South Dakota
INVESTMENT
COUNCIL

Asset Allocation

JUNE 20, 2023

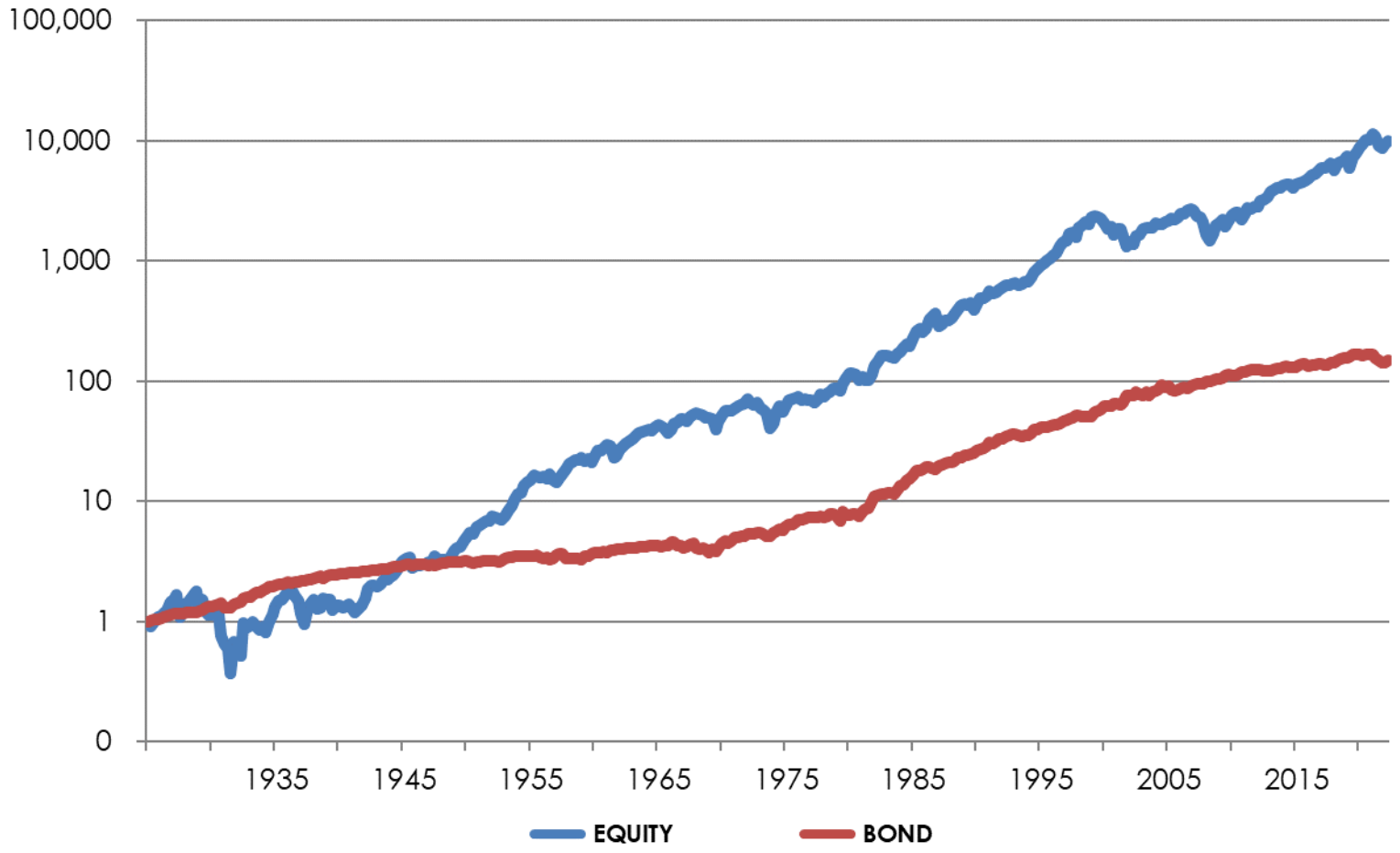
Discussion Topics

- Equity and Bond Risk Assessment
- Benchmark Policy and Ranges
- Expected Return and Volatility
- Asset Category Valuation
- Asset Allocation Implementation

Equity and Bond Risk Assessment

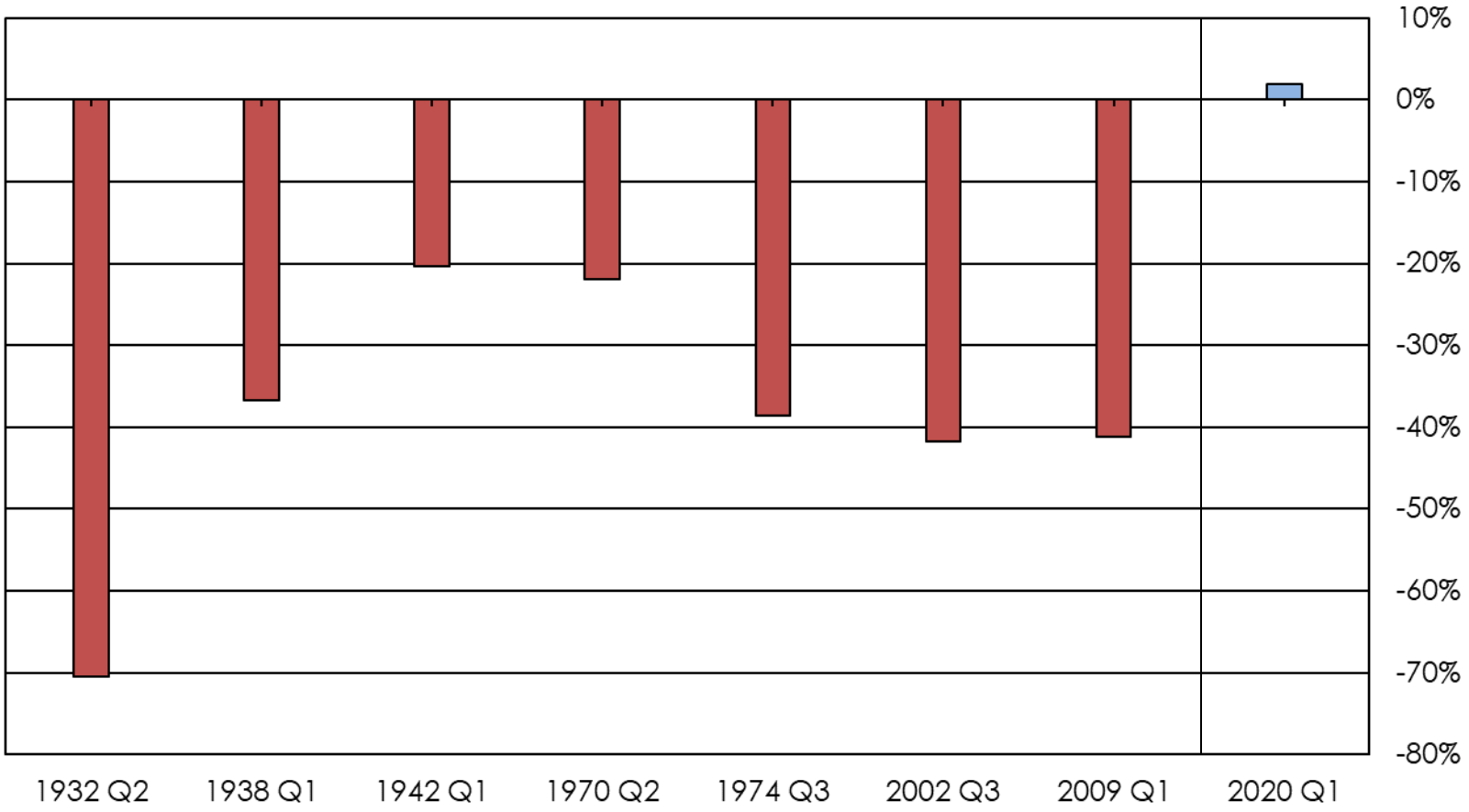
- Historical outcomes are helpful in relating to impact of risk
- Long-term return history is available only for equity, bonds, and cash
- Equity returns are best over the very long term, but are volatile
- Bonds returns are lower over the long term, but provide diversification
- Return/risk tradeoff depends on willingness to endure volatility

Long-Term Equity Returns Exceed Bond Returns



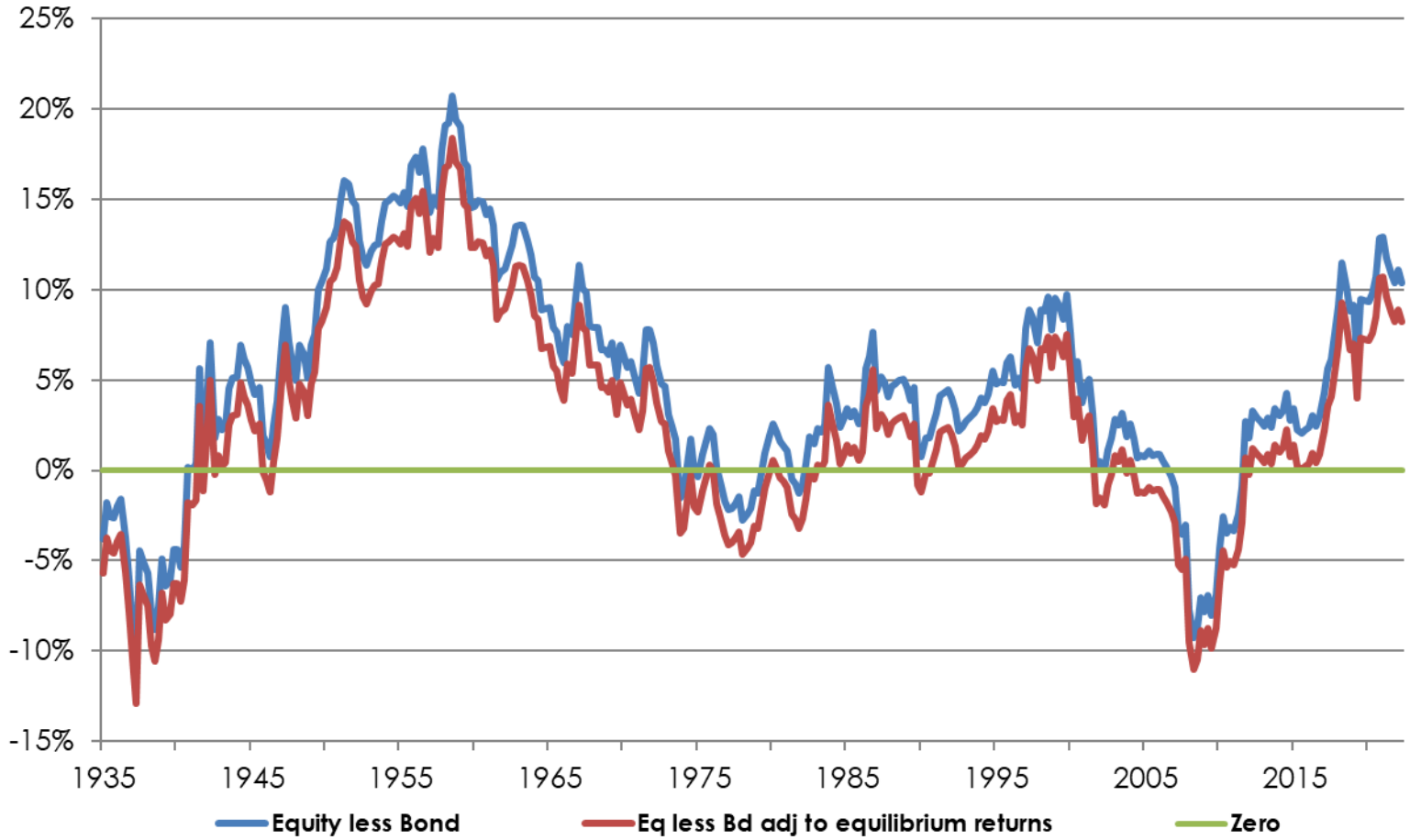
Equity Downturns Can Be Severe

Two-year periods with equity returns below negative 20%



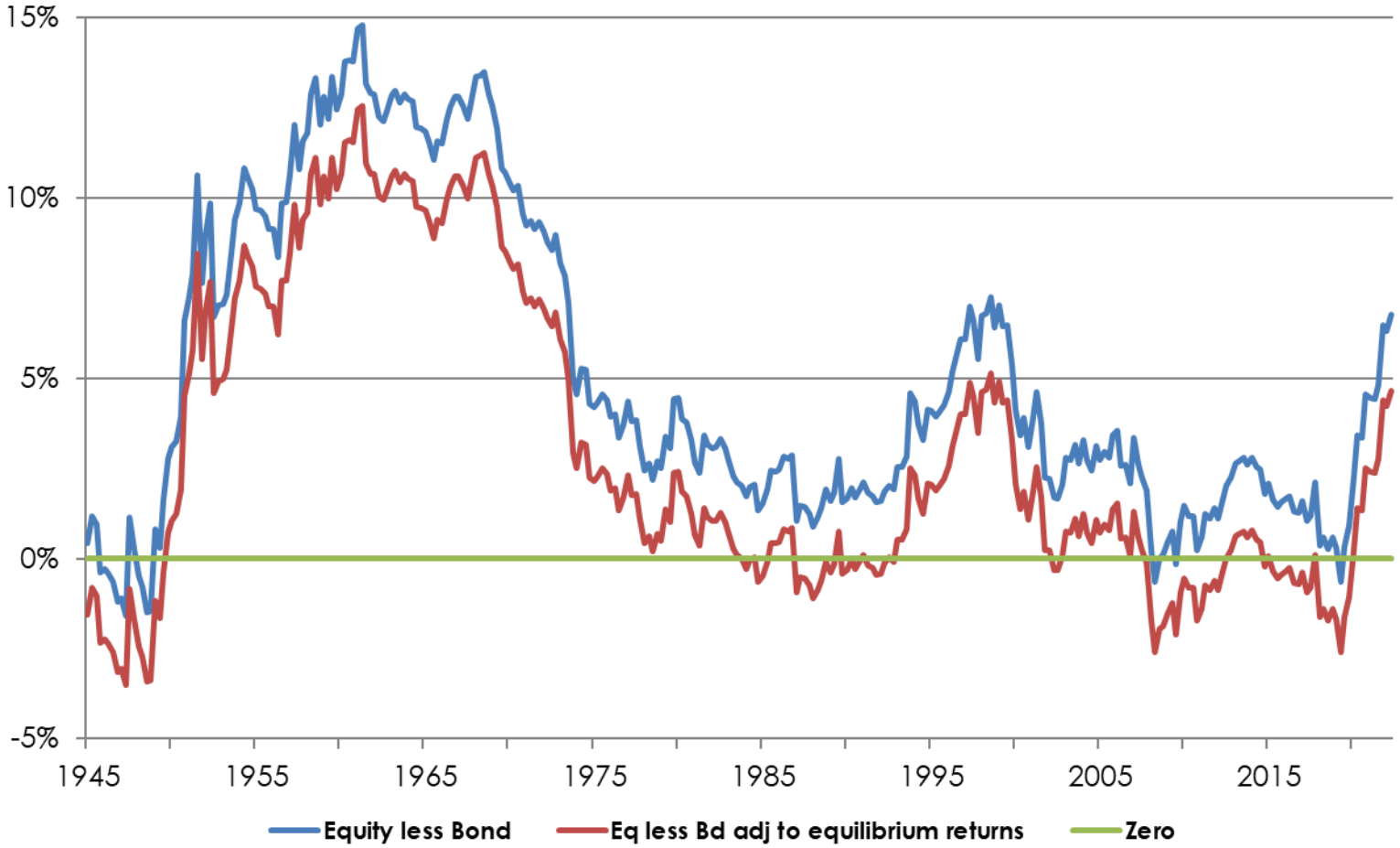
Equity Less Bond Return Rolling 10-Yr Periods

