Proceedings

Conference on Operationalizing Systemic Risk Monitoring

Washington, D.C.
May 26–28, 2010

Christopher Towe and Elie Canetti, Editors

Contents Page

PROCEEDINGS FOR IMF CONFERENCE ON OPERATIONALIZING SYSTEMIC RISK MONITORING

Washington, DC—May 26–28, 2010

The International Monetary Fund hosted a conference during May 26-28, 2010 at IMF headquarters in Washington, D.C. entitled "Operationalizing Systemic Risk Monitoring." The event was designed to advance ongoing work aimed at identifying systemic risk, as well as to further the IMF's response to elements of the G-20's call for work on information gaps.[1] The conference consisted of three separate, but related, modules:

- The first day covered operational frameworks for the Identification of Systemically Important Financial Institutions, Markets, and Instruments (SIMIs).
- The second day aimed at addressing issues related to measuring and monitoring leverage and liquidity risk in the financial sector, as part of the Fund's work to address recommendations 3 and 4 of the G-20 initiative on "The Financial Crisis and Information Gaps."
- The third day covered conceptual and methodological issues related to the use of financial network analysis to assess systemic risk.

The first day of the conference was confined to official sector participants, while academics and market participants joined the conference during its second and third days. This set of proceedings summarizes the discussions during the conference.[2] Most of the conference presentations are posted on the website for the conference, available at http://www.imf.org/external/np/seminars/eng/2010/MCM/index.htm

[1] See "The Financial Crisis and Information Gaps: Report to the G-20 Finance Ministers and Central Bank Governors", 10/29/2009 available at http://www.financialstabilityboard.org/publications/r_091107e.pdf and "The Financial Crisis and Information Gaps Progress Report: Action Plans and Timetables", May 2010, available at www.imf.org/external/np/g20/pdf/053110.pdf

[2] These proceedings were edited by Elie Canetti and Christopher Towe. Contributors were Ritu Basu, Alexandre Chailloux, Xiangming Li, Samar Maziad, Mohamed Norat, Li Lian Ong, Inci Otker-Robe, Hiroko Oura, Andre Santos, Liliana Schumacher, Juan Sole, and Jay Surti.

May 26, 2010

Opening Remarks

Christopher Towe (IMF) *made the following opening remarks:*

Let me warmly welcome all of you to this conference. It is indeed gratifying that so many of you were able to join us from so many different countries and institutions despite the pressures of the recent resurgence of financial market turbulence, not to mention airline strikes and volcanic eruptions. The impressive attendance today provides strong validation of the importance we all attach to the topics we hope to cover in the coming three days:

- identifying institutions, instruments, and markets that pose systemic risk;
- measuring leverage, maturity mismatches, and tail risks that leave the system vulnerable; and
- analyzing the transition and amplification of financial shocks both among institutions and across borders.

The importance of these issues has been amply demonstrated in recent years, but the challenge for us in the coming days will be to try to establish actionable and policy-relevant measures for central bankers and supervisors.

No doubt, an important prerequisite will be to fill data gaps, and a critical goal for us will be to help develop recommendations to fill these gaps, as requested by the G-20. The IMF, together with the FSB and BIS, has already presented to the G-20 initial reports and recommendations, and it is now preparing operational guidance for national authorities and the relevant international bodies.

This said, I would also emphasize that just as important as the financial networks are the personal networks. Hopefully, this conference will also help cement the connections between key players in the world of financial stability, and promote idea sharing and, most importantly, an ongoing dialogue, both bilaterally and collectively.

I. Operational Frameworks for the Identification of Systemically Important Financial Institutions, Markets, and Instruments (SIMIs)

May 26, 2010

Background Note: In April 2009, the G20 leaders requested that the IMF—in collaboration with the BIS and the FSB—produce a common international framework and guidelines for national authorities to assess whether a given financial institution, a market, or an instrument is systemically important. In terms of the broader G20 reform agenda, the guidelines were envisioned to help mitigate systemic risk by ensuring that all Systemically Important Financial Institutions, Markets, and Instruments (SIMIs) are subjected to the appropriate degree of oversight in a manner that precludes regulatory arbitrage. The IMF's Board of Directors acknowledged that while "the primary responsibility for any assessment of systemic importance should lie with national authorities, the Fund has a role to play in further developing the guidelines and in helping member countries, through its surveillance and technical assistance, to implement them."

Introductory Session: Incorporating SIMI Identification into Fund Surveillance, including Methodological Developments

Presentation

Barry Johnston (IMF) discussed the issue of assessing systemic importance and its implications for IMF surveillance. He began by highlighting the national and international initiatives underway to address systemic risk, and provided a summary of the G20 paper. Mr. Johnston noted that assessments of systemic importance should be core to the Fund's work on financial stability. The approaches to assessing systemic importance vary widely across countries—there is no set of best-practice methodologies, and application would be constrained by data availability. However, there are some common elements in the assessment, as identified in the G20 paper.

The IMF also has a role in further developing the assessment guidelines and collaborating with countries, through its surveillance and technical assistance (TA) mandates, to implement those guidelines. Specifically, TA could include advice on institutional arrangements for SIMI assessments; methodologies, information and the assessment framework; and policy responses to address SIMI. From a surveillance perspective, the IMF could (i) conduct assessments focused on identifying and mitigating systemic risks (e.g., through stress testing and Reports on the Observance of Standards and Codes); (ii) complement national assessments with analyses of globally important SIMIs; (iii) contribute to filling critical information gaps; and (iv) advance methodological approaches on measuring systemic risk.

Discussion

Mr. Johnston noted that the Joint Forum (JF) has been working on the differential approach to regulation—the objective is to focus on what institutions do rather than on their legal nature.

Marta Estavillo (Bank of Spain and Co-Chair of the Joint Forum Working Group on Differentiated Nature and Scope of Regulation) noted that the JF has identified inconsistencies in regulation across sectors which could not be justified and that should be amended to prevent regulatory arbitrage.

Andre Bezuidenhout (South Africa Reserve Bank) asked whether any thought had been given to revising Financial Soundness Indicators (FSIs) following the crisis. **Alfredo Leone (IMF)** noted the IMF set up a Working Group to look at information gaps in the wake of the crisis and FSIs are one of the areas being examined. He acknowledged that FSIs are not good leading indicators, but were aimed at gathering standard financial sector data across countries. The IMF is looking into revising the FSIs, including incorporating new measures for gathering leading information, and will incorporate seven indicators into the Special Data Dissemination Standard on an encouraged basis.

Rabi Mishra (Reserve Bank of India) asked about stress testing in the wake of the crisis, and asked if the IMF provided TA in this area. Mr. Johnston said that recent issues in stress testing include (i) prioritizing which institutions to test; (ii) the intensity of the tests; (iii) building contingency considerations into stress testing; and (iv) incorporating network considerations, i.e., potential balance sheet spillovers. The IMF is already providing TA on stress testing to a number of member countries.

Tae Soo Kang (Bank of Korea) asked about policy coordination on SIMI among the international bodies. Mr. Johnston emphasized there is very active coordination among the IMF, BIS and FSB; technical groups have been established, with each institution taking a lead on the different recommendations of the G20 report.

Panel Session I: Cross-Border Issues—Systemically Important Where, and for Whom?

