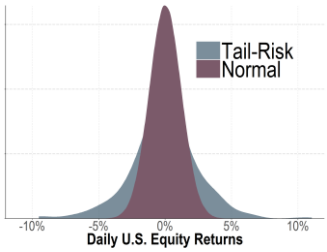
Sometimes referred to as a black swan or tail-risk, a fat-tail event is when something occurs that was unexpected or was thought to be so far-fetched that it was nearly impossible. Due to their nature, these thought-to-be extremely improbable events can turn a well-constructed portfolio on its head. For an investor, this problem can be particularly acute because the traditional tools in the investor toolbox assume that the world that we invest-in is a normal one. Unfortunately, investors have been repeatedly reminded that the world is often not normal and tackling this problem requires a specialized toolbox to measure, understand, and prepare for these events.

A Toolbox for a Non-Normal World

All of the traditional tools used by investors are based on the assumption that returns are 'normally' distributed; however, if we look at history, we see that in fact, this is not the case. To deepen our understanding and help us prepare for a non-normal world we will add three specialized tools to our investor toolbox, each of these will aid our efforts in a particular way.

1. **Financial Turbulence:** Defines and identifies a fat-tail event.
2. **Systemic Risk:** Predicts the likelihood of a fat-tail event at any given time.
3. **Systemic Risk Adjusted Value-At-Risk:** Aids in our planning and preparedness for when a fat-tail event does occur.

Financial Turbulence = Fat-Tail



Using a measure for financial turbulence, we can clearly identify and separate these normal and non-normal periods. Traditional tools leave these tail-risk (non-normal) times as unexpected and unprepared for events.

Being unprepared for any type of event is a situation that any investor would prefer to avoid. For tail-risk events this is especially true since the risk characteristics of investments change markedly during these periods. In the table below we can see by looking at the standard deviation of both equity and fixed income returns that investment outcomes are much more uncertain during turbulent periods.

Standard Deviation Table

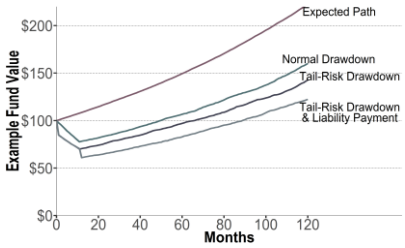
January 2000 – October 2017

	Equity[1]	Fixed Income[2]
Normal	15.7%	3.7%
Turbulent	40.3%	5.0%

Short-Term Risks with Long-Term Impacts

While long-term investors may hope to ride out such scenarios, even a single negative fat-tail event can impact investment outcomes over a very long horizon. In the next chart we can see an example of the same portfolio where four different scenarios have unfolded.

Portfolio Value – Illustration by Path



In the expected path, everything is normal and goes as planned. In the other paths, only a single month experiences a drawdown. Compared with the normal drawdown, the tail-risk scenarios are substantially worse for the portfolio. More importantly, the gap between scenarios increases over time. One particular problem for the portfolio is when net cash outflows are negative. A portfolio would be materially impacted even 10 years into the future and in some cases becomes technically insolvent.

Using financial turbulence to identify and understand the impact of a fat-tail event is a good first step. Obviously, an improvement over just identifying events after the fact would be to have an understanding of when and why these events are more or less likely to occur. Financial turbulence is

[1] U.S. Equity is proxied by the S&P 500 Total Return Index.

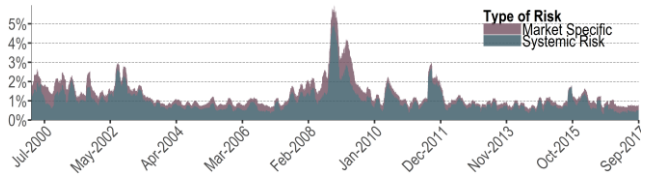
[2] Fixed Income is proxied by the Bloomberg Barclays U.S. Aggregate Total Return Index.

a fat-tail, and we want to know when it is more likely.

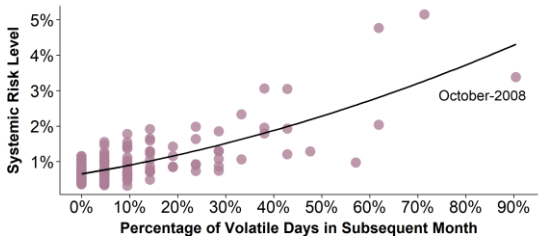
Systemic Risk, the Fat-Tail Precursor

The next tool in our toolbox is Systemic Risk, a measure that differentiates between the type of price fluctuations which are necessary to price assets correctly (e.g., when the earnings in one sector of the economy are growing faster than another) and the type of price fluctuations which are best described as 'panic' behavior when investors try to exit all types of investments at the same time. For example, if Systemic Risk is 5% and Market Specific risk was 0% then daily volatility in the market that day was 5% and none of that risk/uncertainty was market specific.

Below we can see a chart of Systemic Risk. By separating the risk of a particular market (sometimes called *systematic* or *market* risk) from the type of risk that is system-wide (*systemic* or *across-all-markets* risk) this measure can help us understand when and why fat-tail events are more likely.



