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RESILIENT PORTFOLIOS FOR EXCEEDING HARD THRESHOLDS

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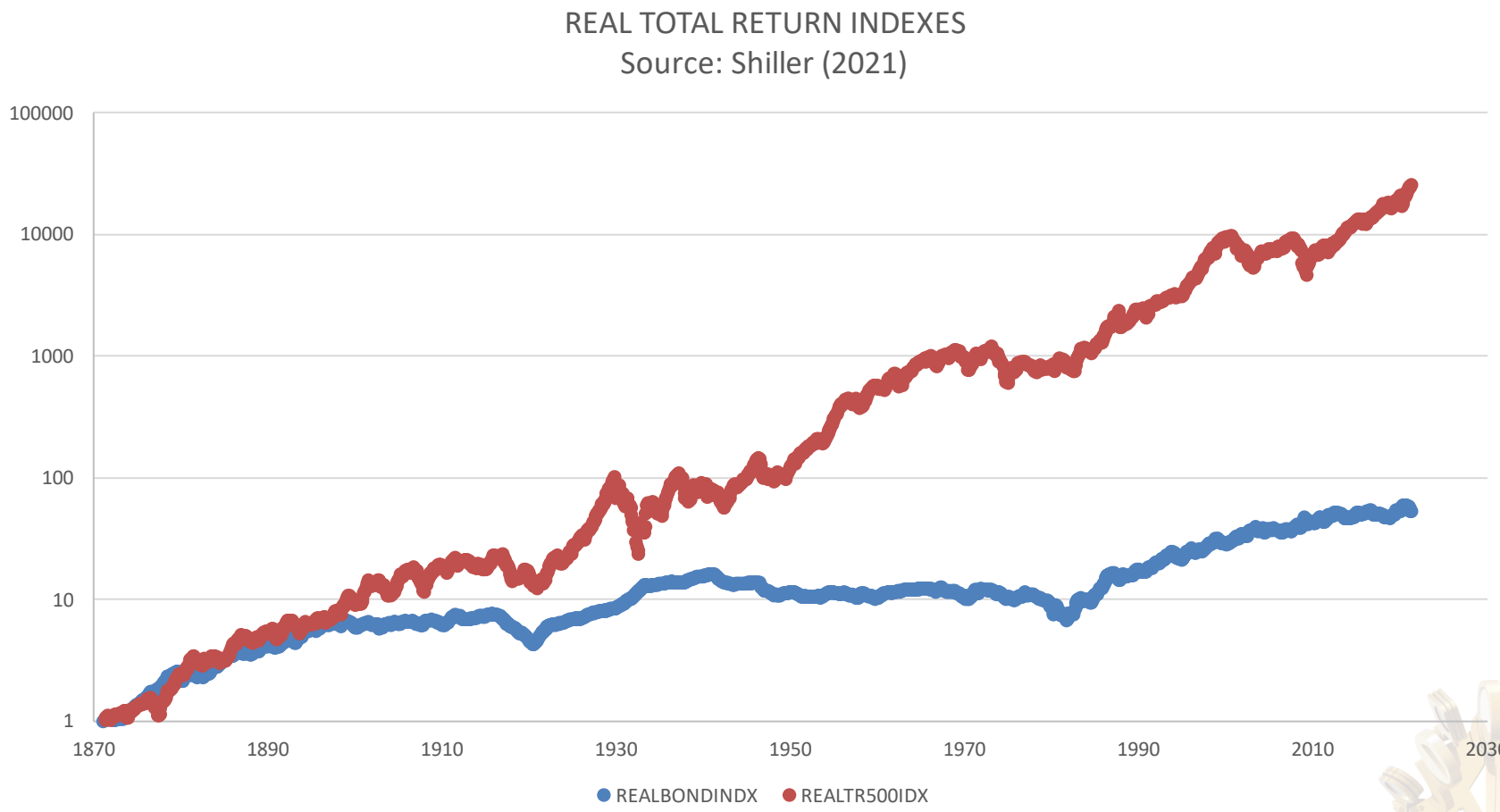
RESOURCES: GITHUB.COM/JARRODWILCOX/RESILIENCE_LAB.GIT

Radical Ideas?

