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Mass Production, Mass Customization and Mass Distribution of Welfare Improving Retirement Solutions with Digital Goal-Based Investing Technology

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Outline

- Making Finance Useful Again

- Mass Production: (Smart) Factor Investing

- Mass Customization: (Retirement) Goal-Based Investing

- Mass Distribution: (Robo-Advised) Digital Investing

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Making Finance Useful Again

- After several decades of relative inertia, a true **industrial revolution** is currently under way in investment management, leading to the emergence of welfare-improving forms of **investment solutions**, with a particularly strong impact expected in the area of retirement solutions.

- Profound changes are taking place on 3 main fronts:
  - **Mass production:** The rise of factor investing;
  - **Mass customization:** The rise of goal-based investing;
  - **Mass distribution:** The rise of digital investing.

- History is in the making – The wait has already been too long.

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Old Paradigm: Cap Weighted Indices as Benchmarks

- Old investment paradigm:
  - **Active money management:** generate abnormal performance w.r.t. a cap-weighted (CW) benchmark through security selection decisions.
  - **Passive money management:** provide a low fee access to the normal performance of the cap weighted (CW) benchmark.

- Problems with this dual approach:
  - CW indices provide a **poor diversification of *unrewarded* risks**.
  - CW indices provide a **suboptimal exposure to *rewarded* risks**.

New Paradigm: Smart Factor Indices

- **"All we really say in finance is hold diversified portfolios along whatever tilt you choose."** (E. Fama).

US Long-Term (Dec 1974 - Dec 2014)	S&P500	Size Factor		Momentum Factor		Low Vol Factor		Value Factor	
		CW	Mid Cap Div. Multi-Strategy	CW	Momentum Div. Multi-Strategy	CW	Low Vol. Div. Multi-Strategy	CW	Value Div. Multi-Strategy
Ann. Returns	12.16%	15.49%	16.75%	13.10%	15.65%	12.40%	15.03%	13.66%	16.70%
Ann. Volatility	17.12%	17.59%	16.57%	17.30%	16.12%	15.50%	14.16%	17.83%	16.37%
Sharpe Ratio	0.41	0.59	0.70	0.46	0.65	0.47	0.70	0.48	0.71
Max. Drawdown	54.53%	60.13%	58.11%	48.91%	49.00%	50.50%	50.13%	61.20%	58.41%
Ann. Excess Returns		3.33%	4.59%	0.94%	3.49%	0.24%	2.87%	1.51%	4.54%
Ann.Tracking Error		5.75%	6.38%	3.50%	4.72%	4.47%	6.04%	4.53%	5.56%
95% Tracking Error		9.39%	11.42%	6.84%	8.58%	9.20%	11.53%	8.72%	10.14%
Information Ratio		0.58	0.72	0.27	0.74	0.05	0.48	0.33	0.82
Outperf. Prob. (1Y)		61.69%	67.78%	62.23%	67.24%	49.36%	66.06%	60.27%	70.83%
Outperf. Prob. (3Y)		69.25%	74.38%	78.47%	83.13%	52.85%	76.04%	66.25%	78.73%

The analysis is based on daily total return data from 31 December 1974 to 31 December 2014 (40 years). Benchmark used for relative analytics is the CRSP S&P 500 index. Mid Cap, High Momentum, Low Volatility, and Value selections all represent 50% stocks of said characteristics in USA universe of 500 stocks. The risk free rate is the return of 3 months US Treasury Bill. Maximum relative drawdown is the maximum drawdown of the long-short index whose return is given by the fractional change in the ratio of strategy index to the benchmark index. Probability of outperformance is the probability of getting positive excess return returns if one invests in the strategy for a period of 1 (or 3) years at any point during the history of the strategy. Rolling window of length 1 (or 3) years and a step size of 1 week is used. Source: CRSP and scientificbeta.com.

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# *Income, not Wealth, should be the Focus!*

- A variety of meaningful goals can be identified for individuals and households, including notably financing consumption in retirement.

