
Portfolios of Everything

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The History and Economics of Stock Market Crashes

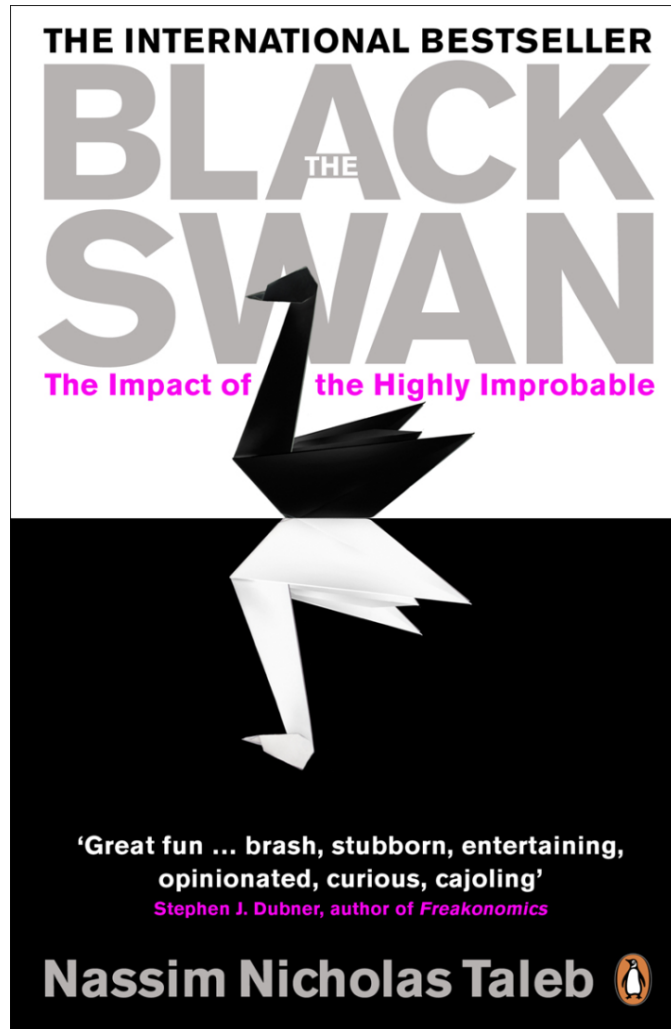
- ▶ Chapter in *Insights into the Global Financial Crisis*, Laurence B. Siegel, ed., CFA Institute, 2009.
- ▶ Authors
 - ▶ Paul D. Kaplan, Morningstar Europe
 - ▶ Thomas Idzorek, Ibbotson Associates
 - ▶ Michele Gambera, UBS Global Asset Management
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"Black Sunday," 14 September 2008



"I THOUGHT WE WERE JUST BUYING A HOUSE!"

The Black Swan



- ▶ An event that is inconsistent with past data but that happens anyway

Gray Swans

- ▶ “Events of considerable nature which are far too big for the bell curve, which are predictable, and for which one can take precautions”
Benoit Mandelbrot (inventor of fractal geometry)

“We seem to have a once-in-a-lifetime crisis every three or four years.”

Leslie Rahl
Founder of Capital Market Risk Advisors

Source: Christopher Wright, “Tail Tales,” *CFA Institute Magazine*, March/April 2007

The Black Turkey



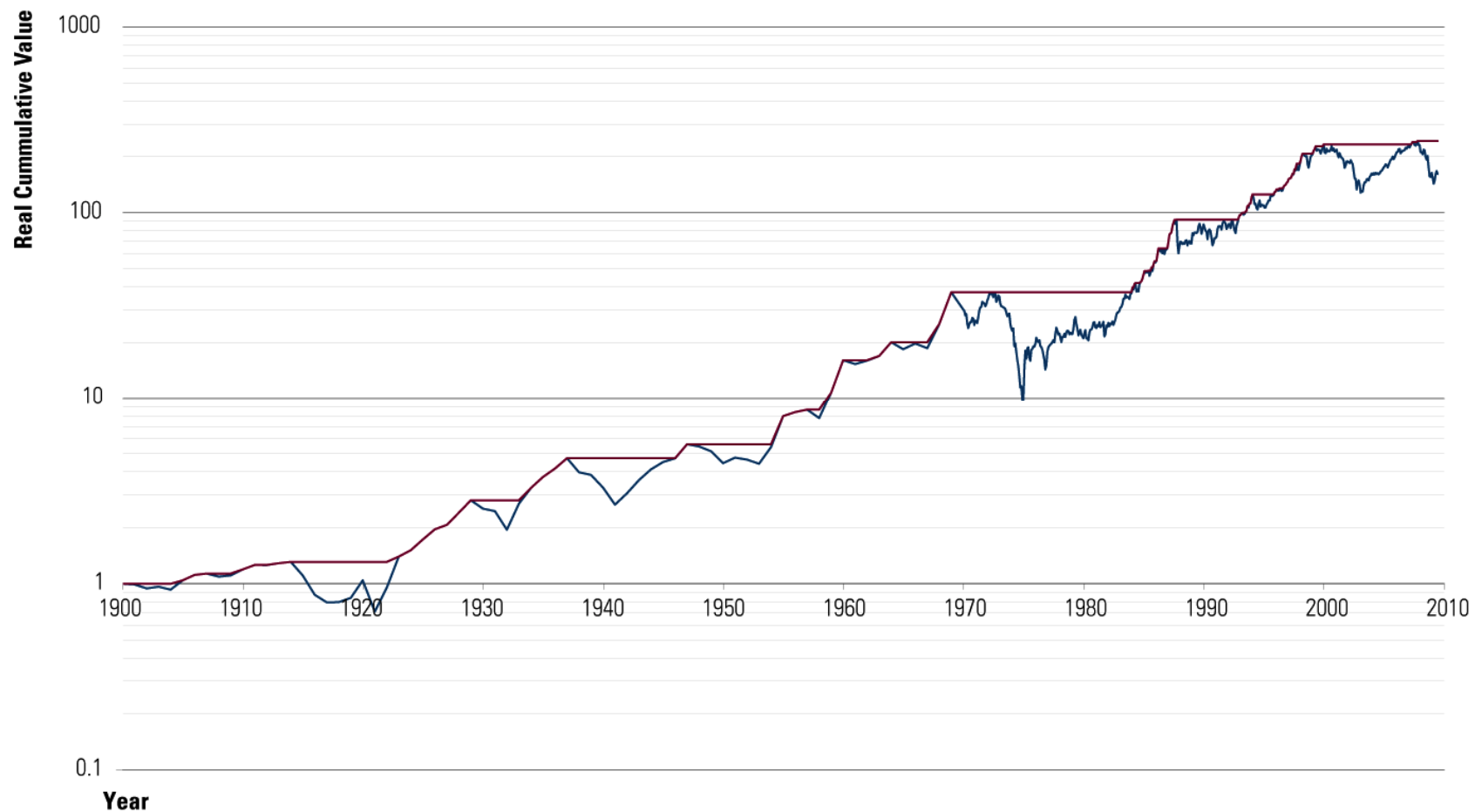
- ▶ “An event that is *entirely consistent with past data* but that no one thought would happen” Larry Siegel

A Flock of Turkeys

Asset class	Time period	Peak to trough decline
US stocks (real total return)	1911-1920	51%
US stocks (DJIA, daily)	1929-1932	89%
Long US Treasury bond (real total return)	1941-1981	67%
US stocks	1973-1974	49%
UK stocks (real total return)	1972-1974	74%
Gold	1980-1985	62%
Oil	1980-1986	71%
Japan stocks	1990-2009	82%
US stocks (S&P)	2000-2002	49%
US stocks (NASDAQ)	2000-2002	78%
US stocks (S&P)	2007-2009	57%

Nominal price return unless otherwise specified.