- In a nearly efficient market, investing that considers an ounce of the investor's situation adds more value than a pound of forecasting.
- Every investor has a tipping point. Scoring a portfolio's distance above a tipping point is easy and productive.
- Discrete probabilities and utility scores allow you to go further than stopping with mean-variance and CVaR:
  - Easier to understand
  - Easier to compose across complexity.

REAL DRIFT AND NOISE



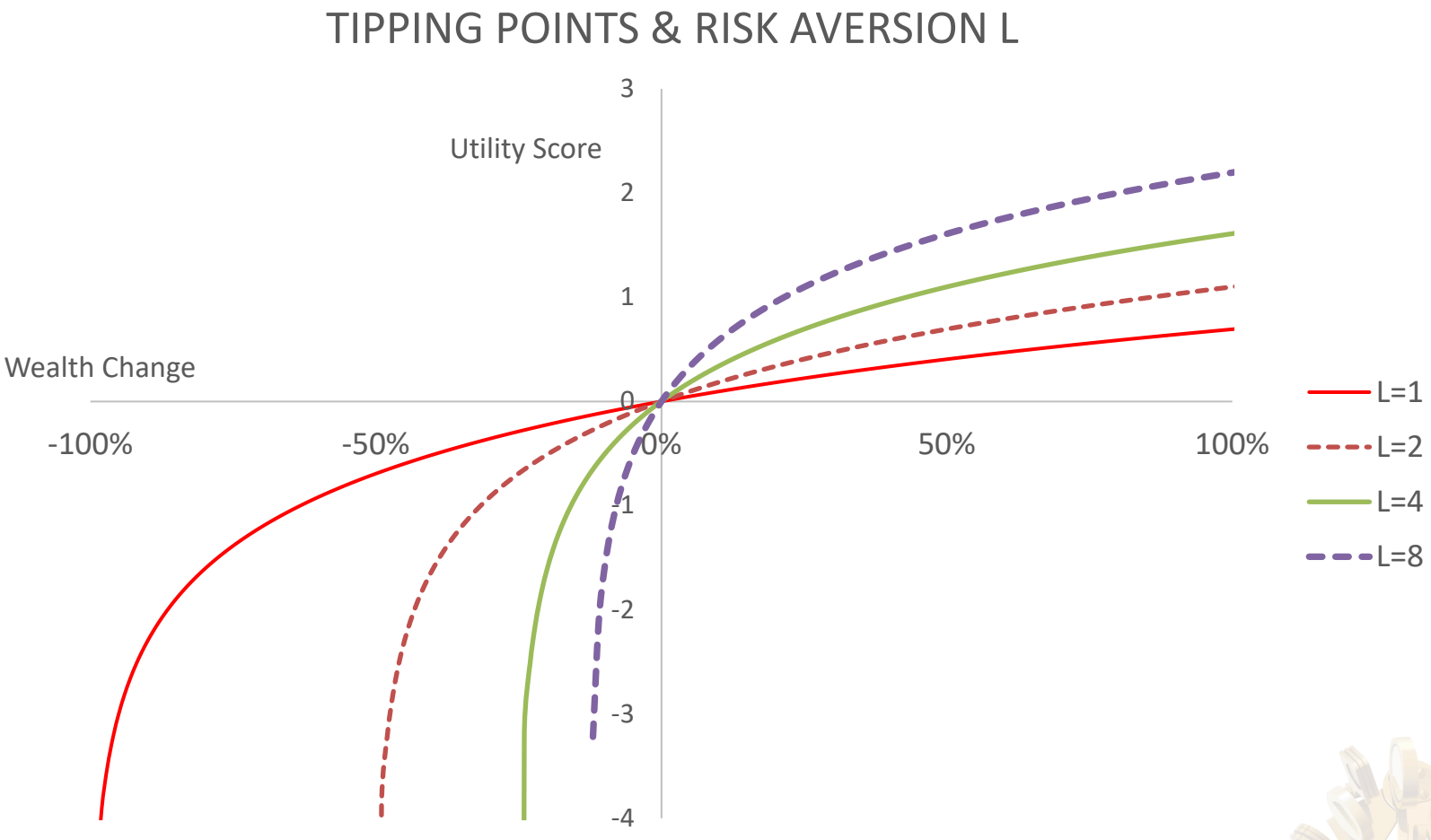
TIPPING POINT

There are some losses you can take.