- Retirement goals are expressed in terms of replacement income:
  - An **essential goal (EG)**: **minimum level of replacement income** (e.g., δ_{ess} = 80% of initial purchasing power);
  - An **aspirational goal (AG)**: **target level of replacement income** (e.g., δ_{asp} = 130% of initial purchasing power).

- GBI strategies rely on dynamic allocation to two building blocks:
  - Well-rewarded risky **performance seeking portfolio** (e.g., improved equity benchmark);
  - Safe **goal-hedging portfolio** (also known as **retirement bond**).

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Standard Bonds versus Retirement Bonds

■ The GHP is a **retirement bond**, that is a bond paying a series of constant or inflation-linked cash-flows starting at retirement date.
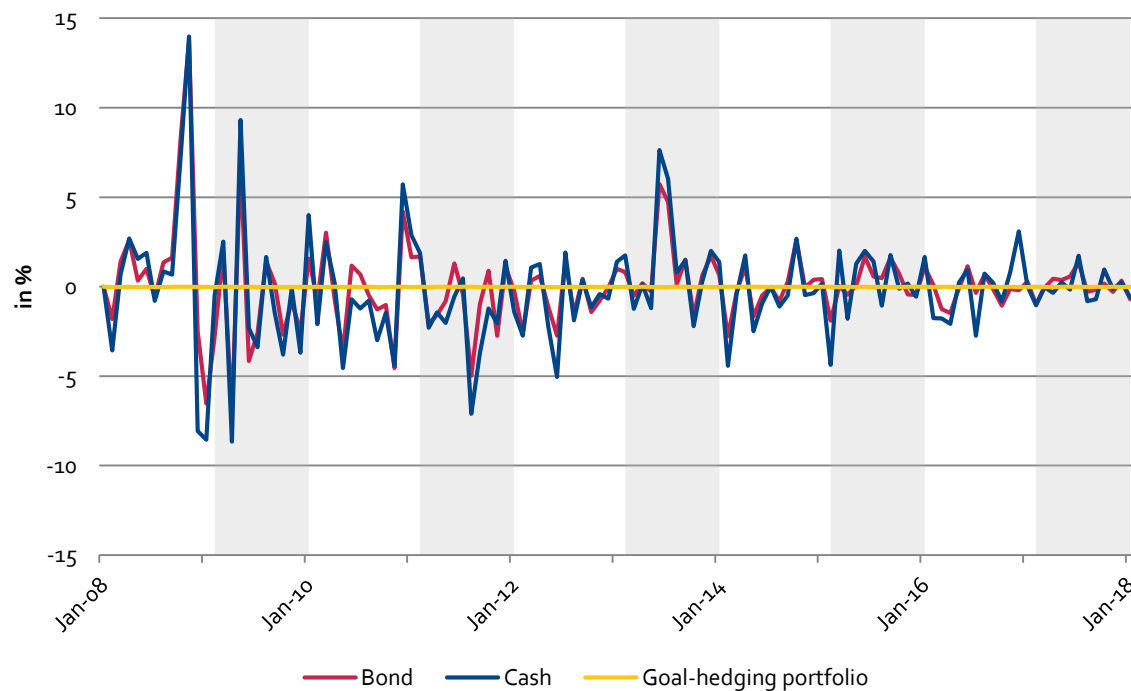

