Risk Management Systems for Long-term Investors: Addressing/Managing Extreme Events

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The study of financial markets includes a significant focus on extreme events. The insurance marketplace, especially re-insurance, must address the measurement and management of extreme risks over long-time periods. The projected frequency of rupture of the New Madrid, MO fault is approximately 500 to 1000 years. Despite this low frequency, many individuals and companies have determined to act in a prudent manner and have bought earthquake insurance. The re-insurance marketplace is primarily concerned with these extreme events since they insure the primary insurance companies. In addition, the design of catastrophic options on earthquakes and hurricanes illustrates a new approach for addressing the risks of losses under severe events with extremely low probabilities.

A number of (re) insurance companies, including several in Bermuda, have begun to develop sophisticated risk management systems. The approach, called dynamic financial analysis, estimates the impact on a company's profit/loss over a large number of probabilistic events (over 40,000 scenarios). The companies diversify their risks by determining the risk-adjusted returns for any new policies or groups of policies, with respect to their current book of business. An important consideration is the amount of capital needed to support these fat tailed distributions. For instance, an insurance

company may wish to maintain adequate capital for 99 out of 100 years, or it may wish to add capital to protect itself 249 out of 250 years. The DFA systems provide estimates of the rare events for the company as part of its strategic planning process.

A related development has taken place in the area of pension planning. Actuaries must evaluate the ability of a pension trust to pay the beneficiaries over long periods of time -- decades into the future. Stochastic risk management systems attempt to protect the beneficiaries and ultimately the public. Again, extreme events must be addressed.

The growth of these stochastic systems has shown the benefits of careful analysis of rare events. Companies are able to protect their stakeholders to a much greater degree. Both the company's profit and risks can be improved at the same time. Nevertheless, a number of significant research issues have emerged. Prominent examples include the following:

1. What level of confidence is needed to protect the public?

2. Many of the models are aimed at reducing excess risks by limiting exposure in specified areas, such as beachfront properties. What are the implications of these policies?

3. The convergence of banks, insurance companies, and brokerage firms, all with different risk management traditions, has given rise to a need for a systematic approach to the integration of risks. What is meant by integration across countries, for example, when multiple regulations exist?

4. Several of the most widely used systems are proprietary, for example in the catastrophic risks area. Should the government provide a more active role in developing these sophisticated analyses? What about the difficulties in measuring the extreme events?

5. Certain countries depend upon the government to support future activities, while others depend upon market solutions. For example, the Japanese government underwrites a large portion of earthquake losses. In France, the government underwrites the pension plan system with almost no help from companies or individuals. What will happen when the shrinking working population cannot support the pensioners? The rare events may be more likely to occur than commonly understood.

6. Extreme events can be induced by joint actions in an economic setting. The use of portfolio insurance, for example, was partially responsible for the October 1987 stock market crash. What mechanisms should be put into place to prevent these forms of panic? Can the government develop policies (for example, using taxes) that reduce the chance of these extreme events from

undermining the country's economy? Systemic risks should be studied in this regard.

7. The standard assumptions regarding multiple risks, i.e. multi-normal distributions as embedded in systems such as J.P. Morgan's riskmetrics, do not adequate address the contagion that occurs in financial markets. There must be a better understanding of joint impacts and conditional distributions, for example using copulas and related techniques. Fundamental research is needed along these lines. It seems unlikely that individual companies will be able to conduct this research without governmental support.

8. The financial market has become more interconnected over the past 20 years. Problems in one country can spillover into other countries. Take the liquidity crisis in early fall 1998. The global nature of investing and the use of information technology increase the vulnerability of the global financial market. What can be done to measure the extreme events under these circumstances?

These topics illustrate that research on extreme events should include the domain of financial markets. It is easy to assume that the financial market will take care of it, or at least sensible parties can work out problems as they arise. Such a view may not be accurate, however. Research on extreme events can directly apply to the aforementioned issues.

Significant Research Issues: