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ECONOMIC AND MONETARY AFFAIRS

Defining and Measuring Systemic Risk

NOTE

Abstract

Financial surveillance before the current crisis erupted suggested that problems were forming but the indications were too imprecise to permit a policy response. Work is currently being undertaken to improve the measurement, monitoring and management of systemic risk. That requires it to be defined, which is unproblematic, and operationalized, which is not. While promising methods to measure risk exist, the data demands are so pronounced that statistical risk monitoring will remain an imprecise science for years to come.

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1. INTRODUCTION

The current financial crisis has illustrated all too vividly that the growth of the interlinkages between financial institutions and markets observed in recent decades has greatly expanded the scope for financial shocks to spread and to become systemic. Indeed, the crisis originated in what many felt was a niche of the global financial system of little significance for financial stability – the US subprime mortgage market – but spread quickly across an almost unimaginably large number of markets and led to the collapse or near-collapse of many financial firms in the European Union and elsewhere.

In response, central banks across the world have adopted unprecedented policy measures – in the form of interest rate reductions and a massively increased provision of interbank liquidity – in order to stabilise financial markets. Exceptional measures – in the form of wide-ranging bank support packages, involving guarantees and partial or full public ownership of some institutions, and highly expansionary fiscal policies – have also been taken by many governments. Furthermore, much thought has been devoted to how the institutional framework for financial supervision could be improved. In the European Union, the Commission has proposed the establishment of a European Systemic Risk Board (ESRB) to perform macro-prudential supervision of the EU-wide financial system and the European System of Financial Supervisors (ESFS) to strengthen micro-prudential supervision.

Looking back on the causes of the crisis, it is difficult to deny that the management of financial firms, who must ensure the viability of their institutions, and policy makers responsible for financial stability underestimated the potential for (what admittedly initially appeared to be) isolated tension in a small part of the financial system to lead to a systemic crisis. As a consequence, much work is currently being undertaken on the question of whether systemic risk can be measured, monitored and managed in real time. This will be an important task of the ESRB.

This note comments on the feasibility of measuring systemic risk. As a prelude to the analysis below, it is useful to review the notion of systemic risk. The IMF (2009a) notes that while the term systemic risk is widely used, it is difficult to define and quantify and suggests that is often viewed as a phenomenon that it is there "when we see it."[1] The Group of Ten (2001, p. 126) proposes the following definition:[2]

> *"Systemic financial risk is the risk that an event will trigger a loss of economic value or confidence in, and attendant increases in uncertainty about, a substantial portion of the financial system that is serious enough to quite probably have significant adverse effects on the real economy. Systemic risk events can be sudden and unexpected, or the likelihood of their occurrence can build up through time in the absence of appropriate policy responses. The adverse real economic effects from systemic problems are generally seen as arising from disruptions to the payment system, to credit flows, and from the destruction of asset values.*

[1] Quotes in the original.
[2] See also the discussion in Hendricks et al. (2006).

> *Two related assumptions underlie this definition. First, economic shocks may become systemic because of the existence of negative externalities associated with severe disruptions in the financial system. If there were no spillover effects, or negative externalities, there would be, arguably, no role for public policy. [...]*
> *Second, systemic financial events must be very likely to induce undesirable real effects, such as substantial reductions in output and employment, in the absence of appropriate policy responses. In this definition, a financial disruption that does not have a high probability of causing a significant disruption of real economic activity is not a systemic risk event."*

This definition highlights three important characteristics of systemic risk. First, it must impact on a "substantial portion" of the financial system. Thus, it is risk to the financial system as a whole.

Second, systemic risk involves spillovers of risk from one institution to many others. In turn, this implies that in measuring it, attention should presumably be focused on the ways in which adverse shocks affecting one or a few institutions can be transmitted to the financial system at large, that is, on the interlinkages between institutions.

Third, episodes in which systemic risk materialised would typically be associated with highly adverse macro economy effects in the absence of rapid and strong policy responses. By this standard, it is clear that the current episode of financial instability reflects a systemic crisis.

