

Interdisciplinary Approaches to Financial Stability



Panel 2: Responding to Fundamental Challenges Thursday, October 22, 2015 at 11:15 a.m. Hutchins Hall 100

Moderator:

Michael S. Barr, University of Michigan

Panelists:

Jeremy Bulow, Stanford University

Lisa Donner, Americans for Financial Reform

Simon Levin, Princeton University

Hans Morris, Nyca Partners

Michael Wellman, University of Michigan

A stable financial system is critical to our country's security and economic growth. A stable financial system directs investments toward companies and industries that offer the highest returns and ensures companies have access to the credit, savings, and risk management products and services they need to grow. Moreover, creating and maintaining a stable financial system helps prevent future financial crises, which are devastating to the real economy and have a long-lasting effect on the well being of average American households and businesses.

The 2007-2009 financial crisis revealed the pressing need to develop better methods to understand and manage risk in the financial system. Since the crisis, financial regulators, scholars, and the financial industry have turned their attention to these issues, and made progress, but our ability to identify, monitor, and mitigate risk in the financial system remains far behind where we need to be.

For example, stress testing, a central and in some ways innovative risk management tool used since the financial crisis by both regulators and practitioners, remains crude and static. Although the goal of stress testing is to analyze and measure capital adequacy and systemic risk, it is in many ways still stuck measuring the static effects of macro-shocks on individual firms. In many respects, stress testing today is where inventory management was in the 1950s—with inventory, in this case, being units of capital.

While there have been significant recent advancements, our current stress tests fail to account for the increased interconnectedness and complexity of the financial system. The models

do not yet capture the complex network of financial transactions that connect firms and that can spread and magnify risk in the event of a crisis. The models are not dynamic—meaning, they do not account for market participants’ responses to stressful events. Such responses themselves may change the nature of the events in question. Moreover, even if these more robust models existed today, regulators do not, at least as of yet, have full access to the financial data needed to use the models to measure systemic risk.

This conference aims to promote new ways of thinking about how to identify, measure, and mitigate systemic risks by drawing on methods from other disciplines and experience from other sectors that face systemic risks. We will explore how methods from other disciplines—such as system analysis, agent-based modeling, machine-based learning, behavioral finance, and data visualization and security—can be used to improve stress testing and financial risk management practices and regulation. We will also examine how risk is measured, monitored, and mitigated in other sectors and contexts, such as in supply chains and electrical grids, and in the context of climate change; how stakeholders in these contexts make tradeoffs between stability, efficiency, and innovation; and how lessons from these contexts can be applied to the financial system.

In the wake of the financial crisis, leaders in the U.S. and global community made restoring and maintaining financial stability a top priority.¹ In doing so, they did not seek a financial system that was completely safe or riskless. Instead, they sought a stable financial system, one that can be relied on to consistently meet the financial intermediation and payment services needs of the real economy.² Such a system allows for beneficial financial innovation, while guarding against conditions that would inflict damage on the broader economy.

For many years, the U.S. financial system maintained this difficult balance between innovation and stability. Consumers, investors, and businesses benefited from financial innovations, while well-designed regulatory safeguards mitigated the risks. The regulatory structure successfully balanced incentives for innovation and competition with protections against abuse and excessive risk taking.

¹ See, for example, Barack Obama, “Remarks on 21st Century Financial Regulatory Reform,” (remarks, Washington, DC, June 17, 2009), and G20 Leaders, *Declaration on Strengthening the Financial System* (London, April 2, 2009).

² 2 C.F.R. § 1310.23 (“The [Financial Stability Oversight] Council will consider a ‘threat to the financial stability of the United States’ to exist if there would be an impairment of financial intermediation or of financial market functioning that would be sufficiently severe to inflict significant damage on the broader economy.”); Eric S. Rosengren, “Defining Financial Stability and Some Policy Implications of Applying the Definition,” (remarks, Stanford Finance Forum, Stanford University, June 3, 2011) (“Financial stability reflects the ability of the financial system to consistently supply the credit intermediation and payment services that are needed in the real economy if it is to continue on its growth path.”).