U.K. Stock Market History, 1900-2009

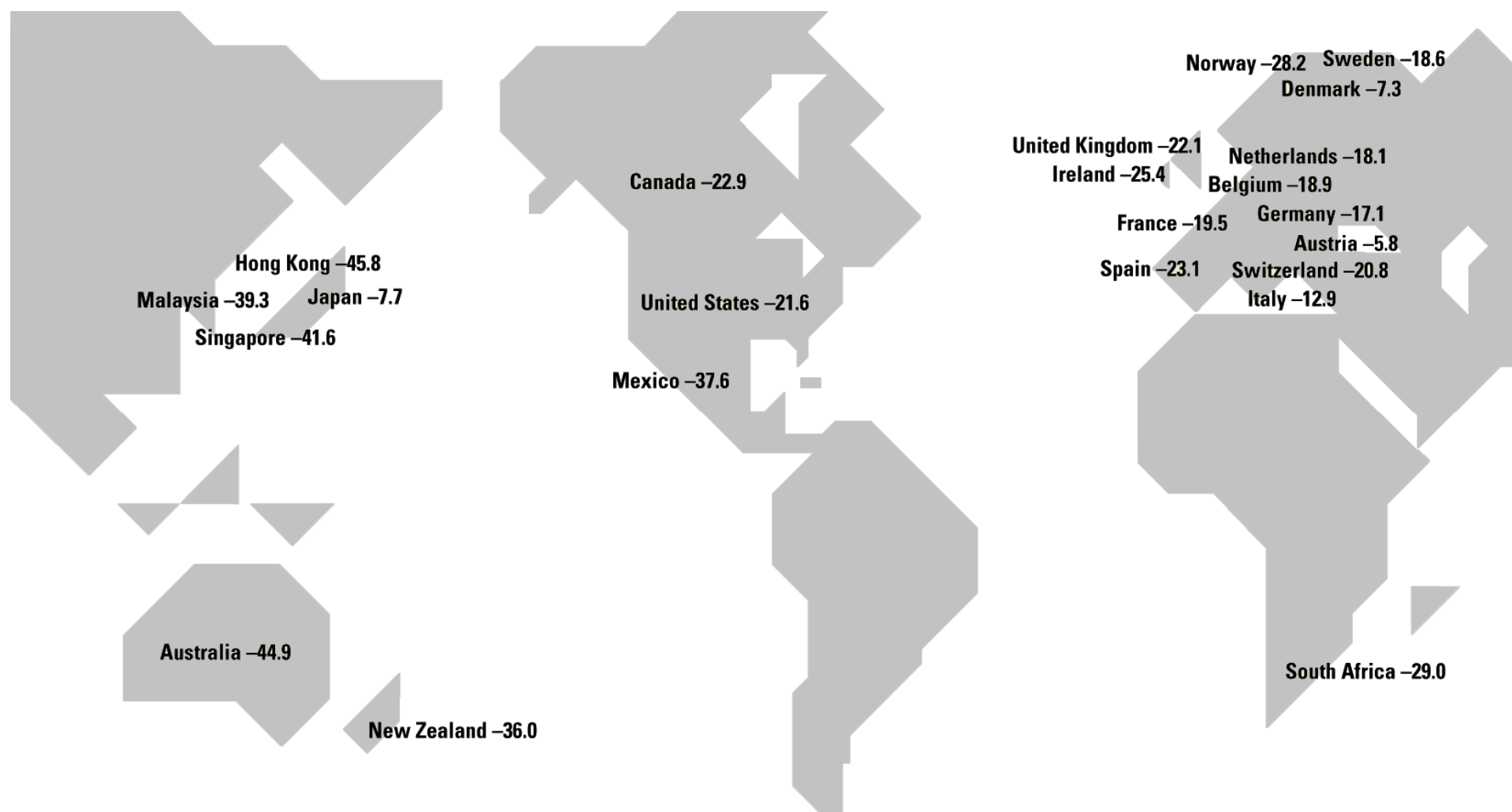


Largest Declines in U.K. Stock Market History, 1900-2009

Real Total Returns

Peak	Trough	Decline	Recovery	Event(s)
Apr 1972	Nov 1974	73.81%	Jan 1984	Oil shock
1913	1920	45.85	1922	World War I
Dec 1999	Jan 2003	44.91	Apr 2007	Information technology bubble and collapse
1936	1940	43.71	1946	Second part of Great Depression; World War II
Oct 2007	Feb 2009	40.99	TBD	Crash of 2007–2009; global financial crisis
1968	May 1970	35.80	Apr 1972	Speculation in currencies; Bretton Woods
Sep 1987	Nov 1987	34.07	Nov 1992	“Black Monday,” 19 Oct 1987
1928	1931	30.57	1933	First part of Great Depression
1946	1952	21.30	1954	Post-World War II correction

October 1987 Stock Market Total Return (% U.S. Dollars)



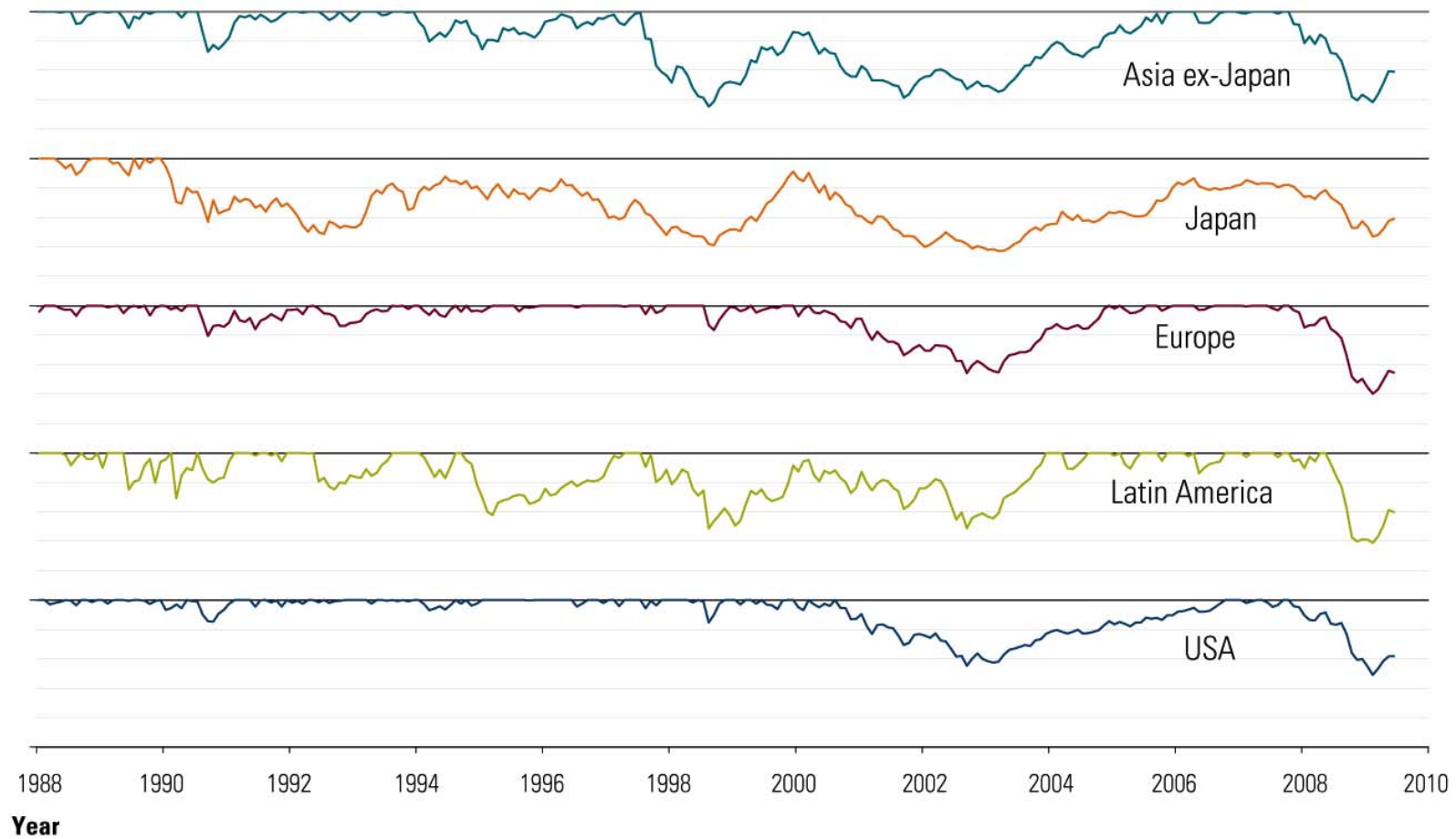
Largest Peak-to-Trough Declines in 8 Countries Since 1969