There are some losses you can barely take.

There are some losses you can't take.

UTILITY: SCORING PORTFOLIOS



Threshold Utility Math

- Mean-variance: $MV = \mu - L\,\sigma^2/2$
  - Return mean μ, variance σ^2 , L risk aversion, ensemble statistics, no individual utility representation
- Rubinstein utility: GLUM=ln(1+Lr)
  - Each outcome portfolio return r has a well-defined utility
  - Kelly rule applied to surplus 1/L of investment value
- Let $Q = L\sigma / (1+L\mu)$, then:
  - Expected GLUM = $\ln(1+L\mu) - Q^2/2 + SQ^3/3 - KQ^4/4 + \ldots$
  - S: r skewness, K: r kurtosis – higher moments included
- Limit $\triangle t \rightarrow 0$ of Expected GLUM = L (MV)
  - Almost identical allocations if Q is small.

Resilience with Mean-Variance

- Appropriate risk aversion = Investments/Surplus
- Use the right returns
  - Untaxed vs after-tax
  - Nominal vs real
  - Absolute vs residual, or a blended cash and index benchmark
- Constrain individual security hazards based on higher moments, patch with tail risk measures

Resilience Against Tail Risk

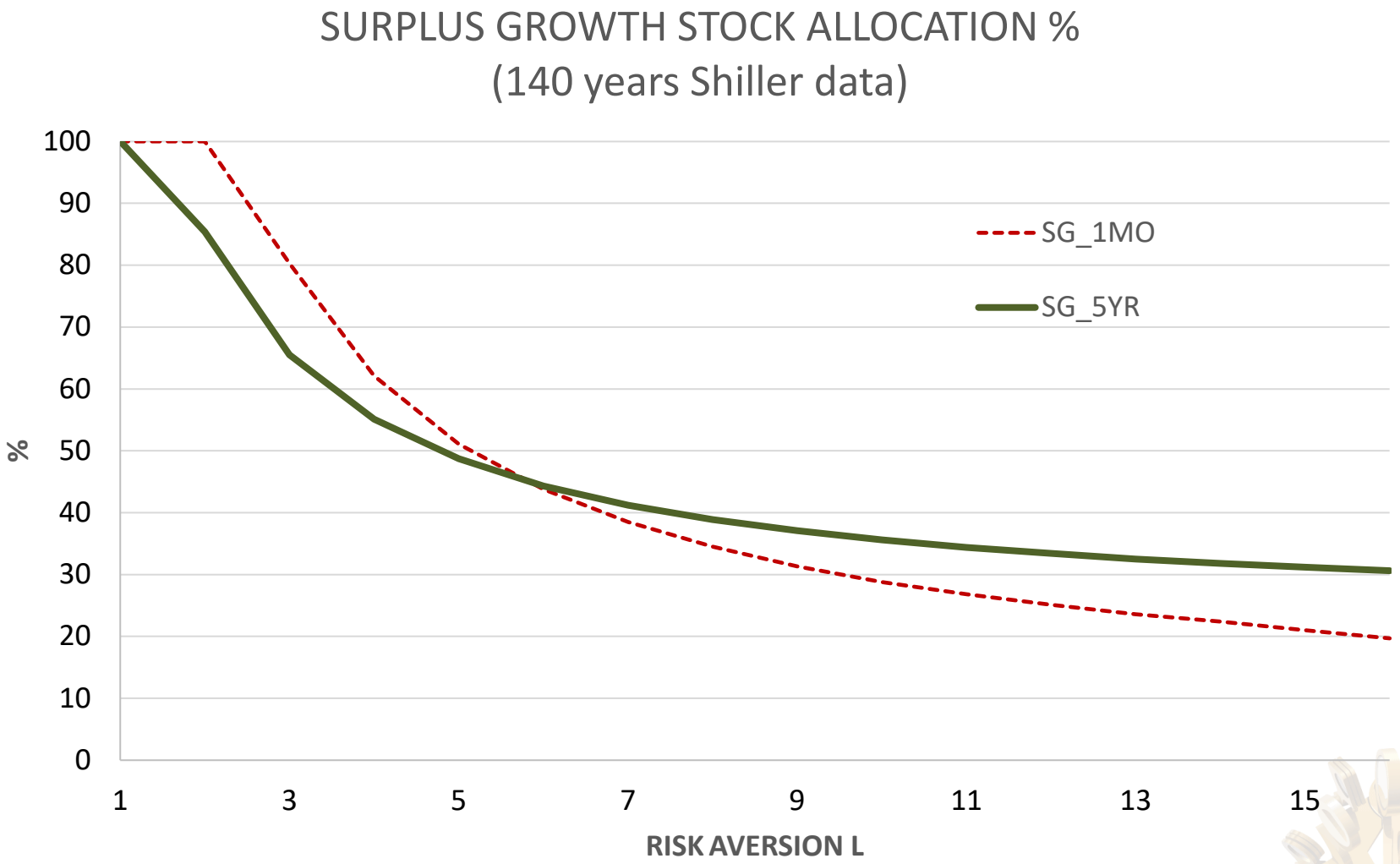
1. Bayesian mean adjustment based on Shiller data +Gold
2. Remaining return distribution18 years of monthly returns through January 2021 for 28 assets
3. Tail risk based on 3rd and 4th moments of GLUM utility probability distribution

