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## Systemic Risk: The Continuing Quest for Models to Monitor and Manage the Ultimate Challenge to Financial Stability

Amid a proliferation of research into the factors and components of systemic risk come some novel approaches from the likes of Moody's Analytics, Santa Fe Institute and Thomson Reuters

By Katherine Heires      September 1, 2016

Awareness of threats to global financial stability rose to unprecedented heights in the aftermath of the crisis of 2008-'09. Prodigious volumes of research have ensued, influencing analytical and monitoring approaches that continue to recast the way banks and other financial companies are regulated as well as those institutions' sensitivity to systemic impacts on their business.

There are, indeed, official bodies with systemic risk management responsibilities, engaged along with regulators, academics and other experts in the ongoing search for new ways to monitor and prepare for systemic risks to financial stability.

The Basel, Switzerland-based [Financial Stability Board](#), formerly the Financial Stability Forum, was handed a more muscular, multinational-coordination mandate at the G-20 Pittsburgh summit in 2009. A [report](#) released in August, for example, was the latest in a series on removing barriers to over-the-counter derivatives trade reporting.

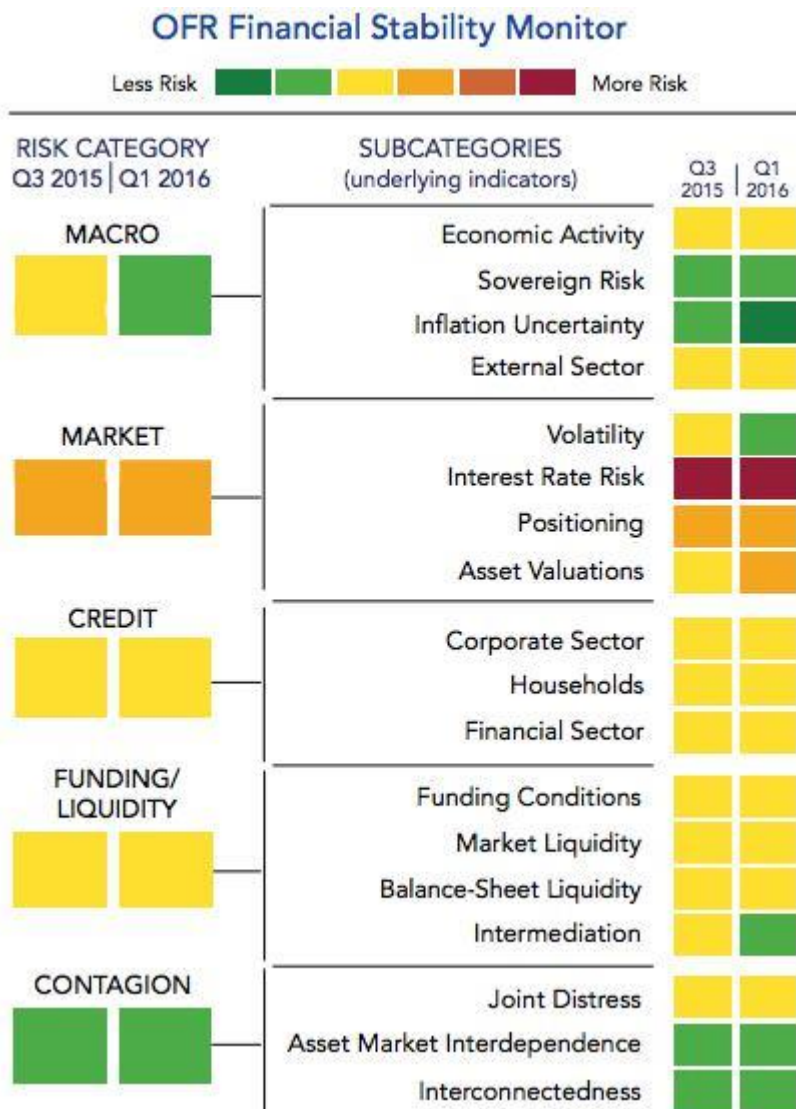
The U.S. Treasury's Financial Stability Oversight Council ([FSOC](#)), whose members are the top federal regulators, was created by the Dodd-Frank Act of 2010 along with a data-gathering arm, the Office of Financial Research ([OFR](#)). Among the latter's publications are dozens of [working papers](#); the first, in January 2012, was titled "A Survey of Systemic Risk Analytics." And among the office's ongoing analytical efforts is the [Financial Stability Monitor](#), which according to the OFR's [annual report](#) "displays current weaknesses in the financial system based on five functional areas of risk: macroeconomic, market, credit, funding and liquidity, and contagion."

