Real World Risk Institute

180 Years of Market Drawdowns

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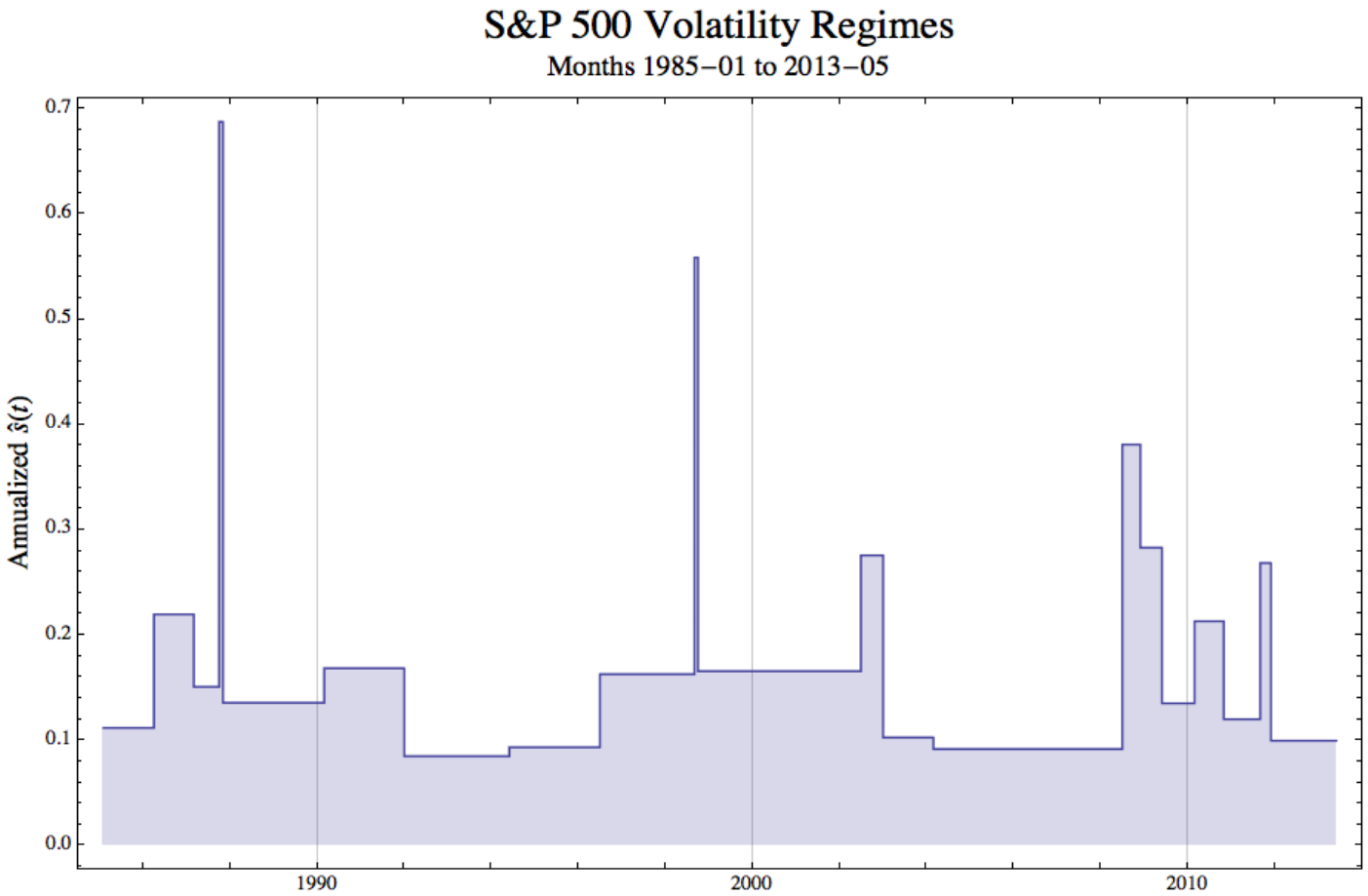
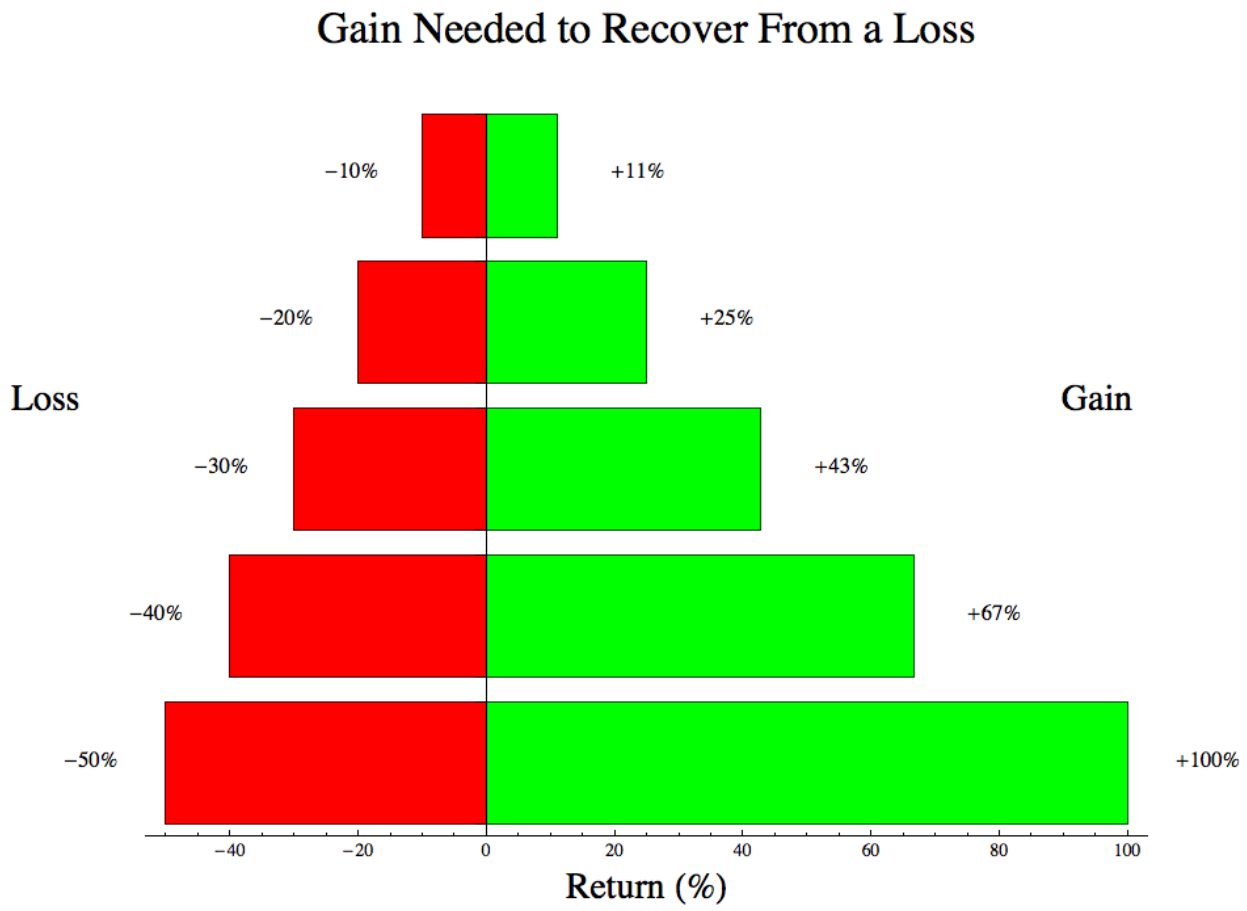
Myopia


S&P 500 Volatility Regimes
Months 1985–01 to 2013–05
Annualized $\hat{s}(t)$
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1990
2000
2010

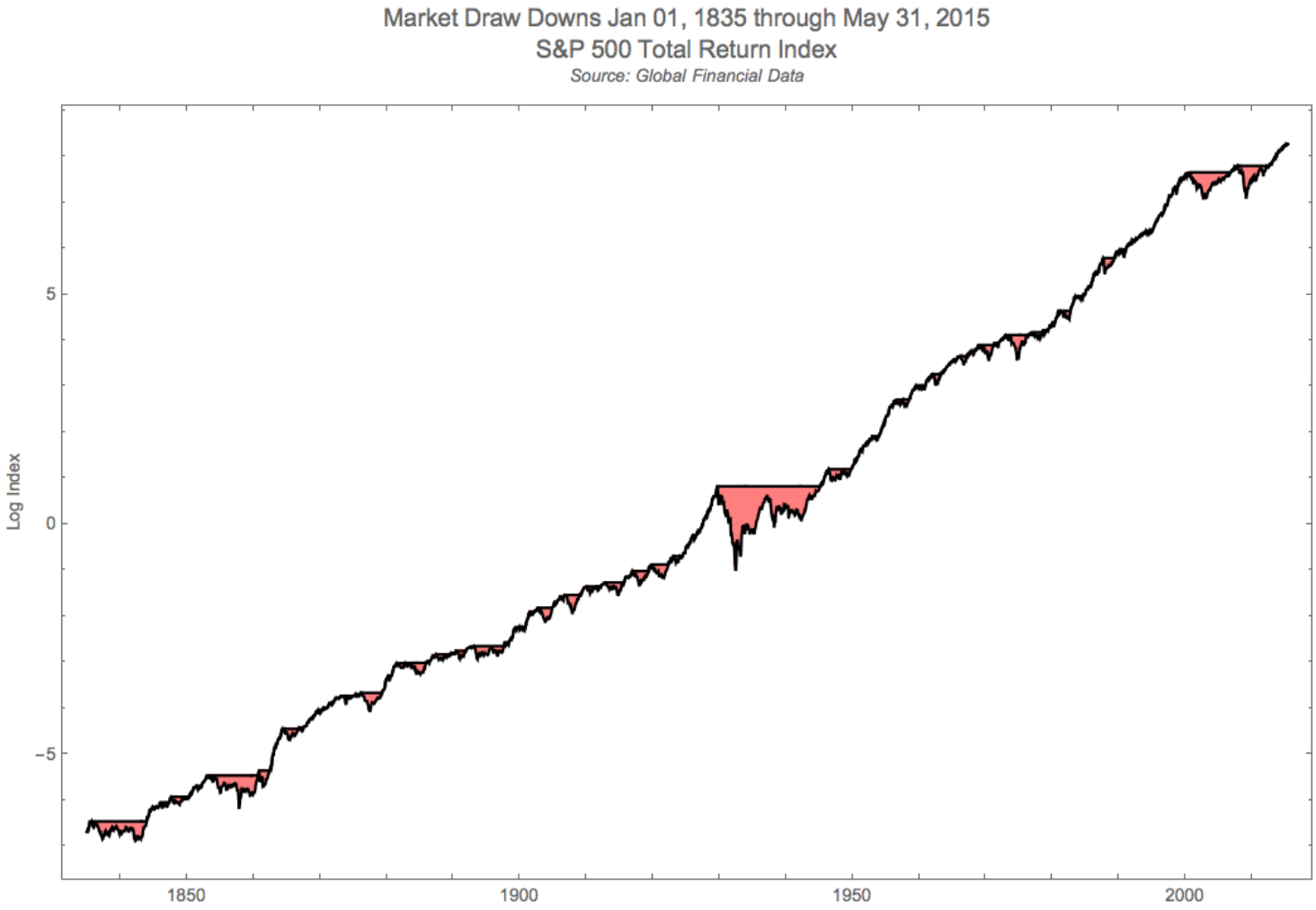
Market Drawdowns

- An investment's drawdown behavior is an important element of its behavior.
- We will focus on a single market: the S&P 500 Total Return from 1835 to 2015 (Global Financial Data).
- Questions?
  - How can drawdowns be modeled and analyzed?
  - How stable is this aspect of performance?
  - What insights can we develop examining the drawdowns in an important market over an extended period?