	MONTHLY RETURN					TAIL RISK BY RISK AVERSION		
ID	MEAN	SMEAN	STD DEV	SKEW	KURT	L:2	L:4	L:8
EFA	0.73%	0.93%	4.97%	-0.54	4.8	0.000	-0.003	-0.032
EZU	0.76%	0.95%	6.23%	-0.38	4.6	0.000	-0.006	-0.066
EST_EEM	1.06%	1.00%	6.28%	-0.34	4.3	0.000	-0.005	-0.062
EWJ	0.63%	0.89%	4.57%	-0.32	3.5	0.000	-0.001	-0.017
IWR	1.07%	1.01%	4.85%	-0.81	6.7	0.000	-0.004	-0.040
IWS	0.99%	0.99%	4.96%	-0.98	8.0	0.000	-0.005	-0.053
IWP	1.16%	1.03%	4.93%	-0.65	5.8	0.000	-0.003	-0.036
SPY	0.93%	0.97%	4.16%	-0.56	4.8	0.000	-0.002	-0.017
XLK	1.26%	1.06%	4.90%	-0.36	3.4	0.000	-0.002	-0.020
XLE	0.75%	0.96%	7.31%	-0.16	7.6	-0.001	-0.013	-0.178
VWEHX	0.57%	0.74%	2.29%	-1.82	16.3	0.000	-0.001	-0.007
IYR	0.93%	0.98%	6.20%	-0.61	9.5	-0.001	-0.011	-0.127
XLP	0.82%	0.92%	3.26%	-0.61	4.1	0.000	-0.001	-0.007
DIA	0.89%	0.96%	4.00%	-0.56	4.6	0.000	-0.001	-0.014
XLY	1.16%	1.03%	5.07%	-0.10	4.9	0.000	-0.002	-0.026
IBB	1.26%	1.04%	5.92%	-0.21	3.7	0.000	-0.003	-0.040
XLV	0.90%	0.96%	3.84%	-0.31	3.7	0.000	-0.001	-0.009
IEF	0.42%	0.48%	1.82%	0.25	4.3	0.000	0.000	0.000
VFITX	0.24%	0.36%	1.37%	-0.44	5.9	0.000	0.000	0.000
VFIIX	0.29%	0.34%	0.81%	-0.38	6.5	0.000	0.000	0.000
VUSTX	0.43%	0.51%	3.34%	0.36	4.1	0.000	0.000	-0.002
TLT	0.61%	0.54%	3.77%	0.46	4.9	0.000	0.000	-0.004
VWESX	0.55%	0.53%	2.78%	0.07	5.3	0.000	0.000	-0.002
EST_GLD	0.88%	0.40%	4.92%	-0.02	3.2	0.000	-0.001	-0.015
VWSTX	0.14%	0.28%	0.22%	0.37	6.8	0.000	0.000	0.000
VWAHX	0.42%	0.47%	1.45%	-1.06	7.2	0.000	0.000	-0.001
VWLTX	0.38%	0.44%	1.39%	-0.92	6.0	0.000	0.000	-0.001
LQD	0.49%	0.52%	2.13%	0.08	11.9	0.000	0.000	-0.002

