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A Framework for Assessing Systemic Risk

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Abstract

When faced with financial crises, authorities worldwide tend to respond aggressively with public support measures. Given the adverse impact on moral hazard and market discipline, support measures involving public money are ideally limited to crisis situations involving systemic risk: a disturbance in the financial system that is serious enough to affect the real economy. This note sets out the main characteristics of a systemic risk assessment framework: a simple analytical framework that can be used by authorities with financial crisis management responsibilities in times of financial crisis to assess the extent to which that particular crisis situation poses systemic risk.

This paper—a product of the Financial Systems Department, Financial and Private Sector Development Vice Presidency—is part of a larger effort in the department to strengthen financial systems by improving the quality and effectiveness of state interventions in finance. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at mdijkman@worldbank.org.

A Framework for Assessing Systemic Risk

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Executive Summary

When faced with a financial crisis, authorities often rush to provide generous support packages, often involving public money. Although public support measures in the form of emergency liquidity assistance, solvency support, and public guarantees may contribute to short-term stabilization, they are can generate adverse long-term consequences, as they weaken market discipline and increase moral hazard. The expectation to be bailed out is likely to fuel the risk appetite of financial institutions, thereby increasing both the likelihood and the costs of future financial crises. Support measures involving public money are therefore ideally limited to crisis situations involving systemic risk: a disturbance in the financial system that is serious enough to affect the real economy. In absence of a pre-established analytical framework, it is difficult to distinguish systemic crises from nonsystemic ones, considering that crises typically involve acute time pressure and incomplete information.

This note sets out the main characteristics of systemic risk assessment frameworks: a simple analytical framework that can be used by authorities with financial crisis management responsibilities in the context of an impending financial crisis to assess the extent to which that particular crisis situation poses systemic risk. At the very core of systemic risk is contagion, which refers to the mechanisms through which shocks propagate from one element of the financial system to another. A distinction needs to be made between *real* and *information* contagion channels. The former refers to the knock-on effects on other parts of the financial system and the real economy through direct exposures. The latter refers to behavioral changes by economic agents in response to a specific crisis event.

Conducting a systemic risk assessment in times of crisis requires considerable preparation in pre-crisis times. A first step is identifying the critical parts of the financial system that are most likely to generate concerns about systemic stability if critically affected: specifically, the relevant financial institutions, markets, and infrastructures. It is also helpful to identify the main interconnections within the financial system and between the financial system and the real economy. This provides authorities with a frame of reference in which to contemplate the most likely contagion effects of an actual financial shock, and prepares them to assess systemic risks in a faster and more disciplined manner when faced with a financial crisis. Similarly, it is imperative that authorities have given prior thought to the data they will need in times of crisis, and that appropriate procedures are in place to ensure that relevant data can be produced at short notice. Lastly, authorities need to develop qualitative and quantitative criteria outlining the particular trigger points that need to be met for a particular crisis event to be accurately considered "systemic."

Performing a systemic risk assessment in the context of an actual crisis involves an assessment of the specific characteristics of the triggering event and the economic and financial context in which it occurs, so as to assess the shock-absorbing capacity of the financial system and the real economy. The backbone of the systemic risk assessment consists of an analysis of the anticipated impact of the triggering shock on financial institutions, the financial infrastructure, and the real economy. The analysis should

include both the direct impact on these parts of the financial system and the most likely contagion effects, through the real contagion channel as well as through the information channel. For the sake of conclusiveness, the outcomes of the systemic risk assessment can be graphically summarized using numerical scores, based on pre-established trigger points.

Ideally, central banks and supervisors should perform systemic risk assessment analyses in close cooperation with one another, as these are the agencies that are most likely to have the necessary technical skills and access to information. Responsibility for conducting the assessment in times of crises also needs to be assigned to specific staff. A serious effort needs to be made to overcome “silo-structures” within central banks and supervisory agencies and to make key staff in different departments familiar with the methodology of the systemic risk assessment framework. It is also imperative to familiarize other domestic stakeholders, such as the ministry of finance, the deposit insurance fund, and other supervisors, with the framework. Depending on the level of cross-border activity, the systemic risk assessment framework may also need to be fed with data from foreign supervisors. Establishing formal Memoranda of Understanding can assist in this task. In addition, it is helpful to engage in regular informal contact to create the basis of trust needed for a proactive exchange of information. Lastly, it is necessary to invest in the regular maintenance of the systemic risk assessment framework, to ensure that it remains up to date.

Introduction

When faced with a financial crisis, authorities are confronted with the basic question of whether or not to provide financial support by granting emergency liquidity, injecting capital from public funds, or providing guarantees. Speed in decision making is usually of the essence, and authorities worldwide typically respond aggressively by rolling out a range of rescue measures (Honohan and Laeven 2005, p. 4). In the context of an impending financial crisis, it is often argued that only sweeping guarantees and extensive liquidity and solvency support can stop a panicky flight of depositors and other creditors. Such accommodative support policies may be helpful in taking away the imminent threat, but they come at significant costs. Honohan and Klingebiel (2003) find that accommodative policy measures tend to be fiscally costly—averaging 14.3 percent of GDP in developing countries—and do not necessarily accelerate the speed of recovery. Accommodative support measures may also be counterproductive through their adverse impact on market discipline and moral hazard. If financial institutions can count on the public sector to step in, they will be more inclined to risk insolvency, which raises both the likelihood and the costs of future financial crises. The costs will accrue to taxpayers and prudently operated financial institutions, which will be disadvantaged by lower returns on investment (World Bank Development Research Group 2008, pp. 17–18). Accommodative support measures may be associated with other unintended consequences, including an increase of the state-owned segment of the financial sector, significant increases in public indebtedness, increasing concentration in the financial sector and a reduction in competition.

Authorities involved in financial crisis management are therefore well-advised to exercise restraint. Support measures involving public money should ideally be provided only in the presence of strong indications of systemic risk: a disturbance in the financial system serious enough to affect the real economy. In the absence of a well-established analytical framework, it will be difficult, however, to distinguish systemic crises from nonsystemic ones. Acute time pressure and incomplete and fragmented data greatly add to the difficulty in making such a distinction. As a result, authorities are likely to err on the side of caution and resort to the sort of generous support measures mentioned above.

This note sets out the main characteristics of a systemic risk assessment framework: a simple analytical framework that authorities with financial crisis management responsibilities can use in the context of an impending financial crisis to assess the extent to which that particular crisis situation poses systemic risk. The framework proposed in this note builds on methodologies proposed by other institutions, especially the Bank of England and the European Central Bank (ECB) (see appendix A). Its main objective is to enhance the quality of the crisis response. Systemic risk assessment frameworks are therefore different from (but complementary to) diagnostic tools such as macro-prudential analysis and stress tests.[1] Similarly, systemic risk assessment frameworks are

[1] Macroprudential analysis is conducted for financial stability purposes, and involves a system-wide analysis aimed at identifying the principal risk factors in the macro environment in which financial institutions operate. Stress testing provides indications of financial soundness of individual financial institutions under predefined stress scenarios. Broader assessments of how a failure of a particular institution affects the financial system and the real economy are usually not included.

complementary to ongoing efforts to upgrade the quality and coverage of financial supervision, which are intended to prevent financial crises from occurring, rather than managing them efficiently once they occur. An additional advantage of using a systemic risk assessment framework is that it provides ex post accountability. By making the authorities' considerations in devising a crisis management response explicit, it also provides additional protection against political backlashes.[2] The principal stakeholders directly involved in financial crisis management (supervisors, central banks, deposit insurance funds, and ministries of finance) are the main intended beneficiaries. Since the latter decide on the use of taxpayer funds, the finance ministries should be especially interested.

