Retirement Lockboxes

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CFA Society of San Francisco
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Based on work with:

- Jason Scott and John Watson
  - Financial Engines' Center for Retirement Research
- For more , see *Post-retirement Economics* at www.wsharpe.com

The Prototypical Problem

- An individual or family has W dollars to finance retirement and
- Must choose a Retirement Financial Strategy, which includes decisions about:
  - Investment
  - Spending
  - Annuitization

Technologies Needed to find the Best Strategy

- Asset Pricing Theory
- Behavioral Economics
- Financial Engineering
- Operations Research

A Retirement Lockbox Strategy

- An analytical approach
  - Can provide greater clarity about the characteristics of traditional retirement financial strategies
- An actual approach
  - Can be tailored to provide better results for some retirees
  - Can provide better discipline to deal with problems associated with declining mental acuity

A Retirement Lockbox

Retirement Lockbox Characteristics

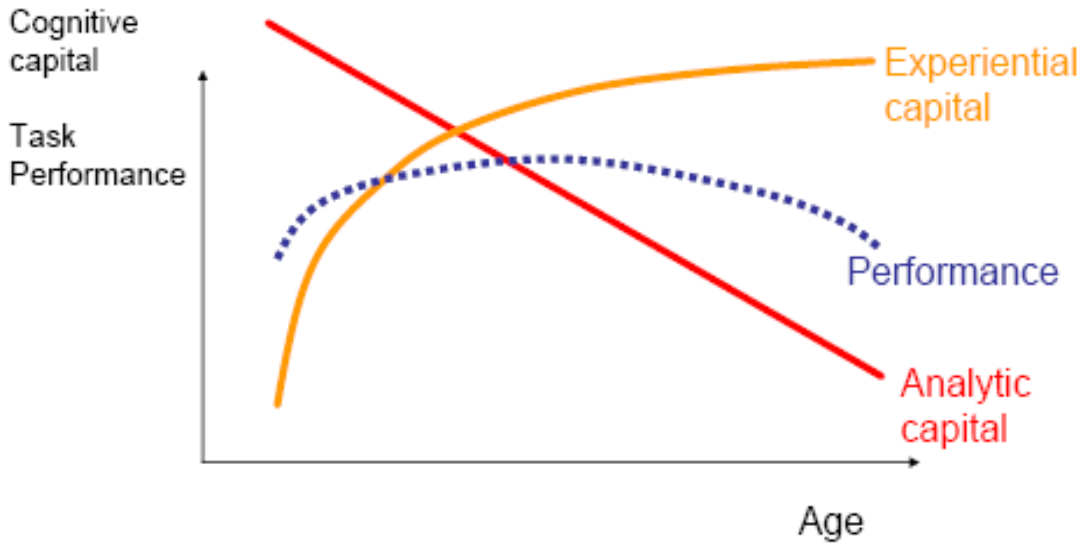
- Owner
  - Bill Sharpe
- Maturity Date
  - 2020
- Iniital Investment
  - $ 20,000
- Investment Strategy
  - 60% Stocks, 40% Bonds, Rebalance annually
- Beneficiary
  - Monterey Institute of International Studies

Types of Retirement Lockboxes

- Bequest
  - Beneficiary gets the box if the owner is dead before the maturity date
- Annuity
  - An insurance company :
    - gets the box if the owner is dead before the maturity date
    - manages the investment strategy
    - matches the ending value in a pre-specified ratio if the owner is alive at the maturity date

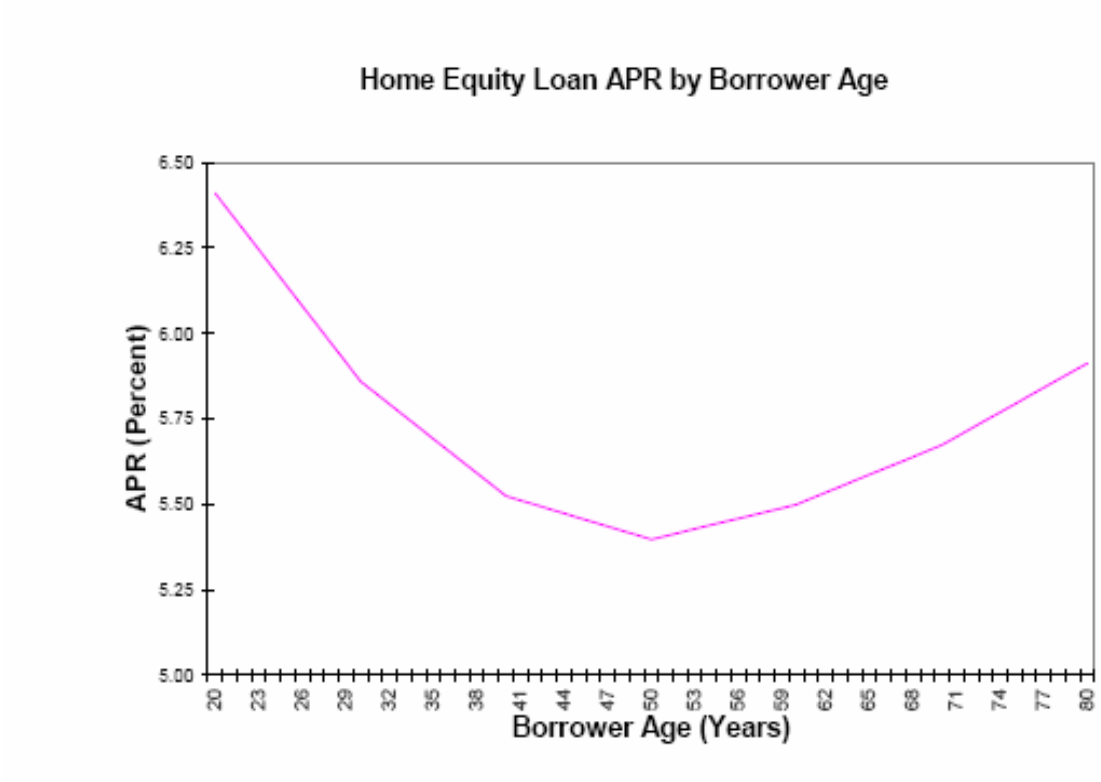
A Retirement Lockbox Strategy

Individuals' Performance When Making Financial Decisions



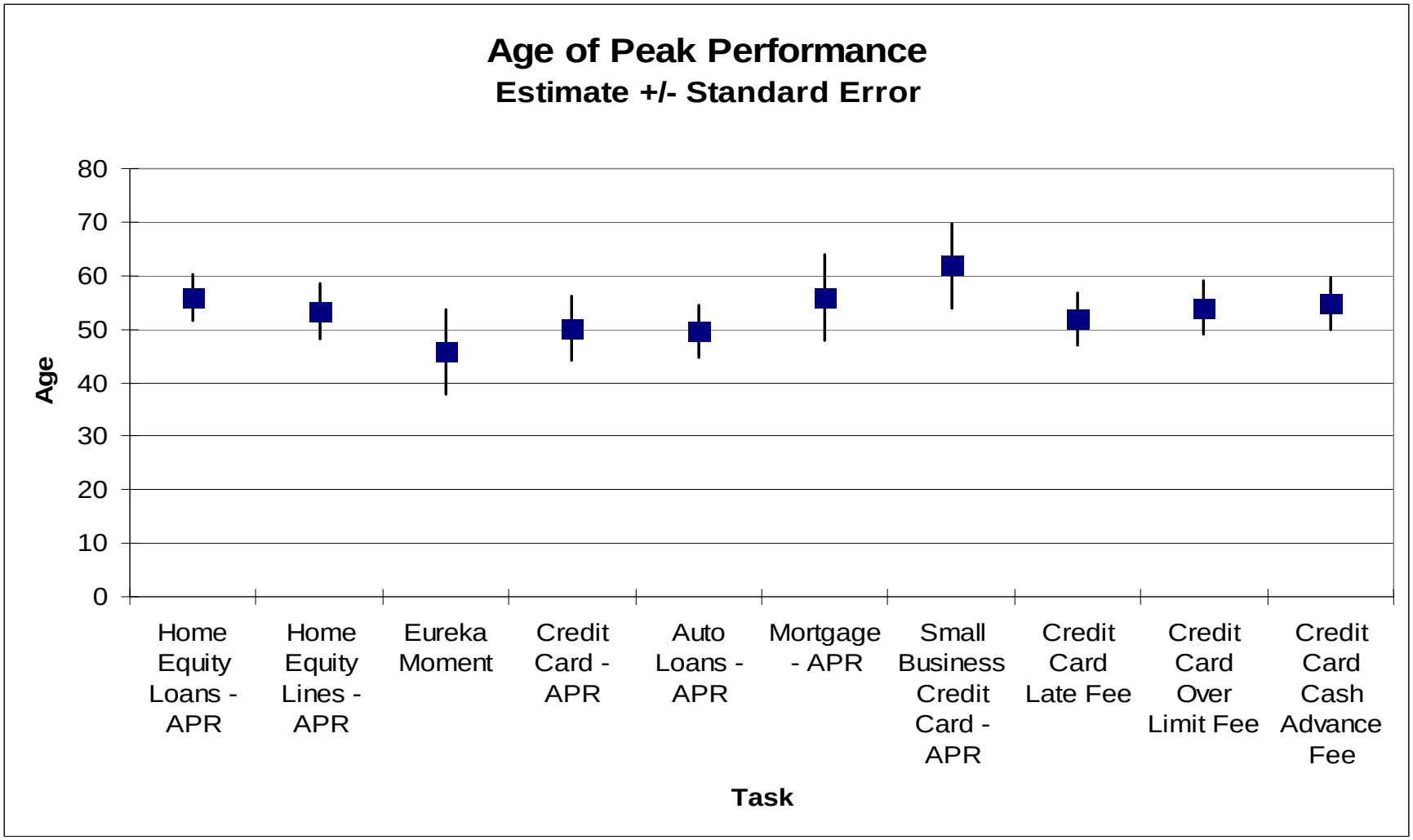
Agarwal, Sumit, Driscoll, John C., Gabaix, Xavier and Laibson, David I., "The Age of Reason: Financial Decisions Over the Lifecycle" (June 7, 2007). MIT Department of Economics Working Paper No. 07-11 :

Home Equity Loan Interest Rates



"The Age of Reason: Financial Decisions Over the Lifecycle"