Presentations

Dong He (Hong Kong Monetary Authority) discussed cross-border banking in Hong Kong and the challenges in assessing related systemic risks. The world's largest banks have a heavy presence in Hong Kong, and cross border banking flows have consistently amounted to more than 30 percent of total assets over the past decade. The Hong Kong Special Administrative Region is a net supplier of funds, with the United Kingdom, Mainland China, Singapore, the United States, and Japan as its main counterparties, accounting for around half of total external claims and liabilities of Hong Kong-based banks. There are three business models among Hong Kong banks—those that export funds, those that import funds, and

those that act as conduits. Thus, Hong Kong is exposed to systemic risks through the inter-connectedness of its banks: importers of funds may face a drying up of liquidity; exporters of funds may suffer credit losses and liquidity squeezes, and the dislocation in interbank money markets and foreign currency markets could affect the banking system as a whole. The challenges in assessing these risks include gaining a better understanding of (i) the different business models of global banking; (ii) inter-connectedness of cross-border funding markets; and (iii) maturity/currency mismatches, and off-balance sheet positions of banks.

Peter Tabak (Central Bank of Hungary) presented an overview of Hungary's banking system, and discussed the challenges faced by supervisors in countries that are both the home of, and host to, foreign banks. Hungary is a host country to several EU-based financial groups, as well as the home country of a large regional banking group. Home and host countries face conflicts of interest in several areas: supervision and regulation; deposit guarantees and the resolution framework; information sharing and coordination. Balancing home and host interests is thus crucial for preventing contagion. Tabak presented the pros and cons of common EU-wide supervision. He also discussed ring fencing, but noted it could lead to higher costs than improved cross-border coordination among authorities. Central banks play an important role in identifying systemic importance—where there is typically a conflict between fiscal and financial stability considerations in defining the role of systemic importance, a central bank's priority is the prevention of contagion. Tabak also presented the new macroprudential framework in Hungary and discussed the composition, roles, and responsibilities of its Financial Stability Council.

Gilneu Francisco Astolfi Vivan (Bank of Brazil) provided an overview of the Brazilian financial system, measures taken to promote financial stability, and perspectives on the regulation of systemic institutions. Foreign banks in Brazil account for 20 percent of banking assets, while Brazilian banks that have activities abroad have 15 percent of their total assets in other Latin American countries. Vivan compared the effects of external shocks from previous crises to the current one. He identified a number of measures implemented prior to the crisis that helped to avoid contagion, including (i) more stringent and inclusive prudential regulations (e.g., capital adequacy ratios; allowable net open FX positions; credit provisioning); (ii) the introduction of a new payment system; (iii) high reserve requirements on deposits; and (iv) increased authority to change regulations quickly. Brazil allows only subsidiaries of foreign banks to operate within its borders, so that they are captured under the same regulations as domestic banks; it has cross border arrangements in place with all relevant countries (e.g., Memorandums of Understanding; colleges of supervisors; regular information exchange; and monitoring of cross-border flows). Brazil supports the proposal for additional capital and liquidity charges for SIFIs.

Discussion

A question was asked about information that host authorities would have liked to have had during the crisis and why the desired data were not available. Vivan said Brazilian

supervisors would have liked to have known the overseas derivatives positions of foreign banks, and the supervisor subsequently asked home supervisors to provide such information.

Martin Johansson (Sveriges Riksbank) noted that Swedish supervisors would have liked to have had more information about other parts of the financial systems of the host countries in which Swedish banks are active. Mr. Tabak said sharing information with home countries proved to be the main difficulty faced by Hungarian supervisors. Foreign bank subsidiaries in Hungary experienced problems with FX liquidity, but it was difficult to convince their parent banks and the ECB that those problems could spill over to parent groups in home countries as well. It was also difficult obtaining information from countries that were host to the biggest Hungarian bank outside the EU.

Tae Soo Kang (Bank of Korea) asked why Brazil only allows foreign bank subsidiaries and not branches. Mr. Vivan explained that currency and cash flow problems are the main concerns. For instance, banks are forbidden from collecting deposits in Brazil and investing them abroad.

Hiroshi Ugai (Bank of Japan) emphasized that branches could utilize intra-bank fund transfer and asked if subsidiaries tend to be in a better position to manage liquidity. Mr. Tabak noted that foreign subsidiaries may experience liquidity problems through their banking groups. In Hungary's case, the central bank would have to step in if a foreign subsidiary was deemed systemic.

Adrian Chua (Monetary Authority of Singapore) said that while legal and regulatory frameworks can be hurdles to information sharing, it is also important to strengthen informal relationships among supervisors and have host supervisors actively engaged with parent banks overseas.

Panelists:
Dong He (Executive Director, Research, Hong Kong Monetary Authority)
Peter Tabak (Head of Financial Stability, Central Bank of Hungary)
Gilneu Francisco Astolfi Vivan (Deputy Head, Department of Banking System Monitoring, Bank of Brazil)

Moderator:
Martin Johansson, Deputy Head, Financial Stability Department, Sveriges Riksbank

Panel Session II: Methodological Developments

Presentations

David Strachan (U.K. Financial Services Authority and co-chair of the macro prudential supervision group in Basel) said the goal of methodological approaches to systemic importance is to model the *ex-ante* marginal contribution that each bank makes to systemic risk. This is a state- and time-dependent measure that requires modeling institutions' behavior and responses during a crisis. Such a measure would allow for an initial regulatory or supervisory focus on systemic institutions and appropriate resolution tools. However, it might be dangerous to have a public list of systemically important institutions because it could lead to moral hazard or, conversely, convey the impression that firms on the list are targeted for tougher regulation.

Strachan noted modeling approaches are at an early stage and have controversial aspects. Most supervisors would be suspicious of a very model-dependent classification, particularly if the model depended on market prices. He was in favor of a simple indicators-based approach, as pursued so far by the UK and the Basel committee, following the IMF paper. Although quantitative, the indicator-based approach is appealing because it leaves room for judgment. There are data gaps to implement this approach internationally (e.g., consistent information) but it will be important to find adequate solutions.

Kevin Stiroh (Federal Reserve Bank of New York) noted systemic importance imposed by financial externalities—i.e., when the actions of financial firms introduced systemic risks and spillovers. As with pollution, policy needed to aim at creating incentives to internalize these types of externality, including through taxes and subsidies (e.g., by making capital cheaper for banks that imposed less systemic risk).

However, the more difficult problem is not to figure out the solution but to measure the externality. In general, second-best approaches will be needed because the day-to-day activities of financial firms are hard to observe, so that policy responses must be based on observable features of institutions. Stiroh also favored an initial approach based on indicators, such as size, interconnectedness, and lack of substitutability. He also pointed to the difficulties in finding consistent international indicators.

Finally, he highlighted the need for legal authority to impose supervisory actions on systemically important institutions. The goal is not solely to identify institutions but to influence their actions to reduce the negative externality. However, this will be a dynamic process and there will be actions and reactions as financial markets innovate.

Discussion

The ensuing discussion focused on the impact of the disclosure of institutions that are considered systemically important, and on the international coordination mechanisms to arrive at consistent indicators.

