Janet L Yellen: Interconnectedness and systemic risk – lessons from the financial crisis and policy implications

Speech by Ms Janet L Yellen, Vice Chair of the Board of Governors of the Federal Reserve System, at the American Economic Association/American Finance Association Joint Luncheon, San Diego, California, 4 January 2013.

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Thank you, Claudia, and thanks to the American Economic Association and the American Finance Association for the opportunity to speak to you on a topic of growing interest to our profession and of great importance to understanding the causes and implications of the financial crisis.[1]

Everyone here today, I'm sure, is familiar with the tumultuous events that introduced many Americans to the concept of systemic risk. To recap briefly, losses arising from leveraged investments caused a few important, but perhaps not essential, financial institutions to fail. At first, the damage appeared to be contained, but the resulting stresses revealed extensive interconnections among traditional banks, investment houses, and the rapidly growing and less regulated shadow banking sector. Market participants lost confidence in their trading partners, and, as the crisis unfolded, the financial sector struggled to cope with a massive withdrawal of liquidity, the collapse of one of its most prominent institutions, and a 40 percent drop in equity prices.[2] The effects of the crisis were felt far beyond the financial sector as credit dried up and a mild recession became something far worse. You are also, no doubt, familiar with the political response to that crisis. After considerable debate, the Congress passed sweeping reform legislation designed to place the nation's financial infrastructure on a more solid foundation.

I'm referring, of course, to the banking panic of 1907. The legislation that President Wilson signed in December 1913 created the Federal Reserve, providing the nation with a lender of last resort to respond to such crises.[3] As we approach the centennial of the Federal Reserve System, it is striking how many of the challenges of that era remain with us today. In 1907, the correspondent banking networks that helped concentrate reserves in New York and other money centers also made the banking system highly interconnected. Today, our capability to monitor and model financial outcomes is vastly greater, and the tools available to the Federal Reserve are vastly more powerful, than the private capital and moral suasion that financier J. P. Morgan summoned in 1907 to stabilize the banks and trusts. But as we learned during the recent crisis, the financial system has also grown much larger and more complex, and our efforts to understand and influence it have, at best, only kept pace.

Complex links among financial market participants and institutions are a hallmark of the modern global financial system. Across geographic and market boundaries, agents within the financial system engage in a diverse array of transactions and relationships that connect them to other participants. Indeed, much of the financial innovation that preceded the most recent financial crisis increased both the number and types of connections that linked borrowers and lenders in the economy. The rapid growth in securitization and derivatives markets prior to the crisis provides a stark example of this phenomenon. As shown in

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[1] The views expressed here are my own and not necessarily those of my colleagues in the Federal Reserve System. I am indebted to members of the Board staff – Celso Brunetti, Cecilia Caglio, Sean Campbell, Erik Heitfield, and John Maggs – who contributed to the preparation of these remarks.

[2] The level of the Dow Jones industrial average dropped 43.8 percent between November 15, 1906 (94.25), and November 15, 1907 (53.00). See Dow Jones & Company (2012).

[3] See Federal Reserve Act, ch. 6, 38 Stat. 251 (1913).

Figure 1, between 2000 and 2007, the notional value of collateralized debt obligations outstanding increased from less than $300 billion to more than $1.4 trillion.[4] From 2004, the earliest date for which comprehensive data are available, to 2007, the outstanding notional amount of credit default swap (CDS) contracts increased tenfold, from $6 trillion to $60 trillion.[5] This incredible growth in securitization and derivatives markets reflects a significant increase in the number, types, and complexity of network connections in the financial system.

Financial economists have long stressed the benefits of interactions among financial intermediaries, and there is little doubt that some degree of interconnectedness is vital to the functioning of our financial system. Economists take a well-reasoned and dim view of autarky as the path to growth and stability. Banks and other financial intermediaries channel capital from savers, who often have short-term liquidity demands, into productive investments that typically require stable, long-term funding. Financial intermediaries work with one another because no single institution can hope to access the full range of available capital and investment opportunities in our complex economy. Connections among market actors also facilitate risk sharing, which can help minimize (though not eliminate) the uncertainty faced by individual agents. Yet experience – most importantly, our recent financial crisis – as well as a growing body of academic research suggests that interconnections among financial intermediaries are not an unalloyed good. Complex interactions among market actors may serve to amplify existing market frictions, information asymmetries, or other externalities. The difficult task before market participants, policymakers, and regulators with systemic risk responsibilities such as the Federal Reserve is to find ways to preserve the benefits of interconnectedness in financial markets while managing the potentially harmful side effects. Indeed, new regulations required by the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 (Dodd-Frank Act) and changes in supervisory practices by the Federal Reserve and other financial regulators are intended to do just that.

In my remarks, I will discuss a few of the major regulatory and supervisory changes under way to address the potential for excessive systemic risk arising from the complexity and interconnectedness that characterize our financial system. The design of an appropriate regulatory framework entails tradeoffs between costs and benefits, and to illustrate them, I will discuss in some detail proposals currently under consideration to mitigate risk in over-the-counter (OTC) derivatives, which proved to be an important channel for the transmission of risk during the recent crisis. I am quite aware that some reforms in the wake of the financial crisis, including those pertaining to derivatives, have been controversial. In connection with recent rulemakings – and, more broadly, in the arena of public debate – critics have asked whether complexity and interconnectedness should be treated as potential sources of systemic risk. This is a legitimate question that the Federal Reserve welcomes and itself seeks to answer in its roles of researcher, regulator, and supervisor. Let me say at the outset, though, that a lack of complete certainty about potential outcomes is not a justification for inaction, considering the size of the threat encountered in the recent crisis.