The Age of Peak Performance

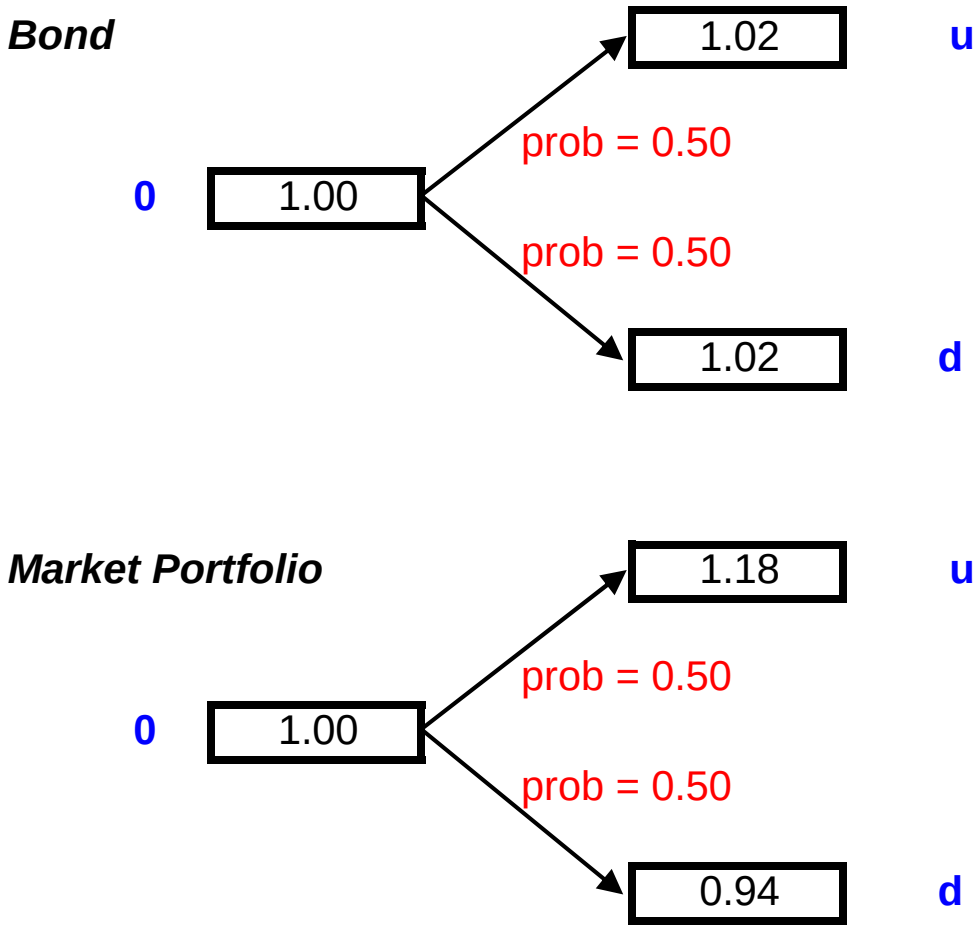


"The Age of Reason: Financial Decisions Over the Lifecycle"

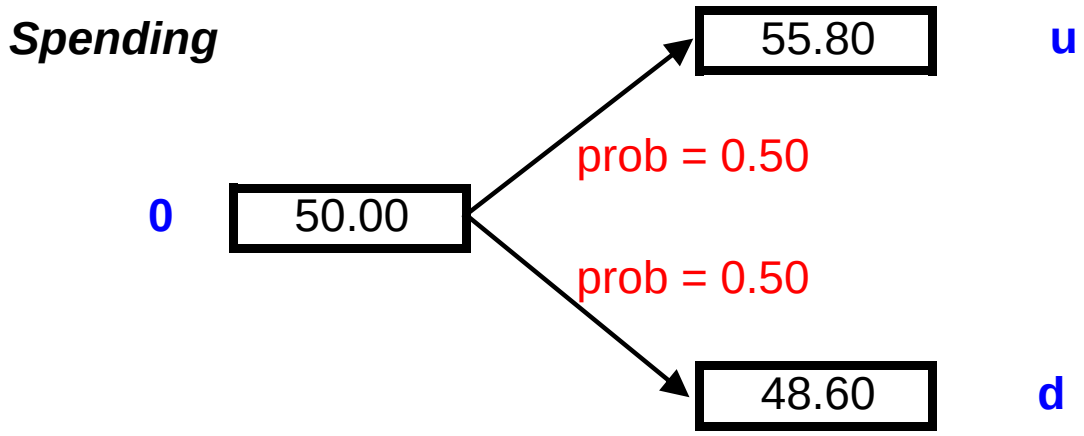
The Simplest Possible Risky Capital Market

- Two periods
  - Now
  - Next year
- Two future *states of the world*
  - The market is up
  - The market is down
- Two securities
  - A riskless real bond
  - A portfolio of risky securities in market proportions

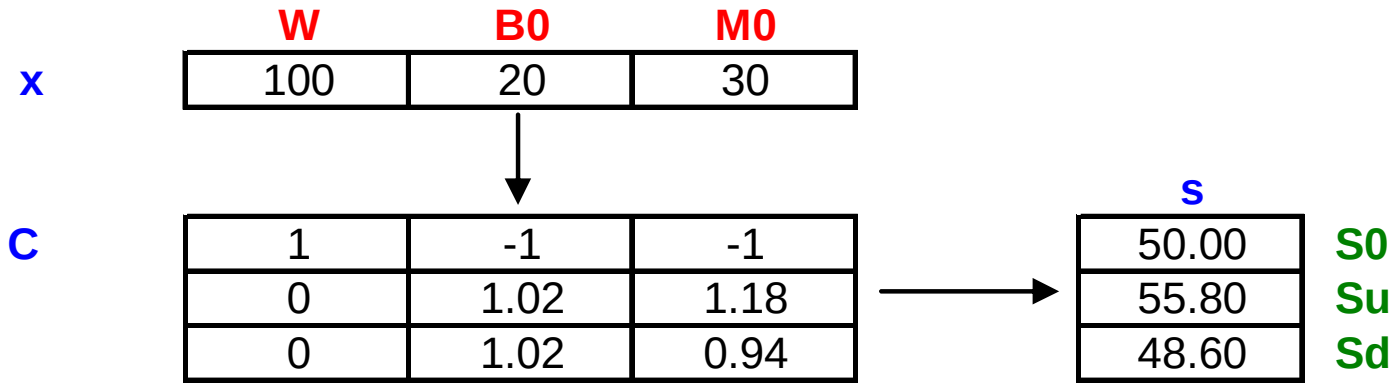
Capital Market Characteristics



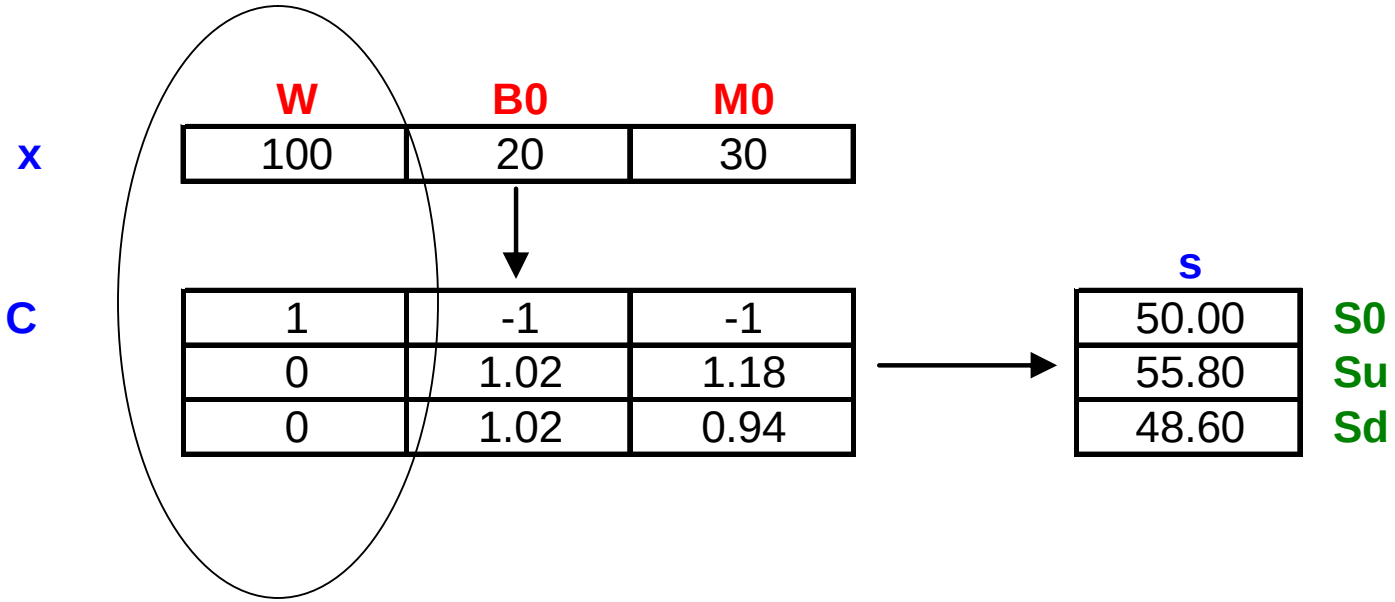
Desired Spending



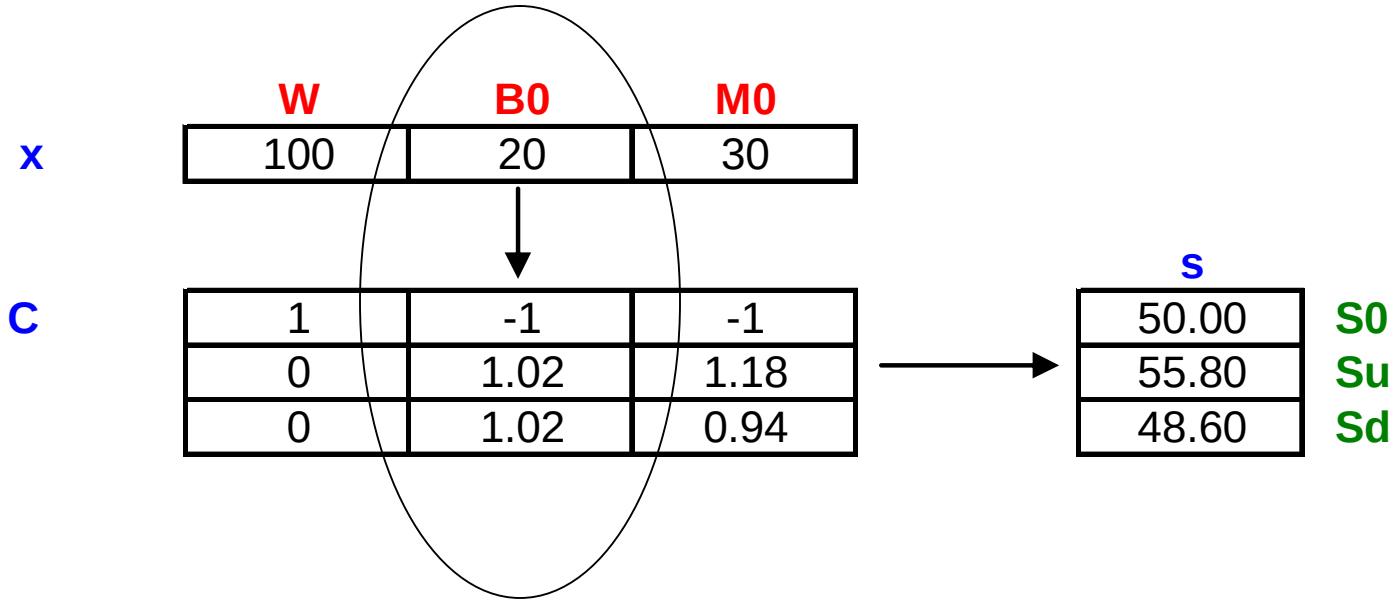
Wealth, Financial Strategy and Desired Spending



