Crazy Money

Humans aren't rational, as the recent economic crisis shows. So why should financial theories assume that they are?

NEW YORK CITY—Falling housing prices, crashing stock markets, contracting credit: Even the experts seem bewildered by the current economic crisis. Quantitative analysts (quants)—the whiz-kid financial engineers whose algorithms have dominated Wall Street trading in recent years—have watched those algorithms fail. Former Federal Reserve Chair Alan Greenspan acknowledged in October that there was "a flaw in the model that I perceived … defines how the world works." U.S. Treasury Secretary Henry Paulson flip-flops about the most effective way to spend an increasingly inadequate-seeming $700 billion of taxpayer money.

How could the experts be at such a loss? "One of the biggest factors in the current crisis is human behavior," says Andrew Lo, a financial economist at MIT Sloan School of Management in Cambridge, Massachusetts. However, the classical theory of finance simply does not address human psychology. It looks more like a physical science than a social science—relying on the premises that markets are "efficient," immediately reflecting new information, and investors are "rational," always acting in their self-interest. Although industry and regulators don't adopt classical finance theory wholesale, its assumptions underlie many of their choices.

Most of the time, classical finance theory works very well—and there's the rub. Lo compares it to Newtonian gravitation. During normal circumstances, people are generally rational, and the theory describes observed reality quite well. But in extreme circumstances—such as the past months for our economy—people panic, and the theory fails. Is a grander, general relativity–like theory of finance in reach? Lo says it is. Others, such as Jeffrey Wurgler, a financial economist at New York University's (NYU's) Stern School of Business, say the effort would be more like searching for a financial "string theory, which is unbelievably more complicated"—and possibly futile.

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What went wrong

Most accounts of the current financial crisis begin earlier this decade, when, inspired by the booming real estate market, mortgage lenders started giving loans to just about anyone who asked for one. Those loans got bundled and repackaged many times into risk-obscuring financial instruments, such as the now-infamous collateralized debt obligations (CDOs).

Through the unregulated "shadow banking system," these instruments ended up in the portfolios of nearly every bank and financial firm around the world. Because of the lack of regulation, members of this shadow system habitually borrowed dozens of times their own worth in cash—a debt that would be perilous if their bets didn't pan out.

And that's what happened when the real estate market, and thus the CDOs, turned sour. The losses surged through the world economy. Many firms—and, in some cases, their associated commercial banks—couldn't stay above water. Not knowing who would fail next, banks stopped lending, leading to further failures. To raise money, investors were forced to sell perfectly good stocks, causing stock prices to fall. "It's a very complicated system that's malfunctioning," says Yale University economist Robert Shiller.

Blame has fallen on quants for various aspects of the crisis. First, mathematical models were increasingly used to determine

whether someone deserved a loan, bypassing individual judgments. "In the end, there was very little sound credit judgment going into making these credit calls," says Bjorn Flesaker, a senior quant at Bloomberg in New York. Then, quant models were used to rate the riskiness of financial instruments, including the CDOs. "We never necessarily viewed the rating agencies as having the greatest rocket scientists around," says Flesaker, yet investors accepted those ratings, taking on more risk than even they realized. Finally, Value at Risk models claimed to tell trading departments of Wall Street companies the maximum loss they could expect to see on any day and therefore how much money they needed on hand to avoid total collapse. These models were "the wink-and-a-nod of Wall Street," says financial engineer Lee Maclin of NYU. Risk managers should have known to use common sense, but, in some cases, Maclin says, "the models were used to justify a bigger appetite for risk."

Despite their errors, Flesaker says he is "not in the 'blame the quants' camp," and he's not alone. Shiller says that, like many of the elements that economists and the media have focused on, the quant models are simply "proximate causes." Ultimately, experts must examine human behavior to find out why the crisis happened. Why did so many people take on mortgages that they would not be able to pay? Why did the best minds of Wall Street ignore warnings about a housing bubble? "The bottom-line question that economists, I think, still are struggling with is: 'Did anybody know that the risks were so great and, if so, why did they continue investing?' " says Lo. "I don't think they have an answer for that."

The madness of crowds

For more than 2 decades, researchers in behavioral finance have sought out the signatures of human irrationality in markets. "Behavioral finance is an intellectual revolution that tries to give a broader perspective from multiple social sciences," including psychology and sociology, says Shiller, a founder of the field.

