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THE COLLECTOR:

Hidden Conditions and Coin Flip Blow Ups

A quick look at the danger of ignoring hidden conditions in quantitative finance

Blowing up

How many times have we heard about traders, hedge funds and trading desks being surprised by sudden massive losses? I am not speaking only about inexperienced traders, for some of the most talented people in this field have lost their shirts. The LTCM blow up with Meriwether and his team including Nobel Prize winners Scholes and Merton offers only one example. Personally, I was lucky enough to burn a considerable amount of my own wealth at an early age, so let's start with the inexperienced trader blowing up. Fortunately, my net wealth was also very low at that time, so despite the large percentage losses, the dollar amount did not make the press, until now. In 1986 I was studying garden plants at a university in southern Norway, and in-between the classes I would go out to the phone booth and call my stock broker. As this was still before the internet and cell phones were commonplace, a big old-time coin phone booth was my only weapon. By mid 1987 I had made fantastic returns simply by flipping in and out of long stock positions, and I of course felt like the master of the universe. Soon my small savings that I originally had saved up from hard physical work at my grandmother's farm had blossomed into a money tree that simply had to be watered daily and would grow predictably, and I planned to soon cash it in and buy a red sports car. On October 20, 1987, the Oslo stock exchange crashed and took my profits with it. I felt the pain, the frustration, and the panic, dumping my stock as fast as possible, and losing almost all my profit, causing my red sports car to ride off and vanish into the sunset.

Now, while trading options on Wall Street, I am very happy that I learned this lesson at an early stage in my career. Losing my red sports car in a stock market crash was far better than losing it in a car crash; at least all my body parts where intact, though I had possibly lost my mojo (which I got back later). Most importantly, this instilled me with a great respect for the markets. What had I done wrong? I had been listening carefully to my broker, who was a professional and had to know what he was doing! Furthermore, the local bank that had given me a loan to invest in stocks had advised me not to invest in shipping-related ones, deeming them far too risky, and advising instead that I invest in banks and real-estate companies. I listened to these self-proclaimed experts, and also thought of myself as one. Why not, I had already built an impressive track record. I ended up investing most of my sweat-earned cash in banks and in fast growing real-estate stocks (that would soon go bankrupt). It all worked very well for a while, until the crash of 1987. In more mathematical terms, I had been assigning a very high probability to the notion that these people, including myself, actually knew what they where doing, and had ignored that this was all based on the condition that basically anybody can make money going long stocks in a bull market, at least for a while. But I soon learned the hard way that making money in a bull market never should be confused with one's IQ. I was a green investor with green fingers studying garden plants, with little or no knowledge about investing or trading, blowing up my own money. Still, why is it that even smart and talented people with many years of experience can also blow up? Can it be that the inexperienced and experienced traders have something in common?

Coin flip blow ups

A model, whether it is simply based on years of experience and common sense or on state-of-the art quantitative financial mathematics, will possibly work excellently in most situations, but in some cases it can and will break down. You would then typically blow up, or be lucky enough to get unexpectedly rich. As Dr. Nassim Taleb once said, "If you are so rich why are you so dumb?" That is why we call it a model.

More precisely, any model is a conditional model. It is typically based on certain explicit assumptions, but often also on some implicit conditions. When it comes to the explicitly stated assumptions, it is typically easier to deter-

"Heads I win the bike, tails you lose ... geez what a schmuck!"

mine in what cases the model will break down or have to undergo major adjustments. For example, Black and Scholes explicitly stated in their 1973 paper that the model was based on the assumption of constant volatility. Based on this, it is not hard to see that the model will possibly (but not necessary) break down under stochastic volatility. It should come as no big surprise that much of the modern option literature has been focusing on this assumption and on how stochastic volatility and jump-diffusion processes affect option values.

