The Persistence of Kurtosis in Financial Markets

"I can calculate the movement of the stars, but not the madness of people"

Sir Isaac Newton said this after losing a small fortune in the South Sea Bubble of 1720. I like to think that after this episode Newton realized that markets are fraught with large and quite unexpected price movements and perhaps exploited this phenomenon in his subsequent trades. As we often discuss, the propensity of markets to generate what are often called "fat-tails" is the cornerstone of our investment philosophy and the primary generator of our returns. A fat-tailed distribution is a probability distribution that has the property, along with the heavy-tailed distributions, that they exhibit larger than Normal kurtosis. That is to say that the probability of large magnitude events is more likely than a Normal distribution would imply. This report highlights the prevalence of this pattern among price movements in many markets and across many timeframes and why they are critical to our trading system.

Consider Figure 1 which shows a histogram of the daily returns for the Dow Jones industrial average since 1933. It is clear that daily returns near 0% are common whereas returns of -5% or +5% are much less frequent. The red overlaid curve is the Gaussian or Normal distribution function with the same average and standard deviation as the DJIA returns. Such a function is how statisticians try to describe, mathematically, information like 'How much more likely am I to observe a return between -3% and -1% than between -1% and +1%?' Much of finance theory is based on the red 'Normal' curve. The efficient market hypothesis (EMH) basically implies that asset movements from one time to the next are unpredictable or random and a common model for this randomness is that the returns are normally distributed (see for example 'Geometric Brownian Motion' and the 'Black-Scholes' option pricing model).

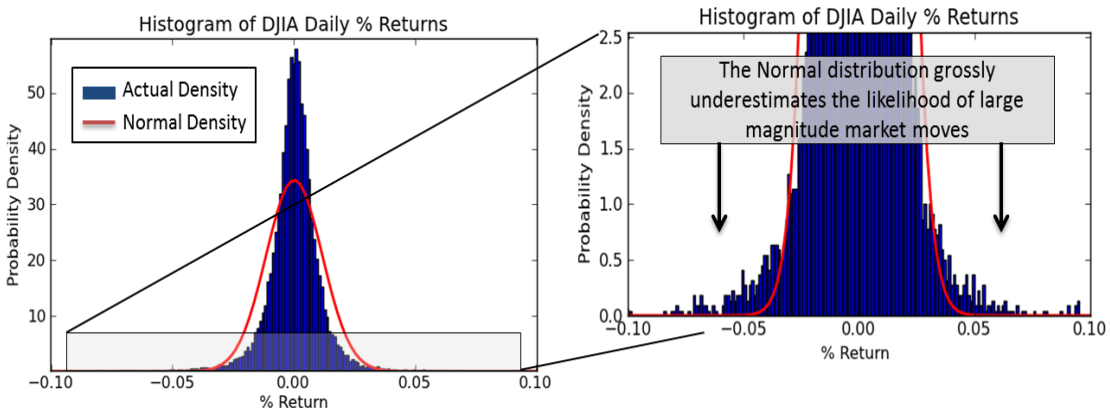

Figure 1: Histogram of daily returns for the Dow Jones Industrial Average since 1933. The Normal (Gaussian) density overlaid in red underestimates the likelihood of both very low magnitude returns (as indicated by the high peak) and very large magnitude returns (as indicated in the inset).

As noted in the right hand portion of Figure 1, this Normal assumption grossly underestimates the likelihood of large magnitude market moves. In fact it suggests a single move outside of +/-5% should occur once every 66,000 trading days – that is once every 264 years. In reality it has happened 129 times in the last 80 years. This is the perfect example of fat tails and it is this fat tail phenomenon which trend followers rely on. Unfortunately due to the way the data is typically presented (as in the left hand side of Figure 1) it is hard to even notice this feature and it is often dismissed as insignificant market inefficiency.