Responsible policymakers try to make decisions with the best information available but would always like to know more. With that in mind, I'll begin by briefly surveying research that

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[4] See Securities Industry and Financial Markets Association (2012). Collateralized debt obligations (CDOs) are a general class of securitized products consisting of bonds that represent claims on the future cash flows generated by a variety of financial assets, including corporate debt and mortgage-backed securities. Growth in notional amounts of CDOs is indicative of the growth in economic exposure.

[5] A CDS is a derivative contract in which one party, the protection "seller," agrees to insure another party, the protection "buyer," from default on an underlying bond or index of bonds in exchange for a fee. Notional amounts do not reflect the economic exposure in these markets, which is a small fraction of the notional value, but the growth noted here is indicative of the growth in exposure. See Bank for International Settlements (2012b).

highlights ways in which network structure and interconnectedness can give rise to or exacerbate systemic risk in the financial system.

The economics of interconnectedness and systemic risk

Academic research that explores the relationship between network structure and systemic risk is relatively new. Not surprisingly, interest in this field has increased considerably since the financial crisis. A search of economics research focusing on "systemic risk" or "interconnectedness" since 2007 yields 624 publications, twice as many as were produced in the previous 25 years.[6] That's not to say that economists were blind to the importance of networks before the financial crisis. In 2000, Franklin Allen and Douglas Gale, for example, developed an important model of financial networks that provides insight into how networks can influence systemic risk.[7]

In the model studied by Allen and Gale, systemic risk arises through liquidity shocks that can have a domino effect, causing a problem at one bank to spread to others, potentially leading to failures throughout the system. In their model, interbank deposits are a primary mechanism for the transmission of liquidity shocks from one bank to another. Allen and Gale compare two canonical network structures: a "complete" network, in which all banks lend to and borrow from all other banks, and an "incomplete" network, in which each bank borrows from only one neighbor and lends to only one other neighbor. ***Figure 2***, panel A, presents an example of a complete network, and figure 2, panel B, an example of an incomplete network.

In the case of the complete network, banks benefit from diversified funding streams. A liquidity shock at one bank is less likely to cause the bankruptcy of another bank since the shock can be distributed among all banks in the system. In the incomplete network, funding is not diversified. A liquidity shock at one bank is more likely to cause liquidity problems at other connected banks because the same shock is spread over fewer banks and is therefore larger and more destabilizing. The principle behind this result is familiar and basic to economics: Diversification reduces risk and improves stability. While this idea is compelling, both economic research and the events of the financial crisis suggest that it is incomplete.

In their classic paper on bank runs, Douglas Diamond and Philip Dybvig showed how rational and prudent actions by individual depositors to limit their own risks may be highly destabilizing to an institution designed to transform short-term liabilities into long-term assets.[8] Xavier Freixas, Bruno Parigi, and Jean-Charles Rochet show that a similar kind of collective action problem can arise in a network akin to a modern check-clearing system in which credit extensions among banks allow claims on one institution to be fulfilled by another.[9] Such a system is socially useful because it allows depositors to shift funds among banks without forcing banks to sell illiquid assets, thus enabling society as a whole to undertake more productive, long-term investment. But in times of stress or uncertainty, such systems can be subject to coordination failures: A "gridlock" equilibrium can arise in which depositors at each bank withdraw funds early in order to avoid losses arising from credit extensions to other banks whose depositors are also expected to force an early liquidation of assets. In Freixas, Parigi, and Rochet (2000), interbank credit extensions, while useful, can result in institutions that are "too interconnected to fail." These models underscore that the

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[6] A search for either "interconnectedness" or "systemic risk" in article abstracts of academic research cataloged by EconLit results in 311 entries from 1988 to 2006. The same search conducted for the period from 2007 through the present yields 624 entries. Restricting the search to articles that have appeared in peer-reviewed journals reduces the number of entries between 1988 and 2006 to 186 and the number of entries between 2007 and the present to 375.

[7] See Allen and Gale (2000).

[8] See Diamond and Dybvig (1983).

[9] See Freixas, Parigi, and Rochet (2000).

pattern of connections throughout a financial network determines the systemwide implications of liquidity shocks or other financial stresses in one part of the network. This finding is one reason why efforts to collect more and better data on the precise linkages among financial institutions are so important. Without such comprehensive and detailed data, it is simply not possible to understand how stress in one part of the network may spread and affect the entire system.

Networks that are more interconnected are inherently more complex than those in which market participants have fewer links to one another, and complexity can exacerbate the kinds of coordination problems highlighted by Diamond and Dybvig and by Freixas, Parigi, and Rochet. Of course, "complexity" is difficult to define in a completely systematic and satisfactory manner, but one way emphasized in recent work by Hyun Song Shin is to consider the number of links required to connect savers to borrowers.[10] Shin's analysis of interconnectedness among financial institutions is based on the idea that the ultimate amount of lending and borrowing that can occur in an economy is determined by economic fundamentals such as income growth, which change only slowly over time, whereas interbank claims can grow or contract far more quickly. Of course, claims within the entire financial system net out to zero, but they do affect the leverage of the institutions involved. In Shin's model, financial institutions seek to take on more leverage during a boom, when banks have strong capital positions and risks are perceived to be low, but can increase leverage, in the aggregate, only by borrowing and lending more intensively to each other. This causes the resulting network of intertwining claims to extend further and further. Conversely, when fundamental conditions or market sentiments change and financial institutions prefer to shed risk, they can deleverage in the short term only by withdrawing credit from one another. Such deleveraging can be particularly destabilizing in longer intermediation chains as debt claims that are called by one financial intermediary to shore up its own assets adversely affect the liability sides of other institutions' balance sheets. As deleveraging accelerates and more and more financial institutions hoard liquidity, other institutions may become concerned that their own funding may dry up and may preemptively withdraw funding from others. Fundamentally strong institutions are forced to liquidate assets at fire sale prices, which results in more deleveraging and instability.