Standard bond   Retirement bond (GHP)
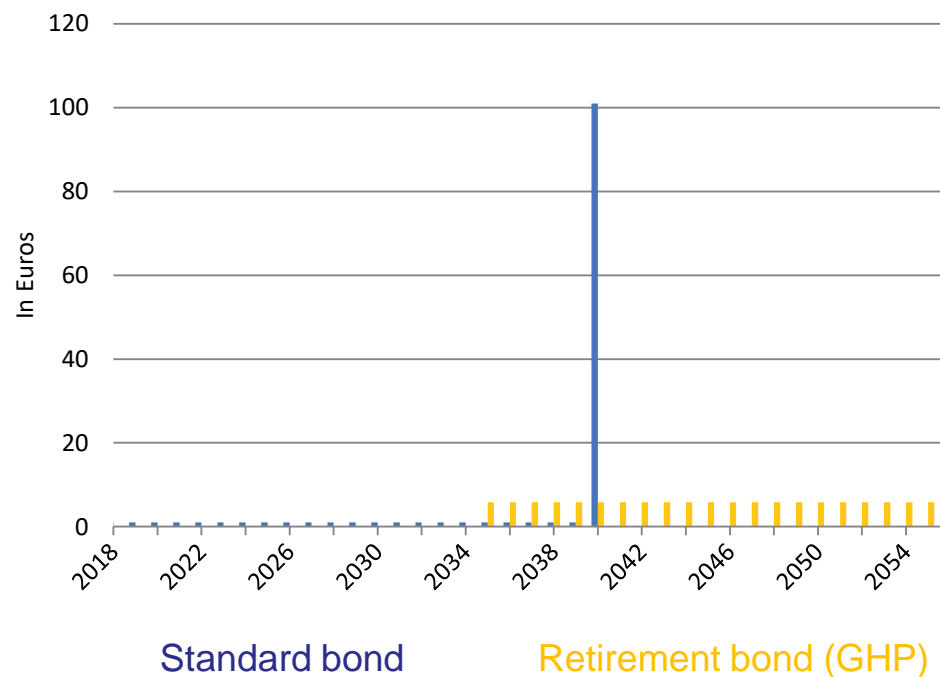
Retirement Bonds are Highly Volatile …
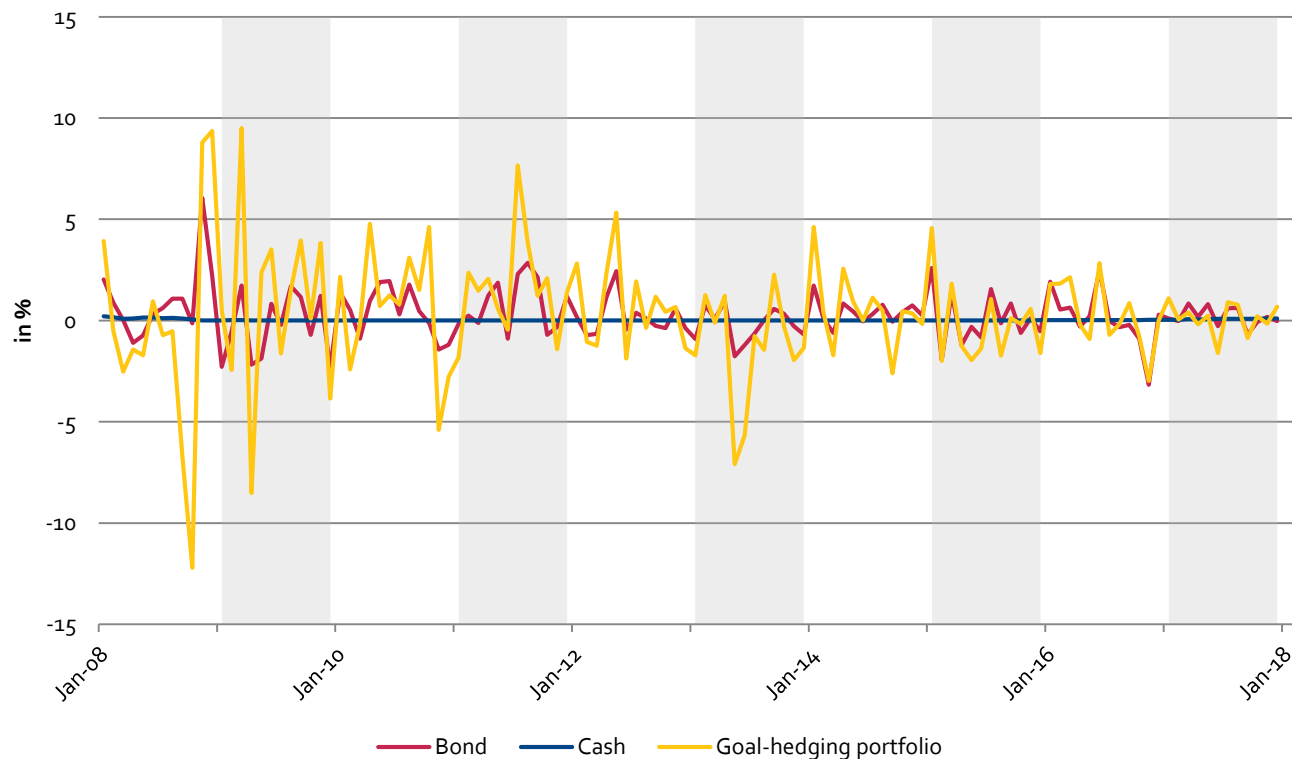
Monthly return of cash, a bond index, and the GHP. Historical values of the GHP are calculated from the US zero-coupon yield curve assuming retirement in 2028 for a 15-year retirement period. The Bond Index is the BofA ML AAA US Treasury/Agency Master and the short-term interest rate is proxied as the 3-month Treasury bill rate.