This note is divided into five sections. Following this opening section, the second section provides a concise introduction to the systemic risk concept. The discussion of the actual systemic assessment framework is split in the two sections that follow. The third section focuses on the preparatory stage: the preparations that need to be undertaken in noncrisis time to put the systemic risk assessment framework to use in times of crisis. The fourth section addresses the actual application of the framework in the context of a financial crisis. The fifth section provides a summary of findings and discusses implementation challenges. The first appendix looks into different approaches as to how various central banks and supervisory institutions measure systemic risk. The second appendix presents a detailed explanation of the contagion matrix described in this note.

The Concept of Systemic Risk

The recent financial crisis has spurred a noticeable increase in theoretical, empirical, and policy analyses of financial instability. While "systemic risk" is now widely accepted as the fundamental underlying concept for the study of financial instability and possible policy responses, most work so far has focused on one or several aspects of that risk. There is limited understanding of the *overall* concept of systemic risk and the linkages among its different facets.

The unfolding of a financial crisis involves a triggering event, which is subsequently transmitted to the real economy through the financial system: the set of financial institutions (including banks, insurance companies, pension funds, and securities firms), markets, and infrastructures through which payments are executed, savings are channeled to investments, and financial risks are managed. A distinction can be made between idiosyncratic and systematic triggering events. An *idiosyncratic shock* occurs when the initial shock affects only the health of a single element of the financial system. An example of an idiosyncratic shock is the failure of an individual bank due to internal fraud. *Systematic shocks* simultaneously affect a greater number of players at the same time: the entire financial system, in an extreme case. Collapses of exchange rate pegs are an example of the latter type of triggering events. The triggering shock may cause second-round effects, which in extreme cases may cause institutions that were solvent before the shock to fail. The shock may spill over to the real economy, too: for instance,

[2] These backlashes often occur after the crisis. In the context of the current crisis, a significant number of countries have set up procedures in their legislatures (parliament or congress) to scrutinize the role of central banks and supervisors in the credit crisis.

when the shock causes a contraction of credit or when the shock is associated with significant loss of financial wealth of households and companies.

Systemic risk usually refers to financial shocks that are likely to be serious enough to damage the real economy. As an illustration, the Group of Ten (2001) defines systemic risk as the risk that an event (shock) 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 large enough to have significant adverse effects on the real economy, in all probability. *Contagion* is at the very core of systemic risk. It refers to the mechanisms through which shocks propagate from one element of the financial system to another and from the financial system to the real economy.

A distinction should be made between real and information contagion channels. Contagion through the *real channel* refers to the direct "knock-on effects" on other parts of the financial system through direct exposures (such as counterparty exposures) and interconnections (such as through payment systems). As financial systems become more sophisticated, the degree of interconnectedness generally increases significantly.

In addition to contagion through direct exposures, contagion may spread through the *information channel*. Contagion through the information channel occurs when economic agents (including counterparties, investors, and depositors) change their behavior in response to a particular event. While the intensity and direction of contagion effects as a result of direct exposures and interconnections can in principle be assessed beforehand, contagion through the information channel is much more difficult to predict.[3] Following the announcement of serious difficulties at a particular bank, investors may start speculating which other banks are susceptible to the originating shock, due to similarities in business models (such as weak internal controls), financial exposures (such as toxic assets), and so on The institutions that are affected in the second round are likely to be confronted with a deterioration of their financial outlook, which may manifest itself in the form of downgrades, rising risk premia and costs of capital, and greater difficulties in attracting finance.

In this way, a crisis in a market may trigger changes in the interpretation given to existing information. Financial markets, however, are not always "right" in the way that information is reassessed. Such "unjustified" information reassessment can materialize in various forms: herd behavior (when diverse investment categories are bucketed together in the same high risk category), informational cascades (situations in which every agent chooses the same action, regardless of his own private information), or sudden reappraisals of economic fundamentals (so-called sunspots; see Vaugirard 2007).

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[3] More sophisticated methodologies are currently being advanced, including network analysis and portfolio models of risk based on market data, aimed at better capturing contagion through the information channel (see IMF, BIS, FSB 2009). Network analysis entails the construction of a matrix of gross institutional exposures, while analyzing the specific characteristics of the network structure (distribution of nodes, intensity and complexity of connections, and so on). Portfolio models are aimed at identifying common risk factors, tracking how distress in one institution may affect others and measuring the contributions of individual institutions to system-wide risk. The availability of data with total exposures, on a consolidated basis, is often problematic, in practice.

The response of financial markets to a particular crisis may also depend on situational factors, including the prevailing financial market sentiment (bull or bear market), the state of the real economy, the financial resilience of other financial institutions, and—importantly in the context of this note—the quality of the crisis response by the authorities. This illustrates the broader point that systemic relevance is not a static concept. In as far as contagion effects arising from direct exposures and interconnections are amplified by contagion through the information channel, systemic risk is driven by circumstances. Put differently: whether a crisis affecting a certain financial institution is systemic or not depends to a large extent on the circumstances under which the crisis occurs.

A Framework for Systemic Risk Assessments: Preparatory Stage

Systemic crises can surprise policymakers in a great number of ways: the triggering event may not have been predicted in macro-prudential analyses, contagion may spread in unexpected directions, and the crisis may unfold more quickly than anticipated. The failure of supervisors to detect and remedy problems in financial institutions before they erupt or reach systemic proportions is a common feature in the run-up to financial crises. Although a lot of the information needed for making systemic risk assessment analyses will be available only during (and in some cases, after) the actual crisis, authorities can do a lot to enhance their preparedness. Preparatory work revolves around the following activities:

- Defining critical elements of the financial system
- Mapping interconnections
- Identifying information needs
- Defining scaling criteria

Defining Critical Elements of the Financial System

A useful starting point in drawing up any systemic risk assessment framework is to identify the critical parts of the financial system. *A critical part of the financial system derives its importance first and foremost from the essential and irreplaceable functions it fulfills for a significant number of other agents.* Whether a given part of the financial system is truly "critical" can be assessed on the basis of the following criteria:

- *Functions*: Are the products and services that the part of the financial system provides essential for certain categories of users (such as households, SMEs, government, and banks) to carry out their business?
- *Main users*: Who are the main users, counterparties, and creditors?
- *Size*: What is the volume of transactions, assets, liabilities, and the like, expressed in absolute numbers and as market shares?

- *Substitutability*: Can the functions of the part of the financial system be taken over by other players within a reasonable time frame and at low cost?

On the basis of these criteria, which are relatively stable in time, authorities can identify a shortlist of financial institutions, markets, and infrastructures that are most likely to cause systemic stability concerns if critically affected. Although the specific outcomes are likely to vary in each country, the shortlist may include the following categories:

- The main banks, and to a lesser extent the main insurance companies
- The key funding markets,[4] and for more sophisticated financial systems, the financial markets that financial institutions rely on for risk management purposes, such as foreign exchange, swap, futures, and the credit derivatives markets
- Large value payment systems and important correspondent banks, central securities depositories,[5] custodian banks,[6] central counterparties,[7] and core collateral management systems.

