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Data Science Meet Up

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The Next Step in the Robo Advisor Landscape: Mass-Customized Investment Solutions in the Post Industrial Revolution Era

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Outline

- Industrial Revolution in Investment Management
- Goal-Based Investing & Applications to Retirement
- Robo-Advisors & the Mass Customization Challenge

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Talking about a Revolution

- After many decades of relative inertia, we have reasons to believe that a true (industrial) revolution is currently under way in investment management, which is leading to the emergence of a welfare-improving, cost-efficient, investor-centric, value proposal for investors.

- Changes are, slowly but surely, taking place on 3 main fronts:
  - **Mass production** of cost- and risk-efficient (smart) factor indices;
  - **Mass customization** of meaningful goal-based investment solutions;
  - **Mass distribution** with digital wealth maangement services.

- These changes take place at a time when two other profound revolutions are impact the investment industry (and beyond): the digital revolution and the environmental revolution.

Key Development # 1: The Rise of Factor Investing

- The concept is simple and meaningful:

"Factors are to assets what nutrients are to food. Just like 'eating right' requires you to look through food labels to understand the nutrient content, 'investing right' means looking through asset class labels for the **underlying factor risks. It's the nutrients in the food that matter. And similarly, the factors matter, not the** asset labels." (A. Ang)

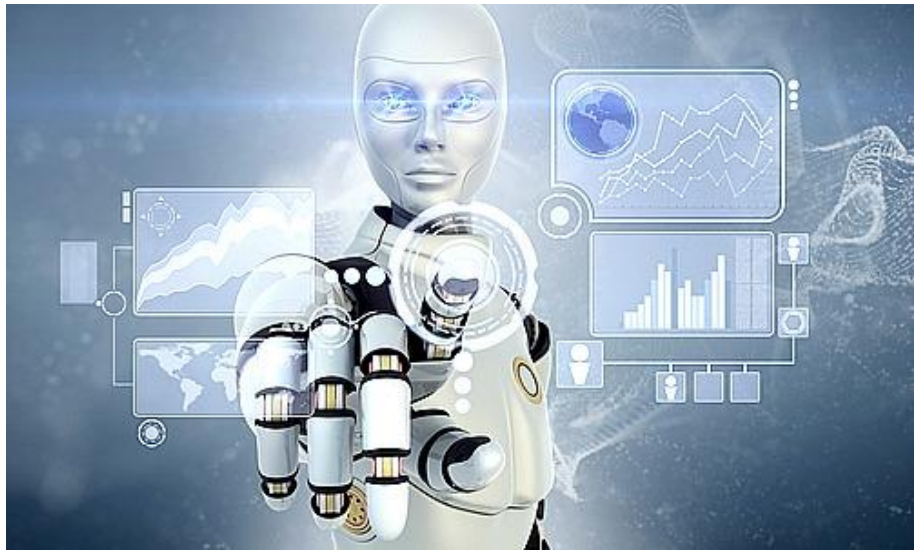
- Implementation & marketing a bit trickier, as usual:
  - Style index vs. factor index
  - Factor index vs. smart factor index

Key Development # 2: The Rise of Goal-Based Investing

- The concept again is simple and meaningful.
- "Modern" portfolio theory is now 65Y old!
- We need a comprehensive framework encompassing diversification, hedging and insurance that can deliver payoffs customized to meet investors' goals.
- Goal-based investing (GBI), similar to liability-driven investing (LDI) for institutions, is the next step.

Key Development # 3: The Rise of the Machines

- In individual money management, distribution costs have been the major cause for inertia.
- Digital disruption is now impacting the wealth management industry.
- It is both a threat and opportunity for existing players, and should be an opportunity for investors.
- Investing with robots versus investing with artificial intelligence?



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Goal-Based Investing is Hardly a New Concept!

"It is, of course, not new to say that optimal investment policy should not be "one size fits all". In current practice, however, there is much more uniformity in advice than is necessary with existing financial thinking and technology. That is, investment managers and advisors have a much richer set of tools available to them than they traditionally use for clients. (…) **I see this issue as a tough engineering problem, not one of new science**. **We know how to approach it in principle (…) but actually doing it is the challenge**."