Month-end results as of May 2009 in inflation-adjusted local currency

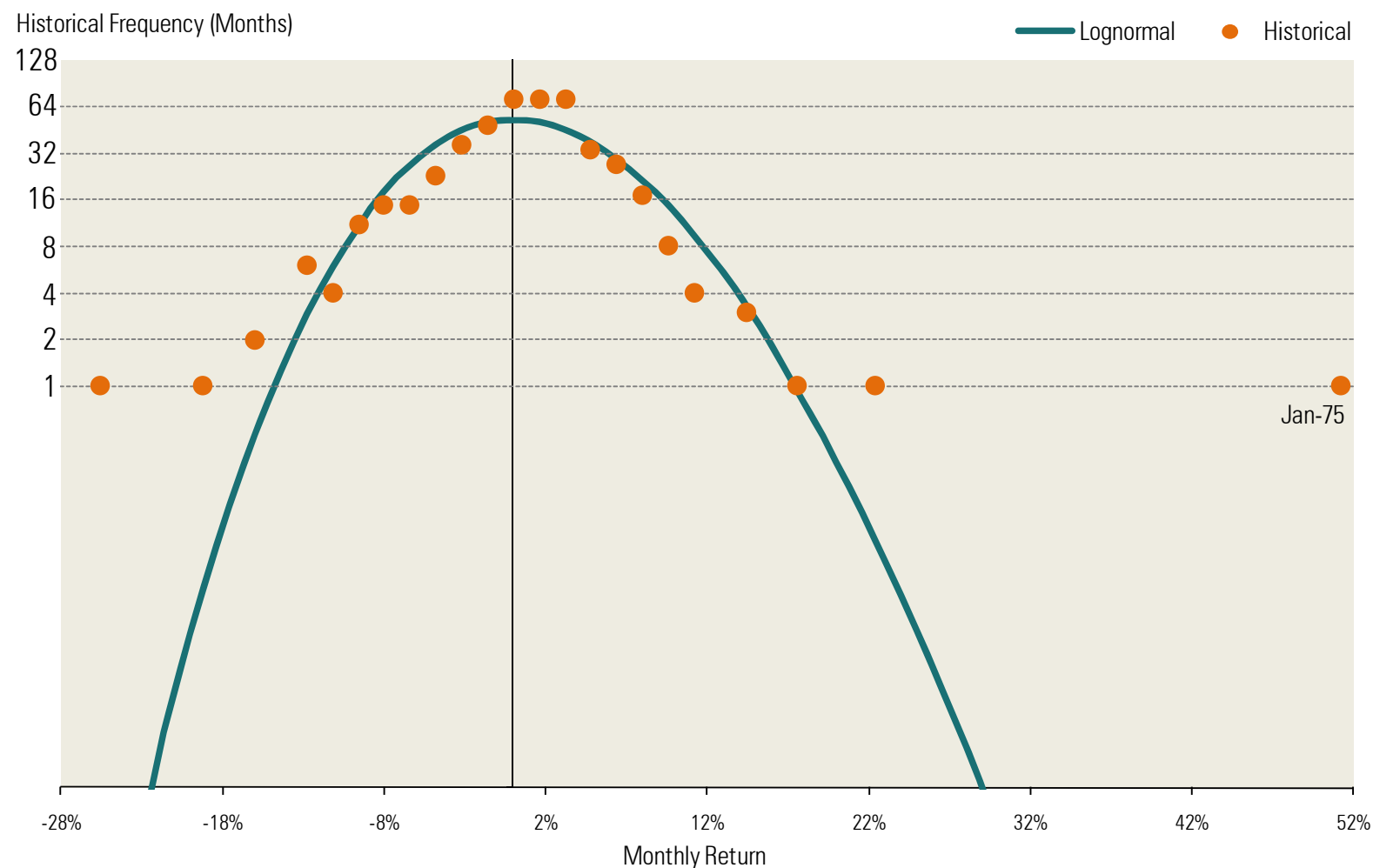
Country	Peak	Trough	Decline	Recovery
Spain	April 1973	April 1980	85.36%	December 1996
Italy	January 1970	December 1977	82.58%	March 1986
U.K.	April 1972	November 1974	73.81%	January 1984
Japan	December 1989	April 2003	70.33%	To Be Determined
Germany	February 2000	March 2003	69.44%	To Be Determined
France	August 2000	March 2003	60.52%	To Be Determined
Canada	February 1980	June 1982	51.38%	March 1986
U.S.	December 1999	February 2009	54.84%	To Be Determined