Significant contributions are coming from universities, notably the [V-Lab](#) risk monitor of New York University's Stern School of Business; the Massachusetts Institute of Technology's [Golub Center for Finance and Policy](#) (one of whose co-directors, Sloan School of Management finance professor Andrew Lo, co-authored OFR Working Paper No. 1); and the [Systemic Risk Centre](#) at the London School of Economics and Political Science, which "was set up to study the risks that may trigger the next financial crisis and to develop tools to help policymakers and financial institutions become better prepared."

The V-Lab is known for the SRISK model, a measure of systemic risk in financial markets developed by NYU professors Christian Brownlees and Robert Engle, who is director of the Stern School's Volatility Institute and won the 2003 Nobel Prize in Economics.

## Varied Definitions

Yet for all the attention to systemic risk and the outpouring of data and publications, there is no universally agreed definition or definitive model.



Sources: Bloomberg L.P., Haver Analytics, SNL Financial, OFR analysis

The Dodd-Frank Act defines systemic risk in a context of how material distress at a financial institution, or the nature, scope, size, scale, concentration, interconnectedness, or mix of the activities of the financial institution, could pose a threat to the financial stability of the nation.

From the standpoint of the FSOC, systemic risks pertain to stability of the financial system as a whole, as opposed to those facing individual institutions or market participants.

OFR director Richard Berner underscores stability, writing last January in the office's 2015 annual report: "Framing how we assess and monitor threats to financial stability is essential to fill data gaps with high-quality financial information fit for its intended purpose. In addition, our research agenda is central to filling gaps in our understanding, develop new tools for analysis, and assess the resilience of the financial system."

A survey in 2015 conducted by academics on behalf of the European Finance Association found it a "hard to define but you know it when you see it" concept that may be characterized by contagion, bank runs, liquidity crises and amplification effects.

While the definitional debates continue, researchers affiliated with Thomson Reuters, Moody's Analytics and the Santa Fe Institute are offering some new and innovative approaches to systemic issues. They consider, respectively, analysis of sentiment in relevant news media; dynamic relationships between financial firms and their firm-level default probabilities; and a systemic risk transaction tax, based on the application of network theory to interbank loan systems, that is said to have the potential to largely eliminate systemic risk.

### **Thomson Reuters' SenSR**

Svetlana Borovkova is associate professor of quantitative finance and program director of the Quantitative Risk Management honors program at Vrije Universiteit in Amsterdam, and has conducted research on behalf of the Dutch central bank. Her research interests include systemic risk and news analytics, which led her to a consulting role with Thomson Reuters, as a preferred consultant.

In July, Borovkova and three colleagues at the university released a [white paper](#), "SenSR: A Sentiment-based Systemic Risk Indicator." They propose a scoring system to anticipate and monitor the rise of systemic risk through a measure that "is constructed by dynamically aggregating the sentiment in news about systemically important financial institutions (SIFIs)," according to a summary that is also on a Thomson Reuters [download page](#).

For the sentiment-based systemic risk indicator, relevant news about SIFIs is aggregated from Thomson Reuters News Analytics, an artificial intelligence engine designed to provide instantaneous interpretations of market sentiment.

"We look at the sentiment scores for every news item relevant to these institutions," Borovkova says. "We filter out the noise using econometric techniques, assign weights based on the relevance score for that news item and assign higher weights to more novel news."

The key component is bank-specific information, related to debt or leverage, which is combined with sentiment data to produce the SenSR score that can be an early indicator of systemic stress.