... *And Yet They are Safe!*

Monthly return of the funding ratio for an investment in cash, a bond index, and the GHP. The funding ratio at a given point in time measures the evolution of the affordable income since inception. Historical values of the GHP are calculated from the US zero-coupon yield curve assuming retirement in 2028 for a 15-year retirement period. The Bond Index is the BofA ML AAA US Treasury/Agency Master and the short-term interest rate is proxied as the 3-month Treasury bill rate. Investing all retirement savings in the GHP implies a constant replacement income.

Safe Should be Truly Safe!

Terminal Funding Ratio
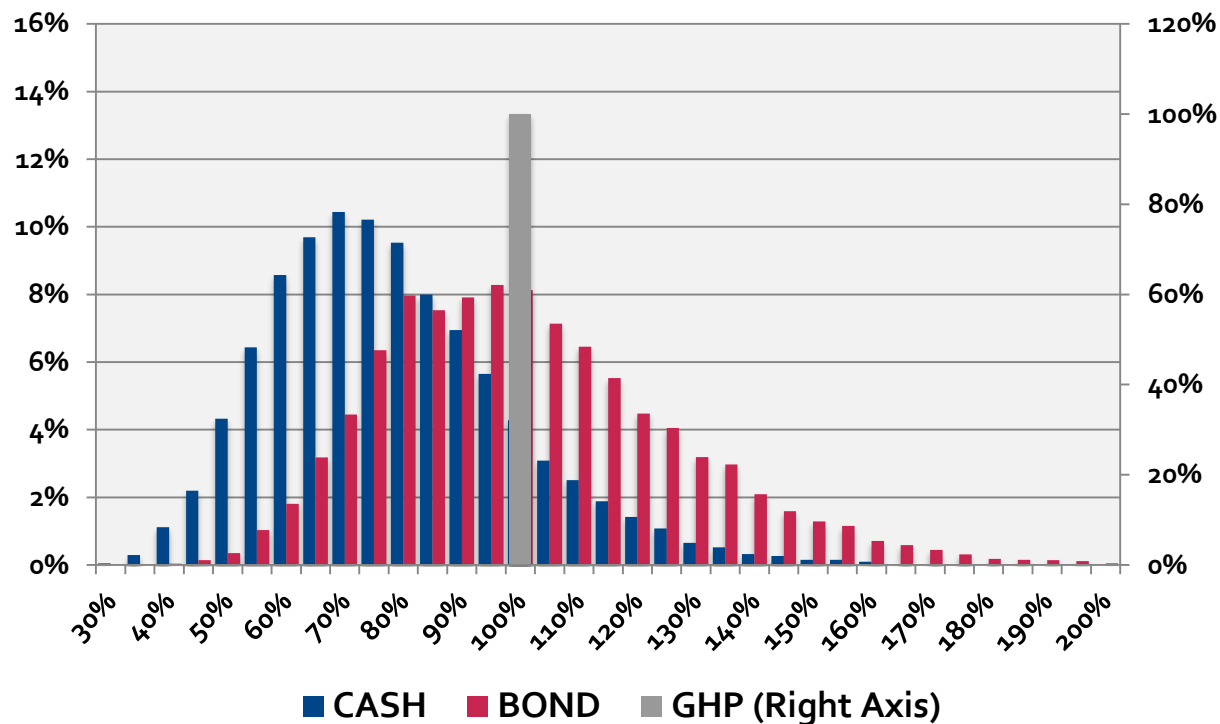
Distribution of the terminal funding ratio for an investment in cash, a bond index, and the GHP based on 10,000 stochastic scenarios