For example, says economist José Scheinkman of Princeton University, classical finance theory's model of speculative bubbles, such as the dot-com bubble of the late '90s and the recent housing bubble, does not match real-life observations. Classical finance contends that rational investors will always have the best possible portfolio, so they will not buy or sell unless they have extra money to invest or need to cash in their investments. However, researchers have observed that people buy and sell much more often than that during a bubble—with the rate of transactions becoming increasingly manic the bigger the bubble gets.

Lacking a good classical model for stock-market bubbles, Scheinkman, whose work is primarily classical, turned to a concept in behavioral finance. Psychologists have found that people often overestimate the precision of their knowledge. Scheinkman and his Princeton colleague Wei Xiong guessed that overconfident investors would trust their own opinions about the price of an asset, so they would consider others' opinions, if different, a little "crazy," says Scheinkman. Looking to make money off others' crazy opinions, investors would be willing to pay more than they think an asset is actually worth because they believe that they will be able to sell it in the future to an overeager buyer. This process would inflate prices and cause a trading frenzy. Incorporating investor overconfidence into a theoretical model published in 2003 in the *Journal of Political Economy*, Scheinkman and Xiong were able to recreate more accurately the hyperactive trading in bubbles.

As Wurgler sees it, the time of most extreme irrationality was the housing bubble of the past several years, not the crash of the past few months. "The crash is the healthy return to normalcy," he says.

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—ANDREW LO

Evolving a theory

Although behavioral theory has succeeded at challenging classical theory—and has spawned several bestsellers, including this year's *Nudge*—some complain that it is only a series of critiques, not an alternative framework for understanding how markets work. "I would argue it takes a theory to beat a theory," says Lo.

Lo started his career developing quantitative models in line with classical finance theory, he says, but when he compared the models' predictions with stock-market data, "the models I developed ended up being rejected by the data pretty soundly." So for the past several years, he has been working on a new theory that combines insights from evolutionary biology and neuroscience, called the Adaptive Market Hypothesis (AMH), in contrast to the Efficient Market Hypothesis. Instead of seeing market participants as computers, which can always calculate the best way to achieve their goals, the AMH sees them as "species," which evolve strategies to compete for limited profits through trial and error. Overconfidence, he explains, is an adaptation. Overconfident investors who bet big and win get noticed; underconfident investors never even get in the game. He has found that quantitative models, based on the AMH's principles and equations from evolutionary biology, can replicate similar behavioral concepts.

Unlike investors in classical finance theory, Lo's species behave differently based on what part of their brains they are using. When things go well and people make money, as they did for the past decade, the experience stimulates investors' reward circuitry. This causes them to seek more profits and ignore possible risk, leading, for example, to a bubble. When things take a turn for the worse, panic overrides rational decision-making, leading to a crash. Only when the market is steady does the rational brain take over. Lo is starting to use functional magnetic resonance imaging and other tools of neuroscience to quantify these behaviors and incorporate them into his models. He also needs more real-world data on the way different funds invest money—data that are now secret or that no one bothers to collect.

Although Lo's idiosyncratic approach lies outside of the behavioral and classical theories, he says it reconciles them. "If you were an efficient-markets type, I think you'd be hard-pressed to explain what happened over the last few weeks. And if you were an irrational finance person, you'd be hard-pressed to explain what happened over the previous 10 years. So I think that the only way to reconcile the two is to acknowledge that both are different aspects of the exact same truth."

Keeping it real

Others say that the very message of behavioral finance is that a comprehensive theory is unrealistic, not only in practice but also in principle. "Economists deeply admire

the physical sciences and wish we could be like that," says Shiller. But, he says, "there's a human element that can get lost" when researchers emphasize quantitative methods instead of, say, historical ones. "I don't want to slavishly copy what is superficially scientific."

Nonetheless, behavioral researchers are eager to prove that their ideas mirror nature by using quantitative methods to link them directly to real-life data, NYU's Wurgler says. Stock pricing lends itself to such studies, because valuing a stock involves conjecture—which is subject to psychological factors—and a lot of stock-market data have recently become available to academic researchers.

