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Over the Cliff: From the Subprime to the Global Financial Crisis

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The financial crisis of 2007 to 2009 can be divided into two distinct phases. The first and more limited phase from August 2007 to August 2008 stemmed from losses in one relatively small segment of the U.S. financial system—namely, subprime residential mortgages. Despite this disruption to financial markets, real GDP in the United States continued to rise into the second quarter of 2008, and forecasters were predicting only a mild recession. For example, the Congressional Budget Office (2008) released one of its periodic "The Budget and Economic Outlook: An Update" reports on September 8, 2008. It said: "According to CBO's updated forecast for the rest of 2008 and for 2009, the economy is about halfway through an extended period of very slow growth. . . . Whether or not that period of slow growth will ultimately be designated a recession is still uncertain. However, the increase in the unemployment rate and the pace of economic growth are similar to conditions during previous mild recessions." In keeping with that view, CBO projected that unemployment would rise modestly from 5.4 percent in 2008 to 6.2 percent in 2009 and that fourth-quarter to fourth-quarter real GDP would grow only 0.9 percent in 2008 but would rebound modestly to 1.8 percent growth in 2009. In summer of 2008, when I was serving on the Federal Reserve Board of Governors, there was even talk that the Fed might need to raise interest rates to keep inflation under control.

In mid-September 2008, however, the financial crisis entered a far more virulent phase. In rapid succession, the investment bank Lehman Brothers

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entered bankruptcy on September 15, 2008; the insurance firm AIG collapsed on September 16, 2008; there was a run on the Reserve Primary Fund money market fund on the same day; and the highly publicized struggle to pass the Troubled Asset Relief Program (TARP) began.

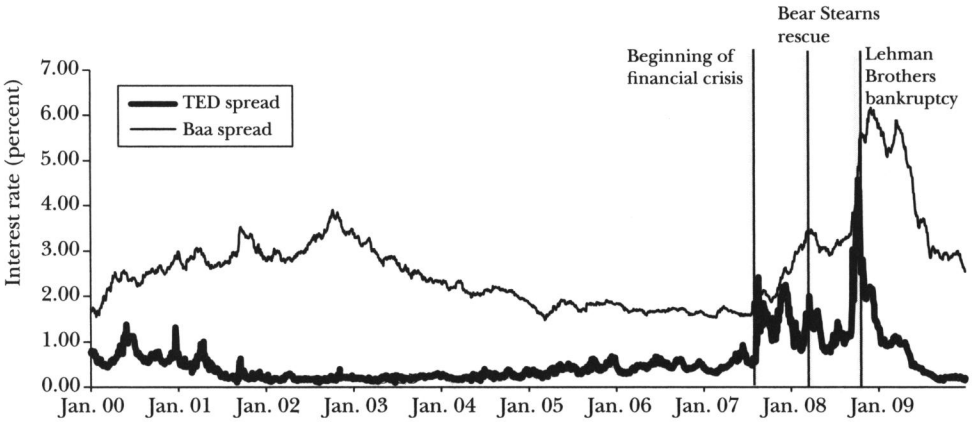
How did something that appeared in mid-2008 to be a significant but fairly mild financial disruption transform into a full-fledged global financial crisis? What caused this transformation? Did the government responses to the global financial crisis help avoid a worldwide depression? What challenges do these government interventions raise for the world financial system and the economy going forward? Let's start with a brief step back to the first phase of the global financial crisis.

The First Phase: The Subprime Mortgage Crisis

The first disruption of credit markets in the recent financial crisis is often dated to August 7, 2007, when the French bank BNP Paribas suspended redemption of shares held in some of its money market funds. A boom in U.S. housing prices had peaked around 2005. As housing prices started to decline, mortgage-backed financial securities—in many cases, securities based on subprime residential mortgages but then divided into more senior claims that were supposedly safe and junior claims that were recognized to be risky—began to experience huge losses. By early 2008, losses on these securities were estimated to be on the order of $500 billion dollars (for example, Greenlaw, Hatzius, Kashyap, and Shin, 2008).

What developed in late 2007 and into 2008 was a series of runs on financial institutions. But instead of the classic bank run, it was, as described by Gorton and Metrick (2009), a run on the shadow banking system. A bank has deposits that are short-term liabilities and assets that are long-term loans. Thus, in a classic bank run, when bank depositors run to withdraw deposits, the bank cannot readily convert its long-term assets into cash. In the shadow banking system, institutions have short-term liabilities in the form of short-term borrowing, like repurchase agreements (or repos), which use longer-term assets like mortgage-backed securities as collateral. A key element of this borrowing is the use of a "haircut," that is, a requirement that borrowers post collateral that is valued at more than the loan. For example, if a borrower took out a $100 million loan in a repo agreement, it might have to post $105 million of mortgage-backed securities as collateral, and the haircut would then be 5 percent. As the value of mortgage-backed securities fell and uncertainty about their future value increased, haircuts rose to levels as high as 50 percent. The result was that the same amount of collateral would now support less borrowing, leading to deleveraging in which financial institutions had to sell off assets. The resulting "fire sale" dynamic (discussed by Shleifer and Vishny in this issue) led to an adverse feedback loop in which the decline in asset values lowered the collateral's value while further raising uncertainty, causing haircuts to rise further, forcing financial institutions to deleverage and sell more assets, and so on.

Figure 1
Credit Spreads 2000–2009



Source: FRED, Federal Reserve Bank of St. Louis, and British Bankers' Association.
Note: The TED spread is the difference between the 3-month LIBOR rate and the constant maturity 3-month Treasury bill rate. The Baa spread is the difference between the constant maturity Baa rate and the 10-year constant maturity Treasury bond rate.

One signal of the resulting credit market disruptions appears in the interest rate spreads between safe and risky financial instruments. For example, the "TED spread" is the spread between the interest rate on interbank lending (as measured by the LIBOR interest rate on three-month eurodollar deposits) and the interest rate on three-month U.S. Treasury bills. The TED spread provides an assessment of counterparty risk from one bank lending to another, reflecting both liquidity and credit risk concerns. Figure 1 shows how the TED spread rocketed up from an average of around 40 basis points (0.40 percentage points) before August 7, 2007, to 240 basis points by August 20, 2007, before abating somewhat.

