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A Case Study in Risk Management: U.S. Monetary Policy

by Henry McMillan

In January 2004, Chairman Alan Greenspan spoke to the American Economic Association about "Risk and Uncertainty in Monetary Policy." In this speech, Chairman Greenspan referred to risk management as a central element in the conduct of monetary policy in the United States. The complete text is at *http://www.federalreserve.gov/boardocs/speeches/2004/20040103/default.htm* and is easy and insightful reading.

I attended the talk and thought it would be interesting to our section membership to hear how the Fed Chairman views risk management. As we define and delineate the scope of risk management in the actuarial profession and our traditional industries and seek to expand our influence beyond the traditional boundaries, we need to remember that many other industries also use "risk management" to describe their activities. We should understand how we view risk management similarly to and differently from others. In this note I quote Chairman Greenspan liberally and provide my interpretation of his comments.

Chairman Greenspan gave his talk in a hotel ballroom in front of several hundred academic, government and private sector economists. He began by recounting the "key developments of the past decade and a half of monetary policy in the United States from the perspective of someone who has been in the policy trenches." He discussed major policy events and decisions during his tenure and during that of his predecessor, Chairman Paul Volcker.

Midway through his talk, he began to explain in general why decisions were made—that they were an application of risk management.

"As a consequence, the conduct of monetary policy in the United States has come to involve, at its core, crucial elements of risk management. This conceptual framework emphasizes understanding as much as possible the many sources of risk and uncertainty

that policymakers face, quantifying those risks when possible, and assessing the costs associated with each of the risks. In essence, the risk management approach to monetary policymaking is an application of Bayesian decision making."

It is noteworthy that Chairman Greenspan emphasizes risk management as a conceptual framework, not as a task or modeling exercise. It is a way of formulating and addressing questions, a way of thinking that we, as actuaries, do as part of our professional existence, with or without formally recognizing it.

Our Bayesian decision making may not be done formally, with priors and posteriors and conjugate distributions, but we all intuitively put more or less weight on recent experience in some proportion to the extent of our prior experience. And I presume that is what policymakers at the Fed do also.

Greenspan next discussed the notion of strategy as applied to risk management.

This framework also entails devising, in light of those risks, a strategy for policy directed at maximizing the probabilities of achieving over time our goals of price stability and the maximum sustainable economic growth that we associate with it. In designing strategies to meet our policy objectives, we have drawn on the work of analysts, both inside and outside the Fed, who over the past half century have devoted much effort to improving our understanding of the economy … A critical result has been the identification of a relatively small set of key relationships that, taken together, provide a useful approximation of our economy's dynamics….

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Risk management involves strategy, not merely risk assessment, which involves measurement. Objectives and measurement are all part of the process, and the process is inherently an approximation.

> *However, despite extensive efforts to capture and quantify what we perceive as the key macroeconomic relationships, our knowledge about many of the important linkages is far from complete and, in all likelihood, will always remain so. Every model, no matter how detailed or how well designed, conceptually and empirically, is a vastly simplified representation of the world that we experience with all its intricacies on a day-to-day basis.*

We have enough problems trying to model policyholder behavior. Imagine trying to think of everything that everyone does. You come to accept that it's not the size of your model, but the huge uncertainty surrounding what you're trying to model.

Earlier in his talk Greenspan had referenced a commonly used distinction between risk and uncertainty due to Frank Knight, an economist active in the '20s and '30s.

> *The term "uncertainty" is meant here to encompass both "Knightian uncertainty," in which the probability distribution of outcomes is unknown, and "risk," in which uncertainty of outcomes is delimited by a known probability distribution. In practice, one is never quite sure what type of uncertainty one is dealing with in real time, and it may be best to think of a continuum ranging from well-defined risks to the truly unknown.*

In our models we have to define and use a distribution, even though we may not know that it is the correct distribution. We shouldn't lose sight of the fact that quantified may only mean that some quantity has been determined, conditional on the assumed underlying distributions, behavioral assumptions and institutional arrangements, which may be unknown or uncertain in the above sense.

Greenspan then turns to how one makes decisions if everything is not known.