Source: Morningstar EnCorr, MSCI Barra, International Monetary Fund

Drawdowns Around the World, January 1988-June 2009



Cracks in the Bell Curve: The UK

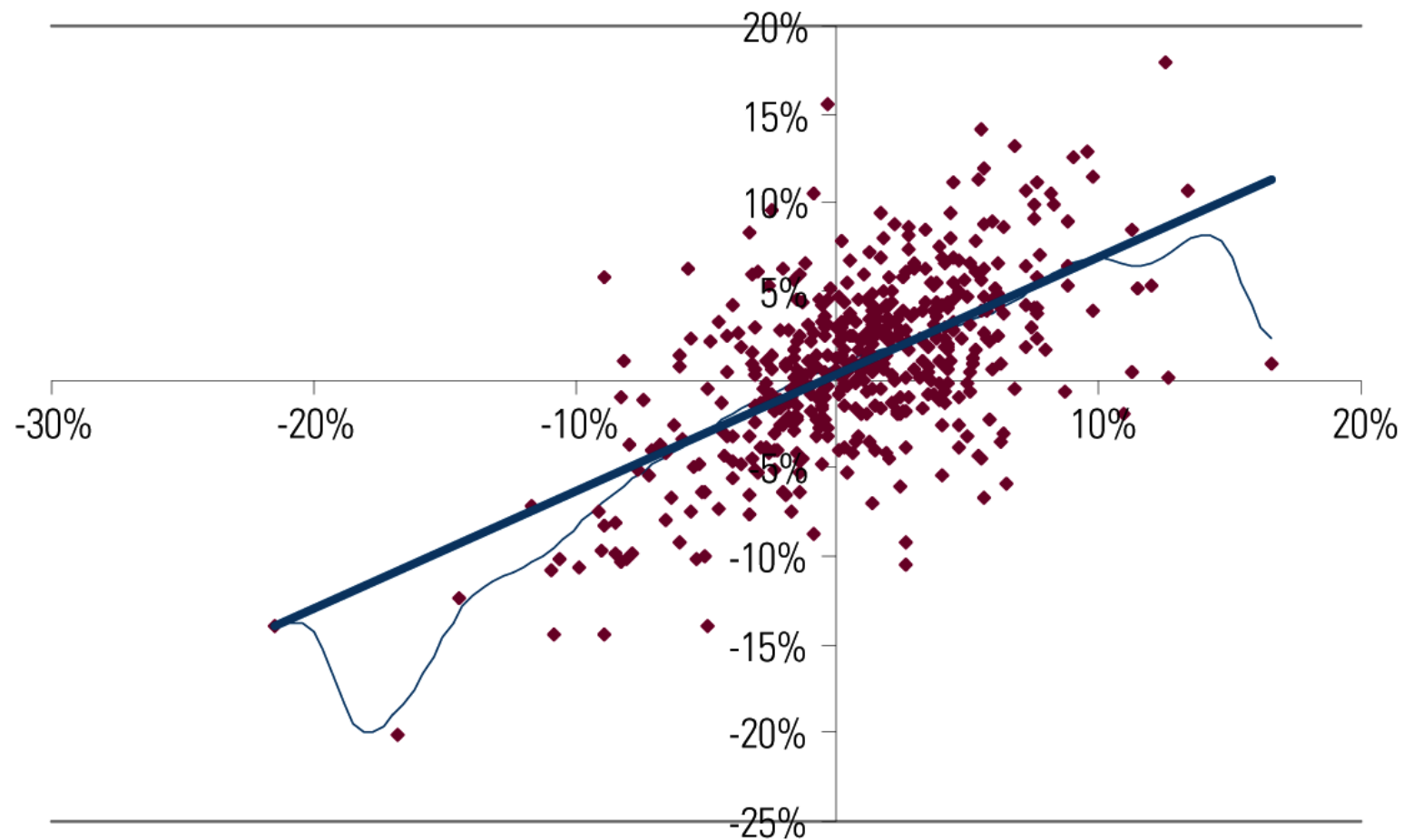


Bases on monthly inflation-adjusted returns on the MSCI UK Gross Return index : January 1926 — May 2009

Source: Morningstar EnCorr, MSCI Barra, and International Monetary Fund

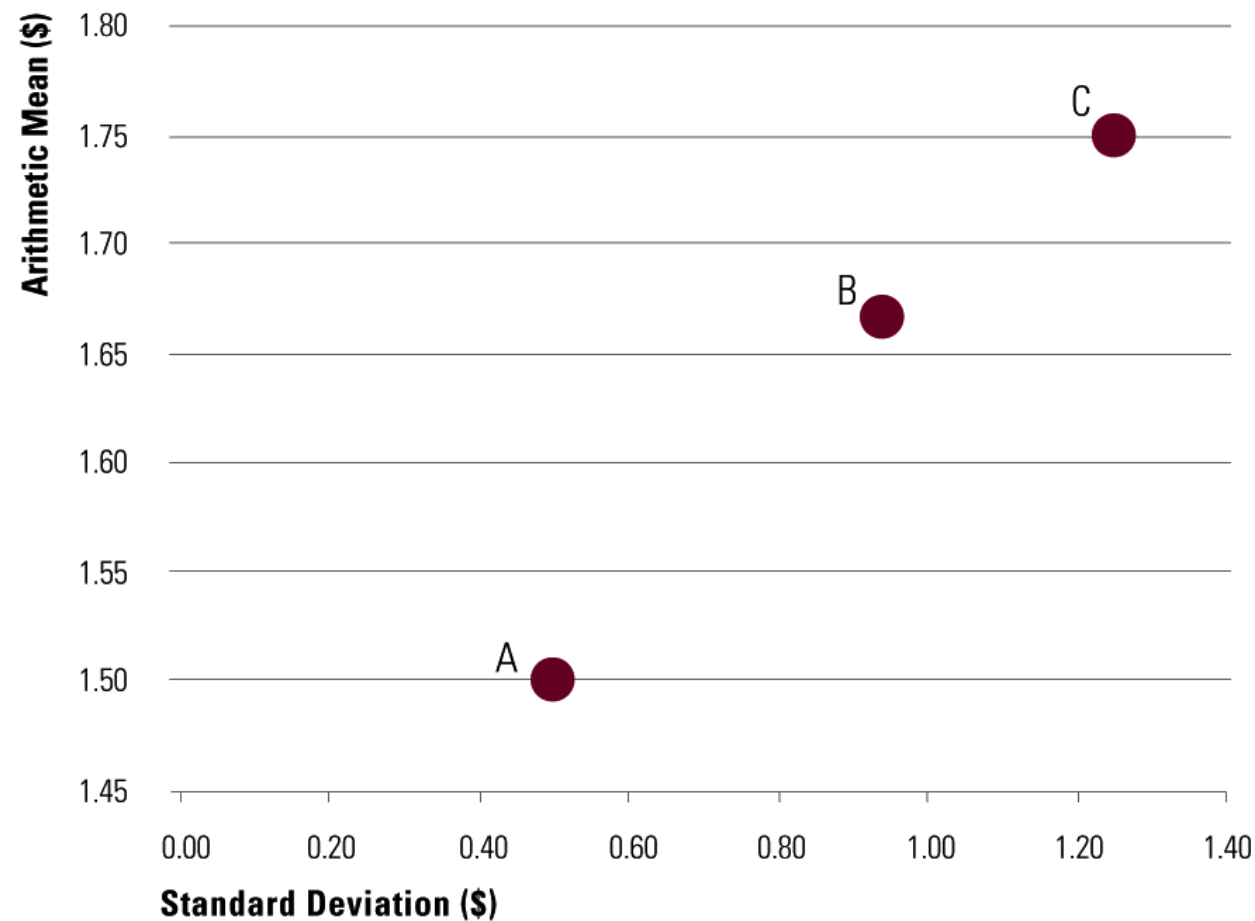
Covariation of Returns: Linear or Nonlinear?

S&P 500 vs. EAFE, Monthly Total Returns: Jan. 1970 – Oct. 2009



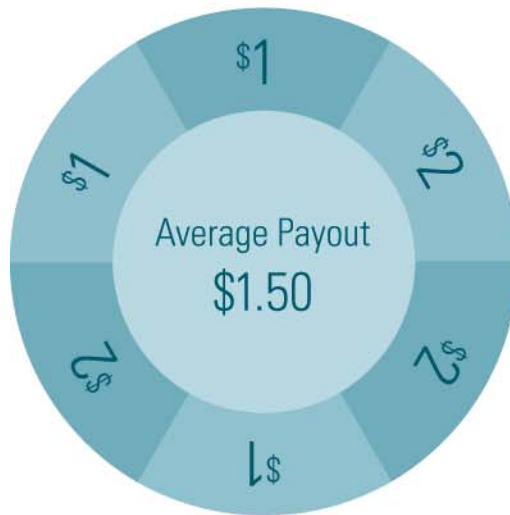
Investment Horizon: One Period or Longer?