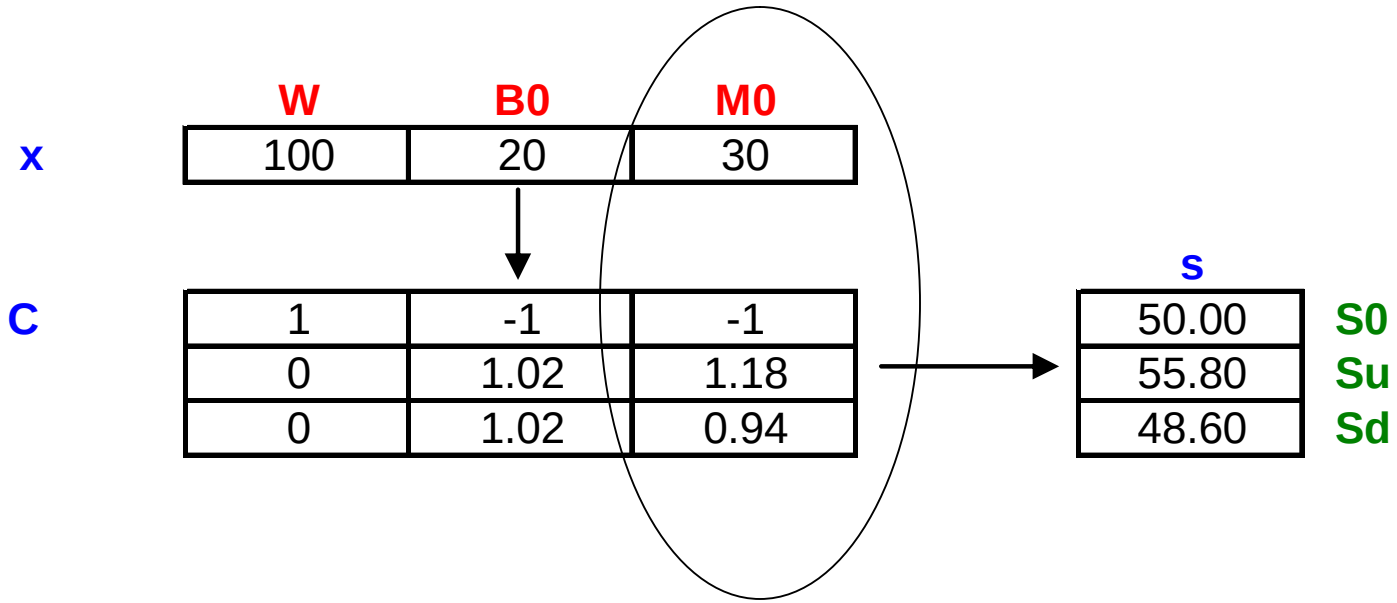
Initial Wealth



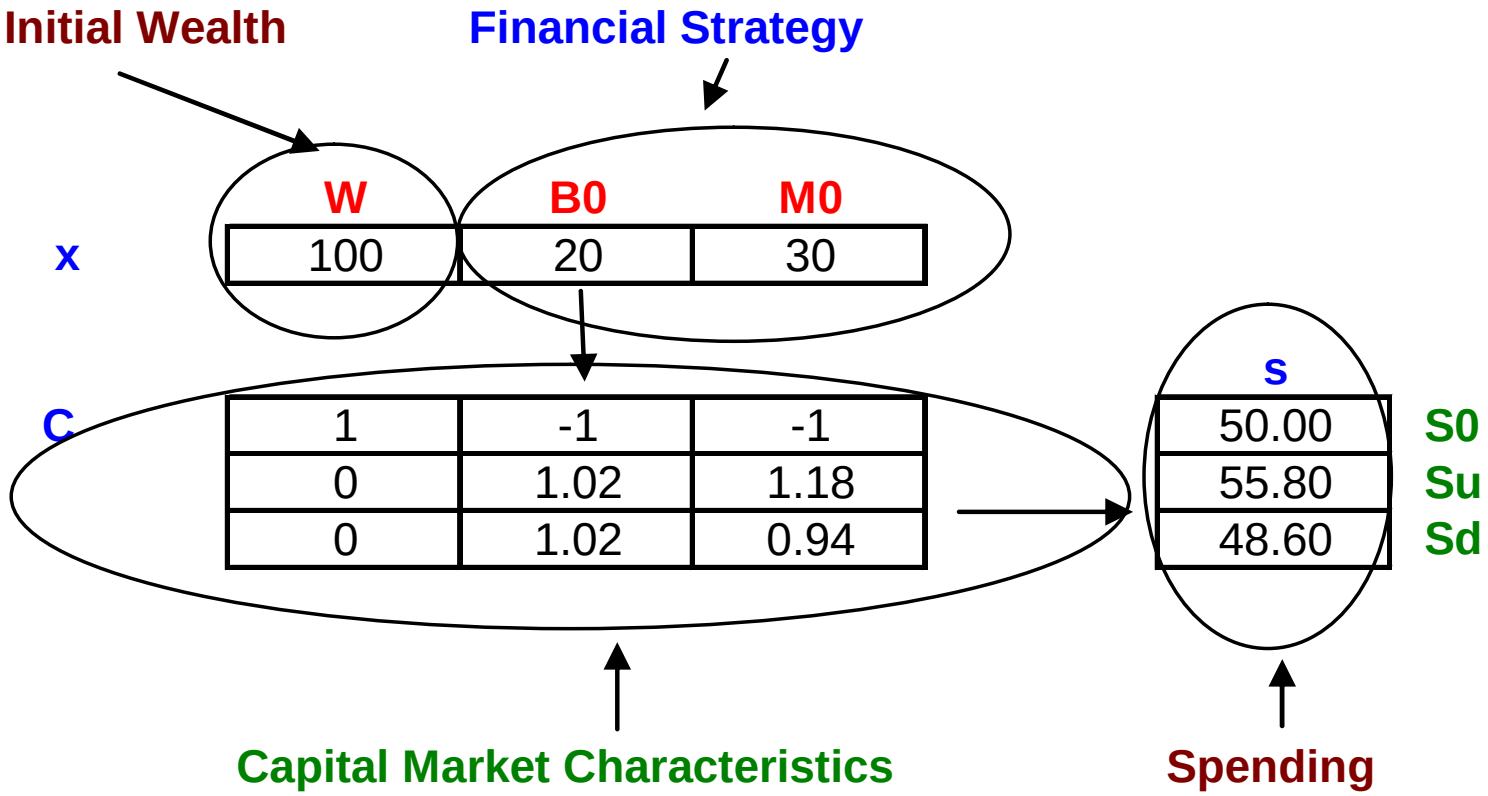
Bond Investment



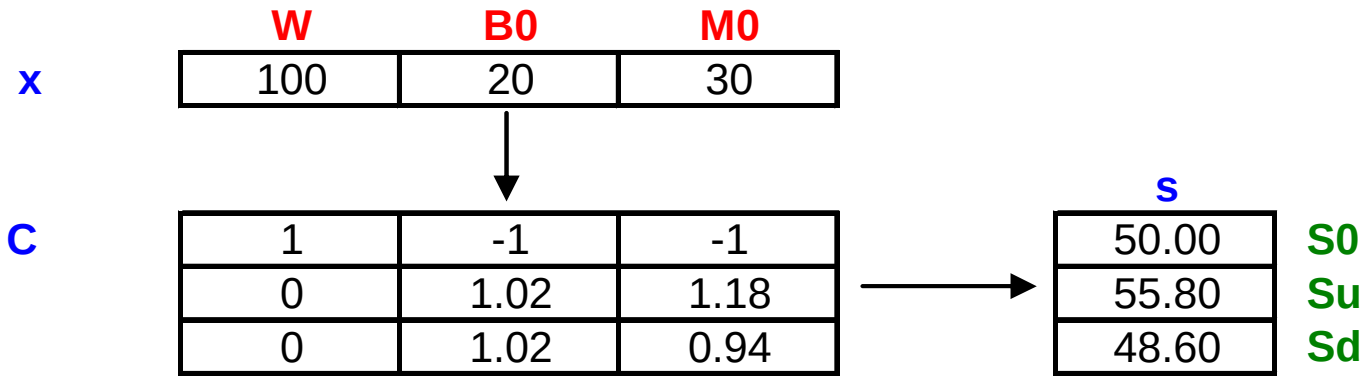
Market Portfolio Investment



Wealth, Financial Strategy, Capital Markets and Spending

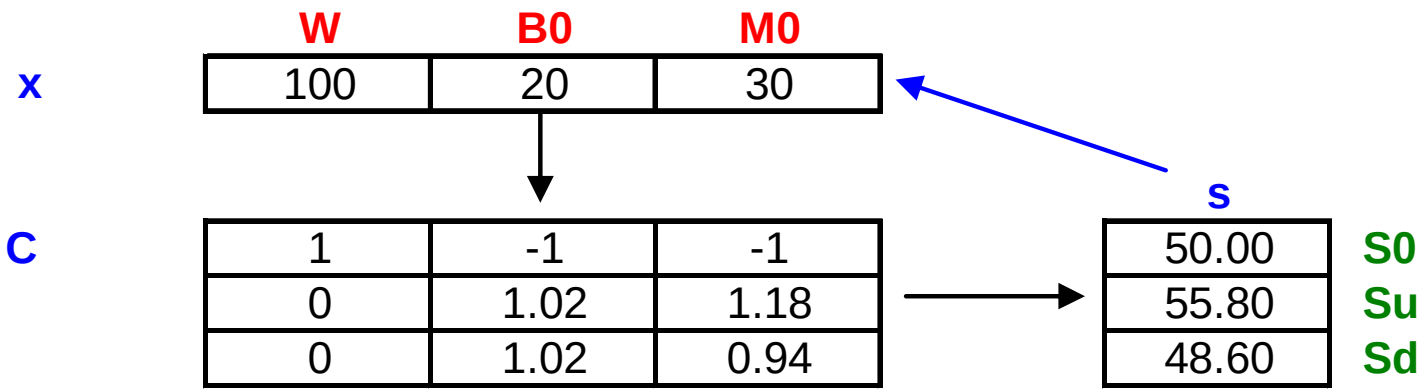


Decisions → Spending
Cx'= s

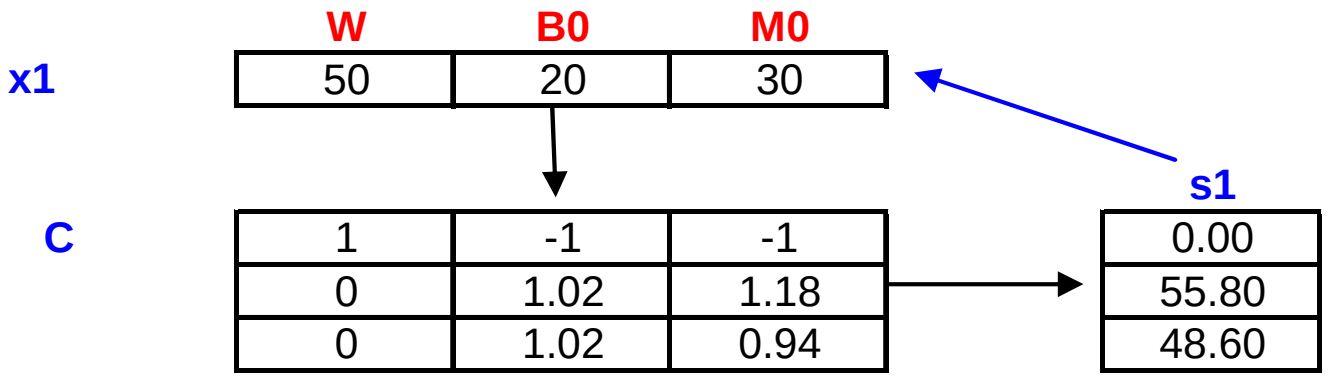


Spending → Decisions

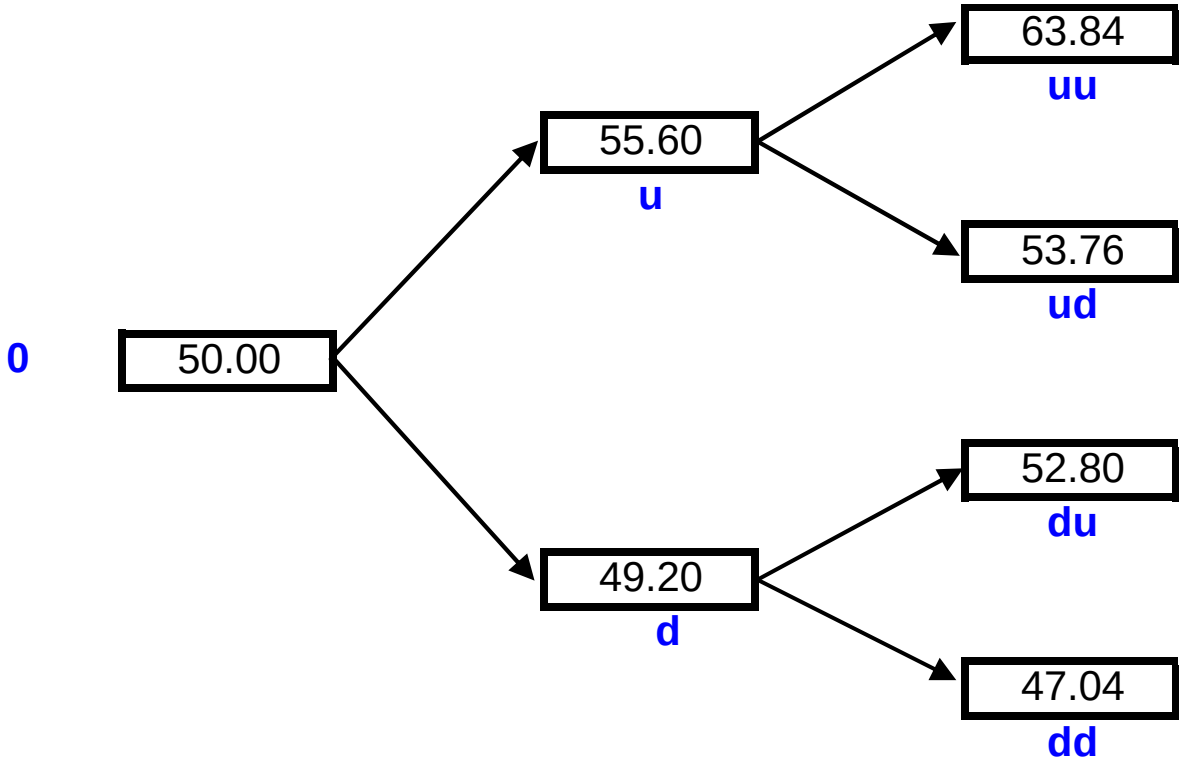
$$x' = C^{-1}s$$



Lockbox, Period 1



Desired Spending: Multiple Periods



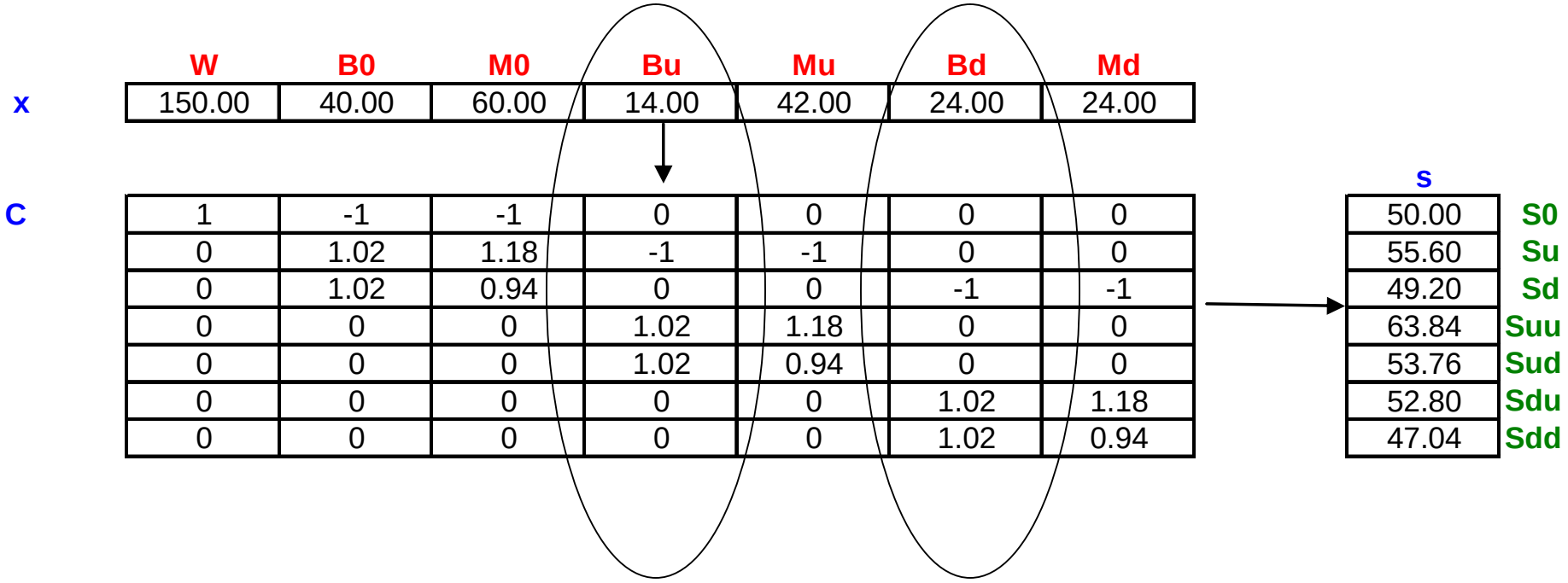
Dynamic Strategies

	W	B0	M0	Bu	Mu	Bd	Md
x	150.00	40.00	60.00	14.00	42.00	24.00	24.00

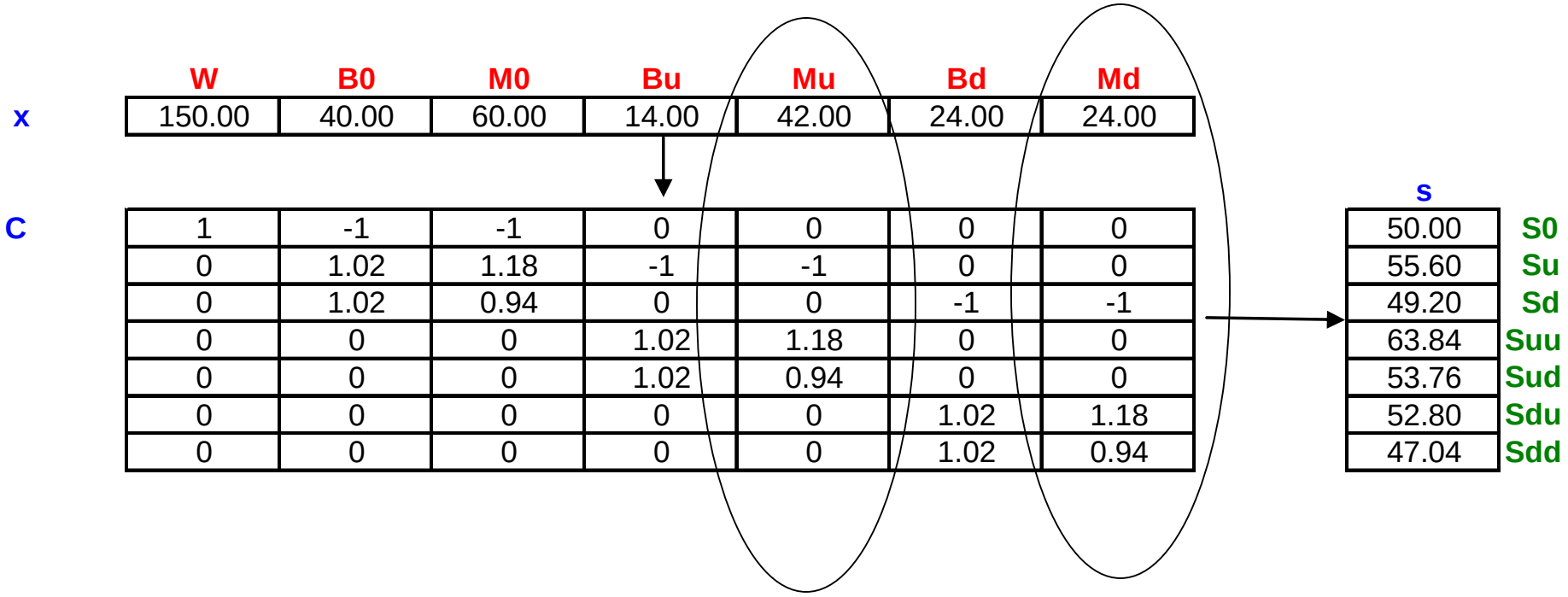
C	1	-1	-1	0	0	0	0	50.00	S0
	0	1.02	1.18	-1	-1	0	0	55.60	Su
	0	1.02	0.94	0	0	-1	-1	49.20	Sd
	0	0	0	1.02	1.18	0	0	63.84	Suu
	0	0	0	1.02	0.94	0	0	53.76	Sud
	0	0	0	0	0	1.02	1.18	52.80	Sdu
	0	0	0	0	0	1.02	0.94	47.04	Sdd

s

Contingent Bond Purchases



Contingent Market Portfolio Purchases



	W	B0	M0	Bu	Mu	Bd	Md
x	150.00	40.00	60.00	14.00	42.00	24.00	24.00

C	1	-1	-1	0	0	0	0
	0	1.02	1.18	-1	-1	0	0
	0	1.02	0.94	0	0	-1	-1
	0	0	0	1.02	1.18	0	0
	0	0	0	1.02	0.94	0	0
	0	0	0	0	0	1.02	1.18