However, while this definition is clear, it is also rather abstract. In order to measure and to control systemic risk, it must be made operational. That is more difficult and an area in which more work is needed.

2. MEASURING SYSTEMIC RISK

There are at least three approaches that can be used to assess the build-up of systemic risk. The first focuses on monitoring traditional indicators of financial soundness or stability in order to assess broad developments in the financial system; the second focuses on measuring interlinkages between financial institutions; and the third focuses on changes in the behaviour of prices of financial assets. I discuss each in turn.

2.1. Aggregate indicators of financial soundness

In the last decade or so, central banks, regulatory and supervisory agencies and international institutions have typically relied on a range of aggregate indicators to gauge vulnerabilities in the financial system. Given the predominance of this approach it is useful to review it in some detail.

There are a large number of indicators that can be used for this purpose, including:

- *Interest rates and asset prices*. Prices of financial assets and interest rates are continuously available with no delay and contain information about markets participants' views of a range of different risks. This information can be used to construct a number of indicators of the functioning of financial markets, including measures of liquidity premiums, risk spreads and implied volatilities.

- *Financial stocks and flows*. These include measures of bank lending, net issuance of bonds and notes by firms and capital flows. The use of such indicators is motivated by the fact that localised financial tensions can become systemic and cause banks and other institutions to scale back lending, which tends to cause or aggravate macro economic weakness with obvious risks for a feedback loop onto the financial system.
- *Surveys of investor sentiment and bank loan officers*. Such information can complement hard data on developments in the financial system. However, surveys are typically infrequent and therefore not helpful for monitoring developments in real time.
- *Macroeconomic indicators*. Since many episodes of financial crises have been triggered by severe business cycle downturns, it is natural for the authorities responsible for financial stability to monitor evidence of macroeconomic vulnerabilities.

One attractive feature of these indicators is that they rely on data that are already collected, thus obviating the need for data collection exercises that can easily be very costly. The monitoring of financial vulnerabilities in this way is arguably best seen as a systematic and careful review of the available information. The alternative approach, which is likely to play a greater role in coming years, is for the responsible authorities to determine what information is needed for financial surveillance and then explore whether it can be collected.

While using aggregate indicators is a natural starting point for assessing systemic risk, it has two shortcomings. First, many indicators are reported infrequently (e.g., monthly) and are subject to reporting lags. As the present crisis has shown, tensions in the financial system can develop very rapidly. Since these indicators are inherently backward looking, capturing the state of the financial system some weeks or months ago, they may be of limited usefulness for assessing risks at the present time.

Second, it focuses on broad developments in the financial system and provides little information about the state of individual financial institutions, in particular about interlinkages between institutions. Since systemic risk materialises through the transmissions of financial stress from institution to institution, this is an important shortcoming.

However, no indicator is perfect and in guarding against systemic risk it is appropriate to use a number of measures, each with its own strengths and weaknesses. While this approach to assessing systemic risk may be simple, one must not lose sight of the fact that it did lead policy makers to identify in advance of the crisis a number of developments that played crucial roles in the financial turmoil that subsequently ensued:

- The presence of *global current account imbalances and the resulting capital flows*. What was perhaps not fully understood was that the risk-management systems of financial firms and government oversight of the financial sector, particularly in the United States, failed to ensure that the capital inflows were prudently invested.[3]
- The *decline in long nominal and, more importantly, real interest rates* and the resulting incentives for financial institutions to "search for yield" as evidenced by

[3] See Bernanke (2009).

sharp reductions in the volatility in financial markets and large contractions in just about all risk spreads in financial markets.[4]

- *The growth of US subprime loan markets*.[5] What was less clear was that subprime mortgages, which constituted only a small portion of overall US mortgage markets, could trigger systemic risk through the securitisation process.
- *The rapid growth of the markets for structured products.* Structured products – which in many cases were extremely complex and opaque, leading them and the risk they entailed to be poorly understood by many investors – came to play a central role in the crisis that followed.
- *Weaknesses of the ratings process*. During the crisis it became clear that many structured products had received unwarranted (high) ratings, typically triple-A. These ratings were in some cases associated with outright faults in the ratings process. Rating agencies were also subject to severe conflicts of interest in that they sold advice regarding how to structure products in such as way as to enhance their ratings. There was also an overreliance on ratings by investors.