The collapse of Bear Stearns in March 2008 was the most visible of these runs on the shadow financing system. Short-term financing for Bear Stearns dried up. Its long-term assets could not quickly be turned into ready cash at a fair price, and without access to short-term funding, it could not continue. The Federal Reserve brokered a deal for JPMorgan Chase to purchase Bear, which was not unprecedented, but as part of the deal the Fed also took onto its books $30 billion of Bear Stearns's toxic assets, which was unprecedented. However, this deal and the opening of new Federal Reserve lending facilities to investment banks helped restore some calm to the market. The TED spread surged to over 200 basis points in March 2008 but then fell back below 100 basis points.

By summer 2008, credit markets were clearly impaired and credit risk was rising, as can be seen by the rise in the spread between interest rates on Baa corporate bonds and Treasury bonds in Figure 1. However, the financial crisis looked like it could be contained. The Baa–Treasury spread had climbed to over 200 basis points, but these levels were similar to those that occurred in the aftermath of the

mild recession in 2001. The TED spread, although elevated, was also below its peak values immediately after the revelations of problems at BNP Paribas and the Bear Stearns collapse. Many public and private forecasters reasoned that the worst was probably over. After all, they argued, the subprime mortgage sector was only a small part of overall capital markets, and the losses in the related mortgage-backed securities, although substantial, seemed manageable. Indeed, the Congressional Budget Office (2008) was forecasting in early September 2008 that the Consumer Price Index would rise from 2.9 percent in 2007 to 4.7 percent in 2008. As discussed in Wessel (2009), there was talk in the Federal Reserve as to whether the easing phase of monetary policy might have to be reversed to contain inflation.

The story of this first phase of the 2007–2009 financial crisis has been discussed extensively in many places, including in symposia in the Winter 2009 and Winter 2010 issues of this journal. Here, the focus is on understanding what happened next.

The Second Phase: Global Financial Crisis

In the space of a few short weeks in September 2008, everything changed. On Monday, September 15, 2008, after suffering losses in the subprime market, Lehman Brothers, the fourth-largest investment bank by asset size with over $600 billion in assets and 25,000 employees, filed for bankruptcy—the largest bankruptcy filing in U.S. history. Many discussions of the evolution of the financial crisis view the Lehman bankruptcy as the key event that morphed the subprime crisis into a virulent global financial crisis. Although the Lehman bankruptcy led a large increase in uncertainty and a wave of distressed selling of securities that caused a collapse in asset prices and a drying up of liquidity, I will argue that the collapse of Lehman was followed by three events that were at least as important in causing the subprime crisis to go global: the AIG collapse on September 16, 2008; the run on the Reserve Primary Fund on the same day; and the struggle to get the Troubled Asset Relief Plan (TARP) approved by Congress over the following couple of weeks.

In considering these events, it's also important to remember that the financial system had been greatly weakened before September 2008 in ways that were not yet fully recognized. Just as a relatively small sound or vibration can trigger an avalanche if the snow conditions have made the danger of such an avalanche high, it may be that given the amount of systemic risk embedded in the financial system, some other stress or failure of a financial institution would also have revealed the fragility of the financial system—and then led to a chain reaction that could also have tipped the financial system over the cliff.

The Lehman Bankruptcy

Many commentators have argued that the Treasury and the Fed's decision to allow Lehmann to go bankrupt was a colossal mistake that turned a mild financial disruption into a global financial crisis. With hindsight, it is hard to argue that allowing Lehman to go bankrupt was the right decision. But it's useful

to remember that at the time, there was a plausible case for letting Lehman go into bankruptcy.

First, in practical terms, the U.S. government or its regulatory authorities had no authority to put Lehman into a government conservatorship so it could keep functioning, as the Treasury was able to do with Fannie Mae and Freddie Mac. Thus, the only possible solution was to broker a purchase of Lehman. Barclays was in discussions about buying Lehman, but British bank regulators were skeptical, and the Fed refused to take more bad assets onto its balance sheet, as it had done with Bear Stearns. Barclays ended up buying parts of Lehman a week after it declared bankruptcy.

Second, the bailout of Bear Stearns had extended the government safety net outside the banking system to investment banks, and the U.S. Treasury and the Federal Reserve were concerned about increasing the moral hazard incentives for a wider set of financial institutions to take on excessive risk. Indeed, as we now know, Lehman was going to extraordinary efforts, including shady accounting practices, to hide its leverage, even after the financial crisis started in August 2007.[1] Letting Lehman fail would serve as a warning to other financial firms that they needed to rein in their risk taking.

Third, it was an open secret in the financial markets and among government officials that if any of the major investment banks would run into trouble, Lehman would be at the top of the list. Lehman was among the most leveraged of the major investment banks; it was unwilling to raise capital; it had a poor reputation for risk management; and it had a high exposure to losses on subprime mortgages because it had large holdings of securities tied to valuations of these mortgages on its books (McDonald, 2009; Sorkin, 2009). Sorkin (2009) documents that immediately after the Bear Stearns bailout, the U.S. Treasury Secretary immediately turned his attention to Lehman because he thought it would be the next trouble spot. With Lehman's vulnerability already well-known, Lehman seemed like a natural test case to provide an object lesson that market participants should take measures to protect themselves. Indeed, many of the derivative contracts with Lehman's counterparties were unwound successfully after Lehman's bankruptcy.

Finally, the financial system in mid-September 2008 was far more vulnerable than almost all policymakers and market participants realized at that time. There is a distinct possibility that the financial system would have imploded even if Lehman had been bailed out.

The AIG Collapse

The Financial Products Unit of American International Group (AIG) had written over $400 billion dollars of insurance contracts called credit default swaps, which had to make payments when subprime mortgage securities suffered losses.

[1] As described in the *Examiner's Report for the United States Bankruptcy Court, Southern District of New York* (Valukas, 2010), Lehman Brothers used a repo transaction, referred to as Repo 105, to reduce net leverage by $50 billion when reporting earnings at Q1 2008 and Q2 2008. In this transaction, repos were treated as sales, rather than borrowings, thereby taking them off the books. In addition, Lehman did not report that only $2 billion of $40 billion of liquid assets were readily accessible.

With the Lehman Brothers collapse, it seemed more likely that AIG might have to make enormous payments under these contracts, so short-term funding to AIG dried up. On September 16, 2008, the Federal Reserve stepped in with an $85 billion loan to keep AIG afloat (with total loans from the Fed and the U.S. government eventually rising to over $170 billion).