Red line adjusted to impose future equilibrium returns on past



Equity Less Bond Return Rolling 20-Yr Periods

Red line adjusted to impose future equilibrium returns on past



Benchmark Policy and Ranges

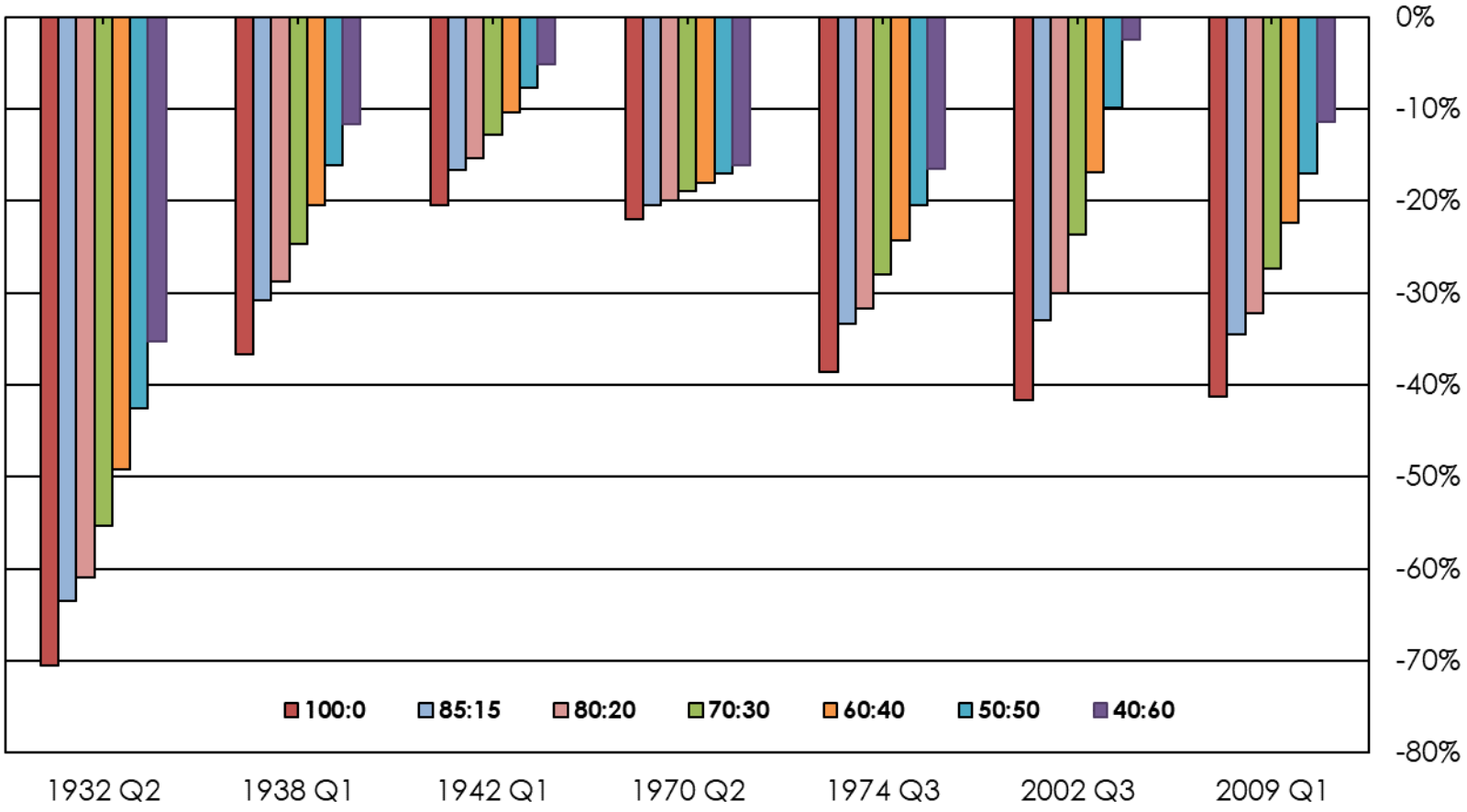
- Recommend benchmark equity-like risk of 70%, bond-like risk of 27%, cash-like risk of 3%
  - Balances long-term returns with drawdown risk
  - Important that the benchmark can be adhered and rebalanced to through thick and thin
- Recommend 40% to 85% equity-like risk range
  - 40% equity-like risk minimum
    - Increases underperformance risk but also reduces absolute risk when markets are extremely expensive
    - Still provides meaningful exposure if wrong or early
    - Steps below 50% are for when markets are extremely expensive such as 1999
  - 85% equity-like risk maximum
    - Recommend for when markets are very cheap (using our valuation measures)
    - Cheapness would suggest much of a potential decline had already occurred
    - Weathered this maximum during the financial crisis

Benchmark Policy and Ranges

- 15% to 60% bond-like risk range
  - Minimum provides diversification
  - Recommend maximum when bonds are cheap
- Goal
  - Enter market downturns with near minimum benchmark risk
  - Increase benchmark risk toward maximum during downturn to benefit from eventual rebound
- Markets typically continue to rise or fall further after reaching minimum or maximum risk thresholds
  - Essential to be patient for 5 years or more

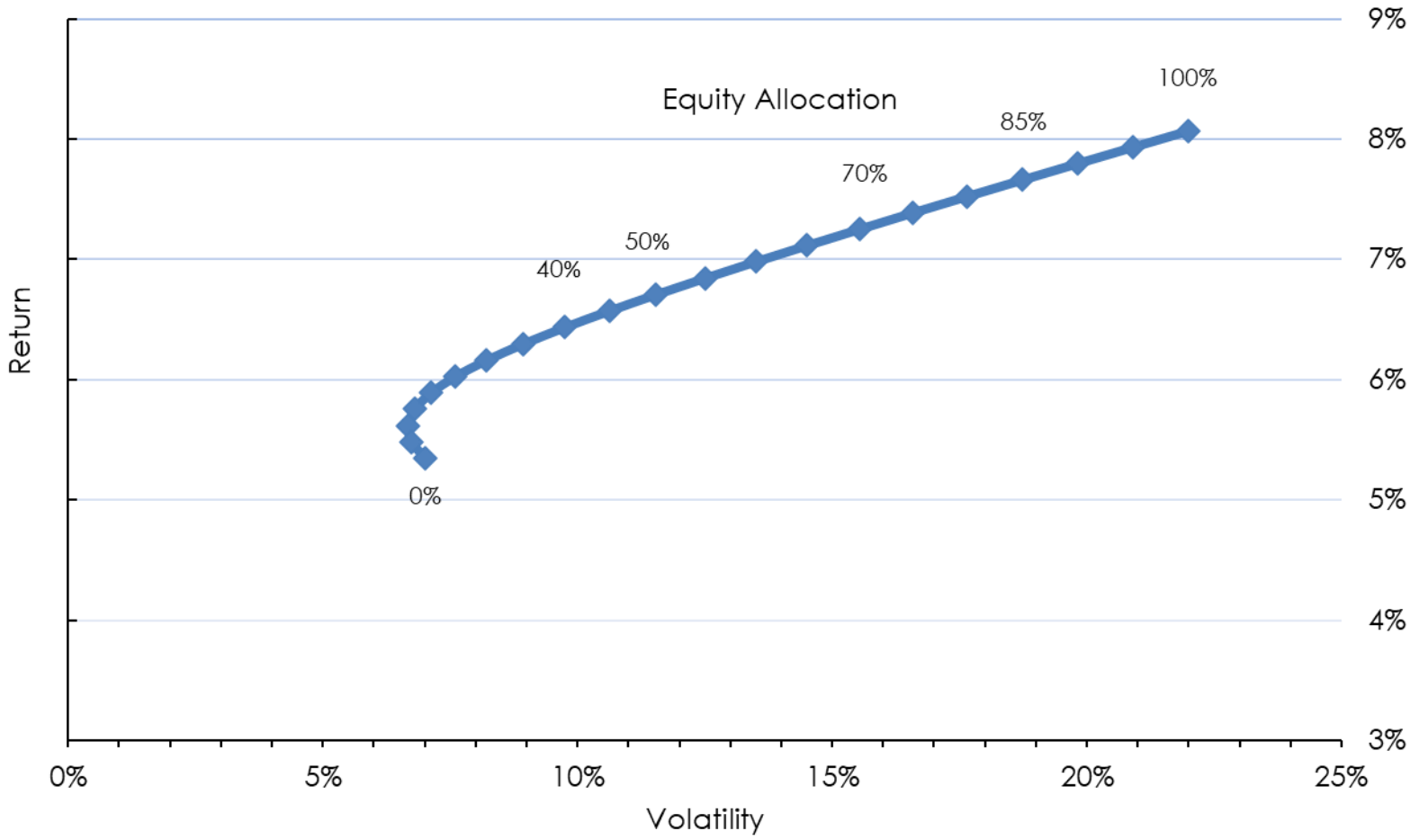
Risk of Various Equity Allocations

Two-year periods with equity returns below negative 20%



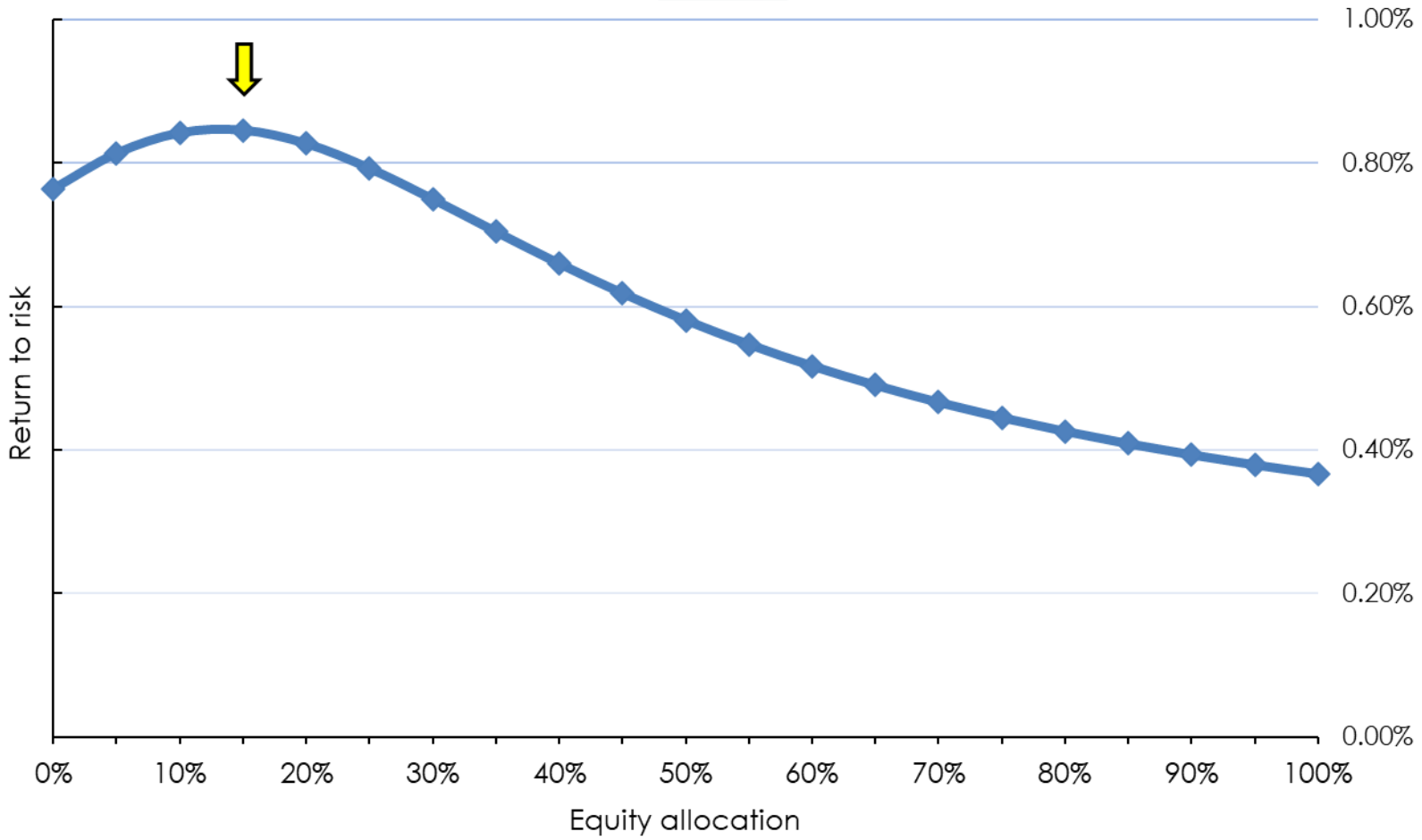
Return and Risk for Stock/Bond Allocations

Using SDIC long term expected returns and fat tail adjusted volatility



Reward for Assuming Additional Equity Risk

Increase in expected return per unit increase in volatility



Risk of Other Asset Categories

- Other categories are mapped to equivalent equity/bond/cash risk
  - REITS mapped primarily to equity with remainder mapped to short duration bonds
  - High yield mapped to equity and short duration bonds depending on credit quality
  - Private equity treated as leveraged equity
  - Opportunistic RE treated as leveraged REITs
- Exposures embedded in other categories is accounted for when targeting overall equity-like / bond-like / cash-like risk

Benchmark Construction

- Categories in benchmark are significant and passively implementable
  - equity, bonds, real estate (REITS), high yield, and cash
- Skill/niche categories excluded from benchmark, but have permitted range
  - private equity, opportunistic real estate, arbitrage and hedge funds, commodities
  - equivalent stock/bond/cash risk is accounted for and offset if invest in these
- Benchmark constructed to achieve 70% equity-like, 27% bond-like, and 3% cash-like risk exposures