But if this approach to monitoring systemic risk led policy makers to be concerned that systemic risk was growing before the crisis erupted, the question arises why these concerns did not trigger policy action. Two factors may have played a role.

First, policy makers had no way of knowing precisely where in the financial system risks were accumulating. Without a clear understanding about where the risks lay, how tensions developed, and how they could be transmitted across the financial system, it was difficult to take the necessary steps to forestall the crisis. Better information about the interconnections of financial institutions, in particular, would have made it easier for policy makers to take action.

Second, policy makers may have doubted the information coming from their monitoring efforts in light of the relative simplicity of indicators used and the fact that, in the absence of any recent episode of a severe and wide-spread systemic crisis, they had little or no practical experience in assessing the severity of the risks.

2.2. Measures of conditions of individual institutions

Policy makers now face the challenge of constructing better macro prudential indicators and measures of systemic risk. In doing so it seems crucial to move from the use of aggregate statistics capturing the overall state of the financial system to indicators of the state of individual institutions.

Data from individual financial institutions can be used to identify what entities are most likely to experience pressures. In an ex post analysis of the current financial crisis, IMF (2009a) studies whether a set of standard Financial Stability Indicators (FSI) contained information about which institutions would experience difficulties sufficiently severe to require government intervention.

Several conclusions are relevant. While measures of leverage contained information useful for predicting intervention, capital adequacy ratios and liquidity ratios did not. Other indicators, including non-performing loans, return-on-equity and equity prices, also seem not be informative about the likelihood that a firm would require government support.

[4] Panetta et al. (2006) reviews some of these developments.
[5] For a discussion of subprime mortgage markets and other developments in the housing finance markets that raised concerns, see CGFS (2006).

These findings indicate that while information from individual financial institutions can help guard against systemic risk, not all such information is useful. Furthermore, as suggested by the fact that the IMF study uses data from merely 36 institutions, data collection problems, both in terms of the number of institutions covered and in terms of the timeliness of the data, are likely to be important. That being said, the number of systemically important institutions is far smaller than the total number of institutions, and data availability is less likely to be a problem in the case of large institutions.

The IMF study also reviews the usefulness of credit risk models for predicting stress in both individual and groups of financial institutions. Also in this case do the results indicate that such models can play a useful role in measuring and monitoring systemic risk. However, these models are data intensive and require timely data, suggesting that using them to monitor a large number of institutions in real time will be a demanding task.

2.3. Assessing systemic linkages

While the IMF study referred to above looked at data on individual institutions, the current crisis indicates that in guarding against systemic risk it is of crucial importance to understand the interlinkages between financial institutions, both domestically and internationally. Only by knowing how the failure of one institution would affect other institutions is it possible to design appropriate policy responses. However, this is an area in which little work has been done until recently, and the field is likely to develop as increasing attention is focused on it.

IMF (2009b) surveys a number of methods to assess interlinkages between financial firms and distinguishes between four approaches:

- The *network approach*, which tracks the transmission of financial stress across the banking system via linkages in the interbank market;
- The *co-risk model*, which uses market data on credit default swaps to assess how the default risk of an institution is affected by the default risk of another institution;
- The *distress dependence matrix*, which allows analysts to study a group of financial institutions and to assess the probability of distress for a pair of institutions, taking into account a set of other institutions; and
- The *default intensity model*, which captures the likelihood of default of a large fraction of financial institutions through linkages.

In brief, three conclusions can be drawn from the IMF's analysis.