The enormous risk-taking at AIG and its potential to blow up the financial system had been largely unrecognized by government officials, regulators, and markets. Once Bear Stearns had to be bailed out, it became apparent that a wider group of financial institutions could pose major systemic risks to the financial system. But in discussions at that time among regulators and academics about the need to regulate a wider group of financial institutions (in which I participated), AIG was *not* mentioned in the category of firms that would require special supervisory attention. This, along with Fed Chairman Bernanke's later statement in Congressional testimony about how angry he was that AIG took on such risk, describing AIG as effectively running a huge hedge fund inside an insurance company (Torres and Son, 2009), indicates that the AIG blow-up was a surprise.

Reserve Primary Fund

The same day of the AIG collapse—September 16, 2008—also saw a run on the Reserve Primary Fund, a large money market market fund run by Bruce Bent, one of the originators of money market mutual funds in 1970. Before the crisis, Bent had publicly criticized the industry for taking on too much risk in its asset holdings. He stated in a letter to the Securities and Exchange Commission in September 2007 (Bent, 2007): "When I first created the money market fund in 1970, it was designed with the tenets of safety and liquidity." He added that these principles had "fallen by the wayside as portfolio managers chased the highest yield and compromised the integrity of the money fund." Alas, Bent did not follow his own advice, and the Reserve Primary Fund held $785 million of Lehman paper. With the Lehman bankruptcy, the fund could no longer afford to redeem its shares at the par value of $1—a situation known as "breaking the buck"—and shareholders pulled out their money, with the fund losing 90 percent of its assets. A run on other money market funds followed, with assets in institutional money market mutual funds falling from $1.36 trillion to $0.97 trillion from September to October 2008. In turn, this run put pressure on the banks, since a significant amount of bank funding was coming from bank commercial paper and certificates of deposits held by money market mutual funds.

TARP

In the wake of these events, U.S. Treasury Secretary, Hank Paulson, then proposed on September 19, 2008, the Troubled Asset Relief Program (TARP) in an infamous three-page document. In its original form, it would have given the U.S. Treasury the authorization, with no accountability to the Congress, to spend $700 billion purchasing subprime mortgage assets from troubled financial institutions—money which was subsequently used to inject capital into banking institutions. It

soon became clear that Congress would vote down the original bill, which it did on September 29. Eventually the bill was passed on October 3, 2008, but passage required numerous "Christmas-tree" provisions such as a tax break for makers of toy wooden arrows.

The Broader Context

If the Federal Reserve had cut a deal with Barclays to rescue Lehman before bankruptcy, would the crisis have been defused? The underlying stresses in the financial system were all too real. A counterfactual history would have to take into account that a weakened Lehman, purchased before bankruptcy, might have later brought down Barclays. Rescuing Lehman would have increased moral hazard among other financial institutions, perhaps setting up a larger crash later. The costs of the AIG credit default swaps were eventually going to come due, quite possibly unexpectedly. Runs on various shadow banking institutions, like the run on the Reserve Primary Fund and then on money market funds in general, were becoming more common. Here, rather than try to lay out a persuasive counterfactual history, I will emphasize two major changes that occurred by late September 2008.

First, even though markets had been digesting bad news about mortgage-backed securities since mid-2007, the events of September 2008 showed that risk taking was far more extensive than markets had realized and the fragility of the financial system was far greater than most market participants could have imagined. The AIG blowup and the run on the Reserve Primary Fund revealed that the financial system was engaged in what could be described as one huge "carry trade." Technically, carry trades are ones in which a trader borrows at a low interest rate to fund the purchase of assets that yield a high interest rate. Carry trades generate immediate profits, but may be very risky because the higher interest rate on the purchased assets may just reflect greater tail risk for that asset. AIG's issuing of credit default swaps is a classic example of a type of carry trade, because the firm was earning large profits on the premiums paid on these contracts until the tail risk became a realization. In a prescient and now-famous paper, Rajan (2005) warned that this carry-trade problem was a danger to the financial system because incentives in compensation schemes for financial firms were leading financial market participants to engage in financial transactions that produced immediate income but exposed the financial system to massive risks.

Second, although markets had been watching government agencies scramble to deal with the financial crisis since late 2007, the events of September 2008 raised serious doubts that the U.S. government had the capability to manage the crisis. After all, the Fed and the U.S. Treasury proved unable to craft a solution so that Lehman would not fail. The AIG bailout was huge and unexpected. TARP was originally proposed as a flimsy, three-page proposal, which raised concerns that the Treasury was unprepared, and the initial TARP proposal failed on a bipartisan vote. Even though the TARP legislation was eventually passed, the reputational damage was done.

After September 2008, the pattern of runs on the shadow banking system intensified and worsened. Banks began to horde cash and were unwilling to lend to each

other, despite huge injections of liquidity into the financial system by the European Central Bank, the Bank of England, and the Federal Reserve. The subprime crisis had become a full-fledged, global financial crisis.

The patterns of credit spreads tell the story. As shown in Figure 1, the TED spread rose from around 100 basis points during the week before the Lehman bankruptcy to over 300 basis points on September 17, the day after the liquidity squeeze on AIG and the Reserve Primary Fund materialized. The TED spread then dropped by 100 basis points, but as confidence in the ability and competence of the government to react quickly to contain the crisis weakened over the next couple of weeks, it climbed to over 450 basis points by October 10. The spread between interest rates on Baa corporate and Treasury bonds, shown in Figure 1, also rose by over 200 basis points and now rose well above the levels seen in 2001 during the prior recession period. The stock market crash also accelerated, with the week of October 6, 2008, showing the worst weekly decline in U.S. history.

Conditions in the financial markets continued to deteriorate. The public anger that resulted from the TARP "bailouts"—which involved injections of capital into financial institutions, with little restrictions on their use—became so intense that it became increasingly clear that the new Obama administration, taking office in January 2009, would not be able to get additional funds beyond those already allocated to TARP, if needed. Figure 1 shows that although the TED spread fell from its peak in October 2008 with the help of government support to the financial sector, the spread between Baa and Treasury bonds continued to rise, peaking at over 500 basis points in December 2009. By the end of 2008, the stock market had fallen by over half from its peak in fall 2007.