Panelists:
Mr. David Strachan (Director, Financial Stability Department, U.K. Financial Services Authority)
Mr. Kevin Stiroh (Senior Vice President, Federal Reserve Bank of New York)

Moderator
Mr. Philippe Mongars, (Deputy Director, Financial Stability Department, Bank of France)

Panel Session III: Establishing a Regulatory Perimeter / Institutional and Organizational Issues

Presentations

Marta Estavillo (Bank of Spain) opened the session with a presentation of the key issues and recommendations of the Joint Forum's (JF) review of the differentiated nature and scope of financial regulation. With regard to group-wide and cross-sector supervision, she emphasized that all business areas—not just the systemic parts—of financial groups ought to be subject to supervision, particularly non-operating holding company structures and other unregulated group units. Estavillo pointed out that international standards do not currently require broker-dealers to be supervised on a consolidated basis, nor are re-insurers consistently subjected to prudential oversight.

Sabine Lautenschläger (BaFin) dealt with the organization of systemic risk oversight. She emphasized that any agent responsible for such oversight would, at a minimum, define, collect, and analyze relevant information; identify and prioritize risks; and provide early warnings and recommendations. The new European Systemic Risk Board (ESRB) is vested precisely with this mandate, and while national supervisory agencies within the EU are not legally bound to follow up on its recommendations, decisions not to do so must be explained. With regard to regulating and supervising internationally active SIFIs, Lautenschläger pointed out that a practical approach could be to enhance the legal scope for information sharing, do joint risk assessments, and coordinate supervisory activities and actions.

David Strachan (U.K. Financial Supervisory Authority) emphasized that for flexibility of the perimeter of financial regulation to financial innovation and risk evolution to be useful, it is vitally important that financial sector surveillance be effective in excavating emerging risks in a timely fashion. Accordingly, apart from limiting the relationship between regulated and unregulated sectors in order to inhibit contagion—both financial and reputational—

vesting supervisors with the power to demand information from unregulated entities currently outside the perimeter is wise. Strachan highlighted that in the United Kingdom, the Financial Supervisory Authority's information gathering powers extend outside the perimeter following the 2010 Financial Services Act.

Discussion

Philippe Mongars (Bank of France) asked why the progress on thinking about oversight of systemically important markets and instruments was slower than for institutions. **Barry Johnston (IMF)** pointed out that while the 2009 SIMI Guidance Paper included a comprehensive list of indicators for markets and instruments, the follow-up work was focused on SIFIs. **Konstantinos Tsatsaronis (BIS)** reasoned that it was difficult to define markets and instruments as systemic, independent of the institutions involved in their use.

Andrea Enria (Bank of Italy) wondered whether the gaps identification process was too backward looking, and who in the new oversight landscape, should have responsibility for understanding financial innovation in real time. Ms. Lautenschläger noted that international coordination was essential for the process to work. Mr. Strachan pointed out that in the U.K., the FSA gathered the information and the MoF adjusted the perimeter, but the Bank of England could also lobby the MoF to do so.

Panelists:
Marta Estavillo (Senior Advisor, Bank of Spain; co-chair, Joint Forum Working Group on the Differentiated Nature and Scope of Regulation)
Sabine Lautenschläger (Chief Executive Director, Banking Supervision, Federal Financial Supervision Authority, Germany)
David Strachan (Director, Financial Stability Division, U.K. Financial Supervisory Authority)

Moderator:
Aditya Narain, Advisor, Monetary and Capital Markets Department, IMF.

Panel Session IV: Country Perspectives—Identification Tools and Challenges

Presentations

Keith Hall (Reserve Bank of Australia) noted that for Australia, grappling with definitions of 'systemic importance' is not a new challenge, since the Reserve Bank has a long-standing policy to allow a bank to access emergency liquidity support only if it is solvent and systemically important. The criteria used for assessing systemic importance include whether the failure of the financial institution would have a direct and material impact on the economy, lead to cascading problems within the financial system via cross-institution exposures, and have the potential to act as a trigger for broader contagion in the economy. Hall did not see a formal classification of financial institutions by systemic importance as

appealing, given the difficulty of knowing the optimal size of a bank from a systemic perspective; such classifications would also formalize the Too-Big-To-Fail (TBTF) status of the existing big banks and create a two-tier banking system. On the policies to contain systemic risk, a surcharge on the largest banks could be a significant extra cost to intermediation in a concentrated banking system. Instead, more mileage could be gained by reducing the probability of failure of a big bank, minimizing the impact of failure through contingency planning (including through living wills), and improving the quality of supervision and oversight.

Pascual O'Dogherty (Bank of Mexico) described the Mexican financial system as bank-dominated, highly concentrated (the seven largest banks make up 85 percent of system assets), and interconnected (through direct interbank exposures and foreign financial counterparties), with the seven largest banks dominating financial services. He was also not sympathetic to identification of SIFIs, for its potential contribution to moral hazard. To reduce systemic risk, O'Dogherty stressed the importance of: intensified supervision; sound macroeconomic framework and macro oversight; reducing interbank contagion risks (by limiting exposures among banks and related parties and through centralized netting or CCPs); reducing risks in OTC derivatives; and an effective resolution authority and instruments. He expressed concerns about some policy options, including: capital and liquidity surcharges and constraints on banks' business activities (e.g., proprietary trading); the former could cause an uneven distribution of costs and benefits between home and host countries and more expensive intermediation as regulatory costs are passed onto customers, and the latter could eliminate an important source of revenue for the majority of emerging market economies.

Jesús Saurina (Bank of Spain) argued that in defining systemic institutions, one would need to be careful not to take short cuts and use only size as a measure of systemic importance. Interconnectedness and lack of substitutability are also very important. In this connection, the risk profile of a bank (e.g., the size of its trading book) is a key driver of systemic risk, since institutions holding these portfolios are the most interconnected and difficult to substitute in key opaque markets. Banking institutions with certain structures are also much more difficult to resolve than others with similar size. For example, clear-cut structures of financially independent subsidiaries, each with stand-alone capital and liquidity and clear ties with the parent bank, are easier to resolve compared to a web of interconnected branches. Given the complexities involved, the supervisor of each bank should determine whether an institution is systemic, but common guidelines should be developed to have a level playing field. Developing a public list of systemic institutions should be avoided, since such a list would be a moving target, and would increase moral hazard as well as instability during crisis. The tool box for systemic institutions should include: improving risk management, corporate governance, and micro supervision of SIFIs; living wills; and specific prudential measures (as opposed to a tax). Nonbank institutions, highly concentrated and opaque markets and systemic instruments should also be targeted in designing what to do with systemic risk.

Hiroshi Ugai (Bank of Japan) emphasized appropriate assessment of systemic importance of financial institutions and reflecting the results onto regulatory/supervisory frameworks, but warned that knowledge regarding systemic importance is limited. Systemic importance is not a binary concept and each IMI's systemic importance may vary depending on the financial and economic conditions. Systemic risk materializes through various channels. Therefore, identifying SIMIs and relying only on regulatory/ supervisory frameworks that focus on identified SIMIs may overlook the source of the next crisis. A more realistic approach would be to adjust flexibly the intensity of supervision/inspection to systemic importance. Model-based approaches have some potential, but are still at the early stages. Indicator-based approaches are useful especially when regulations are not calibrated based solely on systemic importance of individual SIMIs, and overall assessments are not necessary. Currently, the BoJ adopts some form of indicator-based approach into its on-site/off-site monitoring framework, and is open to any refinement. Ugai noted that better understanding of the methods to measure systemic importance would be critical to maintaining financial stability.

