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Rhode Island SIC

2016 Asset Liability Review

Second Run – Model Output

Allan Emkin | John Burns, CFA

September 28, 2016

Rhode Island Asset Liability Review Calendar

	Topic	Date
1	***Liabilities Briefing***	*May 25, 2016*
	a. Review of liability profile and other actuarial considerations	
2	***Benchmarking Briefing***	*June 22, 2016*
	a. Peer institutional fund review	
	b. ERSRI Plan asset portfolio review	
	c. PCA Briefing on how the model works	
3	***Risks and Risk Preferences***	*July 13, 2016*
	a. Financial condition of plan	
	b. Risk sensitivities and definitions of success	
4	***Translating Risk Appetite into Investment Constraints***	*Aug 1, 2016*
	a. Define investment objectives and determine model variables	
	b. New concept review (asset class)	
5	***Asset Class Modeling***	*Aug 1, 2016*
	a. Role of assets	
	b. Capital market assumptions	
6	***First Run of Model***	*Sept 8, 2016*
	a. Model output review - SIC feedback	
	b. Issues for further review	
7	***Second Run of Model***	*Sept 28, 2016*
	a. Model output review	
8	***Adoption of Strategic Allocation***	*Sept 28, 2016*

Today's Discussion

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Today's Meeting

Recap of September 8, 2016 SIC Meeting

Review Focus Portfolio

High Level Conclusions

Adoptions of Strategic Policy Allocation and Portfolio Transition Plan

Next Steps

– Appendix: Model Inputs and Constraints

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SIC Risk Preferences

Asset Liability Review: Key Priorities

Funding:

- Continue progress towards plan full funding (100%)
- Avoid funding level falling below 50% (current funding level 60%)

Contributions:

- Avoid employer contribution rising to > 30% of payroll

Modeling Optimization:

- Success (Goal) = probability of a 100% funding ratio in 22 years
    - i.e., improving fund sustainability
- Risk (Constraint) = probability of breaching 50% funding level in the next 5 years
    - i.e., achieving a more stable return path

Modeling Process:

- Modeled first run with and without Crisis Risk Offset (CRO)
  - Output: 40 optimized policy portfolios
    - Long-term funding ratio / avoid <50% funding ratio in next 5 years

- Narrowed number of policy portfolios for further review down to six
  - 3 without CRO and 3 including CRO
  - Plus current policy allocation and 60/40

- Reassessed investment policy preferences: September 8, 2016 SIC meeting
  - U.S. Equity / non-U.S. Equity: Equal weight
  - Maximum allocation to Crisis Risk Offset: 8%
    - 50% Long-duration U.S. Treasury / 50% Systematic Trend Following

- Determined Focus portfolio allocation

- Run Focus portfolio through model

Model Output: Focus Portfolio vs. Current Policy

Strategic Class %	Current	Focus Portfolio
US Equity	23.0	20.0
Non-US Equity	23.0	20.0
Private Growth	9.0	15.0
Income Class	3.5	6.0
Crisis Risk Offset	0.0	8.0
Inflation Protection	16.5	10.0
IG Fixed Income	15.0	11.5
Absolute Return	7.0	6.5
Cash	3.0	3.0
Total	100.0	100.0

Total Growth allocation unchanged (55%)

Asset Allocation: Differences

- 6% reduction in public equities
- 6% increase in private growth
- Introduction of new Crisis Risk Offset Class: 8% allocation
  - 50% Long Duration
  - 50% Systematic Trend Following
- 3.5% reduction in Investment Grade Fixed Income

Focus Portfolio Comparison

Line	Strategic Class %	60/40	Current	Focus Portfolio
1	US Equity	30.0	23.0	20.0
2	Non-US Equity	30.0	23.0	20.0
3	Private Growth	0.0	9.0	15.0
4	Income Class	0.0	3.5	6.0
5	Crisis Risk Offset	0.0	0.0	8.0
6	Inflation Protection	0.0	16.5	10.0
7	IG Fixed Income	40.0	15.0	11.5
8	Absolute Return	0.0	7.0	6.5
9	Cash	0.0	3.0	3.0
10	Total	100.0	100.0	100.0
11	Median Scenario Comp Return (22-year period)	6.5	7.0	7.3
12	Average Scenario Standard Deviation (22-year period)	11.5	12.3	11.8
13	Sharpe Ratio (22-year period)	0.35	0.37	0.41
14	Sortino Ratio (22-year period)	0.51	0.62	0.74
15	Best Year / Worst Year	29.4 / -22.7	29.0 / -25.0	29.8 / -20.8
16	Average 2-year Loss of Worst 10%	-18.2	-19.8	-16.0
17	Percent of Scenarios <50% [during first 5-years]	11.6	10.4	7.5
18	Median Funded Ratio [end of 5-years]	58.5	59.5	60.0
19	Average Funded Ratio of Worst 10% [end of 5-years]	46.0	46.2	47.7
20	Median Funded Ratio [end of 22-years]	90.3	95.6	99.4
21	Average Funded Ratio of Worst 10% [end of 22-years]	62.1	63.2	67.1
22	Median Avg. Ann. Employer Cntrbs. Rate % [during 22-yrs]	22.0	21.2	20.6
23	Average % of Yrs. w/ Employer Cntrbs. Rate >30% [during 22-yrs]	7.5	6.2	4.4