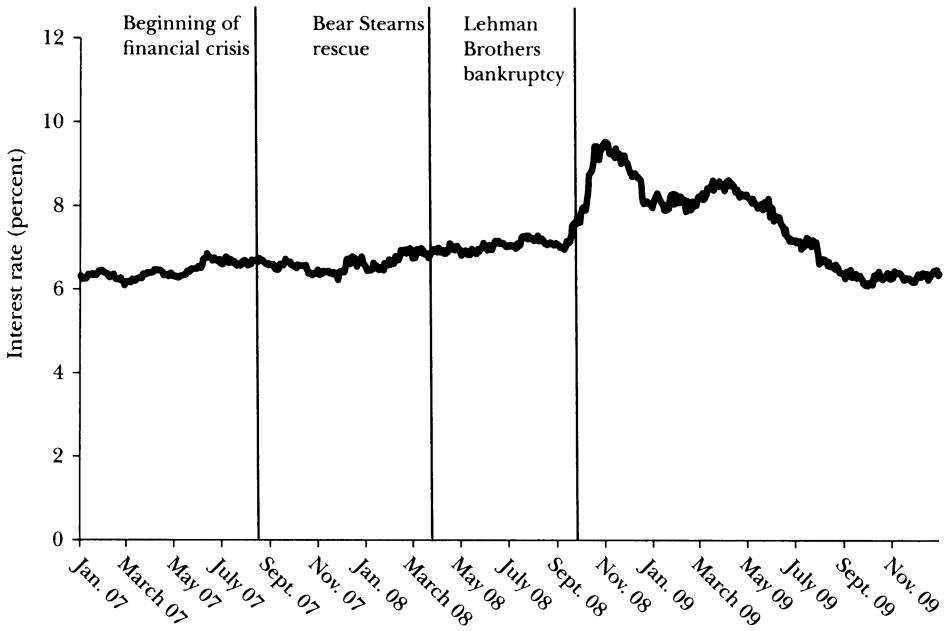
The Links from Financial Crisis to Recession

Data that later became available showed that GDP growth in the U.S. economy had turned down in the third quarter of 2008, falling at a –1.3 percent annual rate, but it was in the fourth quarter of 2008 that the recession that started in December 2007 became the worst economic contraction in the United States since World War II. Real U.S. GDP contracted sharply in the fourth quarter of 2008 and the first quarter of 2009, declining at annual rates of –5.4 and –6.4 percent, respectively. The unemployment rate skyrocketed, exceeding 10 percent by October 2009. A worldwide recession ensued as well. World economic growth fell at an annual rate of –6.4 percent in the fourth quarter of 2008 and –7.3 percent in the first quarter of 2009. A more extensive description of how financial crises lead to sharp economic downturns can be found in Mishkin (2011), but the basic story has three interrelated parts.

First, a financial crisis widens credit spreads, like the difference between interest rates on Baa corporate and Treasury bonds shown earlier in Figure 1. The result is that conventional monetary policy is defanged: even if interest rates on Treasury bonds fall because of a weakening economy and easing of monetary policy, the

Figure 2
Financial Variables, 2007–2009

A: Baa Corporate Bond Rate



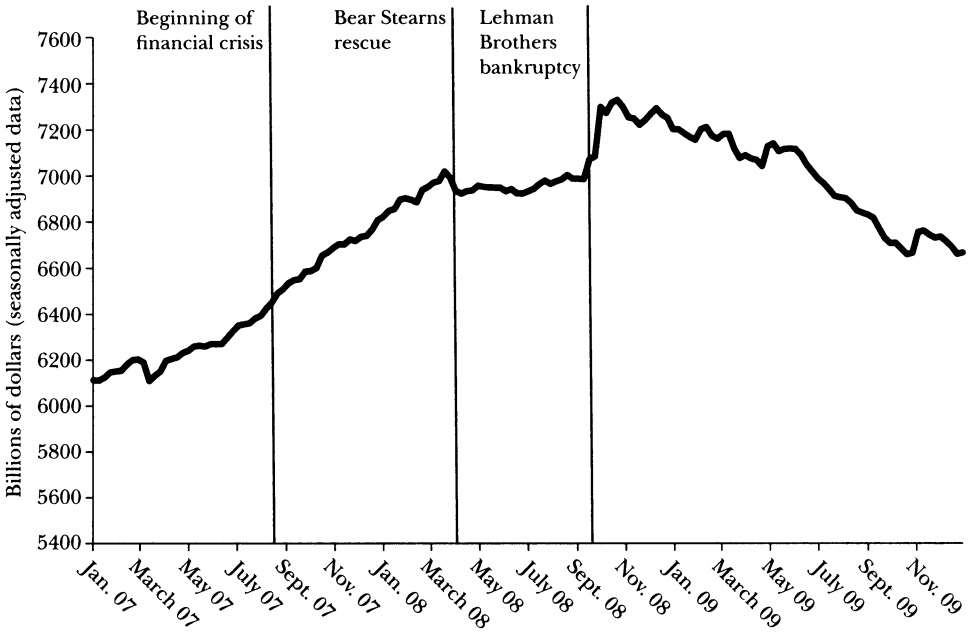
interest rates relevant to household and business purchase decisions go up, causing a drop in aggregate demand. Figure 2A shows that Baa corporate bond rates barely budged at the beginning of the financial crisis in 2007 or during the Bear Stearns episode in March 2008, but climbed substantially in September 2008.

Second, the decline in asset prices during a financial crisis causes a decline in the value of collateral, which makes it harder for nonfinancial firms to borrow. In addition, the deterioration of balance sheets at financial firms, which have the expertise to mitigate adverse selection and moral hazard problems, causes their lending to fall (a process known as "deleveraging"), which causes spending to decline. Figure 2B shows how total bank lending continued to rise early in the financial crisis in 2007, and even remained stable through March 2008 and the Bear Stearns rescue. Right after September 2008, bank lending rises largely because lenders were drawing heavily on already-established lines of credit, but by mid-2009 bank lending is on a downward trend. Of course, this decline should not only be attributed to the decline in the supply of loans, but also to the decline in the demand for loans as a result of weakening economic conditions.

Third, the general rise in uncertainty that occurs during a financial crisis also leads to an increase in asymmetric information, further hindering the ability of financial markets to allocate funds to households and businesses with productive

Figure 2 (continued)

B: Bank Lending



investment opportunities. Figure 2C shows how the market for asset-backed commercial paper, which had seemed to be recovering in mid-2008, dwindled from daily average issuance of $64 billion at the beginning of September 2008 to $16.6 billion by the end of 2009.