More-complex network structures are likely to be more opaque than less complex ones. For example, as the number of intermediaries standing between borrowers and lenders grows, it becomes increasingly difficult to understand how one member of the network fits into the overall system. The well-publicized difficulties that some mortgage borrowers have had in simply figuring out who owns their mortgages illustrates the extent to which lengthening intermediation chains have increased the complexity of the financial system. Moreover, in many cases, market participants may have strong incentives not to disclose their connections to one another. If a bank has a profitable relationship with a borrower, it may be unwilling to disclose it to other banks for fear that competitors will reduce or eliminate the rents that it earns.

Ricardo Caballero and Alp Simsek illustrate how a lack of information can create systemic risk in financial networks.[11] In a model that is structurally similar to the incomplete interbank network model of Allen and Gale, Caballero and Simsek examine how banks might respond to news of a liquidity shock when each bank knows the identities of its own counterparties but not the identities of its counterparties' counterparties. The authors posit that banks deal with this uncertainty by appealing to the "maximin principle": Each seeks to maximize profits under the assumption that the network is configured in the worst possible manner from its own perspective. Because each behaves as though the network structure is "stacked against

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[10] See Shin (2009).

[11] See Caballero and Simsek (2011).

it," when banks learn of an adverse liquidity shock, each tends to sell more of its illiquid assets and withdraw more funding from its counterparties than it would if it had access to complete information about the structure of interbank credit relationships. As in Shin's model, this excessive deleveraging can create a vicious cycle, magnifying the effects of the initial shock.

The four models we've discussed thus far are aimed at exploring general features of financial networks. As such, they are necessarily somewhat abstract. With a few narrow exceptions, they treat all market participants as similar in size and in range of activities, and they use relatively simplistic network structures. In the past few years, research on financial networks has moved beyond stylized models of interbank relationships to examine the propagation of shocks in more-realistic settings. Recent research by Gai, Haldane, and Kapadia and by Cont, Moussa, and Santos examines how shocks propagate in network structures in which some banks are larger and more interconnected than others.[12]

Using numerical simulations, Gai, Haldane, and Kapadia show that, in concentrated networks, contagion occurs less frequently and is less severe for low degrees of network connectivity. Contagion is significantly more likely at higher levels of connectivity. In a concentrated financial network with a few key players, and when liquidity shocks are targeted at the most connected institutions, distress at highly connected banks spreads widely through the rest of the system. In this sense, the intuition of Allen and Gale – that highly connected networks are resilient to systemic shocks – can be misleading. In an empirical study of 3,000 Brazilian banks, Cont, Moussa, and Santos find that, not surprisingly, institutions with larger interbank exposures tend to be more systemically important. But, critically, they also find that an institution's position within the financial network plays a significant role. A bank that does business with a large number of relatively weak counterparties may have greater systemic importance than an institution with a similar number of counterparties that are better equipped to manage potential losses.

The work of Gai, Haldane, and Kapadia and that of Cont, Moussa, and Santos suggest that detailed and comprehensive data on the structure of financial networks is needed to understand the systemic risks facing the financial system and to gauge the contributions to systemic risk by individual institutions. I will describe in a moment how the Federal Reserve is using such data to enhance its understanding of the OTC derivatives market. This line of research suggests that a one-size-fits-all approach to the regulation of financial intermediaries may not be appropriate.

So, what have we learned from this brief tour through recent research on interconnectedness and systemic risk? We have seen how interconnectedness can be a source of strength for financial institutions, allowing them to diversify risk while providing liquidity and investment opportunities to savers that would not be available otherwise. But more-numerous and more-complex linkages also appear to make it more difficult for institutions to address certain types of externalities, such as those arising from incomplete information or a lack of coordination among market participants. These externalities may do little harm or may even be irrelevant in normal times, but they can be devastating during a crisis.

The global policy response to reduce systemic risk

Governments around the globe have responded to the financial crisis by adopting a strong, multifaceted, and coordinated reform agenda aimed at reducing systemic risk. At a meeting in Pittsburgh in September 2009, governments in the Group of Twenty (G-20) endorsed work already under way in the Basel Committee on Banking Supervision to improve capital and the management of liquidity risk in the banking system.[13] I'll briefly review several Basel

[12] See Gai, Haldane, and Kapadia (2010) and Cont, Moussa, and Santos (2012).

[13] See Group of Twenty (2009).

Committee initiatives that address interconnectedness and systemic risk, but first, let me focus on one in particular: higher capital requirements for global systemically important banks (GSIBs).