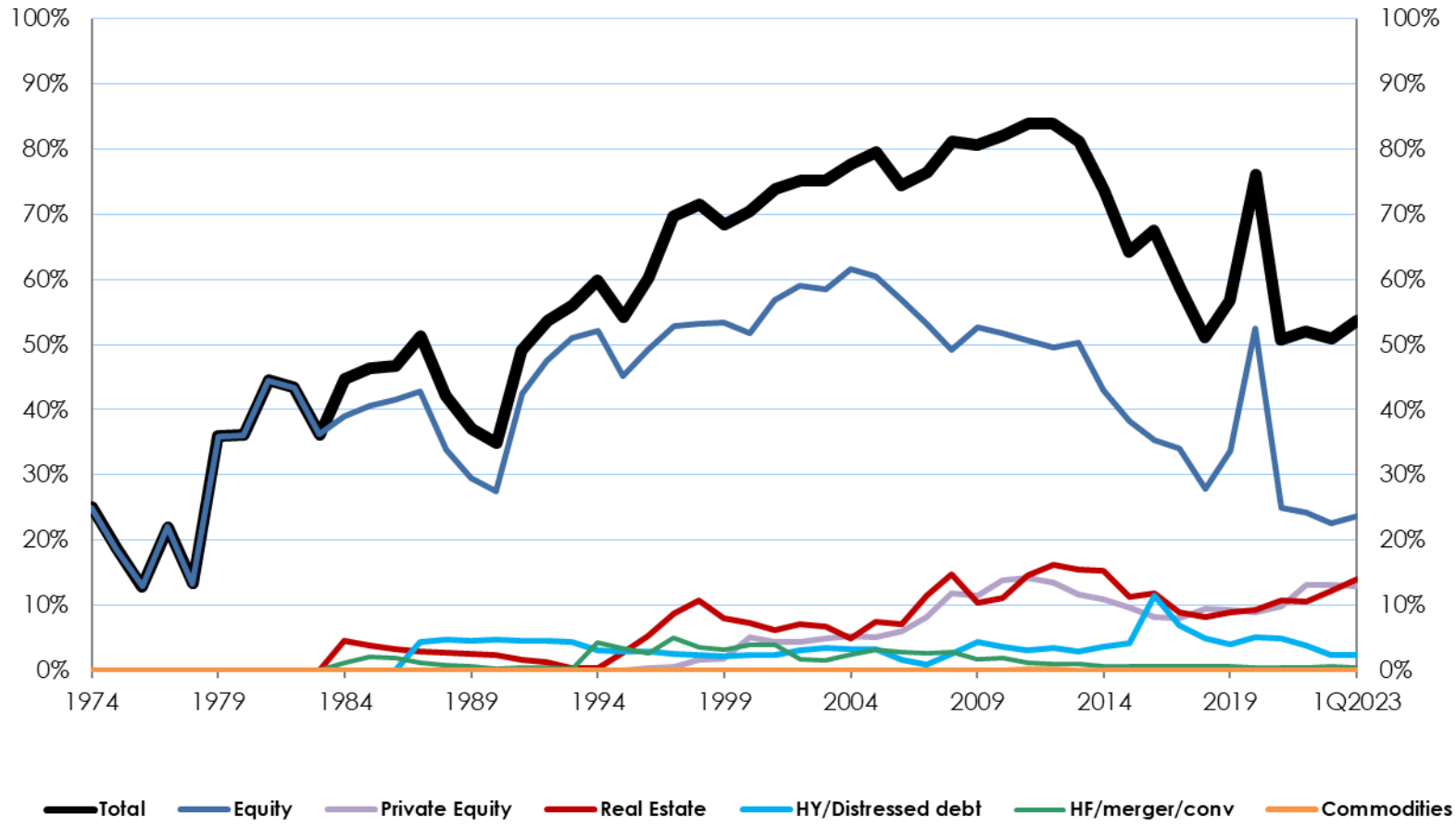
SDRS Capital Markets Benchmark

Proposed FY 24

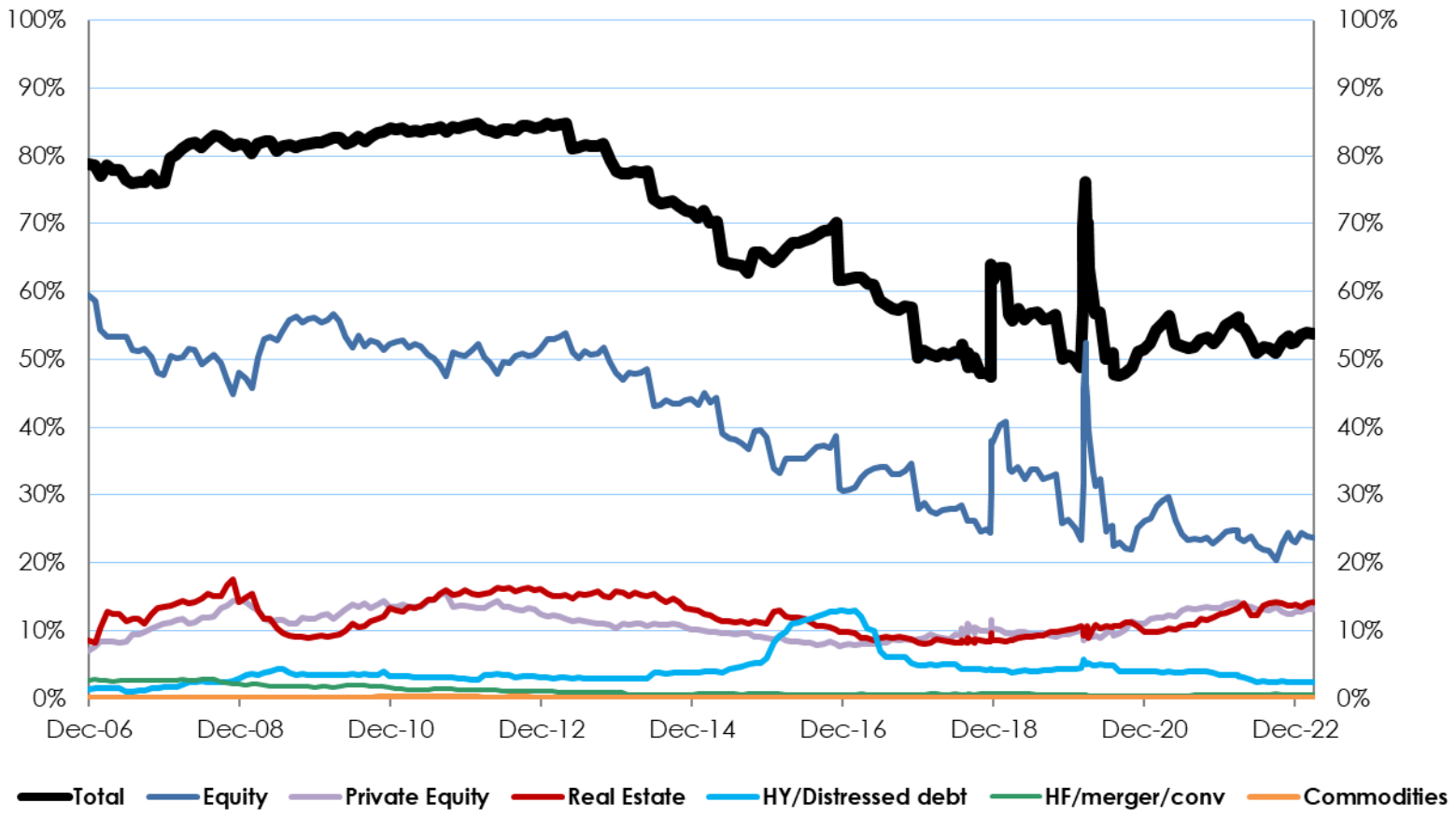
		Primary Asset Categories					Skill/Niche Asset Categories[4]				Other Categories[5]
	Equity-Like Risk	Public Equity[1]	Real Estate REIT/Core[2]	HY Corp Debt	Investment Grade Debt[1]	Cash[3]	Private Equity	Opportunistic Real Estate[2]	HY Real Estate Debt	Aggressive Absolute Return	
Minimum	40%	20%	0%	0%	13%	0%	0%	0%	0%	0%	0%
Proposed 2024 Max	85%	75%	20%	15%	60%	45%	12%	15%	10%	5%	5%
Previous Year (if different)			*2%*		*50%*	*50%*		*2%*			
Proposed 2024 BM	**70%**	**56.3%**	**12%**	**7%**	**22.8%**	**1.9%**					
Benchmark Index		MSCI ACWI IMI ex REITs (3/4) + MSCI USA IMI ex REITs (1/4)	MSCI US REIT	FTSE High Yield	FTSE US BIG	FTSE 3 mo.Tsy bill					
Benchmark History											
2023		56.3%	12%	7%	22.8%	1.9%					
2016-2022		58%	10%	7%	23%	2%					

1. Buffer for market drift of 1% for public equity and 1/2% for debt (example: Investment Grade debt minimum of 13% can drift to 12.5%)
2. Real Estate(RE) min/max applies to REITS/Core RE and Opportunistic combined. Opportunistic RE counts 1.3x against RE max. Projected base case allocation used for partnerships
3. Cash to provide liquidity for benefits payments and rebalancing
4. Since 2015, skill/niche categories have not been included in the BM. This change allowed the BM to consist solely of well fitting, investable indexes. These categories continue to have a permitted range to invest in opportunistically.
5. Other categories, such as TIPS, commodities, and arbitrage have been considered or used in the past. They are not in the BM. Future use would be limited to 5% or less.

Equity-Like Risk Contribution



Equity-Like Risk Contribution



Additional Risk Measures and Control

- Risk measurement
  - Focus on equity-like and bond-like risk
  - Statistical measures of risk (standard deviation and correlations) are calculated but adjusted to reflect higher real-world frequency and magnitude of adverse outlier events
- Risk control
  - Risk managed by broad diversification and reducing amounts in expensive assets
  - Adequate liquidity maintained to avoid liquidations of depressed assets and to allow rebalancing
- Strength and determination to handle tough markets
  - Participation in the free enterprise economic system provides highest long-term rewards but must endure short-term bumps in the road
  - Strong funding and benefit design helpful to managing downside volatility
  - In very difficult circumstances, benefits may require further adjustment to maintain funding

SDRS Return and Volatility Analysis

Using Wall Street firm inputs

	Expected Return	Standard Deviation*	Correlation Matrix: US Eq	Intl	Hedge	Debt	Cash	HY	Comd	REITs	Priv Eq	RE Opp	TIPS
Domestic (US) Equity	7.9%	16%	100%										
International Equity	9.8%	17%	89%	100%									
Hedge Funds	5.4%	9%	82%	84%	100%								
Investment Grade debt	4.6%	4%	19%	22%	10%	100%							
Cash	2.4%	1%	-5%	-3%	-6%	16%	100%						
High Yield Debt	6.8%	9%	74%	78%	79%	36%	-7%	100%					
Commodity Index	3.1%	18%	39%	48%	51%	-16%	-3%	39%	100%				
REITs	6.8%	16%	76%	69%	57%	28%	-4%	64%	26%	100%			
Private Equity	9.9%	20%	77%	80%	83%	-15%	-1%	70%	60%	51%	100%		
Real Estate Opportunistic	7.7%	18%	41%	37%	42%	-22%	-12%	42%	37%	53%	42%	100%	
Tsy Inflation Protected Sec(TIPS)	4.3%	6%	26%	28%	24%	72%	9%	46%	20%	31%	10%	3%	100%

* Standard deviation is a measure of volatility. There is a 66% chance of being within plus or minus 1 standard deviation, a 95% chance of being within 2 standard deviations.

	U.S. Equity	Intl Equity	Hedge Funds	Debt	Cash	HY Debt	Comm -odity	REITs	Private Equity	RE Opport	TIPS	Expected Return	Standard Deviation: 1 year	5 year	10 year	20 year
100:0 Equity/Debt	100%											7.9%	16.1%	7.2%	5.1%	3.6%
70:27:3 Eq/Debt/Cash	70%			27%	3%							6.8%	11.6%	5.2%	3.7%	2.6%
add International EQ												7.2%	11.6%	5.2%	3.7%	2.6%
add REITs												7.1%	11.4%	5.1%	3.6%	2.6%
add High Yield Debt												7.1%	11.3%	5.1%	3.6%	2.5%
Public Equity	56.3%															
Benchmark FY24 (proposed)	39.7%	16.6%	0%	22.8%	1.9%	7%	0%	12%	0%	0%	0%	7.15%	11.3%	5.1%	3.6%	2.5%
add Private Equity												7.2%	11.0%	4.9%	3.5%	2.5%
add RE Opportunistic												7.1%	10.4%	4.6%	3.3%	2.3%
Public Equity	23.7%															
SDRS Current AA	16.7%	7.0%	0.8%	12.9%	34.1%	4.6%	0.0%	1.1%	10.9%	12.0%	0.0%	5.8%	7.4%	3.3%	2.3%	1.7%

Return Ranges	Expected Return	1 Year Horizon: + 1sd	- 1 sd	- 2 sd	5 Year Horizon: + 1sd	- 1 sd	- 2 sd	10 Year Horizon: + 1sd	- 1 sd	- 2 sd	20 Year Horizon: + 1sd	- 1 sd	- 2 sd
Benchmark FY24 (proposed)	7.15%	18.5%	-4.2%	-15.5%	12.2%	2.1%	-3.0%	10.7%	3.6%	0.0%	9.7%	4.6%	2.1%