The U.S. reaped the benefits of this approach. The U.S. financial industry often surpassed its competitors in other major developed economies in innovation and productivity growth.³ The financial system was generally good at directing investment toward the companies and industries that offered the highest returns. Regulatory checks and balances helped create a remarkably long period of relative economic stability, which, in turn, gave rise to extraordinary national wealth. Regulation also provided investors and consumers with strong protections. The system endured crises and recessions, to be sure, including the costly bank and thrift failures of the late 1980s and early 1990s, but these shocks did not threaten the foundations of the financial system.⁴

But over time, the regulatory system found itself outgrown and outmaneuvered by the institutions and markets it was responsible for regulating and constraining, and the carefully designed mix of protections eroded with the development of new products and markets for which those protections had not been designed. The financial sector, under the guise of innovation, piled risk upon ill-considered risk. Financial innovations outpaced the capacity of managers, directors, regulators, rating agencies, and the market as a whole to understand and respond. Rapid growth in key markets hid misaligned incentives and underlying risk.⁵ Capital buffers were increasingly inadequate throughout the financial system, as both market participants and regulators failed to account appropriately for new risks.⁶ The apparent short-term rewards in new financial products and rapidly growing markets overwhelmed or blinded private-sector gatekeepers,⁷ swamping those parts of the system designed to mitigate risk. Consumer and

³ See, for example, Martin Neil Baily, “Competition, Regulation, and Efficiency in Service Industries,” *2 Brookings Papers on Economic Activity: Microeconomics* 71, 106-08 (Martin N. Baily & Peter C. Reiss eds., 1993) (calculating that, in 1989, productivity of the U.S. banking sector considerably exceeded that of Germany and United Kingdom by measures including credit accounts per employee, deposit accounts per employee, and payments per employee).

⁴ Federal Deposit Insurance Corporation, *History of the Eighties: Lessons for the Future*, 75-79 (1997), http://www.fdic.gov/bank/historical/history/3_85.pdf (describing treatment of large bank failures and exercise of systemic risk authority as “[o]pen [q]uestions” after the savings and loan crisis).

⁵ Staff of the Senate Permanent Subcommittee on Investigations, 112th Congress, *Wall Street and the Financial Crisis: Anatomy of a Financial Collapse* (2011), 143-55, http://hsgac.senate.gov/public/_files/Financial_Crisis/FinancialCrisisReport.pdf (detailing decoupling between risk of originated loans and employee compensation at Washington Mutual).

⁶ Financial Crisis Inquiry Commission, *Financial Crisis Inquiry Report: Final Report of the National Commission on the Causes of the Financial and Economic Crisis in the United States*, (Washington, D.C.: U.S. Government Printing Office, 2011), 33 <http://www.gpo.gov/fdsys/pkg/GPO-FCIC/pdf/GPO-FCIC.pdf>.

⁷ Staff of the Senate Permanent Subcommittee on Investigations, *Wall Street and the Financial Crisis*, 267-313 (describing failures of credit rating agencies, including conflicts of interest, inaccurate models, failure to retest ratings of outstanding securities after model changes, inadequate resources, and failure to consider extent of mortgage fraud).

investor protections were weakened, and households took on risks that they often did not fully understand and could ill-afford.⁸

What is more, when home prices declined and losses began to cascade through the financial system, regulators and market participants found they did not have the data or information needed to fully understand what was happening in the system or how to stem the panic. As Senator Jack Reed, who went on to spearhead the creation of the Office of Financial Research, described it: “[N]obody knew who had what. The result was a cascading effect of uncertainty and doubt.”⁹ This pervasive doubt and uncertainty, created by a lack of information, left the government little choice but to resort to a massive recapitalization of the entire system.

In the immediate aftermath of the crisis, the U.S. and the global community put in place reforms designed to restore the market’s ability to generate growth without jeopardizing stability. These reforms included specific, substantive changes, including higher capital standards, mandated central clearing and exchange trading in the derivatives market, and heightened supervision and regulatory standards for the country’s largest, most complex firms. The reforms also included measures designed to increase regulators’ and market participants’ understanding of sources of systemic risk in the financial system, risks posed by new products, and connections among institutions, as well as how the system would respond to shock and how regulators could best respond in a crisis. In the U.S., the Dodd-Frank Wall Street Reform and Consumer Protection Act created the Financial Stability Oversight Council, a council of financial regulators designed to look out for and mitigate systemic risks across the financial system, and the Office of Financial Research, a new financial stability watchdog tasked with measuring and analyzing risk, performing essential research, and collecting and standardizing financial data.