Focus Portfolio vs. Current

Asset Only Statistics:

- Improved risk/return (line 13)
- Improved downside protection
  - ~20% improvement in average 2-year drawdown (line 16)

Asset/Liability Statistics:

- Improved long-term median funded ratio (line 20)
- Improved near-term funding risk cut by ~25% (line 17)
- More stable contribution expectations (line 23 ~30% improvement)

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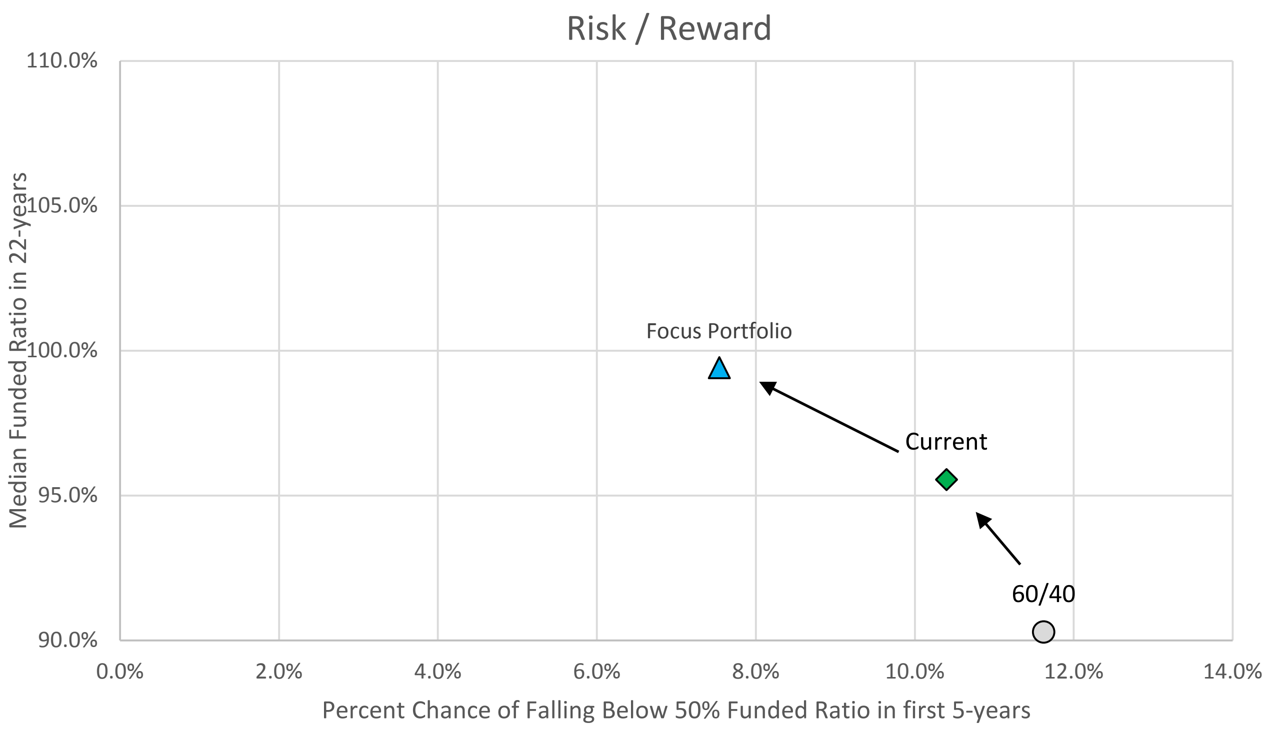
Focus Portfolio Comparison



- Portfolios improve from right to left (Focus Portfolio > Current > 60/40)
- The focus portfolio reduces the downside risk from the Current policy by 27%

Stress Testing: Scenario Descriptions

Stress Testing Scenarios for year 0-5:

1. Equity markets fall -40% in year 2, then recover value in years 3-5
2. 6% inflation in year 2
3. -2% deflation in year 2
4. 200 bps increase in 10-year in year 1
5. New normal = 4% annual equity returns, 1% annual inflation
6. 200 bps rate increase and -20% equity decline in year 2

Process for simulating each scenario:

