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# Building Portfolios in a Non-Normal World

► **Paul D. Kaplan, Ph.D., CFA**

Quantitative Research Director, Morningstar Europe, Ltd.

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**“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

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## The Black Turkey



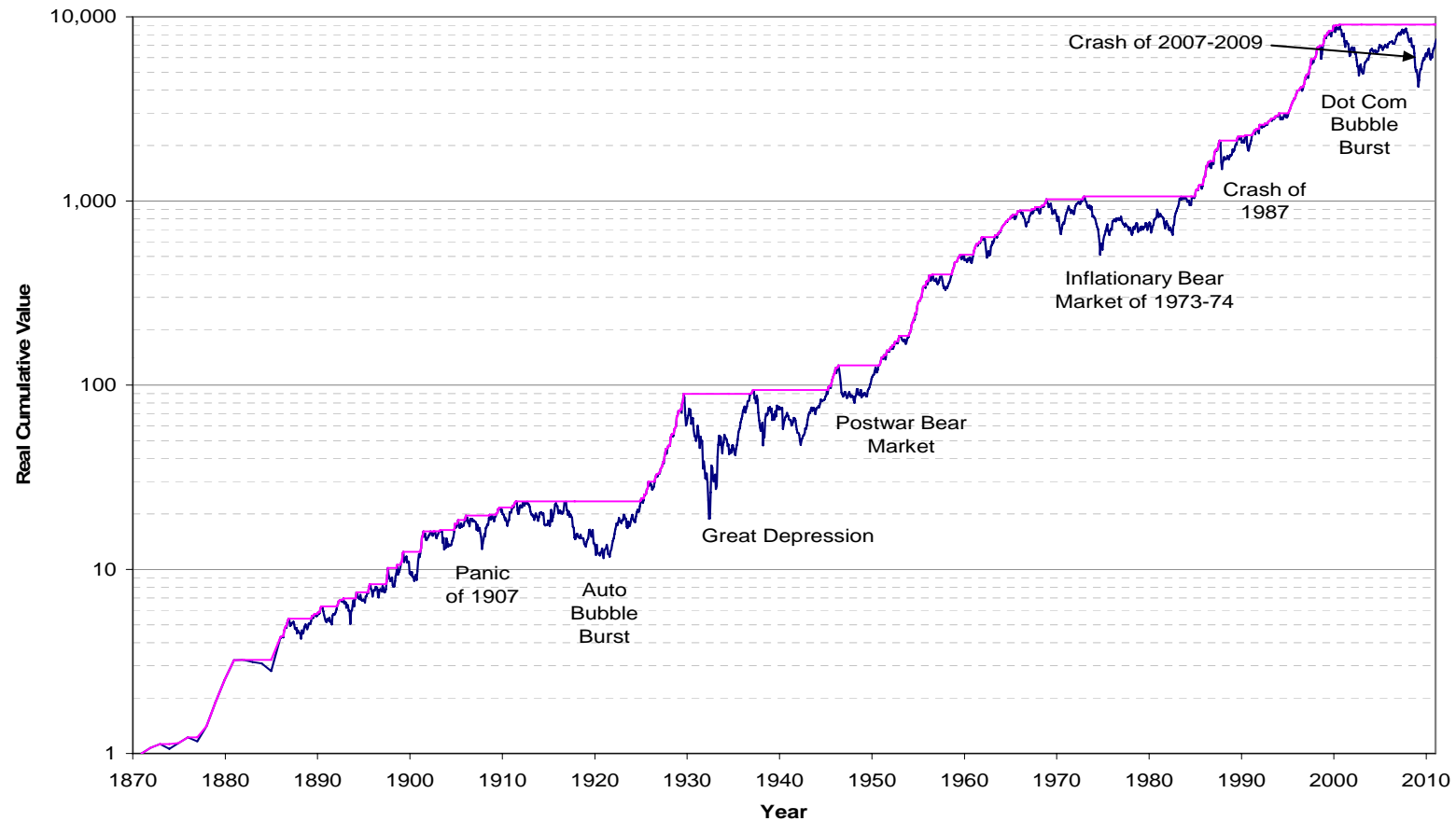
- ▶ “An event that is *entirely consistent with past data* but that no one thought would happen” Larry Siegel

## A Flock of Turkeys

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

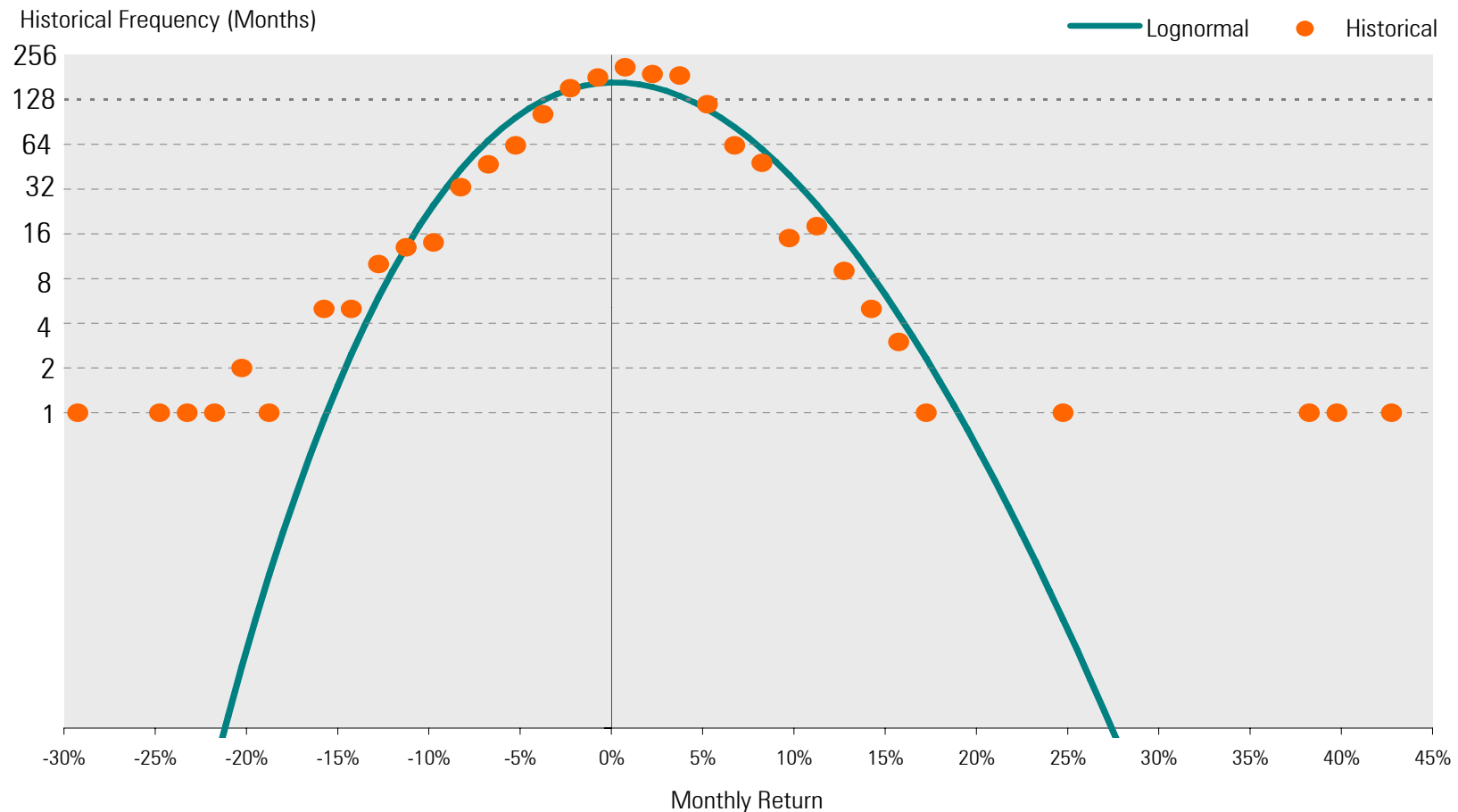
Nominal price return unless otherwise specified.