Optimal Goal-Based Retirement Strategy

- The optimal strategy that maximizes the probability of reaching the AG at terminal date while securing the EG at all dates is:

$$w_t^* = \varphi_t \frac{\lambda_{PSP}}{\sigma_{PSP}} w_{PSP,t} + \left(1 - \varphi_t\right) w_{GHP,t}$$

with:

$$\varphi_t = \frac{\delta_{asp} - \delta_{ess}}{\eta_{t,T} R_t} \phi \left[\Phi^{-1} \left(\frac{R_t - \delta_{ess}}{\delta_{asp} - \delta_{ess}} \right) \right] \xrightarrow[\substack{R_t \to \delta_{ess} \\ R_t \to \delta_{asp}}]{} 0$$

$$\eta_{t,T} = \sqrt{\left(\lambda_{PSP}^2 + \sigma_{GHP}^2 - 2\sigma_{GHP}\lambda_{GHP}\right)\left(T - t\right)}$$

- An implementable version of the strategy maintains the ingredients while adding leverage constraints and discrete rebalancing.

Comparison of Payoff Distributions

- Both the optimal and implementable strategies show a focus on investors' goals (minimum and target level of funding ratios).
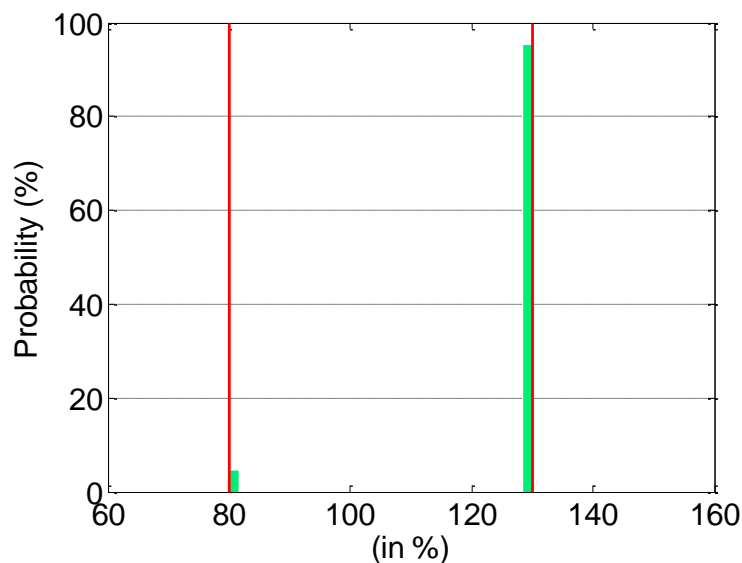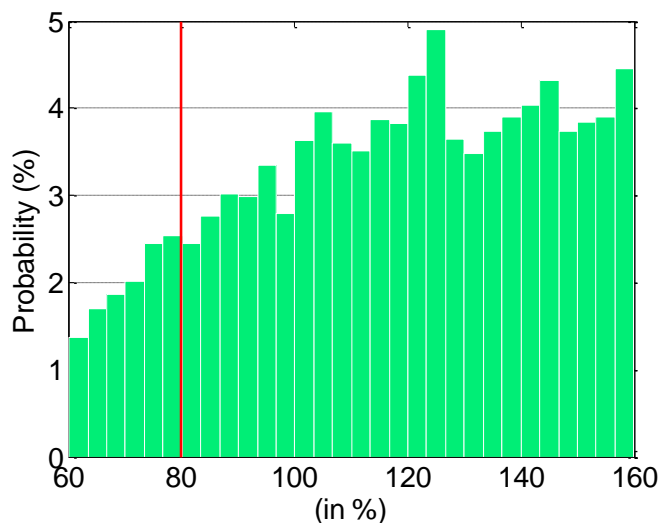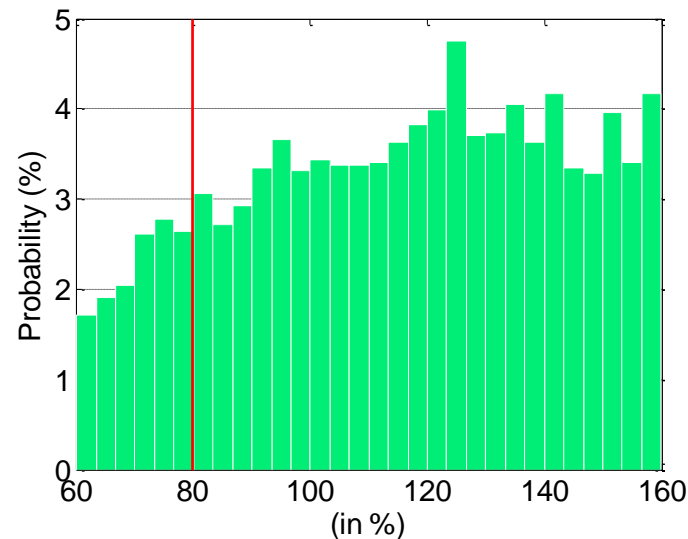

