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STRATEGY

Michael J. Mauboussin

mmauboussin@lmcm.com

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What Do We Need to Fix?

Protecting Against Ourselves

Knead honey-scented wax to stop them fast;
Yet you yourself may listen, sailing past,
If you desire: but make them bind you down
In the swift ship with cables from the mast;

That you, in the mast-socket lashed upright,
May hear the Sirens' singing with delight:
And if you pray them sore to let you go,
Let them but fasten your bonds more tight.

Homer
The Odyssey [1]

Revenge of the Revenge of the Nerds

Over the last 30 years or so, there has been a power shift on many Wall Street trading desks. The trading floors used to be filled with people who had limited formal education but who had worked their way up in the organization. These traders lacked academic pedigrees, but the survivors had street smarts. Then a new breed of trader came in, well-educated and quantitatively-oriented. These traders were book smart and tried to outwit the market by using sophisticated models based on finance theory.

Not surprisingly, the old guard and new guard didn't get along particularly well. The old guard viewed the quants as nerds with indecipherable methods. And the new generation was frankly amazed by the lack of sophistication the veterans showed. Michael Lewis, the acclaimed author, documented the tension in his bestselling book, *Liar's Poker*. Lewis captured an exchange between an old-guard trader at Salomon Brothers, Donnie Green, and a young salesman heading out the door to catch a flight:

> Green tossed the salesman a ten-dollar bill. "Hey, take out some crash insurance for yourself in my name," he said. "Why?" asked the salesman. "I feel lucky," said Green. [2]

The tension between the old and new guards was a major theme in another popular book by Lewis, *Moneyball*. Lewis showed how a new breed of general manager successfully applied quantitative techniques to manage a baseball team. The stats spoke louder than the scouts. Donnie Green's, it seemed, were on their way out everywhere.

But there has recently been a backlash against quantitative techniques, based on the implication that the faulty use of quantitative models was a major *source* of the boom and bust. Felix Salmon, writing in *Wired magazine*, suggested an equation dealing with default correlations "will go down in history as instrumental in causing the

unfathomable losses that brought the world financial system to its knees." [3] A growing chorus is now criticizing the folks who rely on the seat of their intellect instead of the seat of their pants. [4]

Consider the hyperbolic burst from Nassim Taleb, an author and former derivatives trader. He claims that "the biggest myth" he's encountered in his "life" is that theory can lead to practice just as well as practice can lead to theory. [5] Taleb suggests that the Donnie Green's were doing just fine, thank you, and that applying academic theories to real-world markets has done much more harm than good. For instance, he claims that options pricing models "increased our risks and set us back in risk management." [6] After any disaster, there's a natural desire to find the perpetrator. So here's the question of the moment: To what degree are misguided financial models to blame for the economic storm?

To start, here's a thought on Taleb's assertion that theory and practice isn't an equally-paved two-way street. Like most tricky issues, the validity of this assertion depends on the context. In some domains, good theory leads directly to effective practical application. Think of the atomic bomb. But for theory to usefully inform practice, the theoretical models must be a close approximation of reality. This is the case in many physical systems, for example. But since all models are a representation of the world, the greater the difference between the model's output and the real world, the greater the risk in relying blithely on the model. Models in economics and finance frequently fail to capture the dynamics of markets, which is why blind faith in theory can lead to disastrous practice. [7]

So much for the seat-of-the-intellect approach to investing. But romanticizing the seat-of-the-pants approach has its own issues. Take the example of a successful trader or investor who claims to operate mostly through intuition. The initial question is whether the trader's success is simply the result of luck. Investment returns combine skill and luck. And of the two, luck is the more significant over the short term. Successful investors may simply be the survivors of a largely random process. Chance and survivorship bias make it hard to equate success with a thoughtful process.