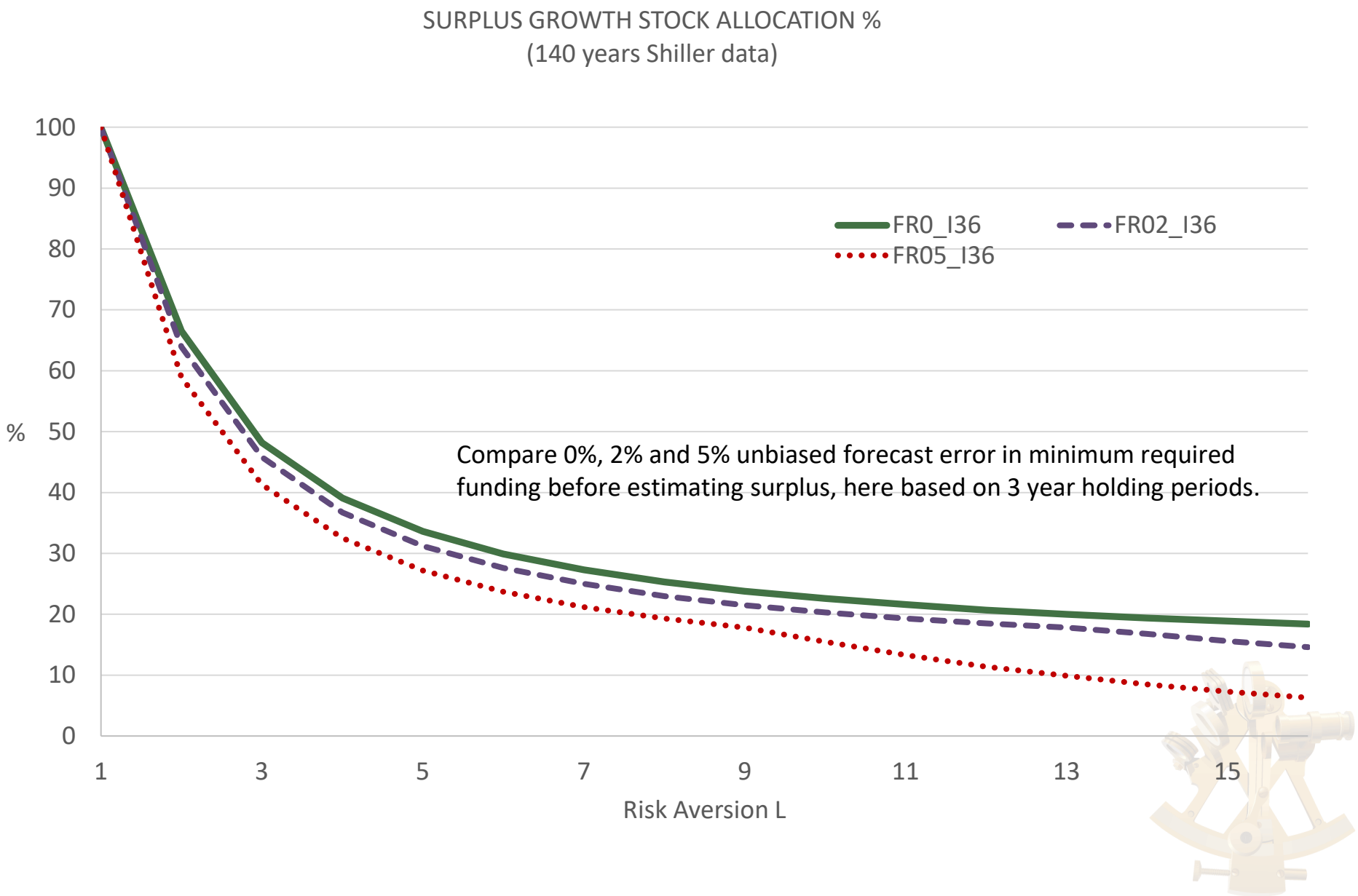
GLUM + Discrete Probability

- Simple treatment of higher moments
  - Including option returns
- Match to time horizon till liquidity need
  - Compounding positive mean returns eventually produces positive return skewness
- Take into account uncertain surplus
  - Example: longevity risk
- Conveniently insert regime scenarios – 2008, covid
- Combine short and long-term time horizons for maximum investment fund needs