	0	0	0	0	0	1.02	0.94

s	
50.00	S0
55.60	Su
49.20	Sd
63.84	Suu
53.76	Sud
52.80	Sdu
47.04	Sdd

Lockbox, Period 2

	W	B0	M0	Bu	Mu	Bd	Md
x	49.67	16.34	33.33	14.00	42.00	24.00	24.00

inv(C)							
	1	-1	-1	0	0	0	0
	0	1.02	1.18	-1	-1	0	0
	0	1.02	0.94	0	0	-1	-1
	0	0	0	1.02	1.18	0	0
	0	0	0	1.02	0.94	0	0
	0	0	0	0	0	1.02	1.18
	0	0	0	0	0	1.02	0.94

s	
0.00	S0
0.00	Su
0.00	Sd
63.84	Suu
53.76	Sud
52.80	Sdu
47.04	Sdd

Lockbox Separation (1)

- A retirement financial strategy is fully specified if spending in each year can be determined for any scenario of market returns
- A market is complete if any desired spending plan can be implemented with a retirement financial strategy
- If the market is complete, any fully specified retirement financial strategy can be implemented with a lockbox strategy

Lockbox Separation (2)

- If a market is not complete
  - it may or may not be possible to implement a given retirement financial plan with a lockbox strategy
  - or, if there is a comparable lockbox strategy it may incur added expense
- But many popular retirement financial plans have equal-cost lockbox counterparts
- Prime examples are the Fidelity Income Replacement Funds