SDRS Return and Volatility Analysis

Using SDIC inputs

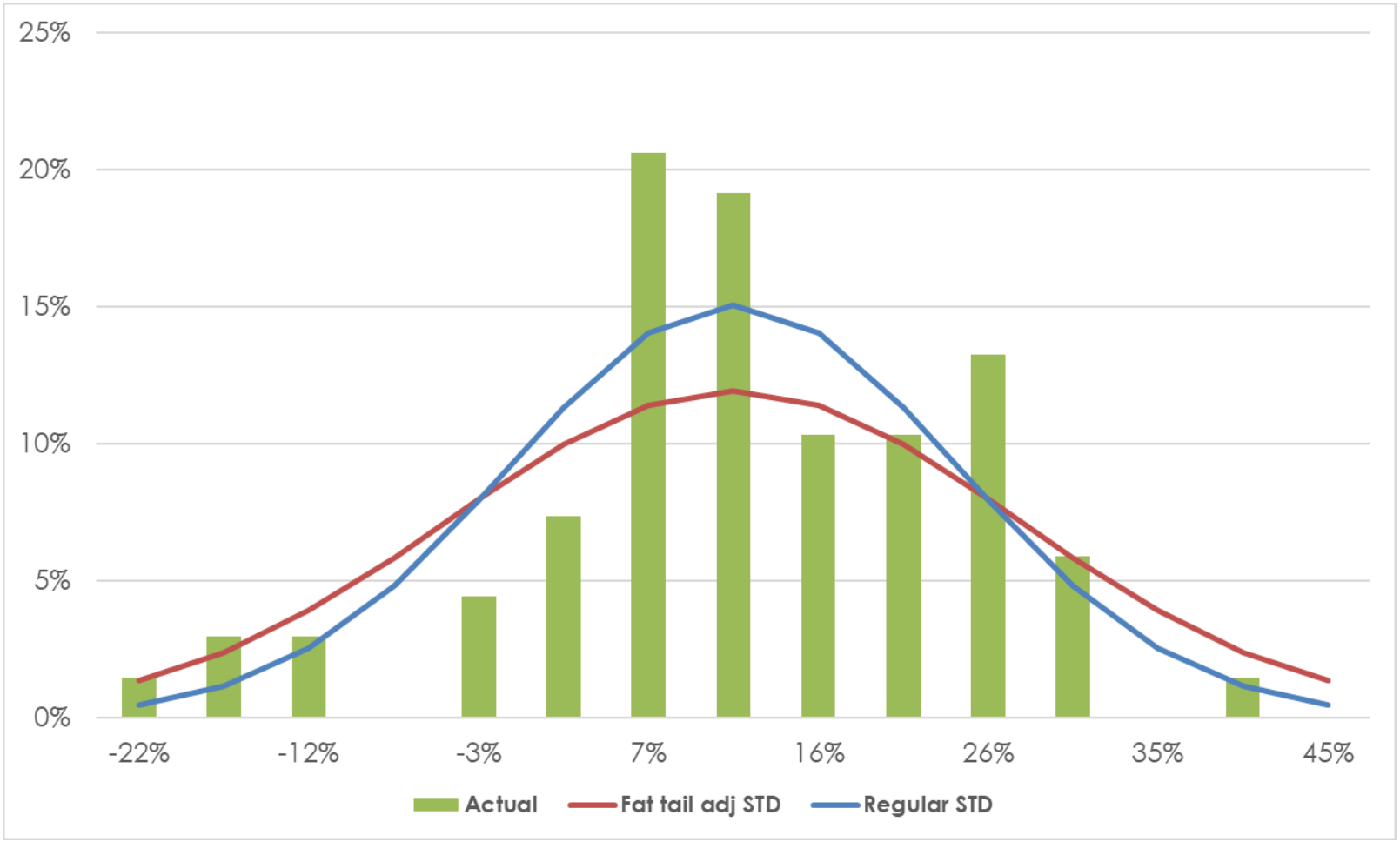
	Expected Return	Est. Volatility*	Correlation Matrix										
			US Eq	Intl Eq	Hedge	Debt	Cash	HY	Comd	REITs	Priv Eq	RE Opp	TIPS
Domestic (US) Equity	8.1%	22%	100%										
International Equity	8.1%	22%	100%	100%									
Hedge Funds	6.5%	12%	73%	73%	100%								
Investment Grade debt	5.3%	7%	0%	0%	-10%	100%							
Cash	5.0%	1%	0%	0%	0%	0%	100%						
High Yield Debt	6.7%	12%	75%	75%	35%	23%	0%	100%					
Commodity Index	5.3%	22%	50%	50%	35%	-20%	0%	20%	100%				
REITs	6.3%	24%	75%	75%	30%	0%	0%	50%	30%	100%			
Private Equity	8.7%	30%	88%	88%	30%	0%	0%	55%	40%	70%	100%		
Real Estate Opportunistic	6.9%	32%	75%	75%	25%	2%	0%	60%	25%	90%	60%	100%	
Tsy Inflation Protected Sec(TIPS)	5.3%	7%	0%	0%	0%	100%	0%	24%	0%	0%	0%	0%	100%

* Standard deviation is a measure of volatility. There is a 66% chance of being within plus or minus 1 standard deviation, a 95% chance of being within 2 standard deviations. This measure has been adjusted to better reflect frequency and magnitude of adverse events.

	U.S. Equity	Intl Equity	Hedge Funds	Inv Gr Debt	Cash	HY Debt	Comm -odity	REITs	Private Equity	RE Opport	TIPs	Expected Return	Standard Deviation 1 year	5 year	10 year	20 year
100:0 Equity/Debt	100%											8.1%	22.0%	9.8%	7.0%	4.9%
70:27:3 Equity/Debt/Cash	70%			27%	3%							7.2%	15.5%	7%	4.9%	3.5%
add Int'l Equity												7.2%	15.5%	7%	4.9%	3.5%
add REITs												7.1%	15.5%	7%	4.9%	3.5%
add High Yield Debt												7.1%	15.4%	7%	4.9%	3.4%
	Public Equity	56.3%														
Benchmark FY24 (proposed)	39.7%	16.6%	0%	22.8%	1.9%	7%	0%	12%	0%	0%	0%	7.08%	15.4%	6.9%	4.9%	3.4%
add Private Equity												7.1%	15.4%	7%	4.9%	3.5%
add RE Opportunistic												7.1%	15.5%	7%	4.9%	3.5%
	Public Equity	23.7%														
SDRS Current AA	16.7%	7.0%	0.8%	12.9%	34.1%	4.6%	0%	1.1%	10.9%	12.0%	0%	6.5%	12.0%	5.4%	3.8%	2.7%

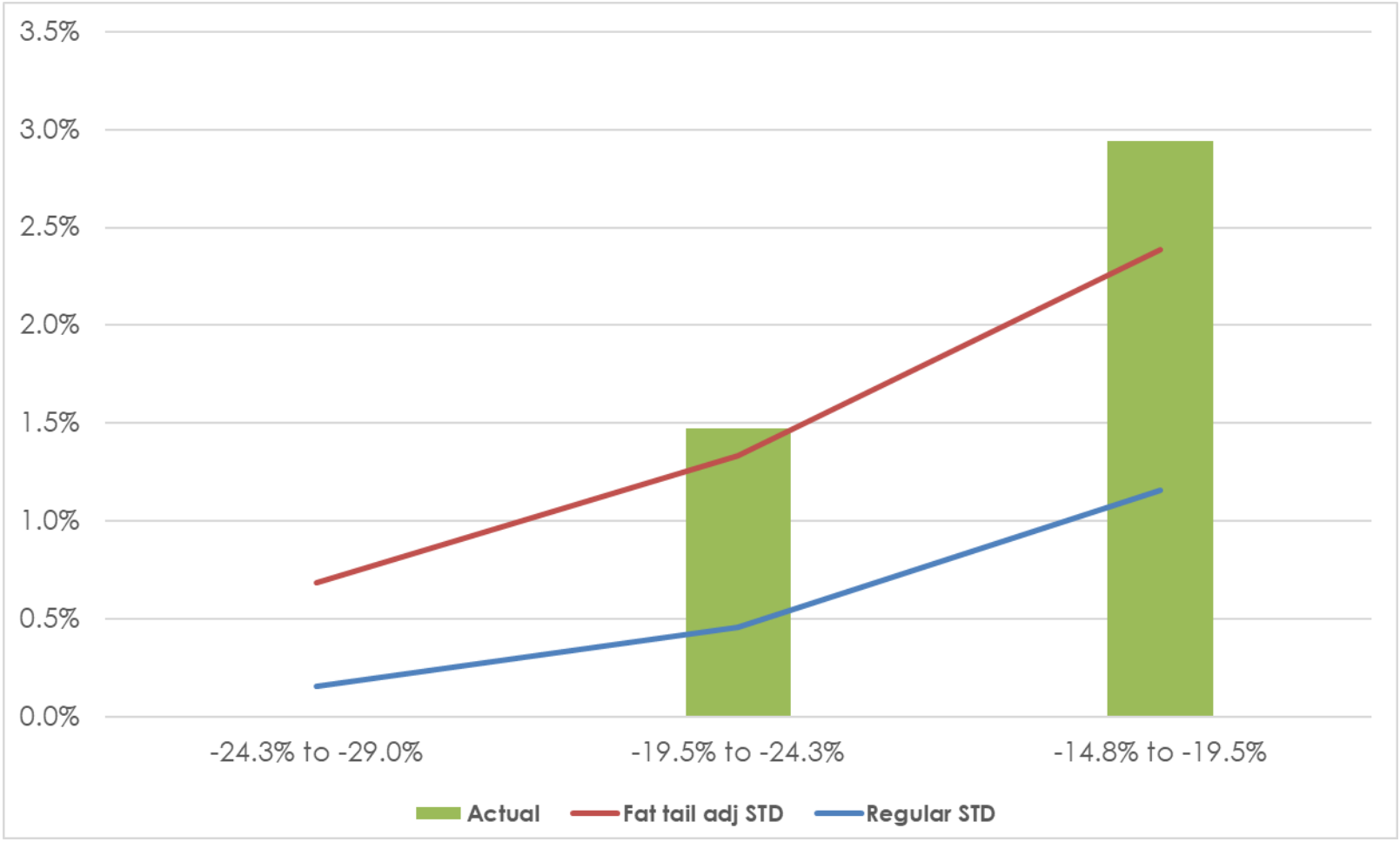
Return Ranges	Expected Return	1 Year Horizon			5 Year Horizon			10 Year Horizon			20 Year Horizon		
		+ 1sd	- 1 sd	- 2 sd	+ 1sd	- 1 sd	- 2 sd	+ 1sd	- 1 sd	- 2 sd	+ 1sd	-1 sd	- 2 sd
Benchmark FY24 (proposed)	7.08%	22.5%	-8.3%	-23.7%	14.0%	0.2%	-6.7%	11.9%	2.2%	-2.7%	10.5%	3.6%	0.2%

Actual vs Expected Two-Year Annualized Equity Returns with Fat Tail Adjusted Volatility



Focus on Severe Adverse Outcomes

Two-year annualized equity returns actual versus expected



SDRS Expected Long-Term Return Recap

- Benchmark asset allocation expected return is 7.08%
  - Uses SDIC inflation process which can vary from SDRS inflation assumption
  - Does not incorporate any negative dollar cost averaging effect nor added value from the long-term contrarian investment approach
- Expected returns are the midpoint of a wide distribution with a 50% chance of being higher and a 50% chance of being lower
- Standard deviation is 15.4% adjusted to reflect real world frequency of severe negative returns and correlations during severe periods. Conventionally measured standard deviation is 10% to 11%.

Asset Category Valuation

- Equity-like and bond-like risk
  - Equity and bond valuation processes
- Real estate (REITS)
  - REIT valuation versus underlying equity and bond components
- High yield
  - High yield valuation versus underlying equity and bond components
- Private equity
  - Subjective and data assessment of risk adjusted added value versus equity
- Opportunistic real estate
  - Subjective and data assessment of risk adjusted added value versus REITS
- Arbitrage and other strategies
  - Monitor for signs of distress and bottom-up underwriting of proxy transactions

Equity Valuation

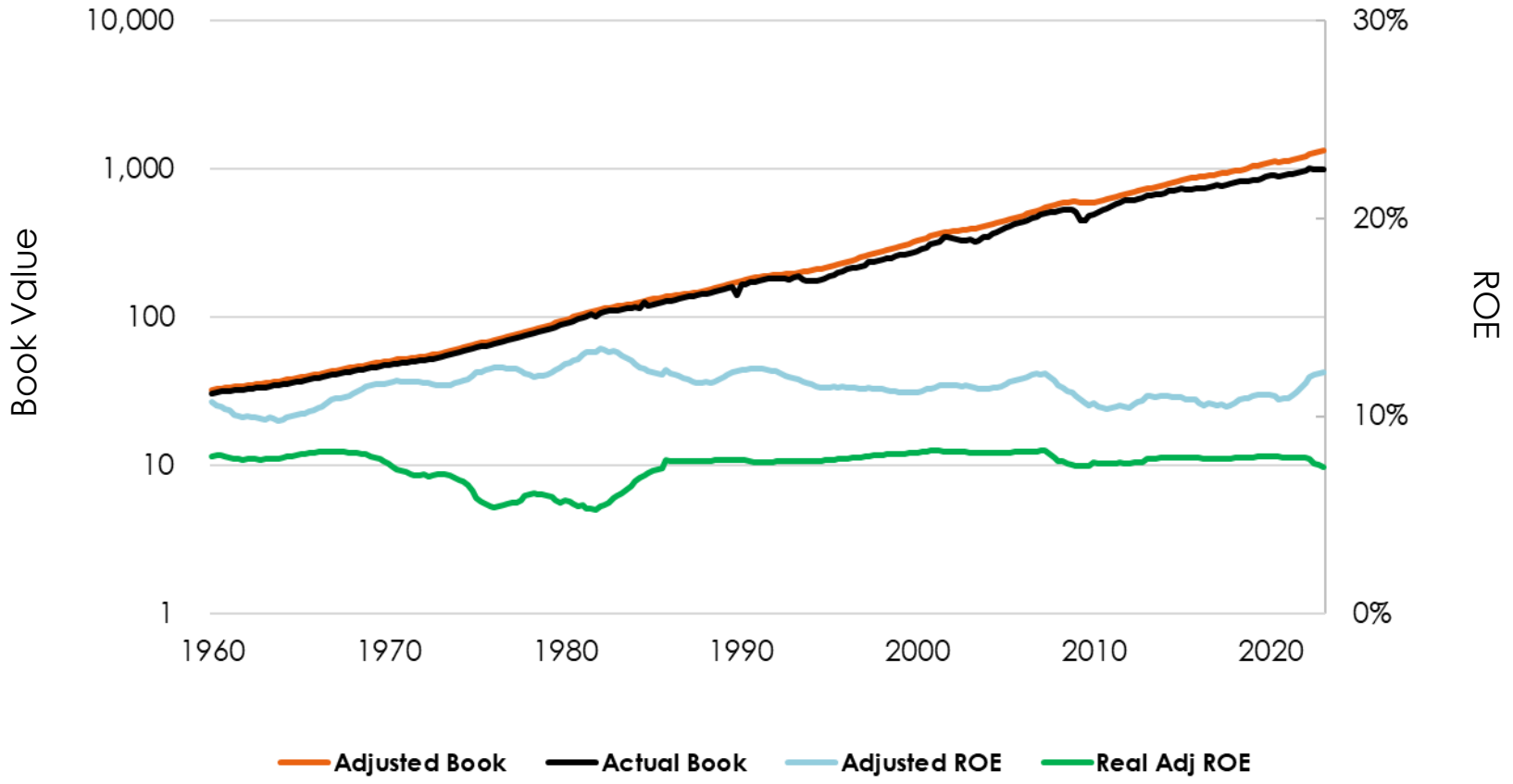
- Estimated future cash flows
  - Normal earnings
  - Growth rate
- Discount rate comprised of
  - Inflation + real cash yield + term premium + risk premium
- Value is discounted value of future cash flows
- Adjustments to value
  - Monetary stimulus/restraint
  - Earnings strength

Normal Earnings

- Normal earnings
  - Adjusted book value multiplied by normal return on equity
- Adjusted book value
  - Book value is balance sheet reported value of assets net of liabilities
  - Book value may not track retained earnings due to index changes, mergers, and buybacks. These leakages must be addressed.
  - Book value write-downs are smoothed
- Normal return on equity = Historic Real ROE + Expected Inflation + ROE Adjustments
  - Return on equity is earnings divided by adjusted book value
  - Real ROE is return on equity less inflation
  - Historic Real ROE is the historic average Real ROE
  - Expected inflation is drawn from long term and recent history
- ROE Adjustments
  - Inflation can impact the level of real ROE
  - Governance can also impact real ROE