In identifying the critical parts of the financial system, the challenge is to be selective. If the systemic risk assessment framework is to provide an appropriate counterweight to the tendency toward accommodative support measures discussed earlier, authorities need to discipline themselves by limiting the number of critical institutions, markets, and infrastructures to a specific number per category: for example, five. The level of financial development should be taken into account as well.

Mapping Interconnections

After identifying the critical elements of the financial system, the next step is to identify interconnections within the financial system and from the financial system to the real economy. This gives a notion about the contagion effects that are likely to occur in the event of a financial crisis.

Contagion within the Financial System–The Contagion Matrix

The contagion channels between each of the constituents of the financial system can be summarized in a contagion matrix. The contagion matrix primarily concentrates on real contagion channels: that is, direct exposures and interconnections. The main purpose of the matrix is to provide authorities with a concise overview of the main interdependencies in the financial system. The matrix indicates the transmission mechanisms of financial shocks through the financial system that can arise as a result of direct exposures. In a crisis situation, this provides authorities with a frame of reference

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[4] Depositors and remittances are other important funding sources, but these do not constitute a financial market.

[5] An entity that holds securities either in certificated or uncertificated form, to enable book entry transfer of securities.

[6] A bank that safekeeps and administers securities for its customers and often provides various other services, including clearing and settlement, cash management, foreign exchange, and securities lending.

[7] Central counterparty clearing (CCC) refers to a process by which financial transactions in equities are cleared by a single ("central") counterparty.

with which to identify the most likely contagion effects of an actual financial shock, thereby giving them an opportunity to conduct a quicker and more disciplined assessment of systemic risk. The contagion matrix presented in table 1, which describes the main interconnections in a relatively advanced financial system, serves for illustrative purposes. The individual cells in the contagion matrix below are elaborated in greater detail in appendix B. The actual content of the matrix should be adapted in the light of country-specific characteristics.

Table 1 – The Contagion Matrix

		Contagion to		
		Institutions	Markets	Infrastructure
Contagion from	Institutions	- *Credit risk exposures* refer to the risk of loss due to a debtor's nonpayment of a loan or other line of credit. - Difficulties in branches or subsidiaries may spread to the group level (or vice versa) through *shareholder links***.** - *Contingent credit lines* are helpful insurance instruments against liquidity distress. They may, however, work as a contagion channel as the guarantor partakes in the resolution of liquidity difficulties of the affected institutions. - In countries without a prefunded *deposit insurance fund*, the remaining banks pay for the costs of invoking the insurance. - Larger banks often provide smaller financial institutions with *access to key financial infrastructure*, which may be disrupted in case of severe difficulties at the level of the access provider.	- Financial institutions, including nonbank institutions such as hedge funds, can play an important role as *market makers for derivatives*, which serve as key hedging instruments for managing interest rate and exchange rate risk. - The bankruptcy of a large *underwriter of Credit Default Swaps (CDSs)* may not only dislocate the CDS market, but may also cause CDS contracts to become void. - Troubled financial institutions may seek to generate liquidity by liquidating assets at *fire sale* prices. Through mark-to-market valuation of the trading portfolio, this can cause other financial institutions to incur serious investment losses.	- In absence of safeguards such as real time gross settlement, delivery versus payment and payment versus payment, failure of an important financial institution can cause *operational disturbances* in financial infrastructure, with possibly broader systemic repercussions.
	Markets	- Adverse price developments in financial markets may cause *investment losses*, mainly in the trading and available-for-sale portfolio. - Deteriorating financial conditions may be associated with losses through the *revenue channel* (for example, through reduced profitability of proprietary trading or lower fee income). - Due to increasing reliance on wholesale funding, disturbances in interbank markets may have a serious impact on banks' *funding and liquidity management*.	- A sudden loss of confidence in one market may limit the willingness of intermediaries to trade through the *information channel*, thus reducing overall market liquidity and affecting the price-formation process. It may also lead to an overall reappraisal of risk-return assessments (as in the form of a flight to quality).	- Adverse financial market developments can cause a fall in collateral values, which can trigger *margin calls*. The trader will have to pledge additional collateral, or close out the position by selling the securities (long) or buying them back (short). The broker may also sell the securities or other assets. If this happens on a large scale, financial asset prices may come under pressure.
	Infrastructure	- Disturbances in financial infrastructure may cause *delays in incoming and outgoing payments*, complicating liquidity management.	- Operational disturbances in market supporting infrastructure (such as *trading platforms and clearing and settlement systems*) can affect market turnover and distort price formation.	- Through *supporting services, technical links and connected ICT systems*, disruptions in critically important systems can spread.

While real exposures can in principle be mapped before a crisis, certain categories of information become available only in the context of the actual crisis. This obviously includes the specific characteristics of the triggering event, but also the information the authorities need in order to assess contagion effects through the *information channel*. The direction and intensity of contagion effects through the information channel ultimately depend on economic agents' behavioral response to the disclosure of financial distress and—are therefore noticeably more difficult to contemplate in advance than contagion through real exposures. In this context, it is relevant to take the state of the business cycle and the prevailing financial market conditions into consideration. As a general rule, contagion via the information channel can be expected to be more serious if the crisis coincides with a trough in the business cycle[8] or unsettled financial market conditions.

Contagion via the information channel also depends on the collective policy response by the authorities. Ill-conceived or poorly coordinated responses are likely to increase uncertainty and may result in loss of confidence. Also, informational contagion to financial institutions may be of special concern if their financial resilience is perceived to be weak or if particular institutions demonstrate special vulnerabilities to the triggering event (such as heavy reliance on wholesale funding after a sharp deterioration of liquidity conditions).

Contagion from the Financial System to the Real Economy

In the absence of a cohesive conceptual framework that has been thought-through in advance, assessing the effect of financial disturbances on the real economy is rather challenging. Most of the literature on the interconnections between the financial system and the real economy typically focuses on the transmission of real-to-financial sector shocks, rather than the other way around.[9] Following the methodology of the Bank of England (the so-called Wheel of Misfortune; see appendix A), two contagion channels from the financial system to the real economy can be identified: financial losses incurred by nonfinancial economic agents; and restricted access to financial services.

The *financial losses* channel essentially relates to negative wealth effects for households, nonfinancial corporations, and the government that arise as a direct result of the particular crisis event. In the case of the bankruptcy of a financial institution, households and nonfinancial corporations may have uninsured deposits that can only be partially recovered. Households' financial wealth or disposable income may also have a considerable exposure to financial markets developments: for example, through defined-contribution pension systems or through unit-linked insurance policies.

The *restricted access* channel relates to disturbances in the supply of financial services to the real economy that can be attributed to the financial disturbance. In a state that is commonly referred to as "financial stability," the financial system supports real economic activity in three main ways: by allocating financial resources efficiently between activities and across time; by assessing and managing financial risks; and by absorbing

[8] See Harding and Pagan (2006) for a more formal approach toward assessing the state of the business cycle.

[9] Academic interest is growing in this area, however. See Claessens, Kose, and Terrones (2008).

economic shocks (Houben, Kakes, and Schinasi 2004, p. 11). The capacity of the financial system to fulfill these functions can be severely affected in the context of a systemic crisis. The most illustrative example is a credit crunch: a situation in which the capacity (through overleveraged balance sheets, for example) and/or willingness (through risk aversion, for example) of the financial sector to grant credit to the real economy is heavily compromised. Contagion through the restricted access channel may also arise in the case of failure of niche players, whose functions or geographic coverage cannot readily be taken over by alternative suppliers.[10] Contagion through the restricted access channel may also occur in case the financial disturbance narrows the range of available financial products, thereby preventing households and enterprises from finding products with an appropriate risk profile.