Policy Responses to the Financial Crisis

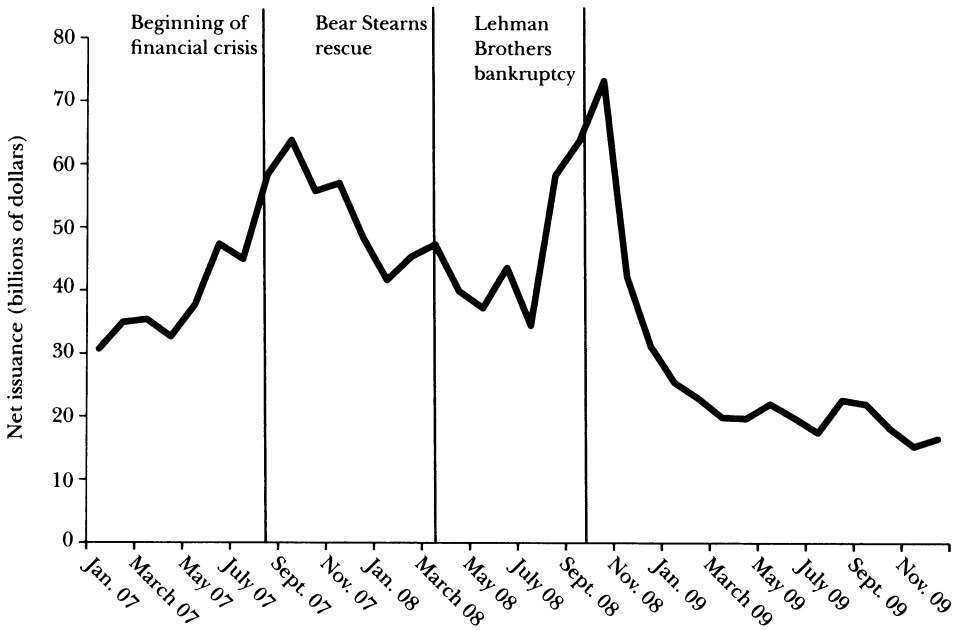
The most powerful U.S. policy responses to the financial crisis came through policies that applied to the financial and banking system: conventional and unconventional monetary policies, bank "stress tests," and bailouts of some banks and financial institutions. Many of these policies were implemented by the Federal Reserve, but others involved cooperation with fiscal authorities.

Unconventional Monetary Policy

In 2002, Ben Bernanke, then a member of the Board of Governors of the Federal Reserve, gave a speech on the occasion of Milton Friedman's 90th birthday and concluded by saying (Bernanke, 2002): "Regarding the Great Depression. You're right [referring to Milton Friedman and Anna Schwarz], we did it. We're very sorry. But thanks to you, we won't do it again." He clearly meant it. During the financial crisis, the Federal Reserve's modus operandi was massive experimentation

Figure 2 (continued)

C: Asset-Backed Commercial Paper Issuance



Source: FRED database, Federal Reserve Bank of St. Louis, and Federal Reserve Board of Governors.
Note: The Baa corporate bond rate is the constant maturity interest rate. Asset-backed commercial paper issuance is the daily average of issuance of asset-backed commercial paper. Bank lending is total loans and leases of commercial banks.

in an unprecedented situation: that is, it was employing a large number of measures to contain the crisis, not knowing exactly which ones would work.

To be sure, the Fed started off using conventional monetary policy—that is, targeting a lower federal funds interest rate. Starting in the September 2007 meeting, the Federal Reserve lowered its federal funds rate target by ½ percentage point from 5.25 to 4.75 percent, and subsequently pushed the rate steadily downward. By April 2008, the rate was down to 2 percent, and by December 2008, the target range for the federal funds rate was 0 to 0.25 percent. Even before the zero-bound for interest rates was reached, the Fed had turned to nonconventional monetary policy measures. Two unconventional policy measures—liquidity provision and asset purchases—result in an expansion of the central bank balance sheet and are therefore usually described under the heading "quantitative easing." One other unconventional measure is management of expectations. I will say a few words about each.

The first unconventional form of monetary policy, *liquidity provision*, involves expanding Fed lending to both banks and other financial institutions. Liquidity provision is directed at maintaining the smooth functioning of financial markets, but it does affect household and business spending.

The traditional method for the Fed to provide liquidity has been through loans made at the discount rate—the interest rate on loans it makes to banks. In mid-August 2007, the Fed lowered the discount rate to 50 basis points (0.5 percentage points) above the federal funds rate target from the normal 100 basis points. It then lowered it further in March 2008 to only 25 basis points above the federal funds rate target. In addition, the Fed expanded the types of securities that would be eligible for use as collateral. But discount lending has two problems: 1) it's traditionally been viewed as a bad signal for banks to borrow through the discount mechanism, because it suggests they have nowhere else to turn; and 2) discount lending has traditionally only gone to banks, not to other financial institutions.

To solve the problem of negative signals, the Fed set up a temporary Term Auction Facility (TAF) which enabled banks to borrow anonymously at a rate determined through a competitive auction. The TAF auctions started at amounts of $20 billion, but as the crisis worsened, the total loans outstanding though this mechanism rose to exceed $400 billion. (The European Central Bank conducted similar operations, with one auction in June 2008 leading to lending of over 400 billion euros.)

The Fed also invented new lending programs to broaden its provision of liquidity beyond banking institutions. These included lending to investment banks and lending to promote purchases of commercial paper, mortgage-backed securities, and other asset-backed securities. In addition, the Fed engaged in lending to prop up Bear Stearns[2] and AIG and to Fannie Mae and Freddie Mac. The enlargement of the Fed's lending programs during the 2007–2009 period was remarkable, expanding the Fed's balance sheet by over $1 trillion by the end of 2008, with the balance-sheet expansion continuing into 2009. The number of new programs over the course of the crisis spawned a whole new set of acronyms: TSLF, PDCF, AMLF, MMIFF, CPFF, and TALF.

Yet another method to increase liquidity was through swap lines with foreign central banks. These foreign central banks also engaged in massive amounts of liquidity provision, but could create liquidity only in their own domestic currency, while many of their financial institutions required dollar funding to conduct their operations. The Federal Reserve provided foreign central banks with U.S. dollar deposits in exchange for deposits in their home currency, often in essentially unlimited amounts.