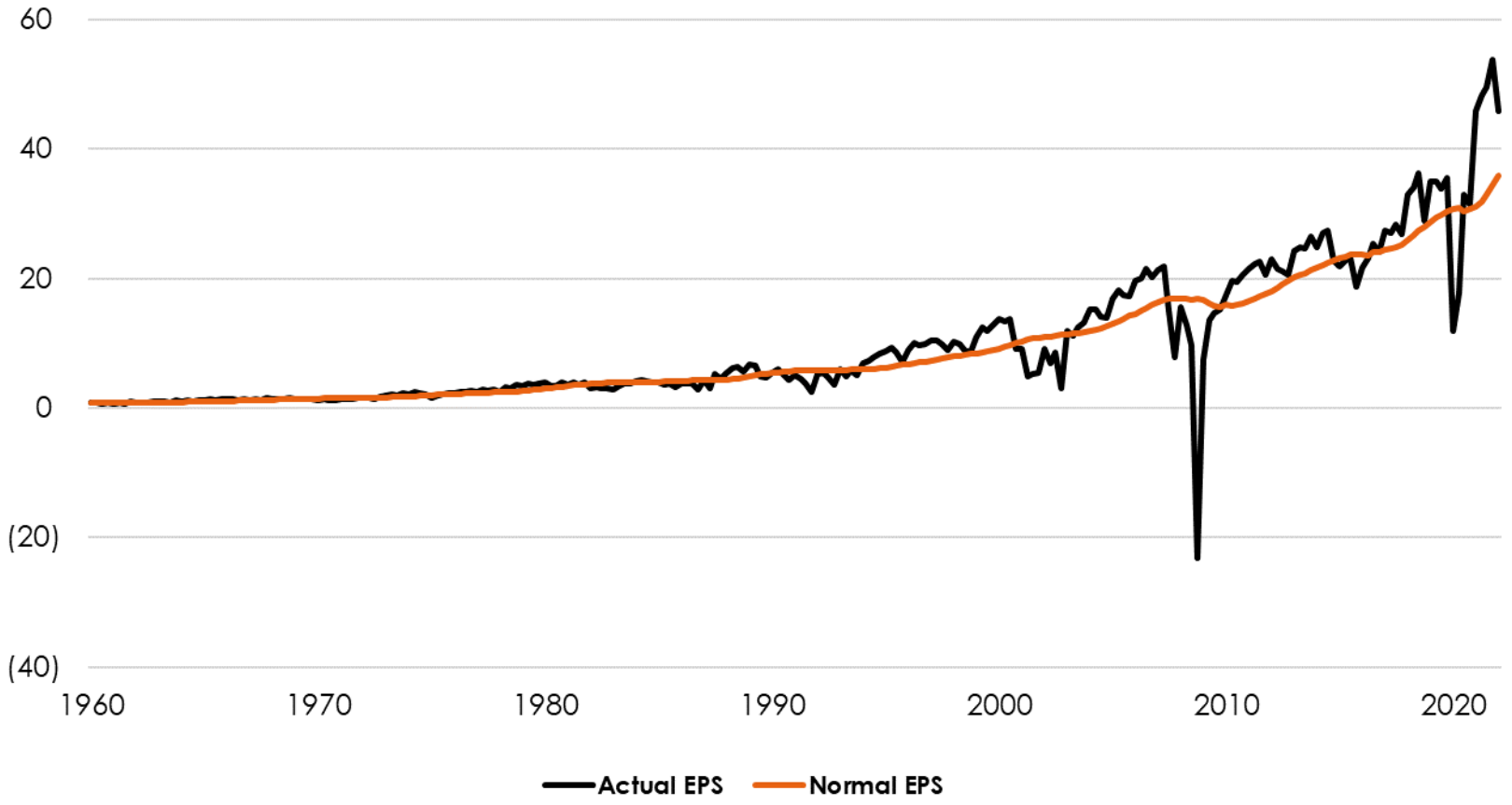
Book Value and Return on Equity

Incorporates book value adjustments



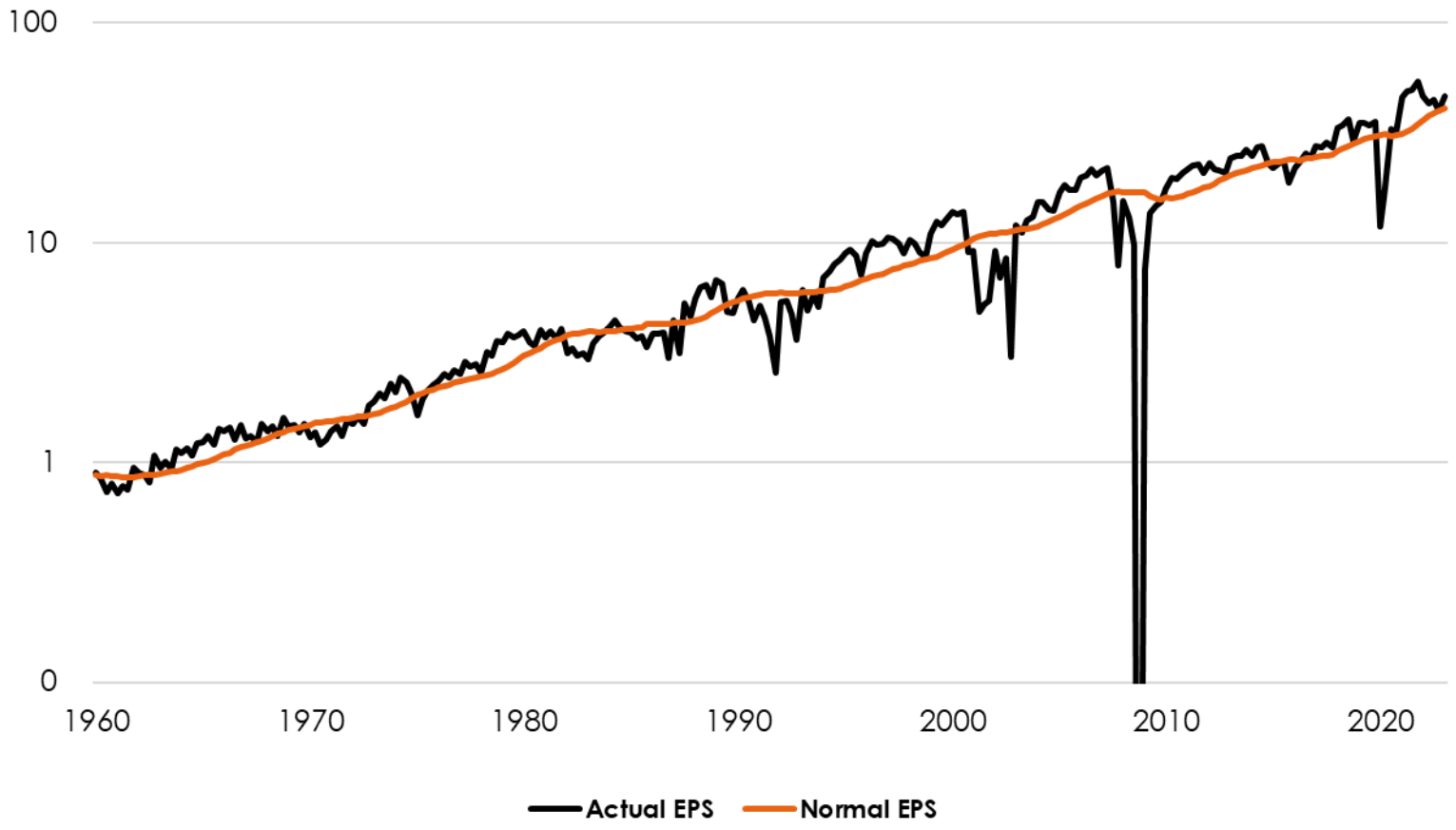
Normal EPS

Book value multiplied by adjusted ROE



Normal EPS

Book Value multiplied by adjusted ROE

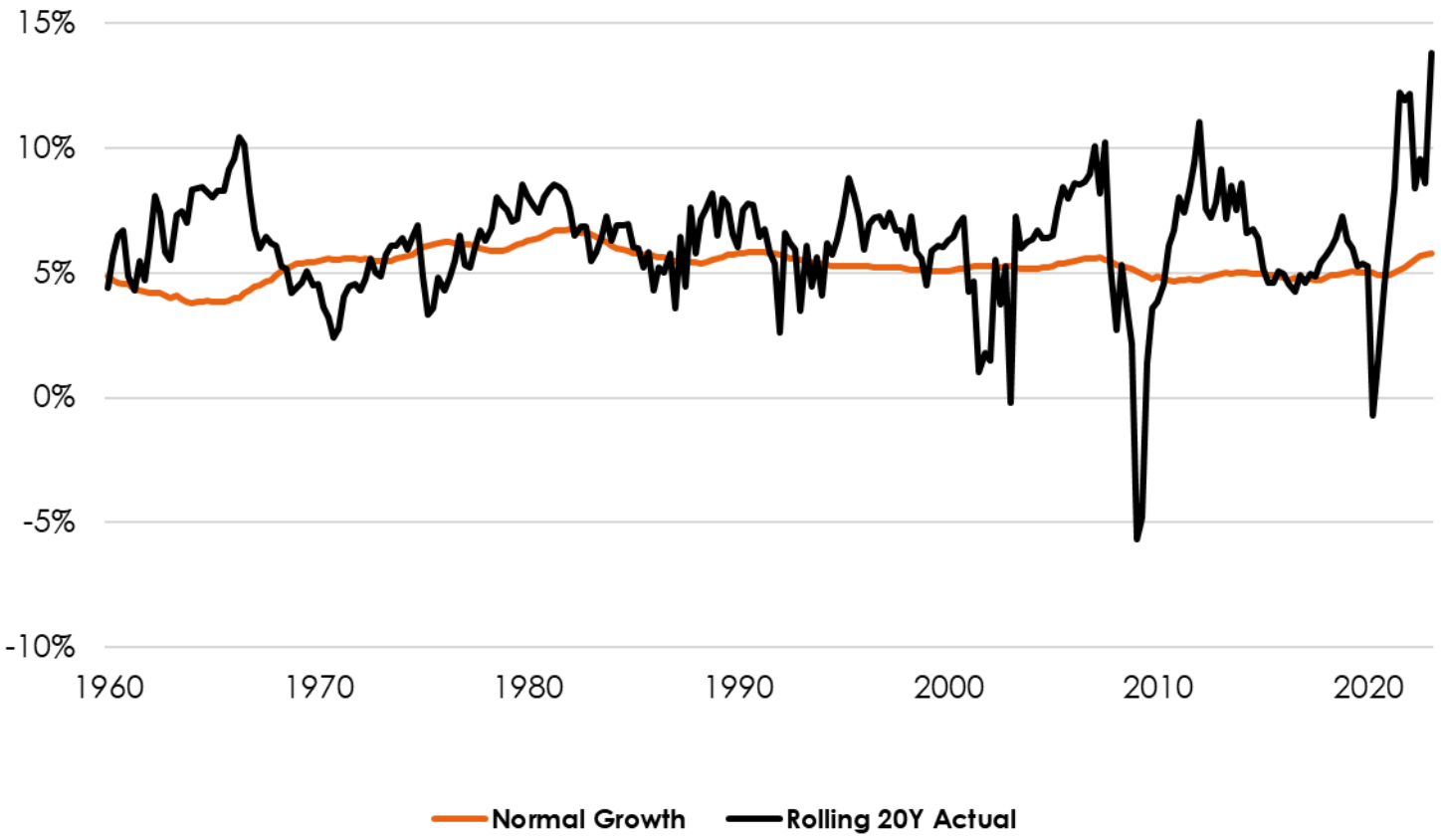


Normal Growth

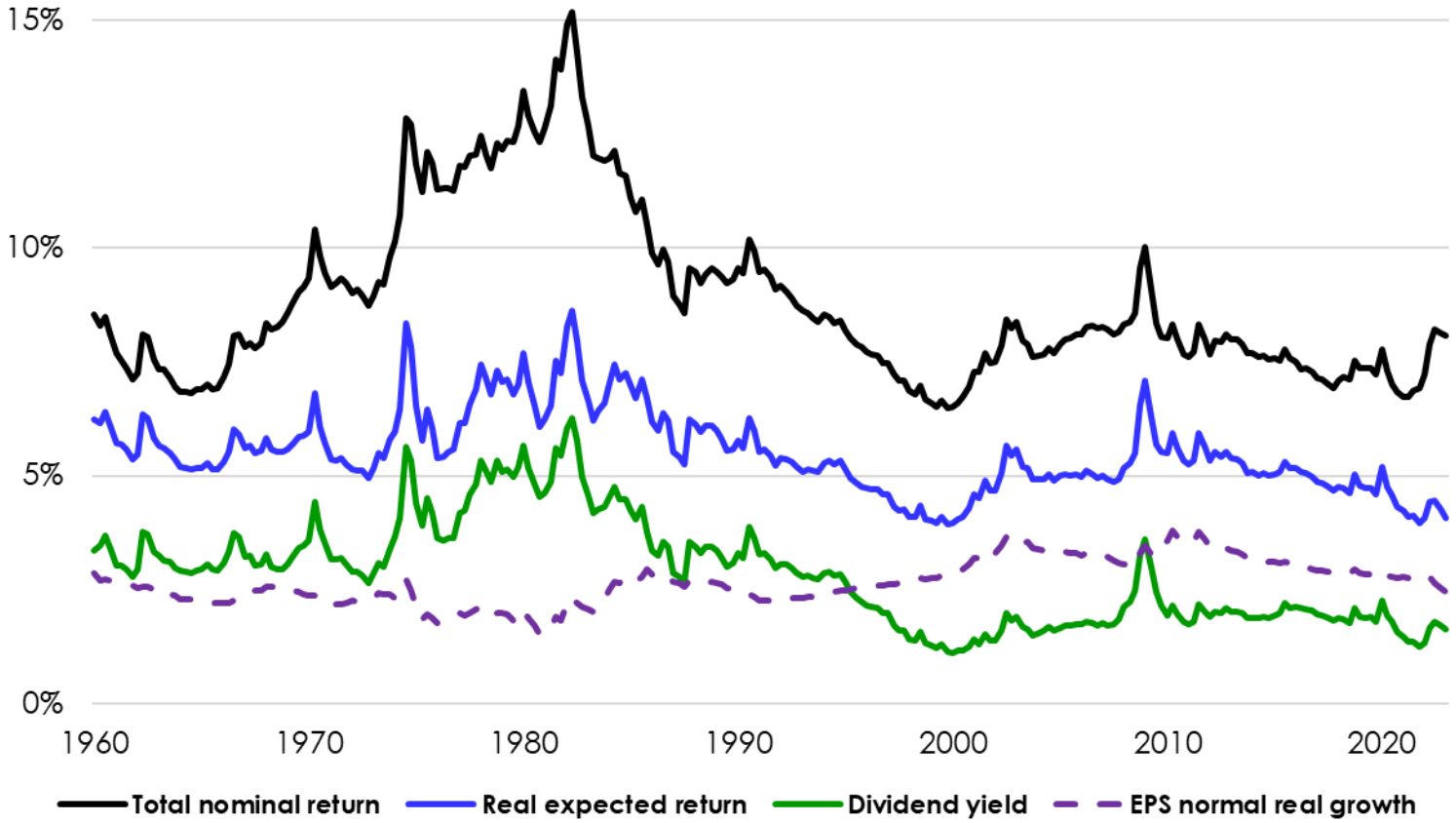
- Normal Growth = organic + acquisition + inflation pass through – attrition
  - Organic growth = organic reinvestment times normal ROE
    - Organic reinvestment = portion of earnings reinvested excluding acquisitions
    - Normal ROE adjusted to avoid double counting of inflation pass-through effect
  - Acquisition growth = acquisition investment times cost of capital
    - Acquisition investment = portion of earnings invested in acquisitions
    - Return of acquisitions based on cost of capital
  - Inflation pass through = expected inflation × pass-through percentage
    - Expected Inflation = same as used for Normal ROE
    - Pass-through percentage = percent of expected inflation estimated to pass through as an increase in normal earnings
  - Attrition = estimated mortality rate of normal earnings
    - Adjust for bias of earnings power (absent further investment) to be at risk of erosion
    - Attrition rate helps reconcile historic actual growth with the growth otherwise expected