Discussion

The topic of stand-alone subsidiarization (SAS) versus branches was discussed among the panel. In responding to Mr. Saurina's support for SAS, **Andrea Enria (Bank of Italy)** wondered if too much weight is being put on the model's ability to enhance resilience of financial institutions. He commented that during crises, having integrated capital and liquidity management is beneficial for resilience of cross-border banking groups, while trapped pools of liquidity associated with the SAS approach could have adverse effects on the banking group's resilience. He noted the Fund initiative to ask the parent banks of Central and Eastern European (CEE) subsidiaries and branches during the crisis was an important stabilizing factor, and SAS would weaken these linkages and benefits.

Mr. Saurina responded that Spain has benefited from SAS, noting it can limit contagion between parents and affiliates and ease resolution. He also acknowledged there is no "one size fits all" solution, and many factors may explain the choice of branches vs. subsidiaries in other countries. Mr. O'Dogherty sympathized with the SAS approach and noted that during the crisis, subsidiaries of some foreign banks provided liquidity to their parents, but agreed that trapped liquidity under SAS could be a problem for some parent banks which have business models that require moving funds around. Mr. Ugai noted counter evidence that after Lehman Brothers' bankruptcy, there were withdrawals of deposits and CDs from branches of Japanese banks in the United States but they maintained smooth funding conditions by using intra-bank dollar funding transfer. **Philippe Mongars (Bank of France)** stressed the importance of having the capacity (which may not be high in some jurisdictions) to enforce this approach.

Panelists:
Keith Hall (Assistant Governor, Reserve Bank of Australia)
Pascual O'Dogherty (Director, Financial Stability Department, Bank of Mexico)

Jesús Saurina (Director of the Financial Stability Department, Bank of Spain)
Hiroshi Ugai, (Deputy Director General, Financial Systems and Bank Examinations Department, Bank of Japan)

Moderator:
Sebastián Katz (Deputy Head of the Economic RES Department, Central Bank of Argentina)

II. Measuring and Modeling Systemic and Tail Risk

May 27, 2010, morning

Opening remarks: G-20 Information Gaps Initiative:

Adelheid Burgi-Schmelz (IMF) *made the following opening remarks:*

In April 2009, the G-20 called on the IMF and the FSB to explore information gaps and develop measures to strengthen data collection. As a first step, the IMF and FSB, in consultation with an interagency group including the BIS, ECB, Eurostat, IMF (Chair), OECD, UN and the World Bank launched the Principal Global Indicators website http://www.principalglobalindicators.org/default.aspx.

A lack of timely, accurate information hinders policy makers and market participants from developing effective responses, as demonstrated by the recent financial crisis. In November 2009, the IMF and FSB report to the G-20 Finance Ministers and Central Bank Governors, *The Financial Crisis and Information Gaps*, identified a need to address data gaps in four main interrelated areas:

- Build-up of risk in the financial sector
- Cross-border financial linkages
- Vulnerability of domestic economies to shocks
- Improving communication of official statistics

While some data on these areas can be filled by using the existing conceptual statistical frameworks, a major challenge is to develop frameworks for collecting data on: (a) tail risk in the financial system; (b) aggregate leverage and maturity mismatches; and (c) global network connections and systemically important institutions. This conference is expected to advance this work.

Opening remarks: Systemic and Tail Risk:

Laura Kodres (IMF) *made the following opening remarks:*

In order to develop appropriate policy responses to systemic and tail risks, it is important to understand the types of such risks, which is also the starting point for developing analytical models. The recent global financial crisis highlighted the need to better understand the following three types of risks: (i) systemic solvency issues for institutions; (ii) remote outcomes for some asset prices occurring together or in succession; and (iii) systemic liquidity risk.

We have now produced a number of models, but without any way to compare them to see when some should be used and when others would be more appropriate. Hence, it is crucial to better understand the limitations of different models, the validity of the underlying assumptions, and even the difficulties of executing the models. Even more important will be how to connect the models with policies and regulatory reforms.

In providing some basis for discussing the pros and cons of various models it might be useful to think about them, broadly speaking, in two classes:

(1) Those that use market data. They are forward looking, based on real money at risk, but, possibly subject to over-reaction or a lack of either diversity of participants or volume.

(2) Those that use actual exposure data (not accounting data). They use data that are closer to payments that would need to be made or unwound in an insolvency, may be forward looking, and could be dependent on valuation models rather than trades.

While they each have their own limitations and implementation challenges, together they provide an important view about how the risks can be assessed though various surveillance tools.

Panel Session I: Applied Modeling Approaches to Systemic Tail Risk

Presentations

The session began with a short description by moderator **Nellie Liang (U.S. Federal Reserve Board)** of the approach taken by the U.S. Federal Reserve Board to assess systemic risks. Ms. Liang emphasized that progress in this area is sought on two fronts: better data collection and development of tools to measure and track systemic risks.

Matthew Richardson (NYU Stern School of Business) began by underscoring the need to have a working definition of systemic risk. Once a definition is agreed, the challenges for systemic regulation become twofold: *(i)* ex-ante identification of firms that pose greater systemic risk, and *(ii)* forcing those firms to internalize risks. To illustrate these issues,

Richardson presented a framework in which, without government intervention, banks choose a level of systemic risk that is higher than socially optimal. In response, the government can take a number of measures, such as the introduction of a tax for systemic institutions. Richardson argued that this tax would incentivize banks to reduce their contribution to systemic risk, and that the tax would also be sensitive to the overall conditions of the economy and the financial sector.

Hao Zhou (U.S. Federal Reserve Board of Governors) enumerated the key components of systemic risk: size of institutions—leading to the too-big-to-fail phenomenon—correlation or concentration in certain activities—leading to the too-interconnected-to fail phenomenon—and, finally, other vulnerability aspects such as high leverage. Against this background, Zhou's work aims to find a method to identify banks' contributions to systemic risk. Zhou argued that an "insurance premium" approach would be a good indicator of the level of systemic risk in a financial system, and showed that when applied to the 19 U.S. banks that participated in the SCAP exercise, his technique identifies size, correlation, and leverage as the factors that contribute most to systemic risk.

Philipp Keller (Deloitte) gave an overview of the systemic risk sources in the insurance industry. Among others, he pointed to pandemics, regulatory arbitrage, and certain government (implicit) guarantees for financial institutions as sources of systemic risk. He argued that stress testing extreme scenarios can be an effective tool to make managers and policymakers aware of these potential risks. However, he underscored that these tests need to be severe enough to identify real sources of systemic risk, lest they produce a false sense of comfort. The challenge, however, is that in designing severe stress scenarios, one may come up with extreme situations that detract realism from the stress test exercises. Keller also argued that to conduct multi-institution (or even multi-country) stress tests, it is necessary to ensure that the different entities use similar valuation principles and that the scenarios depict internally consistent events.

Peter Sohre (Swiss Re) argued that by not relying on short-term funding, core insurance business is not a source of systemic risk, but rather, can act as a shock absorber. In fact, he contended, since insurance losses involve deferred claim payments, institutions have more time to react. That said, capital and liquidity risk management remain key components of any strategy to face large losses. Sohre said a total balance sheet approach should be applied across financial institutions and supplemented by consistent-across-institutions stress tests for capital and liquidity in order to conduct effective systemic risk surveillance. However, expert judgment is as important as modeling techniques in the design of threat scenarios.