Enhanced capital standards for GSIBs serve to limit the risks undertaken by the largest, most interconnected institutions whose distress has the greatest potential to impose negative externalities on the broader financial system. A framework of higher minimum regulatory capital standards for these institutions was issued by the Basel Committee in November 2011, and indicators of interconnectedness account for a significant proportion of the overall score used to determine whether a bank will be subject to higher standards.[14] As shown by Gai, Haldane, and Kapadia, among others, highly interconnected firms can transmit shocks widely, impairing the rest of the financial system and the economy. We saw, for example, that when Lehman Brothers failed, the shock was transmitted through money market mutual funds to the short-term funding and interbank markets. While some participants in each of these sectors had direct exposures to Lehman, many more did not. Moreover, even in cases in which direct exposures to Lehman were manageable, the turmoil caused by Lehman's failure added stress to the system at a particularly unwelcome time. In this way, the failure of a highly interconnected institution such as Lehman imposes costs on society well in excess of those borne by the firm's shareholders and direct creditors. Accordingly, tying enhanced capital requirements to interconnectedness improves the resilience of the system. Of course, higher capital requirements are not costless; they may raise financing costs for some borrowers, and they have the potential to induce institutions to engage in regulatory arbitrage. An important ongoing agenda for research and policy is the design and implementation of data-based measures of interconnectedness to ensure that our understanding of financial system interconnections evolves in tandem with financial innovation.

While enhanced capital standards for GSIBs are an important tool for managing systemic risk that arises through interconnectedness, they are not the only tool. The Basel Committee's program contains a number of initiatives that will help manage interconnectedness and systemic risk. These measures include countercyclical capital buffers, liquidity requirements, increased capital charges for exposures to large financial institutions, large exposure rules, and deductions from capital for equity investments in banks.[15] These and other initiatives will all play a role in managing the effect of complexity and interconnectedness on financial stability. In fact, the multifaceted nature of the reform program is an important design principle. One of the lessons of the recent financial crisis was that capital alone is not sufficient to prevent or stem a crisis. Multiple channels for reform initiatives will enhance systemic stability.

Managing tradeoffs between reducing systemic risk and increasing costs: OTC derivatives market reforms

In addition to the banking reforms I just discussed, the G-20 also committed to reduce risk in OTC derivatives markets by enacting reforms to improve transparency and decrease counterparty exposures among market participants. These policies must be considered carefully, as they are apt to increase the cost of financial intermediation and that of hedging risk. To illustrate the tradeoffs policymakers and regulators must manage when crafting such policies, I'll next discuss in some detail a set of initiatives currently being implemented by

[14] See Bank for International Settlements (2011). It should also be noted that while the assessment methodology depends on interconnectedness, the specific measures employed will be continually reviewed and updated as appropriate.

[15] For a description of these and related regulatory initiatives, see Bank for International Settlements (2010).

prudential, market, and systemic risk regulators around the world to address weaknesses in OTC derivatives markets.

An OTC derivative is a privately negotiated contract between a pair of counterparties to exchange future cash flows that depend on the performance of an underlying asset or benchmark index. Unlike an immediate purchase or sale of assets, OTC derivatives require one or both sides of the transaction to make payments in the future. Counterparty risk is therefore a key element of OTC derivatives transactions. The scale and significance of counterparty risks in the OTC derivatives markets are large and, as we saw, can have economy-wide implications. The prudent management, regulation, and oversight of these risks are critical to ensuring that derivatives markets serve to diversify, rather than exacerbate, systemic risk.

Significant problems with the functioning, regulation, and oversight of derivatives markets became apparent during the financial crisis. These problems are perhaps best exemplified by the widespread effects of large losses by American International Group, Inc. (AIG), on its OTC structured finance and credit derivatives positions. In the absence of government intervention, AIG's failure would have exposed its counterparties to substantial losses at a time of significant financial stress and uncertainty for them and the financial system. Indeed, for a time, the prospect of AIG's failure exacerbated the already impaired functioning in important segments of the OTC market, and, as that happened, it became more costly or even impossible for firms to manage financial risks. Derivatives positions originally undertaken by some firms to hedge risk could not be unwound and instead became sources of risk. AIG's failure revealed, in stark and spectacular fashion, systemic problems inherent in the structure and functioning of OTC derivatives markets that had increased the fragility of the financial system, exposing the rest of the economy to unnecessary systemic risks. Central clearing mandates, minimum margin standards, and data reporting requirements are among the tools that regulators now intend to use to mitigate counterparty risk and improve transparency, thus reducing uncertainty.

The September 2009 commitment of the G-20 to require that standardized OTC derivatives be cleared through central counterparties is directly aimed at reducing systemic risk by changing the structure of the network of derivatives counterparty exposures.[16] In the absence of a central counterparty, the network of counterparty exposures associated with a class of OTC contracts might look something like panel A in ***figure 3***. Each market participant has counterparty risk exposures to one or more other market participants. Although each participant knows its own risk exposure, it is unlikely to have complete information on its counterparties' exposures to others. Such opacity can engender the kind of information-related gridlock that we observed in the fall of 2008 and that is explored in the research of Caballero and Simsek. Moreover, because market participants commonly have partially or fully offsetting positions with multiple counterparties, a fully bilateral network is inefficient from a risk-management standpoint: Gains in the value of positions with one counterparty cannot be netted against losses in the value of positions with other counterparties.

By taking one side of every trade, a central counterparty serves to transform the mesh network shown in panel A of figure 3 into something that looks more like the hub-and-spoke network illustrated in panel B. This network structure has no effect on the exposure of individual market participants to the assets or indexes underlying the derivatives contracts in question, but it dramatically simplifies and improves the transparency of the network of counterparty risk exposures.[17]

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[16] See Group of Twenty (2009), "Improving Over-the-Counter Derivatives Markets" (in item 13).

