

# Valleys of Regret

## Nearly Two Centuries of Market Drawdowns

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Since early 2009, the U.S. equity markets have been in a near-unprecedented rise. It may seem an odd time to talk about market risk, in the context of large drawdowns. However, it is exactly the right time because that nearly decade-long run of steady high returns is neither characteristic nor sustainable. We would be wise not to forget that before the 2008 market crash, there was a long period of steady returns and low volatility with a good deal of talk about how we were in a “new normal.” Investors thought the business cycle was under control.

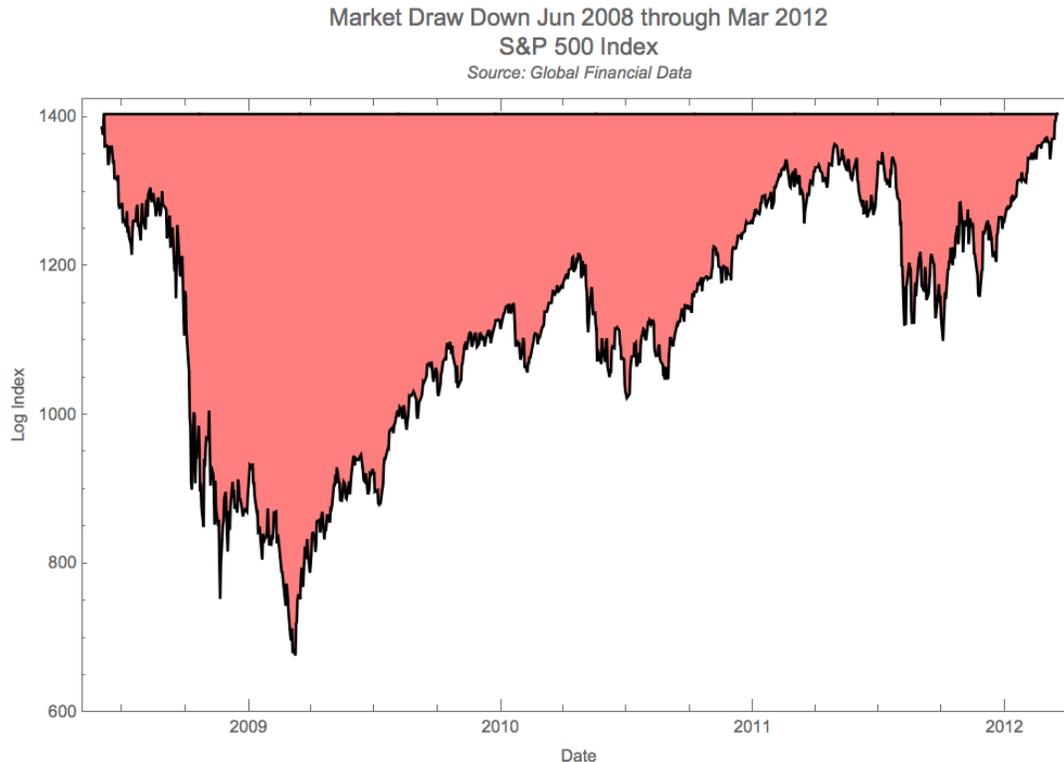
We must recognize that any perspective gained from the past nine years of market gains is cherry-picked from history. In reality, the periods between successive market peaks, what we call drawdown periods or valleys of regret, are an underappreciated risk.

Below in Figure 1 is a plot of the daily S&P 500 from June 2008 through March 2012. This drawdown had a length of 3 years and 9 months, attaining at its lowest point a loss of 52%. As is common, the drop downwards to the trough is much faster than the rise back up. The recent market rise discussed above appears in a different light when we realize that much of it was simply the recovery of prior losses.

The index eventually did regain its prior high, but it is naïve to think those nearly four years of looking back at the prior peak were not frightening, particularly in the beginning as losses relentlessly mounted.

Capital is never just saved. It is saved for a reason. A couple is saving for a house. A retiree is living off of savings. A pension or endowment fund must meet current obligations. Drawdowns of this magnitude and duration often mean that capital is not there when it is needed or that servicing current needs requires a sale of diminished capital.

Even a long-term investor will have the urge to do *something* to regain lost ground. Unfortunately, that often means taking on excessive risk or attempting to time markets. Such emotions drive us in exactly the wrong directions. There is ample evidence that such panic leads to disaster. It is easy for an investment professional to advise us to stay the course. The reality, when in a valley of regret, is that we often do not.