Discussion

Thilo Liebeg (German Bundesbank) wondered which measure of systemic risk should be used in practice. Zhou responded that unfortunately there is no one measure that is better than

the others and that cautious financial sector surveillance necessitates the monitoring of several measures at the same time. **Sheri Markose (University of Essex)** raised the point that most models of tail risk fail to take into account the effects of regulations on the behavior of agents. The panelists agreed and recognized this as an area for more research. Mrs. Liang requested the panelists' views on what constitutes extreme enough simulations. Mr. Keller acknowledged that this was a difficult issue, but said modelers should be courageous enough to simulate severe scenarios despite initial resistance by policymakers. Mr. Sohre agreed and added that the issue hinges in what is expected from the severe scenarios: if the aim is to elaborate new regulations, then it is natural to experience pushback from the industry; on the other hand, if the goal is to be prepared for very adverse events, then the opposition would be much lower.

Panelists:
Matthew Richardson (NYU Stern School of Business)
Hao Zhou (Senior Economist, U.S. Federal Reserve Board of Governors)
Philipp Keller (Head, Insurance Risk Management, Deloitte)
Peter Sohre (Head of Integrated Risk Reporting, Swiss Re)

Moderator:
Nellie Liang (Senior Associate Director, U.S. Federal Reserve Board of Governors)

Panel Session II: Stress Testing Approaches to Systemic Tail Risk

Presentations

Keith Hall (Reserve Bank of Australia) said stress testing should generate meaningful results using scenarios aligned with the most prominent risks in the financial system. There is no single best model, so, if possible, one needs to harness multiple models, combining top-down with bottom-up approaches. In designing stress scenarios, what matters is the "content" of the tail risks, as well as the size. In this context, he drew on Australia's financial history to highlight the extent to which structural change in the banking system can undermine the integrity of model-based projections. Therefore expert judgment is often the key to a successful macro-economic stress test. In addition, conducting a dialogue with banks while trying to establish which tail risks to model is as important and informative as the results themselves.

David Rule (U.K. Financial Services Authority) said stress testing at the FSA included three main elements: firms' own stress testing, FSA stress testing of specific, high impact firms to assess their ability to meet minimum capital levels throughout a stress period, and simultaneous system-wide stress testing. FSA now publishes an "anchor" macro-economic scenario on which firms are asked to base their own stress testing for capital purposes and which the FSA uses in its stress testing. System-wide stress testing is important to find

common exposures and to evaluate feedback effects and interlinkages, and can be conducted with multiple rounds. There are notable challenges with constructing scenarios including: choosing the right stress level (most of the macro scenarios used by UK firms before 2008 assumed milder stresses than actually developed); and how that stress level varies at different stages of the economic cycle; maintaining comparability with previous scenarios versus adapting scenarios to recent developments; and translating macro scenarios into micro variables such as asset values, loss rates, credit spreads, liquidity, etc.

Til Schuermann (Federal Reserve Bank of New York) said the current crisis revealed some weaknesses with existing stress testing practice, including the ability to conduct corporate-wide tests (instead of by product lines), and lengthening the horizon for computing capital adequacy beyond the previously typical one-year horizon.

While the U.S. SCAP exercise seems to have overcome some of the above weakness, it also encountered major difficulties. Most notably was the challenge of translating macroeconomic scenarios (GDP, house price, unemployment) into other variables more directly linked to calculating capital buffers such as the impact on the yield curve, loss rates, and profitability. Eventually, the severity of the stress was measured and justified by loss rates, which were higher than those actually experienced in the Great Depression, rather than the macro scenario *per se*. The need to develop scenarios each time in line with the actual economic environment poses additional difficulties.

Panelists:
Keith Hall (Assistant Governor, Reserve Bank of Australia)
David Rule (Macroprudential Department, U.K. Financial Services Authority)
Til Schuermann (Senior Vice President, Federal Reserve Bank of New York)

Moderator:
Andrea Enria (Head of Regulations and Supervisory Policy, Bank of Italy)

III. Measuring and Monitoring Leverage and Liquidity Risk in the Financial Sector

May 27, 2010, afternoon

Panel Session III: Assessing Hedge Fund (HF) Leverage and Liquidity Risk

Presentations

Michael Alix (Federal Reserve Bank of New York) voiced caution about measuring HF leverage using balance sheet data (e.g., assets-to-equity). Account should be taken of

leverage embodied in off-balance sheet items, and it is useful to formulate various types of risk measures (e.g., risks-to-equity). It is important to take a holistic view that considers leverage by assessing links among asset and funding liquidity, and risk across different accounting standards.

Alix proposed risk-sensitive measures of leverage that could be informed by rigorous stress tests such as VaR or expected shortfall. Avoiding reliance on single measures of leverage and taking into account liquidity risks are also essential. Rather than relying on information from HFs themselves, supervisors should obtain information from prime brokers as a means to assessing HFs contribution to systemic risk.

David Rule (U.K. Financial Services Authority) presented results of the FSA's Hedge Fund survey. The FSA asks HFs for data on investments and borrowings from which it can calculate various leverage measures such as 'footprint.' Such a measure reveals a wide dispersion among different types of funds (for instance, fixed income funds are the most leveraged, managed futures funds the least). Other findings from the survey included that HFs appear to have the most significant share of the market in convertible bonds; and that HFs are not systemically engaged in maturity transformation, although that depends significantly on assumptions made about the market liquidity of assets. In conjunction with a sister survey of prime brokers, FSA uses the survey to assess the financial stability risks from the hedge fund sector, both through the 'credit channel' (through bank credit exposures to HFs) and through the 'market channel' (when HFs individually or collectively cause market disruption through their trading activities in a crisis).

Mila Sherman (University of Massachusetts at Amherst) discussed technical measures of HF liquidity in determining HF risk. She indicated that autocorrelation among HF asset returns could be a good proxy for illiquidity, leverage, and risk. Moreover, it was not the case that illiquid HF assets would be the first to be sold in a crisis. Instead, liquid ones would be sold, precisely because they are easier to sell in a crisis. Deleveraging by HFs could be wide and dramatic.

Mark Dow (Pharo Management LLC) confirmed that HF leverage was low and made clear that HFs do not intermediate directly with the real sector, so their systemic impact was more limited than for banks. He said that the best HFs tend to have the best risk-management framework, and reduce the need to sell assets in an illiquid environment.

Discussion

Links between HFs, banks, insurers and brokers had grown over the years, but the consensus among the panel was that HFs were not the most systemic of institutions in this list. Mr. Dow suggested that for HFs the credit channel was not the big transmitter of systemic risk, given prime brokers' insistence on significant collateral and margins from HFs. Rather, the biggest

transmission channel was through the market (i.e., pricing) channel. HFs could add to unrealistic valuations in specific asset classes, especially in the current environment when HFs are so much more risk-aware.

The asymmetry of transmission between HFs and other financial institutions was also picked up by Ms. Sherman's Granger causality tests, which suggest banks were far more likely to create and transmit systemic risk to HFs, insurers, and brokers than the other way round. It was this "shadow hedge fund system" (i.e., banks that take HF-like risks) that were of more systemic concern than the so-called "shadow banking system."