- If a return level is specified, this is hard coded for that asset class (i.e. equity markets fall -40% in year 2 = US Equity and Non-US Equity -40% in year 2)
- If a return level is not specified, specific years are selected with similar environments of which the model with randomly simulate through
- If there is no specified environments (i.e. Scenario 1, year 1) then the normal stochastic simulation is used
- Starting in year 6, regular stochastic simulation is resumed
- 5,000 simulations run for each stress testing scenario

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Stress Testing: #1 = 40% Equity Decline Year 2

Line	Scenario Statistics	60/40	Current	Focus Portfolio
1	5-Year Median Scenario Comp Return	3.2	3.0	4.1
2	5-Year Average Scenario Standard Deviation	16.7	17.9	15.9
3	Average 2-year Loss of Worst 10%	-37.6	-41.8	-35.6
4	Percent of Scenarios <50% [during first 5-years]	78.4	80.4	52.8
5	Median Funded Ratio [end of 5-years]	47.2	46.8	49.7
6	Average Funded Ratio of Worst 10% [end of 5-years]	39.5	38.5	41.5
7	Median Funded Ratio [end of 22-years]	89.3	93.2	97.2
8	Average Funded Ratio of Worst 10% [end of 22-years]	63.9	64.9	68.3
9	Median Avg. Ann. Employer Cntrbs. Rate % [during 22-yrs]	25.5	25.2	23.8
10	Average % of Yrs. w/ Employer Cntrbs. Rate >30% [during 22-yrs]	21.4	21.7	11.8

Focus Portfolio vs. Current

- Focus Portfolio produced the best performance
- 2-year drawdown statistic improves by ~15% vs. the Current (line 3)
- Near-term funding risk reduced by ~34% (line 4)
- Employer contribution stability improved by ~50% (line 10)
- CRO provides diversification in equity decline resulting in better overall portfolio statistics
- Improves long-term funding expectations (line 7)

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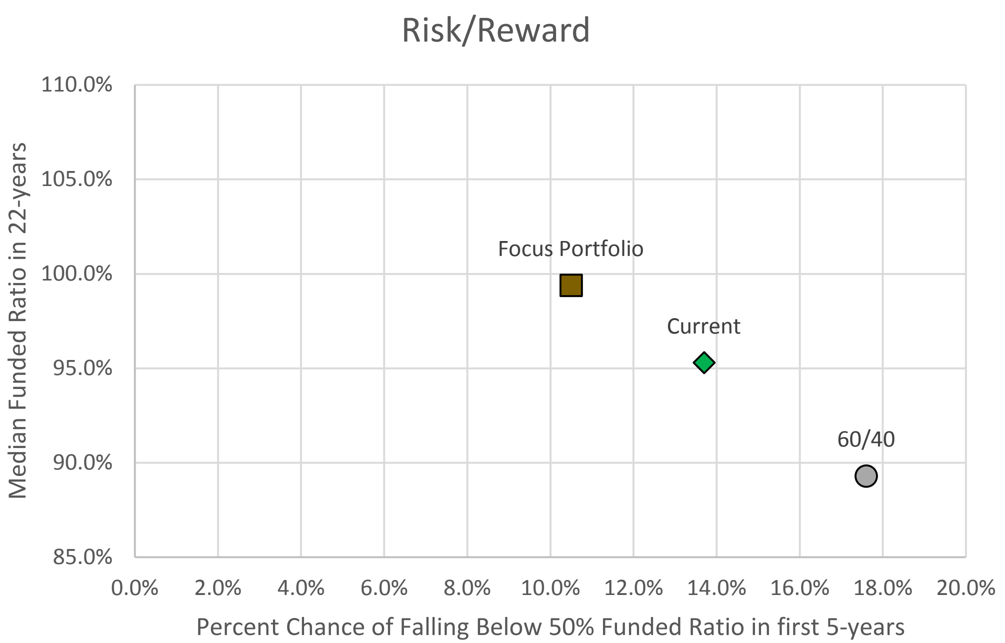
Stress Testing: #2 = 6% inflation Year 2

Line	Scenario Statistics	60/40	Current	Focus Portfolio
1	5-Year Median Scenario Comp Return	5.7	6.6	7.0
2	5-Year Average Scenario Standard Deviation	11.4	12.0	11.6
3	Average 2-year Loss of Worst 10%	-22.4	-22.6	-20.5
4	Percent of Scenarios <50% [during first 5-years]	17.6	13.7	10.5
5	Median Funded Ratio [end of 5-years]	56.5	58.4	59.3
6	Average Funded Ratio of Worst 10% [end of 5-years]	44.3	44.9	46.4
7	Median Funded Ratio [end of 22-years]	89.8	95.3	99.4
8	Average Funded Ratio of Worst 10% [end of 22-years]	63.4	63.5	67.3
9	Median Avg. Ann. Employer Cntrbs. Rate % [during 22-yrs]	22.4	21.3	20.5
10	Average % of Yrs. w/ Employer Cntrbs. Rate >30% [during 22-yrs]	8.1	6.3	4.4