Thoughts on the Future: Theory and Practice in Investment Management
Robert Merton (FAJ, 2003)

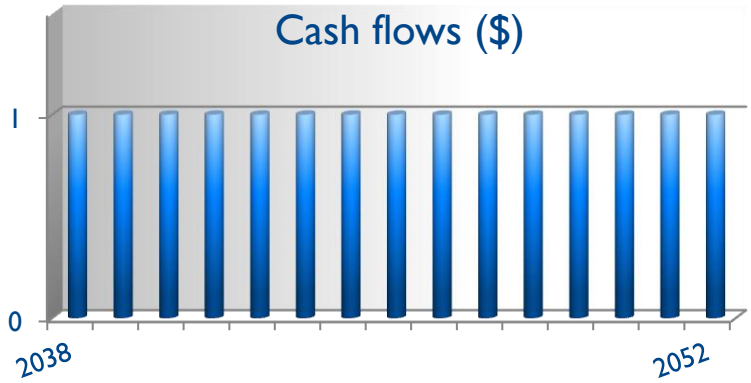
Goal-Based Investing (GBI) Solutions

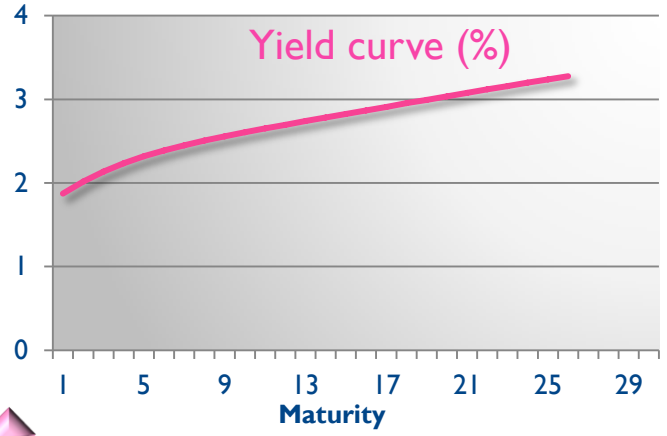
- **Goal-based investing** (GBI) principles can be used to reconcile:
  - Investors' need for the performance required to reach their aspirational goals (AGs)…
  - … with their desire to obtain downside protection with respect to their essential goals (EGs).

- GBI principles:
  - Similar to dynamic liability-driven investment solutions for institutions;
  - Have important applications, most notably the **retirement goal**., where essential and aspirational goals are expressed in terms of **replacement income**.

Income, Not Wealth, Should be the Focus

- Measure the price to pay today to finance $1 of replacement income in retirement (the retirement bond).



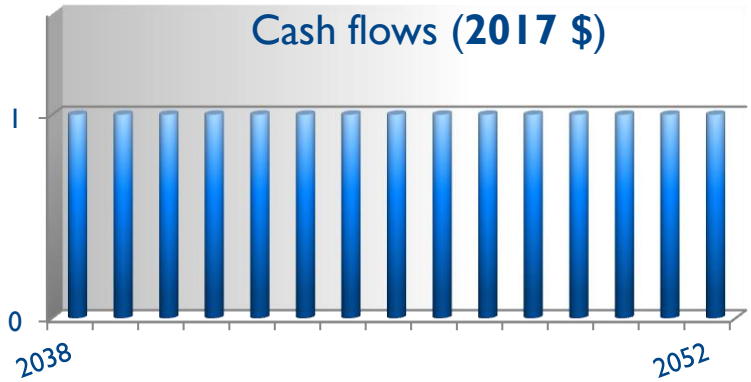


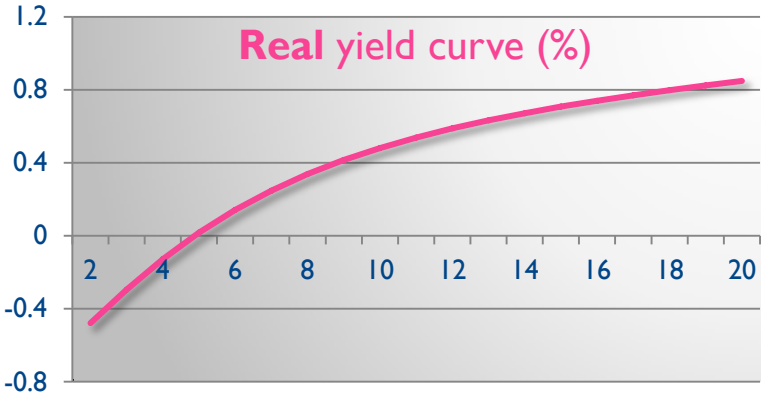
- Safe asset is the goal-hedging portfolio: Cash-flow or duration matching bond portfolio for the retirement bond.

Index value
on May 1, 2017
US
Retirement in 2037;
15-year decumulation

A Version with Inflation-Linked Income

- Replacement income is more costly if protection against inflation is required.