Panelists:
Michael Alix (Federal Reserve Bank of New York)
Mark Dow (Portfolio Manager, Pharo Management LLC)
David Rule (UK Financial Services Authority)
Mila Sherman (University of Massachusetts at Amherst)

Moderator:
Mahmood Pradhan (Senior Advisor, Asia and Pacific Department, IMF)

Panel Session IV: Measuring Leverage and Maturity Mismatch in the Shadow Banking Sector

Presentations

Adam Ashcraft and Zoltan Pozsar (both Federal Reserve Bank of New York) used a comprehensive mapping exercise undertaken by FRBNY staff to define what shadow banking is and is not. They outlined how shadow banking was at the center of leverage and maturity transformation in the U.S. financial system. This led them to explore ways of measuring shadow banking activities, particularly its risk profile (leverage and degree of maturity transformation/liquidity risk). They highlighted the seven specific stages involved in shadow banking activities,[3] elaborated on the roles of non-bank entities in the credit intermediation process (e.g., securitization), their role in maturity transformation (e.g., by money market funds and ABCP), and highlighted the role of certain market instruments (e.g., repo and sec lending).

Morgan Ricks (U.S. Treasury) outlined how the regulatory perimeter should be redrawn to avoid another uncontrolled risk buildup in some "gray areas" of financial markets.

[3] Loan origination, loan warehousing, ABS issuance, ABS warehousing, ABCDO issuance, ABS intermediation, and funding.

Highlighting the inevitability of bail-outs for large scale financial disasters and the limited efficacy of market discipline in such a context, he urged setting up a new "banking social contract" that would avoid moral hazard, reinforce market discipline, and be based on a functional rather than institutional criterion (i.e., a cross-sectional framework applying to *de facto* banking operations rather than to banking institutions). This "modernized banking social contract" would have the following features: it would limit maturity transformation outside of the contract (in the shadow banking system), provide a safety net to short-term creditors within the contract, impose prudential regulations (capital, liquidity, and supervision) to limit moral hazard, levy insurance fees to recover funding subsidies, and mutualize risk among participants.

Everett Rutan (Moody's) offered an exhaustive review of the myriad ABCP program types, and how each of these sub-segments performed during the turmoil.

Discussion

During the discussion one participant put forward the question of the impact on monetary policy of shadow banking system operations, notably, whether a money multiplier taking into account the shadow banking system would make sense for better monetary policymaking.

Panelists:
Adam Ashcraft (Vice President, Financial Risk Department, Federal Reserve Bank of New York)
Zoltan Pozsar (Federal Reserve Bank of New York)
Morgan Ricks (Senior Policy Advisor, U.S. Treasury)
Everett Rutan (Senior Vice President, Structured Finance, Moody's)

Moderator:
Robert Sheehy (Deputy Director, Monetary and Capital Markets Department, IMF)

Session V: Real Sector Leverage and Liquidity Risk Measurement Challenges

Presentations

Tae Soo Kang (Bank of Korea) assessed risks associated with the rapid growth of household leverage in Korea. In particular, aggregate household leverage is currently at a historic peak and consists mostly of variable rate loans, which would tend to imply vulnerabilities. However, Kang suggested that more granular metrics offer a less worrisome picture of debt sustainability. The first set of metrics includes debt servicing ability metrics for households—debt holdings and debt servicing ratios by income group, leverage by borrower's credit rating, household capital gearing ratios, debt-to-income ratios, and demographic changes—while the second set consists of loss absorbing capacity metrics for

financial institutions—vintage delinquency rates, delinquency roll rates, non-performing loans ratios, loan-to-value ratios, coverage ratios, and Bank for International Settlements (BIS) ratios. Analysis of these suggests that a drastic deleveraging by Korean households is unlikely. Nonetheless, the level of household leverage remains an important concern, and the Korean authorities have responded, including by reducing loan-to-value and loan-to-deposit ratio limits and expanding debt-to-income ratio limits to other metropolitan areas.

Pascal O'Dogherty (Bank of Mexico) emphasized the need to improve leverage and liquidity risk measurement in the corporate sector. Following Lehman Brothers' bankruptcy, the depreciation of the Mexican peso not only led to large losses in non-financial firms' foreign exchange derivatives positions, but also triggered margin calls and led to pressures on the exchange rate. O'Dogherty highlighted that the large losses in non-financial firms raised important questions about: (i) their risk management policies; (ii) the incentive structure in financial intermediaries; (iii) the public disclosure of exposures and derivatives transactions; (iv) conflicts of interest in credit rating agencies; and (v) supervisory oversight and surveillance. He emphasized that, to assess vulnerabilities in the real sector, more is needed in terms of timely access to information, vulnerability indicators, and surveillance. The Mexican authorities are seeking to address such concerns by moving all eligible standardized OTC derivatives to derivatives exchanges, and by creating a trade repository where all public companies will register their derivatives transactions. Given the contingent nature of derivatives, O'Dogherty suggested that they cannot be easily included in a leverage ratio. Sensitivity analyses should be conducted on margin calls, exit clauses and cash flows, and on all contracts and counterparties to help policymakers assess potential leverage changes.

Gilneu Astolfi Vivan (Central Bank of Brazil) focused on the impact of the financial crisis on the Brazilian corporate sector. After Lehman Brothers' bankruptcy, the Brazilian currency depreciation led to large losses in non-financial firms using exotic derivatives to hedge f/x positions. In response, Brazil's central bank acted to reduce vulnerabilities associated with derivatives by issuing a special regulation requiring the registration of all derivatives transactions entered with foreign counterparties by domestic residents. In addition, the private sector has proposed the creation of a bureau of derivatives exposures. This bureau would initially collect information on the maximum exposure under bullish and bearish scenarios from clearing houses, summarize it by risk factors, and disseminate it to banks. The Brazilian financial and capital markets association has also worked on derivatives suitability guidelines to classify derivatives as simple or complex according to their characteristics. Vivan pointed out that not only exposures and other metrics should be monitored, but also the capacity to absorb risks by individual non-financial firms, the distribution of derivatives positions (short and long), and the diverse role played by market participants.

Panelists:
Tae Soo Kang (Director General, Financial Stability Office, Bank of Korea)
Pascual O'Dogherty (Director of Financial System Analysis, Bank of Mexico)

Gilneu Astolfi Vivan (Deputy Head of Financial System Surveillance, Central Bank of Brazil)

Moderator:
Christopher Towe (Deputy Director, Monetary and Capital Markets Department, IMF)

IV. THE USE OF NETWORK ANALYSIS TO ASSESS SYSTEMIC RISK,

May 28, 2010

(Hosted by the IMF's Financial Surveillance Group)

Opening Remarks

Christopher Towe (IMF) welcomed participants to the last session and explained that the focus of this three-day event was to try to make concrete the analysis and assessment of systemic risk that would allow the development of policies to identify and act upon risk at an early stage. The first day was about identifying systemically important institutions, markets, and instruments; the second day examined some key data gaps. The third day was to focus on assessing and gauging networks. A key lesson of the last few years is how important the interconnections between markets, instruments and institutions are for propagating shocks. The key goals of this session were to first define which networks are important, some of which, based on past observation, may be less obvious; second, to define, gauge and assess the linkages within those networks — in particular, where the nodes are and how thick are the interlinkages; third, to gauge to what extent these networks respond to shocks, and how the shocks are transmitted across and between individual institutions, instruments and markets.