A Better View

Perhaps a better way to present the data would be to show how often these events occur as compared to how often they would be predicted to occur under the Normal assumption. Figure 2 shows exactly this comparison for the DJIA data. The red line at '1.0' is the baseline Normal assumption and the blue bars are the actual occurrences. The parallels are clear - the middle high peak from Figure 1 is reflected in the fact that the middle bar in Figure 2 shows that small return events happen 1.5 times more often than Normal would predict. And the high blue bars on the left and right extremes in Figure 2 reflect how poorly the Normal distribution underestimates the likelihood of these large magnitude events.

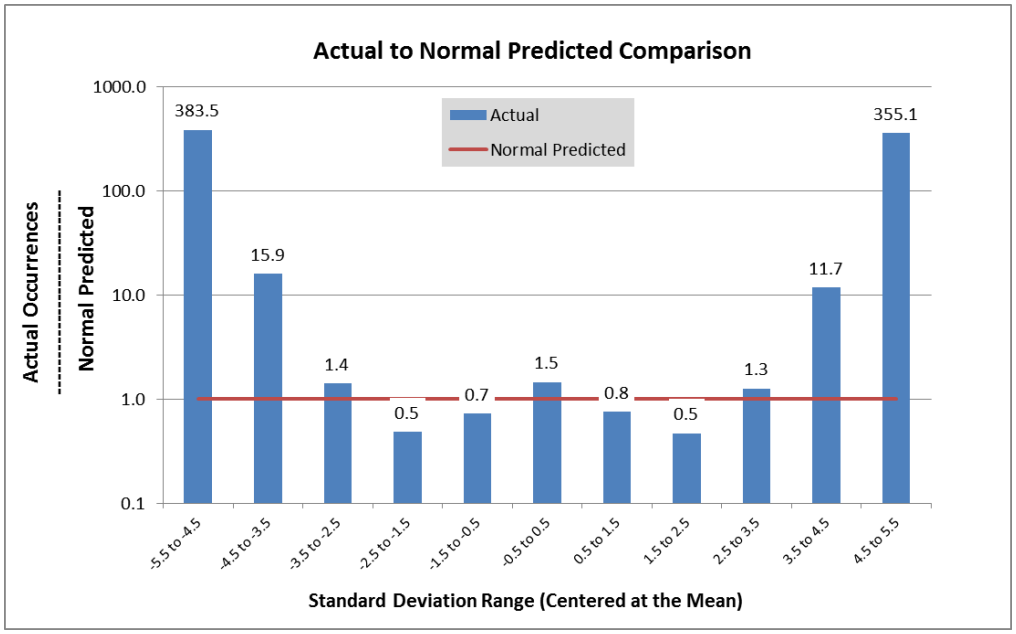

Figure 2: Plot of the number of times certain return events occurred versus how often they were predicted to occur using the Normal assumption.

From Newton's Time to Now

In our research at Covenant Capital we find that this fat-tailed feature of freely traded assets is the most consistent and robust feature of markets. It exists across a variety of markets (commodities, equities, etc.), across a variety of return periods (daily, weekly, monthly, etc.), and across a variety of time periods studied (1970's, 80's, 90's, 2000's). Figure 3 illustrates this fact. It shows the 'Actual to Normal' comparison for a variety of markets, for various return periods, and over differing periods of study.