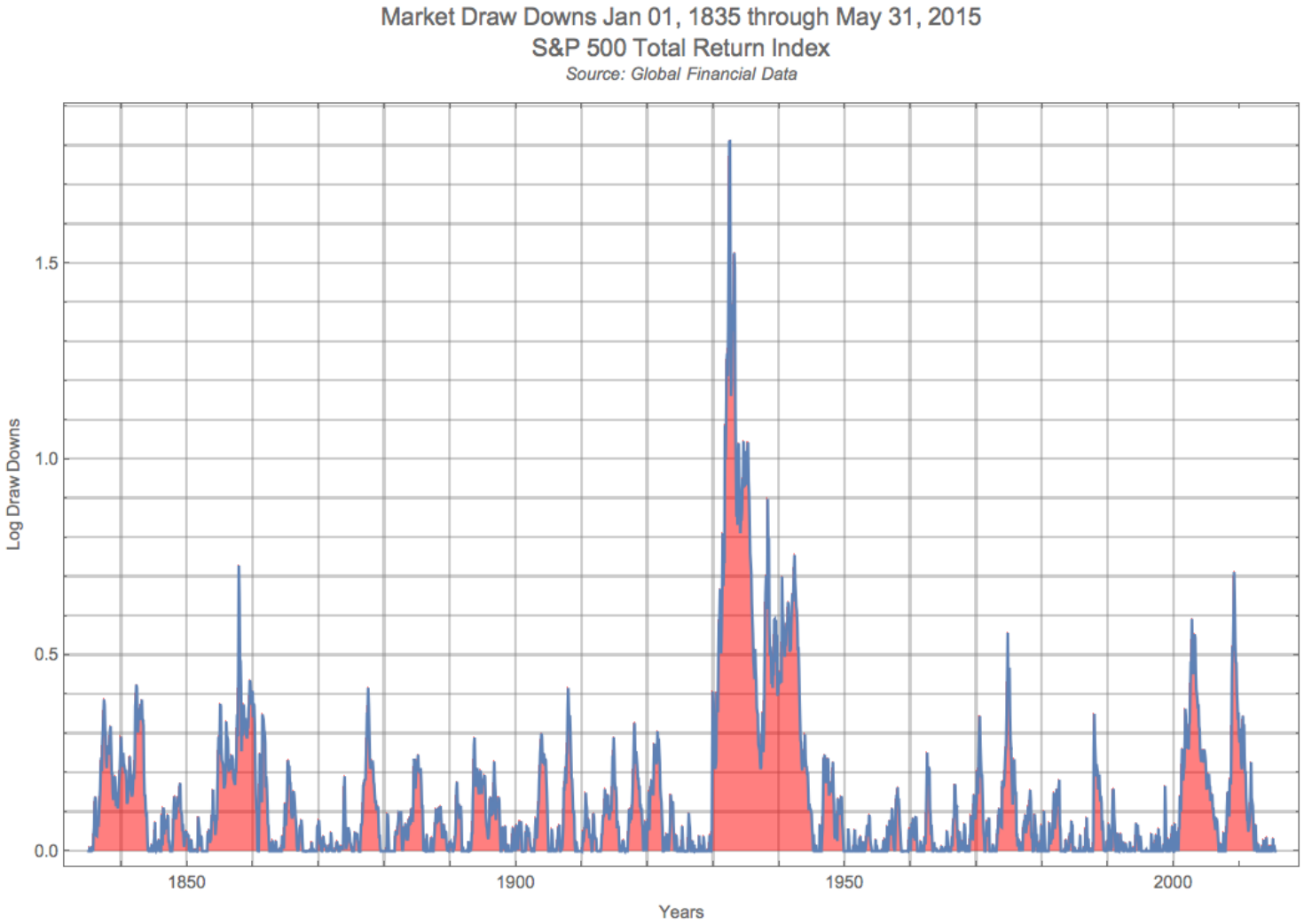
Recovery from Drawdowns



Market Drawdowns

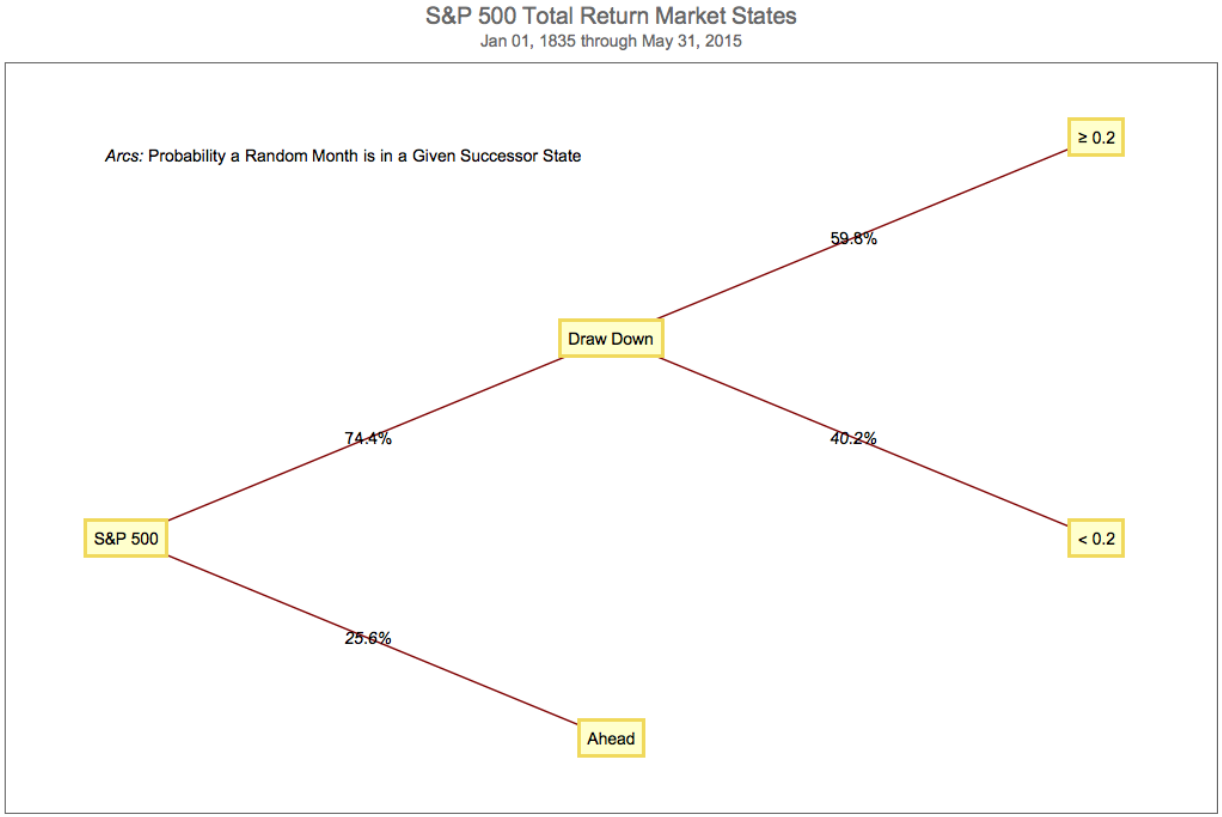


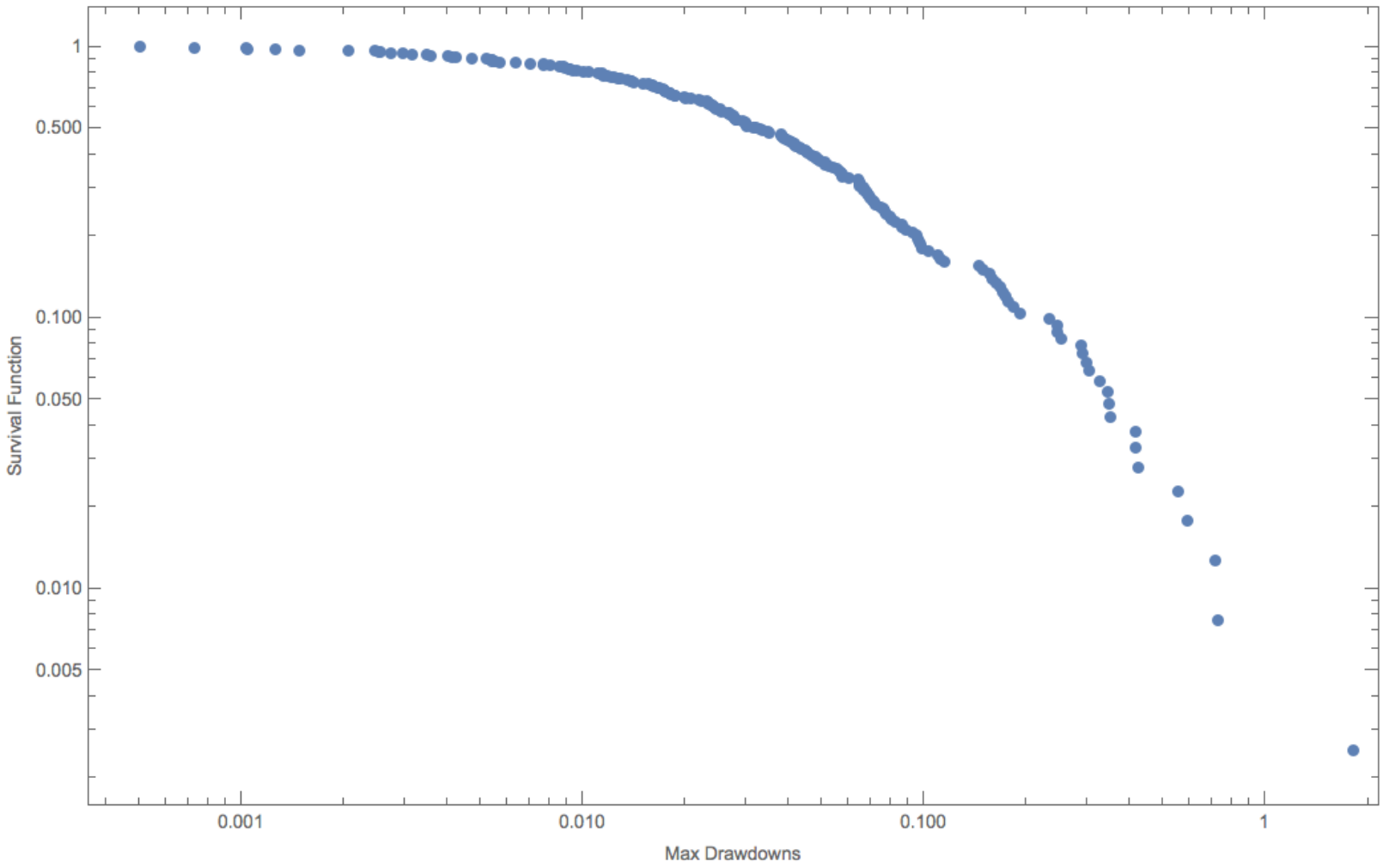
Market Drawdowns



Market Drawdowns

One spends about 75% in a drawdown state. And more than half the time in a major drawdown.




Max Drawdown Log–Log Plot Jan 01, 1835 through May 31, 2015
S&P 500 Total Return Index
Source: Global Financial Data
Survival Function
1
0.500
0.100
0.050
0.010
0.005
0.001
0.010
0.100
1
Max Drawdowns

Drawdown Distribution

- The simplest situation is to assume that the return process consists of independent identically distributed (i.i.d.) random variables.
