# Financial Risk Management

## Of Normal Distributions and Black Swans

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**The current use of the concept of Value at Risk (VaR) in conjunction with the assumption of normal distribution is far from what happens in the emerging markets. Market players in India, will be better off if they are aware of the big risks that happen all too frequently.**

On October 19, 2007, the financial world remembered what happened exactly 20 years ago: The broad stock market index in New York fell on October 19, 1987, by nearly 23% in one day and the rest of the world followed. Until then, experts thought that in a modern financial world with high liquidity of stocks, such a drop could only happen once in a hundred thousand years. It was worse than what happened in 1929. Having two such events was virtually impossible. Such events have been termed "black swans" by Nassim Nicholas Taleb in his new book on financial systems. This book, called *The Black Swan: The Impact of the Highly Improbable* (Penguin, 2007), has become an international bestseller.

Why is it called a black swan? If one lives all his life in the northern hemisphere, all he would ever have seen are white swans. He would conclude that all swans are white. This is exactly what the Europeans concluded before they went to Australia. In Australia, they found only black swans. Thus, the metaphor of the black swan is used to denote anything that appears impossible on the basis of limited number of observations. In modern statistical parlance, it would be called a "model uncertainty." More precisely, what happens when we use a model to predict some future events, but our underlying model is wrong and we do not even know that it is wrong? To paraphrase Mark Twain, "It's what you don't know you don't know gets you into trouble."

The metaphor of black swans has an interesting story. In 1748, the famous Scottish philosopher and historian, David Hume wrote a book entitled *An Enquiry Concerning Human Understanding*. In that book, he explained the logic of model uncertainty precisely in the context of swans. He wrote, "No amount of observations of white swans can allow the inference that all swans are white, but the observation of a single black swan is sufficient to refute that conclusion."

In 1748, nobody in Europe had seen a black swan. Thus, the argument of Hume seemed absurd in Europe. It was almost three decades before Captain Cook would make his first voyage to Australia and discovered that the black swan actually existed! Thus, the argument of Hume took on a new dimension.

Black swans are an extremely important but neglected concept in finance. To understand it, we need to introduce the concept of the measurement of risk for financial products. The most commonly used measure of risk for financial products is called the Value-at-Risk.

The Value-at-Risk is defined as follows. First, we fix a "level of confidence". It is usually set at 1% level. The Value-at-Risk of a financial instrument is defined as that (low) value of the instrument which would happen with no more than 1% probability during a given time period. The financial instrument could be a portfolio of stocks; it could be financial derivatives like an option or it could be a combination of various financial products.

Consider the following example. Bhogle owns 100 shares of a stock S. What is the Value-at-Risk Bhogle is exposed to in the next 10 days? If we denote the stock price on day t as S(t), then we are looking for a value V such that probability((S(t +10) " S(t) ) + V $\leq$0) = 1%. We can then say that with 99% probability (or level of confidence) that the potential loss is at most V. V is called the 1% Value-at-Risk or 1% VaR.

In general, it is not easy to calculate VaR for a given portfolio of stocks. The way banks and other financial institutions simplify the problem of the VaR calculation is by 'assuming' that the underlying financial instruments have a lognormal distribution. However, in real life, even for stocks, such an assumption is far away from the reality. The errors we commit by simply assuming lognormal distributions can be quite large. This implies that our VaR calculations will give us misleading results.

For some Indian stocks, we have calculated the distribution of log returns.

For one specific stock, log returns over one year follows a t-distribution with 3 degrees of freedom with a mean of 0.6 and a standard deviation of 0.28. Thus, the 1% VaR turns out to be 12.5% while if we wrongly use a normal distribution, the 1% VaR will be taken as 5.1%. So, if Bhogle has shares of this company worth Rs. 1 lakh, and he uses the normal distribution, he would be led to believe that maximum loss he would incur at the end of one year with 99% probability is Rs. 5,100, where, in fact, the loss would be up to Rs. 12,500.

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Thus, with the wrong model, we can seriously underestimate our errors while thinking that we are doing the right thing. In technical terms, there are two different levels of risks. The first, which is simpler, is called the Parameter Risk. If we have built a model of the underlying process, it is important that the model is correctly specified. Using past data, we estimate the parameters of the model. However, there always exists the possibility that the estimates of the parameters are wrong. This is called the Parameter Risk.

The second, more dangerous, is the Model Risk. The question there is the following: Is the model and framework with which we are assessing risk appropriate? Until the Europeans arrived in Australia, their model of swans did not admit the possibility of black swans. Until the terrorist attacks of September 11, 2001, such events were considered virtually impossible. Until the tsunami in Asia that killed hundreds of thousands of people a few years ago, a tsunami was considered to be too improbable in India. Until the stock market crash took place in New York in October 1987, most people thought that a crash of the magnitude of 1929, was practically impossible in this day and age in a developed market.

Why do banks and other financial institutions keep making the same mistakes and fail to learn from the past? Taleb gave an intriguing answer. He noted, "Banks have the ingrained habit of plunging headlong into mistakes together where blame-minimizing managers appear to feel comfortable making blunders so long as their competitors are making the same ones." In other words, financial institutions suffer from herd mentality.

If we examine the data from the Indian financial markets, we find one striking feature. The financial markets are inherently much more volatile than their corresponding counterparts in the developed world. Thus, if the models of normality are 'somewhat' wrong for the Western countries, in emerging markets like India, they are 'extremely' wrong!

We, in India, have two bad habits. First, we tend to listen to Western-trained experts without much thought. They have the mindset of Westerners. They are like those Europeans of the 18th Century who had never seen a black swan, until they went to Australia. Second, we tend to ape the regulatory environment of the Western markets. To wit, listen to the policymakers in the government, in the RBI, or in the Ministry of Finance. Their long-term goal is to mimic the regulation adopted by the OECD countries. Banks are considered to be progressive if they follow the so-called Basel II compliant regulations.

Is the empirical evidence from developed markets relevant for India? Events like the Asian meltdown of 1997 are far more frequent in India than they are in the developed world. Markets in the developing world are far more volatile than they are in developed countries. For example, if we use American or British data for assessing operational risk in India, we will be ignoring risks without knowing that we have ignored them. In other words, we would miss the black swans.

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We could have used better measures of risk. Unfortunately, the Bank of International Settlement (popularly known as the Basel Agreement) has institutionalized the VaR measure. Under the Basel II norms, each bank has to estimate its VaR and in turn, the VaR determines the reserve capital that the bank needs to hold. Thus, the accurate estimation of the VaR has assumed great importance after being institutionalized by Basel II.

What is the way forward? The whole idea of Basel II is to make realistic assessments of risk exposures backed by data, using proper statistical techniques to build appropriate models. To this end, the RBI could constitute a High Powered Committee that could lay down the norms for the assessment of advanced statistical model building techniques. Regulatory norms for risk management are at a nascent stage in India at present. The Reserve Bank could insist that only evidence from India would be acceptable. It could issue a clear policy statement on this matter now, so that the banks would encourage such studies on the Indian markets. They would not miss the black swans of the future.

There are already worrying signs that we might be heading down the wrong path. Large credit rating agencies in India are already tying up with large international ones from the developed world. Many models used by these international agencies are proprietary, and therefore, by definition, black boxes - we do not know what goes in there. That is why Indians would be better off and aware of big risks that happen frequently. ♦

*Reference # 02M-2008-01-08-01*

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