> *Given our inevitably incomplete knowledge about key structural aspects of an ever-changing economy and the sometimes asymmetric costs or benefits of particular outcomes, a central bank needs to consider not only the most likely future path for the economy but also the distribution of possible outcomes about that path. The decision makers then need to reach judgment about the probabilities, costs and benefits of the various possible outcomes under alternative choices for policy.*

One should not be surprised to hear an economist use the phrase "costs and benefits" in a public address. Indeed there was an almost palpable relief among the audience when Greenspan anchored his ship to the solid rock of economic orthodoxy.

Chairman Greenspan did not say that stochastic analysis is necessary for effective monetary policy. However, it is quite clear that single-path analysis is not sufficient for monetary policy. Actuaries would probably agree that single path analysis is not adequate for pricing insurance products or for selecting investment strategies to back pension liabilities. What Greenspan is leading up to is that the extent of uncertainty and risk causes us to choose actions that would not be optimal if we knew more—more about the true nature of the economy and more about where the economy is headed in the absence of the Federal Reserve's actions.

> *A policy action that is calculated to be optimal based on a simulation of one particular model may not, in fact, be optimal once the full extent of the risk surrounding the most likely path is taken into account. In general, different policies will exhibit different degrees of robustness with respect to the true underlying structure of the economy.*

> *For example, policy A might be judged as best advancing the policymakers' objectives, con-*

ditional on a particular model of the economy, but might also be seen as having relatively severe adverse consequences if the true structure of the economy turns out to be other than the one assumed. On the other hand, policy B might be somewhat less effective in advancing the policy objectives under the assumed baseline model but might be relatively benign in the event that the structure of the economy turns out to differ from the baseline.

One insight that I take from these comments is that you need to consider "what if" your model is wrong. A particular investment or hedging strategy might appear very appealing in one model, but if the strategy is not robust, if it is too sensitive to parameter estimates or model structure, then it is not likely to turn out to be as good as you thought it would be. For example, a strategy involving multiple long and shorts of futures and options contracts to offset interest rate risk and volatility could be quite wrong or ineffective if the hedging ratios or positions are too highly dependent on a covariance matrix that is estimated with error.

In the next few paragraphs Greenspan makes statements suggestive of tail risk analysis that is increasingly used among actuaries.

As this episode illustrates, policy practitioners operating under a risk management paradigm may, at times, be led to undertake actions intended to provide insurance against especially adverse outcomes. Following the Russian debt default in the autumn of 1998, for example, the FOMC eased policy despite our perception that the economy was expanding at a satisfactory pace and that, even without a policy initiative, it was likely to continue doing so. We eased policy because we were concerned about the low-probability risk that the default might trigger events that would severely disrupt domestic and international financial markets, with outsized adverse feedback to the performance of the U.S. economy.

The product of a low-probability event and a potentially severe outcome was judged a more serious threat to economic performance than the higher inflation that might ensue in the more probable scenario.

Such a cost-benefit analysis is an ongoing part of monetary policy decision making and causes us to tip more toward monetary ease when a contractionary event, such as the Russian default, seems especially likely or the costs associated with it seem especially high.

A parallel to the inflation/liquidity crisis dilemma might be short-run GAAP earnings versus longer term statutory solvency facing risk managers choosing to use derivatives in an accounting challenged world.

Perhaps another view is that we get so caught up in the more likely events that we underestimate or ignore the low-probability events that can and do occur. Greenspan further notes that human behavior changes in crisis events, something that should be acknowledged and incorporated into the risk management process.

The 1998 liquidity crisis and the crises associated with the stock market crash of 1987 and the terrorism of September 2001 prompted the type of massive ease that has been the historic mandate of a central bank. Such crises are precipitated by the efforts of market participants to convert illiquid assets into cash. When confronted with uncertainty, especially Knightian uncertainty, human beings invariably attempt to disengage from medium to long-term commitments in favor of safety and liquidity. Because economies, of necessity, are net long—that is, have net real assets—attempts to flee these assets cause prices of equity assets to fall, in some cases dramatically. In the crisis that emerged in the autumn of 1998, pressures extended beyond equity markets. Credit-risk spreads widened materially and investors put a particularly high value on liquidity, as evidenced by the extraordinarily wide yield gaps that emerged between on-the-run and off-the-run U.S. Treasuries.