**Figure 1 – A Recent Drawdown Period**

While investors have many investment options, it is nevertheless the case that most will hold a significant, and often major, portion of their liquid investments in the equity market. Also, most investment returns are correlated to this market, correlations which increase during difficult periods.

Studying market drawdowns over an extended period of time is important because of the effects it has on investor fortunes and behavior. If we work with monthly returns, we are able to secure reliable numbers for an extended S&P 500 index going back to 1835.<sup>1</sup> The below study used a total return index, which includes the reinvestment of dividends. This gives a more representative picture and, if anything, including dividends reduces the sizes of the drawdowns. Some of the questions explored were:

- How frequently did investors find themselves in a drawdown?
- Can we statistically model the sizes of market of drawdowns?
- How has the character of drawdowns changed over time?
- What can drawdowns tell us about the character of market returns?

The S&P 500 Total Return from January 1835 to July 2018 (2,203 observations or 183 years and seven months) is shown in Figure 2. The logarithm was plotted because this makes relative comparisons across time much more

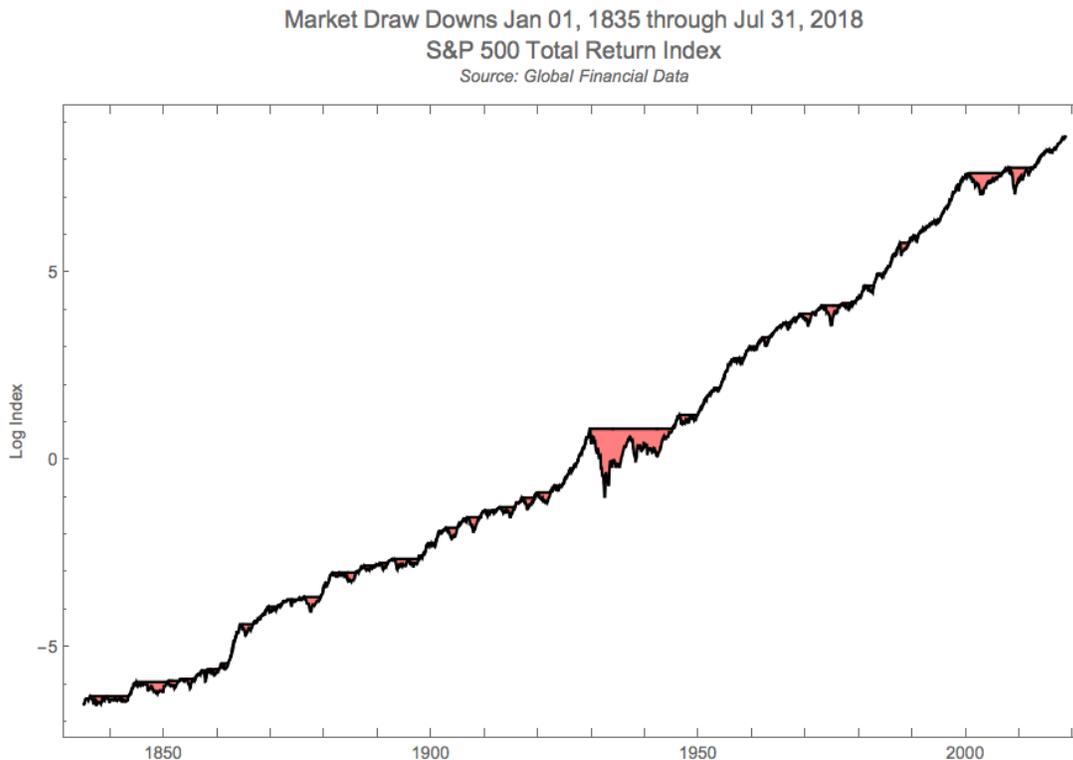
<sup>1</sup> Global Financial Data, [www.globalfinancialdata.com](http://www.globalfinancialdata.com)

natural. Drawdown periods are filled in red. Next in Figure 3 is a plot of the depth and duration of the drawdowns in the prior graph.

It is surprising just how often an investor is in a drawdown, “a valley of regret”. Over this almost two centuries an investor was in a drawdown 74% of the time, and over 40% of those drawdowns ended up being large ones exceeding 20%.

It is difficult to underestimate the effect this has on investor behavior. The plot of the S&P 500 seems to show a steady rise over the years. Yet, day-to-day in the trenches an investor is usually looking backwards at a peak wondering if he or she should reduce exposure. A significant portion of that time he or she experiences serious losses and must wonder if it would have made more sense to get out of the market altogether.

This study was successful in building statistical models for both the depth and length of these drawdowns. Here, one can see a focus on their depth. The results for their duration were similar.