Panel Session I: How to Measure Systemic Interconnectedness—Network Perspectives

Presentations

Kimmo Soramaki (European Central Bank) explained that the main premise of network analysis was that the structure of links between nodes matters. The properties and behavior of a node cannot be analyzed in isolation. To understand the behavior of one node, one must analyze the behavior of nodes that may be several links away in the network. In the financial context, this amounts to a network of interconnected balance sheets.

Networks are comprised of nodes (bank/banking groups), links (positions and exposures), directions, weights, and properties. Algorithms/measures consist of centrality, flow, pattern identification, distance, connectivity (clustering) and cascades. Advances in theory have enabled identification of contagion channels in different parts of the financial system, and of the formation and information content of links between financial institutions and their behavior under normal and stress conditions. Models of systemic risk include real economic interactions among markets. More granular and frequent data with long time series is a

prerequisite for financial network analysis. Regulators should continue to develop ways to systematically collect, share and analyze data from market sources as well as financial infrastructures. Tools have improved substantially over time.[4]

Rama Cont (Columbia University and Centre National de Recherche Scientifique) explained that the financial crisis has simultaneously underlined the importance of contagion effects and systemic risk and the lack of adequate data on exposures and indicators for measuring and monitoring these risks. Cont argued monitoring of exposures between financial institutions is necessary; network analysis provides important insights for measuring the systemic impact of the failure of financial institutions; heterogeneity is important in banking networks (homogenous models maybe give incorrect insights); and that the impact of CDS on financial stability may be measured in a meaningful way using network models.

Cont and his colleagues have developed a forward-looking indicator for measuring the systemic impact of the failure of a large financial institution, which can serve as an early warning of potential future systemic losses. Three measures—a default impact, a contagion index and a systemic risk index have been constructed. Together they combine the effects of correlation (common market factors affecting defaults), network effects (default contagion via counterparty risk) and indirect contagion (via credit risk transfer). They have also studied the impact of macroprudential policies on the magnitude of systemic risk, concluding that mapping exposure networks gives valuable insight to regulators on contagion and systemic risk. Exposures represent potential future losses and provide information from different market-based indicators. Measures of systemic risk need to account for correlations in market shocks across firms as well as contagion risk due to counterparty exposures. Network models provide useful insight into default contagion and systemic risk. They also allow analysis of the systemic impact of CDS, and introduce contingent long-range links between institutions and a meaningful cost/benefit analysis of the impact of macroprudential regulation on contagion risk and the role of clearing houses or central counterparties.

Sheri Markose (University of Essex) said there are only a few empirical studies of financial network interconnections among banks and between banks and non-banks for CDS protection buyers and protection sellers. Technical insolvency of US banks arose not just from legacy/toxic RMBS assets but also due to credit risk exposures from SPV vehicles and CDS markets. She explained that the problem of "too interconnected to fail" came from the dominance of a few big players (e.g., AIG) in chains of insurance and reinsurance for credit default risk.

Using a complex agent-based methodology for modeling financial network systemic risk, Markose presented an empirical reconstruction of the U.S. CDS network using FDIC and DTCC data. The results (from 26 banks) suggest a fundamentally unstable system that does not have enough capital to prevent systemic collapse due to a failure of a large CDS seller. However, the study also suggests that this is a more stable system than an un-concentrated

[4] Ongoing research can be found at www.financialnetworkanalysis.com/fna.

random network. The presentation laid out implications for ICE CDS Central Clearing, found no evidence that CDS markets can deliver AAA cover for bank assets, called for repeal of Basel II regarding unfunded CDS cover leading to capital relief, and introduced the concepts of "super spreader" funds based on centrality in connectivity. Financial entities would have to contribute to the super spreader fund based on their systemic risk impact—measured as liquidity loss impact in terms of aggregate bank core capital loss due to failure of a major bank player from its CDS activity. Markose also explored whether eigenvalue-based centrality statistics for super spreaders could serve as good systemic risk proxies, for measuring percent loss of core capital for the CDS participants from the trigger bank.

Both Markose and Rama Cont in their talks emphasized that market price data-based banking stability indexes provided flawed early warning signals. Such indexes can be shown to be contemporaneous with the crisis and have very little capacity to forewarn authorities.

Discussion

The discussion focused on issues related to stability of central clearing houses and the salient factors that should be borne in mind by policymakers while considering systemic risk issues. Panelists differed on whether stress tests on the adequacy of capital for CCPs had fostered sufficient confidence about stability. Differences in views stemmed from the relevance of the netting of exposures, particularly under conditions of stress.

Nigel Jenkinson (FSB) raised the issue of reputational contagion, and presenters suggested that greater transparency about aggregated exposures and links across networks, including indirect links through financial infrastructure (payments system, CCPs) could be useful in stemming such risks. Speakers emphasized the importance of forward-looking systemic measures, and that it was useful to look at links and not just nodes—so far analysis showed that there are few dangerous links and that these could be easily monitored and buffered. Hiroshi Ugai (Bank of Japan) also raised the question of how the confidence erosion channel of systemic risk could be incorporated into network analysis.

Elie Canetti (IMF) noted this train of work could be very useful to inform the Fund's ongoing work with the FSB on an early warning exercise, and noted that in relation to work on information gaps, the discussions pointed to many challenges vis-à-vis data and reputation risks that went well beyond the legal challenges on data issues.

Panelists:
Kimmo Soramäki (European Central Bank)
Rama Cont (University of Paris)
Sheri Markose (University of Essex)

Moderator:
Stijn Claessens (Assistant Director, Research Department, IMF)

Panel Session II: Public Sector and Central Bank Applications

Ivan Alves (European Central Bank) presented work on network analysis in the ECB, including on essential components of networks—linkages (bars), units (nodes), and mechanisms for transmitting shocks through the network—and challenges going forward. Network analysis originated with the study of payment systems and has morphed to the study of financial flow networks and fragility. The motivation of this work is to answer policy questions and provide recommendations. Linkages across nodes are characterized by positions (holdings of securities), activities (e.g., financing), roles (functions in payments infrastructure/settlements), legal underpinning (ownership), and subsidiary (sensitivity to common shocks, including market perceptions). The work entails information gathering to identify systemic institutions, the fragility of networks linking the system, and developing a structural (rather than reduced form) model of exposures for studying contagion.

In the Euro area, the unit of analysis could be countries, sectors, or institutions. The choice of units defines the transmission mechanism and linkages, with institutions giving the most flexibility and granularity (by position, activity, ownership, etc.) Systemic analysis is largely focused on institutions that span across borders, and this has implications about how to think of supervisory issues, which are often defined within national boundaries and lack a common supporting framework of information and analysis. Shock transmission mechanism could be mechanistic (balance sheet exposure based) or strategic (including reactions to, and transmission of, shocks). Most recently, the ECB is studying networks to depict the concentration of Eurosystem liquidity among counterparties and to identify the systemic importance of institutions central to Eurosystem operations. Networks are increasingly about economic and financial functions rather than national boundaries, which gives a key role to international organizations to study this issue.