Optimal strategy
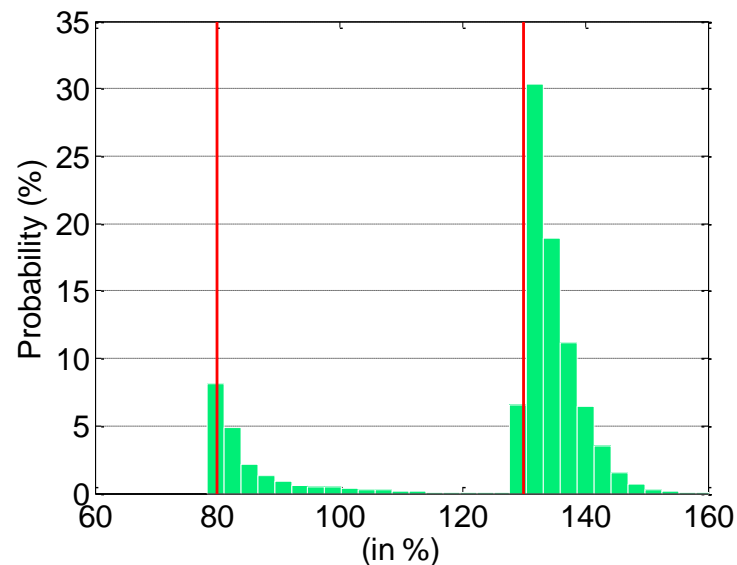
Implementable strategy

Payoff Distributions for Balanced & Target Date Funds

■ Traditional balanced funds or target date funds have no focus on replacement income, which results in significant probabilities of missing the essential goal.

Balanced fund: 50% equity + 50% bond

Target date fund

EDHEC-Princeton Retirement GBI Indices

Benefits of Retirement Goal-Based Investing Strategies

	Target-Date Fund	GBI Strategy	GBI Strategy with Improved PSP
Expected Funding Ratio (%)	208.6	205.7	317.4
Prob. AG 130% (%)	88.5	86.3	96.3
Prob. AG 150% (%)	79.0	75.5	92.4
Prob. AG 200% (%)	53.3	50.8	78.2
Annual Volatility (%)	10.8	12.2	13.1
Prob. Annual Loss > 20% (%)	16	0.2	0.1
Prob. Annual Loss > 10% (%)	84.9	86.2	75.2
Worst Annual Loss	35.6	23.4	23.2