The main danger in applying any quantitative model is not when there is a breakdown in explicitly stated assumptions, for these can be stress-tested relatively easily, or alternatively, we can replace the model with another one closer to reality. Most of the finance literature tends to focus on breakdowns in explicitly stated assumptions. For example, there are hundreds of papers looking into how stochastic volatility will affect the option value relative to the Black-Scholes world. This is naturally great, but it is easy to forget that almost any model is also dependent on many implicit conditions. Many of these conditions are often hidden in such a way that it takes some serious meditation to realize them. One good method is to ask what other models (or common sense) this particular model is based on. For example, almost any option or derivatives model is based on probability theory, typically the Kolmogorov's probability theory that is the cornerstone in modern probability. As described by Ballentine, in Kolmogorov's probability theory, the conditional probability is relegated to secondary status[1], while the mathematical fiction of "absolute probability" is made primary. According to Ballentine there are several objections to taking Kolmogorov's axioms as the foundation of Probability Theory; it should rather be seen as a model of a more fundamental Probability Theory. Among other things, the secondary status of conditions in the Kolmogorov's model can easily make us forget that in reality any probability actually has to be a conditional probability. As an illustration, let's look at the flip of a coin.

Not too long ago, I asked a bunch of people,

some traders, some academics and some quant nerds, for the probability of getting heads-up on a coin toss. Most of them only looked at me as if I was wasting their time with common sense. One trader thought I was trying to trick him and told me that if it was a fair coin then the probability of heads up would be close to 50 per cent, or actually slightly smaller if one included the very slight probability of the coin ending on its edge.

As an options trader, at least he considered some extreme tail events in his model. Even with a fair coin, our answer of a roughly 50 per cent probability of heads-up is still based on many implicit conditions. The reason we would typically not mention or even think about them is that we typically base our answer on common sense, historical experience and what we learned at school. But common sense is dangerous, or as Einstein once said, "Common sense is the collection of prejudices acquired by age eighteen." The answer of 50 per cent probability is implicitly based on a fair coin as well as on the exact time, place and all the particulars that make the event (in this case a coin flip) unique and unrepeatable, see Rocchi for more details on this. For example a 50 per cent probability of heads up on a coin flip is based on gravity. What is the probability of ending heads up or even on the edge in a zero gravity environment? Most of the universe is comprised of "empty space" with close to zero gravity, so a 50 per cent probability of the coin landing heads-up can actually be seen as a tail event. Actually what we consider an extreme tail event, edge up, using our collection of prejudices, could very well be a quite common event in most of the universe. Who knows, next time you walk into a party and someone challenges you to a coin flip bet, it could be an astronaut planning to perform the coin flip in outer space. Of course, to meet a astronaut in a bar is in itself probably a 4 sigma event, so the probability for that condition is no doubt too low to be taken seriously. Or, wait a minute; this is also conditional on what type of party you are invited to. If it is a farewell party for astronauts, then the probability for such an event suddenly becomes significant.

By thinking about probabilities as always conditional, we have uncovered several hidden conditions behind a coin flip bet. Then after we have uncovered the hidden conditions we can consider the probability of the various conditions and thus better judge if it is a good trade or not. But let's get back to reality – what does a coin flip in space have to do with quantitative finance and trading? We are still not in the age of space-time finance[2] . But too often, risk managers, traders, portfolio managers and corporations ignore possibly hidden implicit conditions behind their models and their trades. I can see no other reason why so many smart people have blown up hundreds if not billions of dollars. But didn't I just ignore a possibly hidden condition, in that I just assumed that these people where smart in the first place? Well, I'd better stop before I turn myself into an arrogant *besserweiser*[3] my point is simply that by thinking about every probability as a conditional probability, we will have a greater chance at uncovering what conditions the model is actually based on, and thus in avoiding blow-ups and instead making big bucks. In other words, "Don't assume. It makes an ass out of you and me".[4]

FOOTNOTES & REFERENCES

1 Kolmogorov's axioms basically are 1) $P(\Omega) = 1$. 2) $P(f) \geq 0$ for any f in Ω,3) if $f_1, \ldots, f_n$ are disjoint then $P(f) = \sum_i f_i$ where f is the union of $f_1, \ldots, f_n$, 4) if $f_i \to \emptyset$ (the empty set) then $P(f_i) \to 0$.

2 See Haug 2004

3 {If you don't understand this word, just look upin a German dictionary.}

4 I would like to thank Erik Stettler for helpful comments on this article.

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