

Prone to Fail: The Pre-Crisis Financial System

Darrell Duffie

The financial crisis that began in 2007 was triggered by over-leveraged homeowners and a severe downturn in US housing markets (Mian and Sufi 2014). However, a reasonably well-supervised financial system would have been much more resilient to this and other types of severe shocks. Instead, the core of the financial system became a key channel of propagation and magnification of losses suffered in the housing market (as emphasized in this journal by Gertler and Gilchrist 2018, and discussed in this issue by Aikman, Bridges, Kashyap, and Siegart). Critical financial intermediaries failed, or were bailed out, or dramatically reduced their provision of liquidity and credit to the economy. In the deepest stage of the crisis in September 2008, the failure of Lehman Brothers was accompanied by large, sudden, and widespread increases in the cost of credit to the economy and significant adverse impacts on real aggregate variables (Bernanke 2018).

In short, the core financial system ceased to perform its intended functions for the real economy at a reasonable level of effectiveness. As a result, the impact of the housing-market shock on the rest of the economy was much larger than necessary.

In this essay, I will review the key sources of fragility in the core financial system. The first section focuses on the weakly supervised balance sheets of the largest banks and investment banks. This failure of financial supervision has been widely, if retrospectively, recognized. As one example, Rich Spillenkothen (2010), director of banking supervision and regulation at the Federal Reserve Board from 1991 to 2006, wrote that “prior to the crisis, career supervisors in the regions and at agency headquarters—primarily at the Federal Reserve, Office of the Comptroller of the

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Currency (OCC), and SEC—failed to adequately identify and prevent the build-up of extreme leverage and risk in the financial system, particularly in large financial institutions.” In a recent University of Chicago poll, US and European economists were asked to gauge the relative importance of twelve factors contributing to the financial crisis. The factor receiving the highest average importance rating in both the European and the American polls was “flawed financial sector regulation and supervision” (IGM Forum 2017).¹

The greatest danger to the functionality of the core of the financial system was posed by five systemically large dealers: Bear Stearns, Lehman Brothers, Merrill Lynch, Goldman Sachs, and Morgan Stanley. These investment banks were exceptionally highly leveraged and dependent on flight-prone sources of short-term liquidity. William Dudley (2009), the President of the Federal Reserve Bank of New York, wrote: “A key vulnerability turned out to be the misplaced assumption that securities dealers and others would be able to obtain very large amounts of short-term funding even in times of stress. ... This short-term funding came mainly from two sources, the tri-party repo system and customer balances in prime brokerage accounts. By relying on these sources of funding, dealers were much more vulnerable to runs than was generally appreciated.” (For more details, see Duffie 2011.)

My emphasis of these topics should not be interpreted as downplaying other sources of systemic risk within the financial system. In particular, other disastrous weaknesses allowed the collapses of AIG, Fannie Mae, and Freddie Mac. But these firms were less critical to the day-to-day functionality of the financial system than the largest commercial banks and the five large investment banks, especially with respect to the continued operation of backbone payments and settlements systems and the provision of liquidity to financial markets.

The middle two sections of this essay focus on the run-prone designs and weak regulation of the markets for securities financing and over-the-counter derivatives, respectively.

Before concluding, I address the undue reliance of regulators on “market discipline.” In the decade before the crisis, US regulators often argued that market discipline would support adequate levels of capital and liquidity at the major banks and investment banks, and that aggressive regulation was unnecessary or counter-productive. But clearly, market discipline did not work. I examine the interplay of too-big-to-fail and the failure of market discipline. Admati and Hellwig (2013) argue that the socially excessive and weakly supervised leverage of the largest financial institutions was essentially subsidized by the government through the presumption by creditors that these firms were too big to fail. Creditors apparently assumed that the biggest banks were too important to be allowed by the government to fail, and

¹I was one of those polled. The other factors listed, in order of assessed average importance among all economists, beginning with the second-most important, were: underestimated risks (financial engineering), mortgages (fraud and bad incentives), funding runs (short-term liabilities), rating agency failures, housing price beliefs, household debt levels, too-big-to-fail beliefs, government subsidies (mortgages, home owning), savings and investment imbalances, loose monetary policy, and fair-value accounting.

thus creditors would not take losses if any of the largest banks or investment banks were to approach insolvency.

Finally, I point to some significant positive strides that have been made since the crisis: improvements in the capitalization of the largest financial institutions, a reduction of unsafe practices and infrastructure in the markets for securities financing and derivatives, and a significantly reduced presumption that the largest financial firms will be bailed out by taxpayer money in the future. But I will also mention some remaining challenges to financial stability that could be addressed with better regulation and market infrastructure.

Regulators Failed to Safeguard Financial Stability

In hindsight, essentially all relevant authorities agree that the largest US financial intermediaries—and especially the five large investment banks Bear Stearns, Lehman Brothers, Merrill Lynch, Goldman Sachs, and Morgan Stanley—were permitted by regulators to have insufficient capital and liquidity, in the years leading up to the crisis, relative to the risks they took. Authoritative voices supporting this view after the crisis include successive chairs of the Federal Reserve Board (Bernanke 2010; Yellen 2015), the Financial Crisis Inquiry Commission (2011), supervisory experts for the Board of Governors of the Fed and the Federal Reserve Bank of New York (Spillenkothen 2010; Gibson and Braunstein 2012; Beim and McCurdy 2009), and country-report examiners at the International Monetary Fund (2010). Oversight of the capital adequacy of the largest investment banks by the Securities and Exchange Commission was particularly lax (Kotz 2010; Schapiro 2010; Inspector General of the Securities and Exchange Commission 2008; Government Accountability Office 2009; Valukas 2010; Bhatia 2011; Gadinis 2012). The insurance company AIG was not effectively supervised by the Office of Thrift Supervision (Polakoff 2009; Finn 2010). The Office of Federal Housing Enterprise Oversight placed few limits on the risks taken by the two giant housing finance intermediaries, Fannie Mae and Freddie Mac (Acharya, Richardson, Van Nieuwerburgh, and White 2011; Stanton 2009). Relative to other regulators, the Federal Reserve had significantly greater supervisory resources and focus on financial stability, yet failed to uncover solvency and liquidity threats that now, with the benefit of hindsight, seem clear.

Yet in the pre-crisis years, there was no apparent urgency to act. I am unable to offer a simple explanation for this failure. Rich Spillenkothen, director of banking supervision and regulation at the Federal Reserve Board from 1991 to 2006, suggested that regulators may have been concerned that actions against large banks would have roiled financial markets. Calomiris and Haber (2014) take a different tack, referring to broad themes of political economy, including the historical US emphasis on a decentralized banking system. In their words, “financial crises occur when banking systems are made vulnerable by construction, as the result of political choices.”

For the specific case of the weak oversight by the Securities and Exchange Commission of the capital and liquidity of the largest investment banks, I am drawn to consider whether the failure to supervise this risk lies with the SEC’s original

mission to protect the customers of financial firms, which crowded out a parallel focus on financial stability (for a related point, see Kohn 2014). As one sign of the emphasis of the SEC on investor protection over financial stability, the Inspector General of the Securities and Exchange Commission (2008, 2009) filed a voluminous 457-page report on the SEC's failure to uncover the Bernie Madoff Ponzi scheme but a mere 27-page report on the SEC's failure to supervise adequately the largest investment banks.

After the crisis, some financial regulators challenged and revised their old approaches. For example, the Fed added substantial resources and focus to its supervision of the largest financial institutions in part through the creation of the Large Institution Supervisory Coordinating Committee in 2010 (Government Accountability Office 2017; Eisenbach, Haughwout, Hirtle, Kovner, Lucca, and Plosse 2015). As another example, a report from the Office of the Comptroller of the Currency (2013) offers a post-crisis review of its supervisory work. By comparison, the reactions of the Securities and Exchange Commission to outside criticisms of its supervision of risk-taking by investment banks—for example, by the Inspector General of the SEC, General Accountability Office (2009), and the Financial Crisis Inquiry Commission (Sirri 2010), and in other public defenses of its pre-crisis supervision (Sirri 2009)—seem narrow and grudging.

An alternative hypothesis for the ineffectiveness of pre-crisis supervision is that it was simply too difficult for regulators to detect the excessive buildup of risk and flight-prone short-run debt and derivatives in the core of the pre-crisis financial system, especially given significant financial innovation and complexity (as argued in Spillenkothen 2010). Some financial intermediaries strategically circumvented leverage restrictions (Acharya and Schnabel 2009; Begley, Purnanandam, and Zheng 2017). Some regulated firms even took steps to hide their true financial conditions, as exemplified by Lehman's infamous Repo 105 practice (discussed in Valukas 2010; Vitan 2013). But while these impediments to supervision are real, regulators should not have been overwhelmed by them. For example, Eisenbach, Lucca, and Townsend (2016) point out that the "existence of economies of scale in bank supervision that are sufficiently strong to outweigh the effect of enhanced supervision for larger banks. This result also suggests that, in terms of realized hour allocations [by supervisory authorities], banks in our sample do not appear to have grown to be 'too large to be supervised.'"

As yet another plausible explanation for the failure of regulators to control the buildup of systemic risk, Gennaioli and Shleifer (2018) propose that investors and policymakers assigned irrationally low probabilities to disaster outcomes, especially with respect to the performance of the housing market. They write: "The Lehman bankruptcy and the fire sales it ignited showed investors and policymakers that the financial system was more vulnerable, fragile, and interconnected than they previously thought. Their lack of appreciation of extreme downside risks was mistaken." Gennaioli and Shleifer "put inaccurate beliefs at the center of the analysis of financial fragility." They note that the second-most important crisis factor according to a poll of leading economists conducted by the IGM Forum (2017), after "flawed financial sector regulation and supervision," is "underestimated risks." An internal

review of pre-crisis supervision conducted at the Federal Reserve Bank of New York by Beim and McCurdy (2009) reached a similar conclusion: “Banks [in their adverse stress scenarios] were not pushed too far out into the tail of the risk distribution or asked to review their plans for dealing with an industry-wide liquidity or credit risk event, or to demonstrate their ability to handle a significant loss of confidence in the industry or loss of funding industry-wide.”

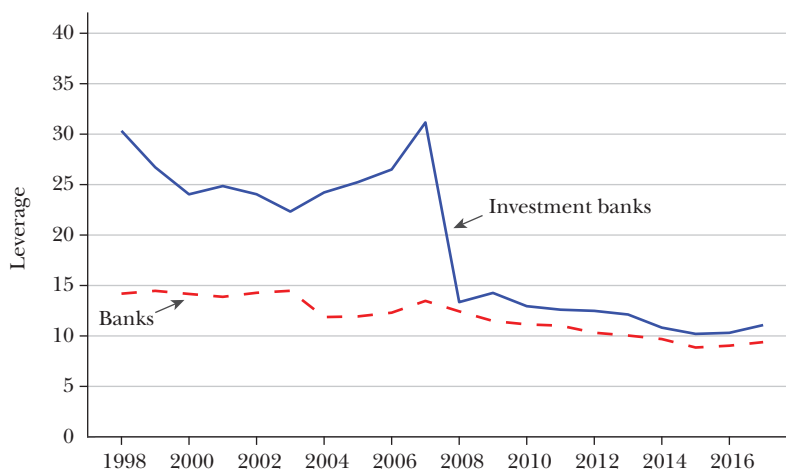
With these various explanations for pre-crisis supervisory failures as a backdrop, I will turn next to how regulation of the main investment banks worked before the financial crisis, and where it fell short. I emphasize two key themes: 1) regulators placed undue reliance on market discipline; and 2) a requirement for reasonable financial stability is that all key financial regulators clearly accept a financial stability mandate (as argued by Kohn 2014; Beim and McCurdy 2009).