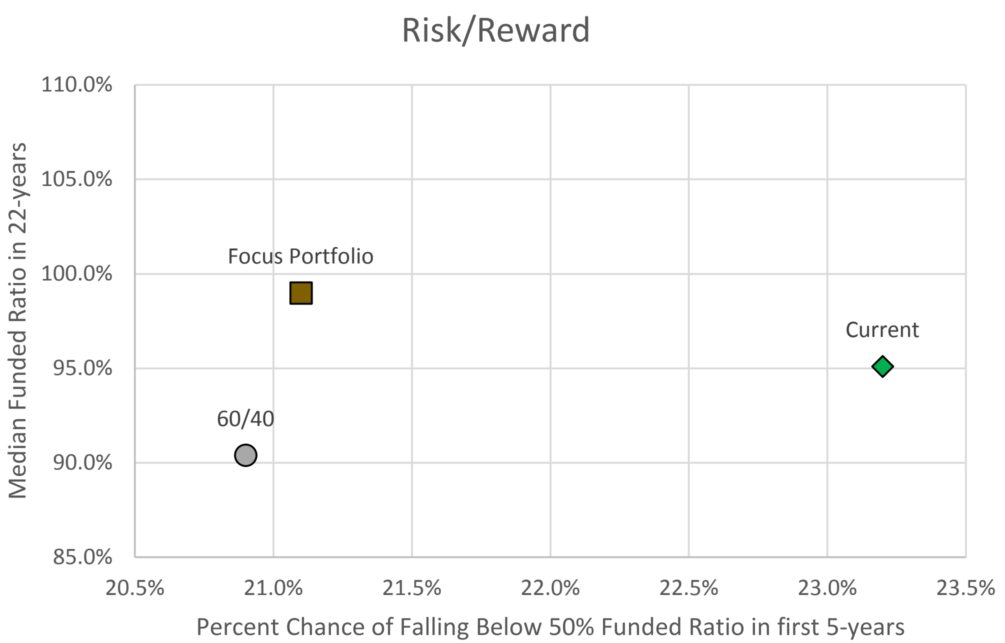


<u>Focus Portfolio vs. Current</u>

- Focus Portfolio produced the best performance
- 2-year drawdown statistic improves by ~10% vs. the Current (line 3)
- Near-term funding risk reduced by ~23% (line 4)
- Employer contribution stability improved by ~30% (line 10)
- Improves long-term funding expectations (line 7)

Stress Testing: #3 = -2% Deflation Year 2

Line	Scenario Statistics	60/40	Current	Focus Portfolio
1	5-Year Median Scenario Comp Return	5.2	4.9	5.2
2	5-Year Average Scenario Standard Deviation	13.2	13.8	13.7
3	Average 2-year Loss of Worst 10%	-29.6	-31.9	-30.9
4	Percent of Scenarios <50% [during first 5-years]	20.9	23.2	21.1
5	Median Funded Ratio [end of 5-years]	57.4	56.8	57.5
6	Average Funded Ratio of Worst 10% [end of 5-years]	41.1	40.2	40.8
7	Median Funded Ratio [end of 22-years]	90.4	95.1	99.0
8	Average Funded Ratio of Worst 10% [end of 22-years]	62.2	63.2	67.0
9	Median Avg. Ann. Employer Cntrbs. Rate % [during 22-yrs]	23.0	22.7	22.0
10	Average % of Yrs. w/ Employer Cntrbs. Rate >30% [during 22-yrs]	13.9	13.9	11.9



<u>Focus Portfolio vs. Current</u>

- Focus Portfolio produced the best overall performance
- Near-term funding risk reduced by ~9% (line 4)
- Employer contribution stability improved by ~15% (line 10)
- Improves long-term funding expectations (line 7)