Index value
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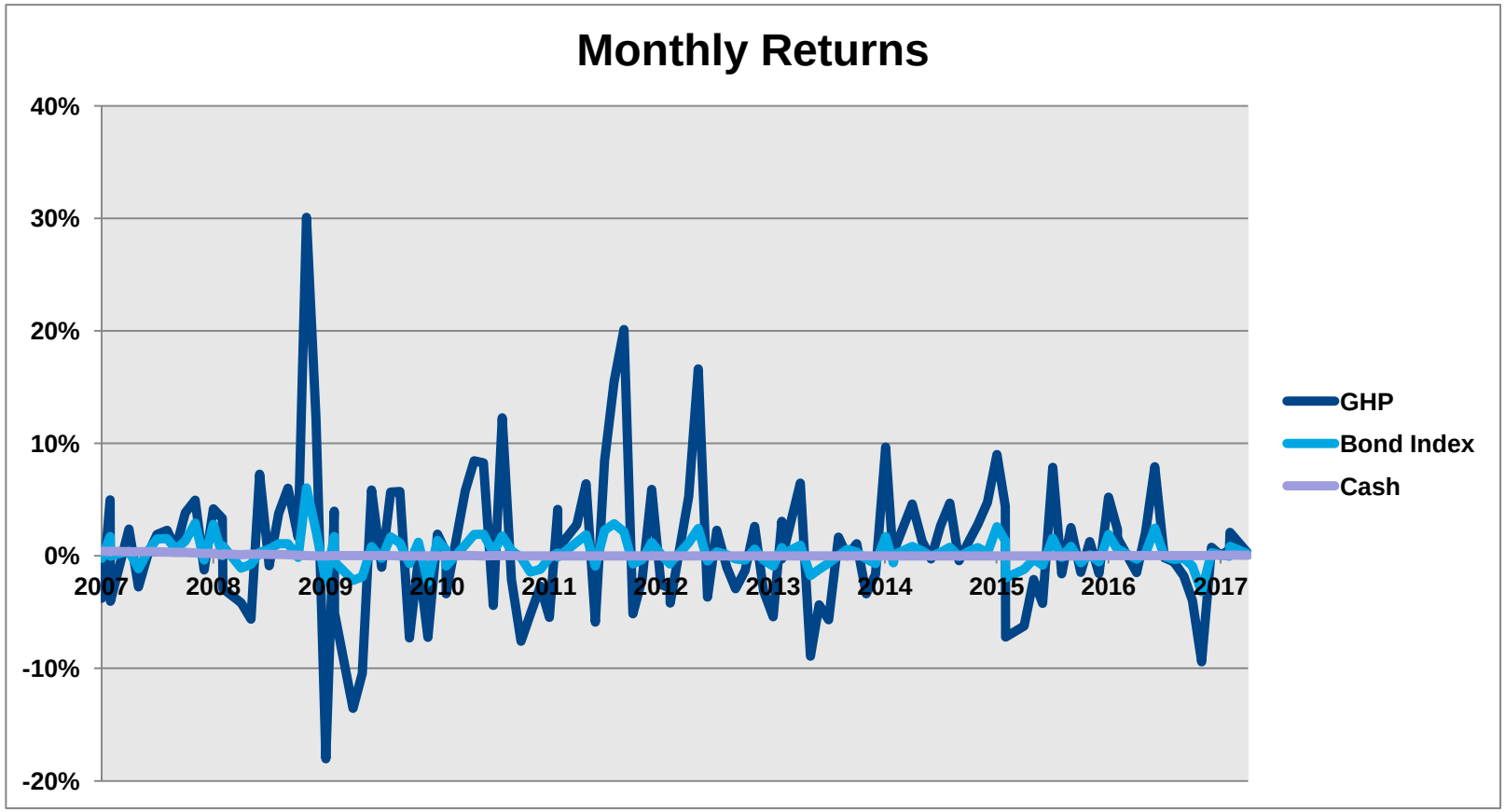
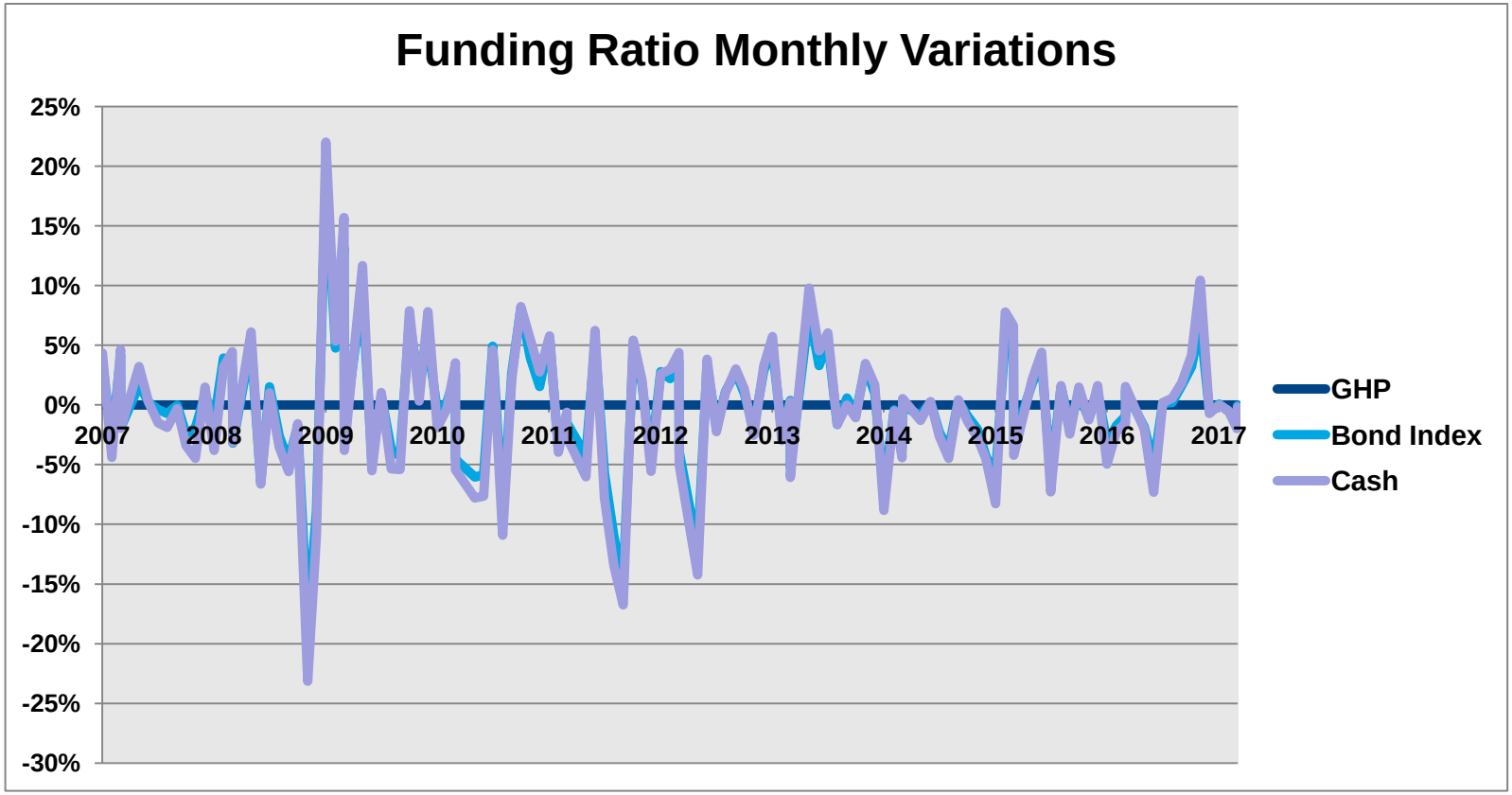
Hedging: Safe Should be Truly Safe



