"Applying Six Sigma Quality Principles to Financial Risk Management"

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ABSTRACT

Introduction

The global financial crisis of 2008 revealed some serious deficiencies in risk management by financial institutions throughout the world. This shocked many observers who believed that these global financial giants, with many highly-educated and highly-paid financial engineers who had developed sophisticated financial products such as Collateralized Mortgage Obligations (CMO) and Credit Default Swaps (CDS), as well as risk models such as Value at Risk (VaR), would not find themselves in the position of having to be bailed out by governments and a few failing or into forced mergers.

Clearly there were some critical elements in the risk models that caused them to fail when they were most needed. Our paper addresses some of these issues in the context of Six Sigma processes, and identifies some limitations of VaR modeling of risk. For example, a target investor in a portfolio may wish, with specified certainty (1-α) that his holding will not fall by more than a desired % (say, 10%) during a his defined target period. In essence, VaR represents, under specific distributional assumptions, a level of risk exposure that results in the probability of asset value loss, say (1-α), to y%. The major weakness of VaR is the typical Gaussian distribution assumption that does not well represent the distribution of stock returns.

Our preliminary research design begins with the construction of a simple risky portfolio comprised of the S&P 500 and Treasury Bills. Subsequently, we estimate sample variance from the portfolio over the previous time period to get an estimate of 1% and 5% VaR's (α) , somewhat arbitrary levels that are nevertheless common in the financial risk management systems. Preliminary data suggest that a "multiplicative" technique based upon Six Sigma provides a reasonably accurate description of maximum price movements observed historically. We also discuss an operational approach that may provide value to financial risk managers.

Preliminary Conclusions

First, the Six Sigma process can be applied to the design of risk management systems. It provides a structured approach to collect data, analyze it, and develop financial products with an integrative plan-achieve-control structure as part of the process. Three key concepts of Six Sigma quality programs have direct applicability to design of investment portfolios. These are the principles of *over-engineering, robust design,* and *reliability engineering.* Over-engineering of a financial product involves combining different instruments that provide an optimal return-risk tradeoff that is immune to extreme tail events. If well done, the result is a robust design for the portfolio that will be able to respond in predictable ways to both expected and unexpected

market shocks and survive Grey and Black Swan events. Reliability engineering provides an extra layer of protection using portfolio insurance methods to hedge for extreme events using options, Credit Default Swaps, and other instruments and requires stress testing and simulation to build in reliability and robustness.

Complicating design of financial instruments are behavioral factors such as the "Persaud Paradox" where a false sense of confidence arises because peers are all using the same approach, such as VaR models. Overcoming this is a responsibility of risk management, and a structured approach as suggested in this paper can help in that effort. Other behavioral issues such as *herding* and *overconfidence* also contribute to the inadequacy of risk models and risk management. Much more research needs to be done to incorporate behavioral factors into risk modeling. The difficulty of doing this is another argument to over-engineer financial portfolios.