But even if you believe a healthy chunk of a successful investor's results are attributable to skill, the next question is whether those skills are transferable. If those skills are unique to an individual—and they generally are—then there's no reason to get too enthused about the man versus the model. Just because some investors relied too heavily on models does not mean that relying solely on gut feeling is better. Evolutionary processes ensure that you see only the intuitive traders who have been successful. But the relevant consideration is how many investors used an intuitive approach and failed. [8]

There's an even more basic problem with blaming fancy mathematical models for today's mess: we've had booms and crashes for as long as markets have existed. [9] You can point a finger at computers, CNBC, the Black-Scholes options pricing model, securitization, credit default swaps, or any other innovation or technology as the source of the problems today. But the same pattern has unfolded time after time before any of these alleged culprits existed.

The models and technology were accessories to the crime, not the perpetrators. The common denominator in financial crises through time is human nature. Specific aspects include the role of incentives and how they shape behavior, how people interact and influence one another, and that humans are capable of creating systems they do not understand. If regulation is to succeed, it has to address these fundamental issues.

Still, we cannot let the quants and their models off the hook totally. One persistent challenge is the problem of induction, or generalizing about the future given a limited sample of the past. This is a major issue in quantitative finance because historical data do not always reveal a system's riskiness and the statistical properties of markets change over time. Quantitative modelers are well aware of these problems, but when a model yields good profits for a time the quants have a tendency to let their guard down. It is well within human nature to assume that the flow of profits

equals insight into the market's workings. This creates a sense of shock when events occur outside the predictions of the models.

Another issue is that the very creation and implementation of models changes the markets. There is an essential feedback between models and markets that the quants often overlook. Donald MacKenzie, an economic sociologist at the University of Edinburgh, argues that financial economics is an "engine" that is "an active force transforming its environment, not a camera passively recording it." [10] For example, credit default swaps (CDS) are not a bad idea and there will likely be an active market for them, with some modifications, for the foreseeable future. But the introduction of CDS changed the nature of the markets. Buyers of CDS who were seeking to reduce risk by hedging their holdings, for instance, may have actually contributed to an *increase* in systemic risk.

The quants, while not blameless, were not the cause of the most recent financial calamity. Human behavior and the systems that result are common to all of the booms and busts, and inexorably link the old and new breed of traders.

The complexity of human behavior makes it nearly certain that there will be similar crises in the future and that the introduction of additional regulation will not be able to stop them. Indeed, many forms of regulation will create more problems than solutions. That is not to say that some regulation would not be useful. It's just that regulation has to recognize the markets for what they are: interrelated, complex, and tightly-coupled systems. [11]

Hindsight Bias and Normal Accident Theory

Investment pundits now proclaiming "the current crisis was obvious and inevitable" should trigger the same reaction as hearing fingernails scraping the chalkboard. This is a classic example of hindsight bias, the tendency to "overestimate what we knew beforehand based upon what we later learned." [12] Everything is obvious in retrospect. Now that we have experienced a very difficult time, our tendency is to believe that the present outcome was the only possible outcome. In truth, what we lived through was only one of a number of plausible scenarios, some worse and some better than what we actually experienced. Counterfactual thinking is crucial when considering the path of a complex system.

Some people, including hedge-fund managers John Paulson and Steve Eisman, did see the trouble brewing and positioned themselves accordingly. [13] They were right for the right reasons, and deserve our applause. Their legacies will grow further if they foresee future market dislocations and profit from them. But it's important to remember that *someone* has a bet on almost every possible outcome. If a market goes way up or down, there will be new heroes and goats. The reason most people didn't see the current crisis coming is because it *wasn't* obvious.

Well, maybe that's overstating the case. When it comes to crises, we can predict that another one will happen with a high degree of certainty. The problem is figuring out when and where. To see why the general prediction is easy but the specific prediction is hard, we can look to normal accident theory, developed by Charles Perrow, a professor emeritus of sociology at Yale University. This theory explains why certain types of systems periodically experience catastrophic events. The term "normal" conveys that these accidents are part and parcel of the systems. Build the system and the accidents will come.

