stock came out of lockup
- Trade generated \$30mm of profit (21% of notional) that can be used to offset losses on the underlying stock. Note that the stock was still a gain for the Public Equity portfolio. The hedging trade helped to preserve the gains on the position.

Hedge Performance (Excluding Financing Costs)



- Transition management of Potomac, our Large Cap US Enhanced Index Strategy, to the IEM team.
- Work with the FI team to expand risk management and portfolio construction tools for internally managed systematic High Yield strategy.
- Continue working with D-Strat and RBI teams to evaluate managers and new strategies.
- Continue research on developing an internally managed systematic macro strategy.
- Evaluate external systematic macro strategies. Look to form partnerships to help with our internal efforts.