EPS Growth

Normal versus 20-year actual

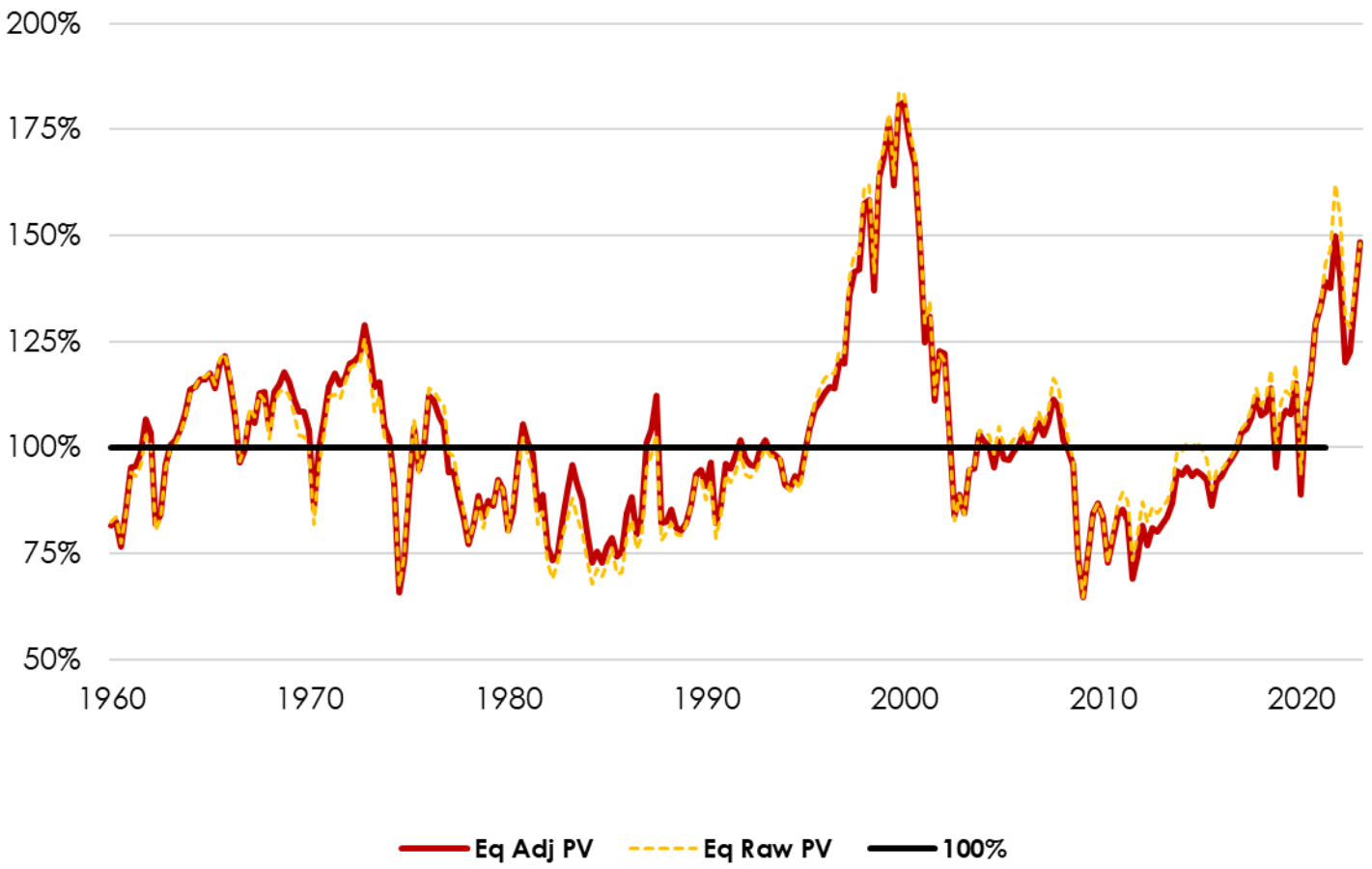


Equity Expected Return



Equity Price to Value

Raw and with monetary and earnings adjustments

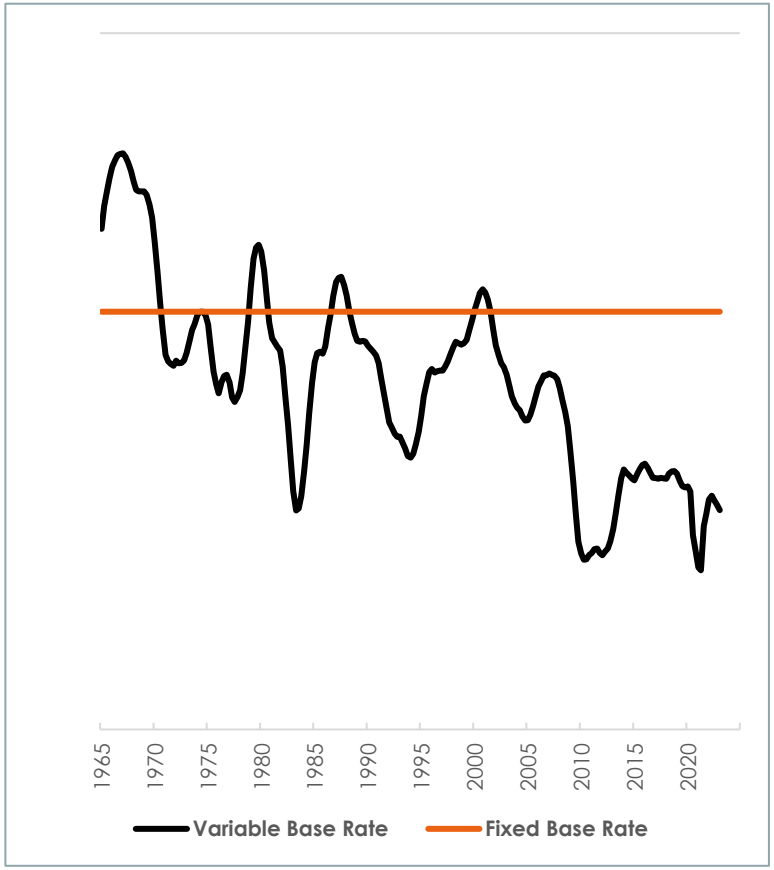


Bond Valuation

- Equilibrium yield components include
  - Inflation
  - Real cash yield
  - Term premium
- Bond value based on equilibrium yield
- Adjustments to value
  - Monetary stimulus/restraint
  - Earnings strength

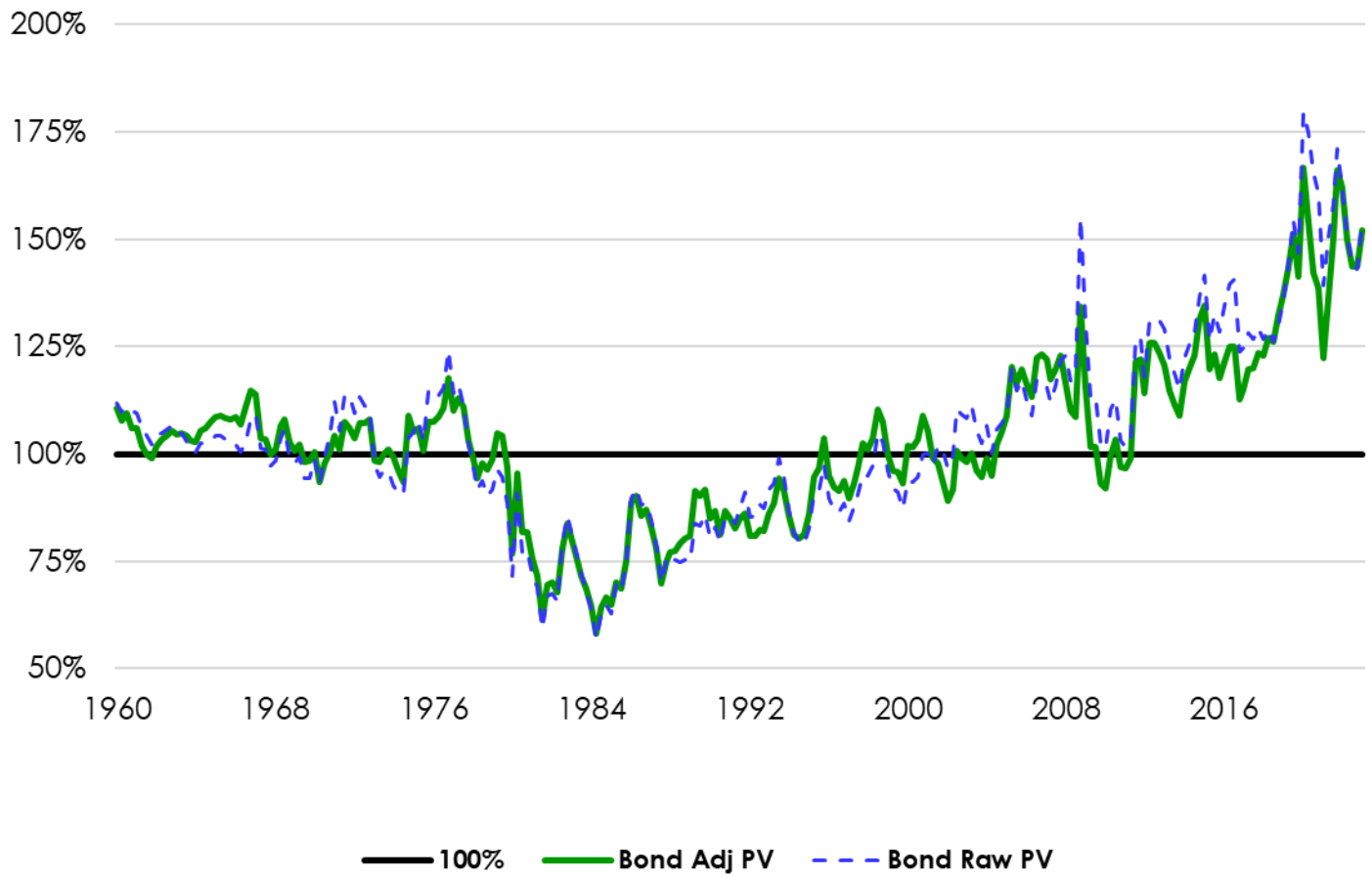
Recent Discount Rate Work

- Recent work includes changes to the real rate, term premium, and equity risk premium
- Real rate now varies with real GDP growth
- Increased term premium between T-bills and 10yr, reduced from 10yr to 30yr resulting in slight total increase
- Equity risk premium adjusted to offset above adjustment



Bond Price to Value

Raw and with monetary and earnings adjustments



Real Estate Valuation

- Real estate capitalization rate is adjusted to a typical equity/debt structure
- Discount rate is linked to the equity discount rate
- Difference between leverage adjusted cap rate and discount rate is converted into price to value

High Yield Spread Model

- Fair spread to treasuries based on long-term average spread and internal credit modeling research

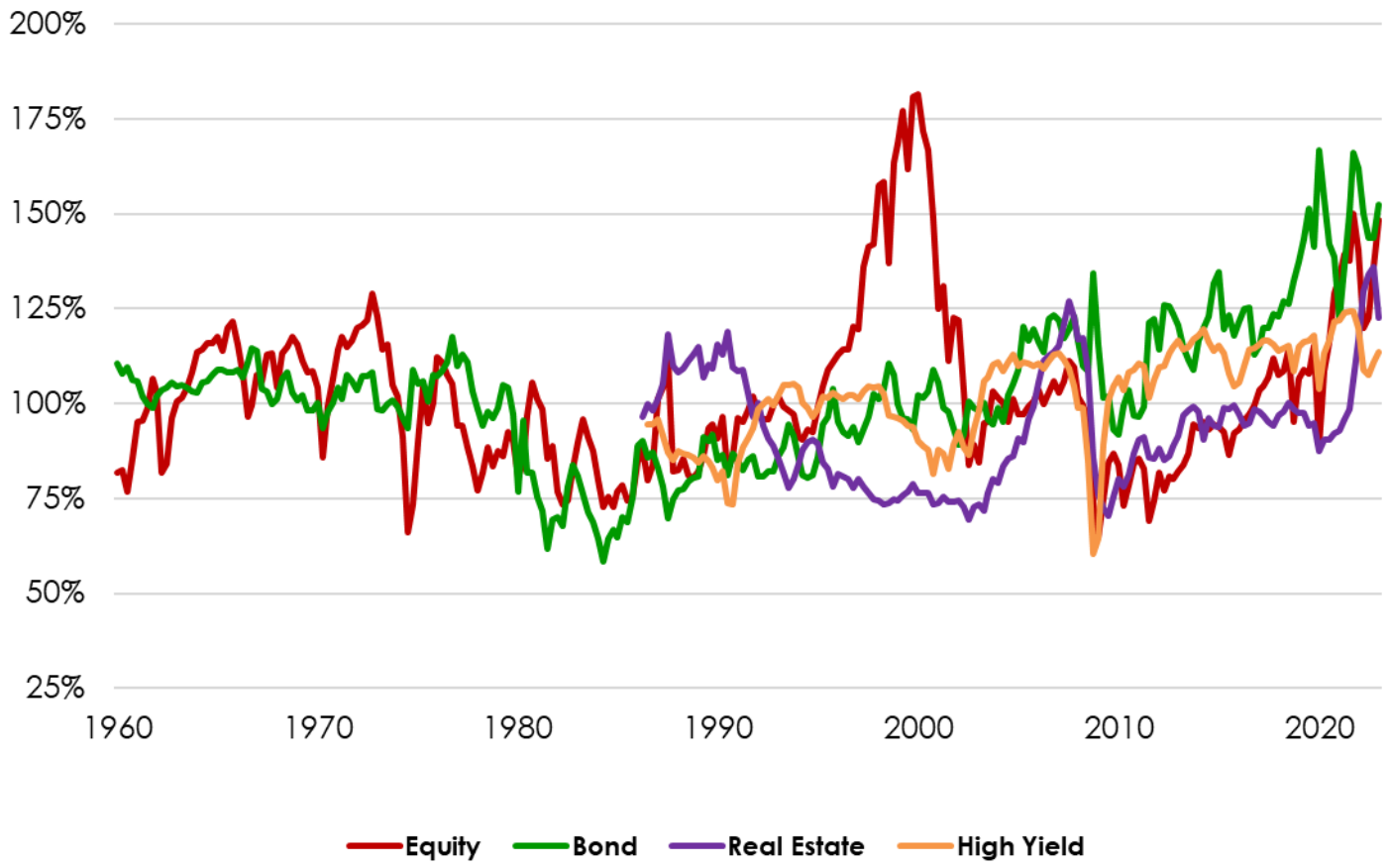
- Difference between current spread and fair spread is converted into price to value