The Office of Financial Research’s reports provide a helpful overview of recent trends in financial stability research.¹⁰ This work has included developing a Financial Stress Index, as well as new models and techniques to visualize financial data.¹¹ OFR has begun to use network analysis and agent-based modeling techniques to develop a better understanding of how risk spreads during a financial crisis.¹² These techniques have been used for more than a decade in other fields, but recent work by the OFR and outside academics represents the first time these

⁸ Ibid. at 104-09 (describing mortgages that “[f]ew . . . fully understood” or “kn[ew] what happened to [the] loan at the end of the fixed interest rate period”); Financial Crisis Inquiry Commission, *Financial Crisis Inquiry Report*, 108-9 (citing testimony of witness, describing “people who got steered or defrauded into entering option [adjustable rate mortgages] with teaser rates or pick-a-pay loans forcing them to . . . pay loans that they could never pay off”).

⁹ Edward Wyatt and Sewell Chan, “Senate Bill on Finance to Include Agency That Tracks Financial Risk,” *New York Times*, March 10, 2010.

¹⁰ Office of Financial Research, *2014 Annual Report* (Washington: Office of Financial Research, 2014), 73, <http://financialresearch.gov/annual-reports/files/office-of-financial-research-annual-report-2014.pdf>.

¹¹ Ibid.

¹² Ibid.

methods have been applied to understanding risk in the financial system.¹³ OFR has sought to conduct research to promote a macroeconomic approach to stress testing.¹⁴ OFR is also seeking to ensure data is available to support assessment and monitoring of threats to financial stability. In its 2015 annual report, the Financial Stability Oversight Council identified “challenges to data quality, collection, and sharing” as an ongoing threat to financial stability.¹⁵

In each of these four areas, much can be gained from incorporating methods and techniques from other disciplines and applying lessons learned in other contexts. A central theme is that, given the uncertainty surrounding understanding, measuring, monitoring, reducing, and alleviating systemic risk, we need to deploy a range of new intellectual approaches. This conference draws upon agent-based modeling, network analytics, and complex systems research. It also draws lessons from biology and neuroscience, epidemiology and public health, electric grids and nuclear plants, to name a few. The goal is not to find the one right approach to measuring and analyzing systemic risk, but to understand how different tools might provide different ways of thinking about, and responding to, risk across the financial sector.

As Simon Levin points out, financial regulation needs new approaches to deal with largely unconstrained complexity, contagion, and innovation in the financial system. The financial system has crossed a threshold of complexity where the system is evolving faster than regulators and regulations can keep pace. This panel will explore what lessons we can learn from evolutionary biology to improve financial stability and build a more robust, yet adaptive regulatory framework.

Biological organisms, like the financial system, must grapple with complexity and uncertainty and develop mechanisms to remain robust in the face of perturbations. This panel will examine the characteristics of robust and resilient biological systems and how these characteristics could be used to create novel, adaptive approaches to financial regulation. For example, biological systems rely on redundancy to protect against the loss of a critical system (our two eyes, two legs, and two arms are a key example), diversity to prevent total collapse from a single threat, and modularity, the creation of discrete, individual subunits, to limit the spread of risk and facilitate rapid, adaptive evolution in the face of stress. These lessons could be

¹³ Richard Bookstaber, “Using Agent-Based Models for Analyzing Threats to Financial Stability,” OFR Working Paper no. 3 (Washington: Office of Financial Research, December 2012); Doyne Farmer et al., “A Complex Systems Approach to Constructing Better Models for Managing Financial Markets and the Economy,” *The European Physical Journal—Special Topics* 214, no. 1 (2012): 295-324; Doyne Farmer and John Geanakoplos, “The Virtues and Vices of Equilibrium and the Future of Financial Economics,” *Complexity* 14, no. 3 (2009): 11-38.

¹⁴ Richard Bookstaber, Mark Paddrik, and Brian Tivnan, “An Agent-Based Model for Financial Vulnerability,” OFR Working Paper no. 14-05 (Washington: Office of Financial Research, July 29, 2014).

¹⁵ Financial Stability Oversight Council, 2015 Annual Report (Washington: Financial Stability Oversight Council, 2015), 120, <http://www.treasury.gov/initiatives/fsoc/studies-reports/Documents/2015%20FSOC%20Annual%20Report.pdf>.

applied to develop ways of limiting the spread of risk through the financial system by, for example, limiting the connections between firms or creating back stops at key points in the system.

The panel will also explore how biological systems respond to shocks, and how these responses could be applied to the financial system. For example, vertebrate immune systems have created a multi-step process for responding to pathogen attacks. The immune systems combine surveillance and early warning signals with generalized initial responses (e.g., specialized white blood cells), followed by more specialized adaptive responses (e.g., antibody proliferation) that also confer lasting immunity to the disease. Emulating the vertebrate immune system would involve a fundamentally new approach to financial regulation.

In 2008, just before Lehman Brothers' collapse, Professor Levin, together with fellow ecologists Robert May and George Sugihara, published a paper in *Nature* pointing out the worrisome similarity between the insufficiently modular banking networks and over-connected ecological food webs, arguing that the financial system might be on the edge of collapse. The rest is history. Today, there is more that can be learned from evolutionary biology to prevent such crises going forward.

Hans Morris highlights the critical role of financial innovation in both risk mitigation and risk propagation. We are currently in a period of potentially high disruption of established business models in banking from financial technology firms. Disruptions are occurring, for example, through deployment of marketplace lending platforms that connect investors with borrowers in the consumer and small business space. New technologies are attempting to transform fundamentally the outdated but widely used payments systems, in order to increase speed, security, or convenience for payments within the financial sector, and for businesses, consumers, and cross-border flows, including remittances. Even more disruptively, some new technologies are seeking to replace government currency with new forms of private, digital currency. Others are attempting to provide low-cost investment advice through "robo" advisers. Many of these initiatives will fail, but others have the potential to transform key aspects of finance.

Morris points out that our regulatory and legal framework typically lags 5 to 10 years behind innovations in finance. That means the regulatory framework is likely both to inhibit useful innovations and to miss key risks developing in these innovations. Areas of concern include illicit or malicious use of the banking system, where innovations could create new vulnerabilities, but also could create new solutions to old vulnerabilities that have long vexed government authorities. Will the regulatory system be able to distinguish between the two? Another potential concern is systemic risk; will regulators be able to understand developments in this area quickly enough, or conversely, will regulators be able to harness the new technologies to better understand and analyze big data in real time? Will the new technologies further worsen the economic and social divides, or will they help to promote financial inclusion and shared growth? Will new innovations undermine privacy, or provide us with better tools to protect it?

Michael Wellman focuses on one aspect of this innovation, the role of high frequency trading, which is transforming financial markets. Wellman argues that three aspects of high

frequency trading—speed, automaticity, and scalability—are transforming markets in ways that regulators, and market participants, poorly understand. While high frequency trading is lowering costs of trading, increasing market making, and eliminating natural arbitrage, it is not without cost. In particular, HFT has led to a latency arms race, in which enormous resources are being spent on reducing trading times to milli-, micro- and potentially nano-seconds. The regulatory and market structure we have generated is also creating arbitrage. HFT strategies may erode market integrity and reduce fairness, as well as siphon off potential gains from trade and waste resources on evasion costs for those seeking to avoid trading with HFTs. Some strategies may violate existing securities regulation, while others may skirt existing legal protections while causing investor harms. Moreover, HFT strategies have high risks from both model and programming errors, and the strong incentives to rapid deployment may undermine robustness, operational and other checks and balances that would normally be used to reduce such errors. HFT models may increase volatility due to correlation among the models, especially in stressed environments. Moreover, HFT liquidity may rapidly disappear just when it is most needed. Research suggests that HFT may have contributed to problems in the 2010 Flash Crash as well as to more recent disruption in Treasury markets.

Jeremy Bulow argues that we need to place much more emphasis on market discipline. He suggests that we went into the last crisis with some exceptionally able central bankers, people like Mervyn King and Ben Bernanke. We also had a complex and sophisticated regulatory system in place. There was also a long run-up to the Lehman collapse: bank stocks peaked around January 1, 2007, non-agency mortgage backed securities issuance came to a standstill in the second half of 2007, Bear Stearns happened in March 2008. The price of insuring against tail risk rose significantly. A senior official from the Bank for International Settlements claimed that they could see the crisis coming but did not feel there was anything they could do about it.

So how can we do better? If the plan is to get people smarter than Ben Bernanke and Mervyn King, Bulow says, “we are in a world of hurt.” How about moving to a more complicated regulatory system with more “safeguards”? Bulow argues that this is not the solution either. Bulow contends that in the last crisis the commercial banks were much less solvent than the investment banks, even though the commercial banks were much more heavily regulated. The thing that kept (most) of the commercial banks going was government guarantees for virtually all of their liabilities. Notably, despite their greater regulation the commercial banks were more loosely regulated on the dimension that probably mattered the most: they marked the same assets at much higher values than the investment banks.

Why was this so? For a variety of reasons investment banks mark to fair value and for liquid assets to market. In Bulow’s view, without the same kinds of government guarantees they were effectively regulated in their borrowing capacity by the market. This is not to say that the market never makes mistakes or that the system of regulating investment banks worked particularly well --- look at Lehman, which still collapsed. But to Bulow, we ignore too much market information in setting regulation, and do so at our peril. So for Bulow, the challenge is (a) how to incorporate market information and so develop a more market-based regulatory system, ideally one that is functional (so essentially the same capital requirements apply to the same assets regardless of whether the owner is a bank or a “shadow bank”), and (b) allocates as much risk as possible to the private sector rather than the taxpayer, taking into account the possibility

that sometimes even a firm that marks its assets to fair value, as Lehman supposedly did, can find itself insolvent.

Lisa Donner focuses on the central problem of finance and inequality, and the central role that public engagement must play in making our financial system safer, fairer and better harnessed to the real economy.

As currently structured, the financial system contributes to inequality and retards equitable growth, rather than facilitating it, in five key ways: First, in the lead up to the financial crisis, managers of firms benefited from excessive risk-taking, while in the wake of the crisis society at large paid for that excess.¹⁶ Second, research in behavioral economics suggests that weak consumer protections and exploitative financial products contributed not only to individual abuses but also to broader economic dislocations from the resulting bust, and that inequality and poverty contributes to the vulnerability of low-income and minority populations to such abuses.¹⁷ Third, the structure of financial products and services often reduces the opportunities for low-income households to save, which dramatically limits their opportunities to invest in human and financial capital that would improve their long-run prospects and contribute to domestic savings.¹⁸ Fourth, minority and female entrepreneurs, who start out with lower income and wealth, have more difficulties accessing finance to sustain and grow their business.¹⁹ Lastly, concentrated power in the financial sector, combined with other factors, may entrench finance-favored tax and regulatory policies and reduce the ability of democratic processes effectively to address necessary reforms.

Public engagement is a key strategy to help independent agencies remain accountable.²⁰ For example, the CFPB uses crowdsourcing of data through its consumer complaint process to identify problems arising in the marketplace before they become endemic. The Bureau uses the information from consumers to analyze and prioritize issues for supervisory, enforcement and regulatory action. The Bureau also releases consumer complaint data publicly under its reporting duty. This database provides a new tool for the agency and the public to hold financial institutions accountable. The CFPB also has new tools to engage private financial institutions in improving disclosures. For example, the CFPB can grant safe harbors to permit private firms to experiment with providing consumers with innovative disclosures that may better need household needs than the current approach.

¹⁶ For a formal model of this effect, see Anton Korinek and Jonathan Kreamer, *The Redistributive Effects of Financial Deregulation*, IMF Working Paper, WP/13/247, Dec. 2013.

¹⁷ See Michael S. Barr, *No Slack: The Financial Lives of Low-income Americans* (Brookings Press 2012); Sendhil Mullainathan & Eldar Shafir, *Scarcity: Why Having Too Little Means So Much* (Times Books 2013).

¹⁸ Barr, *supra*.

¹⁹ Michael S. Barr, *Minority and Women Entrepreneurs: Building Capital, Networks and Skills* (Brookings Institution, Hamilton Project Discussion Paper March 2015).

²⁰ See Michael S. Barr, *Accountability and Independence in Financial Regulation: Checks and Balances, Public Engagement, and Other Innovations*, *Law & Contemporary Problems* 78, no. 3 (2015): 119-28.

The Credit Card Accountability, Responsibility and Disclosure Act of 2009 also embodies reform through public engagement. For example, the CARD Act amends the Truth in Lending Act to create new electronic disclosure requirements for credit card companies. Creditors are required to maintain a website on which all written credit card agreements must be provided. They are further required to turn over these contracts in electronic form to the CFPB. In turn, the CFPB is required to provide these contracts publicly on its site in a readily accessible form.

Donner points out that these kinds of techniques for public engagement should also be used to redress failings in the regulatory system with respect to prudential oversight. Moreover, we need to develop new techniques to engage the public more broadly in the legislative and regulatory process with respect to financial reform, and to determine how to engage the public in the relatively opaque international processes that are so central to global rule making, and as to which the public is only marginally involved. Donner argues that democratic control of the rules governing the financial system will both simplify financial activity and orient it more broadly toward the public interest. Like Bulow, Donner argues that we cannot leave something so important and difficult to regulators alone. Unlike Bulow, Donner suggests that the market will be unlikely to police finance in ways that protect the public.