[17] For clarity, figure 3, panel B, illustrates an idealized centrally cleared network in which only one central counterparty clears all trades. In practice, it is entirely possible that more than one central counterparty may

Central clearing can yield important advantages over a fully bilateral market structure. The simpler hub-and-spoke network structure is more transparent, and the central counterparty is well positioned to impose common margin requirements on all market participants. Central clearing facilitates the netting of gains and losses across multiple market participants, which has the potential to significantly reduce each participant's aggregate counterparty risk exposure. Rather than managing its counterparty risk exposure to all other trading partners, a market participant needs to manage only its exposure to the central counterparty. The central counterparty acts as a pure intermediary and takes no net position in any of the underlying contracts that it clears, so it can experience losses only when a clearing member defaults and has posted insufficient margin to cover the cost of replacing its open positions. Central counterparties are typically designed to distribute any losses they do incur in a relatively predictable way across all clearing members. In this way, central clearing provides for a transparent mutualization of counterparty risks among participants.

Central counterparties are designed to be narrowly focused on intermediation and not the provision of credit and liquidity. This structure improves the chances that, in the event of a significant market stress, market functioning will not be threatened by the failure of market infrastructure itself.

Of course, the other side of this coin is that adding a central counterparty introduces a single point of failure for the network, making it critical that the central counterparty itself be well managed and well regulated. To help ensure this result, title VII of the Dodd-Frank Act adopted stronger safeguards than in the past for central counterparties that clear OTC derivatives. Title VIII aimed at strengthening the supervision of financial market utilities, including central counterparties designated as systemically important, by requiring annual examinations as well as ex ante reviews of material rule and operational changes. In April 2012, the international organizations that set standards for financial market infrastructures such as central counterparties published new and stronger standards for these entities. U.S. regulators, including the Federal Reserve, participated actively in this work and are expected to make formal proposals for incorporating the new standards into U.S. regulations as soon as possible.

More fundamentally, however, a central counterparty's ability to manage risk is determined by its ability to accurately value the contracts it clears on a frequent and possibly real-time basis and to rapidly replace open positions at or near current prices in the event that a clearing member defaults. Requiring less-liquid and highly customized derivatives to be cleared would likely increase systemic risks, as clearinghouses would not be well positioned to manage the complex risks of such derivatives. The G-20 mandate explicitly recognizes this important limitation on the benefits of central clearing, and it requires only that standardized OTC derivatives be centrally cleared. Accordingly, the G-20 commitment has effectively managed the costs and benefits of central clearing in establishing a global clearing mandate.

However, limiting central clearing to standardized derivatives means that a significant proportion of less standardized OTC contracts will continue to be written on a bilateral basis without the benefit of a central counterparty. The International Monetary Fund estimates that one-third of interest rate and credit derivatives and two-thirds of equity, commodity, and foreign exchange derivatives will not be suited to standardization and will remain non-centrally cleared.[18] As more-standardized derivatives migrate to central clearing, it will

accept a given class of contracts for clearing. Research by Darrell Duffie and Haoxiang Zhu, among others, shows that central clearing exhibits significant economies of scale and scope (Duffie and Zhu, 2011). As in other economic enterprises that exhibit strong positive network effects, the potential efficiency gains from consolidation in central clearing need to be appropriately weighed against the countervailing benefits afforded by greater competition among central counterparties.

[18] See International Monetary Fund (2010).

be important to remain vigilant in managing the risks from non-centrally-cleared derivatives exposures.[19] One important tool for managing the systemic risks of non-centrally-cleared derivatives is margin requirements.[20] Globally, regulators have been working on standards for margin requirements on non-centrally-cleared derivatives that would provide for harmonized rules and a level playing field, which is crucial given the global nature of derivatives markets. In July, the Basel Committee and the International Organization of Securities Commissions proposed a framework for margin requirements on non-centrally-cleared derivatives.[21] The finalized framework will inform rulemakings of the Federal Reserve and other U.S. regulators.

The proposed framework would require financial firms and systemically important nonfinancial firms to collect two types of margin. First, they would be obligated to collect variation margin on a regular basis, so if a derivative loses market value, the party experiencing a loss must realize the loss immediately. This requirement codifies current best market practice, since the largest derivatives dealers already exchange variation margin daily. However, and importantly, the framework extends this prudent risk-management practice to other derivatives counterparties. Requiring timely payment of variation margin will go a long way toward ensuring that an AIG-like event will not happen again, since current exposures will not be allowed to build over time to unmanageable levels.[22] Moreover, variation margin requirements will ensure that market participants will know that counterparties that they deal with will not be carrying large uncollateralized exposures that could impair their ability to perform in the future. Those requirements diminish the likelihood of the kind of information gridlock explored by Caballero and Simsek.

More controversially, the proposed framework requires the collection of initial margin. While variation margin collateralizes current derivatives losses, initial margin collateralizes future losses that could occur in the event of a counterparty's default. In essence, initial margin is a kind of performance bond. In the event that a counterparty does not perform as required, the initial margin is used to replace the position with a new counterparty.