Overall, the available research suggests that liquidity provision did help stabilize financial markets during this crisis. For example, McAndrews, Sarkar, and Wang (2008) find that announcements about the Term Auction Facility (TAF) did significantly lower credit spreads. Wu (2008), Christensen, Lopez, and Rudebusch (2009), and Sarkar and Shrader (2010) also conclude that the TAF and other credit facilities

[2] The lending to JPMorgan to prop up Bear Stearns was in effect a purchase of assets. In order for the Federal Reserve to abide by its legal authority, it could not purchase private assets outright. Instead, it made a nonrecourse loan: that is, the Fed had no recourse to require JPMorgan to pay back the loan, but instead would take ownership of the collateral, the $30 billion of toxic assets. Hence the Fed would bear any losses or gains on these assets, so in economic terms it had purchased these assets.

helped lower interest rates.[3] Baba and Packer (2009), McAndrews (2009), and Goldberg, Kennedy, and Miu (2010) find that the U.S. dollar swap facilities helped improve the performance of the dollar swap markets. Using a similar event-study methodology, Ait-Sahalia, Adnritzky, Jobst, Nowak, and Tamirisa (2010) find that liquidity provision, not only in the United States, but also in the United Kingdom and Japan, did help lower interbank risk premiums.

The second category of nonconventional approaches to monetary policy, *asset purchases*, is based on the belief that a direct purchase can stimulate spending by raising prices on particular classes of bonds, thereby lowering the interest rates that households and businesses have to pay. This policy began with the purchase of $300 billion of long-term Treasury bonds, which started in March 2009 and ended in October 2009. Empirical evidence on a previous Fed attempt to lower long-term interest rates relative to short-term rates in the 1960s—which was dubbed "Operation Twist" because its intent was to "twist" and flatten the yield curve—deemed that it didn't work (Modigliani and Sutch, 1967). However, as Solow and Tobin (1987) pointed out, Federal Reserve purchases of long-term Treasury bonds at that time were small and ended up being offset by issuance of long-term bonds.

A larger asset purchase program, announced in November 2008 and terminated in March 2010, was the outright purchase of $1.25 trillion of mortgage-backed securities. The Fed purchased mortgage-backed securities in an attempt to lower residential mortgage rates, thereby stimulating the demand for housing, which would not only stabilize housing prices and the financial markets, but would also stimulate spending on residential construction. Research on the effect of the Fed's large-scale asset purchases during the global financial crisis by Gagnon, Raskin, Remache, and Sack (2010), finds that these programs lowered long-term bond rates relative to short rates on the order of 50 basis points, and lowered interest rates on mortgage-backed securities even further by improving liquidity in this market, thereby having a substantial effect on residential mortgage rates.

Both liquidity provision and asset purchases fit under the general heading of *quantitative easing*—that is, ways in which the Federal Reserve greatly expanded the monetary base along with its balance sheet. There has been some question as to whether this expansion of the monetary base by itself could stimulate the economy. It's not clear why this would work: as Curdia and Woodford (2010) argue, why should an expansion of the monetary base lead to higher aggregate demand when it was unable to further lower interest rates or stimulate bank lending? In addition, evidence from Japanese experience in recent decades doesn't lend much support to the idea that a pure expansion of a central bank's balance sheet is particularly effective in stimulating aggregate demand (Kuttner, 2004). Bernanke (2009) has also expressed his skepticism that quantitative easing by itself would be effective. He indicated that the expansion of

[3] Presenting an alternative view, Taylor and Williams (2009) find no evidence that actual lending from the Term Auction Facility (TAF) helped to ease credit markets.

the balance sheet should instead be viewed as a result of what he referred to as *credit easing*, that is, an attempt to lower spreads between different asset classes through asset purchases and liquidity provision.

A final nonconventional approach to monetary policy is *management of expectations*. In March 2009, the Fed Open Market Committee added to its policy statement that it would maintain "exceptionally low" interest rates "for an extended period." There is theoretical support for the proposition that a commitment to keep short-term interest rates low for a substantial period of time helps lower long-term interest rates and also raises inflation expectations, thereby reducing the real interest rate (Eggertsson and Woodford, 2003, 2004; Woodford, 2003). But at least so far, no empirical evidence is available on how effective the management of expectations was during this episode.

The Bank Stress Tests

Financial markets began to recover in the first half of 2009. The provision of huge amounts of liquidity appeared to do the trick in the interbank lending market, with the TED spread falling from its peak of over 400 basis points in October to below 100 basis points in January 2009. This spread fell to below pre-crisis levels (less than 20 basis points) by May 2009. Credit spreads also began to fall with the Baa–Treasury spread declining from its peak in October, but at a slower pace than the improvement in the interbank market, as illustrated in Figure 1. By late 2009, however, credit spreads were returning to normal, reaching levels that were just a little above those before the crisis, and actually lower than the spreads that existed in 2002 shortly after the previous recession ended. The stock market also began to recover from its trough in March 2009, leading to a sustained bull market in which it rose over 50 percent over the next year.

A key element in the financial market recovery was the U.S. Treasury's requirement, announced in February 2009, that the 19 largest banking institutions undergo the Supervisory Capital Assessment Program (SCAP) or "stress tests," as they were commonly called. The stress tests were a supervisory assessment, led by the Federal Reserve in cooperation with the Office of the Comptroller of the Currency and the FDIC, of the balance sheet position of these banks to ensure that they had sufficient capital to withstand bad macroeconomic outcomes. The stress tests were designed as a forward-looking exercise to project possible erosion of bank capital under two scenarios: the baseline consensus forecast by private sector economists as of February 2009, which entailed a continuing decline in economic activity, and a worse scenario of a much more severe recession (for details of the scenarios, see Board of Governors of the Federal Reserve System, 2009).

The Treasury announced the results in early May 2009 and they were well received by market participants, allowing these banks to raise substantial amounts of capital from private capital markets, as was required by the stress tests. The stress tests were a key factor that helped increase the amount of information in the marketplace, thereby reducing asymmetric information and adverse selection and moral hazard problems. Hoshi and Kashyap (forthcoming) found that similar stress

tests in Japan in 2003 were a key element of the recovery of the Japanese banking system after the "lost decade" from 1992 to 2002.

Bailing Out Financial Institutions

Some of the Fed's liquidity provision was to bail out financial institutions, as occurred with Bear Stearns, AIG, and the government-sponsored enterprises Fannie Mae and Freddie Mac. In each of these cases, the Federal Reserve provided this liquidity in cooperation with the U.S. Treasury, which also made large loans.