As was the case with contagion within the financial system, amplification may take place through the information channel. Contagion through the information channel may arise if the financial shock has a material impact on saving, investment, and consumption decisions by economic agents. Such amplification may arise if a severe financial shock triggers a generic reappraisal of the economic outlook, with consumers and nonfinancial businesses raising their savings at the expense of current investment and consumption expenditure (as in Japan in the 1990s, for example, because the underlying vulnerabilities in the financial system have not been addressed). Again, contagion to the real economy through the information channel will be more difficult to predict than contagion through direct linkages.

Identifying Information Needs

Performing a systemic risk assessment in the context of an actual crisis requires that before the crisis, authorities have identified their data requirements and have put in place appropriate procedures to ensure that these data can be produced at short notice. The list that follows presents some indicators that authorities may take into consideration when establishing the extent to which a particular crisis causes damages to financial institutions, financial infrastructure, financial markets, and the real economy:

Financial Institutions

Key quantitative indicators to assess the extent of the disturbance in financial institutions include:

- *Shortages in liquidity.* This could be reflected in several indicators, including an unusually high amount of pending payments (inability to settle payment systems obligations in a timely manner; backlogs in transaction confirmations), unusually high spreads on interbank loans, deposit withdrawals, lack of liquid assets, and a low volume or lack of undrawn interbank credit lines.

- *Loss of (core) capital*. Losses may arise due to credit, market and operational risk. It is helpful to differentiate the losses according to the extent that they are irrevocable

[10] An example is the 2001 bankruptcy of the Australian insurance company HIH, which was effectively the sole supplier of warranty insurance for building projects in a large number of Australian states.

(write-downs of delinquent loans as losses versus market valuation losses, which can be booked as unrealized losses, for example).

- *Fall in expected future profits*. This relates to the effect on the institution's future income generating capacity (and its loss absorption capacity over time). Examples are lower volume of business or lower margins.

- *Risk mitigants***.** These include the institution's solvency (overall solvency ratio, Tier 1 ratio) and profitability (return on equity) and liquidity buffers (liquidity ratio; quick or acid test ratio; and the like). The presence of legal (guarantees, collateral, netting) and institutional safeguards (deposit insurance) help to mitigate the impact of the disturbance on the affected institution, but these safeguards may also function as contagion channels to other parts of the financial system.

Financial Infrastructure

The effect of the disturbance on financial infrastructure can be assessed on the basis of the following indicators:

- *Volume and value of pending transactions*. The main factor in assessing the potential for a payment system to trigger or transmit systemic disruptions is the volume and value of payments that the particular system processes—either in aggregate or individually—relative to the resources of the system's participants and in the context of the financial system more generally. In this context, the extent of the disruption of payment systems may be assessed on the basis of the volume and value of pending transactions. The damage may be aggravated by long expected recovery times and lack of back-up systems.

- *Critical dependency of other systems and/or markets*. In assessing the extent to which the proper functioning of financial infrastructure is impaired, authorities may also consider whether the affected part of financial infrastructure is used to settle other payment systems or financial market transactions.

- *Risk mitigants.* These include the presence of readily available back-up systems, the use of collateral, guarantees, netting and central counterparties, and effective oversight.

Financial Markets

Financial markets contain a wealth of information that is helpful not only in assessing the extent of the disturbance in individual markets, but that in the event of a crisis is also highly informative about market perceptions about systemic risk; such information, in turn, gives valuable guidance about the intensity and direction of contagion through the information channel (see IMF 2009). The following indicators are relevant in this context. Their availability may be problematic, especially in countries that are in their initial stages of financial market developments.

- *Spreads*. Spreads contain a lot of information about market perceptions on risk and returns. The total spread on a bond is the sum of the inherent risk profile of the

underlying obligation and market factors, such as liquidity and the efficiency in executing transactions. Ideally, these elements should be disentangled. CDS spreads reflect the cost of insuring that a particular firm or institution defaults on its bond or loan payments and therefore reflect the market's perception on credit risk. Bid-ask spreads denote the price difference between a quote of a market maker for immediate sale (bid) and an immediate purchase (ask). The level of the bid-ask spread is a common measure of the liquidity of the market. In developing countries, the availability of CDS spreads for individual companies[11] may be subject to limitations, while the accuracy of the bid-ask spread as an indicator for market liquidity depends on the efficiency of financial markets.[12]

- *Volatility indices***.** Volatility indices are common indicators of the general level of risk aversion in markets. Most volatility indices calculate implied volatility on the basis of option prices. The Chicago Board Options Exchange Volatility Index (VIX index; also known as the *fear index*) represents a measure of the market's expectation of volatility over the next thirty-day period.

- *Market turnover data.* These constitute a basic indicator of overall liquidity conditions for a particular financial asset or asset class.

- *Risk mitigants.* These include safeguards in the market: both legal (collateral, guarantees, netting) and institutional (central counterparty, regulation/supervision).

The Real Economy

- *Financial losses for households and nonfinancial corporations*: Relevant indicators include the amount of uninsured deposits and possible shortfalls in the deposit insurance fund (which may need to be borne by taxpayers, depositors, and others). The expected pay-out time for the deposit fund is also relevant, as negative wealth effects may be amplified in case depositors lose access to their accounts for a prolonged period. In case of a crisis involving financial markets, households and nonfinancial corporations may be facing losses due to ownership of financial assets. This includes not only direct ownership but also indirect ownership: for example, through participation in life insurance and pension funds.

- *Restricted access to financial services*: Relevant indicators include sectoral and regional lending concentrations of banks. The banking system's capital adequacy ratio may also be taken in consideration, as this gives a sense about the financial capacity of banks to provide the real economy with loans.

- *Consumer and business confidence indicators.* These may give a notion about the risk that the financial disturbance causes economic agents to reappraise the economic outlook, with postponements of consumption and investment expenditure. In this

11 Sovereign spreads are usually available.

12 In inefficient financial markets, high bid-ask spreads may reflect high transaction costs rather than liquidity pressures. This should already be visible in non-crisis times.

context, the strength of the balance sheets of households and nonfinancial corporations may also be relevant.

Defining Scaling Criteria

It is advisable to give some thought to scaling. This includes the development of qualitative and quantitative criteria outlining the thresholds that need to be exceeded for a particular occurrence of financial stress to be labeled "systemic." This applies not only to the overall systemic assessment, but also to the assessed impact of the financial disturbance on the individual components of the financial system and the real economy (which subsequently feed into the overall assessment). In other words, appropriate scales with corresponding trigger points need to be established as a basis upon which authorities can assess whether a particular financial stress situation constitutes limited, moderate, serious, or very severe risks. In order to make for a more disciplined assessment, authorities may choose to represent the outcomes of their systemic risk assessments on a numerical scale (as discussed in the next section).