It is here that some of the most significant policy tradeoffs arise, because higher initial margin requirements will make it more costly for market participants to use derivatives to hedge risk. Liquid resources that are set aside as initial margin cannot be deployed for other purposes. Given the sheer size and scope of derivatives markets, requiring initial margin on all derivatives transactions could result in significant opportunity and liquidity costs. In a public comment letter to the Federal Reserve and other regulators, the International Swaps and Derivatives Association estimated that initial margin requirements could lock up as much as

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[19] For example, participants and their supervisors will need to closely monitor the risk positions flowing from non-centrally-cleared derivatives to ensure that removing centrally cleared derivatives from existing bilateral netting arrangements will not inadvertently lead to significant growth in risk concentrations from non-centrally-cleared derivatives.

[20] In addition to margin standards, enhanced capital standards prescribed by Basel 2.5 will serve as an important tool for managing systemic risk. See Bank for International Settlements (2009).

[21] See Bank for International Settlements (2012a).

[22] As documented by the Financial Crisis Inquiry Commission, from 1998 to 2007, AIG, through its subsidiary AIG Financial Products, built up huge indirect exposures to real-estate-backed debt by writing OTC credit protection on structured finance products, including mortgage-backed securities and collateralized debt obligations that were in many cases ultimately backed by mortgages. Importantly, because AIG enjoyed a credit rating of AAA for much of this period, its derivatives counterparties did not typically require it to post collateral at the time that new contracts were written. Rather, AIG agreed to post collateral only if contracts fell in market value and AIG itself was downgraded. AIG was first downgraded to AA in the spring of 2005. It faced its first margin calls for credit default swaps covering mortgage-backed collateralized debt obligations in mid-2007. Initially, AIG was able to delay or minimize the collateral it had to post by disputing the contract valuations proposed by its counterparties. But as the bonds it had insured continued to fall in value and AIG was further downgraded, it faced increasing and ultimately insurmountable collateral demands from its derivatives counterparties. For more information, see Financial Crisis Inquiry Commission (2011).

$1.7 trillion in liquid assets globally.[23] This number is eye opening, to say the least. In an effort to better gauge the liquidity costs of initial margin requirements, the Federal Reserve, as part of the international group of prudential and market regulators that issued the July proposal, has conducted a detailed impact study to quantify the liquidity costs associated with initial margin requirements. The results of this study, as well as comments received on the proposal, will help ensure that in the final framework, the need to reduce systemic risk is appropriately balanced against the resulting liquidity costs.

Even in light of the significant costs of initial margin, it seems clear that some requirements are needed. The current use and application of initial margin is inconsistent, and a more robust and consistent margin regime for non-centrally-cleared derivatives will not only reduce systemic risk, but will also diminish the incentive to tinker with contract language as a way to evade clearing requirements. Robust and consistent initial margin requirements will help prevent the kind of contagion that was sparked by AIG: They would serve, in effect, to limit the effects of interconnectedness within the financial network. The failure of a financial counterparty could be contained in the manner described by Allen and Gale. As I noted in connection with variation margins, initial margin requirements would also improve transparency because derivative market participants will know that their counterparties are at least partially insulated from defaults. Of course, these benefits need to be appropriately balanced against the burdens imposed by initial margin. But it seems highly unlikely that the status quo is consistent with achieving the goals of the G-20 to reduce the potential for systemic risk in the OTC derivatives markets that could threaten the financial system.

Finally, let me turn to data requirements. Both the research that I have highlighted today and practical experience demonstrate that market, prudential, and systemic risk authorities need detailed information on derivatives transactions and bilateral positions to assess evolving market risks and to execute their financial stability responsibilities. Indeed, the Federal Reserve has already used preliminary information from the Depository Trust & Clearing Corporation's Trade Information Warehouse to construct network graphs of the CDS market such as the one illustrated in ***figure 4***. The data enable identification, for example, of firms, such as A and B in figure 4, that are large net sellers of protection. Such information can play a valuable role in supervision. Moreover, the analyses for monitoring and measuring systemic risks suggested and described by Gai, Haldane, and Kapadia and by Cont, Moussa, and Santos require this kind of detailed data to gain a holistic view of systemic risk.

Title VII of the Dodd-Frank Act requires that data on U.S. swaps transactions be reported to swaps data repositories regulated by the Commodity Futures Trading Commission or to securities-based swaps data repositories regulated by the Securities and Exchange Commission. Similar European regulations impose trade reporting requirements on swaps transacted in Europe. But there is still no guarantee, due to confidentiality concerns and legal barriers to data sharing, that the data reported into these trade repositories will ultimately be accessible to all of the regulators who require the data to obtain a holistic view of the derivatives market. Given that the derivatives market is global in scope, access to those data is essential for authorities with systemic risk responsibilities, such as the Federal Reserve, to monitor and respond to risks. To make this point concrete, it is unclear whether we will be able, on a regular and comprehensive basis, to produce the sort of analysis illustrated by figure 4. In order to effectively monitor market developments and systemic risks, it is crucial that regulators across jurisdictions and countries share data on a consistent and regular basis.

While better data and more transparency are important for monitoring and responding to the buildup of systemic risks, we do, of course, also recognize the confidentiality concerns. Information is a valuable resource to most financial market participants, and unnecessarily

[23] See International Swaps and Derivatives Association (2012).

burdensome or overly revealing information disclosures could compromise the position of market participants and reduce incentives for trade, thus decreasing liquidity and market efficiency. Dodd-Frank's real-time reporting requirements for swaps transactions recognize this important point by allowing for delayed reporting of large "block trades" where immediate reporting could reveal and undermine a participant's position and ultimately discourage market transactions, depth, and liquidity. In this way, enhanced reporting and transparency requirements are being set to provide the public and regulators with useful information without compromising market integrity. Moreover, while market integrity and appropriate confidentiality are important considerations, the events of the financial crisis have clearly shown that effective systemic risk management demands more, and not less, data disclosure.