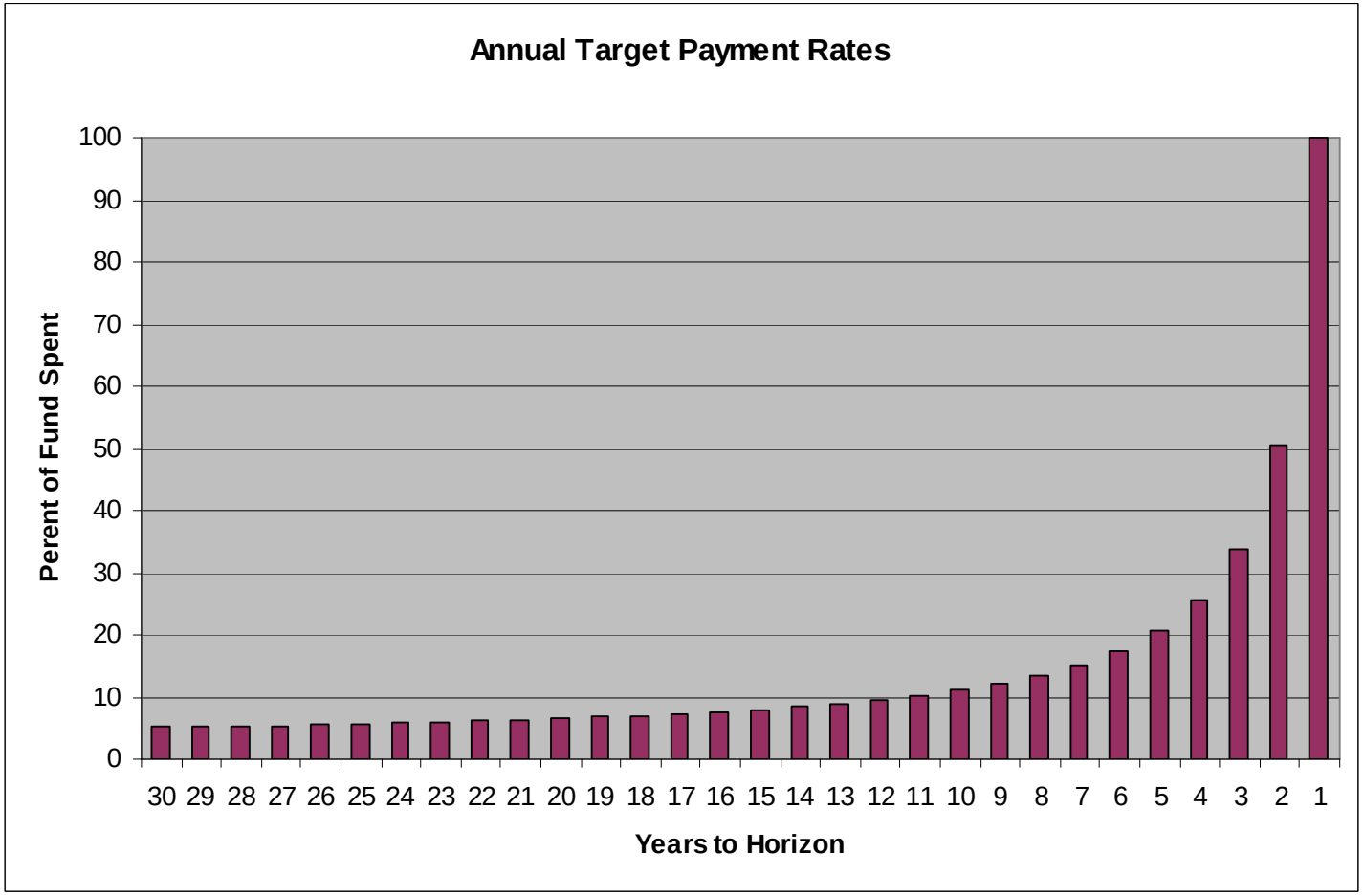
The Fidelity Income Replacement Funds

- Horizon date
  - E.g. 2036
- Investment strategy
  - Time-dependent “glide path” asset allocation
- Spending Rule
  - Pre-specified time-dependent proportions of asset value

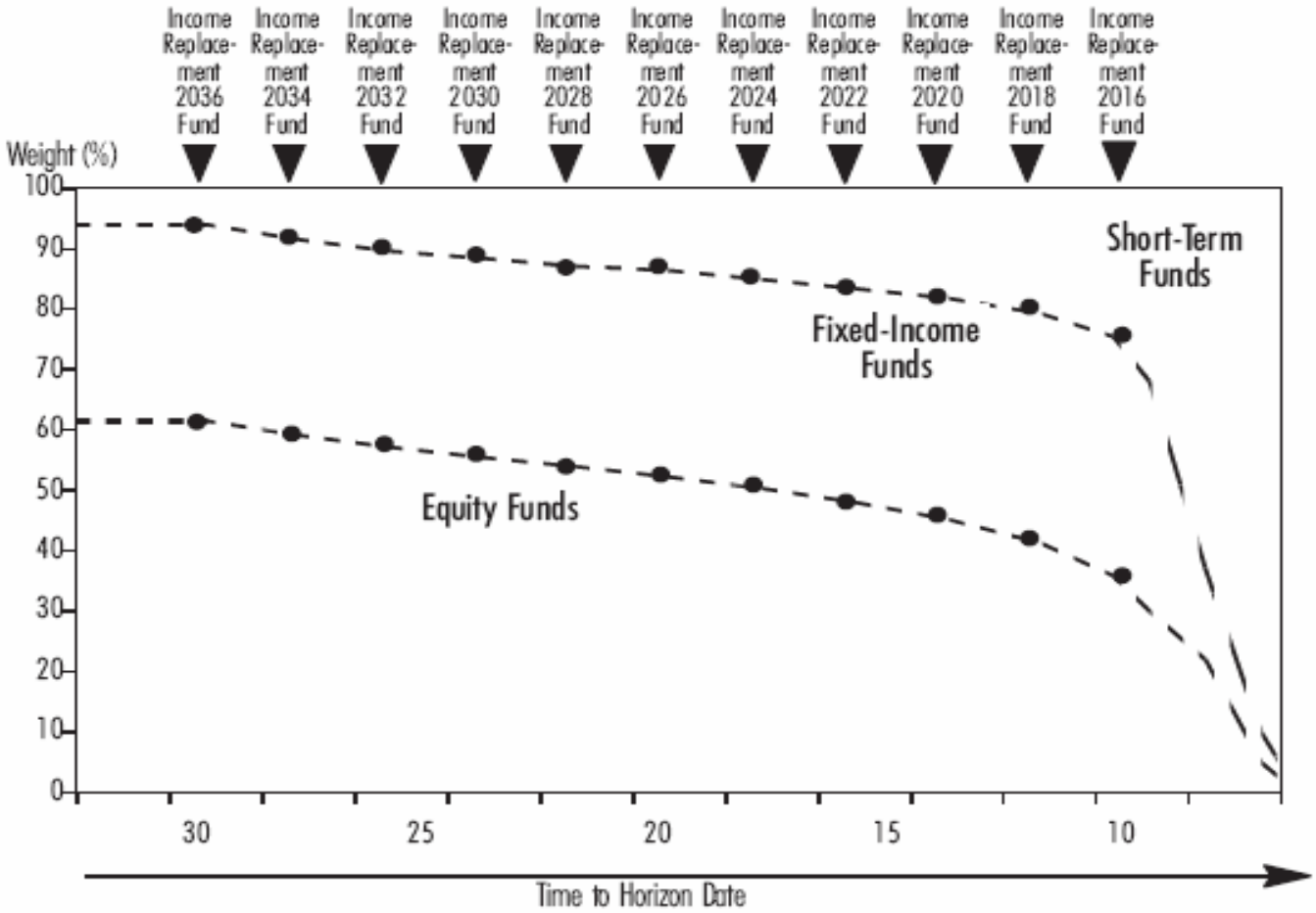
Fund Characteristics
(from prospectus)

- "The Income Replacement Funds are designed for investors who seek to convert accumulated assets into regular payments over a defined period of time …
- The payment strategy for each Income Replacement Fund is designed to be implemented through a shareholder's voluntary participation in the Smart Payment Program[SM] …
- Each Income Replacement Fund's investment objective is intended to support the Smart Payment Program's payment strategy …
- The income Replacement Funds are not designed for the accumulation of assets prior to retirement… [but they] do not provide a complete solution for a shareholder's retirement income needs."

Spending Rule



Investment Strategy



Lockbox Equivalence

- Any strategy with a time-dependent proportional spending rule and a time-dependent investment strategy is equivalent to a lockbox strategy
- Each lockbox will have the same investment strategy and
- The initial amounts to be invested in the lockboxes can be computed from the pre-specified spending rates

Initial Lockbox Values (1)

- Let:

  K_t = the proportion spent in year t

  R_t = the total return on investment in year t
  (e.g. 1.02 for 2%)

- The amounts spent in the first three years will be:

  Wk_0

  $(1-k_0)WR_1k_1$

  $(1-k_0)WR_1(1-k_1)\ R_2k_2$

Initial Lockbox Values (2)

- Re-arranging:

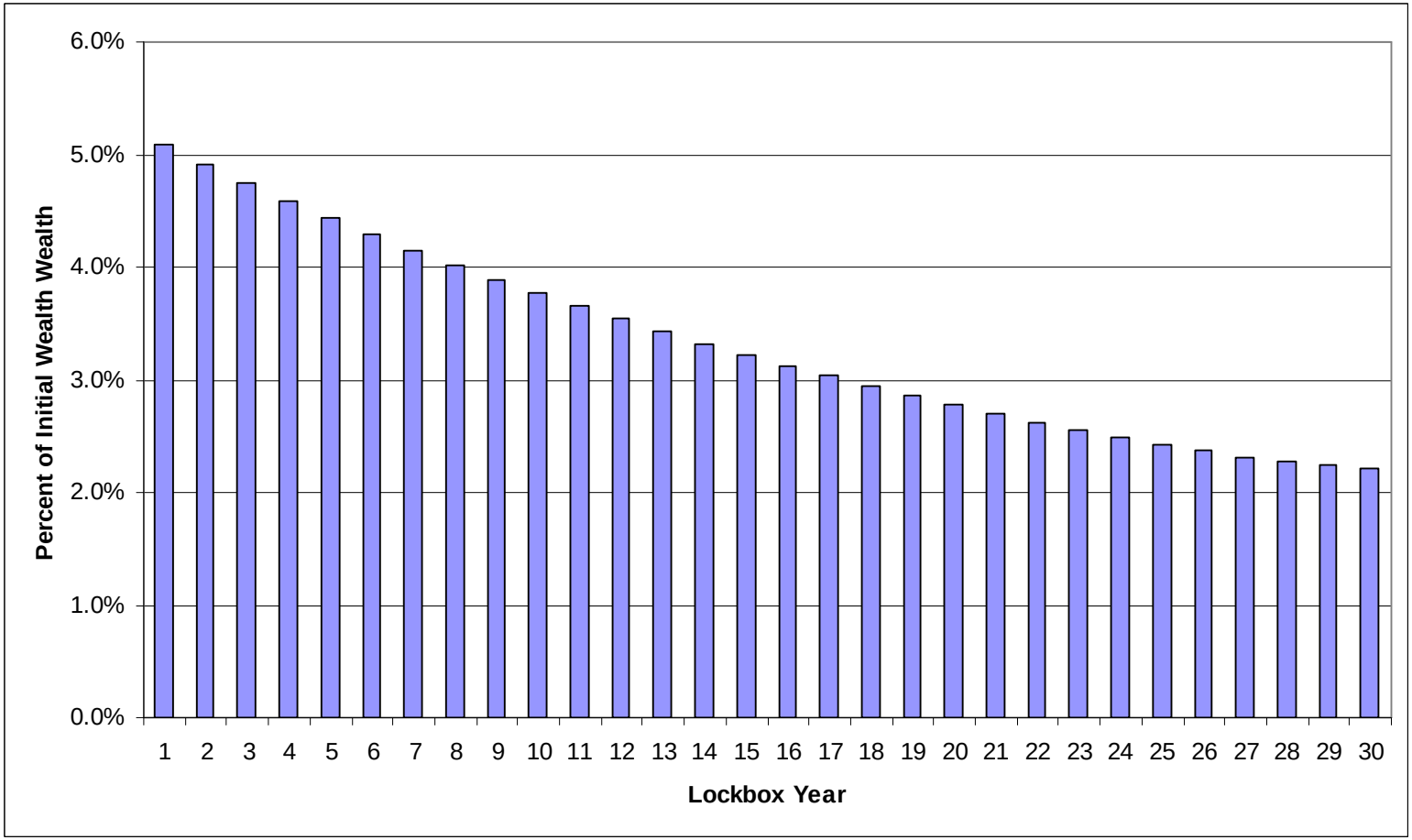
  $\{Wk_0\}$

  $\{W(1-k_0)k_1\}$ R_1

  $\{W(1-k_0)(1-k_1)k_2\}$ R_1R_2

- But these are the ending values for lockboxes with the initial investments shown in the brackets { }
  - investing these amounts in lockboxes will give the same spending plan as the original strategy