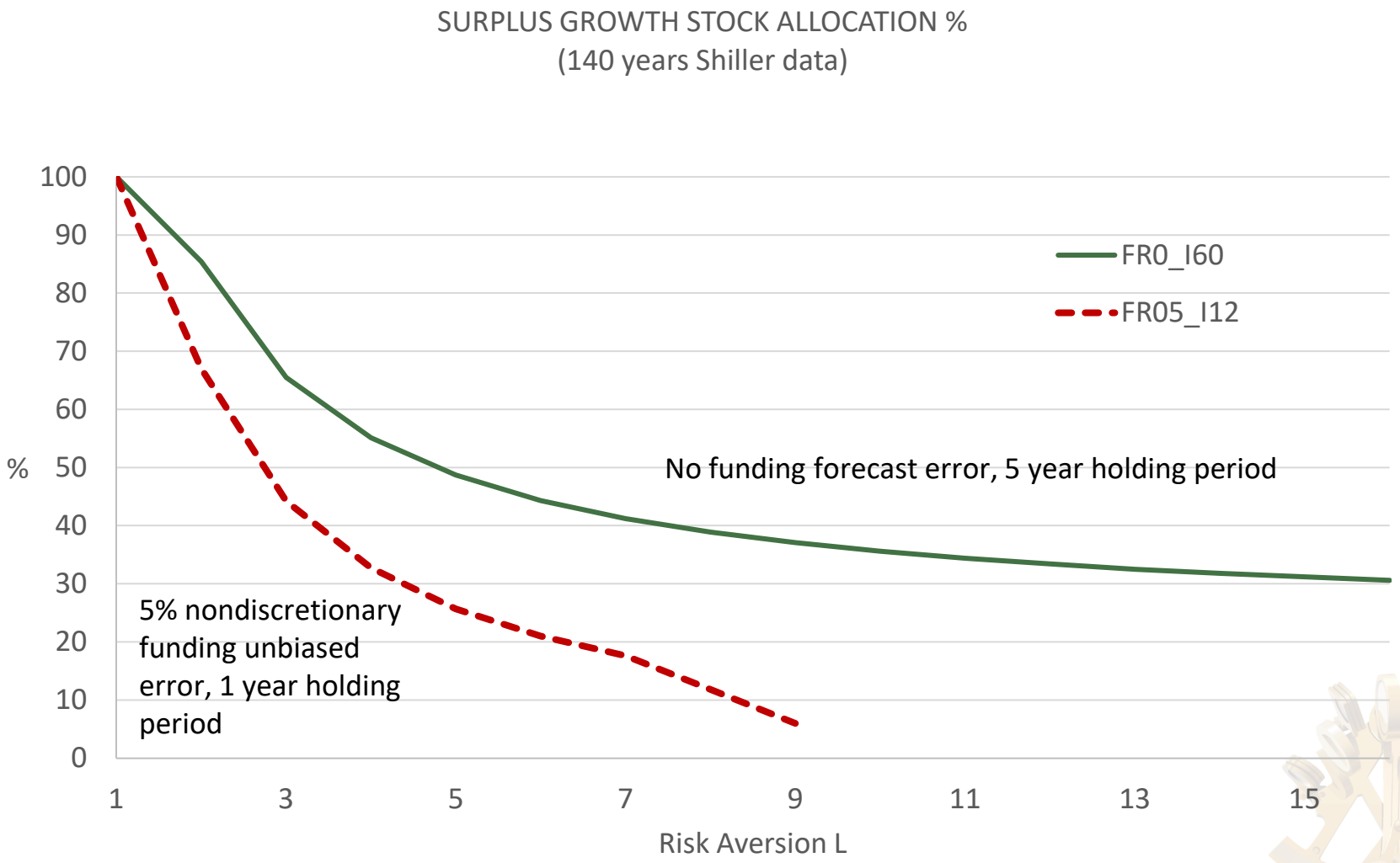
Resilience by Matching To Time Horizon



RISK TO MINIMUM REQUIRED FUNDING



TIME INTERVAL AND FUNDING RISK INTERACTION

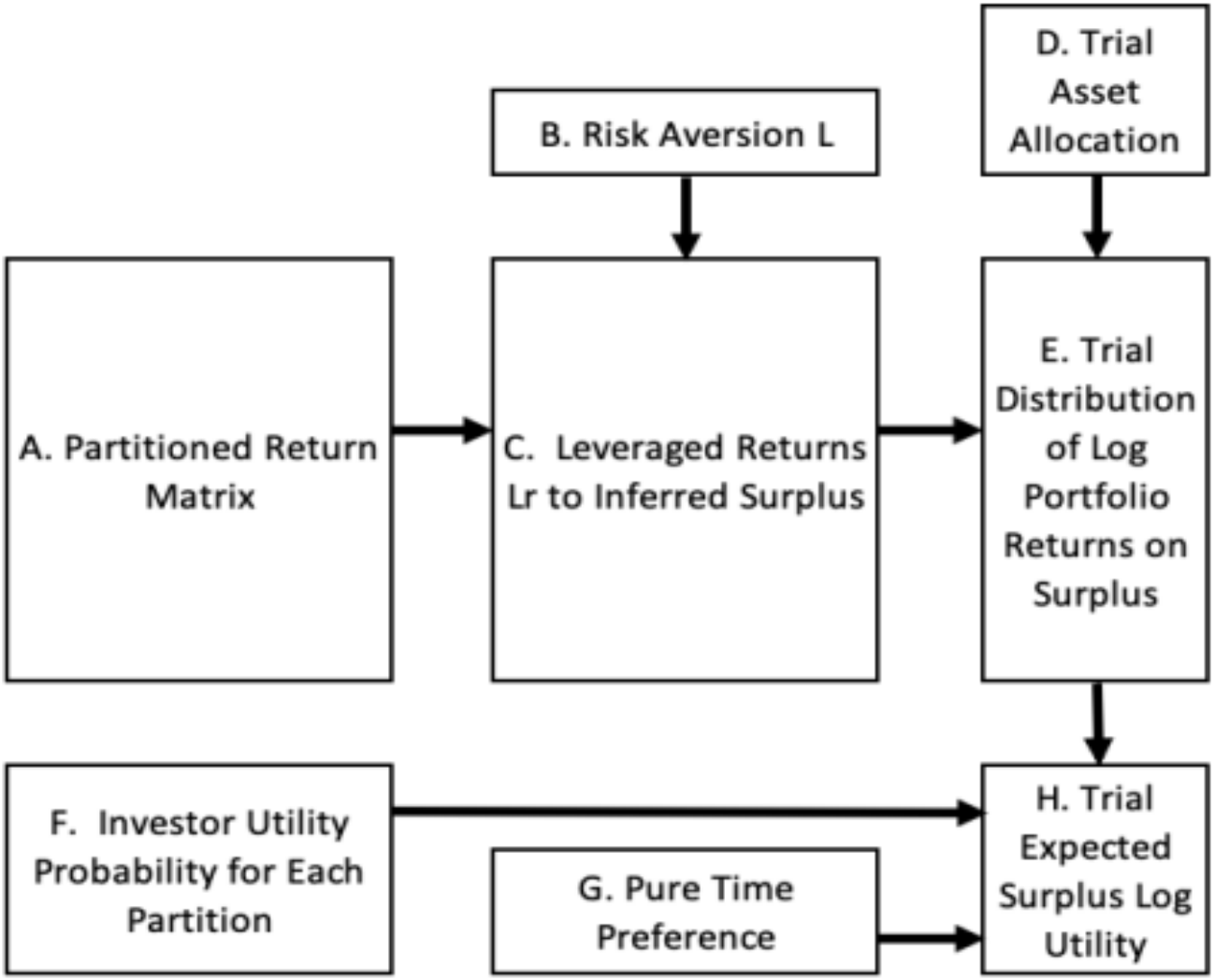


ADDING AN INVESTOR LAYER TO THE UTILITY PROBABILITY DISTRIBUTION TREE

- Single period decisions can respond to multiple…
  - Beliefs in investment regimes,
  - Time horizons, and…
  - Surplus forecasts.

Investor's Probability of Consequent Utility Need		Investment Return Probability Distributions		Trial Allocation
		Pa1 Outcome	X	Utility a1
Pa	{	Pa2 Outcome	X	Utility a2
		Pa3 Outcome	X	Utility a3
		Pb1 Outcome	X	Utility b1
Pb	{	Pb2 Outcome	X	Utility b2
		Pb3 Outcome	X	Utility b3
		Pz1 Outcome	X	Utility z1