Concluding remarks

I began this talk by describing the events surrounding the banking panic of 1907 and the founding of the Federal Reserve. A lesson from that episode, as relevant today as it was then, was that financial stability is essential to sustained economic growth and prosperity. Just as the banking panic of 1907 revealed fundamental weaknesses in our financial system, so, too, did the financial crisis of 2007 and 2008. The recent crisis showed that some financial innovations, over time, increased the system's vulnerability to financial shocks that could be transmitted throughout the entire economy with immediate and sustained consequences that we are still working through today. Some of these vulnerabilities were a consequence of innovations that increased the complexity and interconnectedness of aspects of the financial system. In response to the crisis and the weaknesses it revealed, governments around the globe are acting to improve financial stability and reduce the risks posed by a highly interconnected financial system. These efforts, of course, must account for the costs of new rules and ensure that these costs are clearly outweighed by the benefits. I am confident that the policies I have described today will make the economy more resilient to financial shocks and help reduce the risk of another crisis, while properly balancing these important benefits against the necessary costs.

In striking this balance, government has been guided by new research that has added to our understanding of systemic risk. And this work continues. I have no doubt that some of you here today will perform that research and make those discoveries. So, allow me to close by offering my thanks, in advance, for those contributions. I hope my talk today has made it clear that the work of safeguarding our financial system will depend on these efforts and insights, which will empower policymakers to make the right decisions.

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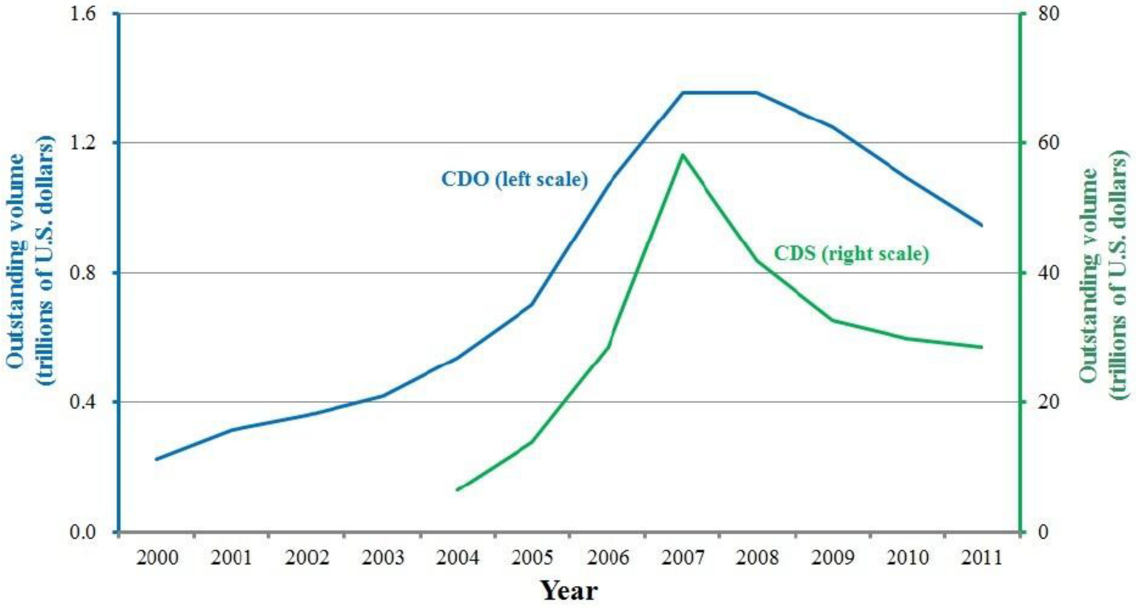
Figure 1
Growth in CDO and CDS Markets, 2000-11

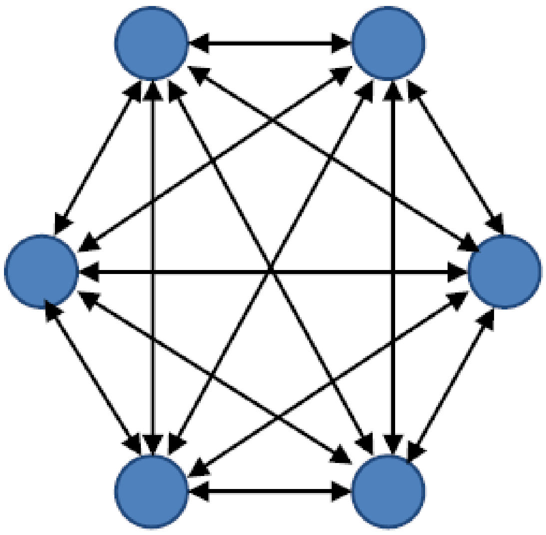


Note: CDO is collateralized debt obligation; CDS is credit default swap. CDS data start in 2004.

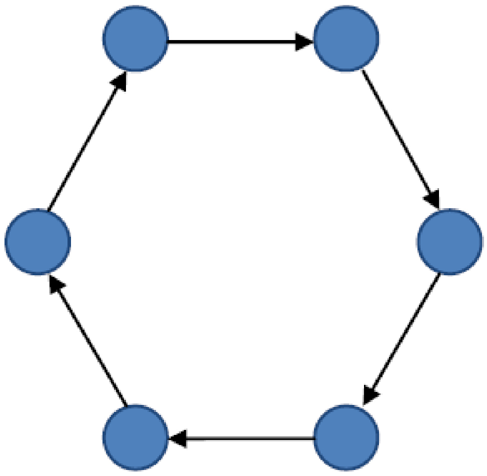
Source: For CDO, Securities Industry and Financial Markets Association; for CDS, Bank for International Settlements.