To this end, appropriate scaling criteria need to be established; this is more of an art than a science. It is likely to be one of the more challenging aspects of the preparatory work for conducting systemic risk assessments. It involves not only establishing indicative quantitative trigger points, but considering qualitative elements, as well. As an illustration, the extent of the disturbance of financial institutions may be assessed on the basis of the estimated loss of capital for the banking system and its impact on the available solvency buffers. Assuming a scale that ranges from 0 ("negligible") to 3 ("very severe"), estimated losses that bring the capital adequacy ratio (CAR) of a significant part of the banking system close to or below the statutory minimum may be considered "very severe" (3). Significant losses that still leave part of the existing solvency buffers above the statutory minimum intact (more than 3 percentage points above the statutory CAR, for example may be considered "serious" (2). Smaller losses with limited impact on existing solvency buffers may be "moderate" (1) or "negligible" (0). Estimates of the expected loss are bound to involve quantitative judgments of the estimated credit, market, and other losses, which in turn rely critically on assumptions regarding the development of the real economy (Probability of Defaults and recovery ratios) and key financial variables (interest rates, yield curve, exchange rates, and so on).

A Framework for Systemic Risk Assessments–Application During Crises

Performing a systemic risk assessment in the context of an actual crisis requires that authorities have a thorough understanding of the critical parts of their financial system and the main contagion channels (as elaborated in the previous section). If the analytical foundations are not well-established, it will be very challenging for authorities to face the particular challenges posed by financial crises, including acute time pressure and incomplete information.

A logical starting point for making a systemic risk assessment is to assess the specific characteristics of the triggering event and the context in which it takes place. In this context, the authorities can address the following issues:

- A brief assessment of the specific events leading to the crisis

- An assessment of whether the triggering event is idiosyncratic or systematic: that is, whether it affects an isolated part of the financial system (such as fraud at a specific bank) or whether it hits various elements of the financial system at the same time (such as collapse of a fixed exchange rate regime)

- An assessment of the state of the real economy and the financial system, with particular attention for the level of resilience.

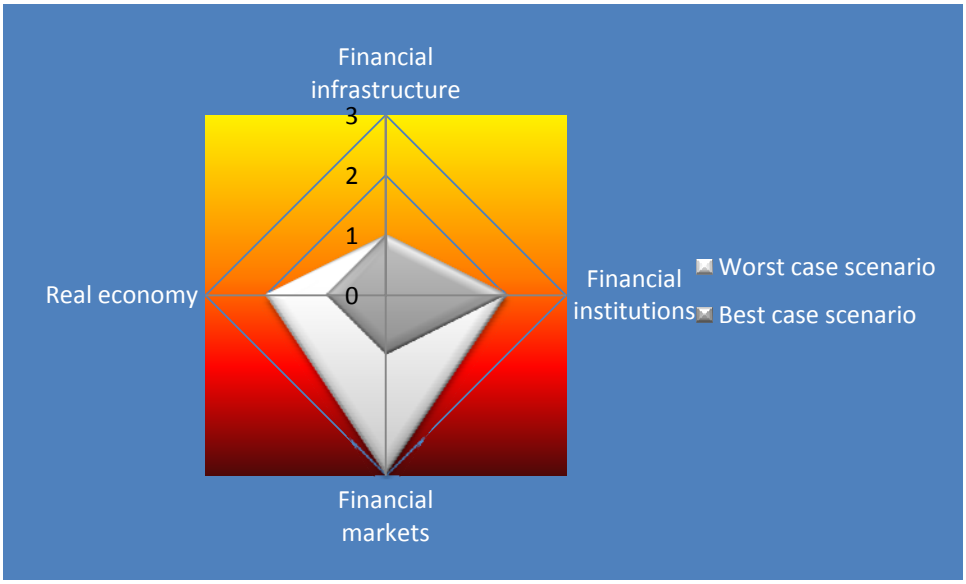
Subsequently, the impact of the shock needs to be assessed in greater detail by analyzing its initial effect on financial institutions, financial infrastructure, financial markets, and the real economy. This is the backbone of the systemic risk analysis. The extent of the disturbance should be assessed using the pre-established indicators and scaling criteria. In making the actual assessment, it is important to take into consideration the effectiveness of risk mitigants that are already in place, including capital buffers, hedges against adverse financial market developments, and insurance policies.

After assessing the initial impact, the next step is to estimate adverse second-round effects by assessing the expected direction and intensity of contagion effects. The contagion matrix drafted in the preparatory stage should provide a basis for this assessment. Authorities may wish to add new contagion channels that develop following the triggering event and that were not included in the original contagion matrix. This may include (but may not necessarily be limited to) contagion effects transmitted through the information channel. These contagion effects should be added to the assessment of the impact of the triggering event on each of the subcomponents of the financial system.

The systemic risk assessment should also include an assessment of how the transmission of the shock through the financial system impacts the real economy. Some thought should also be given to the risks of feedback loops from a deteriorating real economy to the financial system. In analyzing the impact on the real economy, particular attention should be paid to adverse wealth effects (financial losses incurred by nonfinancial economic agents) and to restricted access of financial services to nonfinancial economic agents. As was the case with contagion within the financial system, authorities may include contagion through the information channel in their assessment: for example, if the triggering event can be reasonably expected to have a negative impact on business and/or consumer confidence.

For the sake of conclusiveness, the outcomes of their systemic risk assessment can be graphically summarized using numerical scores indicating the extent of the disruption, with the scores matching with the pre-established trigger points. Figure 1 provides an illustration. This can be done for each of the components of the financial system and the real economy. Instead of a point score, authorities may assign a range of scores if the assessment involves a considerable amount of uncertainty and discretion: for example, regarding the direction and impact of contagion effects. In that case, the lower boundary corresponds to a “best case” scenario and the upper boundary to a “worst case” scenario. In the figure below, the systemic impact is assessed on a 0–3 scale, ranging from “limited” to a “very serious” impact.

Figure 1 – The Severity of Systemic Risk



This graphical representation should be complemented with a clear statement motivating and explaining why the disturbance does or does not constitute systemic risk. Similarly, it should provide guidance to policy makers as to whether the disturbance justifies public intervention, usually in the form of liquidity and solvency support and official guarantees. It may also be useful to add explanatory notes to discuss the outcomes in greater detail. Typically, this discussion also includes a description of the main assumptions (real economy and key financial market variables) on which the analysis is based and a description of the main downside risks.

Conclusion: Putting the Systemic Risk Assessment Framework to a Successful Use

Recurrent crisis has been a feature of banking for centuries, but there are strong indications that the frequency and severity of such crisis has increased since the 1970s (Honohan and Laeven 2005, p. 5). Despite welcome efforts to upgrade the quality and coverage of financial supervision aimed at crisis prevention, authorities are therefore well-advised to give serious consideration to contingency planning in the event disaster strikes. As part of a broader contingency planning effort, systemic risk assessment frameworks may significantly enhance the quality of the crisis response by the affected authorities. The framework can help authorities avoid committing to overly generous support measures, thereby containing moral hazard and limiting the taxpayer's bill. It also has the advantage of providing accountability after the fact, by making the authorities' considerations in devising the crisis management response explicit.

At the same time, successful implementation of the systemic risk assessment framework in the context of an actual crisis poses considerable institutional demands to authorities involved in supervision and financial stability. Besides the initial effort of identifying the critical parts of the financial system and the main contagion channels, responsibility for conducting the systemic risk assessments needs to be assigned. Ideally, central banks and

supervisors perform systemic risk assessment analyses in close cooperation with one another, as these are the agencies that are most likely to have the necessary technical skills and access to information. Ministries of finance should ensure that they have sufficient knowledge to understand and interpret the analysis performed jointly by the supervisor and the central bank.[13] The same applies to other domestic agencies, such as the Deposit Insurance Fund (DIF), and other supervisors, such as the Securities and Exchange Commission (SEC). Final responsibility for conducting the assessment should be assigned to specific staff, such as financial stability departments, where these exist. Information needs in times of crises should be identified. Procedures need to be put in place to ensure that the information that is most likely to be needed is either readily available in so-called fact books or can be made available at short notice. Those responsible for conducting the assessment also should have adequate access to information.