High Yield Valuation Model

- Fair yield
  - Fair yield of similar duration treasuries plus
  - Fair yield spread to treasuries
- Current yield is compared to fair yield
- Yield difference is converted to price to value

Price to Value

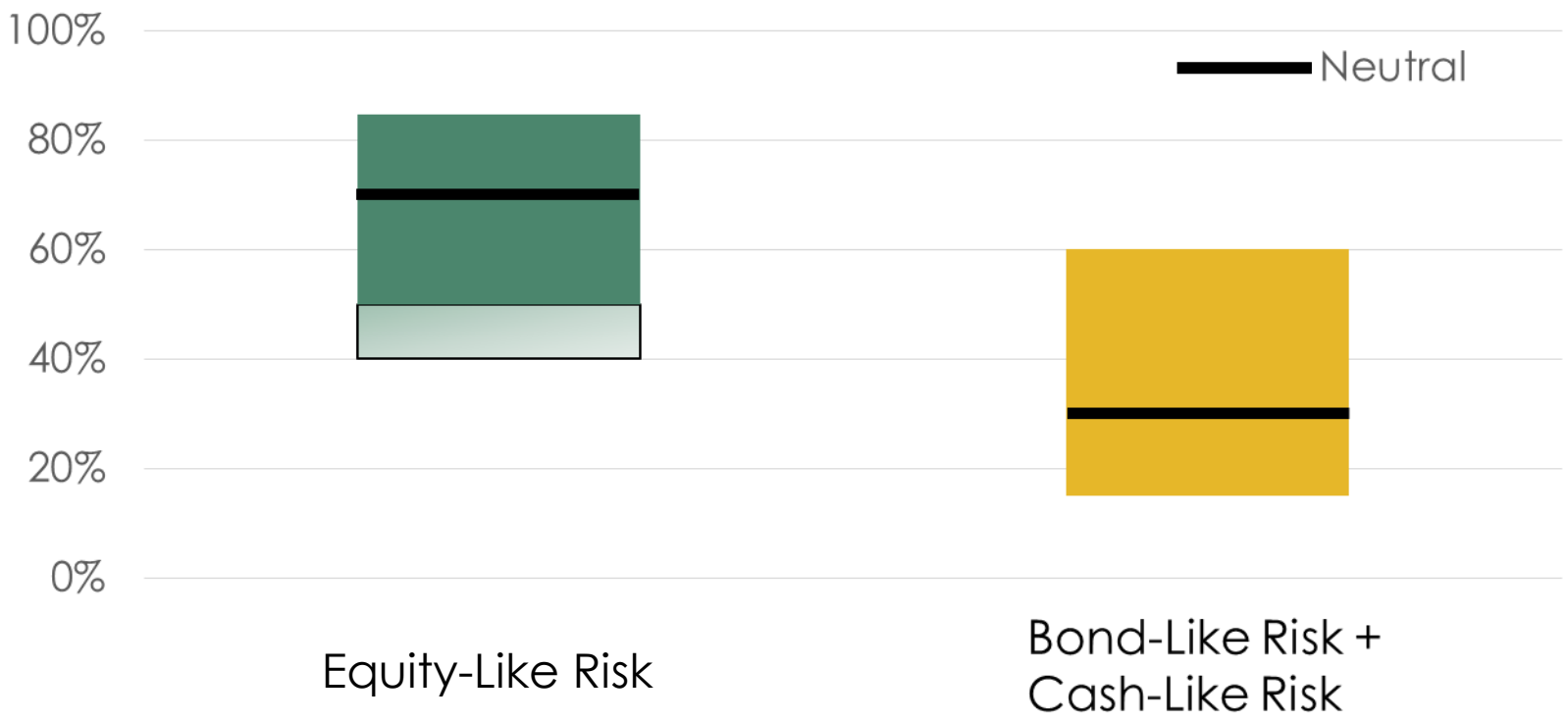
Equity, bond, real estate, high yield



Asset Allocation Implementation

- Equity-like and bond-like risk
  - Meaningfully cheap or expensive to initiate over or under-weight
  - Move back toward fair value to remove over or under-weight
  - Several steps between the benchmark and minimum and maximum levels
- Other category over and under-weights depend on valuation relative to risk mapping
  - Equity-like, bond-like, and cash-like risk is offset by adjusting weight of stocks, bonds, or cash

Risk Allocation Ranges



Asset Allocation Exposure Monitor

Risk Category	Policy Details				Rebalance Thresholds			Wgts	Current Target	Rebalance Trigger		Compliance Check
	Absolute Policy Minimum	Achievable Minimum[2]	Absolute Policy Maximum	FY23 Benchmark	Target @ Minimum	Target @ Maximum	All Other Targets	*Risk Wgt 4/30/23 preliminary*	*Risk Wgt 4/30/23 preliminary*	Lower Limit at Min	Upper Limit at Max	
Equity Like Risk	40%		85%	70%	1%	1%	2%					
Bond Like Risk	15%		50%	27%	0.5%	0.5%	1%					
Cash Like Risk	0%		50%	3%								
Asset Category	Absolute Policy Minimum	Achievable Minimum[2]	Absolute Policy Maximum	FY23 Benchmark	Target @ Minimum	Target @ Maximum	All Other Targets	*Port. Wgt 4/30/23 preliminary*	Current Target	Lower Limit at Min	Upper Limit at Max	
Public Equity[1]	20%		75%	56.3%	1%	1%	2%					
Real Estate REIT/Core	0%		20%	12%		1%	2%					
Opportunistic Real Estate	0%		15%	0%		1%						
Combined Real Estate Exposure	*2%*		*20%*	*12%*	1%							
HY Corp Debt	0%		15%	7%		0.5%	1%					
Investment Grade Debt	13%		50%	22.8%	0.5%	0.5%	1%					
Cash	0%		50%	1.9%	0.5%	0.5%						
Private Equity	0%		12%	0%		1%	2%					
HY Real Estate Debt Aggr	0%		10%	0%		0.5%	1%					
Aggressive Absolute Return	0%		5%	0%		1%	2%					

	Max Limit for Projected 5 yr Allocation			Curr FV + All Uncalled Commitments		
Private Real Estate Risk Check	12/31/2022[3]	Limit	Risk Check	12/31/2022	Limit	Risk Check
Opportunistic Real Estate Partnerships Wgt			PASS			
Uncalled Commitments						
Opp RE Wgt + Uncalled Commitments						PASS
Private Equity Risk Check	12/31/2022	Limit	Risk Check	12/31/2022	Limit	Risk Check
Private EQ Wgt			PASS			
Uncalled Commitments						
Total PE Wgt + Uncalled Commitments						PASS

Model Suggested Asset Allocation Positioning

Asset Allocation Weights Matrix

Equity Position	max	steps	neutral	steps	regular min	steps	absolute min
Equity Wgt	85%		70%		50%		40%

Bond Position	Bond Weights
max steps	
neutral steps	
min	

Equity Position	Equity Entry	Equity Exit	Equity Weight
max			85%
steps			
neutral			70%
steps			
regular min			50%
steps			
absolute min			40%

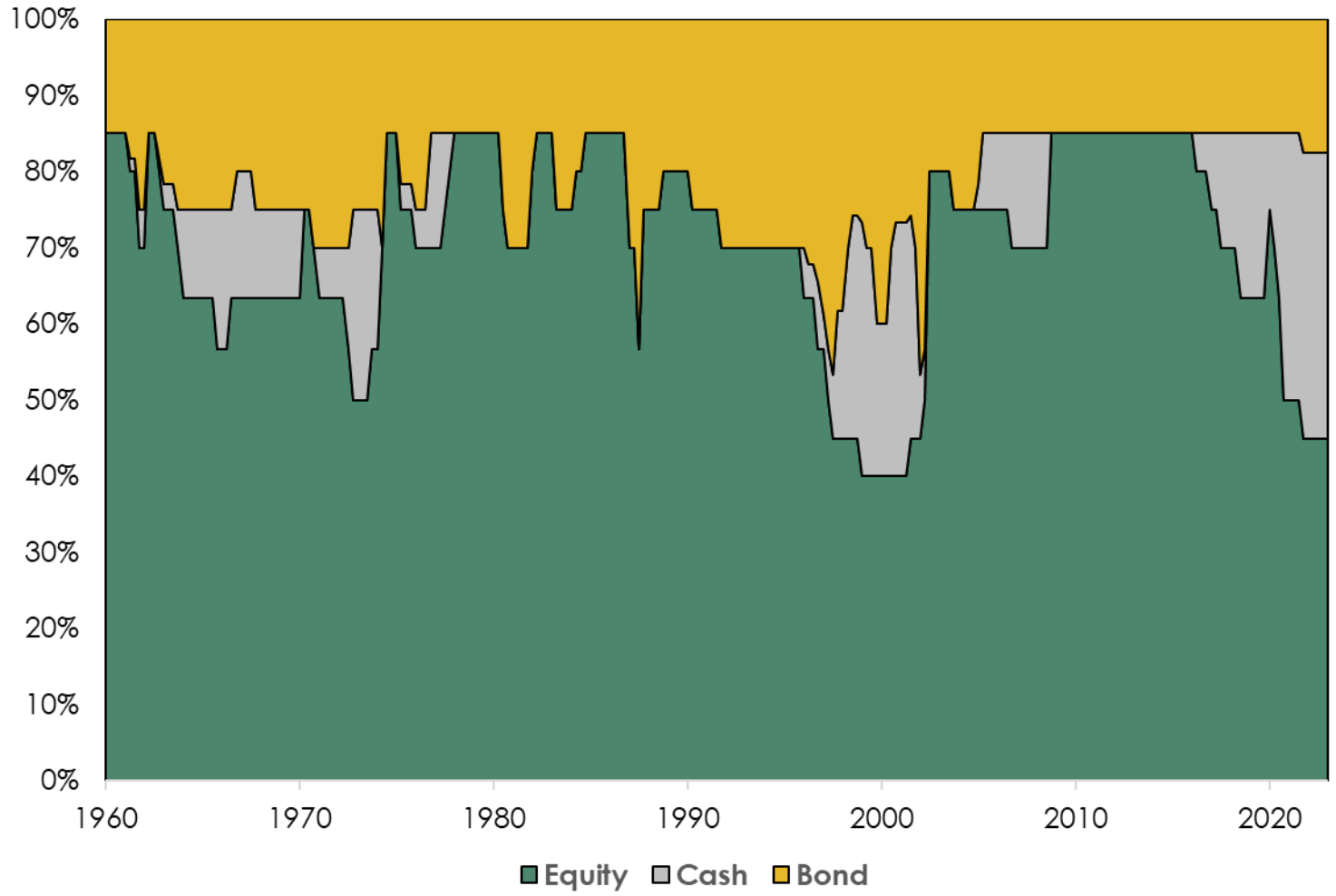
Bond Position	Bond Entry	Bond Exit	Bond Weight
max			
steps			
neutral			
steps			
min			

Input Table	
Date:	31-Mar-23
Equity Position	*
Target Equity Wgt	
Bond Position	
Target Bond Wgt	
Target Cash Wgt	
Equity Fair Value	
Bond FV Yld	

Allocation Triggers Summary				
	Incr Wgt At	Target Wgt	Decr Wgt At	Target Wgt
Equity				
Bond				