Figure 2
Complete and Incomplete Networks

A. Complete Network



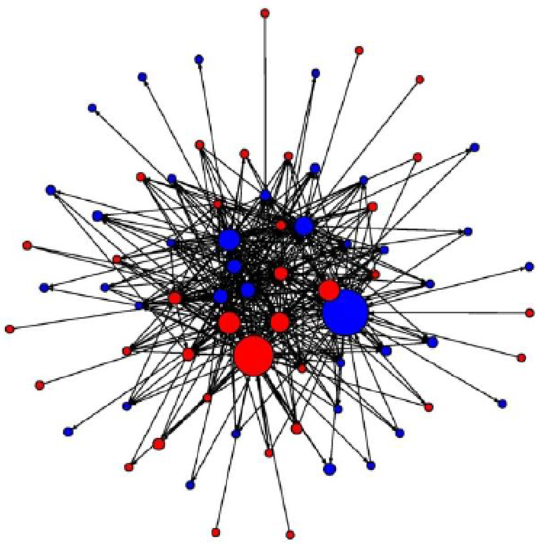
B. Incomplete Network



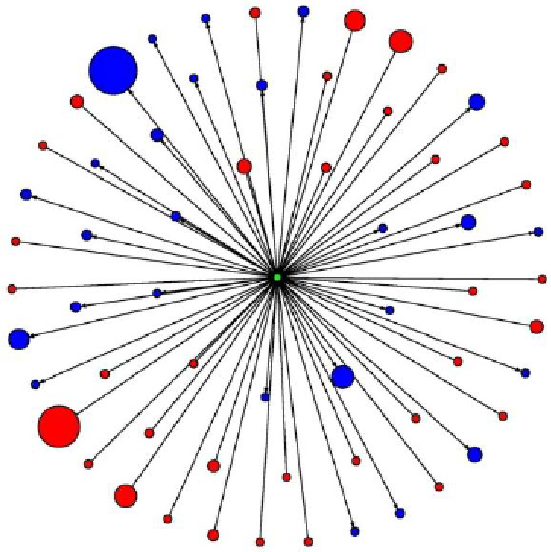
Note: The two figures represent hypothetical and stylized examples of a complete network (panel A) and an incomplete network (panel B).
Source: Federal Reserve Board staff.

Figure 3
Bilateral and Centrally Cleared Networks

A. Fully Bilateral Network



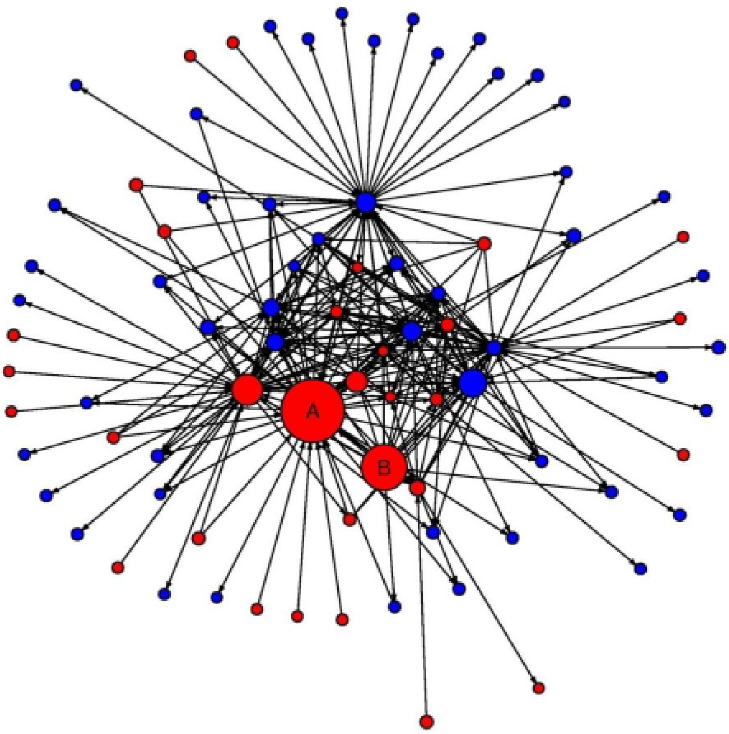
B. Centrally Cleared Network



Note: Panel A shows a bilateral network in the credit default swap (CDS) market for a single and highly traded CDS contract. Panel B shows the hypothetical network that would exist if the contract were cleared through a single central counterparty. In each panel, a red circle denotes a protection seller and a blue one denotes a protection buyer. The size of the circle represents the amount of protection bought or sold.

Source: Depository Trust & Clearing Corporation.

Figure 4
A Network in the Credit Default Swap Market



Note: The figure shows a credit default swap (CDS) market network. CDS exposures across different contracts (underliers) are netted against each other so that any circle represents the net protection bought or sold by a market participant. Red circles represent participants that are net sellers of CDS protection; blue circles represent participants that are net buyers of CDS protection. The size of the circle indicates the amount of protection bought or sold. The sample has been trimmed to exclude small market participants for ease of exposition.

Source: Depository Trust & Clearing Corporation.