Testing this systemic risk indicator against others led Borovkova to conclude that "SenSR tells us about increased risk in the financial system up to 12 weeks before other systemic risk measure start to pick up on it.

“This is an extremely innovative approach to monitoring systemic risk,” she adds. Nothing like it has been done before.” Its breakthrough is in showing how “soft information,” as opposed to “hard financial fundamentals,” can enhance predictive value. “In combination with other hard measures, sentiment-based data can give us a more complete picture of what is actually happening in the financial system.”

Borovkova says that the model can eventually be used to identify the riskiest financial institutions in real time, social media data will be incorporated, and Thomson Reuters is expected to make the SenSR findings and risk scores available on its service.

### **Moody’s Systemic Risk Monitor**

Samuel Malone, director of the specialized modeling group at Moody’s Analytics, is the architect of the Systemic Risk Monitor ([SRM](#)), released in 2015, that uses network connectivity between financial institutions as a way to identify and monitor systemic risk in the global banking and financial sector.

Malone joined Moody’s Analytics in 2014, six years after the publication of “[Macrofinancial Risk Analysis](#),” which he co-wrote with Dale Gray, a senior risk expert at the International Monetary Fund. The book offered “an early and effective systemic risk framework for the global financial system,” Malone says, and its concepts are used by the IMF in courses on systemic risk and financial sector surveillance.

Malone, who has taught and consulted at Oxford University, where he was a Rhodes Scholar, and is a four-time winner of the international Mathematical Contest in Modeling, says the SRM identifies an institution as contributing to systemic risk when it has three qualities: It is large in terms of asset size; it is risky or displays a relatively high probability of default compared to its peers over a one-year period; and it is highly interconnected within the financial system. Those qualities are assigned weights of 40%, 30% and 30%, respectively, although the SRM allows users to modify the settings as they see fit.

Interconnectedness — and how it is measured — is what sets the model apart.

“It builds upon recent results in the academic literature on dynamic networks and applies these techniques to quantify the strength of spillovers across firm default probabilities,” Malone explains. The SRM employs Granger causality tests and vector auto-regressions as well as accumulated financial market and balance sheet data. This includes information on the drivers of overall credit risk via Moody’s CreditEdge database. Malone noted that Moody’s Credit Risk Cascades model employs the network results of SRM to forecast default probabilities for stress testing purposes.

Malone says that when the model was run prior to the Brexit vote, at the end of May, systemic risk was shown to be on the rise in the U.S. — after hitting a nadir last year — and is growing among student loan providers, insurers and asset managers, but not in the banking sector.

In Europe at that time, the risk environment was stable, though Malone expects systemic risk levels in Europe to rise through the end of 2016, led by British and Italian banks.

The highest-risk firms in the U.S. were nonbanks: Genworth Financial, Navient Corp., Principal Financial Group, Lincoln National Corp., BlackRock, Ameriprise Financial and Charles Schwab Corp. In Europe: Société Générale, Aegon, Banco Santander, Caixa Bank, Intesa San Paolo, Banca Popolare di Milano, Credit Agricole and Royal Bank of Scotland.

While large U.S. banks have fallen in the league tables, in terms of their contribution to systemic risk, since the crisis, Malone says, “There is an ongoing need to closely measure the shadow banks and bring them out of the shadows.”

### **Santa Fe Institute and a Systemic Risk Tax**

At the [Santa Fe Institute](#), an interdisciplinary research center renowned for work on complexity theory, [Stefan Thurner](#) is an external professor focusing on complex systems — including network theory and evolutionary systems — as they relate to the financial sector as well as to biology. He is also a full professor in science of complex systems at the Medical University of Vienna.

Thurner and [Sebastian Poledna](#) are co-authors of “[Elimination of systemic risk in financial networks by means of a systemic risk transaction tax](#),” a paper that, according to Thurner, is the first to quantify the systemic risk that individual transactions may add to a given financial network. In an interbank lending network, if one bank gets into trouble, the disaster can spread to many others. This “snowball effect” of contagion can magnify systemic risk.