In the years leading up to the financial crisis, the regulatory status of the main investment banks was in some flux. In 2002, the European Union introduced rules that required financial intermediaries operating in the EU to have a consolidated regulatory supervisor. Therefore, all five of these investment banks needed to become supervised by a regulatory agency at the holding-company level. In 2004 and 2005, they elected to be supervised for this purpose by the Securities and Exchange Commission under its new Consolidated Supervised Entity program. In 2008, as the brewing financial crisis came to a full boil, Bear Stearns and Merrill Lynch were forced into mergers with J.P. Morgan and Bank of America, respectively. Lehman Brothers failed. To support their survival, Goldman Sachs and Morgan Stanley became licensed as bank holding companies, giving them direct access to the banking system’s “safety net.” As a result, the SEC shut down its Consolidated Supervised Entity program.

Figure 1 shows the asset-weighted average leverage—that is, the ratio of total accounting assets to accounting equity—of the holding companies of the largest four bank holding companies (J.P. Morgan Chase, Bank of America, Citigroup, and Wells Fargo) and likewise of the five large investment banks (Bear Stearns, Lehman, Merrill Lynch, Goldman Sachs, and Morgan Stanley). The leverage of the investment banks is much higher than shown in the figure at times within each quarter, because they were monitored for compliance only at the end of each quarter (Financial Crisis Inquiry Commission 2011).

The figure clarifies that the SEC’s Consolidated Supervised Entity program was probably not directly responsible for a significant increase in leverage among the investment banks (Sirri 2009). Indeed, Figure 1 shows that the leverage of the investment banks was about as high a decade before the crisis as it was on the opening of the crisis. The SEC’s Associate Director of Trading and Markets, Michael Macchiaroli (2009) emphasized that “the Commission did not relax any requirements at the holding company level because previously there had been no requirements.”²

²A former director of Trading and Markets, Lee Pickard, suggested in 2008 that a 2004 change in the SEC’s minimum net capital rule, Section 15c-3, was responsible for a significant increase in leverage of the investment banks (Securities and Exchange Commission 2004). This assertion is contradicted by Sirri (2009), Lo (2012), and McLean (2012).

*Figure 1***Average Leverage (Weighting by Assets) of the Holding Companies of the Largest Investment Banks and Bank Holding Companies**

Source: Author using data from SEC 10K filings.

Note: The five investment banks included here are Goldman Sachs, Morgan Stanley, Lehman, Bear Stearns, and Merrill Lynch. The largest bank holding companies are J.P. Morgan Chase, Bank of America, Citigroup, and Wells Fargo. J.P. Morgan Chase merged during the sample period with Bank One and Chase Manhattan. For these calculations, it was treated on a consolidated basis throughout, pro forma, as though these mergers had occurred at the beginning of the sample period.

The extreme leverage of the five investment banks, the existential crises faced by all of them in 2008, and the big post-crisis drop in leverage of the two survivors (Goldman Sachs and Morgan Stanley), all support a view that the SEC had not supervised the investment banks (or their subsidiaries) adequately from the viewpoint of solvency. The Inspector General of the Securities and Exchange Commission (2008) found that the SEC’s Division of Trading and Markets “became aware of numerous potential red flags prior to Bear Stearns’ collapse [in March 2007], regarding its concentration of mortgage securities, high leverage, shortcomings of risk management in mortgage-backed securities and lack of compliance with the spirit of certain Basel II standards, but did not take actions to limit these risk factors.”

As a further illustration of the limited focus of the Securities and Exchange Commission on the solvency of the investment banks, the SEC’s net capital rule (Katz 2004) did not actually constrain the investment banks. The required net capital is 2 percent of “aggregate debt items” (ADI), which is essentially a measure of customer-related claims on the broker dealer subsidiary of the investment bank. There was also an early warning trigger; specifically, the reporting firm is required to notify the SEC whenever the firm’s net capital has breached 5 percent of ADI. Ohlrogge and Giesecke (2016) discuss supplementary forms of capital requirements, but their findings imply that during 2001–2007 the SEC’s net capital requirements represented an average of under 13 percent of the actual net capital reported by

the five investment banks and the broker-dealer subsidiary of Citigroup. Although the investment banks and their subsidiaries had supplementary forms of capital requirements, none of these were effective in controlling solvency risk, nor were they emphasized in SEC supervision.

From a financial stability perspective, a key concern is that the SEC's supervision of risk-taking by the investment banks focused mainly on the protection of the customers of the investment banks from losses rather than on the solvency of their balance sheets and the attendant systemic risks.³ For example, a member of the IMF's country examination staff for the United States wrote that the SEC's mission "stresses ex post enforcement over ex ante prudential guidance" (Bhatia 2011). As another illustration, by my count, only one of a list of 545 pre-crisis SEC regulatory enforcement actions reported in Gadinis (2012) was related to the adequacy of capital or liquidity.⁴ According to the Financial Crisis Inquiry Commission (2011):

Michael Halloran, a senior adviser to SEC Chairman Christopher Cox, told the FCIC the SEC had ample information and authority to require Bear Stearns to decrease leverage and sell mortgage-backed securities, as other financial institutions were doing. Halloran said that as early as the first quarter of 2007, he had asked Erik Sirri, in charge of the SEC's Consolidated Supervised Entities program, about Bear Stearns (and Lehman Brothers), 'Why can't we make them reduce risk?' According to Halloran, Sirri said the SEC's job was not to tell the banks how to run their companies but to protect their customers' assets.

Indeed, the Securities and Exchange Commission devoted few resources to the supervision of the five large investment banks. In September 2008, the SEC's Consolidated Supervised Entity program had a total of only 21 employees supervising these five huge firms, or about four staff members per firm (as noted by Schapiro 2010; see also Financial Crisis Inquiry Commission 2011). By comparison, a very rough estimate based on data from staff reports⁵ of the Federal Reserve Bank

³Ohlrogge and Giesecke (2016) write: "[A] key feature of net capital for broker-dealers is its focus on liquidity, rather than solvency as is the case for bank capital. Calculations of net capital for broker-dealers start with a computation of net worth as defined under generally accepted accounting principles (which thus roughly covers assets minus liabilities, but does not deduct equity). Afterwards, a broker-dealer makes certain adjustments to net worth by adding qualifying subordinated loans, deducting illiquid assets, and then finally applying specified haircuts to the remaining liquid assets in consideration of the market risk they bear. As a result, as the SEC put it, 'net capital essentially means ... net liquid assets.'"