- Fairly simple arguments, supported by simulation studies, tell us that the depth of drawdown of an i.i.d. process will be exponentially distributed.
- The data for market drawdowns are *profoundly* different.
- Recall our questions?
  - How can drawdowns be modeled and analyzed?
  - How stable is this aspect of performance?
  - What insights can we develop examining the drawdowns in an important market over an extended period?

Max Drawdown Distribution

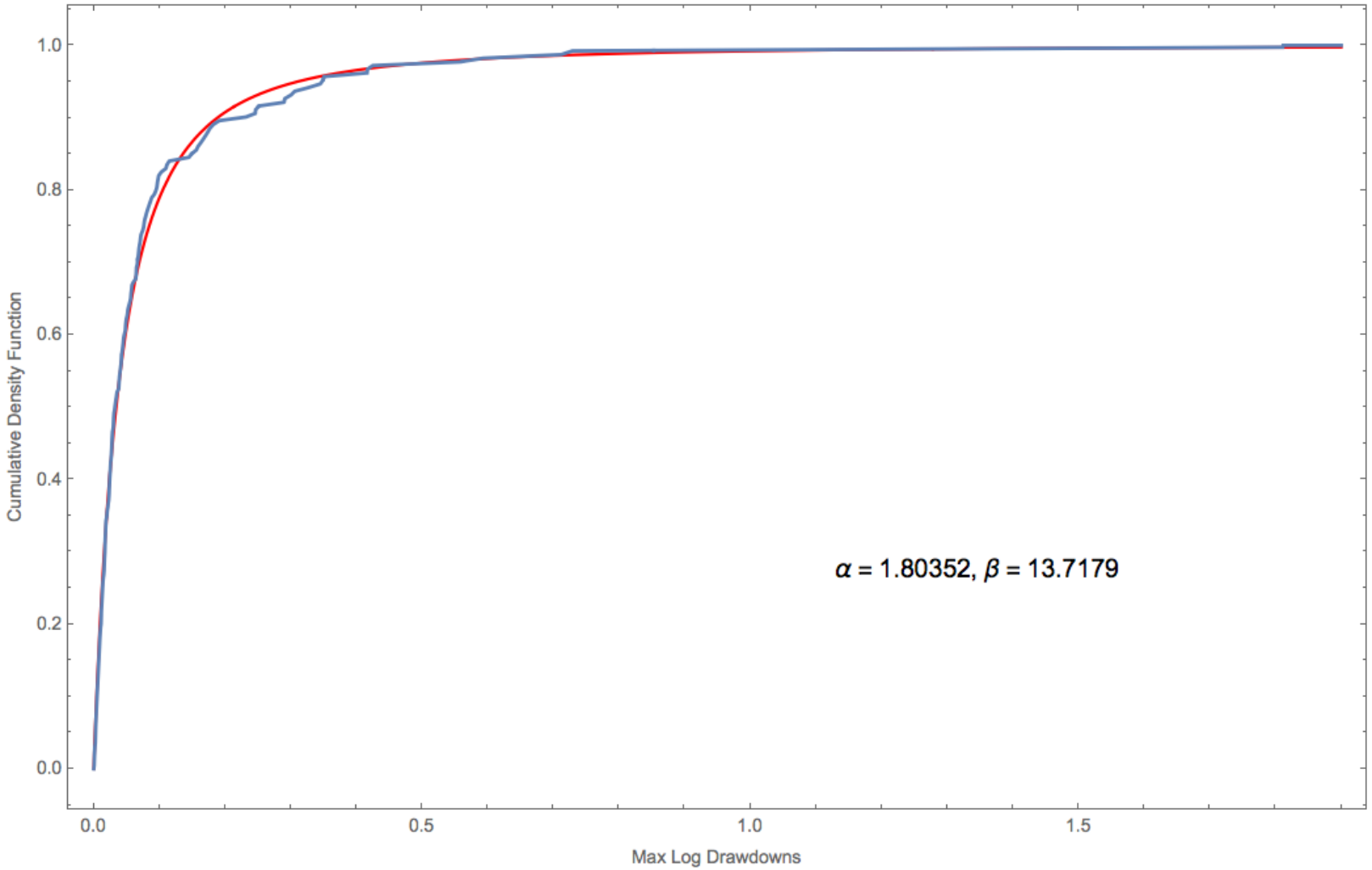
Gamma-Exponential Mixture. Gamma distribution is a maximum entropy distribution for rate parameters:

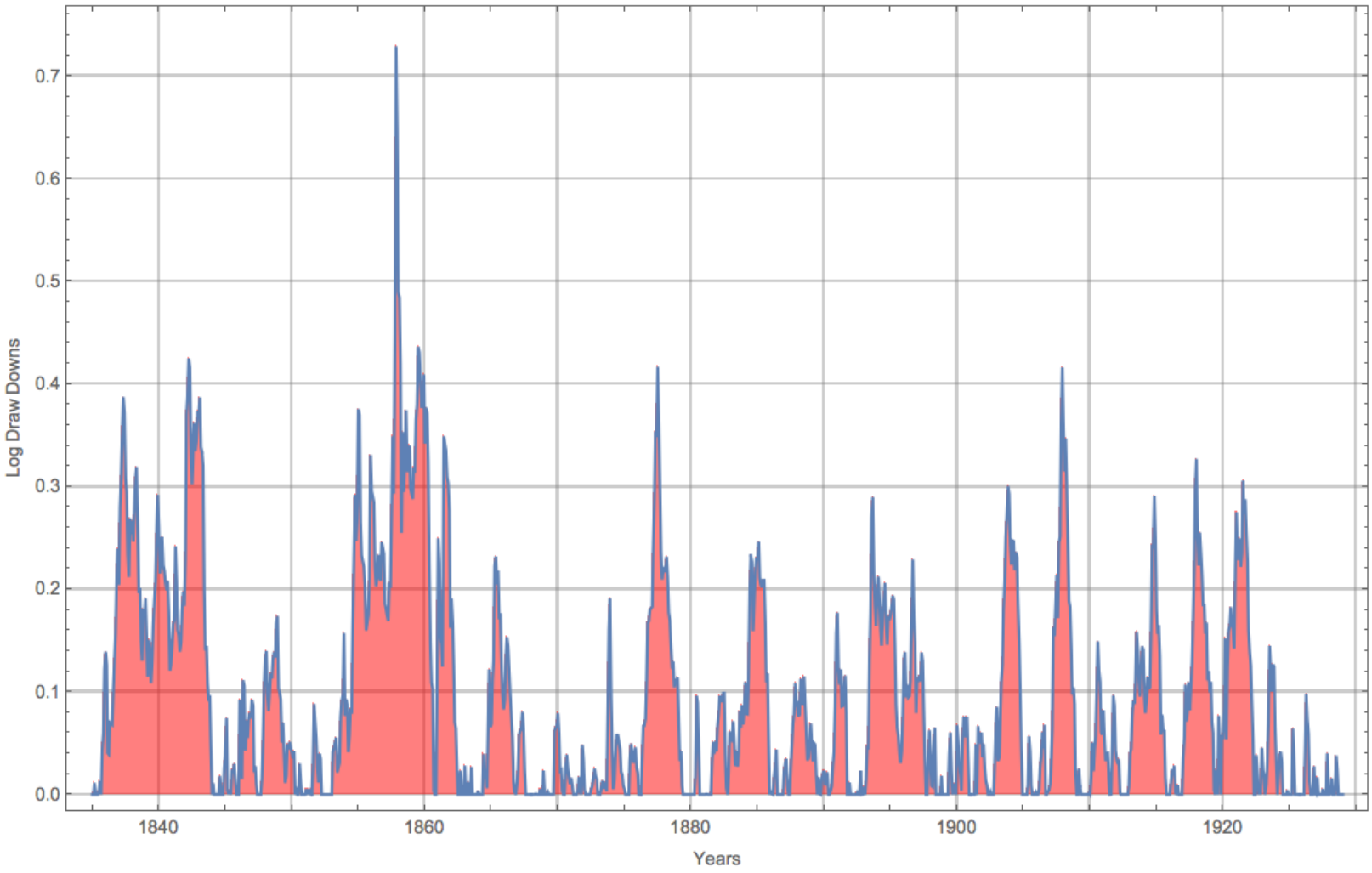
$$\int_0^\infty \left(\frac{e^{-\lambda/\beta} \beta^{-\alpha} \lambda^{-(1+\alpha)}}{\Gamma[\alpha]} \right) \left(\lambda e^{-\lambda x} \right) d\lambda$$

Result is a variant of a Pareto distribution (Lomax):

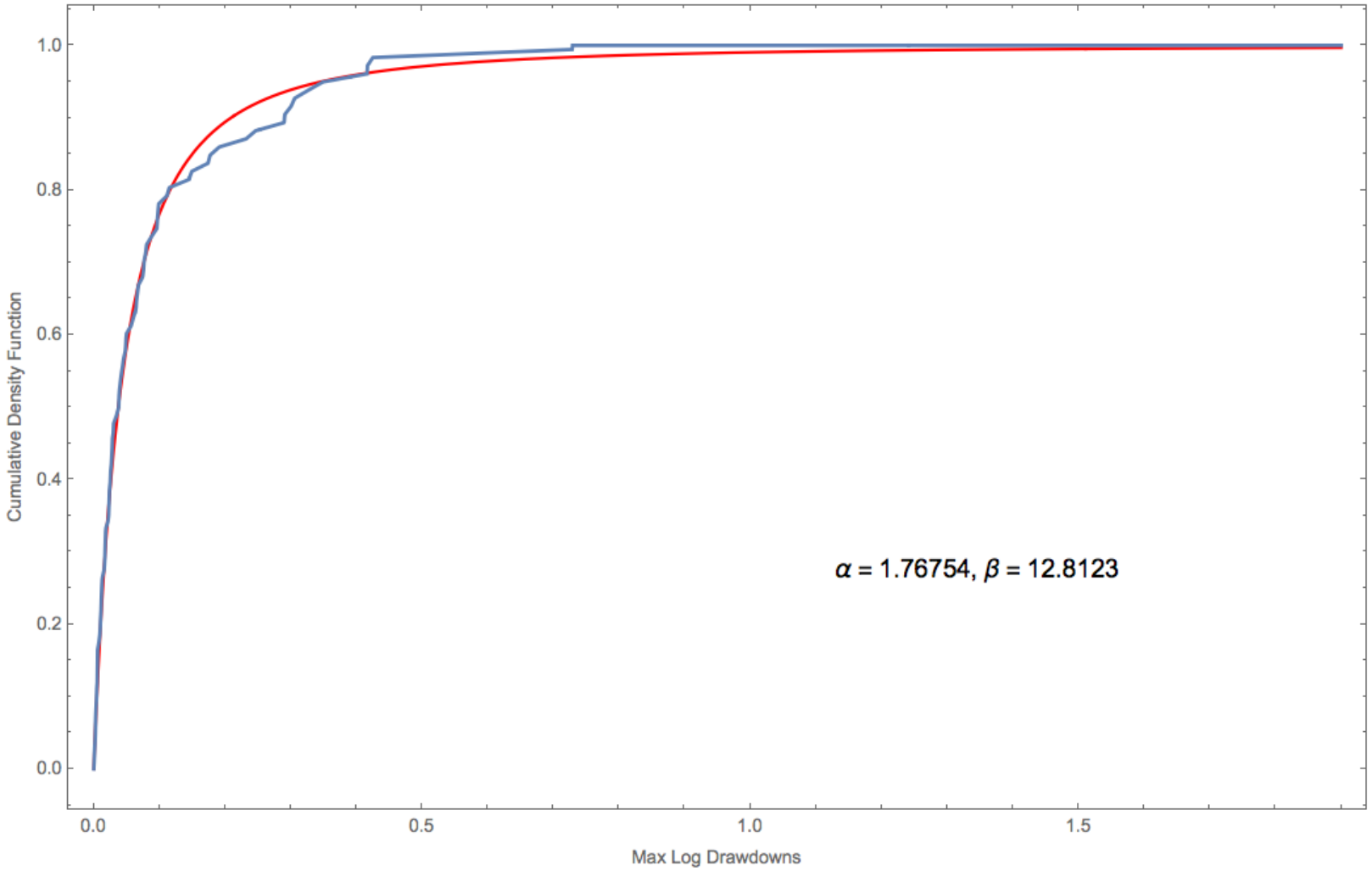
$$f_\Delta[x] = \alpha\beta \left(1 + \beta x\right)^{-(1+\alpha)}$$

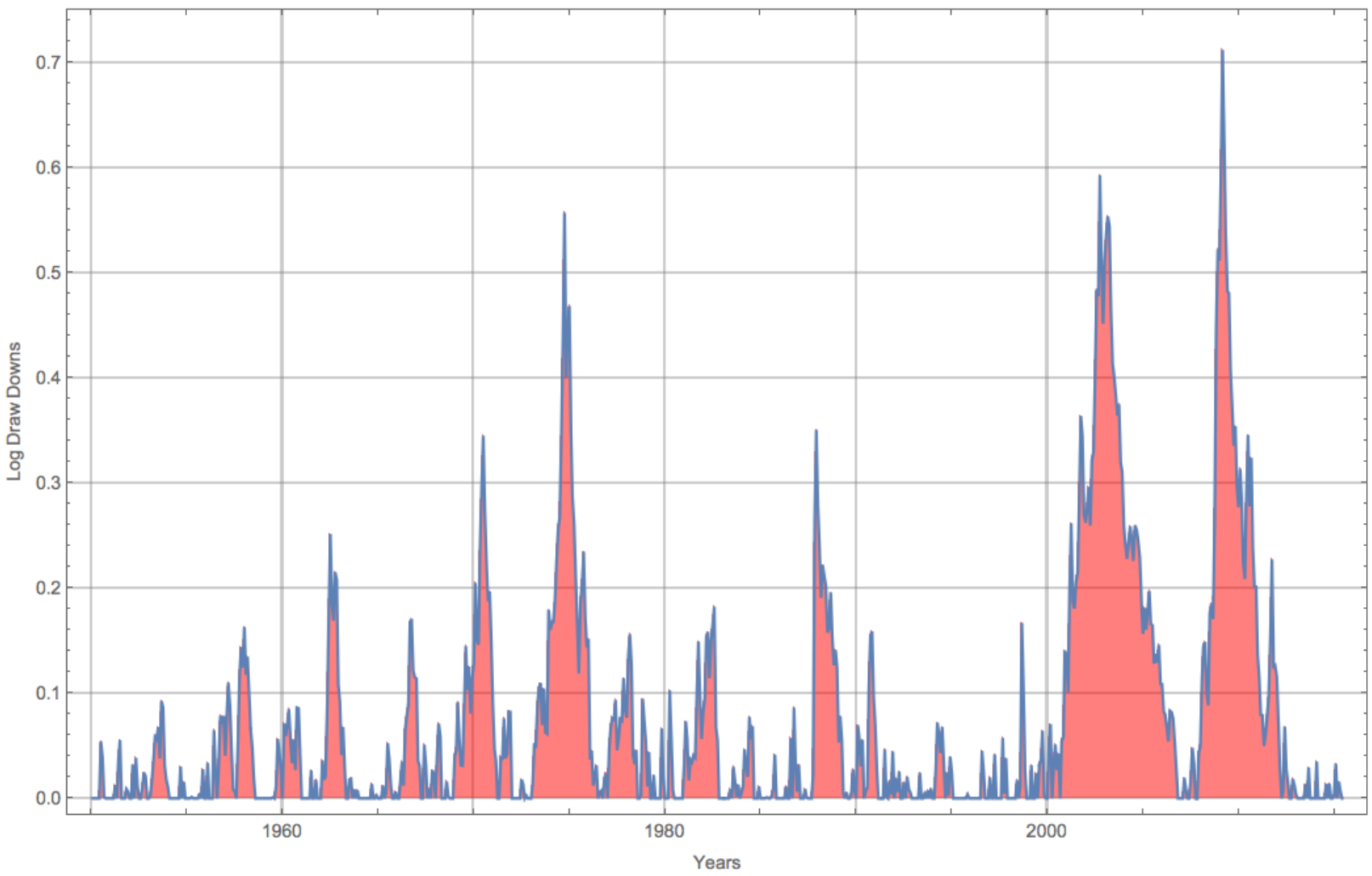
Max Drawdown Distribution Jan 01, 1835 through May 31, 2015
S&P 500 Total Return Index
Source: Global Financial Data