# U.S. Stock Market History, 1871 – April 2011



Source: 2011 *Ibbotson Stocks, Bonds, Bills, and Inflation (S&P) Classic Yearbook*, Morningstar, Inc. Morningstar EnCorr. Goetzmann, William N., Roger G. Ibbotson, and Liang Peng, "A New Historical Database for the NYSE 1815 to 1925: Performance and Predictability," *Journal of Financial Markets*, December 2000. Pierce, Phyllis S., ed., *The Dow Jones Averages, 1885—1980*, Homewood, IL: Dow Jones Irwin, 1982. [www.econ.yale.edu/~shiller/data.htm](http://www.econ.yale.edu/~shiller/data.htm).

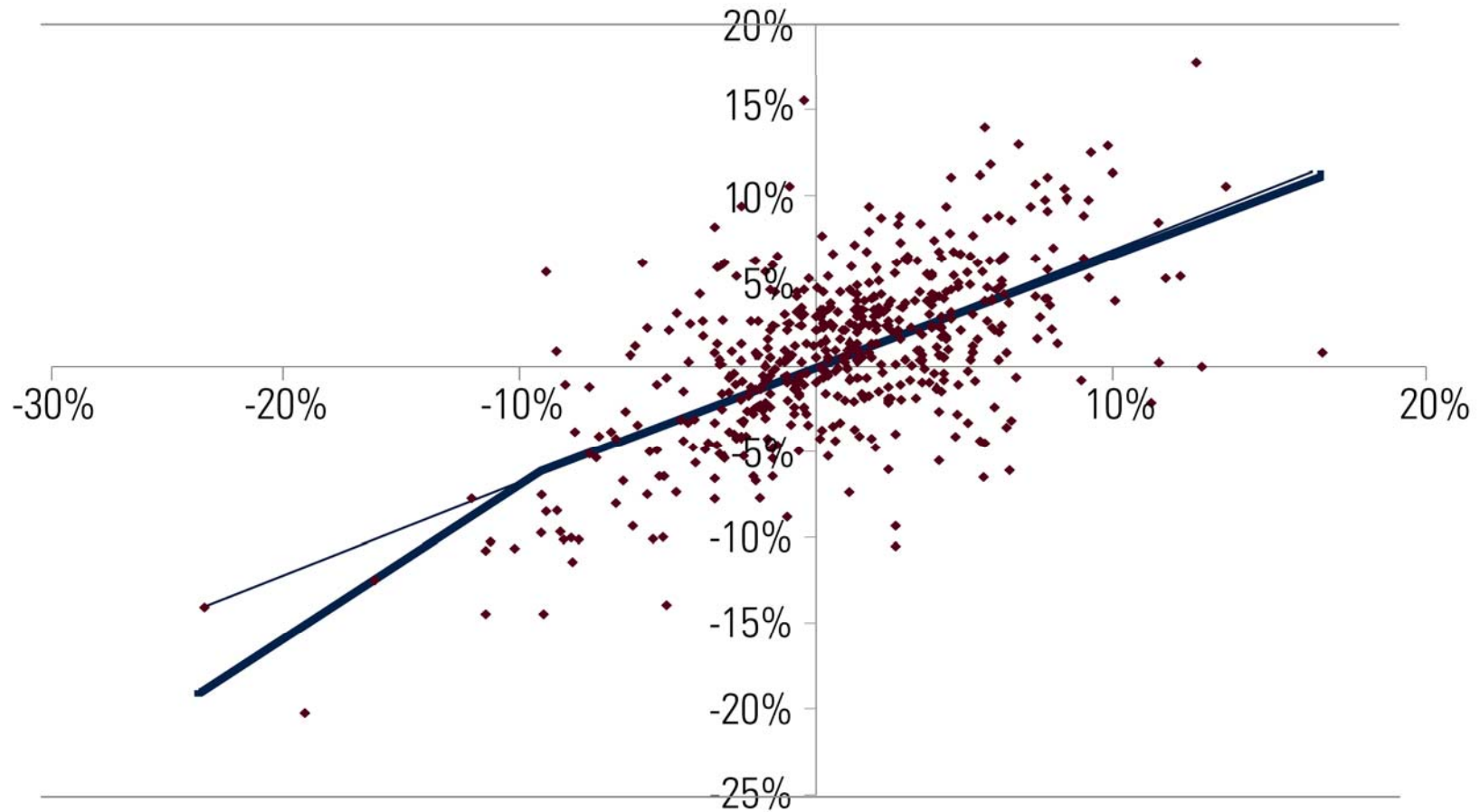
# Cracks in the Bell Curve: U.S. Real Monthly Returns, January 1886 – April 2011



Source: 2011 Ibbotson Stocks, Bonds, Bills, and Inflation (SBBBI) Classic Yearbook, Morningstar, Inc. Morningstar EnCorr. Goetzmann, William N., Roger G. Ibbotson, and Liang Peng, "A New Historical Database for the NYSE 1815 to 1925: Performance and Predictability," *Journal of Financial Markets*, December 2000. Pierce, Phyllis S., ed., *The Dow Jones Averages, 1885—1980*, Homewood, IL: Dow Jones Irwin, 1982. [www.econ.yale.edu/~shiller/data.htm](http://www.econ.yale.edu/~shiller/data.htm).