We typically allow for changing policyholder behavior as gaps between credited rates and market rates expand, but do we also allow for

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changing behavior in crisis situations? It seems that knowing what is in the model, and what is left out, combined with more qualitative thinking is all that can be done and what must be done.

Chairman Greenspan then turns to a discussion relating models to risk management, and the role of policy rules in risk management.

The economic world in which we function is best described by a structure whose parameters are continuously changing. The channels of monetary policy, consequently, are changing in tandem. An ongoing challenge for the Federal Reserve—indeed, for any central bank—is to operate in a way that does not depend on a fixed economic structure based on historically average coefficients. We often fit simple models only because we cannot estimate a continuously changing set of parameters without vastly more observations than are currently available to us. Moreover, we recognize that the simple linear functions underlying most of our econometric structures may not hold outside the range in which adequate economic observations exist. For example, it is difficult to have much confidence in the ability of models fit to the data of the moderate inflations of the postwar period to accurately predict what the behavior of the economy would be in an environment of aggregate price deflation.

Seems like there are a lot of lessons here for risk management in insurance companies and pension plans. We must expect change in estimated parameters and in behavior and in legal environments and so on. Model estimates from a previous era may not fit the current era. Calibration of a model to historical data may inadvertently straitjacket risk management if we do not allow the future to look different from the past.

But if the past is not prologue, what are we to do? Greenspan offers his pragmatic approach.

In pursuing a risk management approach to policy, we must confront the fact that only a limited number of risks can be quantified with any confidence. And even these risks are generally quantifiable only if we accept the assumption that the future will, at least in some important respects, resemble the past. Policymakers often have to act, or choose not to act, even though we may not fully understand the full range of possible outcomes, let alone each possible outcome's likelihood. As a result, risk management often involves significant judgment as we evaluate the risks of different events and the probability that our actions will alter those risks.

So does the future resemble the past? It's a hard question for an economic policymaker. It is perhaps even harder for an individual risk manager because the financial markets depend on the behavior of the economic policymaker too. An investor's world changes if the Federal Reserve changes its behavior, regardless of whether the economic world is fundamentally changed. That is, an investor must consider not only whether the world has changed, but also whether the Federal Reserve's view of the world has changed.

Certainly company executives must make decisions before our models are final or perfected or even ready for prime time. Judgments are part of real life, and must be factored into the risk management process, even if only qualitatively or judgmentally.

Greenspan notes that rule-based behavior has value, but can be overvalued if evaluated in the context of theoretical models rather than actual policy worlds.

Some critics have argued that such an approach to policy is too undisciplined—judgmental, seemingly discretionary and difficult to explain. The Federal Reserve, they conclude,

should attempt to be more formal in its operations by tying its actions solely, or in the weaker paradigm, largely, to the prescriptions of a simple policy rule…. And the prescriptions of formal rules can, in fact, serve as helpful adjuncts to policy, as many of the proponents of these rules have suggested. But at crucial points, like those in our recent policy history—the stock market crash of 1987, the crises of 1997-98, and the events that followed September 2001—simple rules will be inadequate as either descriptions or prescriptions for policy. Moreover, such rules suffer from much of the same fixed-coefficient difficulties we have with our large-scale models.

So many investment houses attempt to model the Fed's behavior, and thereby gain an edge in their investment strategy. It's not clear whether they want the Federal Reserve's behavior to be more transparent—thereby making the forecasting of Federal Reserve behavior easier—or to be even more clouded—thereby making the value of a correct forecast just that much higher.

At any rate, Greenspan appears to feel that rules are good, but meant to be broken. Judgment must rule the day.

To be sure, sensible policymaking can be accomplished only with the aid of a rigorous analytic structure. A rule does provide a benchmark against which to assess emerging developments. However, any rule capable of encompassing every possible contingency would lose a key aspect of its attractiveness: simplicity. On the other hand, no simple rule could possibly describe the policy action to be taken in every contingency and thus provide a satisfactory substitute for an approach based on the principle of risk management.