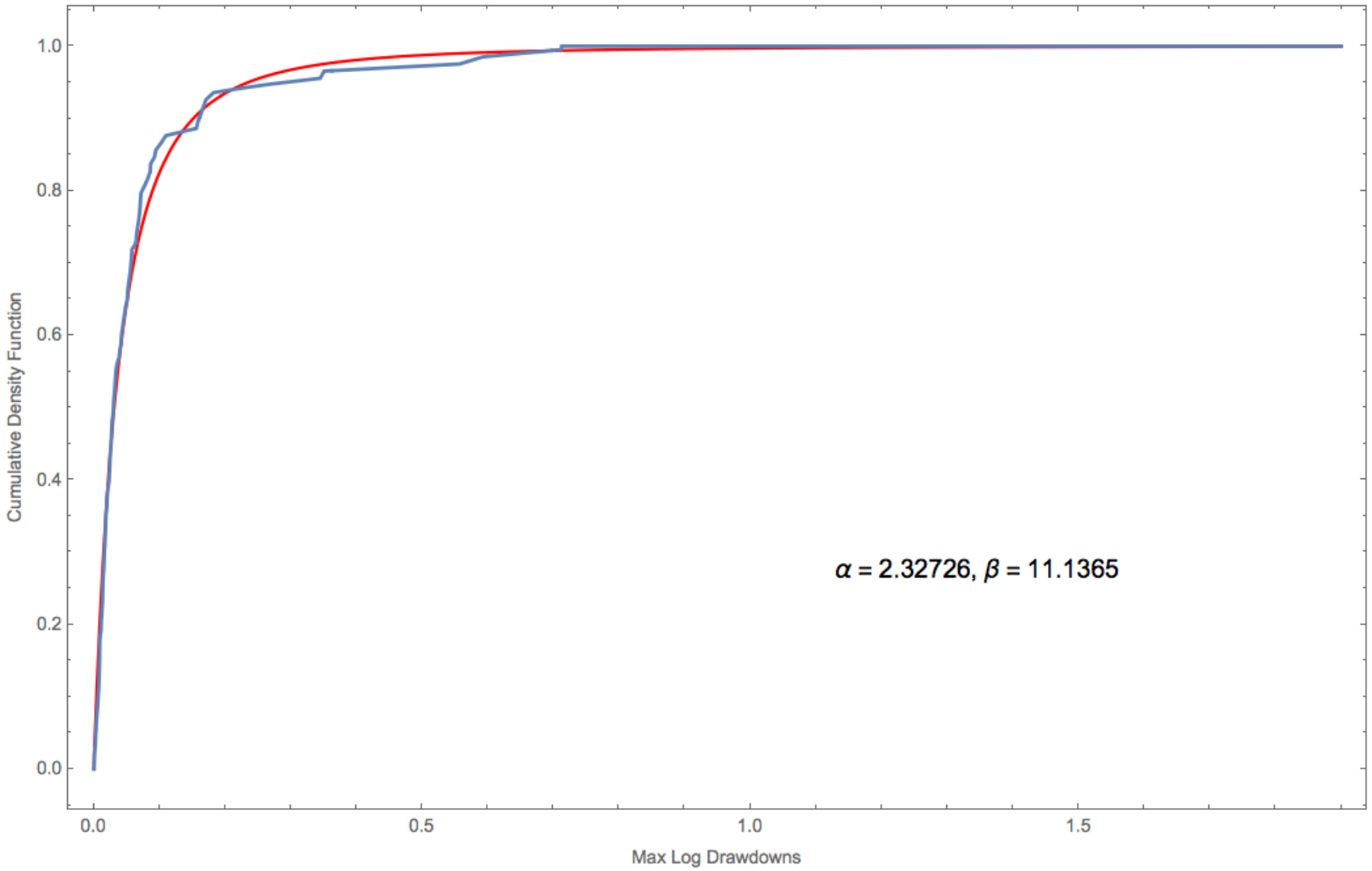

Market Draw Downs Jan 01, 1835 through Dec 31, 1928
S&P 500 Total Return Index
Source: Global Financial Data
Log Draw Downs
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
1840
1860
1880
1900
1920
Years

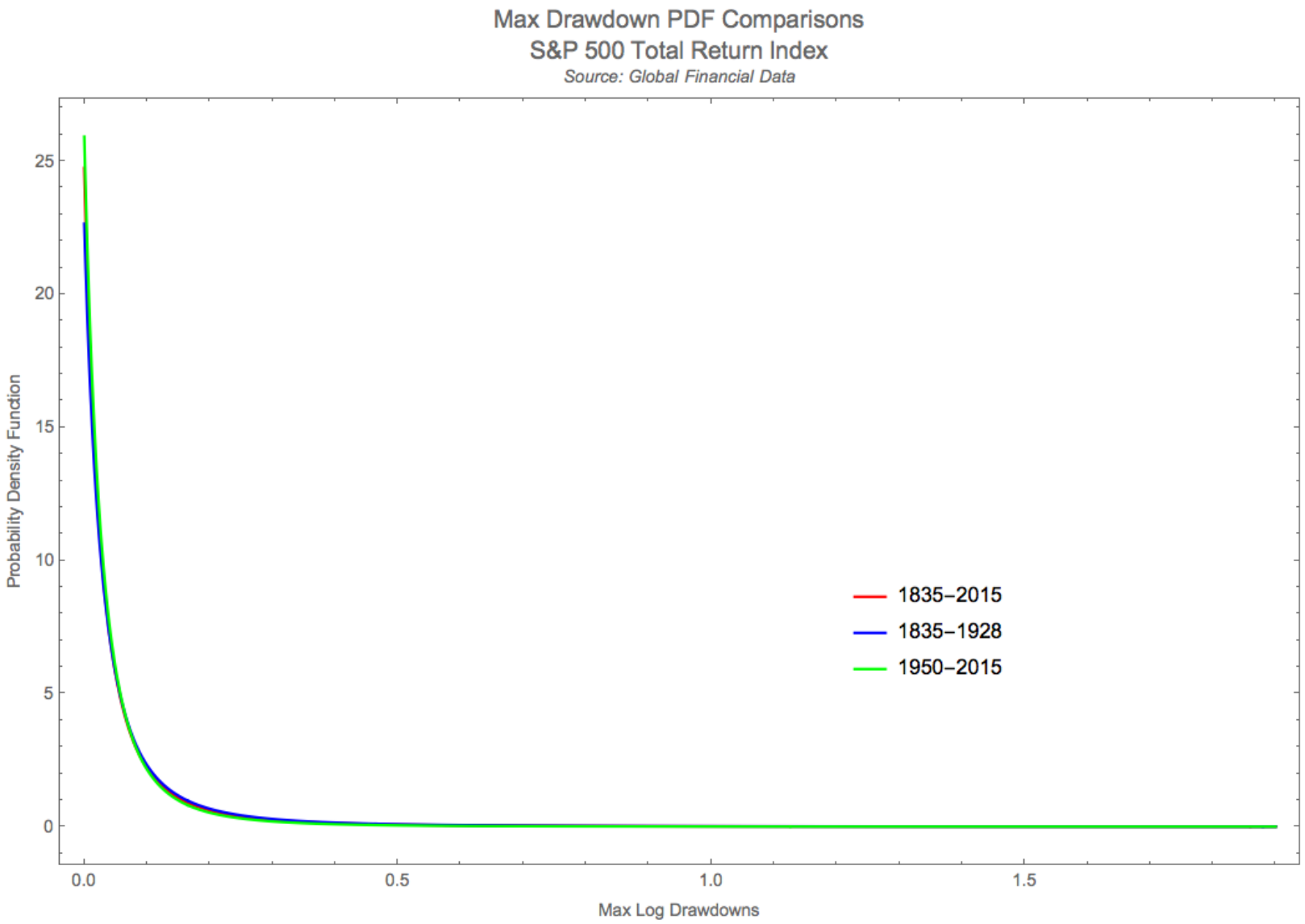
Max Drawdown Distribution Jan 01, 1835 through Dec 31, 1928
S&P 500 Total Return Index
Source: Global Financial Data