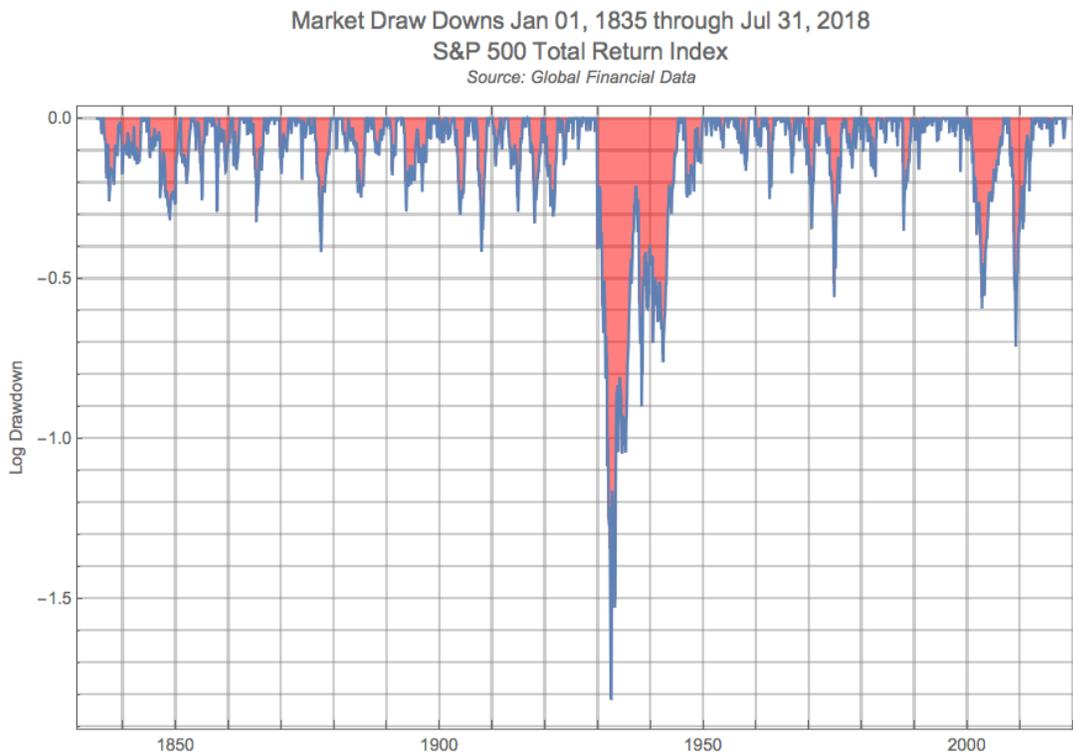
**Figure 2 – S & P 500 Extended Total Return Index**

These drawdowns are best characterized by a “fat-tailed” distribution; *i.e.*, one that exhibits large deviations from its average behavior. Based on theoretical considerations, a Lomax Distribution was the best choice. A key parameter of this distribution is its tail exponent. The smaller the tail exponent, the fatter the distribution’s tail—and the greater likelihood of extreme events.

Weather is one fat-tailed phenomenon we all familiar with, as the fine and seemingly sedate weather of late summer is punctuated by violent thunderstorms and even the occasional gale or hurricane. In fact, one area that pioneered the use of this type of analysis was the weather-related field of hydrology, the analysis of the movement and distribution of water, where the likelihood of extreme events such as floods must be modeled.

The drawdowns are consistent with a tail exponent of 1.9. This is fat-tailed indeed. The large drawdowns we see are not surprising aberrations any more than the random summer storms are.