## Covariation of Returns: Linear or Nonlinear?

S&P 500 vs. EAFE, Monthly Total Returns: Jan. 1970 – Sep. 2010



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## Limitations of Mean-Variance Analysis

- ▶ Fat tails in returns not modeled
- ▶ Covariation of returns assumed linear, cannot handle optionality
- ▶ Single period investment horizon (arithmetic mean)
- ▶ Risk measured by volatility



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## Building A Better Optimizer

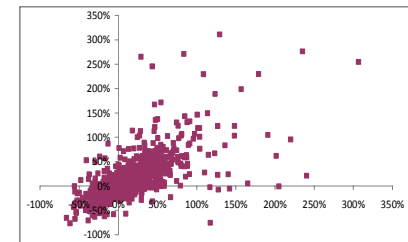
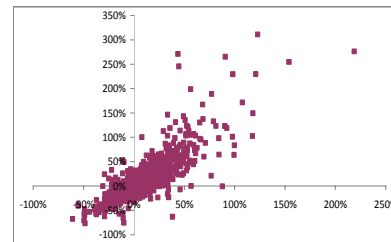
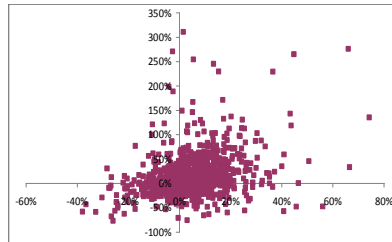
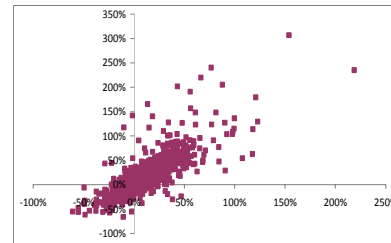
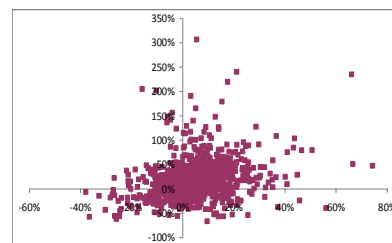
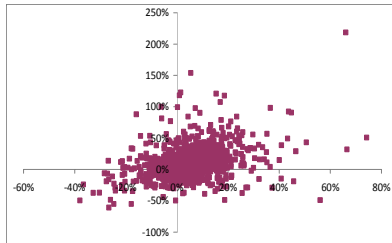
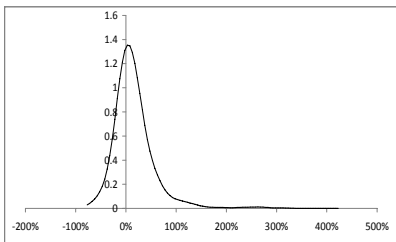
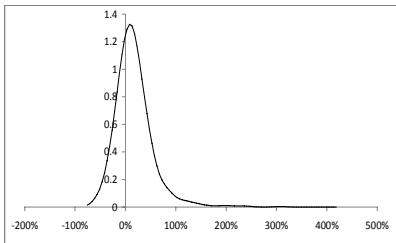
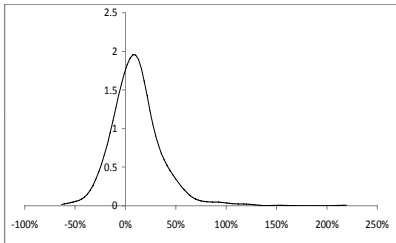
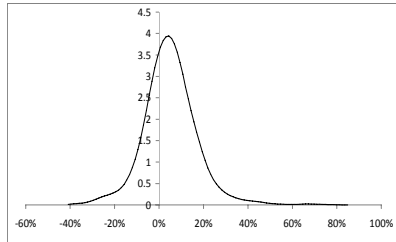
Issue	Markowitz 1.0	Markowitz 2.0
Return Distributions	Mean-Variance Framework (No fat tails)	Scenarios + Smoothing (Fat tails possible)
Return Covariation	Correlation Matrix Linear	Scenarios + Smoothing Nonlinear (e.g. options)
Investment Horizon	Single Period Arithmetic Mean	Can use Multiperiod Kelly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

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## Markowitz 1.0 Inputs: Summary Statistics

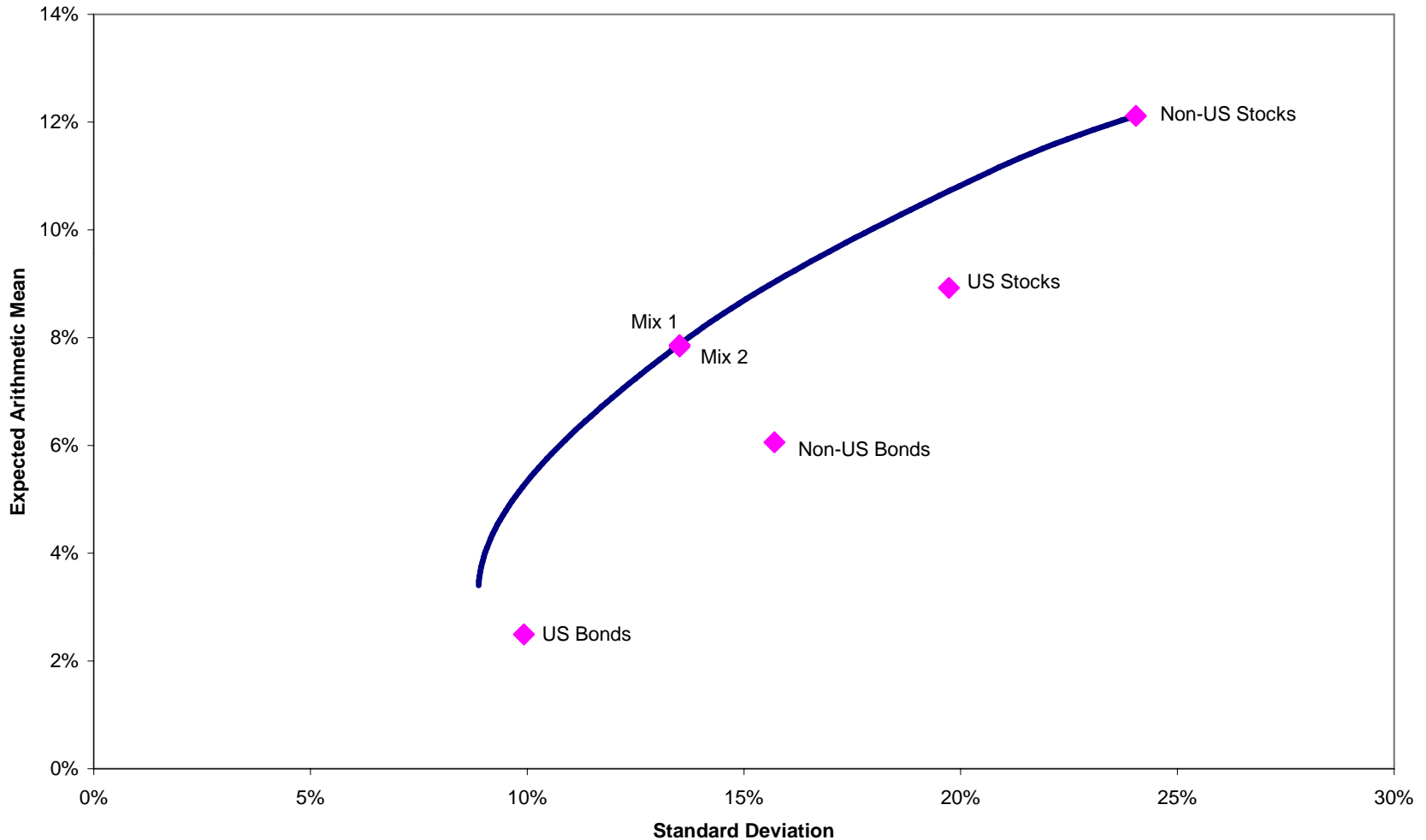
Asset Class	Expected Return	Standard Deviation	Correlation			
			1	2	3	4
A	5.00%	10.00%	1.00	0.34	0.32	0.32
B	10.00%	20.00%	0.34	1.00	0.82	0.82
C	15.00%	30.00%	0.32	0.82	1.00	0.71
D	13.00%	30.00%	0.32	0.82	0.71	1.00

# Markowitz 2.0 Inputs: Scenarios



# Markowitz 1.0

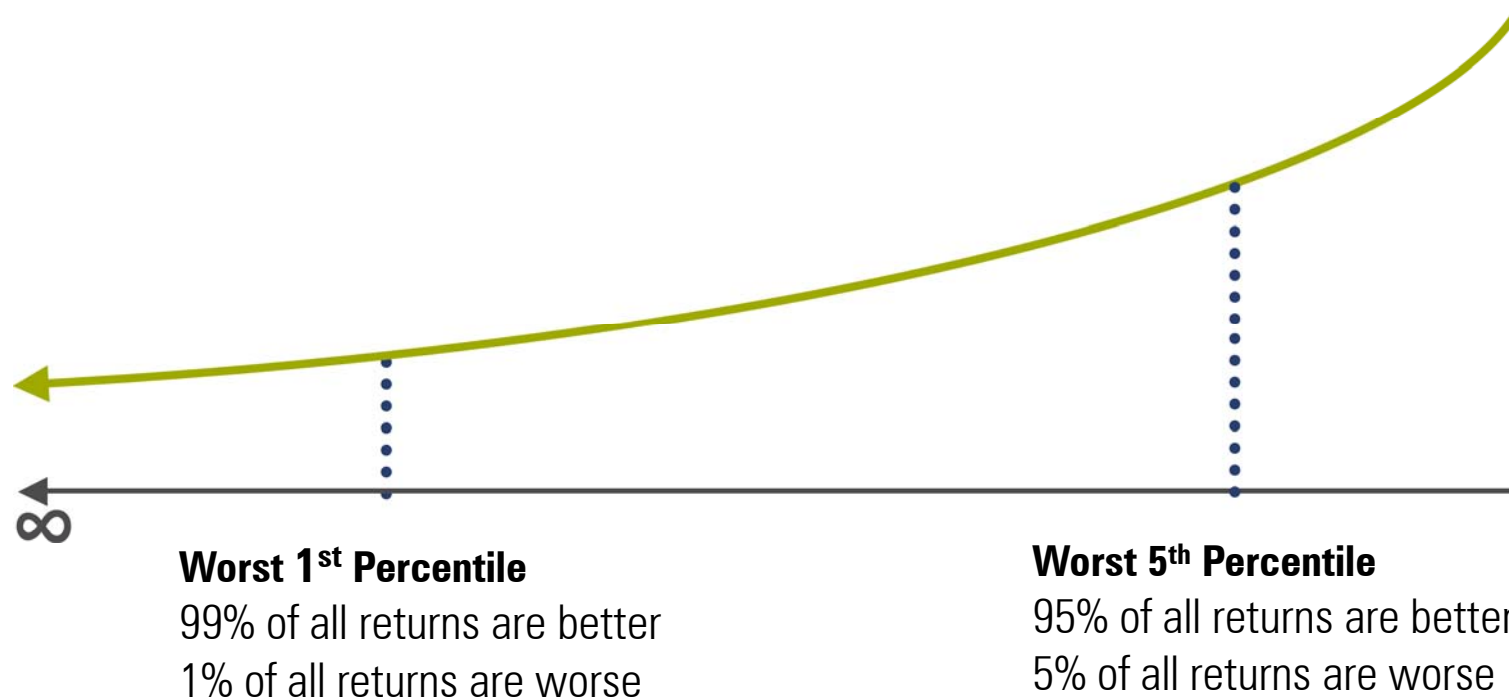
Reward = 1-Period Return, Risk = Volatility