10,000 Monte-Carlo simulation for US investor starting to accumulate in Jan. 2018 and retiring in Jan. 2038; 15-year decumulation; Constant cash-flows; Cap on annual loss at 20%; Improved PSP is simulated with a 50% higher Sharpe ratio.
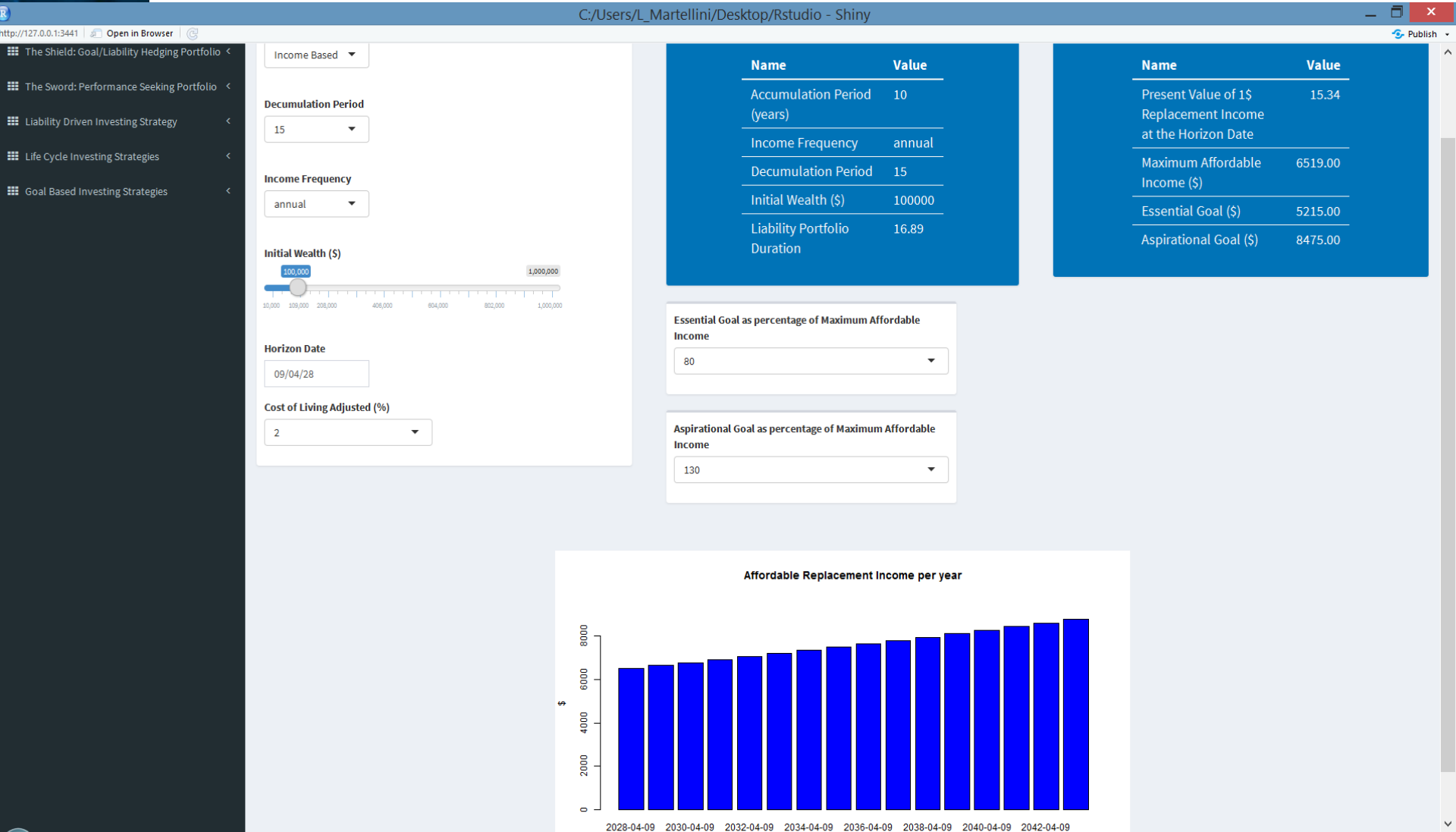
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Creating, Executing a Plan and Reporting Against the Plan

- A goal-based investing process requires the establishment of a goal-based dialogue, which requires a **digital interface**.