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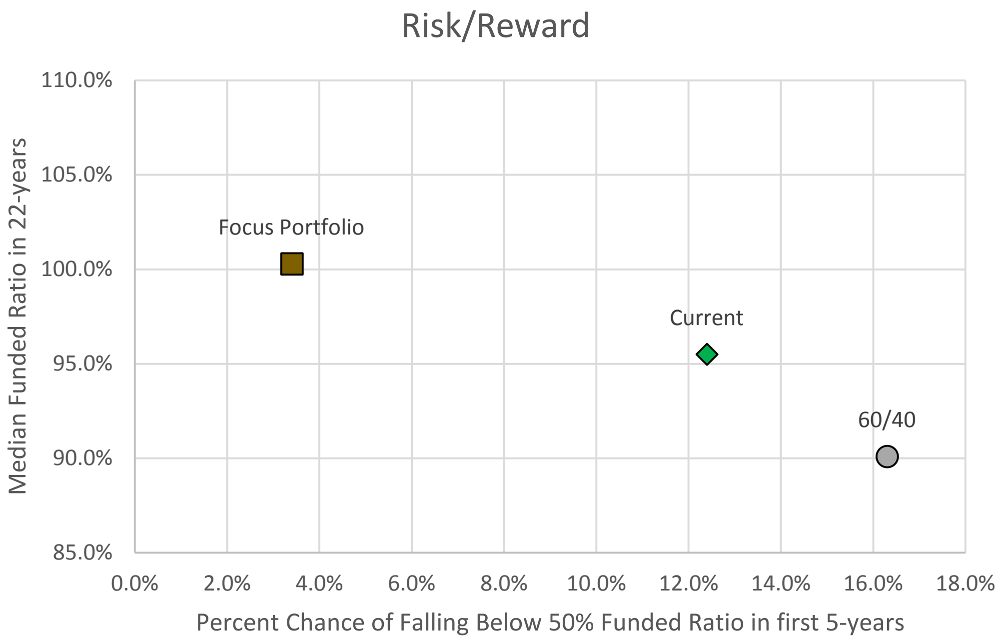
Stress Testing: #4 = 2% Rate Increase Year 1

Line	Scenario Statistics	60/40	Current	Focus Portfolio
1	5-Year Median Scenario Comp Return	6.1	6.9	8.3
2	5-Year Average Scenario Standard Deviation	10.4	11.2	11.0
3	Average 2-year Loss of Worst 10%	-16.0	-16.3	-10.8
4	Percent of Scenarios <50% [during first 5-years]	16.3	12.4	3.4
5	Median Funded Ratio [end of 5-years]	56.4	58.1	62.2
6	Average Funded Ratio of Worst 10% [end of 5-years]	45.6	46.3	50.4
7	Median Funded Ratio [end of 22-years]	90.1	95.5	100.3
8	Average Funded Ratio of Worst 10% [end of 22-years]	62.6	93.3	67.3
9	Median Avg. Ann. Employer Cntrbs. Rate % [during 22-yrs]	22.7	21.6	19.8
10	Average % of Yrs. w/ Employer Cntrbs. Rate >30% [during 22-yrs]	9.1	7.1	2.9



Focus Portfolio vs. Current

- Focus Portfolio produced the best performance
- Long duration bonds may suffer in this environment
- Focus portfolio performs worse in year 1, but produces better results over the next 4-years (and 21-years) resulting in better Median Funding Ratio (lines 5 and 7)
- Focus portfolio produces better near-term and long-term expected results

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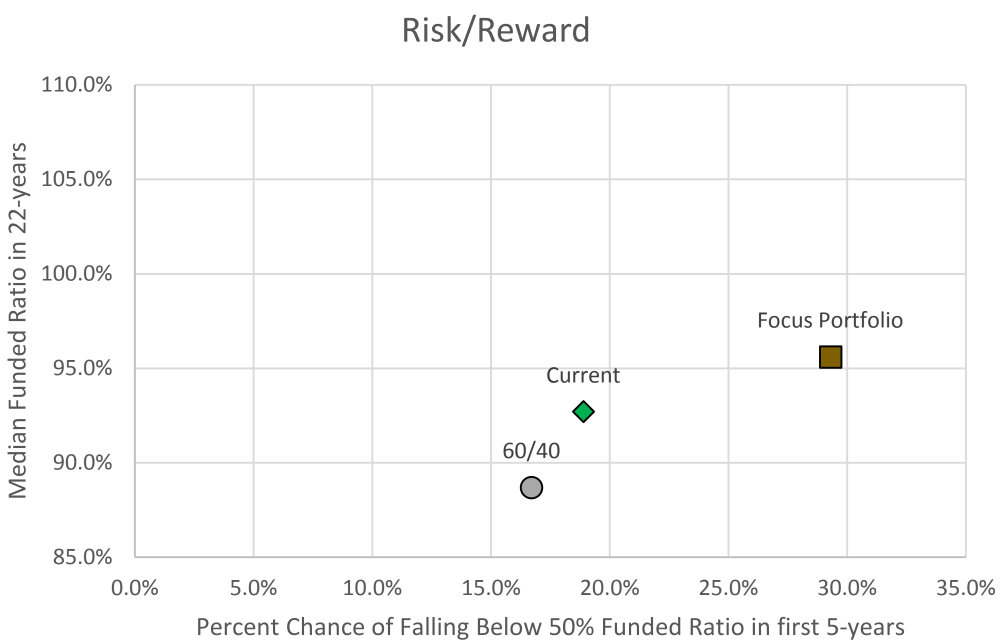
Stress Testing: #5 = New Normal Low Ret. & Inflation