Pz	{	Pz2 Outcome	X	Utility z2
		Pz2 Outcome	X	Utility z3
		Expected Utility		

SEARCHING ALLOCATION SPACE WITH COMPOSABLE GLUM UTILITY DISTRIBUTIONS



RESILIENCE by PLANNING for DISASTER and RECOVERY

- By adding an investor layer to the probability distribution…
- We can mix in hypothetical regime scenarios and time horizons.

HISTORY, 1-MONTH AHEAD

MEAN-VARIANCE ALLOCATION

	L:1	L:2	L:4	L:8	L:16
Utility:	0.007	0.0147	0.0269	0.0413	NaN
Allocation Weights:					
IEF	0	0	0	1%	44%
EWJ	0	0	1%	2%	2%
VWEHX	0	0	0	28%	26%
XLP	0	34%	44%	29%	15%
IBB	22%	12%	4%	1%	0
XLV	0	11%	19%	12%	6%
TLT	0	0	10%	19%	0
DIA	0	0	0	0	3%
XLK	79%	43%	23%	10%	5%

0.4 MONTHLY HISTORY, 0.2 CRISIS, 0.4 6-MONTH AHEAD

EXPECTED SURPLUS GROWTH ALLOCATION

	L:1	L:2	L:4	L:8	L:16
Utility:	0.0175	0.0381	0.0702	0.1186	0.1863
Allocation Weights:					
IEF	0	0	0	50%	63%
VWSTX	0	0	0	0	4%
VWEHX	0	0	0	3%	4%
XLP	66%	85%	66%	37%	17%
IBB	7%	10%	11%	8%	7%
TLT	0	0	22%	0	0
XLK	27%	4%	2%	3%	5%
Utility Delta?:	0.011	0.023	0.043	0.077	+Inf

OPPORTUNITY FOR RESILIENCE

- If you build portfolios with mean-variance allocations:
  - You can still benefit from the most investor-relevant returns and surplus-based appropriate risk aversion,
  - And from constraining securities with unfavorable tail risk potential contingent on surplus.
- But you can go on further by prototyping expected utility strategies with greater flexibility for fitting investor situations.