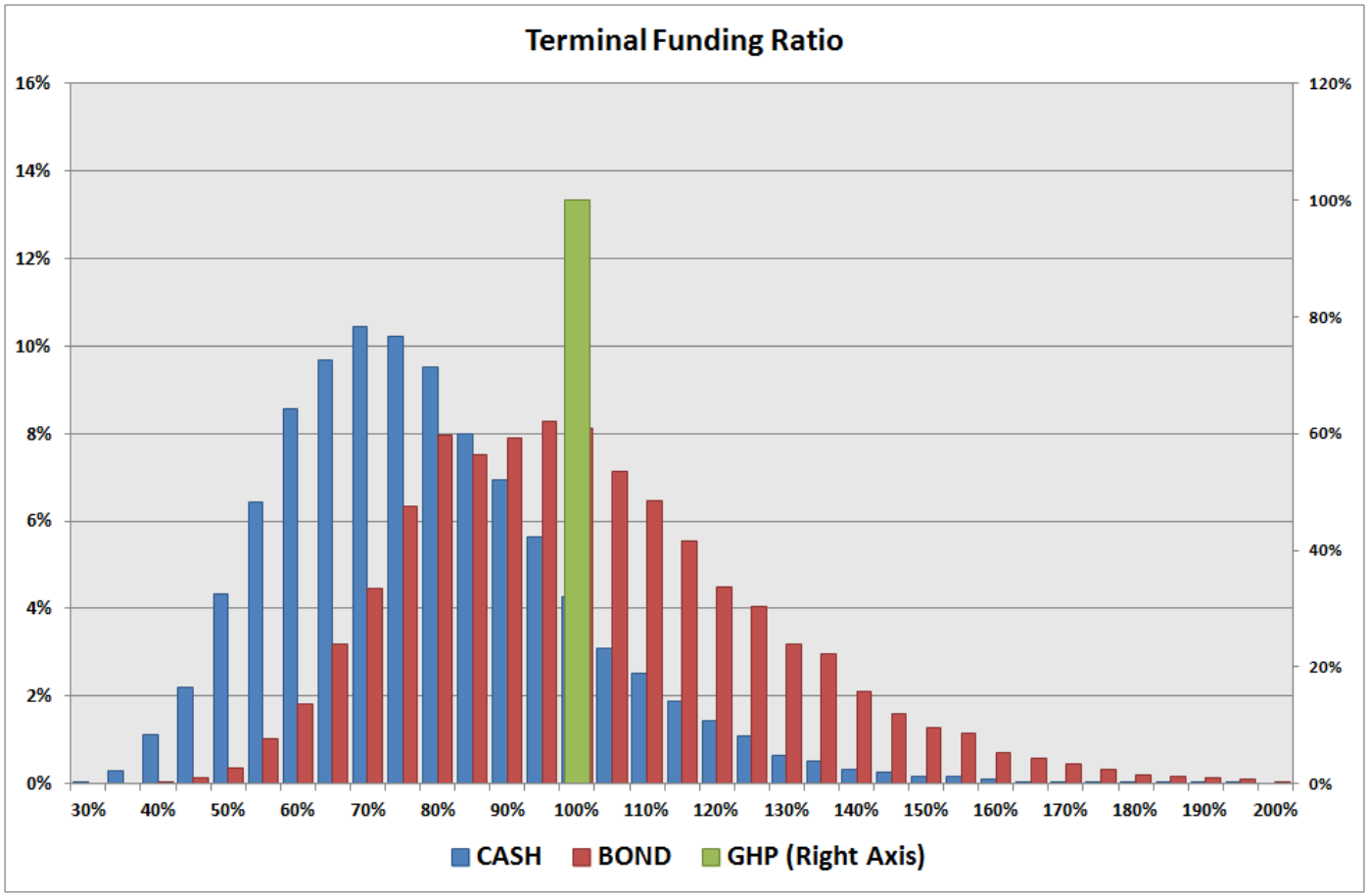
Monthly return of cash, a bond index, and the GHP. Historical values of the GHP are calculated from the US zero-coupon yield curve assuming retirement in 2027 for a 15-year retirement period. The Bond Index is the BofA ML AAA US Treasury/Agency Master and the short-term interest rate is proxied as the 3-month Treasury bill rate. In 2007, the duration of the GHP is 27,5 years.