Although the Troubled Asset Relief Program (TARP) was initially intended to purchase subprime mortgage assets to help prop up financial institutions' balance sheets, it soon became clear that agreeing on a price for those assets was unworkable. The Treasury switched to using the TARP funds to inject capital into financial institutions, thereby shoring up their balance sheets more directly. In addition, on September 29, the U.S. Treasury announced a Temporary Guarantee Program for Money Market Funds, which insured that investors would receive at least the $1 par value per share. On October 14, 2008, the FDIC announced the Temporary Liquidity Guarantee Program (TLGP) that guaranteed newly-issued senior unsecured bank debt, such as loans of deposits at the federal reserve and commercial paper, as well as non–interest-bearing transaction accounts. Its stated purpose was to "strengthen confidence and encourage liquidity in the banking system" (FDIC, 2008). Although these programs were initially intended to last less than a year, they have been extended several times.

The spreading bank failures in Europe in fall 2008 led to similar bailouts of financial institutions: for example, the U.K. Treasury set up a bailout plan that guaranteed 250 billion pounds of bank liabilities, added 100 billion pounds to a facility that swaps these assets for government bonds, and allowed the U.K. government to buy up to 50 billion pounds of equity stakes in British banks. Allessandri and Haldane (2009) discuss $10 trillion worth of these bailout packages across 20 countries, which include both guaranteeing the debt of the banks and injecting capital into them. There was a high degree of international coordination in these policies.

Ait-Sahaliam, Adnritzky, Jobst, Nowak, and Tamirisa (2010) find that comprehensive bailouts which helped recapitalize the financial sector did help lower interbank risk premiums, but bailouts of individual banks on an ad hoc basis were received poorly by the markets and led to a rise in interbank risk premiums. A plausible explanation is that when governments pursue ad hoc bailouts, it suggests to markets that the problem in the credit markets may be worse than they expected. In contrast, pursuing a comprehensive approach to recapitalize the financial system helps to restore confidence and unfreeze the credit markets. Furthermore, they find that there were strong spillovers from actions taken in one country to others, suggesting the benefits of a coordinated policy response between countries to cope with a global financial crisis.

Expansionary Fiscal Policy

Fiscal stimulus to directly increase aggregate demand was another key piece of the government response to the global financial crisis, both in the United States

and in many other countries. The incoming Obama administration pushed for the $787 billion fiscal stimulus package, the American Recovery and Reinvestment Act of 2009. The plan featured $288 billion of tax cuts and $499 billion in government spending increases. The evidence on the effect of the fiscal stimulus package is mixed, but two arguments suggest that that it was far less important to addressing the financial crisis than were actions by central banks to provide liquidity and government recapitalization and guarantees of the financial system.

First, as a basic matter of timing, most of the additional government stimulus package did not come on line until late 2009 and into 2010. While one can construct a theoretical argument that the expectation of the stimulus package helped to reassure financial markets, any direct effect of the stimulus on the financial crisis through the early months of 2009 was necessarily quite limited.

Second, there is a very active debate about how much a fiscal stimulus will affect output. For example, Hall (2009) summarizes the theoretical and empirical evidence on fiscal stimulus as yielding an output multiplier between 0.7 and 1. Analysis of the stimulus using dynamic stochastic general equilibrium models in Cogan, Cwik, Taylor, and Wieland (2009) and Uhlig (2010) find multipliers in the 0.6 range, while econometric evidence employed by Barro and Redlick (2009) finds an output multiplier of around 0.7. On the other hand, economists in the Obama administration and the Congressional Budget Office, using large-scale Keynesian econometric models, estimated that the output multiplier for fiscal stimulus was well above one. Moreover, a number of models point out that when the interest rate falls to the zero lower bound after a large negative aggregate demand shock, the output multiplier from a fiscal stimulus may be much higher because expansionary fiscal policy raises inflation expectations, thereby lowering real interest rates: for example, Eggertsson (2009), Woodford (2010), and Christiano, Eichenbaum, and Rebelo (2009) find such a result in calibrated New Keynesian models. The controversy over discretionary fiscal stimulus is explored by Auerbach, Gale, and Harris in the Fall 2010 issue of this journal.

Have Policies to Ameliorate the Financial Crisis Succeeded?

The question of whether or in which ways the policies to defuse the financial crisis have succeeded will be debated for years. One group of skeptics points out that households and firms have seen tighter credit standards and a higher cost of credit during the recession, from which they conclude that monetary policy has not been effective during the recent financial crisis (for example, Krugman, 2008). Another view holds that many government actions were ineffective, while others may have raised the perceived level of risk in financial markets (for example, see Taylor, 2009).

My own view, as I have argued more extensively elsewhere (Mishkin, 2009), is that conclusions about the effectiveness of policy should begin by considering the counterfactual—that is, what would the likely course of events be without the policy interventions? For example, if the Federal Reserve had *not* lowered the federal funds rate by over 500 basis points starting in September 2007, it seems clear that interest

rates on default-free Treasury securities would have been higher, but I believe, further, that credit spreads would have widened by even more than they did during this crisis because the weaker economy would have made conditions in financial markets even more stressed. The outcome would then likely have been that households and firms would have faced much higher interest rates, with the result that household and firm spending would have declined even more precipitously than we saw. The banking stress tests and systematic efforts to recapitalize the banking system also seem to have been useful. Some parts of the government intervention were less useful than others. But taken as a whole, I believe the government actions helped to prevent a far deeper recession and even possibly a depression.

Aftermath: Cleaning Up after the Crisis

The global financial crisis of 2007–2009 appears to be waning. There are three key areas where government policies are needed to clean up after the crisis in order to restore the world's financial sector and the broader economy to health.

Shrinking Central Bank Balance Sheets

Actions by central banks to contain the global financial crisis resulted in huge expansions of their balance sheets. The expansion of balance sheets arising from liquidity provision is typically easy to reverse because most of the liquidity facilities have provided loans at interest rates that are higher than market rates during normal times. As financial markets return to normal, market participants are no longer willing to borrow at above-market rates, and this source of balance sheet expansion naturally reverses itself as the financial system recovers—which is exactly what has happened.