Financial crises are by nature multidisciplinary phenomena and transcend the boundaries of individual departments. Different disciplines will need to work together in crisis situations. This is very likely to be a challenging aspect. The current financial crisis has revealed a striking lack of interaction and cooperation between micro and macro-prudential supervision. A considerable effort may therefore be needed to overcome "silo-structures" within key agencies, where the focus is inward, communication is vertical and operational interaction between various business areas is limited. Key staff in relevant departments (such as financial stability, financial markets, onsite and offsite supervision, and payment and settlement systems) needs to be made familiar with the methodology of the framework. This requires strong support at the executive level. Possible ways to achieve these objectives include applying the framework to previous crises ("backtesting") or tailoring a crisis simulation exercise (either domestically or internationally) around the conduct of a systemic risk assessment. The latter is also likely to reveal shortcomings in the banking resolution framework. Addressing such shortcomings in a timely manner may widen the range of available resolution options, which may contribute to a more efficient handling of bank failures, thereby lowering costs.

Countries that have a high share of foreign ownership in their financial sectors or have financial sectors with significant overseas operations may also want to reach out to foreign supervisors. The former group of countries often find themselves in at a disadvantage as relevant supervisory information at the group level is not always made available to host supervisors. These countries have most to gain from enhanced cross-border cooperation and information exchange between authorities, since national assessments are more complete when they can draw on additional information from the home supervisory authorities. Besides establishing formal Memoranda of Understanding (MoU) with the home supervisors, it is helpful for home and host-country authorities to establish networks, such as supervisory colleges. Ideally such networks would cover not

[13] While the central bank, in close cooperation with the supervisor, may decide to grant emergency liquidity assistance (ELA) to institutions experiencing pressing liquidity needs, it is usually the ministry of finance that ultimately decides whether distressed financial institutions should be provided with solvency support from public sources.

only ongoing supervision but also address crisis management issues. Another way to promote information exchange between home and host supervisors is conducting joint inspections. Cross-border crisis management arrangements may also be periodically tested in crisis simulation exercises. In addition to establishing formal MoUs, engaging in regular informal contact with the home supervisor helps create a basis of trust needed for a proactive exchange of information.

In addition to these initial efforts, the framework requires regular maintenance. Authorities need to be willing to invest in keeping the short list of critical parts of the financial system and the contagion matrix framework up-to-date by reviewing it at least once a year. Fact books with key financial data should also be updated frequently. Staff turnover may present an additional challenge, as new staff involved in the conduct of the assessment is likely to require some sort of training.

Overall, the staffing and resource implications of implementing a systemic risk assessment framework are considerable. This requires a strong commitment on behalf of the implementing country. It is important that the implementation costs are seen against the background of the potentially staggering costs of financial crisis, which can undo years of economic growth and progress in fighting poverty. This implies that any policy that contributes to enhancing the quality of the crisis response is likely to be cost-efficient.

Appendix A. Approaches Toward Measuring Systemic Risk

A recent questionnaire from the IMF, BIS, and FSB in the G20 countries revealed that a variety of methods are applied to measure systemic risk. A number of countries have established quantitative methodologies that primarily serve diagnostic purposes in pre-crisis times. The Banco de México, the Bank of England (BoE), De Nederlandsche Bank (DNB), the Deutsche Bundesbank, the Monetary Authority of Singapore (MAS), the National Bank of Belgium (NBB), the Oesterreichische Nationalbank (OeNB), and the Swiss National Bank (SNB) regularly conduct network analyses with a view to identifying institutions whose failure could have systemic implications. These analyses take banks' large exposures and interbank credit activities as a starting point. Interpolation techniques are applied to construct exposure matrices, which are subsequently used to analyze hypothetical stress scenarios (IMF, BIS, FSB 2009, p. 20). Some countries combine detailed network analyses with an assessment of the risk implications of banks' common exposures to different factors. While many countries are increasingly focusing on macrofinancial linkages in their analysis of systemic relevance, work in this area is still in its early stages. The Bank of England's Risk Assessment Model for Systemic Institutions (RAMSI), which is currently under development, is a novel approach toward analyzing the interaction between institution-specific and systemwide vulnerabilities.

In practice, few countries are known to have a formal systemic risk assessment framework in place to assess systemic risk in crisis situations, while countries that have established frameworks typically keep them confidential. In part, this reflects fears that disclosure of the assessment framework might invite moral hazard behavior. Public knowledge of the framework would allow investors and financial institutions to determine which financial institutions are most likely to be considered systemically relevant and would therefore be most likely to qualify for public support in the event of financial crises. Information on existing frameworks is therefore sparsely available.

The Bank of England Framework

The original idea to establish systemic risk assessment frameworks was pioneered by the Bank of England. The Bank's framework was deliberately designed in a flexible way so as to capture a wide variety of crisis situations. It can be applied to banking crises, which is the most common form of financial distress, as well as to financial market and financial infrastructure disruptions. The Bank of England's framework was dubbed "The Wheel of Misfortune," as the overall assessment is expressed graphically in a radar diagram with six spokes. It distinguishes between internal damage to the financial system and damage to the real economy. Four dimensions, or spokes, indicate the "internal" damage to the financial system: "capital" and "funding" together determine the financial system's capacity for intermediation, while "infrastructure" and "markets" are the key tools for harnessing that capacity through the delivery of financial services of financial services to the economy. The other two spokes of the wheel capture the direct impact on the real economy, as financial crises may lead to reductions in financial wealth and loss of access to financial services. These factors limit consumption and production potential.

The Bank of England is in the process of further developing its analytical tools. While the Wheel of Misfortune is applied in the context of crisis situations, the Bank of England is also exploring how systemic risk can be integrated in microprudential and macroprudential policy. In a recent

discussion paper (Bank of England 2009)[a] proposals are made to capture systemic risk by establishing capital surcharges over and above the prevailing statutory capital requirements. The starting point of the analysis is the observation that current prudential regulation does not address two key aspects of systemic risk. First, financial firms tend to overexpose themselves to risk in the upswing of a credit cycle and to become overly risk-averse in a downswing. Second, individual banks typically fail to take account of the spillover effects of their actions on risk in the rest of the financial network.

The first aspect of systemic risk could be addressed by calibrating time-varying capital surcharges contingent upon the degree of exuberance prevailing in financial markets. By requiring banks to raise equity, the marginal cost of lending can be raised and thus provide incentives to slow balance sheet growth. In regulatory terms, this could be described as varying the risk weights that apply to different classes of lending and other exposures. Note that capital surcharges would fall in a downturn, to provide incentives for banks to maintain the supply of credit.

The second aspect of systemic risk could be addressed by imposing so-called cross-section systemic capital surcharges aimed at reducing the default probabilities of institutions whose failure would cause greater damage across the financial system and the real economy. An obvious challenge is to quantify an individual institution's contribution to systemic risk. It is the product of its Probability of Default (PD) and the system-wide spillover effects associated with distress or default. The latter is derived on the basis of an institution's size, the distribution of its exposures (using a network model), and fire sale propensities.[b] After calculating an institution's systemic impact score, the Loss Given Default (LGD) for the entire financial system is determined. These system-wide losses are then allocated across financial institutions according to their systemic impact score. The final step is to calculate the additional amount of capital needed for each institution to neutralize the expected system-wide losses.

The European Central Bank Framework

The European Central Bank (ECB) has on occasion communicated about the main characteristics of the European systemic risk assessment framework.[c] The framework, which was strongly inspired by the Bank of England's Wheel of Misfortune, was designed to provide cross-border authorities with a "common language," hence enriching the quality of the policy discussion of the systemic impact of a particular crisis situation. It also aimed to reduce the risk that under the pressure of circumstances authorities would roll out public support measures before assessing the potential impact of a particular crisis.

The framework calls on authorities to conduct separate assessments of the impact of a crisis on financial infrastructure, financial markets, financial institutions, and the real economy. The systemic impact is assessed taking into account the critical importance of the affected parts and

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[a] http://www.bankofengland.co.uk/publications/other/financialstability/roleofmacroprudentialpolicy091121.pdf

[b] Fire sales of assets by a weak institution can inflict damage on the balance sheets of other institutions in the context of mark-to-market valuation, which requires the nonaffected institutions to make corresponding downward price adjustments on the available for sale trading portfolio. Fire sales may also occur when secured lenders to defaulting banks sell the assets pledged by the bank as collateral.

[c] See ECB (2008).

the extent of the disruption. Uncertainty about the systemic impact can be expressed by assigning a range of scores (best versus worst possible). The assessment results are to be graphically represented in a so-called heat map, indicating the severity of the disturbance. The framework was developed by an ECB task force, while EU ministers of finance committed to putting the framework to use in the EU Memorandum of Understanding on Cross-Border Financial Stability.[d] Attempts were made to familiarize the finance ministries with the main characteristics of the framework, with a one-day workshop for central bankers, supervisors, and finance ministries held in May 2008. Despite the efforts to reach out and the commitments to put the framework to use, its impact seems to have been fairly limited in the current wave of financial turmoil.

[d] Memorandum of Understanding on Cooperation between the Financial Stability Authorities, Central Banks and Finance Ministries of the European Union (http://www.ecb.int/pub/pdf/other/mou-financialstability2008en.pdf).

Appendix B. The Contagion Matrix in Detail

The contagion matrix is a convenient tool to map interconnections in the financial system, which in times of financial crisis may function as contagion channels (see table B.1). Filling in the cells of the contagion matrix before a crisis erupts has the advantage of providing the authorities with a frame of reference in contemplating the most likely contagion effects of an actual financial shock, hence allowing for a quicker and more disciplined systemic risk passessment. The content of the cells depends crucially on country-specific characteristics, including the stage of financial development. The following matrix serves for illustrative purposes.

Table B.1 – The Contagion Matrix (Summary)

		Contagion to		
Contagion from		**Institutions**	**Markets**	**Infrastructure**
	Institutions	- Credit risk exposures - Shareholder links - Guarantor/provider of contingent credit lines - Deposit insurance (through financing funding shortfalls or replenishments) - Access provider to financial infrastructure	- Market maker for derivatives - Underwriter of CDSs - Fire sales of financial assets	- Operational disturbances
	Markets	- Investment losses on available for sale assets/trading portfolio - Revenue channel - Funding/liquidity management	- Information channel	- Coverage for counterparty exposures with collateral (margin calls)
	Infrastructure	- Overdue incoming and outgoing payments	- Trading platforms and clearing and settlement systems	- Supporting services, technical links, and connected ICT systems

Contagion from Institutions to Institutions

- *Credit risk exposures*. Financial institutions can be linked in a great number of ways, which may lead financial problems to spread from one institution to another. Credit risk exposures are an obvious contagion channel, with the failure of one institution to honor its debt obligations imposing financial damage on another.

- *Cross-border participation and shareholder links*. Many financial systems are characterized by a high degree of cross-participations between financial institutions, both nationally and internationally. In order to offer a broad range of products, for instance, banks may have significant stakes in insurance companies, investment firms, and other kinds of financial

institutions.[a] Similarly, cross-border integration has progressed steadily over the past 15 years, with many financial institutions owning significant stakes in overseas subsidiaries. While cross-participations may have diversification benefits, they also create a contagion channel through which severe difficulties of subsidiaries or branches can spread to the group level.

- *Liquidity management*. Banks rely to a large extent on the key funding markets for liquidity management. Rumors about financial difficulties (such as an upcoming downgrade) may lead to a deterioration in the terms of interbank market access for the affected banks. In extreme cases, the interbank markets may close for the affected institution, which necessitates rapid activation of alternative liquidity sources (such as selling assets, perhaps at fire sale prices, or use of the emergency liquidity assistance window of the central bank). Note that such behavior may not always be fully "justified" (see the second section).

- *Contingent credit lines (CCLs)*. CCLs are widely used in bank lending and also play an important role in the functioning of short-term capital markets. By providing liquidity back-up lines, CCLs are helpful insurance instruments in preventing liquidity distress. Nonetheless, they may also function as contagion channels, as the provider of the guarantee partakes in the resolution of liquidity difficulties of the affected institution.

- *Deposit insurance*. Deposit insurance helps to mitigate adverse wealth effects from bank failures and prevent contagious bank runs. It therefore reduces the likelihood of banking crises and also contributes to damage control when banking crises occur, provided that coverage is sufficient and funding is credible. Nonetheless, deposit insurance can sometimes cause contagion effects, especially in countries that do not have prefunded regimes (or where the arrangement is significantly underfunded). Under such circumstances, the remaining banks usually pay for the costs of activating the deposit insurance fund after the crisis has struck, which may entail substantial costs (depending on the coverage of the deposit insurance arrangement, the deposit base, and the share of insured deposits of the affected institution). Even in countries with prefunded deposit insurance regimes the remaining banks may be faced with steep increases in insurance premia in order to replenish the fund.

- *Access to payment services*. Larger banks often provide smaller banks (and other financial institutions) with access to key payment services. They may act as system operators (beneficiary and payer service providers), provide correspondent banking services (a domestic banking institution that handles payments on behalf of a foreign financial institution, through so-called vostro or nostro accounts), and custodian banking services (a bank that safekeeps and administers securities for its customers and often provides various other services, including clearing and settlement, cash management, foreign exchange, and securities lending). Disruptions at the level of the access providers may leave the end users cut off from effective payment services, especially in absence of back-up providers.

[a] This trend is most clearly manifested in the emergence of financial conglomerates: financial groups conducting at least two main types of financial services activities.

Contagion from Markets to Institutions

- *Investment losses*. Adverse price developments in financial markets can expose financial institutions to investment losses. As a general rule, an institution's vulnerability to adverse market developments depends largely on the size and riskiness of its investment activities. Losses on the investment portfolio are an important channel through which financial market corrections affect financial institutions. The trading portfolio is the greatest source or risk, as it needs to be valued mark-to-market according to International Financial Reporting Standards (IFRS) and most other accounting regimes, with losses passing through the profit and loss account.[b] In principle, this risk may be mitigated by hedges and other safeguards, but these may break down in times of severe crisis.

- *Exposure through the revenue channel*. Financial institutions are also exposed to losses through the revenue channel. Banks, especially investment banks, often actively trade stocks, bonds, options, commodities, derivatives, or other financial instruments for their own account (proprietary trading, as opposed to trading on their customers' account). Deteriorating financial market conditions may be associated with decreasing profitability of proprietary trading, and may also reduce fee income that financial institutions receive for undertaking financial market transactions for their clients, as clients may be less inclined to invest in bear markets. Share and debt issues and major acquisitions may be postponed, too.

- *Funding/liquidity management*. As many banks have become more dependent on wholesale funding (as opposed to deposits), banks' reliance on a smooth functioning of the interbank markets has also increased. Interruptions in the key funding markets can therefore be associated with severe liquidity stress in the banking system. This was illustrated in the summer of 2007, when uncertainty about the distribution of subprime losses caused banks to hoard liquidity, with the main funding markets charging prohibitive spreads and coming to a near-standstill.

Contagion from Infrastructure to Institutions

- *Overdue incoming and outgoing payments*. Disturbances in the smooth functioning of financial infrastructure are most likely to affect financial institutions through delays in: incoming and outgoing payments; or deliveries or receipts of securities. Delays in incoming payments may in turn cause liquidity difficulties, while a failure to ensure that outgoing payments are processed in a timely manner may expose financial institutions to reputational damage or legal risk. Risk mitigants such as real time gross settlement (RTGS), delivery-versus-payment, collateralization, and margining help to limit counterparty risk.

Contagion from Institutions to Markets

- *Market maker for derivatives*. Financial institutions, including nonbank institutions such as hedge funds, can play an important role as market makers for derivatives (swaps, options, futures, warrants). These instruments serve as key hedging instruments, especially for managing interest rate and exchange rate risk. A shock that affects a large number of market

[b] Available for sale securities are not valued as frequently (fair value instead of mark-to-market) and losses are booked through equity. Held to maturity (HTM) assets are booked against fair value, with losses booked through the profit and loss account.

makers at the same time (such as a simultaneous failure of a large number of hedge funds) could impede the proper functioning of these derivatives markets, which in turn may have an impact on the capacity of financial and nonfinancial companies to manage financial risk effectively.

- *Underwriter of CDSs.* A special kind of swap contract is the Credit Default Swap (CDS), in which the buyer of the CDS makes a series of payments to the seller, and in exchange receives a payoff if a credit instrument (typically a bond or loan) goes into default.[c] CDSs are used to manage the credit risk which arises from holding debt.[d] A bankruptcy of a large underwriter of CDS (such as Lehman or AIG) may not only cause a disturbance of the CDS market, but can also effectively cause the CDS contracts to become void.[e] Similarly, a bankruptcy of an institution for which a substantial amount of CDS has been written can expose the underwriter to significant contagion effects.

- *Fire sales of financial assets*. Disturbances at financial institutions may also spill over to financial markets through the risk of fire sales of financial assets. Weak institutions may seek to generate liquidity by liquidating assets at fire sale prices, which may disturb the market for the specific asset category. Fire sales may also occur when secured lenders to defaulting banks sell the assets pledged by the bank as collateral. Disturbances in financial markets created by fire sales may in turn inflict damage on financial institutions as IFRS requires mark-to-market valuation of the trading portfolio.

Contagion from Markets to Markets

- *Information channel*. A sudden loss of confidence in one market may limit the willingness of intermediaries to trade, thus reducing overall market liquidity and affecting the price formation process. Unexpected disturbances in one market may also lead to an overall reappraisal of risk-return assessments through the information channel. This may cause sudden price corrections (such as a flight to quality) as investors seek less risk in exchange for lower profits. This may lead investors to sell what are perceived to be higher-risk investments and purchase safer investments (government bonds, gold).

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[c] Less commonly, the credit event that triggers the payoff can be a company undergoing restructuring, bankruptcy, or even just having its credit rating downgraded.

[d] Typically, the holder of, for example, a corporate bond may hedge their exposure by entering into a CDS contract as the buyer of protection. If the bond goes into default, the proceeds from the CDS contract will cancel out the losses on the underlying bond. While CDSs are welcome tools to insure against credit events, they may also be associated with undesirable side effects, notably the so-called empty creditor phenomenon. Creditors generally want to keep solvent firms out of bankruptcy and to maximize their value, but credit default swaps and other products now permit a creditor to avoid any actual exposure to financial risk from a shaky debt—while maintaining formal contractual control rights to enforce the terms of the debt agreement, and legal rights under bankruptcy and other laws. Thus the "empty creditor": a creditor who may have the contractual control but, by simultaneously holding CDSs, has little or no economic exposure if the debt goes bad. Indeed, if a creditor holds enough CDSs, the creditor may simultaneously have control rights and incentives to cause the debtor firm's value to fall. And if bankruptcy occurs, the empty creditor may undermine proper reorganization.

[e] In practice, chains of CDS transactions can arise. If one of the companies in the chain fails, a "domino effect" of losses may start, with possibly a disorderly unwinding of positions. The risk of escalating losses is an important reason for establishing clearing houses, since it would mean that all trades faced a central counterparty guaranteed by a consortium of dealers.

Contagion from Infrastructure to Markets

- *Trading platforms and clearing and settlement systems*. Financial markets rely on the smooth functioning of the supporting financial infrastructure, including trading platforms and clearing and settlement systems. Operational disturbances may impede the timely processing of financial market transactions, which can cause market liquidity to dry up and distort the price formation process.

Contagion from Institutions to Infrastructure

- *Operational disturbances*. Most modern payment systems contain safeguards such as real time gross settlement (RTGS), delivery versus payment (dvp) for securities settlement, and payment versus payment (pvp) for foreign exchange payments. In addition, some derivative and securities settlement systems reduce counterparty and credit risk through central counterparties. These safeguards mitigate the risk that failure of a major player (typically a financial institution) jeopardizes the functioning of the key payment and clearing and settlement infrastructure.[f] In the absence of such safeguards, failure of an important financial institution can cause serious operational disturbances in financial infrastructure, with broader systemic repercussions. Note that there are as of yet no central counter parties present in some important over-the-counter derivative markets (CDS market) where wholesale trading takes place between large banks. This is bound to change in the medium term.

Contagion from Markets to Infrastructure

- *Coverage for counterparty exposures with collateral (margin calls).* Corrections in financial markets can cause a decline in the value of collateral. As a result, the participant in a collateralized payment or settlement system may find it hard to obtain the necessary collateral. Margin trading (buying securities with cash borrowed from a broker, using other securities as collateral), for instance, relies heavily on the use of collateral. Corrections in financial markets can cause the value of the collateral to fall short of the maintenance requirements, in which case the trader either must pledge additional collateral or close out the position. This can be done by selling the securities, options, or futures if they are long and by buying them back if they are short, making up for possible shortfalls. If the trader does not take any of these steps, the broker can sell its securities or other assets to meet the margin call from the clearing house. If this occurs on a sufficiently large scale, financial asset prices may come under pressure.

Contagion from Infrastructure to Infrastructure

- *Supporting services, technical links, and connected ICT systems*. Disruptions in a critically important system can spread through several technical links that exist between different systems. The large value wholesale payment systems often function as a basis on which other systems—including retail and stock exchange settlement systems—are constructed. While the large value wholesale systems are mostly based on real time gross settlement, the dependent systems are often netted only once a day by adjusting the position of the

[f] The best practices outlined in the Committee on Payment and Settlement System's (CPSS) Core Principles for Systemically Important Payment Systems explicitly state that payment systems should be able to withstand the failure of more than the largest debtor to the system.

respective players in the wholesale system. Payment systems also rely on a smooth functioning of ICT systems, including SWIFT for communication.

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