⁴The Gadinis (2012) dataset includes all SEC enforcement actions finalized in 1998, 2005, 2006, and the first four months of 2007 against broker-dealers for any violation of the securities laws.

⁵Table 1 of Eisenbach, Haughwout, Hirtle, Kovner, Lucca, and Plosser (2015) shows that in 2014 the Fed had 22 supervisory staff for each of its "complex financial institutions," which at the time were The Bank of New York Mellon Corporation, Citigroup Inc., The Goldman Sachs Group, Inc., JP Morgan Chase & Co., Morgan Stanley, and the US operations of Barclays PLC, Credit Suisse Group AG, Deutsche Bank AG, and UBS AG, as well as the nonbank firms American International Group, Inc., General Electric Capital Corporation, and MetLife, Inc. From the data underlying Figure 1 of Eisenbach, Lucca, and Townsend (2016), I arrive at a rough estimate of 19 staff per firm in 2008 by multiplying the 2014 number, 22, by the ratio of the total number of full-time equivalent supervisory staff at the Fed in 2008 (which was 583) to the corresponding number in 2014 (which was 671).

of New York is that the Fed devoted about 19 supervisory staff, on average, to each of the systemically important financial firms that it oversaw. The Office of the Comptroller of the Currency also devotes substantial supervisory resources to the largest banks (Office of the Comptroller of the Currency 2013).

The lax supervision of capital adequacy by the Securities and Exchange Commission seemed to be clearly understood by the big investment banks. The Financial Crisis Inquiry Commission (2011) noted,

In January 2008, Fed staff had prepared an internal study to find out why none of the investment banks had chosen the Fed as its consolidated supervisor. The staff interviewed five firms that already were supervised by the Fed and four that had chosen the SEC. According to the report, the biggest reason firms opted not to be supervised by the Fed was the “comprehensiveness” of the Fed’s supervisory approach, “particularly when compared to alternatives such as Office of Thrift Supervision (OTS) or Securities & Exchange Commission (SEC) holding company supervision.

Securities Financing Markets: Core Meltdown Risks

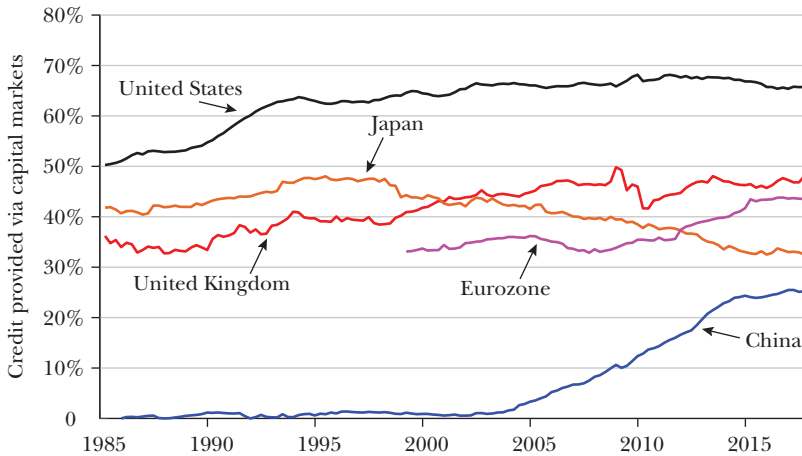
Relative to other major economies and in an absolute sense, credit provision in the United States is significantly more dependent on capital markets than on conventional bank lending. Figure 2 compares the fraction of credit provided via capital markets in several major economies over time. In turn, the intermediation of US capital markets relies heavily on the largest dealers, who make markets by buying securities from investors who want to sell, then selling them to investors who want to buy. Dealers hold securities on their balance sheets in order to provide immediacy to sellers and to have a stock on hand for buyers. Before the crisis, the largest securities dealers (subsidiaries of the investment banks and large commercial banks) financed enormous quantities of inventoried securities with very short-term debt, leaving themselves exposed to risks of creditor runs and fire-sale losses. As famously remarked by Diamond (2013), “[P]rivate financial crises are everywhere and always due to problems of short-term debt.”

The particular crisis of 2007–2009 manifested itself in new forms of short-term debt runs in which repurchase agreements, commonly known as repos, played a major role. Before the crisis, each of the major dealers—again, Goldman Sachs, Morgan Stanley, Lehman, Bear Stearns, and Merrill Lynch—obtained hundreds of billions of dollars in overnight credit in the repo market. On each repo, a dealer transfers securities as collateral to its creditor, and in turn receives cash. When an overnight repo matures the next morning, the dealer is responsible for returning the cash with interest, and is given back its securities collateral.

Money market mutual funds, securities lending firms, and other cash investors in repos often held the collateral securities provided to them by dealers in accounts at two “tri-party” agent banks, J.P. Morgan Chase and Bank of New York Mellon

Figure 2

Fraction of Credit via Capital Markets



Source: Author using data from BIS Statistics Warehouse, at [https://stats.bis.org/#df=BIS:WEBSTATS_TOTAL_CREDIT_DATAFLOW\(2.0\);dq=.CN+GB+JP+US+XM.P.A+B.M+N.XDC.A%3FstartPeriod=1985-01-01&endPeriod=2017-12-01;pv=1,3~7~0,0,0~both](https://stats.bis.org/#df=BIS:WEBSTATS_TOTAL_CREDIT_DATAFLOW(2.0);dq=.CN+GB+JP+US+XM.P.A+B.M+N.XDC.A%3FstartPeriod=1985-01-01&endPeriod=2017-12-01;pv=1,3~7~0,0,0~both).

Note: The fraction shown in the figure is 100 percent minus the percentage of total credit provided by banks to total credit.