At this point Greenspan provides some ammunition for those of us who want some discipline in risk management and its associated modeling. In short, we must remember his audience: academic economists, a group that might make an SOA Section Council seem exciting. Greenspan has been saying that models and rules, by themselves, are not the answer. One should not, therefore, conclude that no models and no rules are the answer. Greenspan wants

good models and good rules, but also judgment and discretion. Undoubtedly, he feels that he has something to contribute to the risk management process known as monetary policy.

As I indicated earlier, policy has worked off a risk management paradigm in which the risk and cost-benefit analyses depend on forecasts of probabilities developed from large macro-models, numerous sub-models, and judgments based on less mathematically precise regimens. Such judgments, by their nature, are based on bits and pieces of history that cannot formally be associated with an analysis of variance.

Yet, there is information in those bits and pieces. For example, while we have been unable to readily construct a variable that captures the apparent increased degree of flexibility in the United States or the global economy, there has been too much circumstantial evidence of this critically important trend to ignore its existence. Increased flexibility is a likely source of changing structural coefficients.

So, could we say that not only does he rely on data, but his knowledge of how data are produced and collected. From that knowledge he and others at the Federal Reserve use qualitative adjustments to quantitative models and recommendations to arrive at the actual policy that is implemented. He sums up this portion of his talk—that it's not that we're complex, it's that the world is complex.

Our problem is not, as is sometimes alleged, the complexity of our policymaking process, but the far greater complexity of a world economy whose underlying linkages appear to be continuously evolving. Our response to that continuous evolution has been disciplined by the Bayesian type of decision-making in which we have engaged.

Chairman Greenspan continued his remarks on the role of forecasting, inflation targeting and future challenges for policy makers. He closed the presentation with a question and answer period.

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icyholder's attained age is high, reserves have built up and the net amount at risk (NAAR) is much smaller than the face amount of the policy (face amount = reserve + net amount at risk). With group life, sold as annual renewable term (ART) to all employees at many firms, the net amount at risk is a large percentage of the face amount. And reinsurers generally provide ART coverage to direct writers. As a profession we spend a lot of time studying tail risk of equity-based and casualty products. However, the greatest tail risk of all for insurers might be a product most life insurers and reinsurers have been happy selling for years as a core product, life insurance.

How it could happen

Several months ago the Extreme Values Subgroup of the SOA's Risk Management Task Force had a contest to describe an extreme event. In my entry I described a college all-star soccer camp held in the Midwest over semester break in late December. One of the campers isn't feeling well, but this camp increases his chance to make the U.S. National Team and it is worth playing even while feeling a little sluggish. The campers sleep in bunk beds set up in a gym. They spend all their time together, making many new friends. After the camp everyone flies back to his home to finish the rest of break, and then returns to their respective universities. No one realizes that all of them are now infected with influenza and contagious. Before anyone

knows it an influenza outbreak has occurred. How can society stop this scenario? It can't, and that is what is so scary about influenza.

Pandemic Basics

Every year approximately 30,000 Americans die from the flu. Most are very old or very young, with immune systems that are either not as strong as they once were or as they will become. Many get sick and spend a few days in bed to rest and recover. Few in the prime of life die from it. The general pattern is high morbidity and low mortality. Occasionally, perhaps five times per century, the virus mutates into a form that is either more contagious or experiences higher mortality. About once every century or two it takes a form that history remembers. This last happened in 1918, when 600,000 Americans and up to 100 million people worldwide died, most over the course of less than three months. While history is very likely to repeat itself, and the odds seem to increase over time, the more we know about the last pandemic the better we can deal with the

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In listening to Chairman Greenspan I found so many insights and applications of his comments to my work that I thought you all might feel the same. In trying to summarize what I take from his comments, here's the Top Ten:

1. Risk management is a conceptual framework.
2. Use your models as tools, as means to an end, not the end.
3. The simpler the better.
4. But the world's complex so even the simplest models might need to be complicated.
5. Robust is better than precise.
6. Rules help, but judgment matters too.
7. Know what you know and know what you don't know and never confuse one with the other.
8. Don't confuse the future with the past.
9. Avoid a big mistake from which you can't recover.
10. Never stop learning.

Now, I'm not going to run out and campaign to be the next Federal Reserve Chairman. But if that's your dream, go for it. ✦