First, it is in principle possible to measure and monitor systemic risk continuously. While each method discussed above is necessarily imperfect, by using several complementary approaches policy makers could construct a mosaic of the systemic risks faced by the financial system.

Second, a massive amount of data is required to perform this monitoring exercise. The information most important for policy makers concerns the links between a myriad of individual financial institutions spread across the world. These links can change rapidly in response to market sensitive information, requiring large amounts of data to be gathered and transmitted with very short delays to the authorities responsible for monitoring financial risk. It seems unreasonable to assume that this form of monitoring can be implemented in the next few years, if at all.

Third, as the financial crisis reminds us, there is always the risk that financial models, including any used to monitor systemic risk, are incorrect. Thus, few policy makers would

be willing to rely excusively on the indications provided by statistical risk monitoring tools. Policy judgment will always be called for.

3. POLICY CONCUSIONS

Overall, the analysis suggests a number of conclusions for policy in this area.

First, while the notion of systemic risk is clear, there is no agreement among regulators and academics about how best to operationalize it. Promising work on measuring systemic risk is now in progress at the IMF and many other institutions, including the ECB, but it is too early to judge how successful it will be and what the advantages and drawbacks of alternative approaches are.

Second, an improved understanding of cross-market, cross-currency and cross-country linkages and the location of risk in the financial system would be helpful for the authorities responsible for monitoring systemic risk. It is important to note that better information of this kind is likely to make them less hesitant to take action if there is evidence that systemic risk is accumulating. It is plainly much easier to justify strong regulatory action on the basis of hard data than mere suspicions that financial stability may be at stake.

Third, risk monitoring requires rapid access to detailed data from financial institutions and markets at home and abroad. For a number of reasons – including legal rules regarding access to supervisory information; limited disclosure for some markets/products (in particular structured products); difficulties in collecting information from non-bank intermediaries (including investment banks, insurance companies and hedge funds); and unavoidable reporting lags – it seems unlikely that these informational barriers can be overcome rapidly. Thus, some time will pass before such a systemic risk monitoring system can be made operational at the European level. Despite this, of course, the ESRB will contribute importantly to macro-prudential supervision.

Fourth, the challenges noted above of course do not imply that technical work on measuring and monitoring systemic risk should not go forward; rather they suggest that there are reasons to believe that progress will not be rapid. Since the task ahead appears large and time consuming, it is important that unnecessary delays are avoided: work should start early and the momentum must be maintained.

Fifth, while responsibility for financial stability oversight and early warning in the first instance will fall on national authorities, finance by its very essence is international. There is thus an obvious need for international cooperation and coordination of financial surveillance, regulation and supervision. Following the suggestions in the de Larosière report, the Commission has made a detailed set of proposals for how these processes should be conducted at the level of the European Union.[6]

The report also proposes that a global financial stability early warning system, including a global risk map and credit register, be developed by the IMF with the assistance of other bodies. That judgement seems correct: work in this area will demand large resources, in particular staff. While a new institution can always be created or an existing institution be expanded, progress will be much more rapid if work can build on existing expertise. Of the international organisations, only the IMF has the critical mass and prerequisite experience in macro prudential surveillance to lead in this area.[7]

[6] See de Larosière et al. (2009).
[7] Of course, within the euro area, only the ECB has the required critical mass, staff resources and expertise. It is therefore natural that it plays a leading role for the European Union as a whole.

But other international institutions also have a role to play. The Financial Stability Board (FSB) and the Bank for International Settlement (BIS) are important forums where senior central bankers and regulators and, in the case of the FSB, treasury officials meet to discuss macro prudential surveillance and to promote and enhance international cooperation and coordination in the financial stability area. These institutions also provide secretariat services to a large number of committees and working groups of technical experts in which vital operational issues are discussed. This helps build international consensus for common action in these areas. But while this "Basel process" is immensely valuable and should be strengthened, the staff resources of the FSB and the BIS are too small for them to play an operational role in the area of macro prudential surveillance.

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