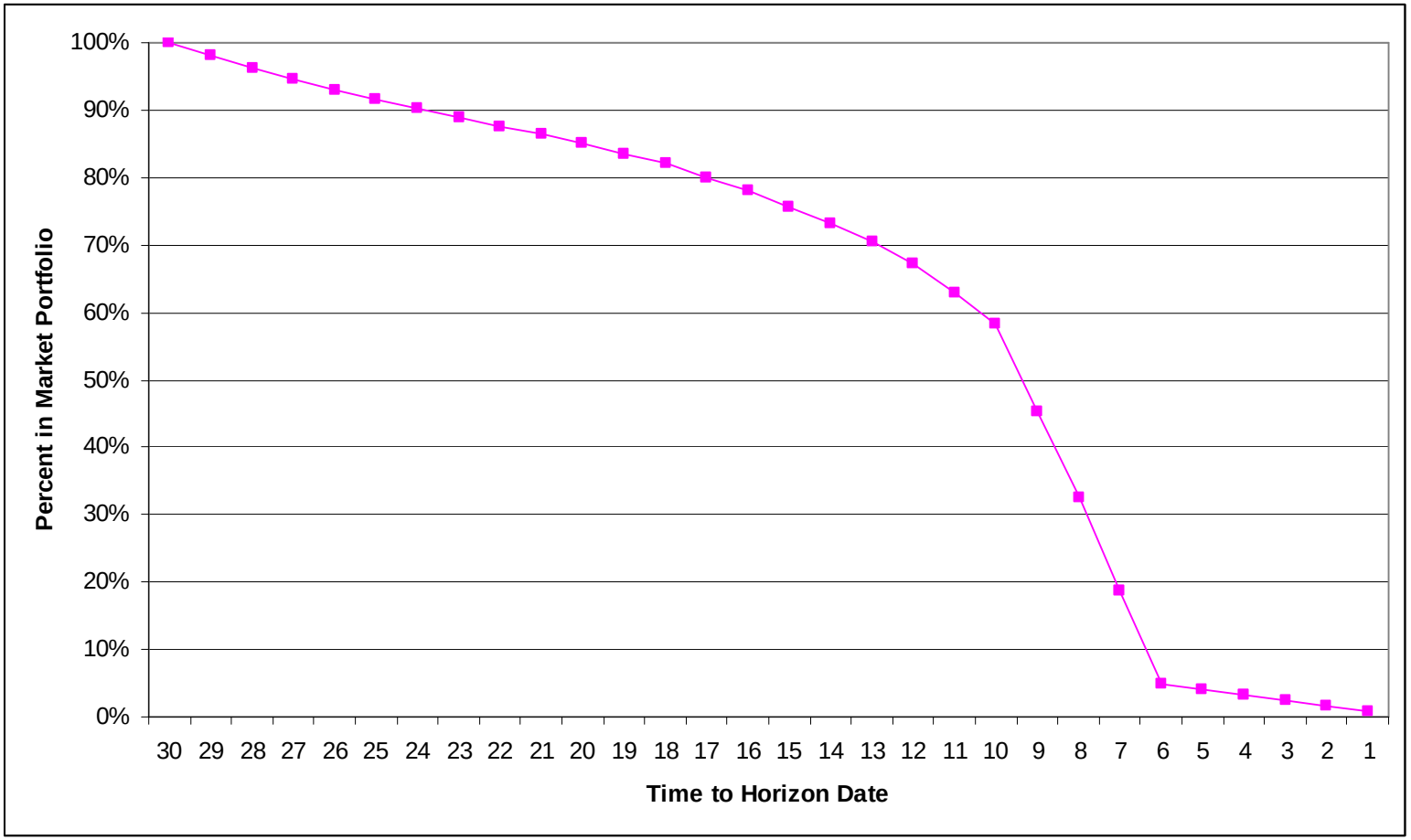
Percentages of Initial Wealth in Lockboxes



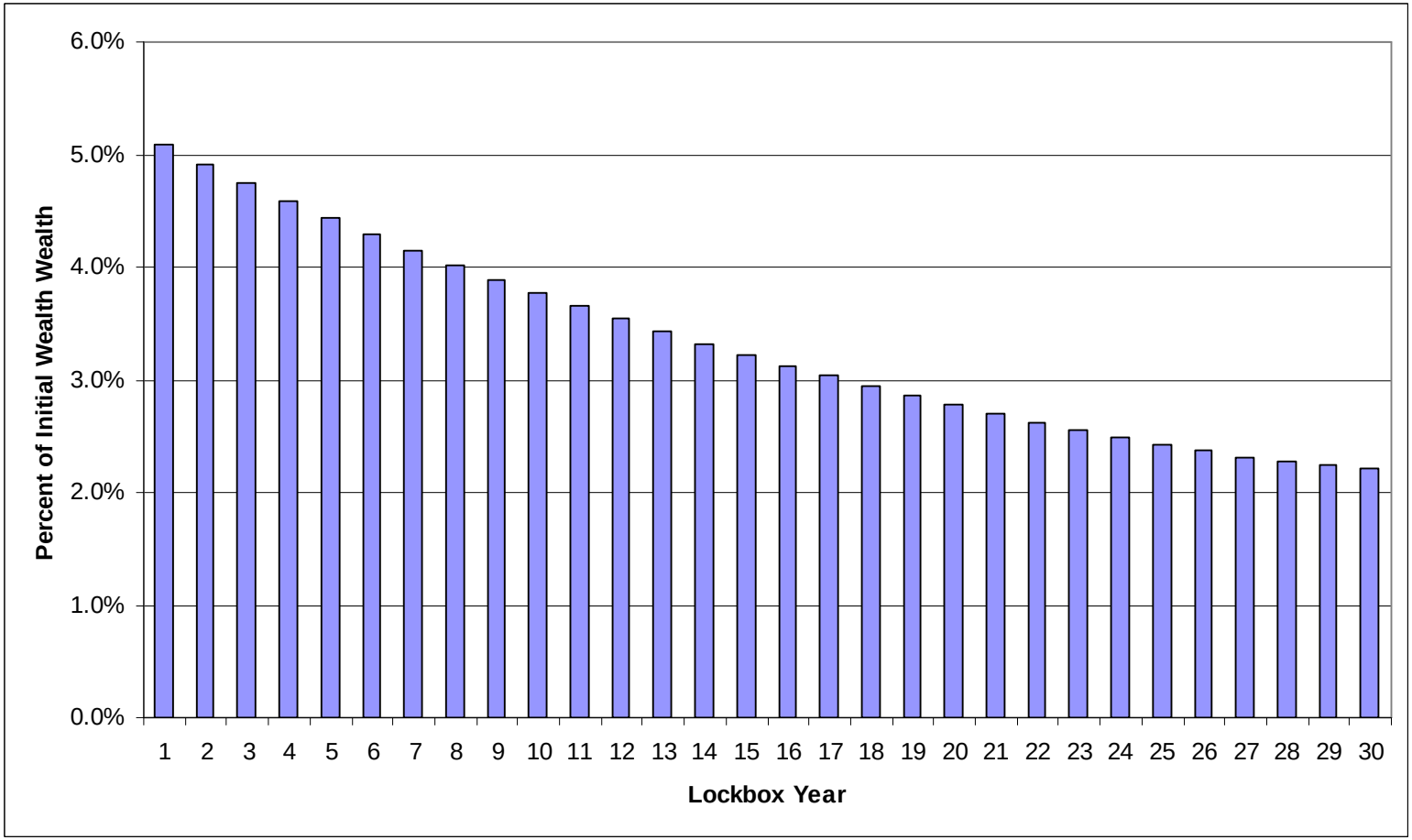
Rover: a Simple Income Replacement Fund

- Two assets
  - A riskless real bond
  - A market portfolio
    - (e.g. 60% Stocks, 40% Bonds)
- A glide path similar to that for equity funds in the Fidelity Income Replacement Funds
- A 30-year horizon
- Annual payment rates equal to those of the Fidelity Income Replacement Funds

Rover: Investment Strategy



Rover: Percentages of Initial Wealth in Lockboxes



Capital Market Characteristics

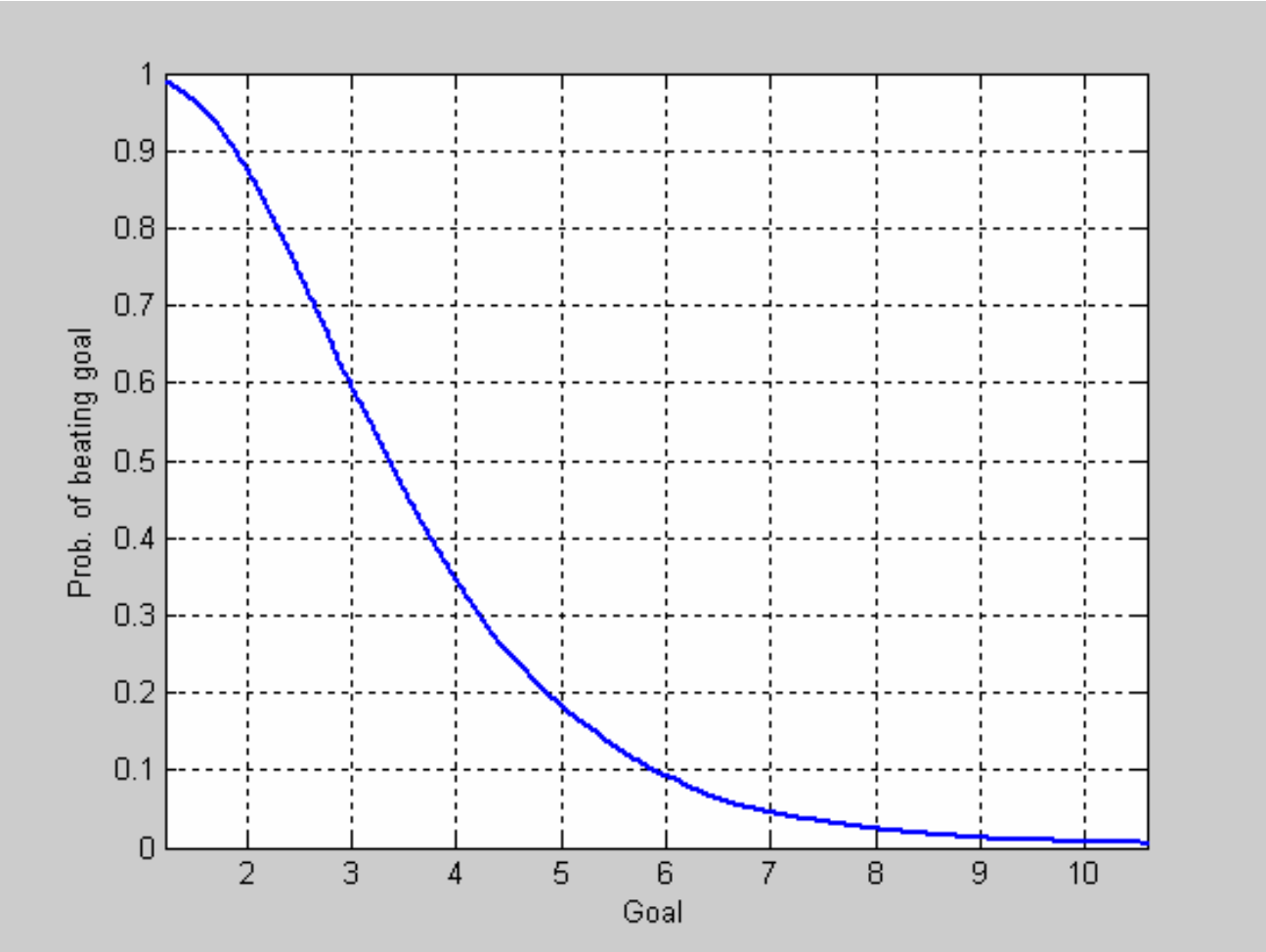
- Riskless real return
  - 2 % per year
- Market portfolio real return
  - Lognormally distributed each year
  - Expected annual return
    - 6 % per year
  - Annual standard deviation of return
    - 12 % per year
  - No serial correlation from year to year