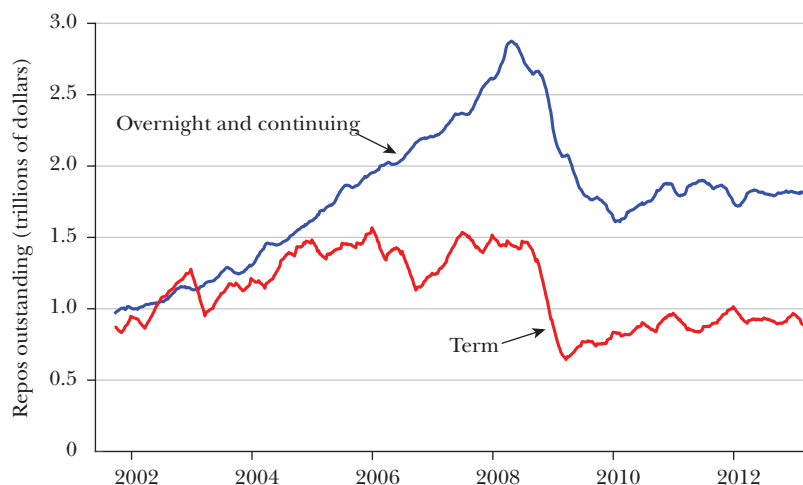
(Copeland, Martin, and Walker 2014). Likewise, these repo investors transferred their cash to the dealers' deposit accounts at the same two tri-party banks.

Each morning in the pre-crisis period, when the dealers' repos matured and they repaid the cash investors, the dealers needed intra-day financing for their securities inventories until new repos could be arranged and settled near the end of the same day. This intra-day credit was provided by the tri-party agent banks. Even "term" repos that had not matured on a given day were temporarily cashed out in the morning and financed during the day by the tri-party banks, a practice that offered operational simplicity. In this manner, up to \$2.8 trillion in intra-day financing was provided to the dealers every day by the two tri-party agent banks (Copeland, Martin, and Walker 2010).

Borrowing in the repo market can either be done on a very short-term basis, such as one day, or on a term basis. Figure 3 shows a significant increase between 2001 and 2008 in the reliance by dealers on one-day repo financing, both in absolute terms and also relative to longer-term repos. This is consistent with the central hypothesis of Gorton, Metrick, and Xie (2014), which is that as financial fragility increased over time, wholesale creditors became more and more anxious to have a quick option to cut their exposures. Of course, this also meant that securities dealers who were continually rolling over their repo agreements, day after day, were vulnerable to the risk that creditors might back away.

This practice is clearly fraught with systemic risk, which is dramatically magnified when key infrastructure providers such as these two tri-party banks are also large sources of credit to their users. This "wrong-way" systemic risk was further

Figure 3

Total Repurchase Agreements Outstanding of US primary dealers*(quarterly rolling averages)*

Source: Author using data from Federal Reserve Bank of New York at <https://www.newyorkfed.org/markets/gsds/search.html#>.

Note: “Overnight and continuing” repos are those whose original maturity is one day or which are renewed on a daily basis. Term repos are those with an original maturity of more than one day.

heightened by the practice of settling the cash side of tri-party repos with unsecured commercial bank deposits in the same two tri-party agent banks. These tri-party repo practices exposed the core of the securities funding market to extreme threats in crisis scenarios, and are contrary to well-recognized international standards for financial market infrastructure.⁶ Indeed, since the crisis, an industry task force forced the provision of intra-day credit by the tri-party clearing banks to be almost entirely eliminated (Federal Reserve Bank of New York 2010). However, the practice of settling tri-party repos in unsecured commercial bank deposits persists to this day.

It is useful to spell out how systemic risk can arise in this setting. In the event that a dealer’s solvency or liquidity comes under suspicion, money market funds and other cash investors could decide not to renew the daily financing of the dealer’s securities. This happened to Lehman (Copeland, Martin, and Walker 2014; Krishnamurthy, Nagel, and Orlov 2014).

⁶The settlement of financial market infrastructure transactions in commercial bank deposits is naturally contrary to principles set down by Committee on Payment and Settlement Systems, Technical Committee of the International Organization of Securities Commissions (CPSS-IOSCO) (2012), whose Principle 9 for financial market infrastructure (FMI) states: “An FMI should conduct its money settlements in central bank money where practical and available. If central bank money is not used, an FMI should minimize and strictly control the credit and liquidity risk arising from the use of commercial bank money.” For more details and discussion, see Duffie (2013).

Even if money-fund managers were willing to finance the dealers on a given day, the money fund's own institutional cash investors could run at the first sign of trouble. Moreover, a key SEC regulation governing the composition of money fund assets, Rule 2a7, precludes investment by money funds in the bonds and other assets that they were assigned as repo collateral. Thus, when a dealer fails, its money-fund counterparties could be forced to sell substantial amounts of collateral very quickly—even at fire-sale prices.

If a major dealer was unable to roll over its secured funding during a pre-crisis business day, a tri-party bank's balance sheet would suddenly become imbalanced by the risk of revaluation of hundreds of billions of dollars worth of securities provided by that dealer as intra-day collateral (Duffie 2013). This raised several possible channels for contagion.

First, the tri-party agent banks would have had an incentive (or could be forced by regulations) to sell the collateral securities. A rapid sale would cause a sudden drop in the prices of weaker collateral—of which there was a large amount during the pre-crisis period, including equities and a significant amount of asset-backed securities (Begalle, Martin, McAndrews, and McLaughlin 2016). The spillover of such fire sale prices into security markets and thus onto other investors could have been severe.

Second, under the stress of an intra-day failure by a client dealer, a tri-party agent bank could easily have been prevented from offering tri-party clearing services or intra-day financing to other major dealers. Both operationally and in terms of access to intra-day credit, tri-party repo services were existentially important to the major dealers. With no obvious alternative source of financing, a dealer could have been forced to join the fire sale of securities.