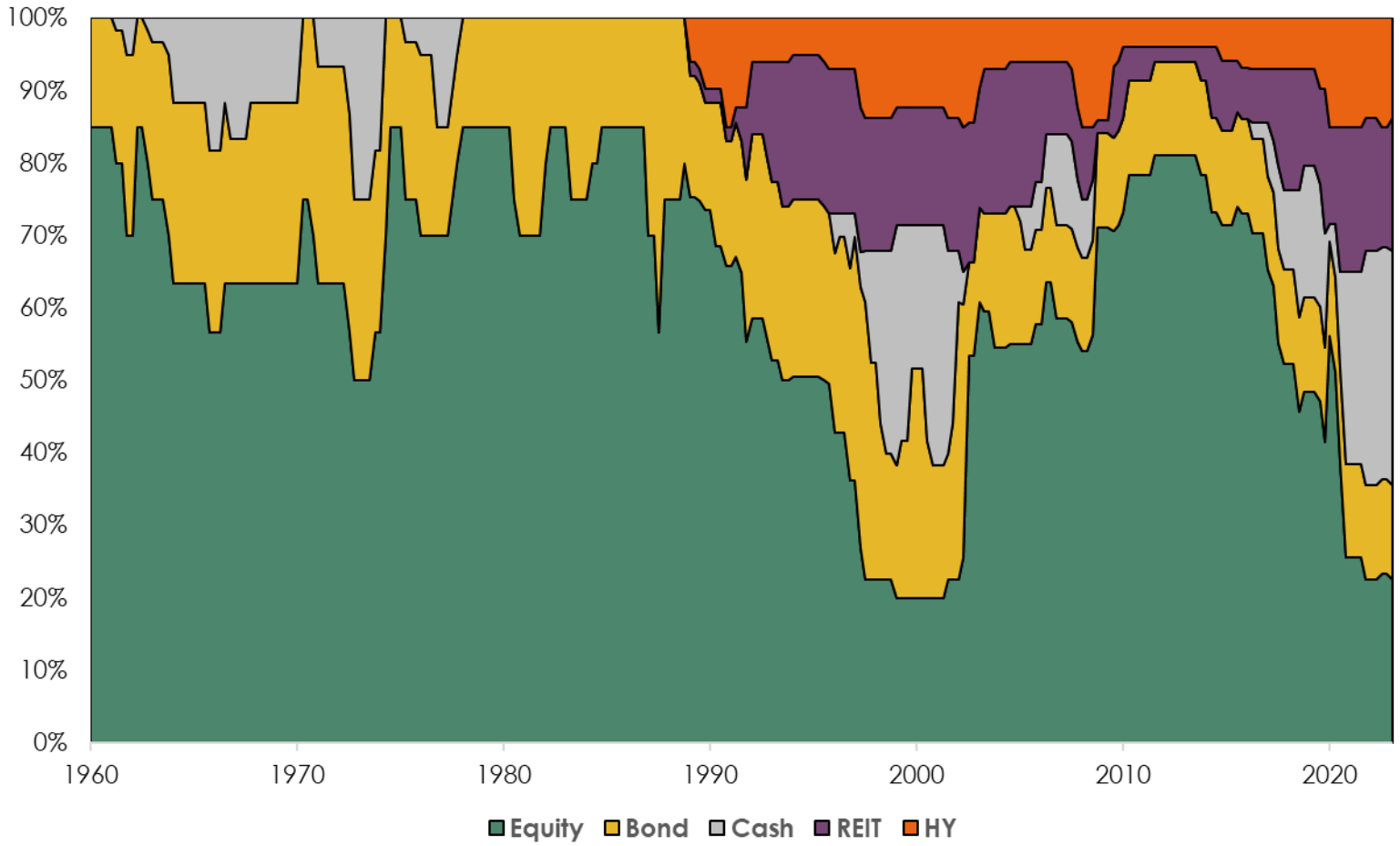
Model Suggested Allocations

Equity-like, bond-like, cash-like



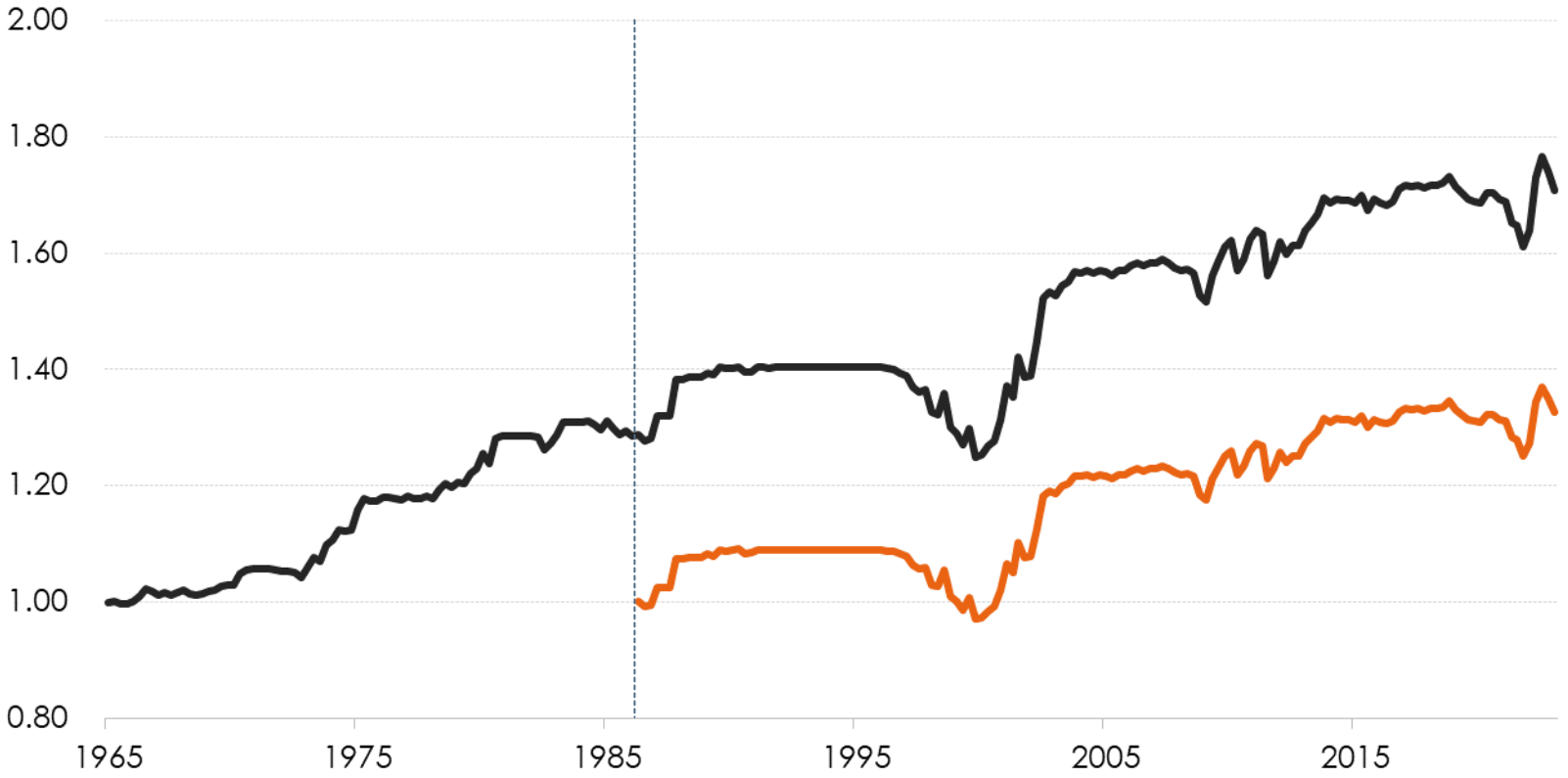
Model Suggested Allocations

Including REITS and high yield



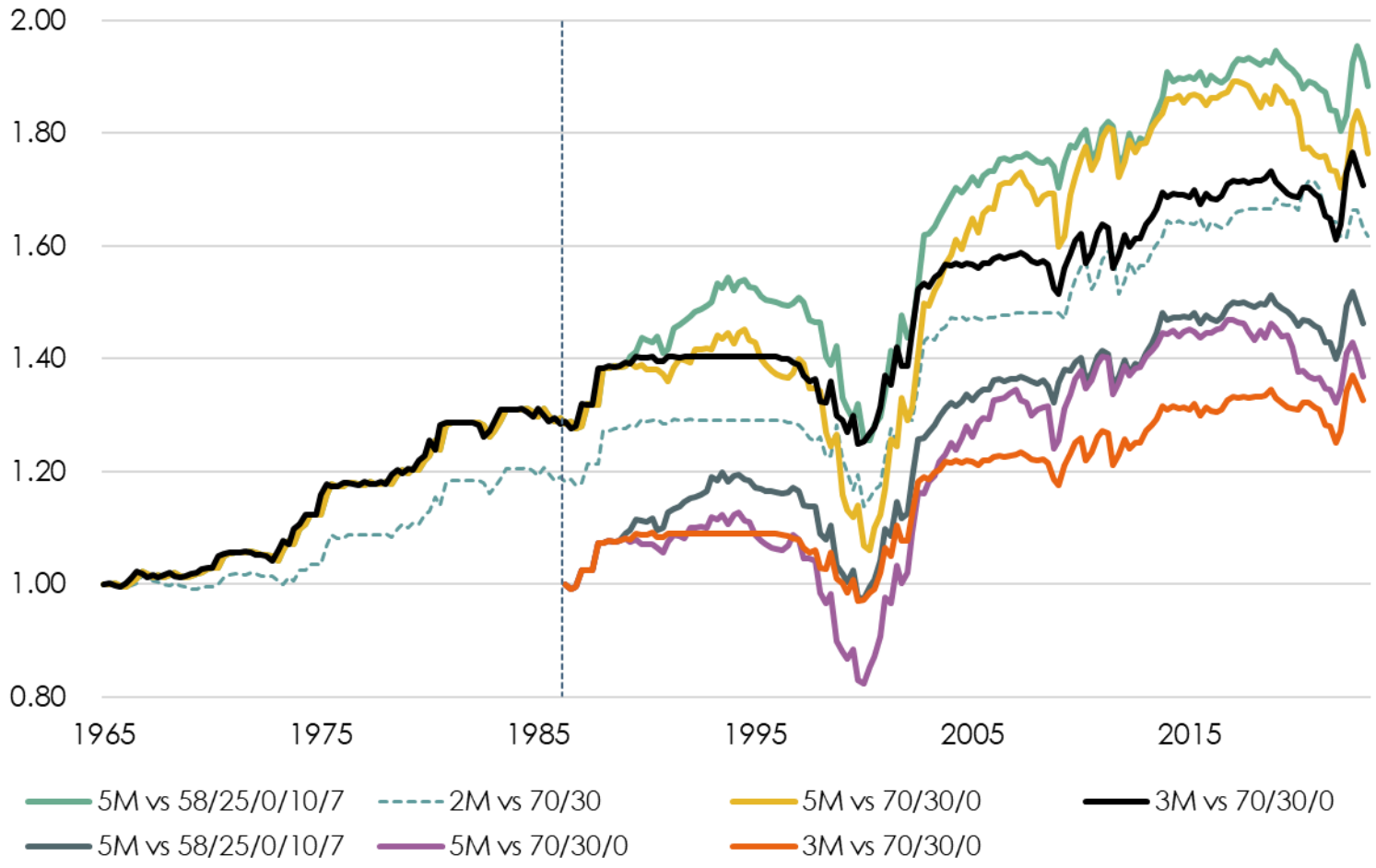
Model Return vs 70/30 Stock/Bond

From 1965 to now and from 1986 initial use



Model Return From 1965 and From 1986 Initial Use

Eq/Bd/Ca vs 70/30/0, Eq/Bd vs 70/30, and Eq/Bd/Ca/REIT/HY vs 58/25/0/10/7

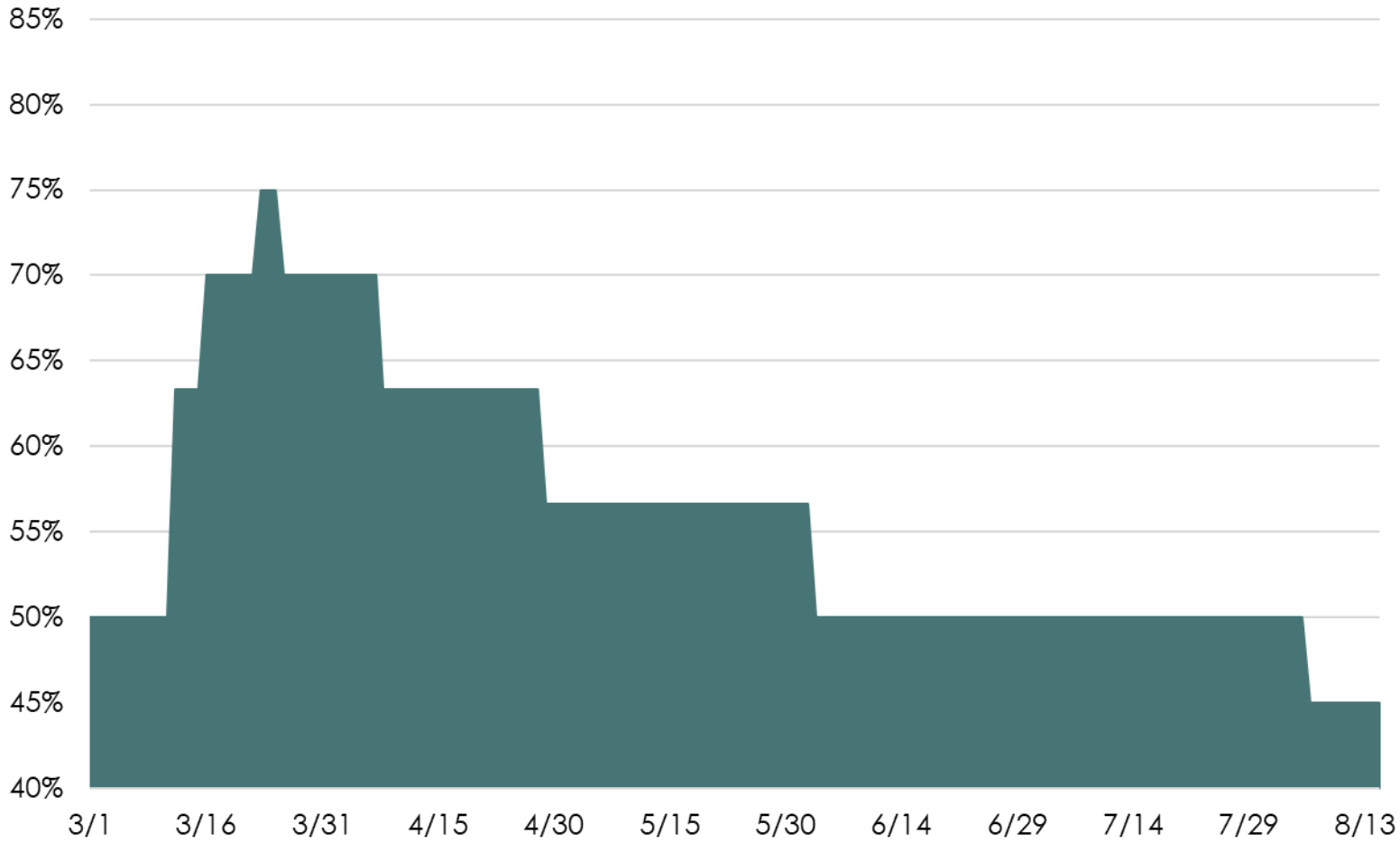


Daily Asset Allocation Valuation and Thresholds

Date	S&P500 Price	Equity Position	Next Buy Price	Next Sell Price
8-Mar-20	2972.37	Min	2700	At Min
9-Mar-20	2746.56		2700	At Min
10-Mar-20	2882.23		2700	At Min
11-Mar-20	2741.38		2700	At Min
12-Mar-20	2480.64	Increased	2500	3100
13-Mar-20	2711.02		2500	3100
14-Mar-20	2711.02		2500	3100
15-Mar-20	2711.02		2500	3100
16-Mar-20	2386.13	Increased	2400	2900
17-Mar-20	2529.19		2200	2700
18-Mar-20	2398.10		2200	2700
19-Mar-20	2409.39		2200	2700
20-Mar-20	2304.92		2200	2700
21-Mar-20	2304.92		2200	2700
22-Mar-20	2304.92		2200	2700
23-Mar-20	2237.40	Increased	2100	2600
24-Mar-20	2447.33		2100	2600
25-Mar-20	2475.56		2100	2600
26-Mar-20	2630.07	Decreased	2200	2700
27-Mar-20	2541.47		2200	2700

Model Suggested Equity-Like Risk

3/1/2020 through 8/15/2020



Evolution of Implementation

- Ranges and asset categories have evolved over time
  - Initial implementation subjectively phased in
  - Highlighted importance of disciplined implementation
- Developed internal risk metrics for alternative asset categories to further quantify underlying risk of portfolio
- Good luck/ bad luck