Lavan Mahadeva (Bank of England) discussed the spread of contagion and the role of interconnectedness from an interbank network perspective, which comprises different banking groups (nodes) and a set of bilateral claims (links) across them. The objective was to build a map of how financial stress travels through networks, and in particular when stress is likely to be contained in a particular country or group and when it is likely to become systemic. The BoE uses BIS locational residency-based data and provides evidence of large super clusters: Japan, the UK, and the U.S., in the early 1980s. The clusters broke up by the beginning of the 1990s. Over the subsequent decade and a half, European banking groups increased in relative importance with small, but still influential, clusters. Networks became more contagious prior to the current crisis, but recent deleveraging and strengthening of bank balance sheets could make the system more resilient to contagion from shocks.

Serafín Martínez Jaramillo (Banco de Mexico) defined systemic risk as the risk of an event that threatens the functioning of the system of payments, banking or financial systems. It consists of two main components, an initial shock, and a contagion mechanism. The relevance of the macroeconomic environment is crucial to this process as is the

interconnectedness of the system. Direct contagion in banking systems through interbank markets has been widely studied by central banks in several countries. More recently, contagion and systemic risk have been studied via network theory, general equilibrium models of endogenous defaults and credit and deposit markets, relevant measures of distress of individual banks, groups of banks and distress on the system due to individual bank, and simulation model-based studies of losses and financial stability. On the systemic importance of institutions, a number of authors have provided complementary ideas.

Simulation models generate macroeconomic shocks and map them into risk factors, credit and market losses. Thresholds are determined to generate failures that impact losses in the system through network (e.g. interbank) exposures, and allow for computation of distribution of initial losses compounded by contagion losses. A model is simulated for the Mexican economy and concludes that the topology of the network is not enough to characterize the systemic riskiness of a particular financial system. The relevance of the initial macroeconomic shock is important. To concentrate on size and interconnectedness (alone) to determine the systemic importance of institutions could be misleading. Other aspects such as size of losses and the relationship with the capacity of a bank to absorb losses are important as well.

Discussion

David Marston (IMF) asked how this work was affecting internal policy discussions. Panelists said that in the area of payment systems this work had gained traction long ago; the work on financial interconnectedness, however, was still in its infancy. It is being applied in some central banks, Banco de Mexico being a case in point, but is yet to gain prominence in a systematic manner. One of the participants asked how meaningful it was to cluster together banks into countries and carry out country level analysis. Mahadeva responded saying that was a fair question, and that thinking about contagion in the context of national boundaries was to put in perspective the complex regulatory issues that come into play in the spread of contagion. A related question on the role of bank structure, subsidiary vs. branches, in transmission of shocks was raised; panelists responded that to understand the impact of the structure it was essential to introduce a domestic component to the analysis that would allow the study of longer maturity assets and liabilities relative to shorter maturity cross-border assets and liabilities of the large banks.

Panelists:
Ivan Alves (Principal Financial Stability Expert, Financial Stability Surveillance, European Central Bank)
Lavan Mahadeva (Bank of England)
Serafín Martínez Jaramillo (Senior Financial Researcher, Banco de Mexico)

Moderator:
David Marston (Senior Advisor, Strategy, Policy, and Review Department, IMF)

Panel Session III: Private Sector Applications

Presentations:

Michael Zerbs (Algorithmics) presented a conceptual approach to systemic risk simulation. He argued for shifting from managing risks at the firm level to managing systemic risks on a timely basis. His presentation showed that it is difficult to separate different measures of risk such as credit risk from market risk, and argued for a generalized framework to assess risk in all directions. There is also a need to model the dynamic evolution of a balance sheet and create hedging and portfolio optimization scenarios.

Richard Berner (Morgan Stanley) discussed how Morgan Stanley as an LCFI manages risk in practice. The presentation highlighted three lessons for regulators and risk managers: i) stress testing is a useful tool as value at risk (VaR) analysis does not cover systemic interconnectedness; ii) liquidity matters, as lack of liquidity can cause significant losses; iii) disentangling market and credit risk is very difficult. To address the limitations of VaR in the above dimensions, the paper presented a Stress VaR methodology, which is forward looking, quantifies extreme tail risks, and uses a long time horizon to simulate systemic risk.

Discussion:

Serafin Martinez-Jaramillo (Bank of Mexico) asked about dealing with the differentiated impact on large and medium or small banks in the event of a crisis. Zerbs pointed out that assessing systemic risk has to account for the non-linearities in the system and take that into account when assessing value at risk.

Zerbs also clarified that the time dimension is accounted for in the simulation. In addition, the cash flow that is used in the simulations varies over time; however, this is based on a number of behavioral assumptions to estimate those cash flows. Berner clarified that his analysis also accounted for the time dimension as well as counterparty risk, and tries to shock the model to account for some network interconnectedness.

Both panelists clarified that they try to account for liquidity risk from both perspectives: funding liquidity and asset liquidity risks.

Panelists:
Richard Berner (Co-Head, Global Economics, Morgan Stanley)
Michael Zerbs (President and CEO, Algorithmics)

Moderator:
Laura Kodres (Division Chief, Monetary and Capital Markets Department, IMF)

Panel Session IV: Data Issues for Network Analysis
Presentations:

Patrick McGuire (Bank for International Settlements) presented a framework to use BIS data to monitor the buildup of funding shortages in foreign currency. He stressed that this would be a useful tool for supervisors to monitor and assess risks to their banks and the potential stress they might face as a result of reliance on cross-border funding. He also pointed to the importance of making aggregate level data publically available to support market discipline and appropriate pricing of risk. The paper developed a measure of effective maturity mismatch and built a picture for the global consolidated balance sheets of a number of banking systems broken down by currency. The paper concluded that global banking systems were facing a large 'dollar funding gap' in the run-up to the crisis. The paper also argued for rethinking the residency-basis of assessing external vulnerabilities by complementing it with a nationality dimension to collect consolidated country-level statistics.

Andrei Kirilenko (Commodity Futures Trading Commission) discussed how the CFTC applies network analysis to understand systemic risk in trading networks. The presentation discussed the value of network analysis in understanding how certain events take place, e.g. a severe market dislocation or withdrawal of liquidity. Also, the CFTC is trying to use network analysis to understand algorithmic trading and provide information on trading patterns and market risk, i.e., how market participants interact and who ultimately holds the risk.

Stewart Macbeth (The Depository Trust & Clearing Corporation) presented a paper on derivatives repositories, particularly credit default swaps. DTCC manages a trade information warehouse that has about 2.5 million position records, most of which include full legal records from over 50 domiciles. In terms of data reporting, DTCC produces weekly public reports on total market information and transaction activity. It also reports aggregate anonymous data to regulators, while named participant data is available based on attestations of a material interest, including to market regulators and central banks.

Discussion:

McGuire clarified that data on the inter-office flow of funds within LCFIs already exists with the supervisors, and he argued for making that data available at an aggregated level to understand the mechanism of cross-border flows.

Laura Kodres (IMF) noted a lot of data is already available, but there is skepticism about how useful it can be given the difficulty in aggregation. However, we should consider using the data as is, regardless of issues of measurement or definitional uniformity, given that market participants use that data to take decisions and transmit shocks.

Panelists:
John Kambhu (Vice President, Federal Reserve Bank of New York)
Andrei Kirilenko (Senior Financial Economist, U.S. Commodity Futures Trading Commission)
Stewart Macbeth (General Manager, The Depository Trust & Clearing Corporation Trade Information Warehouse)
Patrick McGuire (Senior Economist, Monetary and Economics Department, Bank for International Settlements)

Moderator:
Gian Maria Milesi-Ferretti (Assistant Director, Research Department, IMF)