Third, the entire system depended on the willingness of money fund managers and their own sophisticated institutional investors to remain exposed to dealers and to the tri-party repo banks. Institutional investors in “prime” money market funds (those permitted to hold nongovernment securities) are particularly flight prone. As one example, the Reserve Primary Fund disclosed significant losses on investments in commercial paper issued by Lehman Brothers on September 16, 2008. The Fund's net asset value dropped to 97 cents per share, “breaking the buck.”⁷ Within a few days, over \$300 billion of investments in prime money market funds had been redeemed, mainly by “fast” institutional investors (Schmidt, Timmermann, and Wermers 2016; in this journal, see also Kacperczyk and Schnabl 2010). These redemptions occurred even at money funds with little or no exposure to Lehman Brothers. This run on prime money market funds grew in the ensuing

⁷Under post-crisis pressure from the newly created Financial Stability Oversight Council, the Securities and Exchange Commission changed its rules governing money market mutual funds, allowing only those funds investing exclusively in US-government-quality assets to apply “constant net asset value” (CNAV) accounting, which amounts to a fixed price of a dollar a share until rounding forces a fund's net asset value per share below one dollar, thus “breaking the buck.” SEC rules were changed to prevent prime money market funds from using CNAV accounting, and forced these funds to have the ability to apply redemption gates and fees. As a result, over \$700 billion in prime fund investments shifted to government-only money market funds.

days. Absent a halt to this massive flight of one of the main sources of short-term credit to the securities dealers, some or all of these dealers might have been unable to continue financing a substantial fraction of their securities inventories.

In the lead-up to the crisis, an alternative source for substantial amounts of short-term funding was the issuance of “commercial paper” (that is, unsecured debt typically issued for up to six or nine months), either directly or indirectly through off-balance-sheet “structured investment vehicles” (SIVs) created by banks. Baily, Litan, and Johnson (2008) describe the associated liquidity risk as follows.

Until the credit crunch hit in August 2007, this business model worked smoothly: a SIV could typically rollover its short term liabilities automatically. Liquidity risk was not perceived as a problem, as SIVs could consistently obtain cheap and reliable funding, even as they turned to shorter term borrowing ... Technically, the SIVs were separate from the banks, constituting as a ‘clean break’ from a bank’s balance sheet as defined by the Basel II Accord (an international agreement on bank supervision and capital reserve levels), and hence did not add to the banks’ capital or reserve requirements. Once the SIVs ran into financial trouble, however, the banks took them back onto their balance sheets for reputational reasons, to avoid alienating investors and perhaps to avoid law suits.

The asset-backed commercial paper market was particularly prone to runs (Gorton and Metrick 2010, 2012; Gorton, Metrick, and Xie 2014; Schroth, Suarez, and Taylor 2014). A combination of a run on prime money market funds, on other (non-tri-party) sources of repo financing, and on the asset-backed commercial paper market could have caused a complete meltdown of the securities financing market.

Indeed, when such a run began in September 2008, only aggressive action by the Fed and the US Treasury averted an enormous collapse of core financial markets and even deeper panic. The mechanics of this intervention were not straightforward. Securities dealers, including the huge dealer subsidiaries of bank holding companies such as Citibank, Bank of America, and J.P. Morgan, have no direct access to the Fed financing. The Fed’s discount window can provide financing only to regulated banks, and only for “Fed-eligible” collateral, which does not include a significant portion of the assets that were financed in the repo market before the crisis. Moreover, regulatory barriers (Sections 23A and 23B of the Federal Reserve Act) effectively prevent the securities dealer subsidiary of a bank holding company from taking indirect advantage of Fed liquidity that is obtained through the bank subsidiary of the same holding company.

The Fed, lacking other options, invoked its emergency lending authority to provide liberal lender-of-last-resort funding to dealers through a host of new emergency lending facilities: the Term Auction Facility in December 2007; the Primary Dealer Credit Facility in March 2008; the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility on September 18, 2008; the Commercial Paper Funding Facility on October 7, 2008; the Temporary Liquidity Guarantee Program on October 14, 2008; and the Money Market Investor Funding Facility

on October 21, 2008. Kacperczyk and Schnabl (2010, 2013) offer more details on these programs. The US government and Federal Reserve offered additional crisis support through a vast array of other programs, even to the point of offering a full government guarantee to all money market mutual funds. Without this aggressive fiscal and central-bank support, the impact of the financial crisis on the real economy would have been far deeper than it actually was.

Since the financial crisis, risks associated with the financing of securities by dealers has been reduced in several important ways. I have already mentioned the elimination of intra-day credit provision by tri-party agent banks. The securities inventories themselves are also much smaller, so the need for financing has been correspondingly reduced, as reflected in Figure 3. Because of the declining presumption by bank creditors of “too big to fail,” which I detail later, dealer financing costs have gone up substantially, so the incentive to hold giant inventories is much reduced. The dependence of dealers on flight-prone financing from money market mutual funds has been lowered by a tightening of the regulation of those money funds. Further, bank capital requirements now apply to all large dealers at the holding company level. The two surviving investment banks, which had not been regulated as “banks,” took banking charters and thus became regulated as banks. These capital rules are much more stringent than they were before the crisis, and substantial new bank liquidity coverage regulations have also been introduced, forcing runnable short-term financing to be covered by a stock of high-quality liquid and unencumbered assets.

The Opaque and Unstable Pre-Crisis Swap Market

The enormous pre-crisis over-the-counter derivatives market contributed significantly to the fragility of the financial system. Across the entire over-the-counter derivatives market, there were essentially no regulations governing minimum margin, central clearing, and trade reporting. In practice, the actual amount of margin provided was low (Financial Stability Board 2017). Counterparty exposures and the degree to which they were protected by collateral were generally not observable by anyone other than the two counterparties to each individual position—not even by regulators. Deputy Governor of the Bank of England for Financial Stability Jon Cunliffe (2018) remarked: “The financial crisis exposed complex and opaque webs of bilateral derivatives contracts both between financial firms and with real economy end users. These were often poorly collateralised or not collateralised at all.”