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## Value-at-Risk (VaR)

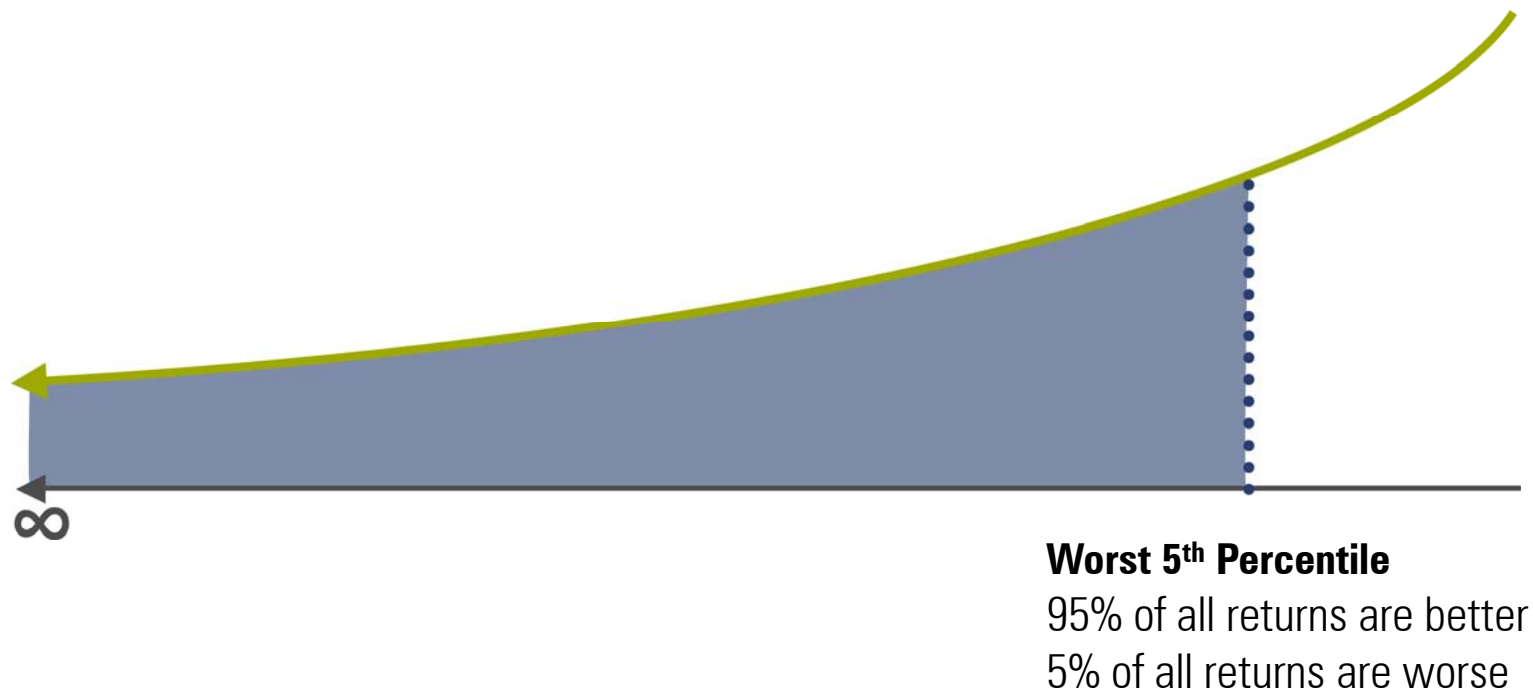
VaR identifies the return at a specific point (e.g. 1<sup>st</sup> or 5<sup>th</sup> percentile)



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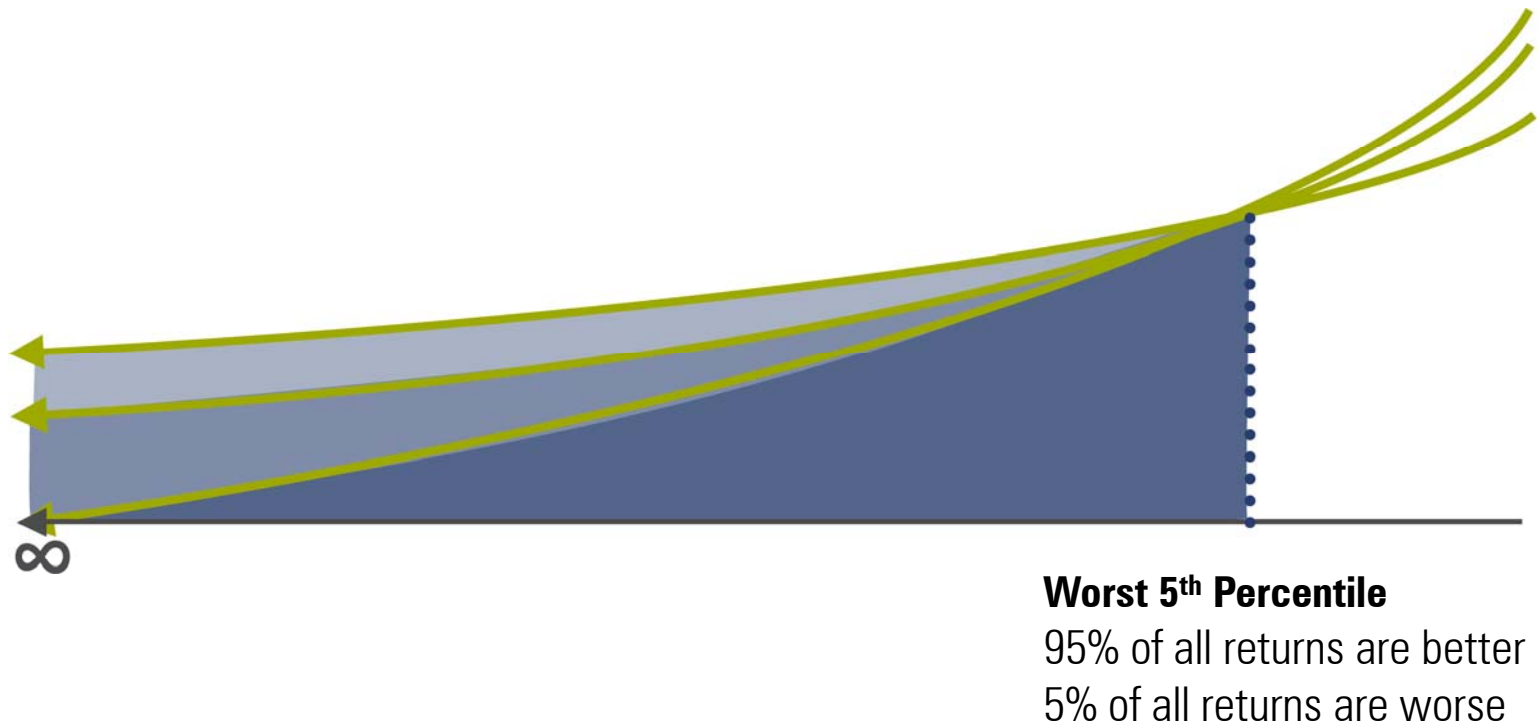
## Conditional Value-at-Risk (CVaR)