Line	Scenario Statistics	60/40	Current	Focus Portfolio
1	5-Year Median Scenario Comp Return	2.3	2.5	2.3
2	5-Year Average Scenario Standard Deviation	2.0	2.5	3.3
3	Average 2-year Loss of Worst 10%	-0.3	-1.4	-3.4
4	Percent of Scenarios <50% [during first 5-years]	16.7	18.9	29.3
5	Median Funded Ratio [end of 5-years]	51.3	51.5	51.2
6	Average Funded Ratio of Worst 10% [end of 5-years]	49.1	48.7	47.6
7	Median Funded Ratio [end of 22-years]	88.7	92.7	95.6
8	Average Funded Ratio of Worst 10% [end of 22-years]	63.0	64.0	67.5
9	Median Avg. Ann. Employer Cntrbs. Rate % [during 22-yrs]	25.8	25.3	25.2
10	Average % of Yrs. w/ Employer Cntrbs. Rate >30% [during 22-yrs]	24.1	21.2	21.5



<u>Focus Portfolio vs. Current</u>

- 60/40 and Current portfolios produced the best results
- Driven by model assumptions
  - Low equity returns for 5-years
  - 60/40 has 60% of assets that are allocated to this more constant return = best results
  - Current and then Focus portfolio have a larger percentage allocated to more volatile assets
- Focus portfolio produces better long-term expected results but suffers in the short-term due to model assumptions

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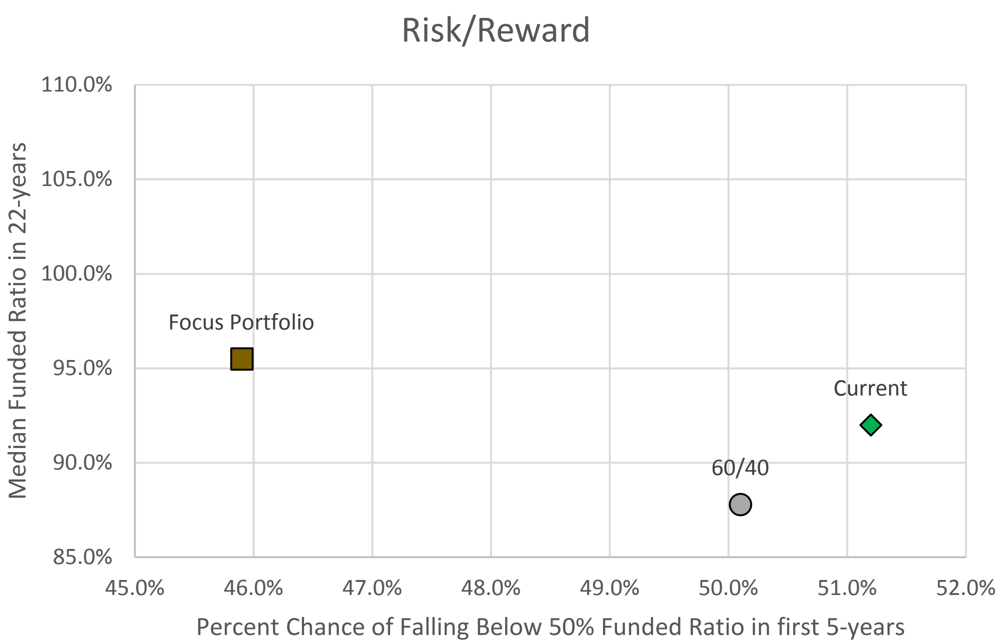
Stress Testing: #6 = 2% Rate Increase & -20% Equities Year 2

Line	Scenario Statistics	60/40	Current	Focus Portfolio
1	5-Year Median Scenario Comp Return	2.8	2.7	3.2
2	5-Year Average Scenario Standard Deviation	13.3	14.4	13.9
3	Average 2-year Loss of Worst 10%	-26.6	-29.8	-26.6
4	Percent of Scenarios <50% [during first 5-years]	50.1	51.2	45.9
5	Median Funded Ratio [end of 5-years]	50.0	49.9	50.6
6	Average Funded Ratio of Worst 10% [end of 5-years]	40.2	39.4	40.8
7	Median Funded Ratio [end of 22-years]	87.8	92.0	95.5
8	Average Funded Ratio of Worst 10% [end of 22-years]	62.9	64.0	67.5
9	Median Avg. Ann. Employer Cntrbs. Rate % [during 22-yrs]	25.2	24.8	24.1
10	Average % of Yrs. w/ Employer Cntrbs. Rate >30% [during 22-yrs]	20.9	19.9	16.2