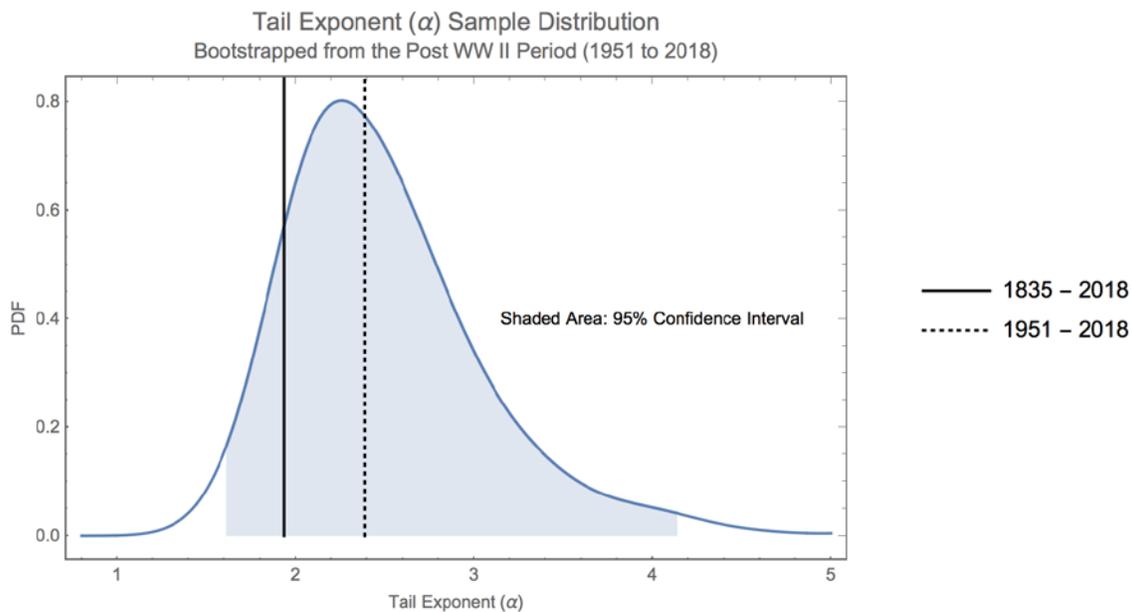
However, one drawdown, corresponding to the Great Depression, does seem outsized. Many may consider this is such an unlikely event that it would be foolish to include it in the analysis. There is also the question whether the data prior to that is relevant. There have been many changes in society over this period. The role of the Federal Reserve was greatly expanded in response to the Great Depression. We have had many innovations in economic theory to guide interventions by the Fed and by government in general, within the markets. Regulation and other controls have expanded and become more complex. Examples include going off the gold standard in 1971. Technology has advanced, further changing how investments are evaluated and trades executed.



**Figure 3 – S & P 500 Extended Total Return Drawdowns**

The model was fitted again using data from only the post-War period (1951 - 2018, inclusive). When dealing with a smaller sample size this will tend to bias the tail exponent upwards. The study found a tail exponent of 2.4. This is slightly higher (hence, slightly less fat-tailed). However, the three largest drawdowns occur in the latter half of the 1951-2018 period and these drawdowns are deeper than any occurring pre-Great Depression 1835-1928. Thus, we are not of the opinion that there is evidence for increasing stability in the market.

The likelihood of a deeper than 50% drawdown is 1.2% based on the full 1835-2018 data and 0.6% based on the post-War 1951-2018 data. While encouraging that it is less, in practical terms, both are distressingly likely. In either fit a drawdown of the magnitude of the Great Depression is a rare but hardly unthinkable result. Finally, the difference between the estimates of the tail exponent is not statistically significant as shown in Figure 4, where the estimates are plotted against a 95% confidence interval derived from the post-War 1951-2018 data.



**Figure 4 - Bootstrapped Sample Distribution of Tail Exponent**

The real danger is choosing a model which ignores tail events. The thin-tailed distribution that corresponds to the Lomax is the Exponential Distribution, which is the distribution of drawdowns that would result if the returns followed the conventional assumption of log-normality. Following this model would underestimate the likelihood of a deeper than 50% drawdown by a factor of 200.

*Despite advances in regulation, management and economic theory, coupled with a model that was based only on post War drawdowns, there is no convincing statistical evidence across more than 183 years examined to prove that the character of market drawdowns has not changed. We did ask ourselves how we are able to*

make this statement given the many changes over time. However, perhaps a more important question is that if these changes increased market stability, why isn't this reflected in the actual behavior of the market?

If you randomize the order of actual market returns, then the drawdowns are much shallower. This indicates a deeper structure within the returns that is not well modeled by standard time series analyses and, therefore, will not be adequately dealt with in many market simulations used in stress testing. Hence, the size of potential future drawdowns in many analyses will be underestimated and the consequent risks of being underfunded will be much greater than one would expect.

What is the answer then? Does it make sense to flee away from investments such as the stock market and the many things that move with it? Nonsense. As can be seen in Figure 2, the market is an excellent investment that has performed well over time for a patient investor. The greatest danger from drawdowns comes from not being aware of them, from not observing the facts of a history that has demonstrated consistent behavior over nearly two centuries despite our desire to hope otherwise. To use a weather analogy, you don't build a house to survive the "typical" weather of the area. You build it to survive the climate, which inevitably includes the possibility of extreme events such as hurricanes. *The most important lesson from the history of drawdowns is to be in a position with the required patience to get through them.*