In his book, *Normal Accidents*, Perrow describes the two characteristics that make a system vulnerable to periodic failure. The first is what he calls "interactive complexity," which means the system will witness a combination of failures among its components that were not anticipated by the designers—in fact, the components were not intended to be linked in the first place. Perrow illustrates this concept with the accident at the Three Mile Island nuclear power plant that occurred thirty years ago. The accident was the result of "four independent failures, all small, none of which the operators could be aware of." [14] Perrow walks through the incident and shows

how the cascade of small errors culminated in the frightening accident. Automatic safety devices kicked in along the way but they either failed or, in some instances, created new sets of problems.

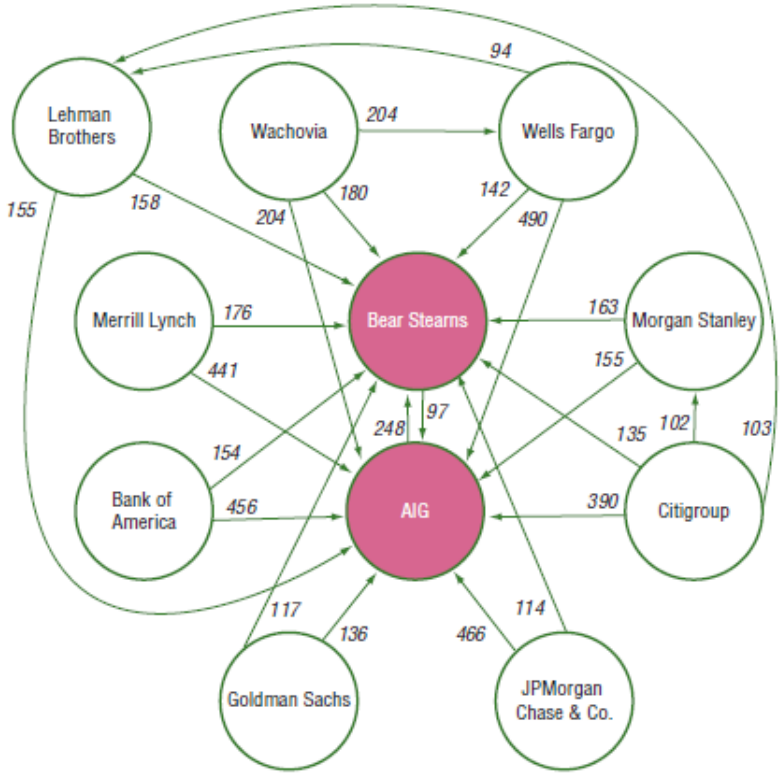
The second characteristic is tight coupling, which means "there is no slack or buffer between two items. What happens in one directly affects what happens in the other." [15] You can think of a line of dominoes standing on edge. Topple the first one and each domino will fall in turn, and there's no way to stop the process. Naturally, system designers recognize these risks and try to build in safety features. But if these backups fail, even a modest initial problem can propagate through the system and cause a large failure. The power grid is a good example of a tightly coupled system. If the conditions are right, small grid failures can lead to large-scale blackouts. [16]

The Swiss cheese model, developed by James Reason, a professor of psychology, is a useful way to visualize how interactive complexity and tight coupling can lead to failure. Imagine levels of possible failure—for example, human error and unsafe conditions—as slices of Swiss cheese. At each level the holes in the cheese represent points of vulnerability, and these holes move around as conditions change. Only when the holes align can a failure cascade through all of the levels, which happens to the system with some (typically small) probability. [17]

We need to demonstrate that markets exhibit interactive complexity and tight coupling in order to show why normal accident theory is a useful way to consider the recent crisis. One measure of interactive complexity in the financial system is how the credit risk of one institution affects the credit risk of others. Research by the International Monetary Fund (IMF) highlighted that co-risk increases during periods of stress. This means that heightened perceived credit risk at one financial institution leads to an above-average increase in perceived credit risk for an associated financial institution. For example, IMF analysis shows that when Lehman Brothers' CDS spreads rose to distressed levels in March of 2008, AIG's CDS spreads went to a level in excess of two times what would be expected. [18]

The IMF research also reveals the degree to which major financial institutions were connected to one another. In Exhibit 1, the numbers attached to the arrows show how much the risk for the linked financial firm rose, above and beyond what you would expect, when the source firm was in distress. For example, the default risk of AIG, conditional on the risk of JP Morgan, was 466 percent higher than AIG's standalone risk under stress.