In a 2007 paper in the *Journal of Economic Perspectives*, Wurgler and co-author Malcolm Baker, a financial economist at Harvard Business School, looked for signatures of investor sentiment—irrational optimism or pessimism—in stock-market data since the 1960s. They hypothesized that certain stocks would be more subject to sentiment than others: broadly speaking, stocks for which the true value is difficult to determine. For example, a young, promising company would fit the bill. "The combination of no earnings history and a highly uncertain future allows investors to defend valuations ranging from much too low to much too high," they write.

Behave! Jeffrey Wurgler (*left*) and Andrew Lo (*right*) incorporate irrational behavior into models of financial markets.

Comparing the stock-market data with their measure of investor sentiment, they found what they had expected. In optimistic times, difficult-to-value stocks were wildly popular and therefore made much more money than average. In pessimistic times, they were wildly unpopular and therefore made much less money than average. On the other hand, easy-to-value stocks, which are considered safer, were more popular in pessimistic times than optimistic ones, but their prices stayed much closer to average. This helps explain past bubbles in certain types of stocks—say, dot-com stocks in the 1990s—and is also useful for making predictions for the future, Wurgler says.

Mathematician Gunduz Caginalp of the University of Pittsburgh in Pennsylvania unifies theoretical modeling, laboratory experiments, and statistical studies of real-world market data. He and his colleagues, including Nobel Prize–winning economist Vernon Smith of George Mason University in Fairfax, Virginia, wanted to know how increased cash in the stock market would affect a bubble. In classical finance theory, more cash would make no difference, Caginalp says. "The fact that you have extra money, why should that push up prices?" he asks. "But that's exactly what we saw." In a 2001 paper in the *Journal of Psychology and Financial Markets*, Caginalp and his colleagues had volunteers trade for real money in an experimental market. They found that adding $1 per share to the market pushed up the price of shares by about $1. The result fit their predictions in an earlier theoretical modeling paper. Later, they also saw the effect in an analysis of New York Stock Exchange data. Caginalp draws the connection with the recent housing bubble: Loosened mortgage lending policies poured money into the housing market. "There's really no place for that money to go except to fuel various bubbles," he says.

Using behavioral finance, researchers will get better at explaining specific phenomena such as bubbles, says Wurgler. But, he argues, human psychology is so complex that a unifying theory is not within reach. "We'll putter along with an increasingly complex and diverse set of models," he says.

Putting it into practice

New theoretical models from academics may not affect Wall Street quants all that much. Quant models can be loosely divided into two types, says Flesaker: "trying to forecast future states of the world and trying to forecast the behavior of a particular financial instrument given the state of the world." The algorithms that help make decisions on when to buy and sell assets fall into the latter category, and they have held up reasonably well, he says. They work by exploiting tiny insights that others don't yet have, so anything published in the academic literature will be useless almost immediately.

The quant models that failed catastrophically—ratings models, Value at Risk models—are all in the former category, says Flesaker. But even these can be "pretty useful, if local, approximations to a much more complex reality," says Lo. A new theoretical framework could help quants better understand where their models are likely to be wrong. That could prevent managers from putting too much trust in their models, a factor in the failure of many companies. "The true skill of the practitioner is to know the ins and outs of the models," says financial engineer Petter Kolm of NYU. Practical decisions "can't just be based on some numbers that a model spits out."

On the other hand, new models could be very useful on the regulatory side. Last month, Lo testified at the U.S. Congress House Committee on Oversight and Government Reform's hearing on hedge funds. If markets are adaptive, he argued, then regulation should also be adaptive. For example, instead of making a rule about a particular new financial instrument, regulators could make a rule that applies to any new financial instrument that becomes "too big to fail." In that way, innovation would not get ahead of regulation, as it did in the shadow banking system.

Unfortunately, although new models—small or grand—may help experts understand bubbles and crashes better, behavioral finance predicts that they will never be able to prevent the behaviors that cause them. "Financial crises may be an unavoidable aspect of modern capitalism, a consequence of the interactions between hard-wired human behavior and the unfettered ability to innovate, compete, and evolve," Lo told the committee. In other words, says Caginalp, "human nature being what it is," when it comes to money, people will always be just a little bit crazy.

–CHELSEA WALD

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