Focus Portfolio vs. Current

- Focus Portfolio produced the best performance
- Focus portfolio benefits from having less public equity exposure and more diversification
- Near-term risk reduced by ~10.5% (lines 3 and 4)
- Employer contribution stability improved by ~18.5% (line 10)
- Improves long-term funding expectations (line 7)

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Portfolio Policy Transition Plan

Strategic Class %	Current Policy	2017	2018	2019	2020	2021	Proposed Policy
US Equity	19.0	23.0	22.0	22.0	21.0	20.0	20.0
Equity Hedge Funds	8.0	---	---	---	---	---	---
Non-US Equity	19.0	22.0	22.0	21.0	21.0	20.0	20.0
Private Growth	9.0	10.0	11.0	12.0	13.0	15.0	15.0
Income Class	3.5	4.0	5.0	6.0	6.0	6.0	6.0
Crisis Risk Offset	0.0	6.0	8.0	8.0	8.0	8.0	8.0
Inflation Protection	16.5	13.0	11.0	10.0	10.0	10.0	10.0
IG Fixed Income	15.0	12.0	11.5	11.5	11.5	11.5	11.5
Absolute Return	7.0	7.0	6.5	6.5	6.5	6.5	6.5
Cash	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Liquid asset transitions can be implemented quickly

Illiquid asset class pacing must be measured – to ensure vintage year diversification

Transition plan is subject to revision as market conditions evolve

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Proposed Portfolio Rebalancing Policy

Strategic Class	Focus Portfolio %	Rebalancing Bands
Global Equity	40	+/- 2%
Private Growth *	15	+/- 4%
Income Class	6	+/- 2%
Crisis Risk Offset	8	+/- 2%
Inflation Protection *	10	+/- 3%
IG Fixed Income	11.5	+/- 2%
Absolute Return	6.5	+/- 2%
Cash	3	+/- 2%
Total	100%	100%

Note: Current rebalancing policy is +/- 2% for all classes

- Wider rebalancing bands for functional classes with illiquid assets --- minimizes denominator effect in market crisis
- Will promote smoother investing of additional allocations to illiquid assets and promote vintage year diversification
- Current policy is to rebalance monthly

* Functional Class includes illiquid assets

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Next Steps

- Revise Investment Policy Statement
- Structural Reviews – individual asset and functional classes
  - Policy benchmark review
    - Does the policy benchmark reflect the role of the class?
    - Given investment market conditions – are there other strategies that may achieve the class role in a more efficient manner?
  - Investment manager reviews

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APPENDIX:

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Inflation Protection Class Review

Strategic Class %	Weight	Ann. Ret.	Ann. StDev.	Correlation			
Inflation Protection	100.0	5.78	5.88	**Bank Lns.**	**Core RE**	**Core Infra.**	**TIPS**
Bank Loans	21.0	6.80	15.60	1.00			
Core Real Estate	37.0	6.10	12.00	-0.30	1.00		
Core Infrastructure	18.0	6.75	9.25	0.44	0.19	1.00	
TIPS	24.0	3.65	6.00	-0.01	-0.06	0.28	1.00

- While each component has higher volatility, the total class benefits from a diversification effect

- In total over the longer-term (46-years) the underlying components are more diversifying than may be expected

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Income Class Review

Strategic Class %	Weight	Ann. Ret.	Ann. StDev.	Correlation			
Income Class	100.0	8.23	16.97	REITs	HY Infra.	HY	Pr. Credit
REITs	25.0	8.40	20.00	1.00			
HY Infrastructure	25.0	9.90	25.00	0.61	1.00		
High Yield	25.0	7.30	15.30	0.67	0.84	1.00	
Private Credit	25.0	7.30	15.30	0.61	0.91	0.97	1.00

- High positive correlation across the classes results in high total class volatility
- REITS Assumption:
  - Based on current and historical yield plus inflation assumption and a volatility of slightly higher than US Equity
- HY Infrastructure (MLPs):
  - Based on current and historical yield plus inflation assumption and a volatility based on the average of income and return volatility
- High Yield
  - Based on current YTW adjusted for the default and historical recovery rate and a volatility same as historical
- Private Credit
  - Modeled similar to high yield assumptions with and underlying blended return behavior of credit and high yield