This combination of factors contributed to the risk of a run on major derivatives dealers, which were subsidiaries of the same cast of investment banks and giant commercial banks. In the pre-crisis over-the-counter derivatives market, runs could occur in two main forms. One form was “novation,” a transfer of existing derivatives positions from one counterparty to another. Counterparties of a risky dealer could in some cases use novations to flee to safer dealers. But the most problematic form of run is through the option to terminate over-the-counter derivatives contracts whenever a counterparty experiences an insolvency, a failure to pay, or a change of

control. These run options, legally bypassing bankruptcy rules that force most other types of contracts to stay in place during a reorganization or liquidation, played important roles in the failures of Bear Stearns and Lehman Brothers (Duffie 2011). Derivatives runs drain liquidity and eliminate hedges that are needed by a dealer to manage market-risk exposures. The threat of these runs, as a dealer's position weakens, can cause ordinary creditors to run, a destabilizing feedback that adds to uncertainty over the viability of a dealer, especially given the opaqueness of the dealers' derivatives. In addition to runs, as asset prices related to subprime mortgages fell sharply and concern about counterparty creditworthiness grew, margin calls on derivatives acted as a stress amplifier.

When the largest securities dealers began to fail, their potential exposure to over-the-counter derivatives was huge and opaque, which added to the atmosphere of extreme concern. For example, Cunliffe (2018) notes: "Following its collapse, Lehman's uncleared derivatives counterparties filed claims totalling \$51 billion in relation to its derivatives business. In the event, it was four years before the first payments were made to these uncleared derivatives creditors, and claims against Lehman's are still ongoing." At its failure, Lehman's book of swap positions was actually small in comparison with those of the largest other dealers.

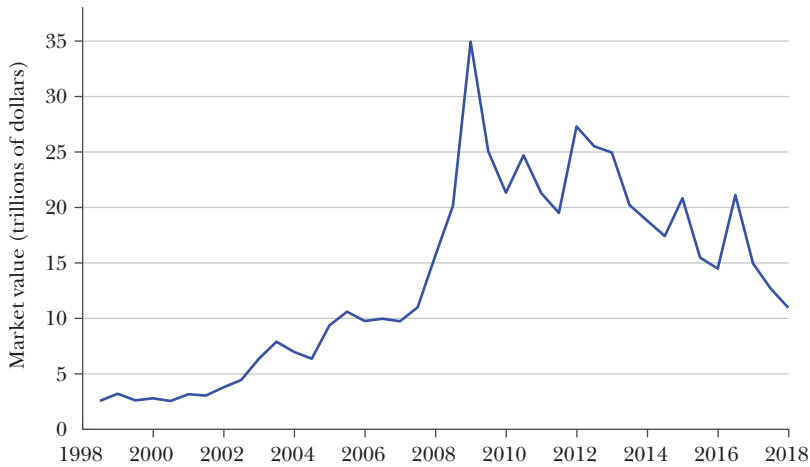
Another form of systemic risk in the derivatives market was caused by AIG's sudden and heavy cash margin calls on credit-default-swap protection that AIG had provided to a number of major dealers on their holdings of subprime mortgages. The dependence of these dealers on AIG's performance on these credit default swaps was an important factor in the decision by the Fed and then the Treasury to rescue AIG (as discussed in this journal by McDonald and Paulsen 2015).

Figure 4 shows a huge pre-crisis buildup in the aggregate gross market value of outstanding over-the-counter derivatives, peaking in 2008 at roughly \$35 trillion dollars. There was ample opportunity before the crisis for regulators to control the buildup of systemic risk in the over-the-counter derivatives market. But when the Commodity Futures Trading Commission (1998) made a move to regulate this market, other regulators pushed back. Treasury Secretary Robert Rubin, Fed Chair Alan Greenspan, and SEC Chairman Arthur Levitt (1998) immediately urged Congress to block the proposed regulation (see also President's Working Group 1999).⁸

Those blocking the regulatory impulses of the Commodity Futures Trading Commission were concerned that new regulations would reduce the legal certainty of over-the-counter derivatives contracts, or would merely encourage a migration of derivatives trading to London. Their concerns led to the passage of deregulatory legislation, the Commodity Futures Modernization Act of 2000, a key step in the striking failure to regulate the enormous build-up of risk in the over-the-counter derivatives market at any time before the crisis (Greenberger 2010). From that point, the size of the over-the-counter derivatives market grew exponentially, and

⁸Rubin, Greenspan, and Levitt (1998) discuss alternative legislation called "Broker-Dealer Lite" under which the Securities and Exchange Commission, and not the Commodity Futures Trading Commission, would regulate the over-the-counter derivatives market.

Figure 4

Global Aggregate Gross Market Values of Over-the-Counter Derivatives

Source: Author using data from Bank for International Settlements (BIS).

Note: For the BIS definition of “gross market value,” see <https://www.bis.org/statistics/glossary.htm?section=312&scope=Statistics&c=a&base=term>.

with almost no oversight by regulators. One of the “major regulatory and supervisory policy mistakes” identified by Spillenkothen (2010) was the “unwillingness to directly regulate the over-the-counter derivatives market, relying instead on counterparty and market discipline and on supervisors’ assessments of regulated entities’ risk management practices.” McCaffrey (2016) writes:

Many observers view the deregulation of OTC [over-the-counter] derivatives in 2000, through the Commodity Futures Modernization Act, as a serious mistake contributing to the financial crisis. However, no widespread support for external regulation of OTC derivatives existed until after the financial crisis began in 2007. Rather, most analysts accepted on substantive and/or political grounds that the system of private regulation of the OTC derivatives, with informal government oversight, would continue ...

As reflected in Figure 4, post-crisis regulations caused a major decline in the gross outstanding market value of over-the-counter derivatives since the crisis.

A key change is the increased use of central clearing, which was directly mandated in post-crisis regulation and further encouraged by new regulatory capital requirements that, in effect, expressed a preference for central clearing. A central counterparty (CCP), also known as a clearinghouse, enters a derivatives trade as the buyer to the original seller, and as the seller to the original buyer. In this way, original counterparties become insulated from each other’s default risk—provided of course that the clearinghouse meets its own obligations. Central clearing also

improves the transparency of derivatives positions and enforces uniform collateral practices that are more easily supervised by regulators.