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



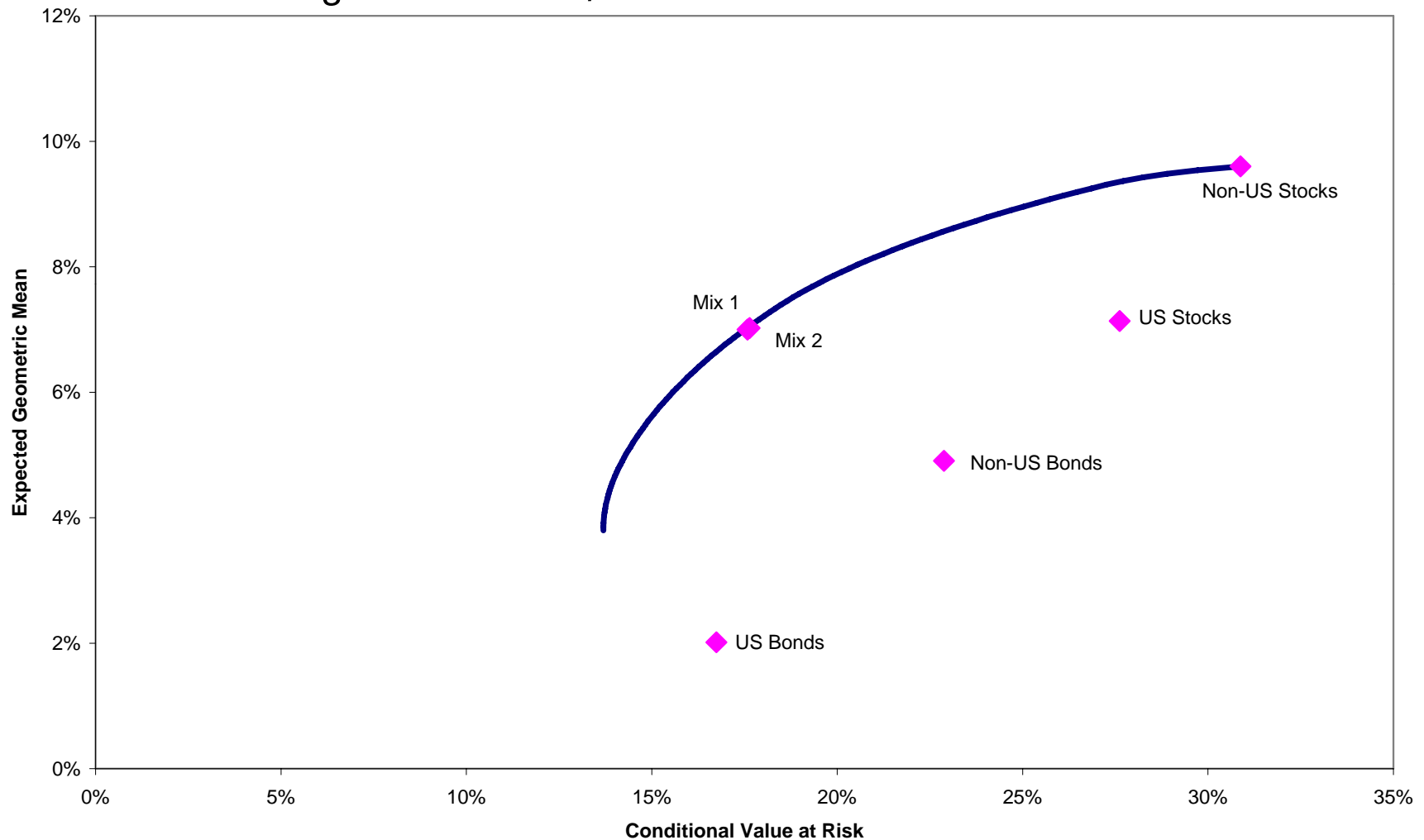
## CVaR vs. VaR

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



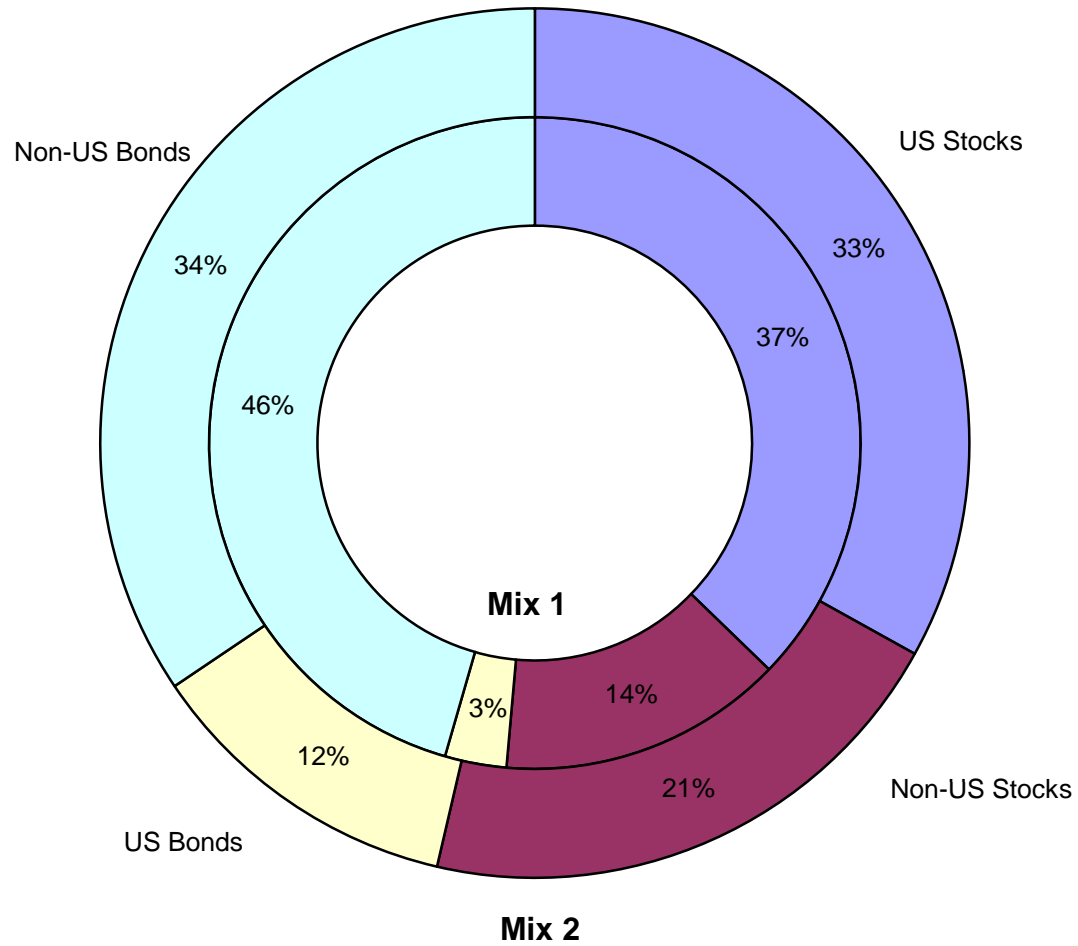
## Markowitz 2.0: More Relevant Risk & Reward Measures

