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To use financial risk models effectively, we need to understand the role they play in decision making

By Roger Pielke Jr.

In 1936, John Maynard Keynes warned that "the ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Indeed the world is ruled by little else." Today, almost 75 years later, the power of economics often manifests itself through sophisticated financial and risk models which — when they are right and when they are wrong — exert a powerful influence on many aspects of our daily lives. Understanding the role of these models and how to use them wisely is something that we are still learning how to do.

One key factor underlying the ongoing financial crisis has been the role of complex financial risk models in creating what are now considered to be many billions of dollars of toxic assets resulting from credit derivatives based on subprime mortgages. The toxic assets led directly to the banking crisis, resulting in massive government bailouts, and an economic disruption that is still unfolding.

Since the 1990s, banks have used risk models to assess the probability of experiencing a financial loss in their

portfolios and to create complex new financial products. The models also served as the basis for decisions about how much risk to take and how much capital to hold in reserve. As it turned out, not only did the banks rely on faulty assumptions about risk of experiencing losses, which were calculated based on unrepresentative historical periods without financial crises, but those who rated the creditworthiness of the banks and their sophisticated financial products relied on the exact same models used by the banks. There was thus a circular logic at play which makes it no surprise that when a crisis developed, no one had a sense of the actual risks held by the banks. The resulting carnage has left the public in many countries around the world as the new owner of massive amounts of toxic assets.

Risk models can be valuable tools and modern finance would be impossible without them. But they must be used appropriately. In a 2000 book on the role of predictions in decision making that I co-edited (Prediction, Science, Decision Making, and the Future of Nature, Island Press) we developed a set of guidelines indicating when to rely on predictions in decision making in various fields of the geosciences, where there is far more experience in using and misusing predictive risk models. The criteria are met when predictive skill is known, decision makers have experience in understanding and using the predictions, the feedback loop between use of the prediction and evaluation of that use is relatively short (such that it can feed back into future decisions), there are limited alternatives to relying on prediction and the outcomes of decisions based on predictions are highly constrained (in other words, the magnitude of the consequences of decision error is limited).

In the case of financial risk models, each of these five guidelines was violated.

For instance, predictive skill is not known because risk models break down in times of crisis. Jon Danielsson of the London School of Economics explained this dynamic in a 2000 paper appropriately titled “The Emperor has No Clothes: The Limits to Risk Modelling.” He argues that “The basic statistical properties of market data are not the same in crisis as they are during stable periods; therefore, most risk models provide very little guidance during crisis periods.” The same models that make sophisticated financial instruments possible and profitable during normal times are virtually useless during times of crisis, and in fact may exacerbate problems when unique events occur.

Sometimes even the most sophisticated decision maker may either forget or fail to appreciate that models are just that — simplifications of the real world — and not the real world itself. According to Peter Hancock, one of the creators of such risk models at JPMorgan in the 1990s, users of risk models often failed to recognize their limits in circumstances of decision making, “It is an obvious point, but it is also something people so often forget.”

A second problem is that decision makers had little experience with the models in a group setting. It is now understood that the models encouraged a herd mentality among firms, exacerbating the crisis. According to an Inspector General’s report from the U.S. Securities and Exchange Commission released on Sept. 25, 2008, “In times of market stress, trading dries up and reliable price information is difficult to obtain. Models therefore become relatively more important than market price in times of market stress than in times when markets are liquid and trading actively. Such stressed circumstances force firms to rely more on models and less on markets for pricing and hedging purposes.” And if firms rely on the same models, they are likely to make the same decisions, which can exacerbate the crisis in a vicious cycle.

The role of risk models in the banking crisis shows that having many large institutions making bad decisions with flawed information is not a recipe for financial stability. But unfortunately, the pathologies of such financial modelling in decision making are found in many different contexts.

Consider the evaluation of catastrophe risk by insurance and reinsurance companies, as well as by regulators and investors. Such catastrophe models play a very important role in enabling companies and regulators to quantify risks and uncertainties associated with extreme events such as floods, hurricanes and terrorism. They also have direct impacts on the pricing of insurance and reinsurance in places exposed to catastrophes, such as along the U.S. Gulf and Atlantic coasts. But the use of these models also fails to meet the criteria that we developed for effective utilization.

In 2008, I participated in an “expert elicitation” conducted by the leading catastrophe modelling firm, Risk Management Solutions (RMS), to generate a one to five year prediction of hurricane landfalls for the United States. The prediction is one important component of the RMS catastrophe model because a small change in expected hurricane activity

can lead to large impacts on expected losses, with implications for capital reserve requirements among companies and homeowner insurance rates among policy holders. For instance, in 2006, loss estimates increased by about 40% after RMS conducted an expert elicitation that resulted in a 30% increase in expected landfalls.

Being a long-term observer of and participant in the hurricane research community, I welcomed the chance to participate in the elicitation, as I am well aware that the scientific community has yet to develop skill at forecasting hurricane landfalls or damage for periods of one to five years. After the elicitation, I wondered if the risk modelling could do something that the scientific community could not by offering up skillful one to five year probabilities for U.S. hurricane landfalls. I discovered from material published by RMS on prior years' elicitation that the resulting prediction of hurricane activity was no different than that which would have resulted from substituting random numbers for those produced by the RMS panel of world leading scientists on hurricanes and climate. Skillful prediction was not in cards, yet the results of the RMS process have a major effect on industry and markets.

Consequently, it is not surprising that, according to Karen Clark, founder of one of the leading catastrophe modelling firms which competes with RMS and now an independent consultant, when one looks at the first generation of such near-term predictions made in 2006, "all of the near-term models significantly over-predicted the number of hurricanes that would form in the Atlantic." Clark's criticisms of her own former company, as well as its competitors, included a reminder that echoes the lessons of the role of models in the banking crisis, "Catastrophe models are designed to simulate thousands of potential scenarios of what could happen to an insurance company — not what will happen in any given year or short time period. While catastrophe models, used appropriately, can provide credible estimates of a company's potential loss experience, the models are not able to predict where, when or how big actual events will be."

More troubling still is the fact that many of the reinsurance clients of the catastrophe modelling firms tend to benefit financially from more aggressive estimates of losses (enabling higher premiums). And similar to the circularity in evaluation seen in the case of financial risk models, the rating agencies rely on the exact same suite of catastrophe models to evaluate risks (and thus the creditworthiness of insurance and reinsurance companies) as well as financial instruments which are created

based the results of the catastrophe models. Catastrophe models may not have the same global importance as financial risk models, but the circularity and lack of connection to the real world might be of concern to those with real money at stake.

The general lesson to take from such experiences is that it is rarely the models that are at fault; it is instead the use of those models in ways that are inappropriate and can lead to flawed decisions, sometimes with very large consequences. Too often the models are treated like black boxes and their use is overlooked as being the domain of technical experts. To make better use of risk models in business decisions, we need to open up the black box and better understand the role of models in decision making. Because of the potential for conflicts of interest, it is important to have independent eyes looking at the models and their use, a role that too often goes overlooked.

Here again Keynes was prescient. On economics and other matters he wrote that "our knowledge of the future is fluctuating, vague and uncertain." Efforts to create or impose certainty when certainty does not exist can be dangerous to our welfare. Consequently we have to be ever vigilant that our ability to engage in sophisticated modelling does not outstrip our ability to effectively use the results of those models in making decisions.

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