Hedging: Safe Should be Truly Safe – Cont'd



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 2027 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. In 2007, the duration of the GHP is 27,5 years. Investing all retirement savings in the GHP implies a constant replacement income.

Hedging: Safe Should be Truly Safe (Also in the Long-Run)



Distribution of the terminal funding ratio for an investment in cash, a bond index, and the GHP based on 10,000 stochastic scenarios (see Appendix for more details about model and parametric assumptions)

"We Know How to Approach it in Principle"

- Starting with a funding ratio FR at 100% (based on purchasing power of current wealth), optimal strategy that maximizes the probability of reaching the AG (FR=δ_{asp}) at terminal date while securing the EG (FR=δ_{asp}):

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

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

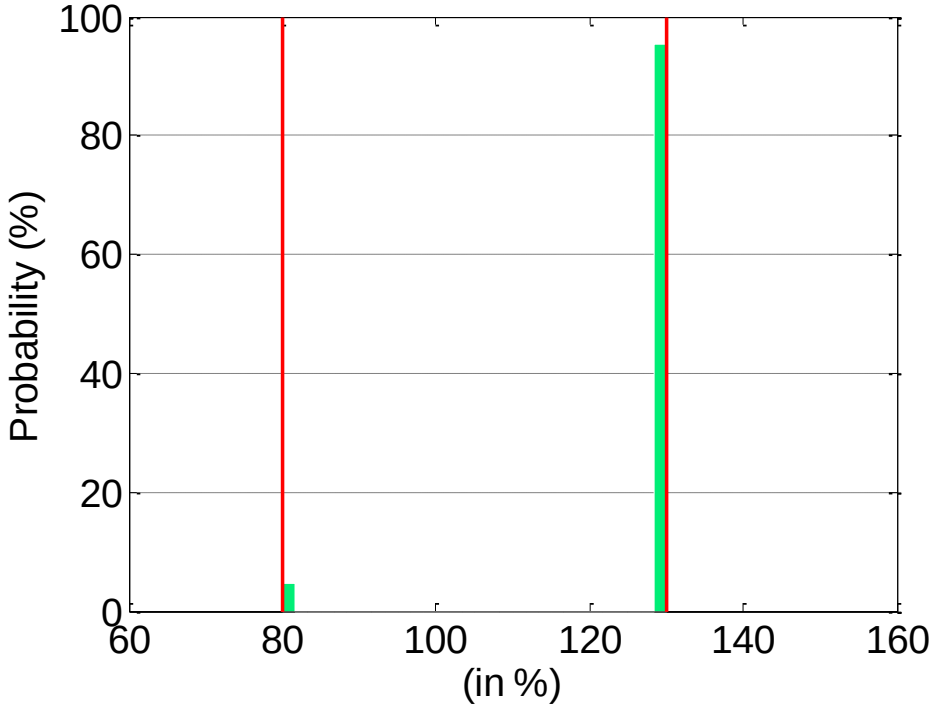
$$\eta_{t,T} = \sqrt{\left(\int_t^T \lambda_{MSR,s}^2 + \sigma_{GHP,s}^2 - 2\sigma_{GHP,s}\lambda_{GHP,s}\right) ds}$$

- **Success probability** with optimal strategy at horizon (the highest by design):

$$\Pr\left(W_T^* \geq \beta_T \delta_{asp} \frac{W_0}{\beta_0}\right) = \Phi\left[\Phi^{-1}\left(\frac{R_t - \delta_{ess}}{\delta_{asp} - \delta_{ess}}\right) + \eta_{t,T}\right]$$

"Actually Doing it is the Challenge"

- The **optimal payoff** is a digital option payoff that generates high chances to reach the aspirational goal.
- In practice, however, the strategy is **not implementable** (must be implemented in CT, generally involves leverage and shortsales, etc.).



The investor is aged 45 in January 2016 and retiring in 2036 at the age of 65.

From Optimal to Implementable

- 3 key properties of the **optimal** strategy:
  - Involves **hedging** through a "smart" safe building block, the goal-hedging portfolio or GHP (forward start inflation-linked bond ladder);
  - Involves **diversification** through a "smart" risky building block, performance-seeking portfolio or PSP (efficiently harvest risk premia);
  - Involves **insurance** through a "smart" dynamic allocation to the building blocks with a zero PSP allocation when $W_t=EG_t$ *or* $W_t=AG_t$.

$$\varphi_t \xrightarrow[R_t \to \delta_{ess}]{} 0$$

$$\varphi_t \xrightarrow[R_t \to \delta_{asp}]{} 0$$

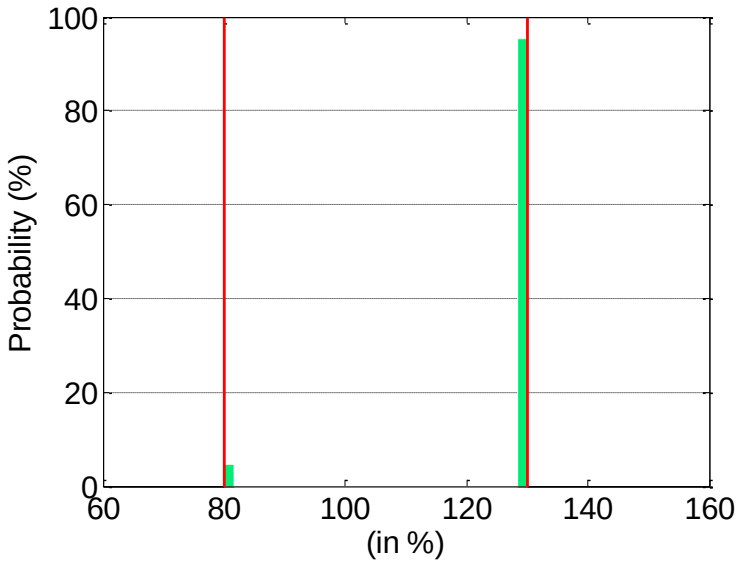
- Consider now the following simple and **implementable** strategy (similar in flavor to utility maximizing strategy with implied minimum funded ratio constraints) that satisfies the 3 same requirements (with quarterly rebalancing):

$$\phi_t = 0 \text{ if } R_t \leq \delta_{ess} \text{ or } R_t \geq \delta_{asp}$$