Exhibit 1: Co-Risk Feedbacks in the Financial System, March 2008



Source: International Monetary Fund, "Global Financial Stability Report: Responding to the Financial Crisis and Measuring Systemic Risks," April 2009, 90. See www.imf.org.

The financial institutions that have arrows with high numbers pointing at them were highly connected to other institutions. Of the top four firms the IMF deemed most vulnerable (AIG, Bear Stearns, Wachovia, and Lehman Brothers), one received a massive bailout, two were acquired, and one went bankrupt. Even though these financial institutions had capital requirements designed to prevent failure, the interactive complexity overwhelmed the safeguards when distress hit.

Financial markets also have tight coupling. One example is the role of leverage. After a period of rising asset prices, debt is often easily accessible and relatively cheap. The positive feedback between rising asset prices and higher leverage sets up the tight coupling on the downside. Specifically, a decline in an asset price triggers a margin call, forcing the investment manager to sell more of the asset, thus triggering additional margin calls, and so forth. Once the process gets going, it's virtually impossible to stop. Leverage can help drive asset prices to extreme valuations. [19]

Derivatives play a large role in both interactive complexity and tight coupling. For example, CDS are effectively a form of unregulated insurance that promote interactive complexity. Companies selling CDS are able to book immediate profits (unlike an insurance company collecting premiums) but also create counterparty risk. If a triggering event occurs, an insufficiently-capitalized CDS seller might go into bankruptcy, propagating a painful ripple through the financial system. This concern is what prompted the Federal Reserve and Treasury Department to bail out AIG. As Federal Reserve Chairman Ben Bernanke testified before Congress, "It is unlikely that the failure of additional major firms could have been prevented in the wake of the failure of AIG." [20]

Failure to grasp the increase in interactive complexity was one of the lessons I learned from the financial crisis. Despite the large notional value of CDS outstanding, I chose to focus more on the net exposure. For example, when Lehman declared bankruptcy the outstanding CDS exposure was reported to be in excess of $500 billion, but the final close out on the CDS contracts on Lehman's debt was $5.2 billion—a large, but manageable sum. [21] But now I realize the "net" didn't matter as much as the "network." The rapid growth in CDS, and the shadow banking system in general, increased interactive complexity to unprecedented levels.

Perrow anticipated the role derivatives would play in increasing tight coupling. In 1999, he wrote, "Arbitrage, of which derivatives are an especially powerful set, increases coupling." [22] While derivatives play a large and generally useful role in the financial system, they can create externalities that are sizeable and tricky to measure.

Normal accident theory is a useful way to think about the financial system, including markets and institutions, and offers some ideas about how to proceed with regulation. Despite the challenges of the recent crisis, markets remain a useful mechanism to allocate resources. The goal is to preserve what markets do best while mitigating the risk of future financial catastrophes.

What Do We Need to Fix?

Andrew Lo, a professor of finance at MIT and chief scientist at a hedge fund, describes the main market failures economists agree exist. Regulatory oversight makes sense to address these potential failures: [23]

- *Public goods.* These benefit everyone in a population, so regulation has to make sure that everyone contributes so as to avoid the problem of free riding—i.e., enjoying the benefits without bearing any of the costs. National defense is one example.

- *Externalities*. An economic transaction that produces costs or benefits to parties not involved in the transaction creates an externality. Since negative externalities are not included in market prices, regulators have to step in to limit their extent. Pollution from a factory is a classic illustration of a negative externality.

- *Incomplete markets*. When there is not enough supply or demand for a product or service, a market can be incomplete. In such cases, the government may step in to provide that product or service. Government-sponsored unemployment insurance is a case in point.