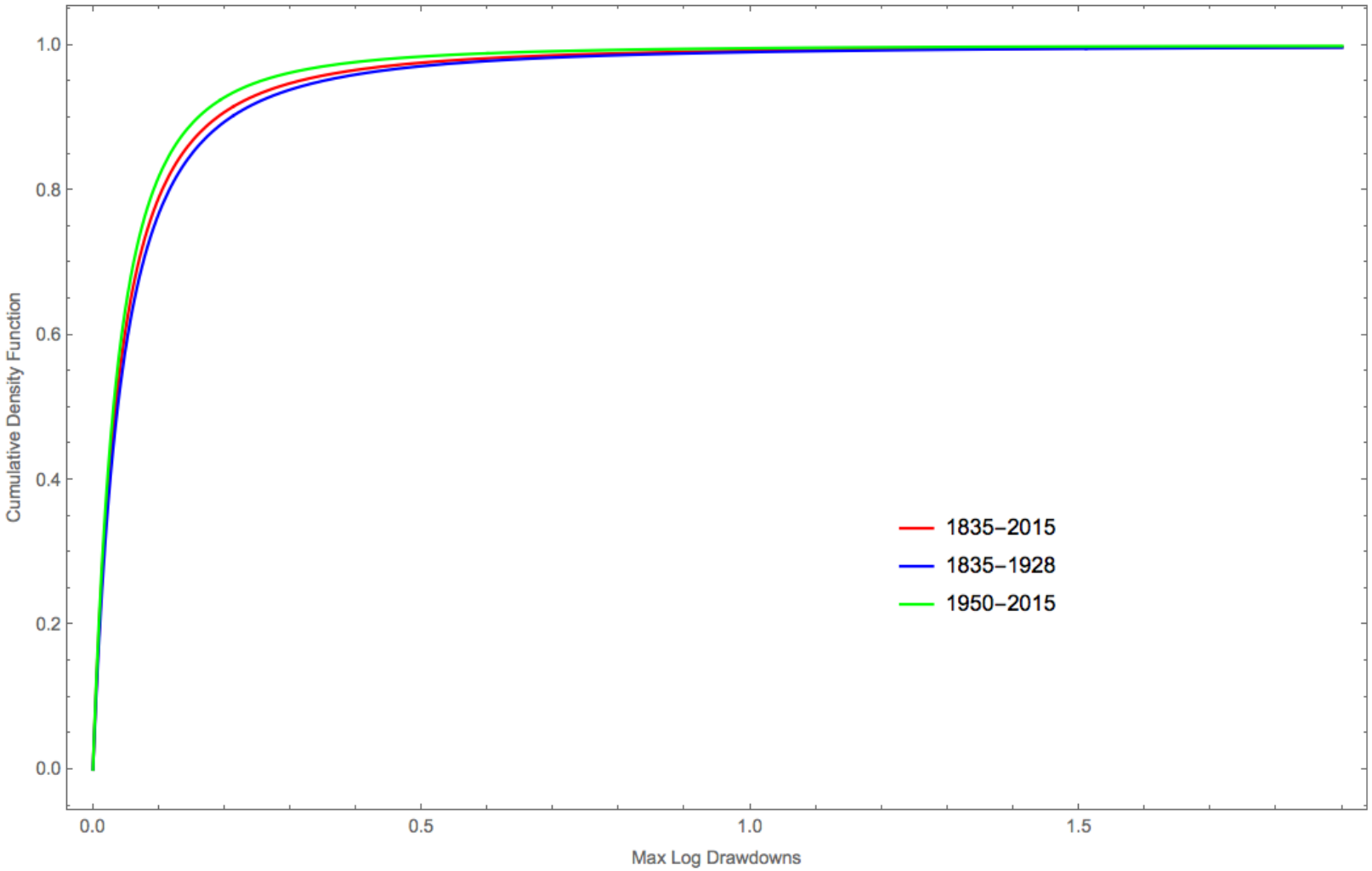

Market Draw Downs Jan 01, 1950 through May 31, 2015
S&P 500 Total Return Index
Source: Global Financial Data
Log Draw Downs
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
1960
1980
2000
Years

Max Drawdown Distribution Jan 01, 1950 through May 31, 2015
S&P 500 Total Return Index
Source: Global Financial Data




Max Drawdown PDF Comparisons
S&P 500 Total Return Index
Source: Global Financial Data
Probability Density Function
25
20
15
10
5
0
0.0
0.5
1.0
1.5
Max Log Drawdowns
1835–2015
1835–1928
1950–2015

Max Drawdown CDF Comparisons
S&P 500 Total Return Index
Source: Global Financial Data



Comparing Intervals

- The basic character of the max drawdown process is reasonably similar across time.
- The recent period does show slightly lower incidence of larger drawdowns but it is neither materially nor statistically significantly so.

Probability of a Larger Max Drawdown			
	1835-2015	1835-1928	1950-2015
0.2	0.0924836	0.105866	0.0720977
0.4	0.0343117	0.0406223	0.0233763
0.8	0.0113593	0.0138692	0.00659758
1.6	0.00351434	0.00441435	0.00171291

Conclusions

- Market max drawdowns, as a driver of “regret”, may play a greater role than we realize.
- The character of the market over the past 180 years does not seem to have changed greatly despite immense changes in technology and government policies.
- We have a rational model of market max drawdowns but we are not yet able to *convincingly* model returns from “first principles” to reproduce the observed market max drawdowns.
- It would be a mistake to view the Great Depression as an “outlier”.
- Taking the long historical view provides insights that are valid *today*.
- At least in terms of this measure of market stability, there is no convincing evidence that markets are more stable today than they were two centuries ago.