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In Modeling Risk, the Human Factor Was Left Out

By STEVE LOHR

Today's economic turmoil, it seems, is an implicit indictment of the arcane field of financial engineering — a blend of mathematics, statistics and computing. Its practitioners devised not only the exotic, mortgage-backed securities that proved so troublesome, but also the mathematical models of risk that suggested these securities were safe.

What happened?

The models, according to finance experts and economists, did fail to keep pace with the explosive growth in complex securities, the resulting intricate web of risk and the dimensions of the danger.

But the larger failure, they say, was human — in how the risk models were applied, understood and managed. Some respected quantitative finance analysts, or quants, as financial engineers are known, had begun pointing to warning signs years ago. But while markets were booming, the incentives on Wall Street were to keep chasing profits by trading more and more sophisticated securities, piling on more debt and making larger and larger bets.

"Innovation can be a dangerous game," said Andrew W. Lo, an economist and professor of finance at the Sloan School of Management of the Massachusetts Institute of Technology. "The technology got ahead of our ability to use it in responsible ways."

That out-of-control innovation is reflected in the growth of securities intended to spread risk widely through the use of financial instruments called derivatives. Credit-default swaps, for example, were originally created to insure blue-chip bond investors against the risk of default. In recent years, these swap contracts have been used to insure all manner of instruments, including pools of subprime mortgage securities.

These swaps are contracts between two investors — typically banks, hedge funds and other institutions — and they are not traded on exchanges. The face value of the credit-default market has soared to an estimated $55 trillion.

Credit-default swaps, though intended to spread risk, have magnified the financial crisis because the market is unregulated, obscure and brimming with counterparty risk (that is, the risk that one embattled bank or firm will not be able to meet its payment obligations, and that trading with it will seize up).

The market for credit-default swaps has been at the center of the recent Wall Street banking failures and rescues, and these instruments embody the kinds of risks not easily captured in math formulas.

“Complexity, transparency, liquidity and leverage have all played a huge role in this crisis,” said Leslie Rahl, president of Capital Market Risk Advisors, a risk-management consulting firm. “And these are things that are not generally modeled as a quantifiable risk.”

Math, statistics and computer modeling, it seems, also fell short in calibrating the lending risk on individual mortgage loans. In recent years, the securitization of the mortgage market, with loans sold off and mixed into large pools of mortgage securities, has prompted lenders to move increasingly to automated underwriting systems, relying mainly on computerized credit-scoring models instead of human judgment.

So lenders had scant incentive to spend much time scrutinizing the creditworthiness of individual borrowers. “If the incentives and the systems change, the hard data can mean less than it did or something else than it did,” said Raghuram G. Rajan, a professor at the University of Chicago. “The danger is that the modeling becomes too mechanical.”

Mr. Rajan, a former chief economist at the International Monetary Fund, points to a new paper co-authored by a University of Chicago colleague, Amit Seru, “The Failure of Models That Predict Failure,” which looked at securitized subprime loans issued from 1997-2006. Their research concluded that the quantitative methods underestimated defaults for subprime borrowers in what the paper called “a systematic failure of default models.”

A recent paper by four Federal Reserve economists, “Making Sense of the Subprime Crisis,” found another cause. They surveyed the published research reports by Wall Street analysts and economists, and asked why the Wall Street experts failed to foresee the surge in subprime foreclosures in 2007 and 2008. The Fed economists concluded that the risk models used by Wall Street analysts correctly predicted that a drop in real estate prices of 10 or 20 percent would imperil

the market for subprime mortgage-backed securities. But the analysts themselves assigned a very low probability to that happening.

The miss by Wall Street analysts shows how models can be precise out to several decimal places, and yet be totally off base. The analysts, according to the Fed paper, doggedly clung to the optimists' mantra that nominal housing prices in the United States had not declined in decades — even though house prices did fall nationally, adjusted for inflation, in the 1970s, and there are many sizable regional declines over the years.

Besides, the formation of a housing bubble was well under way. Until 2003, prices moved in line with employment, incomes and migration patterns, but then they departed from the economic fundamentals.

The Wall Street models, said Paul S. Willen, an economist at the Federal Reserve in Boston, included a lot of wishful thinking about house prices. But, he added, it is also true that asset price trends are difficult to predict. "The price of an asset, like a house or a stock, reflects not only your beliefs about the future, but you're also betting on other people's beliefs," he observed. "It's these hierarchies of beliefs — these behavioral factors — that are so hard to model."

Indeed, the behavioral uncertainty added to the escalating complexity of financial markets help explain the failure in risk management. The quantitative models typically have their origins in academia and often the physical sciences. In academia, the focus is on problems that can be solved, proved and published — not messy, intractable challenges. In science, the models derive from particle flows in a liquid or a gas, which conform to the neat, crisp laws of physics.

Not so in financial modeling. Emanuel Derman is a physicist who became a managing director at Goldman Sachs, a quant whose name is on a few financial models and author of "My Life as a Quant — Reflections on Physics and Finance" (Wiley, 2004). In a paper that will be published next year in a professional journal, Mr. Derman writes, "To confuse the model with the world is to embrace a future disaster driven by the belief that humans obey mathematical rules."

Yet blaming the models for their shortcomings, he said in an interview, seems misguided. "The models were more a tool of enthusiasm than a cause of the crisis," said Mr. Derman, who is a professor at Columbia University.

In boom times, new markets tend to outpace the human and technical systems to support them, said Richard R. Lindsey, president of the Callcott Group, a quantitative consulting group. Those support systems, he said, include pricing and risk

models, back-office clearing and management's understanding of the financial instruments. That is what happened in the mortgage-backed securities and credit derivatives markets.

Better modeling, more wisely applied, would have helped, Mr. Lindsey said, but so would have common sense in senior management. The mortgage securities markets, he noted, grew rapidly and generated high profits for a decade. "If you are making a high return, I guarantee you there is a high risk there, even if you can't see it," said Mr. Lindsey, a former chief economist of the Securities and Exchange Commission.

Among quants, some recognized the gathering storm. Mr. Lo, the director of M.I.T. Laboratory for Financial Engineering, co-wrote a paper that he presented in October 2004 at a National Bureau of Economic Research conference. The research paper warned of the rising systemic risk to financial markets and particularly focused on the potential liquidity, leverage and counterparty risk from hedge funds.

Over the next two years, Mr. Lo also made presentations to Federal Reserve officials in New York and Washington, and before the European Central Bank in Brussels. Among economists and academics, he said, the research was well received. "On the industry side, it was dismissed," he recalled.

The dismissive response, Mr. Lo said, was not really surprising because Wall Street was going to chase profits in the good times. The path to sensible restraint, he said, will include not only better risk models, but also more regulation. Like others, Mr. Lo recommends higher capital requirements for banks and the use of exchanges or clearinghouses for the trade of exotic securities, so that prices and risks are more visible. Any hedge fund with more than $1 billion in assets, he added, should be compelled to report its holdings to regulators.

Financial regulation, Mr. Lo said, should be seen as similar to fire safety rules in building codes. The chances of any building burning down are slight, but ceiling sprinklers, fire extinguishers and fire escapes are mandated by law.

"We've learned the hard way that the consequences can be catastrophic, even if statistically improbable," he said.