Payout from \$1 investment for 3 choices



Meet the Choices

A



Geometric mean = \$1.41

B



Geometric mean = \$0.00

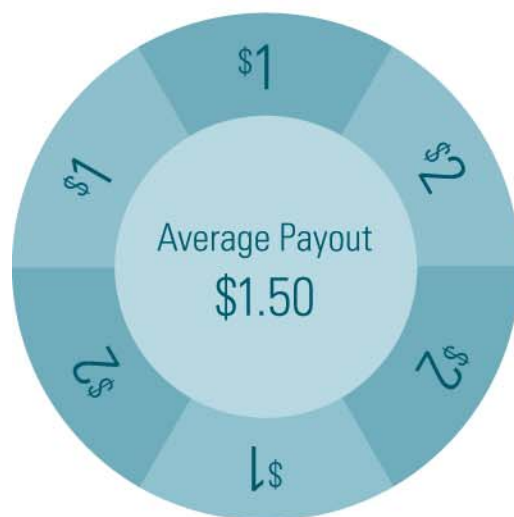
C



Geometric mean = \$1.22

Meet the Choices

A



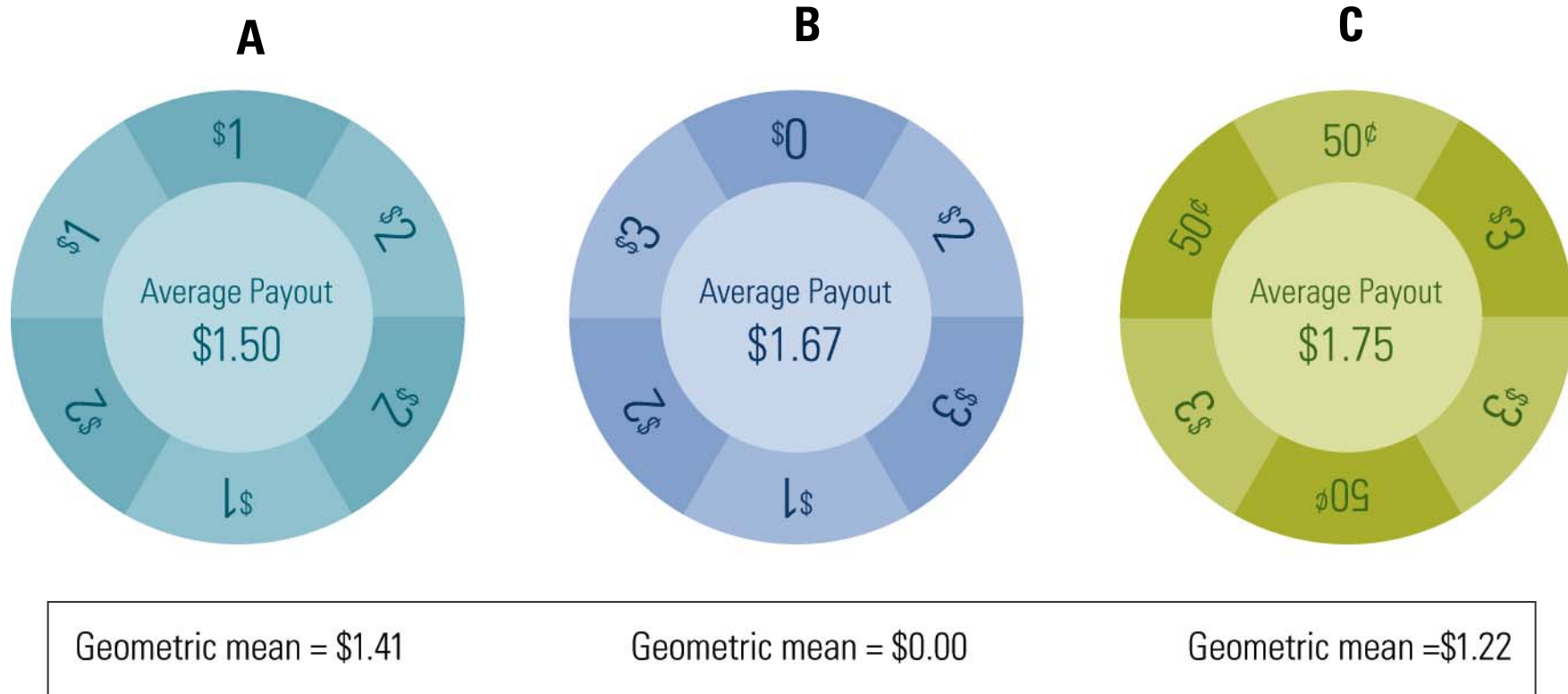
B



C



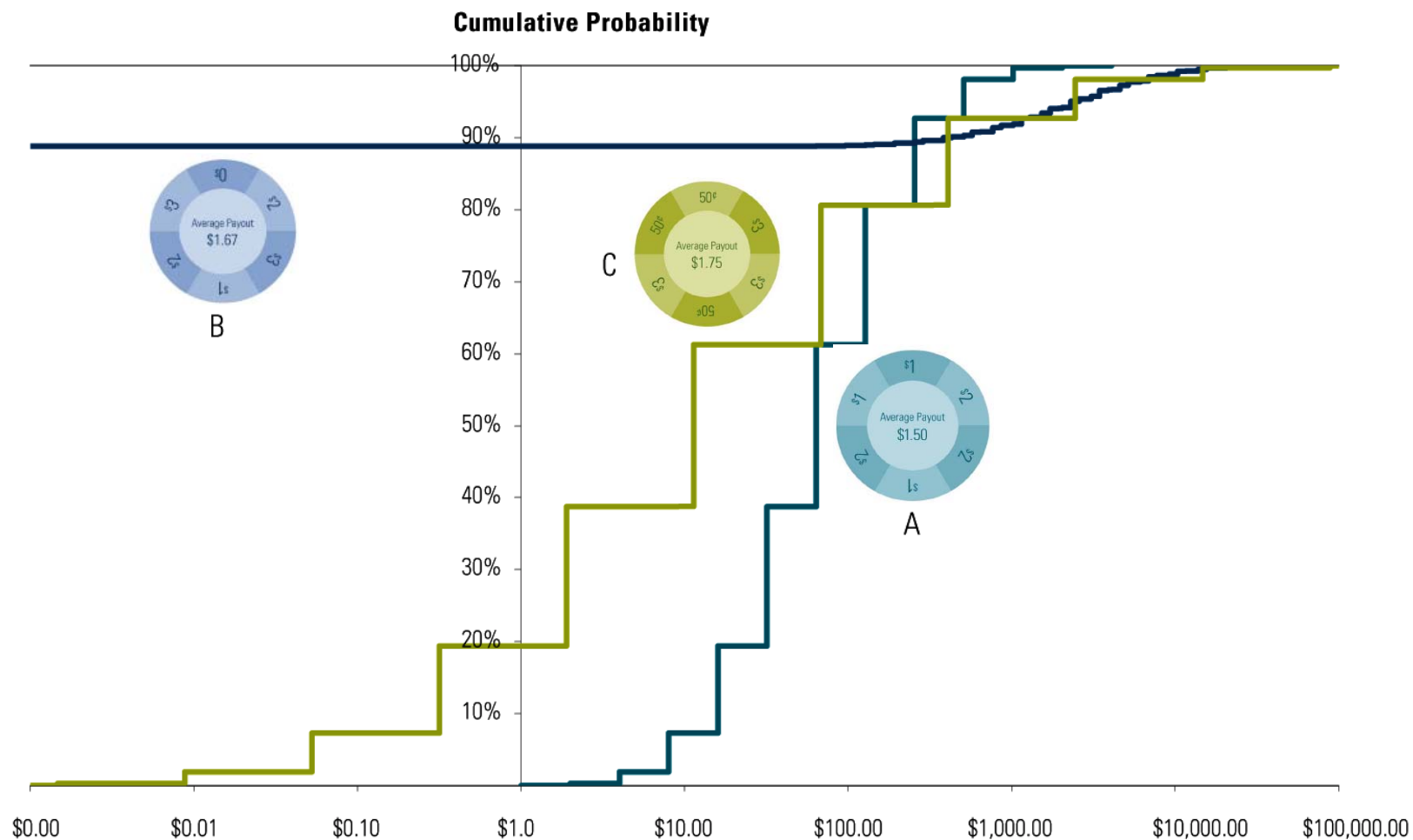
Meet the Choices



Kelly Criterion:
Rank Alternatives by Geometric Mean

Why the Kelly Criterion Works

Cumulative Probability Distribution after Reinvesting 12 Times



Building A Better Optimizer

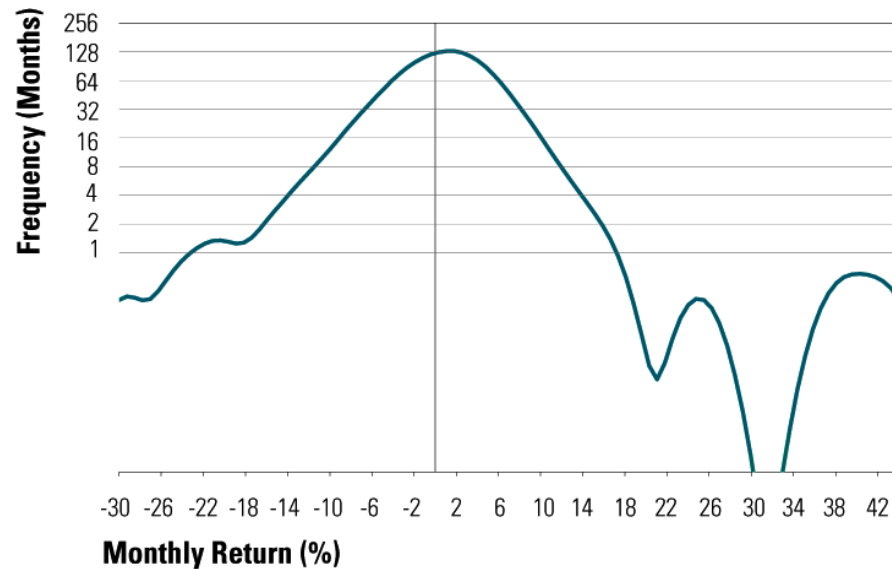
Issue	Markowitz 1.0	Markowitz 2.0
Return Distributions	Mean-Variance Framework (No fat tails)	Scenarios + Smoothing (Fat tails possible)
Return Covariation	Correlation Matrix Linear	Scenarios + Smoothing Nonlinear (e.g. options)
Investment Horizon	Single Period Arithmetic Mean	Multiperiod (Kelly Criterion) Geometric Mean
Risk Measure	Standard Deviation	Conditional Value at Risk

Scenario Approach to Modeling Return Distributions

Scenario #	Economic Conditions	Stock Market Return	Bond Market Return	Real Estate Return	60/30/10 Mix
1	Low Inflation, Low Growth	5%	4%	4%	4.6%
2	Low Inflation, High Growth	15%	6%	11%	11.9%
3	High Inflation, Low Growth	-12%	-8%	-2%	-9.8%
4	High Inflation, High Growth	6%	0%	3%	3.9%

In practice, 1,000 or more scenarios typical so that fat tails and nonlinear covariations adequately modeled

Smoothing



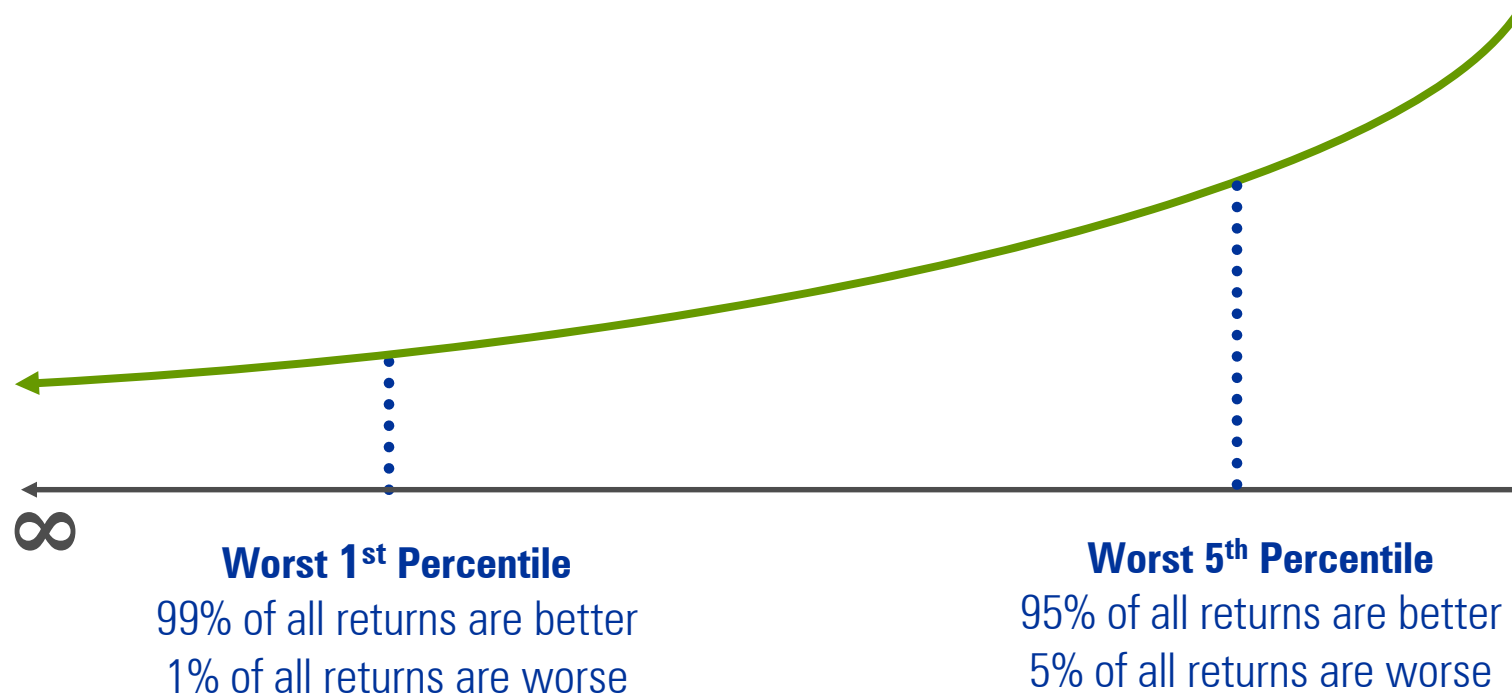
- ▶ Each scenario return a randomly chosen mean of a normal distribution
- ▶ Normal components maintain correlation structure of scenario model
- ▶ Resulting distributions smooth curves
 - ▶ Richer set of outcomes than scenario returns alone
 - ▶ Desirable mathematical properties

Risk Measurement

- ▶ Value at Risk (VaR) describes the tail in terms of how much capital can be lost over a given period of time
- ▶ A 5% VaR answers a question of the form
 - ▶ Having invested 10,000 euros, there is a 5% chance of losing X euros in T months. What is X?
- ▶ Conditional Value at Risk (CVaR) is the expected loss of capital should VaR be breached
- ▶ $CVaR > VaR$
- ▶ VaR & CVaR depend on the investment horizon