A systemic risk transaction tax could rearrange the incentives in a given network so that if disaster strikes, the contagion and possibility of systemic catastrophe are mitigated.

To simulate the strategy, Thurner made use of the growing body of available transaction data — specifically, historical central bank data pertaining to interbank lending in Austria and Mexico. He assigned a systemic risk value to every financial institution in the system and, using mathematical techniques, was able to measure and identify the systemic risk value of individual transactions.

Thurner says the Austrian central bank “has a great quantity of data,” and the Mexican central bank “has kept track of every transaction for more than 10 years,” allowing us to really test our assumptions.”

Network analysis revealed that because the systemic risk tax is risk-proportional — zero if there is no systemic risk attached to an individual transaction, and rising with the magnitude of systemic risk — participants have an incentive to reduce their risk-taking.

“The beauty of this approach is that if the systemic risk tax is high, everyone tries to avoid it and people in the network stop making systemically risky trades,” Thurner says. The revenue collected in such a scenario could go into a government fund to support banks that pose a danger to network stability — so that the public would not have to fund bailouts.

Turner contrasts this contagion-reducing mechanism with a [Tobin tax](#), a fixed-percentage levy on all transactions that he says does not incentivize behavioral change in a way that helps to reduce risk. That form of financial transaction tax would tend to reduce credit volume significantly, and “no one wants that,” he says.

Turner says that many central banks monitor interbank financial trades, and the technology required to set up a systemic risk tax system is “not more complicated than what Google is doing every day. From a technology perspective, it’s a triviality.” Unless financial networks across the globe start to “rearrange” their networks and shift incentives, he contends, “you cannot truly address systemic risk.”

## **Future Steps**

The research and analysis continue apace. Out of the OFR alone, as listed in its annual report for 2015, is a catalogue of working papers and briefs that includes these titles: Hidden Illiquidity with Multiple Central Counterparties; Systemic Risk: The Dynamics Under Central Clearing; Systemic Importance Indicators for 33 U.S. Bank Holding Companies: An Overview of Recent Data; A Comparison of U.S. and International Global Systemically Important Banks; Contagion in Financial Networks; and Process Systems Engineering as a Modeling Paradigm for Analyzing Systemic Risk in Financial Networks.

Central banks have a long and continuing track record of systemic and stability analysis. The Bank of England’s Financial Policy Committee publishes [Financial Stability Reports](#) — known as Financial Stability Reviews prior to 2006 — twice a year. Banque de France issued its 20th [Financial Stability Report](#) in April, titled “Financial Stability in the Digital Era.”

Conferences are also adding to the body of knowledge. The OFR and Federal Reserve Bank of Cleveland, for example, have scheduled their third annual [Financial Stability Conference](#) for December 1-2 in Washington.

MIT’s Golub Center for Finance and Policy will hold its [third annual conference](#), “Causes of and Policy Responses to the U.S. Financial Crisis: What Do We Know Now that the Dust Has Settled?” September 28-29 in Cambridge, Massachusetts. The Golub Center is one of three MIT initiatives — the others are the Laboratory for Financial Engineering and the Institute for Data, Systems, and Society — into which the activities of the Consortium for Systemic Risk Analysis were merged, according to a September 2015 [announcement](#).

[“Where the Risks Lie: A Survey on Systemic Risk,”](#) a 2015 paper by Sylvain Benoit of Université Paris Dauphine and three co-authors, notes that while many methodologies are available to identify and help manage different sources of systemic risk, it is less clear how to link up and aggregate all the measures to fully reap the benefits of their insights.

The authors conclude that more structured models, directly linking systemic risk measures to well defined policy objectives and available tools such as stress tests, would be useful to central bankers and regulators concerned about systemic risk.

Malone of Moody's Analytics, a proponent of the analysis of bank interconnectedness to inform systemic risk models, adds, "When Federal Reserve Board governor Daniel Tarullo said last year that in the next generation of stress tests, he foresees the interconnectedness of banks as becoming far more important, that was music to my ears!"

*Katherine Heires is a freelance business journalist and founder of MediaKat LLC.*