Monte Carlo Simulations

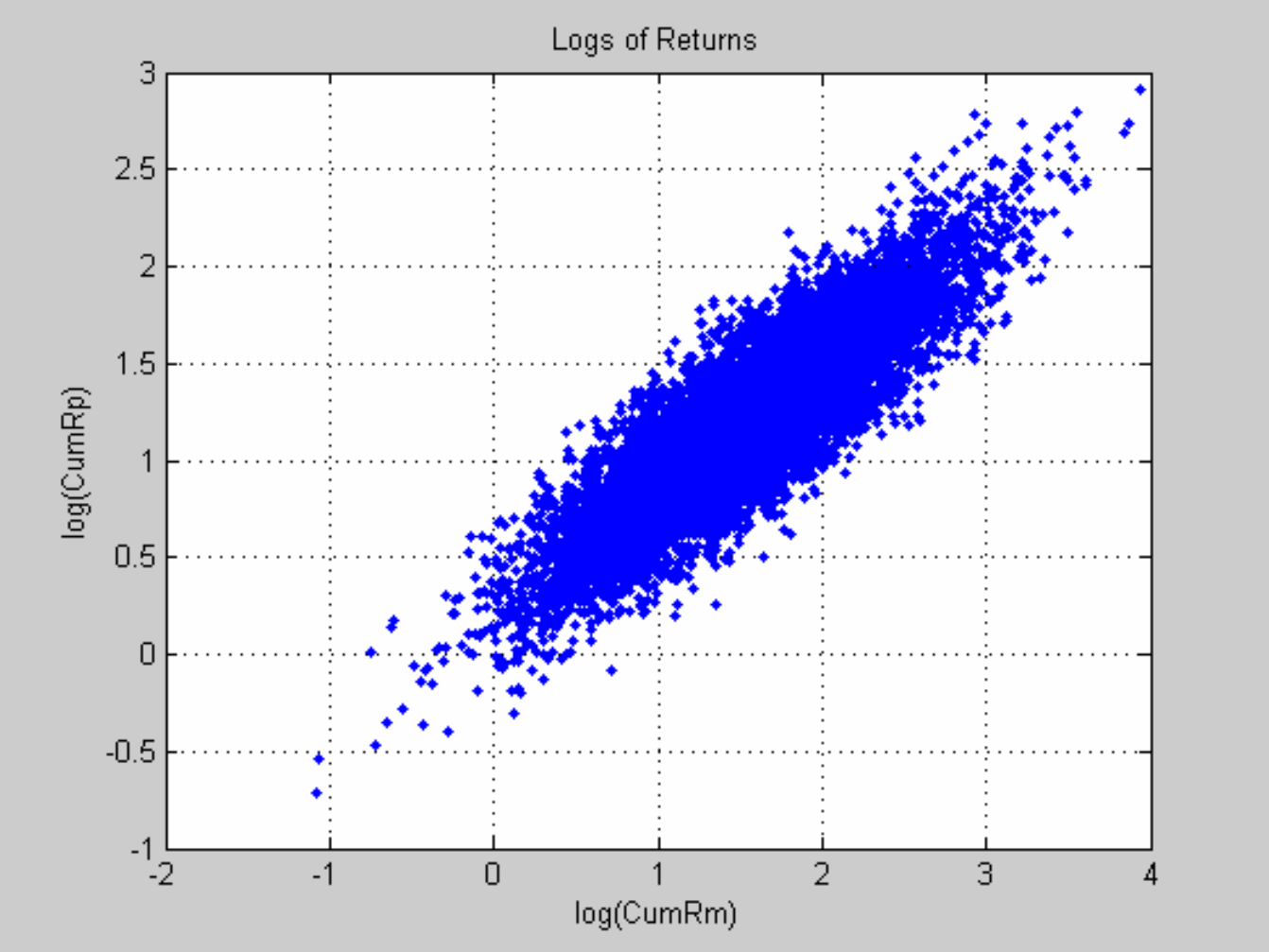
- 10,000 scenarios of 30 years each
- Returns for each lockbox are simulated
  - Results are the same as those for the original strategy
- The original set of scenarios is then used to evaluate alternative strategies

Rover: Spending in Year 30

per dollar invested in lockbox



Rover: Spending in Year 30: Strategy versus Market



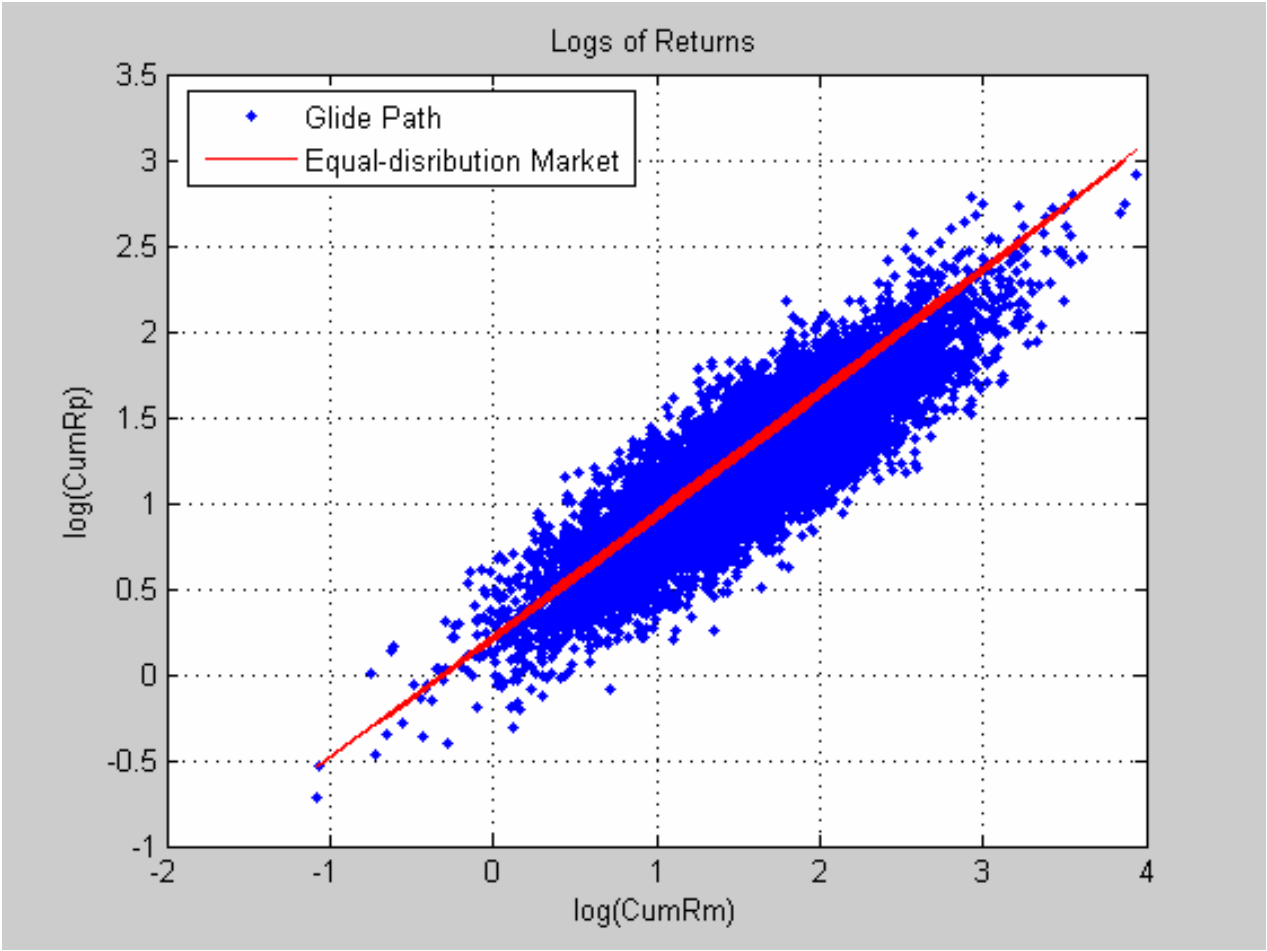
Market Risk and Path Risk

- Market risk
  - Uncertainty about return due to uncertainty about cumulative market return
- Path risk
  - Uncertainty about return due to uncertainty about the path market returns will take
- In this setting, only market risk is rewarded with higher expected return

Minimizing Path Risk

- Sort all 10,000 amounts to be spent in the year from highest to lowest
- Construct a strategy with the highest return in the scenario with the highest cumulative market return, the next highest return in the scenario with the next highest market return, and so on.
- This equal-distribution market strategy will have precisely the same distribution of spending with minimum path risk