- *Behavioral biases.* Some patterns of human behavior are undesirable, and regulation can help mitigate their costs. Examples of regulation include making school lunches healthier and cracking down on drunk driving.

Systemic risk is a public good. Everyone wants markets that are reliable and stable but no one wants to shoulder the cost of risk management. Governments can try to manage the risk of these failures through various means, including imposition of taxes (or subsidies), sharpened oversight, and enforced disclosure. Government officials will undoubtedly introduce some of these measures as a result of the recent crisis, as they did in the wake of past crises (e.g., the Securities Exchange Act of 1934 and the Sarbanes-Oxley Act of 2002).

If the common denominator of all crises is human nature, then it stands to reason that regulation should also take into account incentives, interaction, and the complex systems humans create. Just as a diet is a form of regulation to keep you from eating too much, financial regulations must prevent individuals from doing what they would like to do. Like Odysseus passing the Sirens, we must devise regulations to temper natural human tendencies.

The first big issue that regulation must address is the principal-agent problem. This arises when the people making the economic decisions (agents) have different payoffs than the people who live with the consequences of those decisions (principals). This problem existed at multiple levels in the recent housing-related crisis.

One prominent example is the change in ownership structure of Wall Street firms from private partnerships to public corporations. Private partnerships used to dominate, but were eclipsed by a public corporate structure in the last few decades. Private partnerships watched their capital closely, tended to use less leverage than what is common today, and stuck with comprehensible strategies to make money. The partners made sure they allocated their capital prudently and had little appetite for esoteric products. Private partnerships did fail, but they rarely posed systemic risk (Long-Term Capital Management is one notable exception).

The incentives are different for employees of a public company than for those of a partnership. John Gutfreund, former CEO of Salomon Brothers, explains it this way, “Shareholders share in the downside and not necessarily in the upside, that’s the whole story.” He continues with his bottom-line assessments, “It’s OPM: Other People’s Money.” [24] The recent rise of boutique Wall Street firms is a step in addressing the principal-agent problem. [25]

Another example of the principal-agent problem is the behavior of the credit agencies. The large rating agencies are designated as “Nationally Recognized Statistical Rating Organizations,” or NRSROs. This designation is important because the Securities and Exchange Commission allows financial firms to use the ratings by NRSROs to determine which firms are in compliance with regulatory requirements. A rating of AAA from an NRSRO implies a high degree of creditworthiness.

The problem was that the ratings agencies made tidy fees, paid for by the issuers, to rate all sorts of financial instruments that were relatively new. The NRSROs didn’t have the models to properly rate those instruments and were vastly too liberal in doling out their highest credit ratings. Poor incentives and poor oversight were complicit in the ultimate meltdown. [26]

The second big issue regulation must address is removing the too big to fail problem. In recent decades, there has been a trend toward bigger and more complex networks. This trend has been urged by the benefit of economies of scale and technological advancement. Think of social networks, as a simple example. Duncan Watts, a scientist at Yahoo! Research, notes that while these networks allow us to spread solutions faster than ever, they also permit problems to cascade. So problems with subprime mortgages in the U.S., which might have remained contained in the past, propagated into a worldwide financial crisis. [27]

In a follow up book that explains what to do about systems susceptible to normal accidents, Charles Perrow offers a relatively straightforward prescription: we should “reduce concentrations of the things that make us vulnerable.” [28] The idea would be for a regulatory body—most likely the Federal Reserve—to periodically assess what the sudden failure of one company would mean to the rest of the financial system. If the regulators deemed the company “too big to fail,” the company would have to restructure, break up, or downsize.

This prescription presumes that there are objective ways to judge the risk of being too big to fail and that the Fed will be diligent in its regulatory oversight. Indeed, the term “too big to fail” is a misnomer; it is more accurate to say “too interconnected to fail.” [29] Interconnectedness may be related to size, but that is not the case necessarily. Further, the concern is not that a certain financial institution fails—AIG, Bear Stearns, Wachovia, and Lehman Brothers all failed from the point of view of their shareholders—but rather that its failure imperils the rest of the financial system. So regulations really need to monitor the interconnectedness of institutions, which is harder to measure than the simple size of an institution.

Another challenge is that the financial system is global. Since some economies of scale exist in financial services, non-U.S. financial institutions may expand to fill the niches left open by downsized U.S. institutions. In this case, U.S. institutions would end up less competitive and still exposed to systemic risk. So U.S. regulators must monitor changes in the global system, not just in the U.S.

In an attempt to dampen volatility, regulators can institute some countercyclical measures (these are contemplated in the administration's current proposal). For example, regulators can tighten margin and capital requirements following a period of good economic and asset price performance, and loosen those same requirements in more challenging environments. Again, such measures are easier said than done, because the political and economic pressures at market tops and bottoms are acute.

Can We Tame Human Nature?

Here are some conclusions from this discussion:

1. *Faulty quantitative models were not the core problem in the recent crisis*. The main challenge in blaming models is that many crises have occurred before today's models were developed. So while the models may have been an accessory to the slide, they were not the perpetrator. The source behind the boom and bust cycle was more fundamental.

   In *Normal Accidents*, Perrow dismisses three commonly-cited culprits—technology, capitalism, and greed—that people invoke to explain failures. He argues that the real culprit is the externalities from the technology. In the recent financial crisis this was the rise in moral hazard. In other words, the possibility of the system's failure was not priced into market transactions, leaving the government to pick up the pieces. Regulation needs to address those externalities. [30]

2. *Accidents will happen*. Our society has created a large number of systems that are interactively connected and tightly coupled. These include aircraft, industrial factories, and the electric power grid. Because, as Perrow says, "our reach has surpassed our ability to grasp," we are in for failures in the future. From a societal perspective we must first ask whether the benefit of the technology exceeds the cost of periodic failures. In almost all cases, this is true. Despite tragic plane crashes, for instance, air travel confers large benefits.

   On an individual level it's important to prepare for periodic failure. Depending on a portfolio's mandate and time horizon, some sort of insurance may be a good idea, just as it is for an individual.

3. *Some regulation can help*. In principle, some regulation makes sense, although in practice it is tricky to implement. As Perrow and others have argued, one goal is to remove targets that are too big to fail. This is an enviable goal in the financial markets but requires good methods to measure systemic risk and the political will and means to implement the remedies.

   Specifically, regulation should try to tackle the principal-agent problem and the negative externalities that arise as a consequence. Some of the administration's proposals, including sharpening reporting requirements and insisting securitization originators have a greater stake in what they produce, are steps in the right direction.

Endnotes

[1] Homer, *The Odyssey*, Translated by J.W. Mackail (London: John Murray, 1905), 105. The idea to use the story of Odysseus as an example of regulation came from a talk by Andrew Lo.
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[3] Felix Salmon, "Recipe for Disaster: The Formula That Killed Wall Street." *Wired Magazine*, March 2009, 74–79, 112. See other examples, including, Sam Jones, "The formula that felled Wall Street," Financial Times, April 24, 2009, and Andrew Lo, *Hedge Funds: An Analytical Perspective* (Princeton, NJ: Princeton University Press, 2008), 255-302.
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[13] Michael Lewis "The End," *Portfolio*, December 2008.
[14] Charles Perrow, *Normal Accidents: Living with High-Risk Technologies* (Princeton, NJ: Princeton University Press, 1999), 12.
[15] Ibid., 90.
[16] Michael J. Mauboussin and Kristen Bartholdson, "Watts on Watts (and Much More)," *The Consilient Observer*, September 9, 2003. See http://cdg.columbia.edu/uploads/stories/Consiient_Observer.pdf.
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[19] John Geanakoplos, "Liquidity, Default, and Crashes," *Cowles Foundation Paper*, No. 1074, 2003.
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[23] Andrew W. Lo, "Hedge Funds, Systemic Risk, and the Financial Crisis of 2007-2008," *Written Testimony for the U.S. House of Representatives Committee on Oversight and Government Reform*, November 13, 2008.

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