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Unboxed

## Wall Street's Math Wizards Forgot a Few Variables

By [STEVE LOHR](#)

IN the aftermath of the great meltdown of 2008, Wall Street's quants have been cast as the financial engineers of profit-driven innovation run amok. They, after all, invented the exotic securities that proved so troublesome.

But the real failure, according to finance experts and economists, was in the quants' mathematical models of risk that suggested the arcane stuff was safe.

The risk models proved myopic, they say, because they were too simple-minded. They focused mainly on figures like the expected returns and the default risk of financial instruments. What they didn't sufficiently take into account was human behavior, specifically the potential for widespread panic. When lots of investors got too scared to buy or sell, markets seized up and the models failed.

That failure suggests new frontiers for financial engineering and risk management, including trying to model the mechanics of panic and the patterns of human behavior.

"What wasn't recognized was the importance of a different species of risk — liquidity risk," said Stephen Figlewski, a professor of finance at the Leonard N. Stern School of Business at [New York University](#). "When trust in counterparties is lost, and markets freeze up so there are no prices," he said, it "really showed how different the real world was from our models."

In the future, experts say, models need to be opened up to accommodate more variables and more dimensions of uncertainty.

The drive to measure, model and perhaps even predict waves of group behavior is an emerging field of research that can be applied in fields well beyond finance.

Much of the early work has been done tracking online behavior. The Web provides researchers with vast data sets for tracking the spread of all manner of things — news stories, ideas, videos, music, slang and popular fads — through social networks. That research has potential applications in politics, public health, online advertising and Internet commerce. And it is being done by academics and researchers at [Google](#), [Microsoft](#), [Yahoo](#) and [Facebook](#).

Financial markets, like online communities, are social networks. Researchers are looking at whether the mechanisms and models being developed to explore collective behavior on the Web can be applied to financial markets. A team of six economists, finance experts and computer scientists at Cornell was recently awarded a grant from the [National Science Foundation](#) to pursue that goal.

“The hope is to take this understanding of contagion and use it as a perspective on how rapid changes of behavior can spread through complex networks at work in financial markets,” explained Jon M. Kleinberg, a computer scientist and social network researcher at Cornell.

At the [Massachusetts Institute of Technology](#), Andrew W. Lo, director of the Laboratory for Financial Engineering, is taking a different approach to incorporating human behavior into finance. His research focuses on applying insights from disciplines, including evolutionary biology and cognitive neuroscience, to create a new perspective on how financial markets work, which Mr. Lo calls “the adaptive-markets hypothesis.” It is a departure from the “efficient-market” theory, which asserts that financial markets always get asset prices right given the available information and that people always behave rationally.

Efficient-market theory, of course, has dominated finance and econometric modeling for decades, though it is being sharply questioned in the wake of the financial crisis. “It is not that efficient market theory is wrong, but it’s a very incomplete model,” Mr. Lo said.

Mr. Lo is confident that his adaptive-markets approach can help model and quantify liquidity crises in a way traditional models, with their narrow focus on expected returns and volatility, cannot. “We’re going to see three-dimensional financial modeling and eventually N-dimensional modeling,” he said.

J. Doyne Farmer, a former physicist at [Los Alamos National Laboratory](#) and a founder of a quantitative trading

firm, finds the behavioral research intriguing but awfully ambitious, especially to build into usable models. Instead, Mr. Farmer, a professor at the interdisciplinary Sante Fe Institute, is doing research on models of markets, institutions and their complex interactions, applying a hybrid discipline called econophysics.

To explain, Mr. Farmer points to the huge buildup of the credit-default-swap market, to a peak of \$60 trillion. And in 2006, the average leverage on mortgage securities increased to 16 to 1 (it is now 1.5 to 1). Put the two together, he said, and you have a serious problem.

“You don’t need a model of human psychology to see that there was a danger of impending disaster,” Mr. Farmer observed. “But economists have failed to make models that accurately model such phenomena and adequately address their couplings.”

When a bridge over a river collapses, the engineers who built the bridge have to take responsibility. But typically, critics call for improvement and smarter, better-trained engineers — not fewer of them. The same pattern seems to apply to financial engineers. At M.I.T., the Sloan School of Management is starting a one-year master’s in finance this fall because the field has become too complex to be adequately covered as part of a traditional M.B.A. program, and because of student demand. The new finance program, Mr. Lo noted, had 179 applicants for 25 places.

In the aftermath of the economic crisis, financial engineers, experts say, will probably shift more to risk management and econometric analysis and concentrate less on devising exotic new instruments. Still, the recent efforts by investment banks to create a trading market for “life settlements,” life insurance policies that the ill or elderly sell for cash, suggest that inventive sales people are browsing for new asset classes to securitize, bundle and trade.

“Good or bad, moral or immoral, people are going to make markets and trade via computers, and this is a natural area of financial engineers,” says Emanuel Derman, a professor at [Columbia University](#) and a former Wall Street quant.