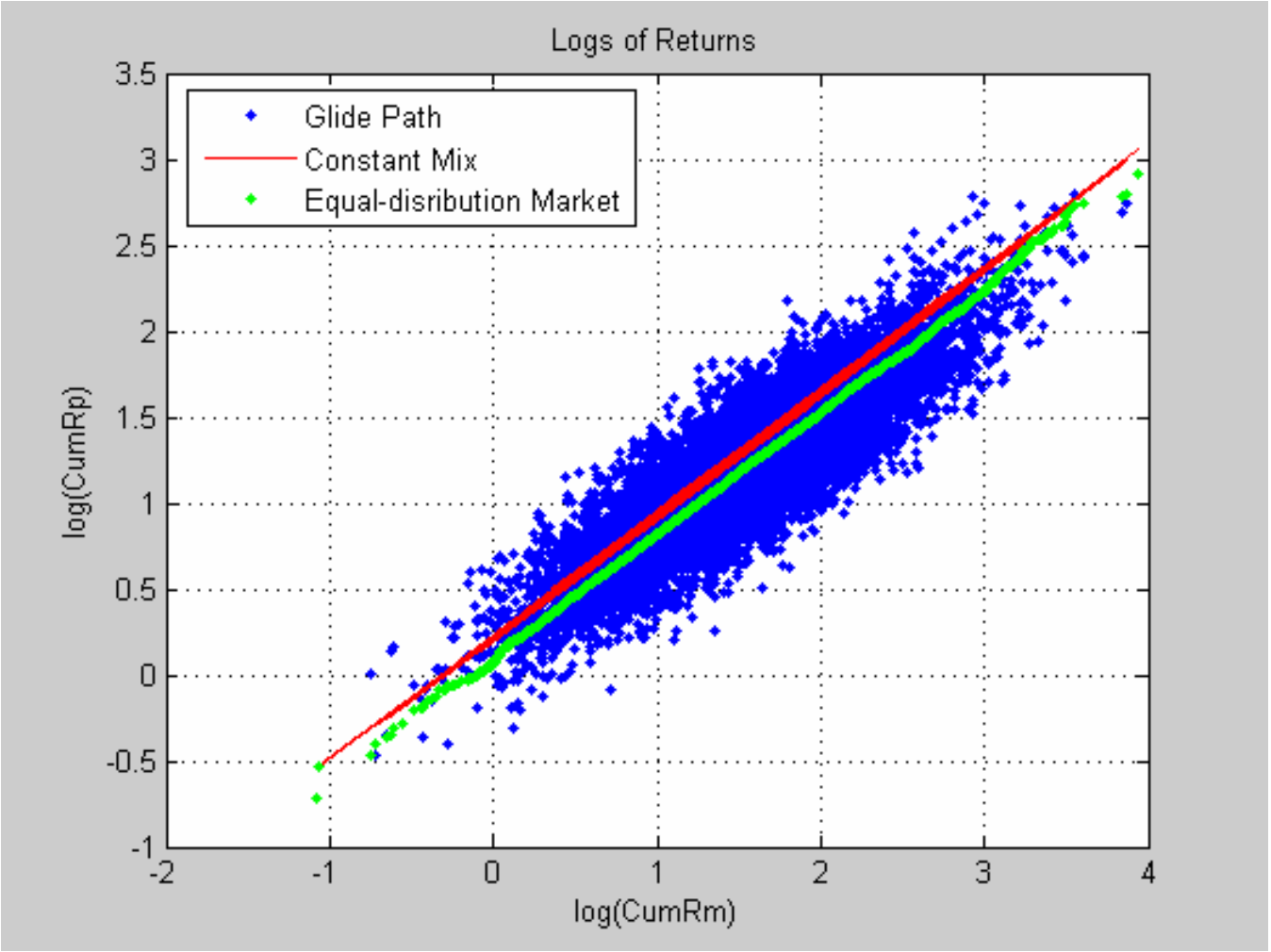
Rover: Spending in Year 30: Two Strategies versus Market



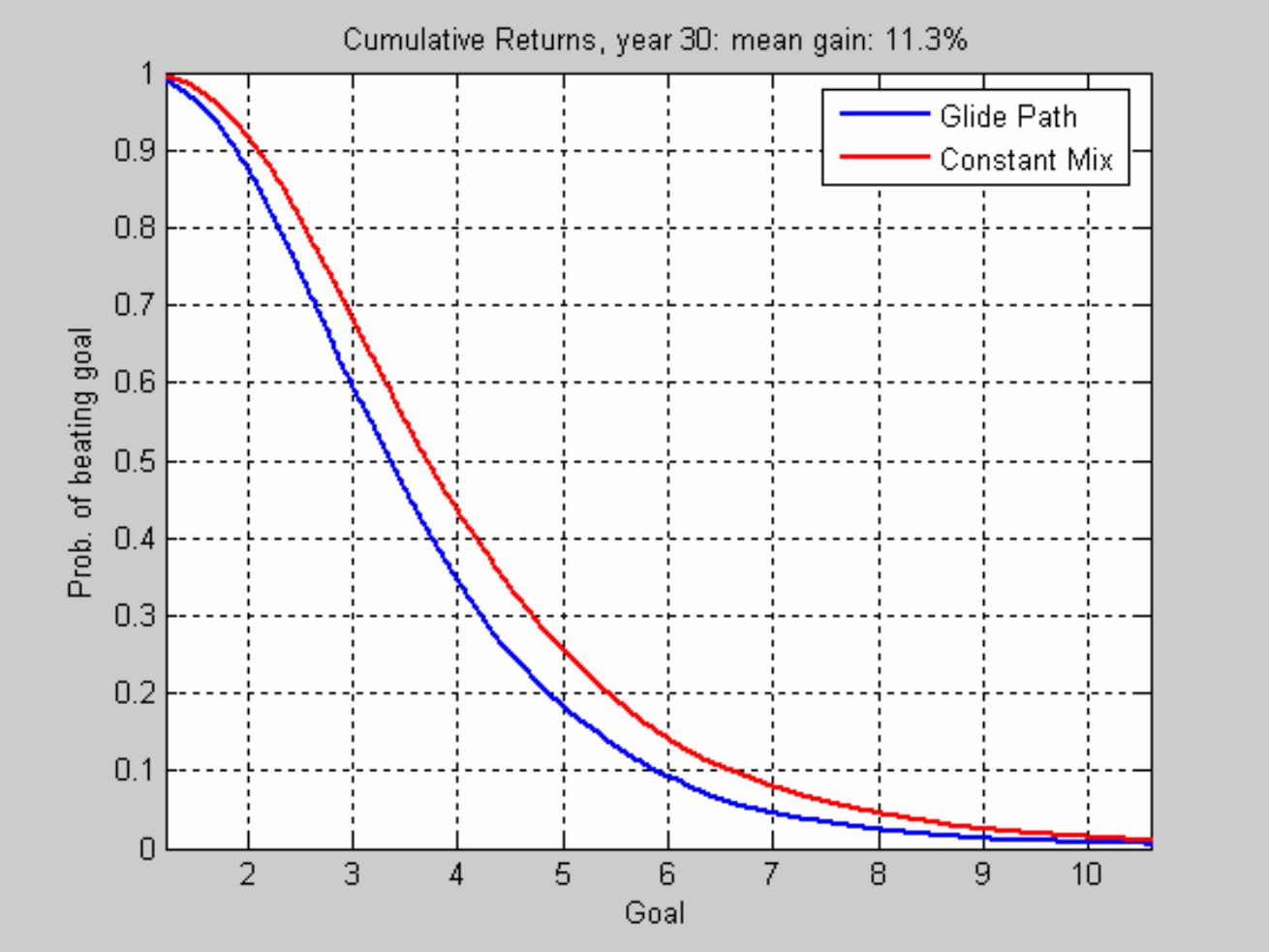
The Equal-distribution Market Strategy

- Provides returns almost the same as those from a constant-mix strategy rebalanced annually to give
  - 71% in the market portfolio
  - 29% in the riskless bond
- But it is cheaper to obtain these results since only market risk is taken
- Following such a constant-mix strategy with the funds in the lockbox will produce higher returns
  - In this case, over 11% better

Rover: Spending in Year 30: Three Strategies versus Market



Rover: Spending in Year 30: Glide Path versus Constant Mix



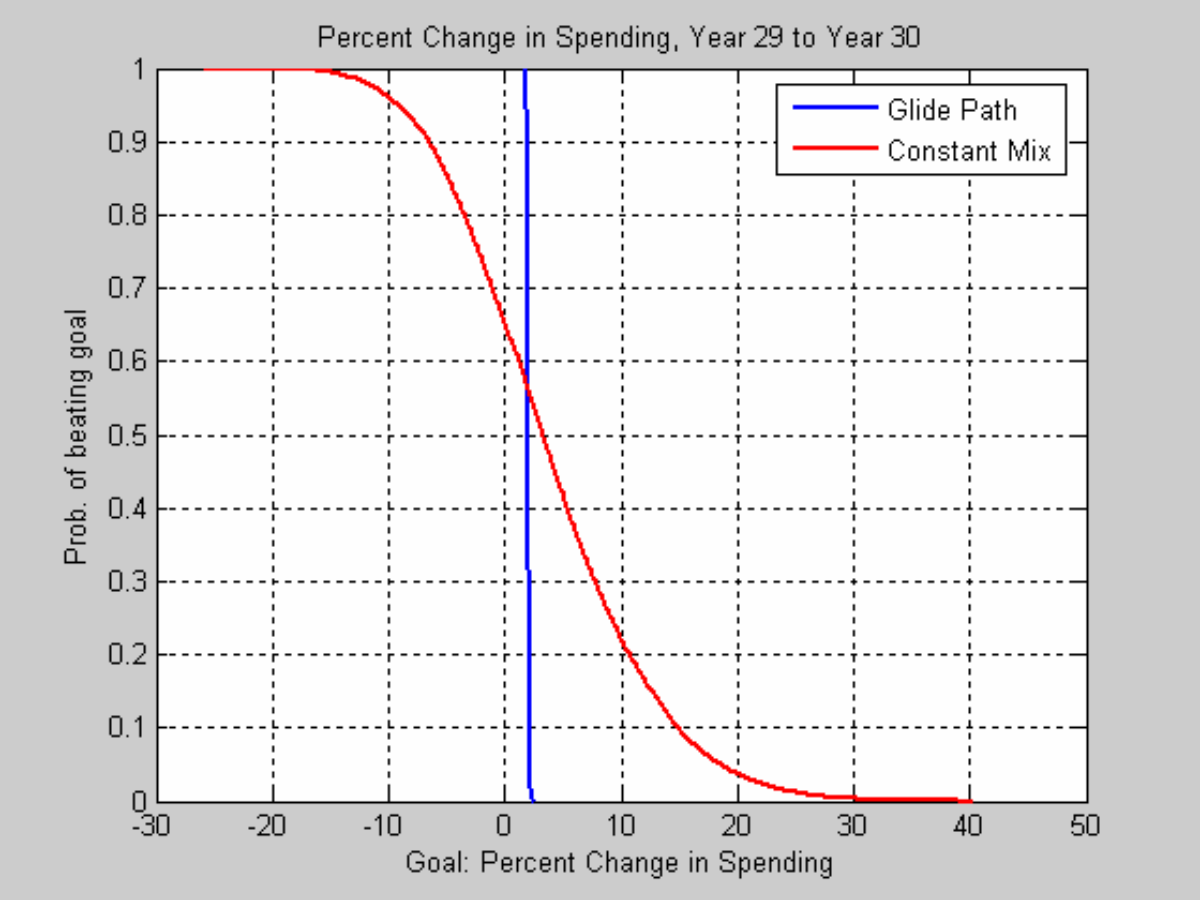
An Alternative Strategy

- Each lockbox follows a constant mix strategy
- The proportions invested in the market portfolio differ among boxes
- Boxes for later dates have more conservative asset allocations
- The distribution of outcomes for each year will be better than that for the original strategy
  - But the improvements will be greater for boxes with later dates

Is the Alternative Strategy Better?

- Probably for most retirees
- But it can provide more variation in spending from year to year

Percent Change in Spending for Two Strategies: Year 29 to Year 30



The Ultimate Goal

- To find the best retirement financial plan for a given retiree or retiree family
- This will depend on
  - Capital market characteristics
  - Personal preferences

Finding an Optimal Retirement Financial Strategy

Maximize:

$$H(s)$$

Subject to:

$$x(1) = W$$

$$x = C^{-1}s$$

where H(s) is the investor's happiness with spending plan s

Happiness and Future Spending

- If a strategy determined today is to be followed without change, the appropriate objective is to maximize the happiness a retiree gets today from contemplating future spending when he or she may be ill or have diminished mental capacity
- Such a strategy allows a retiree to act in loco parentis for his or her future (possibly dimished) self
- Key is representing a retiree's personal preferences adequately

Personal Preferences and Retirement Lockboxes

- Economists have an approach to formulating personal preferences in terms of utility functions
- The goal is to maximize expected utility, taking probabilities of states of the world into account
- Much more work needs to be done to adapt this framework to help solve the retirement financial problem
- But it is likely that lockboxes can help as analytic constructs and, in some cases, in practice

Are There Retirement Lockboxes in Your Future?