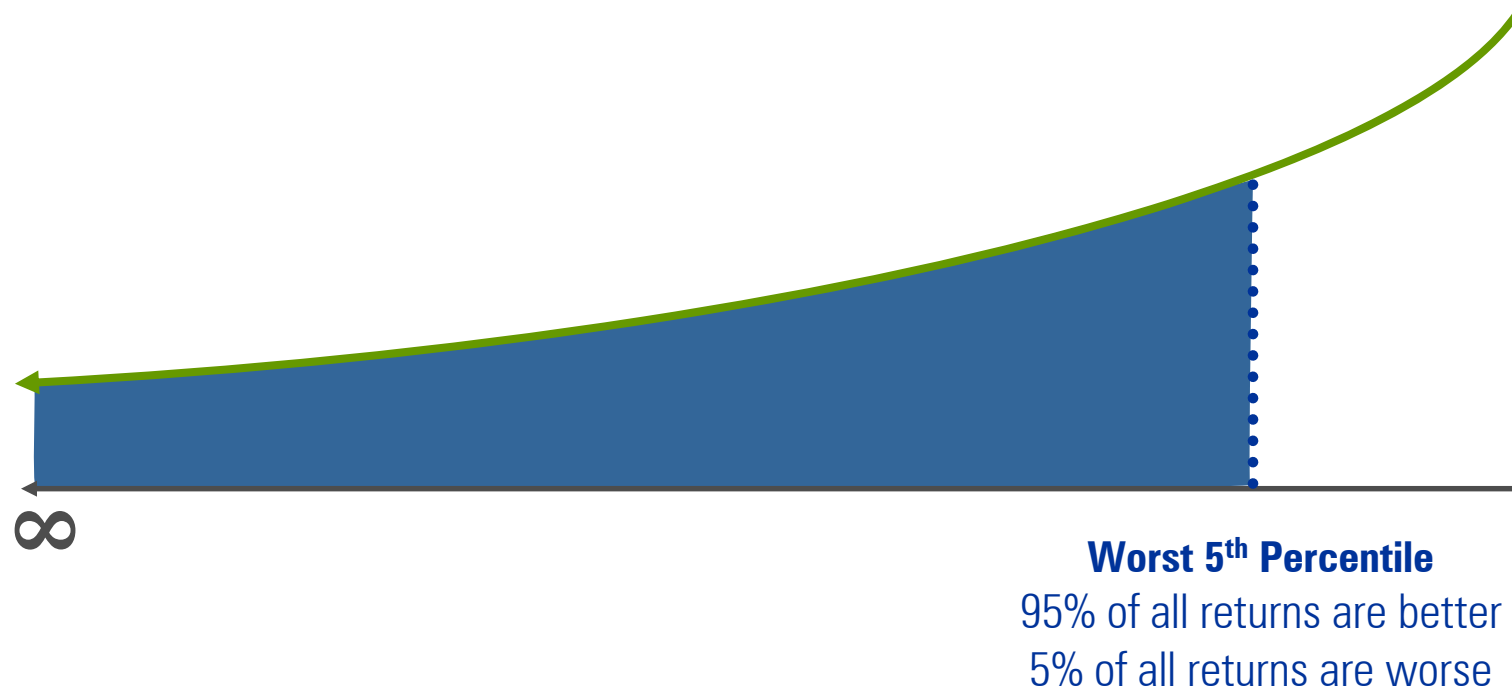
Value-at-Risk (VaR)

VaR identifies the return at a specific point (e.g. 1st or 5th percentile)



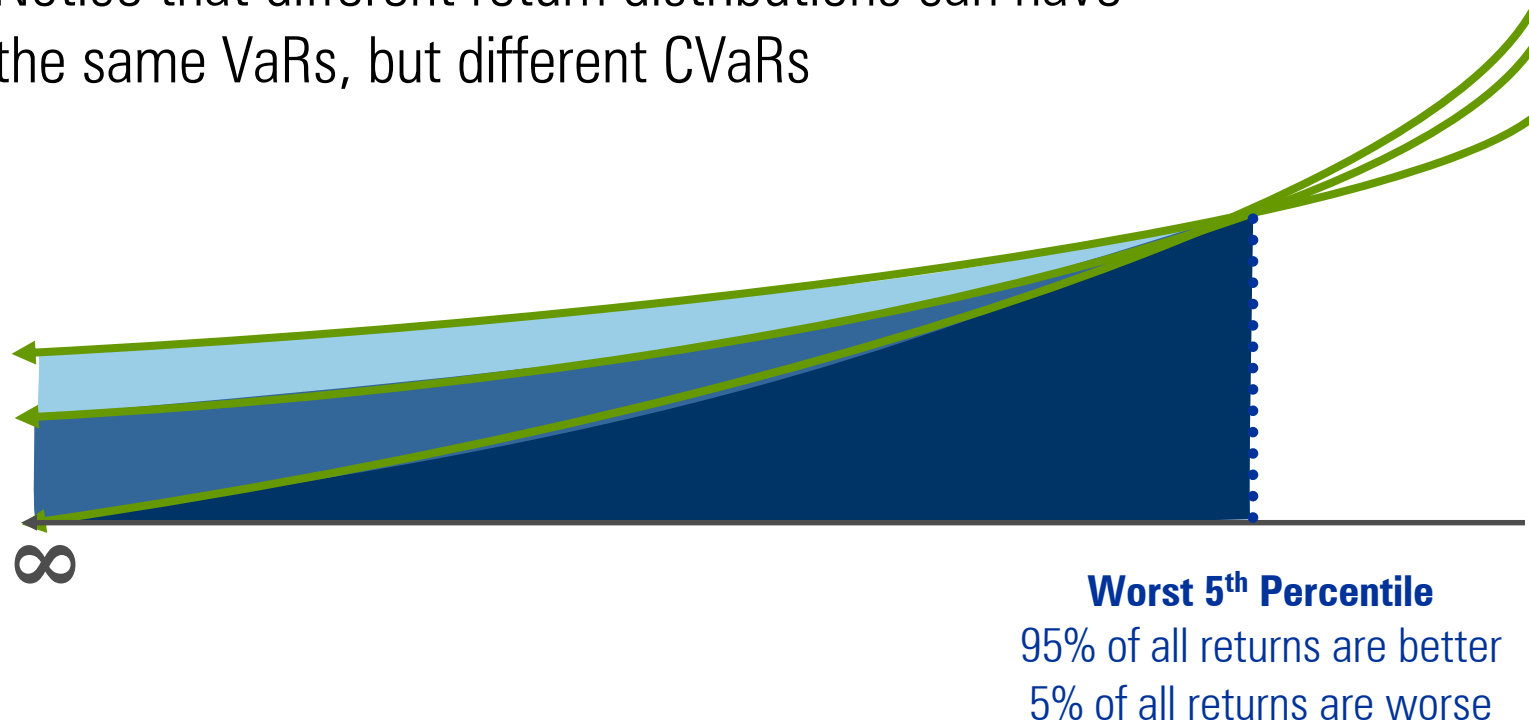
Conditional Value-at-Risk (CVaR)