The asset market purchases of long-term mortgage-backed securities are not self-liquidating in this way. Over $1 trillion of the mortgage-backed securities have maturities of ten years or more. Thus, a strategy of just letting them run off will leave the Federal Reserve in this market for a long time, which raises several issues. First, by holding these securities, the Federal Reserve will be exposed to both credit and interest rate risk.[4] Second, the presence of private securities on the Federal Reserve balance sheet means that the Fed has become directly involved in perhaps the most politicized financial market in the United States. The public and Congress may begin to hold the Fed accountable for what happens specifically to mortgage rates, rather than to interest rates in general. Politicians may tend to see the Fed as institutionally responsible for developments in the housing markets.

Can the Fed extricate itself from this situation by selling the mortgage-backed securities? The experience of the conclusion of the purchase program

[4] Because the balance sheet of the Federal Reserve is in effect part of the overall government balance sheet, it is not clear why potential losses on the Fed's balance sheet should matter. However, such losses would likely result in severe criticisms of the Federal Reserve and so weaken its independence.

for mortgage-backed securities at the end of March 2010 is encouraging. For some months before this date, the Fed had been in essence the sole buyer in this market. However, given that financial markets had stabilized and that the end of the purchase program was well publicized, the Fed's exit from the market did not cause any disruption. The spreads of mortgage-backed securities over Treasury bills did not rise after April 1, 2010. This experience suggests that if the Fed announces a program of asset sales well in advance and financial markets are functioning normally, it should be able to liquidate its positions. Of course, if this turns out not to be the case, then the Fed could discontinue its sales and announce that its sales are contingent on the market continuing to function normally.

A final concern sometimes raised is that the expansion in the monetary base will necessarily be inflationary, but this is unlikely to be the case in the current environment. The reason is that banks are perfectly happy to hold huge amounts of excess reserves—thus essentially neutralizing the effect this money would have on demand or the price level—as long as they are paid interest on the reserves, as is now the case. However, purchase of long-term government bonds has raised concerns that the Fed is willing to accommodate profligate fiscal policy by monetizing government debt, and this does have the potential to cast inflation expectations adrift without an anchor, which could have inflationary consequences in the future.

Too-Big-To-Fail

The global financial crisis has revealed the need to revamp financial regulation. French et al. (2010) offer discussions of financial regulation in the future, as do some of the other papers in this symposium. Here I will focus on just one issue, the too-big-to-fail problem.

"Too big to fail" is a misnomer. A financial firm can be systemically important—that is, its failure can threaten the health of the financial system—because 1) it is very large or 2) its activities are so interconnected with the rest of the financial system. So a more accurate term would be "too interconnected to fail" or "too systemically important to fail." The failure of the hedge fund Long Term Capital Management in 1998 is a classic example of a firm that was not enormous in size, but was systemically important. In any case, the difficulty is that when creditors know a firm falls into this category, they can expect government to provide some assistance if the firm gets into trouble, which means that they have less incentive to monitor the firm and pull out their money if it is taking on too much risk. Of course, this makes excessive risk-taking more likely and raises the cost to taxpayers of the eventual government bailout.

Too-big-to-fail is now a larger problem than before, in part because banks have merged in a way that creates even larger banking institutions and because, with the Fed bailout of Bear Stearns in March 2008 and then the financial assistance to AIG by the Fed and the U.S. Treasury in September of 2008, it has become clear that a much wider range of financial firms are likely to be considered "too big to fail" in the future. Indeed, the most prominent case of a firm that was not bailed

out—Lehman Brothers in September 2008—was followed by such a severe crisis that it is unlikely that governments would let this happen again. In the wake of the Lehman failure, governments throughout the world bailed out or guaranteed all their major financial institutions.

One way to address the too-big-to-fail problem is to limit the size of financial institutions, which might involve either the breakup of large financial institutions and/or limits on what activities banking institutions can engage in. However, arbitrary limits on their size or activities might well decrease the efficiency or raise other risks in the financial system. An alternative approach is to subject systemically important institutions to greater regulatory oversight, say by a systemic regulator (as discussed in Mishkin, 2010a; French et al., 2010), or by imposing larger capital requirements for systemically important financial firms.

The Dodd–Frank financial reform bill passed in summer 2010 gives the federal government one more tool for dealing with systemically important financial companies. Before Dodd–Frank, the U.S. government only could take over individual banking institutions, but not financial holding companies that own banks and other financial institutions. (In other words, it could take over Citibank, but not Citigroup or a free-standing investment bank like Lehman Brothers.) It used to be that the government had only two alternatives with such firms: send them into bankruptcy or bail them out. Now, the federal government has "resolution authority" over such firms, which means that they can treat them as they would an insolvent bank. Critics have expressed concerns that this federal resolution authority will further entrench too-big-to-fail and so make the moral hazard problem worse (for example, Wallison, 2010). As with all regulatory authority, the devil will be in the details. But the new resolution authority is likely to help limit moral hazard because it gives the government a big stick to force systemically important financial institutions to desist from risk taking or to raise more capital—or else face a government takeover that imposes costs on managers and shareholders.

Retrenching Fiscal Policy

The combination of massive bailouts, fiscal stimulus packages, and the sharp economic contractions that reduced tax revenue has shifted the fiscal situation for many countries. As Reinhart and Rogoff (2009) point out, the aftermath of financial crises is almost always a large increase in government indebtedness, and we have seen exactly this pattern in the aftermath of the current crisis. Budget deficits over 10 percent of GDP in advanced countries like the United States have been common in 2009 and 2010. This rise in government borrowing can even raise the risk of sovereign debt defaults, which can be a particular problem if sovereign debt is being held by many banks as a "safe" asset. This risk has become a serious concern in Europe after the Greek sovereign debt crisis.

As budget deficits surged after the crisis, the ratio of government debt to GDP is projected to jump to very high levels in many countries. In the next decade or so, getting fiscal houses in order will become one of the highest priorities for government policy throughout the world. In many countries, governments already faced a

long-term problem of unsustainable spending growth on health care and pensions; the current fiscal imbalances have brought those problems forward in time from the long-term into the middle-term, and in some countries into the short-term and the immediate future.

Conclusion

What started in 2007 as a crisis in one small part of the financial system led to a worldwide economic conflagration by late 2008 and early 2009. There are two key lessons from what has happened. First, the global financial system is far more interconnected than was previously recognized and excessive risk-taking that threatened the collapse of the world financial system was far more pervasive than almost anyone realized. Understanding how systemic risk can arise and designing policies to rein in this risk taking are tasks of the highest priority. Second, extraordinary actions by central banks and governments have contained this global financial crisis, but successfully unwinding these policies will prove to be a highly challenging task.

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