- A digital interface can allow for:
  - The creation and execution of a plan consistent with investors' needs.
  - A proper measurement of **opportunity costs** associated with essential goals in terms of impact on the probability to achieve aspirational goals.
  - A meaningful reporting to the the investor against the plan.

Defining Investor Goals

Goal-Based Dialogue

EDHEC Risk Investment Solutions Serious Game

- The Holy Grail: Define your Goal
- The Shield: Goal/Liability Hedging Portfolio
- The Sword: Performance Seeking Portfolio
- Liability Driven Investing Strategy
- Life Cycle Investing Strategies
- Goal Based Investing Strategies
  - Historical Backtest
  - Monte Carlo Simulation

Probability (%) to reach certain level of Funding Ratio

Funding Ratio Level	PSP	GHP	Static GBI	GBI
80 %	93.70	100.00	100.00	100.00
110 %	81.40	0.00	60.40	69.90
130 %	71.90	0.00	27.80	67.30
150 %	59.80	0.00	0.00	0.00
200 %	35.60	0.00	0.00	0.00

Essential Goal as percentage of Maximum Affordable Income

80

Risk Budget Annual Reset? Secure the Essential Goal each Year

No

Multiplier

3

Cap ?

Yes

- No
- Yes

Statistics on Funding Ratio

Funding Ratio	PSP	GHP	Static GBI	GBI
Median	187.24	100.00	114.92	117.90
Worst Case (5%)	74.93	100.00	94.99	82.72
Standard Deviation	88.95	0.00	12.34	18.42
Probability of Annual Loss > 20 %	48.30	0.00	0.10	24.80
Miss the Essential Goal	6.30	0.00	0.00	0.00
Exp. Shortfall	14.47	NA	NA	NA

Risk and Performance

Relative Risk and Performance

Strategy to Plot

GBI

Opportunity Cost of Increasing the Essential Goal Level

Looking Forward
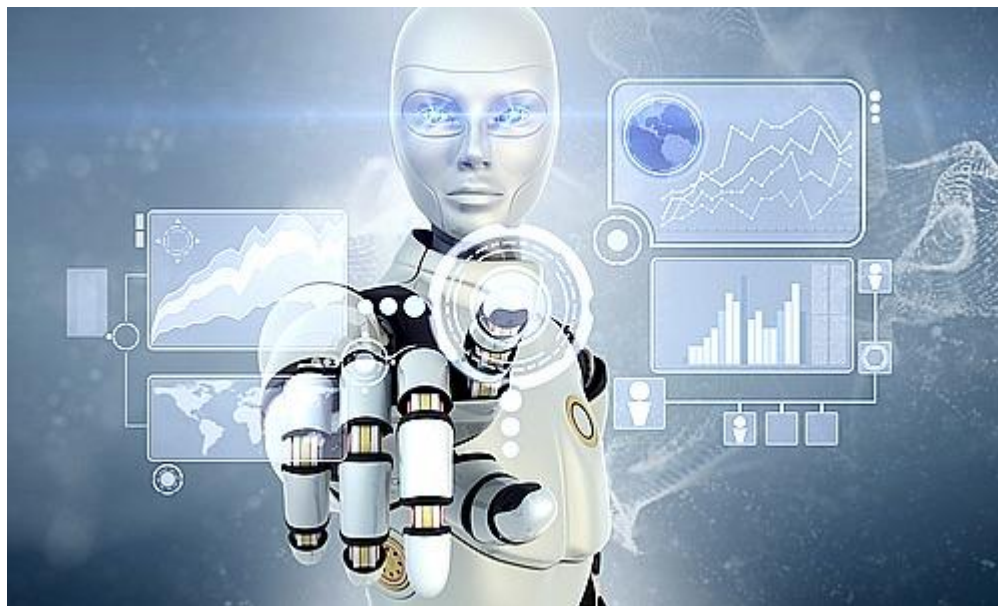
How far are we from seeing robo-advisory technology deliver cost-efficient mass-customized retirement GBI solutions based on efficient factor index building blocks?