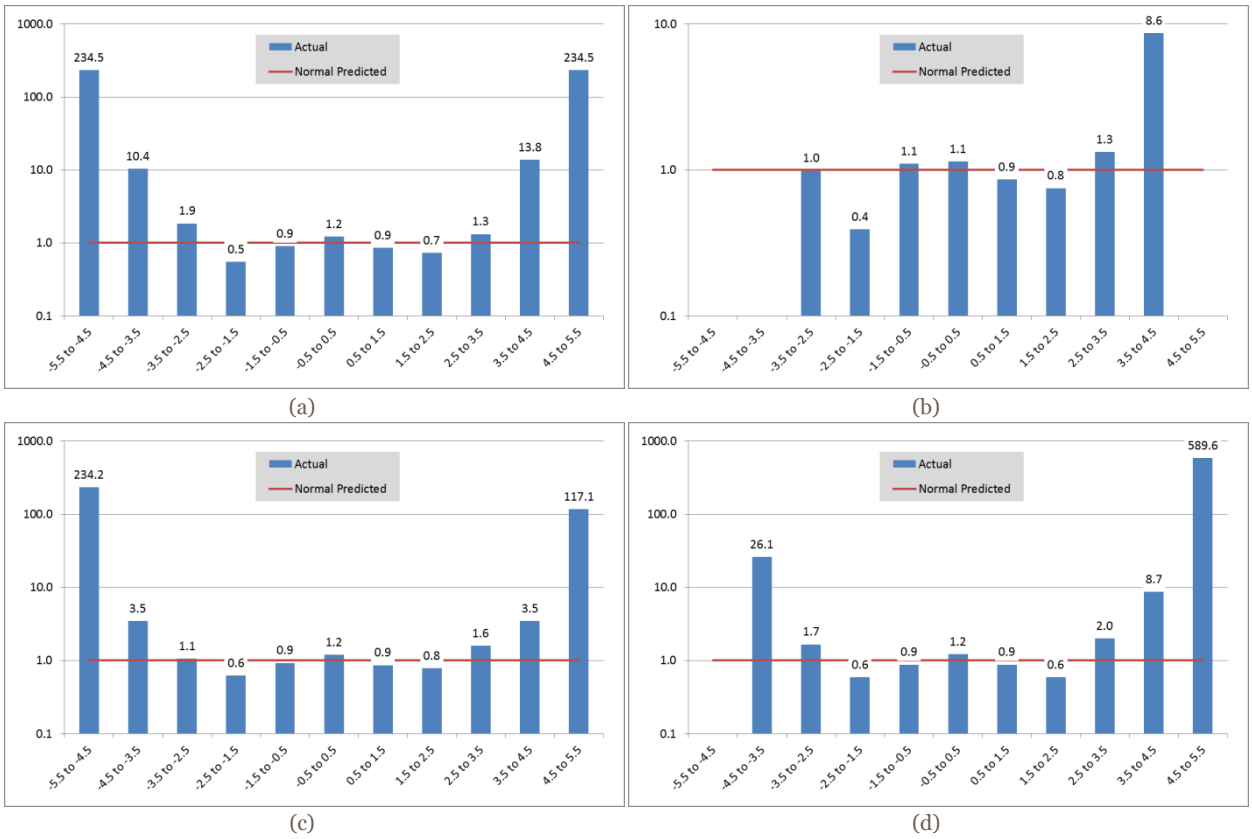

Figure 3: (a) Fat tail behavior of Corn 1-day returns from 1980-1990. (b) Fat tail behavior of Japanese Yen futures 5-day returns from 1990-2000. (c) Fat tail behavior of General Electric 1-day returns from 1980-1990. (d) Fat tail behavior of Callaway Golf 5-day returns from 2000-2010.

As one can see this sampling encompasses a variety of asset types, industries, time frames, and return frequencies yet they all have one thing in common – kurtosis or fat tails. The entire goal of our systematic trading system at Covenant Capital is to exploit this inefficiency. The trends our system follows go hand-in-hand with these fat tail events. We make no predictions about markets other than to predict that markets will continue to exhibit this feature and hence trend in the future and we choose to invest in this phenomenon via our systematic trading.

Further Illustration

Naturally, we are only able to show the results of a small number of markets and timeframes in this short report. However, given an adequately sized data sample we were unable to find any markets on any timeframes that failed to demonstrate the type of kurtosis (fat tails) illustrated in the charts above. For those of you who are curious, I have provided a link below that will allow you to explore the subject much further.

The link below contains an Excel spreadsheet which I used to generate some of the plots in this report. The data base within the sheet contains market histories on most all of the liquid futures markets as well as approximately 200 equities markets. It will allow you to conduct this analysis very quickly on your own. Simply download the spreadsheet and when opening it choose 'Enable Editing', 'Enable Content' and 'make this a trusted document' or 'Enable Macros' should Excel provide you with questions of this sort. Once the file is open you will find instructions on how to use it contained within. Should you have any questions please let us know. **http://bit.ly/1j3jVtP**