CVaR identifies the probability weighted return of the **entire tail**

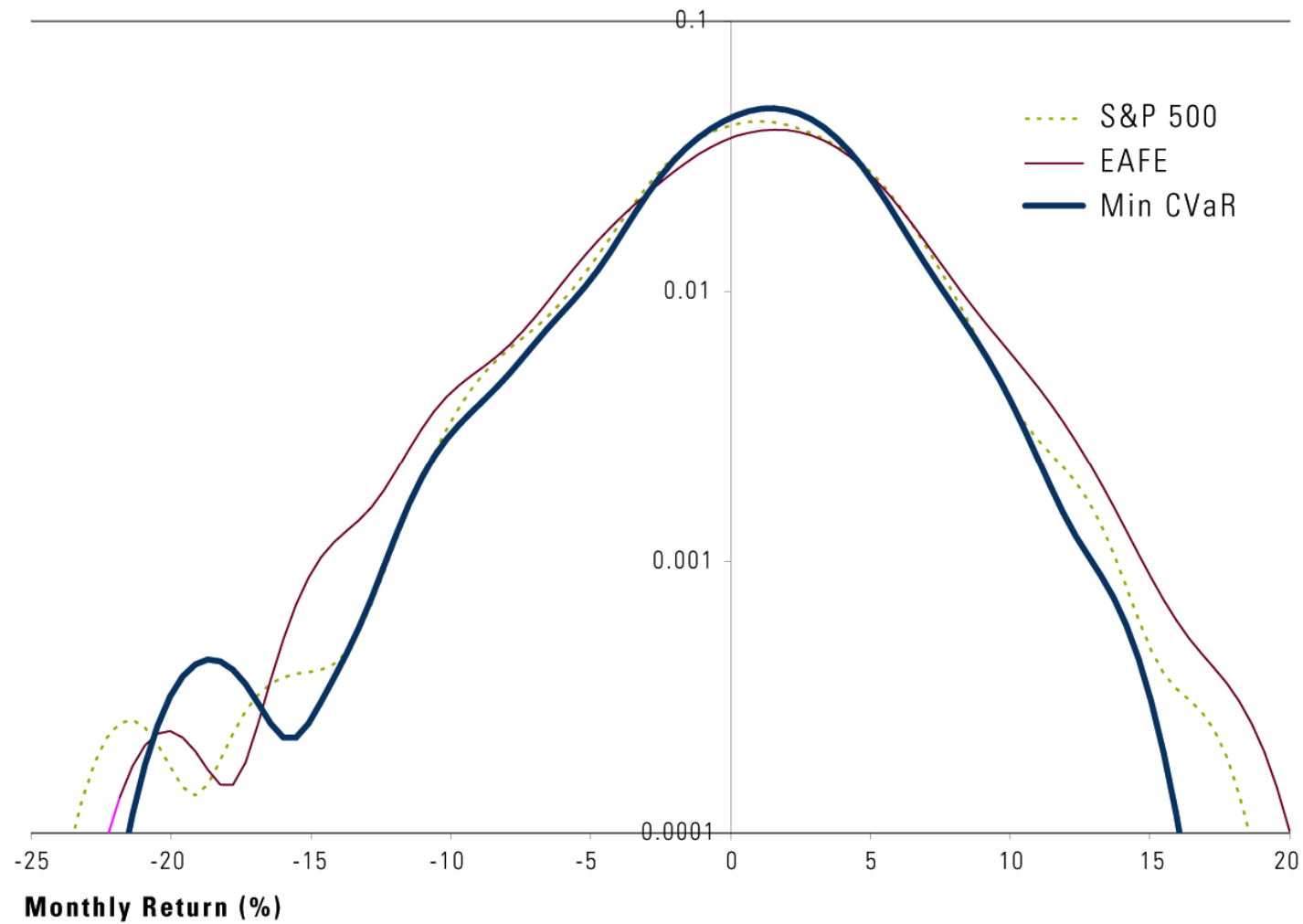


CVaR vs. VaR

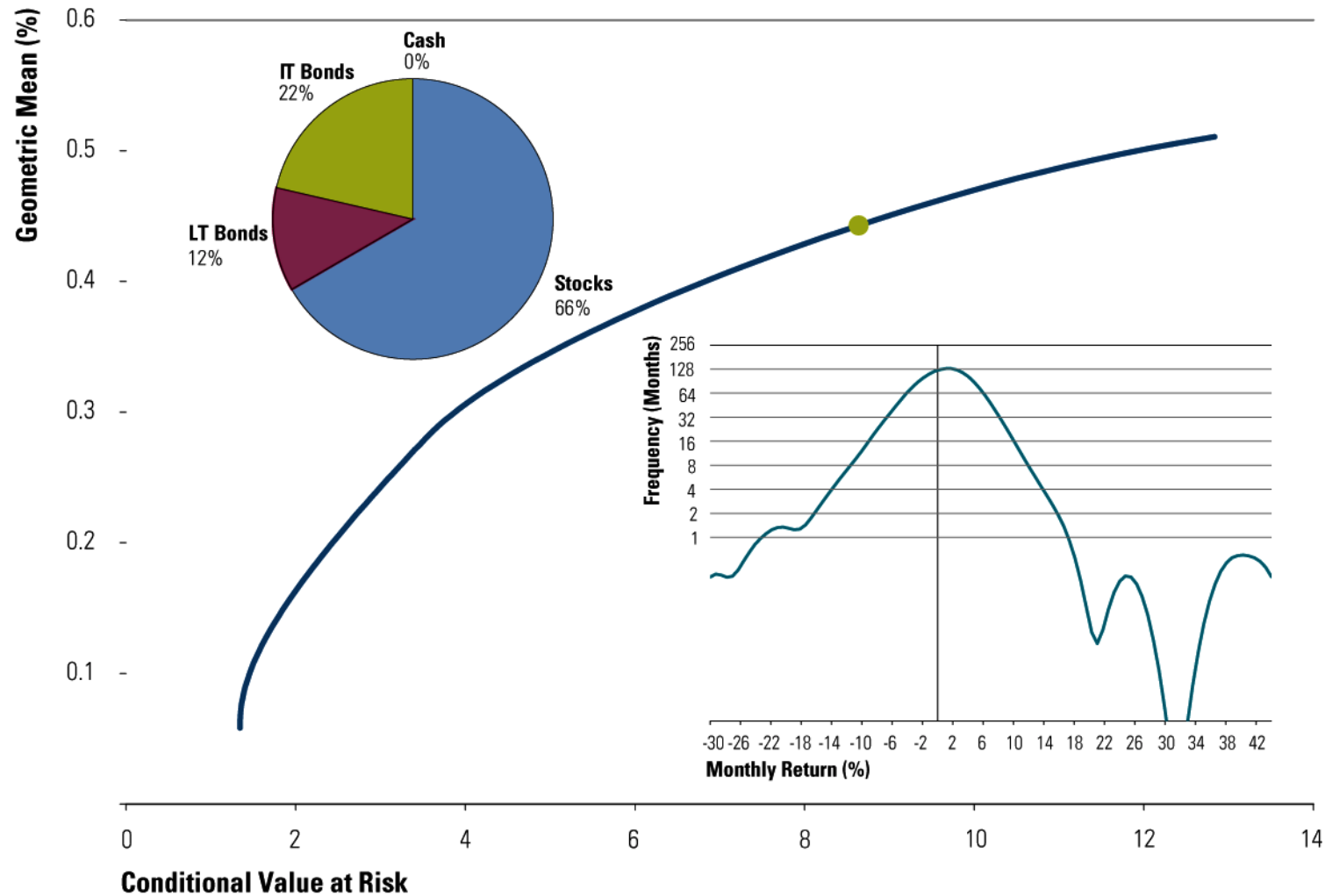
Notice that different return distributions can have the same VaRs, but different CVaRs



Minimizing Conditional Value at Risk



The Markowitz 2.0 Efficient Frontier



Scenario Libraries for Asset Allocation



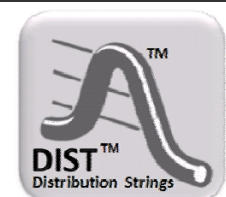
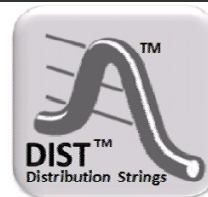
**Stock
Expert**

**Bond
Expert**

**R.E.
Expert**

Scenario #	Economic Conditions	Stock Market Return	Bond Market Return	Real Estate Return
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4	High Inflation, High Growth	6%	0%	3%

**Coherent
Scenario
Library**



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