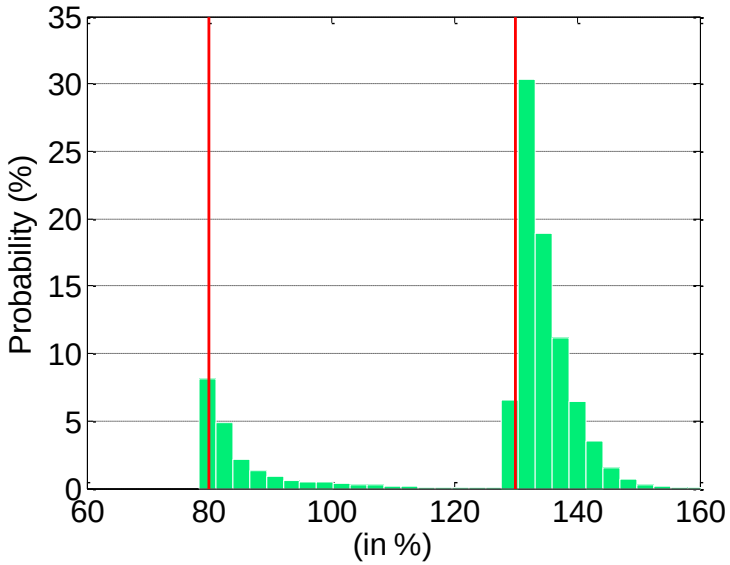
$$\phi_t = \max\left[m\left(1 - \frac{\delta_{ess}}{R_t}\right), 100\% \right] \text{ otherwise}$$

Comparison of Payoff Distributions

- The implementable strategy has a payoff which is no longer strictly bimodal, but it secures the floor and generates substantial upside.



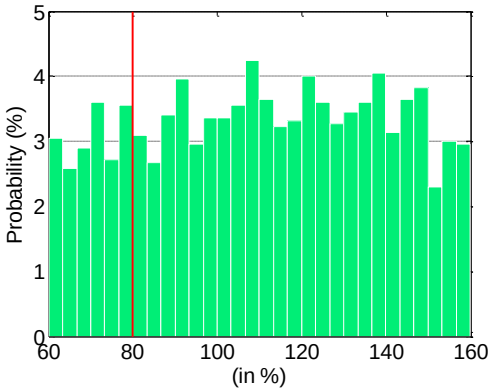
Optimal strategy



Implementable strategy (with *m* = 3)

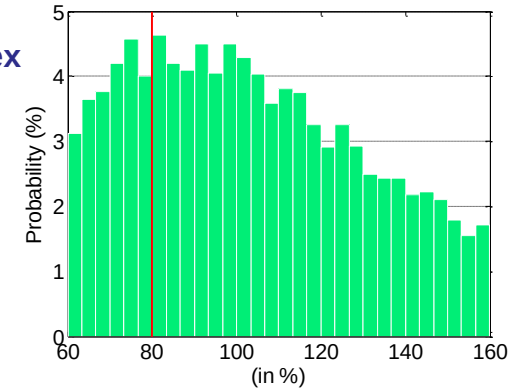
Payoff Distributions for Balanced & Target Date Funds

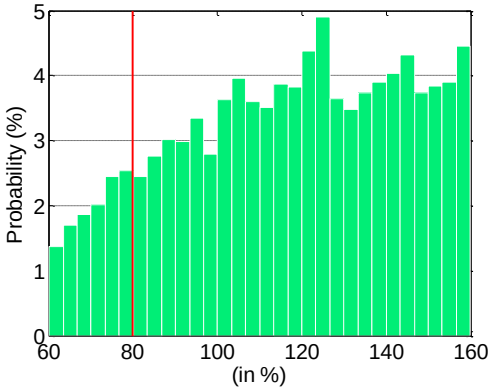
- Traditional balanced or target date funds have significant probabilities of missing the essential goal at 80%, and as such are ill-suited to address investors' needs in retirement .