Review: Capital Markets Assumptions Summary

** Using GRS' Inflation Assumption of 2.75%*

Strategic Classes	Sub-Classes	Assets Modeled	10-Year Expected Risk & Return: Arithmetic Return	Standard Deviation	Compound Return
Growth Class	US Equity	US Equity	9.00%	18.50%	7.62%
	NonUS Equity	NonUS Equity	10.00%	21.00%	8.24%
	Private Growth	Private Equity	12.60%	26.00%	10.00%
		Non-Core Real Estate	10.10%	20.80%	8.38%
		Opportunistic Private Credit	10.10%	20.80%	8.38%
Income Class	REITs	REITs	8.40%	20.00%	6.78%
	High Yield Infrastructure	High Yield Infrastructure	9.90%	25.00%	7.43%
	High Yield	High Yield	7.30%	15.30%	6.33%
	Private Credit	Private Credit	7.30%	15.30%	6.33%
Risk Reduction Class	Crisis Protection	Treasury Duration	4.50%	18.00%	3.13%
		Systematic Trend Following	7.90%	18.00%	6.58%
	Inflation Protection	Bank Loans	6.80%	15.60%	5.79%
		Core Real Estate	6.10%	12.00%	5.49%
		Core Infrastructure	6.75%	9.25%	6.39%
		TIPS	3.65%	6.00%	3.49%
	Volatility Protection	IG Fixed Income	3.50%	4.00%	3.43%
		Absolute Return	5.35%	9.75%	4.95%
		Cash	2.50%	1.00%	2.50%

Review: Portfolio Structure for Optimization Purposes

Strategic Classes	*Classes/Assets for Optimization Purposes*		*Components of Optimization Classes/Assets*
Growth Class	US Equity	=	100% US Equity
	NonUS Equity	=	100% NonUS Equity
	Private Growth	=	75% Private Equity 15% Non-Core Real Estate 10% Opportunistic Private Credit
Income Class	Income Class	=	25% REITs 25% High Yield Infrastructure 25% High Yield 25% Private Credit
Risk Reduction Class	Crisis Protection	=	50% Treasury Duration 50% Systematic Trend Following
	Inflation Protection	=	21% Bank Loans 37% Core Real Estate 18% Core Infrastructure 24% TIPS
	IG Fixed Income	=	100% IG Fixed Income
	Absolute Return	=	100% Absolute Return
	Cash	=	100% Cash

Nine Asset / Functional Classes to be Optimized

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Review: CMAs and Preliminary Constraints

** Using GRS' Inflation Assumption of 2.75%*

		10-Year Expected Risk & Return		
		Arithmetic Return	**Standard Deviation**	**Compound Return**
Growth Class	US Equity	9.00%	18.50%	7.62%
	NonUS Equity	10.00%	21.00%	8.24%
	Private Growth	11.98%	24.07%	9.73%
Income Class	Income Class	8.23%	16.97%	7.05%
Risk Reduction Class	Crisis Risk Offset	6.20%	12.76%	5.52%
	Inflation Protection	5.78%	5.88%	5.63%
	IG Fixed Income	3.50%	4.00%	3.43%
	Absolute Return	5.35%	9.75%	4.95%
	Cash	2.50%	1.00%	2.50%

Note:

- Equity Hedge funds not included in analysis
- Current Portfolio does not include Equity Hedge Funds (allocation assumed in public traded equity portfolio)

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Definitions

Median Scenario Comp Return: median expected compound investment return based on 5,000 simulations

Average Scenario Standard Deviation: average expected portfolio standard deviation based on 5,000 simulations

Sharpe Ratio: measure of risk-adjusted return (higher the better), calculated as expected return – risk free rate (cash) / standard deviation

Sortino Ratio: measure of risk-adjusted return (higher the better), calculated as expected return – risk free rate (cash) / standard deviation of negative returns

Best Year / Worst Year: best and worst year for the portfolio through 5,000 simulations

Average 2-year Loss of Worst 10%: average 2-year drawdown of worst 10% of 5,000 scenarios (i.e. average return of the worst 500 scenarios after 2-years)

Percent of Scenarios <50% [during first 5-years]: probability of falling below 50% funded ratio at any point in the first 5-years (if equal to 10% then 500 of 5,000 simulations crossed below 50% funded ratio at some point in the first 5-years)

Median Funded Ratio [end of 5-years]: median expected funded ratio at the end of 5-years based on 5,000 simulations

Average Funded Ratio of Worst 10% [end of 5-years]: average funded ratio of worst 10% of 5,000 scenarios at the end of 5-years (i.e. average funded ratio of the worst 500 scenarios after 5-years)

Median Funded Ratio [end of 22-years]: median expected funded ratio at the end of 22-years based on 5,000 simulations

Average Funded Ratio of Worst 10% [end of 22-years]: average funded ratio of worst 10% of 5,000 scenarios at the end of 22-years (i.e. average funded ratio of the worst 500 scenarios after 22-years)

Median Avg. Ann. Employer Cntrbs. Rate % [during 22-yrs]: median expected average annual employer contribution rate across the 22-year period

Average % of Yrs. w/ Employer Cntrbs. Rate >30% [during 22-yrs]: average percent of years an employer contribution rate of greater than 30% during the 22-year period

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