Price changes that are driven by fear are systemic, or system-wide, by their nature and help explain the behavioral rationale for why turbulence or fat-tail events occur. Using this insight we can see in the following graph that the level of Systemic Risk exhibits a strong predictive relationship with how many days in the *following* month will be turbulent.



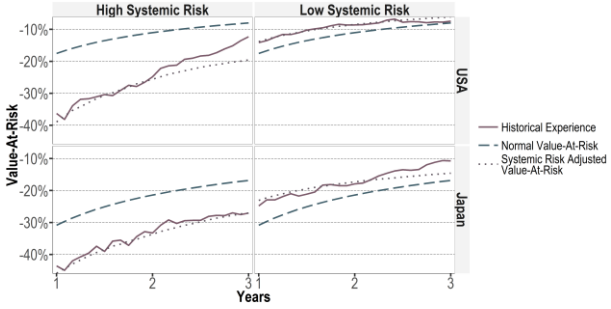
We began our investigation of Systemic Risk in the hope that we would be able to do more than identify a fat-tail event after the fact and we have seen that Systemic Risk is able to tell us when and why these types of events are more likely. Using the first two tools in our toolbox we have now accomplished that. Understanding when a fat-tail event is more likely is great, but a more complete risk tool would also tell investors how this would affect the capital they have at risk at any given time so that they might improve their management of and response to these events.

Refining Traditional Risk Metrics

To give ourselves a more refined risk measure we merge the insights of Systemic Risk with a traditional risk metric called "Value-at-Risk." Value-at-Risk is an estimate used by investors that suggests what percentage of portfolio value could be lost at any given time over some horizon. Again, this traditional tool is based on the assumption that the world is normal and therefore risk is constant.

In the real (non-normal) world, we experience a changing likelihood and severity of fat-tail events which are highly related to the level of Systemic Risk. In order to account for this, we adjust the Value-at-Risk estimate for the level of Systemic Risk to get a more accurate picture of risk through time and across different markets.

To see an example of this we look at a comparison of Value-at-Risk across U.S. and Japanese equity markets during periods of High and Low Systemic Risk in the graph below. The important takeaways from the chart are twofold. First, notice that the Normal Value-at-Risk doesn't change between Systemic Risk scenarios and that as it result it is either overestimating or underestimating the true Value-At-Risk. Second, after making an adjustment for Systemic Risk, the Value-at-Risk level closely matches historical experience. Thus, adjusting Value-at-Risk for the level of Systemic Risk makes for a more accurate estimate of capital at risk.



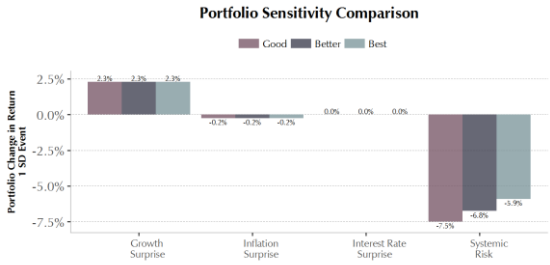
While the above graph tests among different regional equity markets, we have tested across types

of asset classes, other regions, etc., and always find similar results.

Implementation of Insight

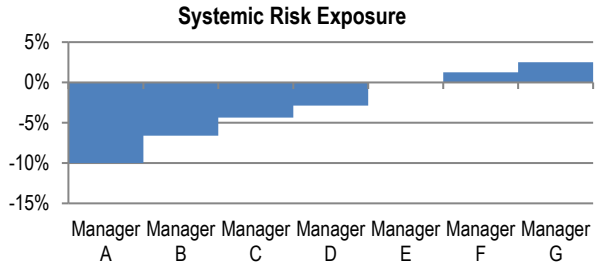
A full description of how we can implement these insights about fat-tails is beyond the scope of this short introduction. We suggest that interested readers read our full white paper on *"Tail Risk Management"* available on our website.[3]

Insight about fat-tails can be helpful at all levels of the portfolio construction and maintenance process. Starting with top-level portfolio construction, when choosing among strategic portfolio options it is common and good practice to examine the type of risk exposures the portfolio contains. In the graph below we have added Systemic Risk to three other common economic risk factors and shows the portfolio sensitivity to a one standard deviation shock in each factor. So the graph below shows that when Systemic Risk increases a portfolio will lose value holding all else equal. We can also see that Systemic Risk tends to be the biggest risk factor in a portfolio.



In this illustrative example, all else is equal so there is a clear case for having less Systemic Risk exposure as the investor is not compensated for that risk.

Insight about Systemic Risk exposure can also help an investor compare managers on a fat-tail metric and may be especially helpful when choosing managers to help protect portfolio value during drawdown events.



Conclusion

Understanding how a portfolio will perform during severe drawdowns and fat-tail events is one of the most important risk management questions an investor will face. A deeper understanding of the financial turbulence that is a fat-tail event and the Systemic Risk that makes those events more likely can aid the investor at all levels of the portfolio construction and maintenance process, not only to help weather the storm when it eventually does arrive but also to take smarter risks when opportunities present themselves.

[3] http://www.meketagroup.com/documents/Tail%20Risk%20Hedging%20WP.pdf