Reward = Long-Term Return, Risk = How Bad is Bad

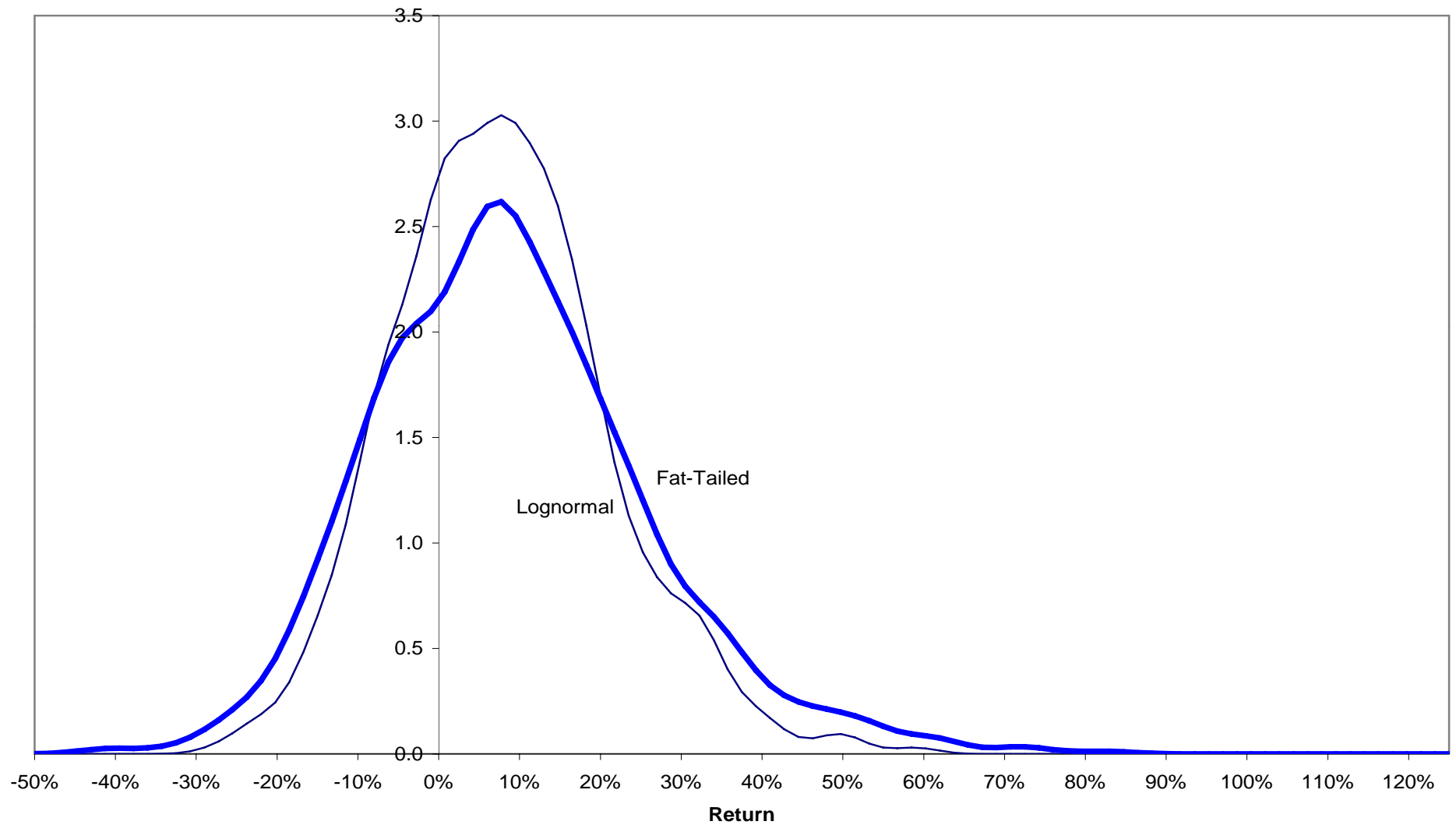




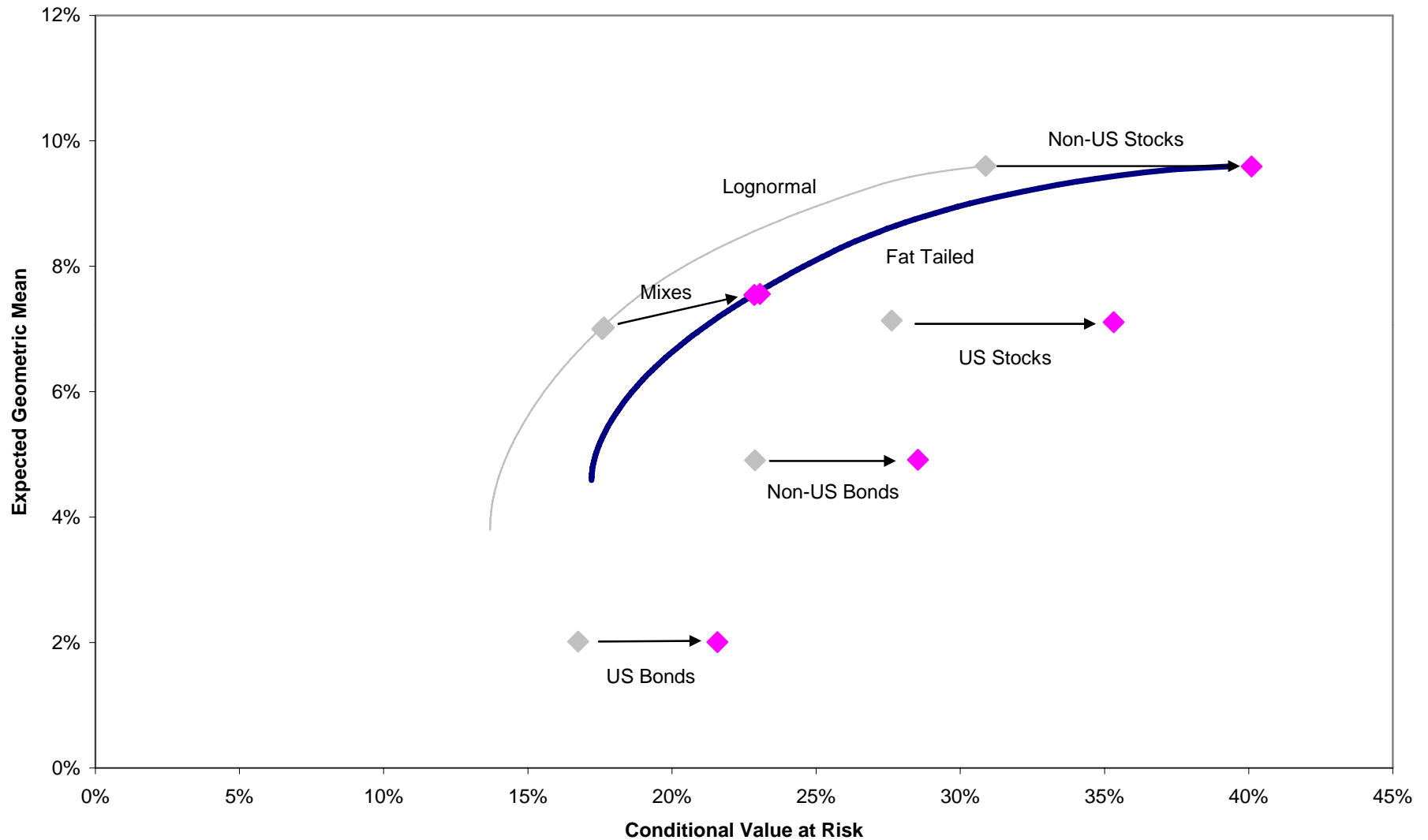
## Mixes 1 & 2



## Modeling Fat Tails: Mix 2

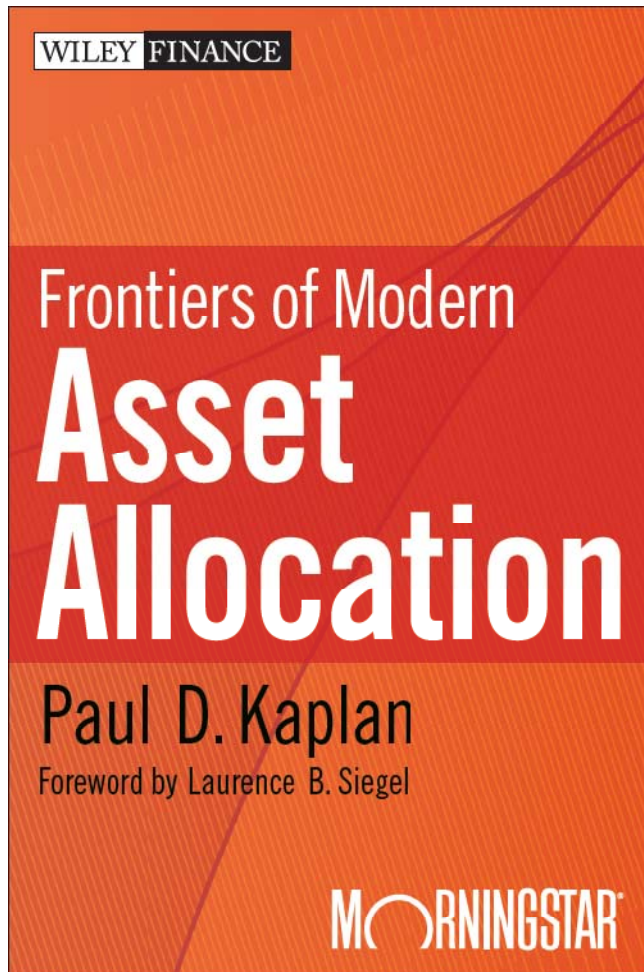


# Markowitz 2.0: Fat Tails Modeled



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## Read More About These and Other Ideas in December



"The breadth and depth of the articles in this book suggest that Paul Kaplan has been thinking about markets for about as long as markets have existed."

From the foreword

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