100% equity index

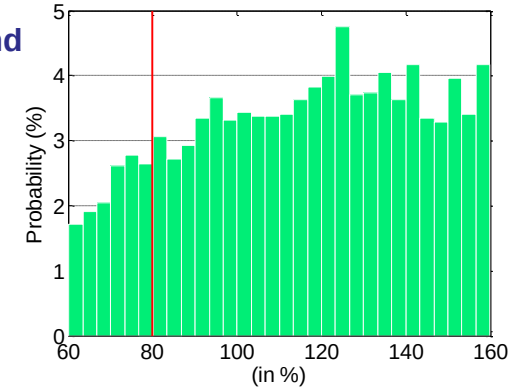
100% bond index





50% equity + 50% bond

Target date fund



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What and Who are They?

- "A robo-advisor is an online wealth management service that provides automated, algorithm-based portfolio management advice without the use of human financial planners." Investopedia

- A typology of the robo-advisor landscape shows a clear distinction between three types of players.
  - New players in digital wealth management business (e.g. Betterment).
  - Existing players in the digital space who enter the wealth management space: mostly online brokers today (e.g., Charles Schwab), but potentially other digital players tomorrow?
  - Existing players in the asset/wealth management business who enter the digital space (e.g., Vanguard).

Durability of the Robots?

- So far investors are paying management fees + distribution fees: concerns exist about the viability of stand-alone robo-advisors based upon a pure low cost advisory and/or management model.
  - Costs per account are too high for the bulk of the many small accounts (€10,000) robo-advice is targeted for. For example, a fee of 0.5% on €10,000 amounts to a mere €50 per year, which hardly covers the costs of running an automated execution and fund management platform.
  - Why should anyone pay a 0.5% fee for advice on how to structure a €500,000 investment? Instead, one would invest €5,000 and replicate the advice (usually buying a portfolio of ETFs) on the remaining €495,000 for free: the bulk of the fees remain with the ETF producer!
  - This might change if technology allows them to also disrupt production. Imagine investors being able to disintermediate ETFs by investing in low cost individualized baskets via trading platforms?

Robo-Advisors – How Useful Are They?

- Expected benefits: lower cost or better service or both?
  - Cost side: Strong improvement compared to traditional wealth management, not compared to online brokerage.
  - Service side: When facing physical health problems, we know that we need both medicine and also advice from a medical doctor.
- For our financial health problems, we already have online pharmacies (online brokers).
- The question is: do we get online meaningful goal-based investment solutions/advice by robo-advisors?
- We are not quite there yet – but we're moving ahead in the right direction.

Robots: How Meaningful Are They?

	Building Blocks	Strategy name	Asset Allocation Strategy	Notes	Retirement Planner	AUM
Schwab Intelligent Portfolios	6 Building blocks: core equity, non-traditional equity, US inv grade, non traditional bonds, commodities, cash)	MPT	MPT & Full Scale Optimization to create building blocks, Risk allocation to allocate between the building blocks	Risk Budgeting (for asset class), ETF cost reducing		$8,000,000,000
Betterment	2 Asset class (stock or bond) with 12 Building blocs (6 stocks, 6 bonds)	"Goal-Based" Investing	Deterministic target date fund: Stock/Bond ratio as unction of time (glide path)	low cost index funds (stock and bond ETFs), Tax loss Harvesting, different goals (Retirement, Safety Net, Major Purchase..)	•	$5,101,000,000
Wealthfront	11 Building blocks	Solving the efficient frontier	MPT	ETF cost reducing, tax efficient		$4,020,000,000
Personal Capital	6 Building blocks (US stocks, international stocs, US bonds, international bonds, alternatives, cash)	"Nobel Prize investing strategy"	MPT on the building blocks (based on historical returns)	Building blocks construct with equal sector and style weighting (avoid cap-weighted index), tax loss harvesting	•	$3,100,000,000

Robots: How Meaningful Are They? – Con't

	Building Blocks	Strategy name	Asset Allocation Strategy	Notes	Retirement Planner	AUM
Future Advisor	2 Asset class (stock or bond) with 13 Building blocks	Dynamic Fund selection	Deterministic Target Date Fund (glide path adjusted yearly)	Tax saving , low-fee index funds, presence of factor tilted building blocks	•	$808,000,000
Rebalance IRA	5 Building blocks (US stocks, bonds, real estate, foreign equities, and emerging market stocks)	MPT	MPT, rebalancing based on risk aversion and retirement timeframe	ETF cost reducing (cap-weighted)		$225,000,000
SigFig	3 Asset class (stock, real estate, fixed income) with 9 Building blocks	Nobel-prize winning portfolio research	MPT, Fix Mix	ETF cost reducing, tax efficient	•	$60,000,000
WiseBanyan	Asset class allocation	MPT	MPT	ETF cost reducing, stress test on building block		$13,000,000