An alternative method for lowering counterparty default risk is “compression trading.” By this approach, dealers can eliminate redundant sequences of derivatives positions within the network of dealers that are identified by financial technology companies such as TriOptima. In Duffie (2018), I explain how compression trading has eliminated well over \$1 quadrillion (in notional value) of redundant over-the-counter derivatives. Compression accounts for a substantial portion of the post-crisis reduction in the gross market value of outstanding derivatives shown in Figure 4.

We now know, contrary to concerns expressed in the late 1990s about the potential danger of regulating these markets, that it is possible to add substantial prudential regulation to the over-the-counter derivatives market without stamping out market activity—because this has actually been done in the post-crisis period! Roughly three-quarters of standard swaps are now centrally cleared, all inter-dealer swaps have minimum margin requirements, and all swap transactions must be reported publicly, with details provided to regulatory data repositories that allow the supervision of exposures to individual market participants. Under the Basel-III regulatory capital accord, the largest dealers are now subject to markedly higher capital requirements on their over-the-counter derivatives exposures. Despite these stringent new regulations, potentially useful derivatives trading has not been stifled. In fact, turnover in the over-the-counter derivatives market has continued to rise. For example, the daily turnover for interest-rate derivatives, by far the largest segment of the over-the-counter market, has risen steadily from \$1.7 trillion in 2007 to \$2.7 trillion in 2016 (Bank for International Settlements 2016).

There do remain, however, important concerns over the ability to resolve the failure of central counterparties, which have become enormous concentrations of risk under post-crisis regulations. If a clearinghouse has insufficient resources to manage the default of the derivatives obligations of a clearing member, the consequences could be catastrophic, now that hundreds of trillions of derivatives have been cleared by a small number of systemically important central counterparties. The default management resources of the central counterparty consist primarily of the margins provided by clearing members against their positions, and by a default fund to which all clearing members contribute. If the initial margin of a failed clearing member is not enough to cover the losses, the default fund is then applied. If the clearinghouse burns through both of these paid-in default management resources, and a small layer of its own capital, it then has the contractual right to stop paying clearing members the amounts otherwise due on their derivatives, even to the point of “tearing up” their derivatives positions. In the worst scenarios, the cessation of payments to clearing members and tear-ups would be catastrophic, and contagious. The largest clearing members are generally also large members of other central counterparties. This tail contagion risk is subject to regulatory stress tests and ultimately to regulations that could trigger a failure resolution process for central counterparties. However, actual implementable plans for the failure resolution of clearinghouses have still not been designed, at least in the United States (Duffie 2013, 2015, 2018). Cunliffe (2018) provides an update of regulatory progress in this area.

Too-Big-to-Fail Eviscerates Market Discipline

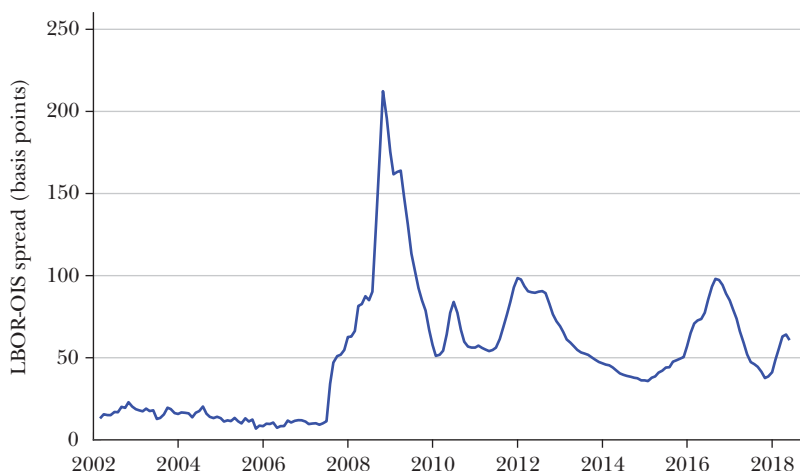
In the decade or so before the financial crisis arrived in 2007, it was common to see claims that market discipline could lead to less government regulation. In 1997, Fed Chair Alan Greenspan stated: “As we move into a new century, the market-stabilizing private regulatory forces should gradually displace many cumbersome, increasingly ineffective government structures. This is a likely outcome since governments, by their nature, cannot adjust sufficiently quickly to a changing environment, which too often veers in unforeseen directions.” In 2000, Fed Governor Laurence Meyer stated: “As large banking institutions become increasingly complex—and fund themselves more from non-insured sources—market discipline and its prerequisite, public disclosure, must play a greater role. Indeed, increased transparency and market discipline can also help substantially to address concerns about increased systemic risk associated with ever-larger institutions and to avoid the potentially greater moral hazard associated with more-intrusive supervision and regulation.” The sentiment was international. For example, the Basel Committee on Banking Supervision (1999) wrote that market discipline “imposes strong incentives on banks to conduct their business in a safe, sound and efficient manner.”

Evidence from the crisis of 2007–2009, however, soundly rejects the power of market discipline to maintain financial stability. As Fed Chair Janet Yellen (2015) acknowledged: “The checks and balances that were widely expected to prevent excessive risk-taking by large financial firms—regulatory oversight and market discipline—did not do so.”

In a post-crisis Congressional hearing, Henry Waxman (D-CA) asked Greenspan, “Well, where did you make a mistake then?” Greenspan replied, “I made a mistake in presuming that the self-interest of organizations, specifically banks and others, were such that they were best capable of protecting their own shareholders and their equity in the firms” (House of Representatives, Committee on Oversight and Government Reform 2008, p. 33). In his prepared remarks, Greenspan (p. 17) similarly commented: “Those of us who have looked to the self-interest of lending institutions to protect shareholders’ equity, myself included, are in a state of shocked disbelief. Such counterparty surveillance is a central pillar of our financial markets state of balance.”

An internal Federal Reserve Bank of New York review of pre-crisis supervisory weaknesses conducted by Beim and McCurdy (2009) offers similar and more pointed criticisms. They describe two “basic assumptions [that] are wrong: 1. ‘Banks can be relied upon to provide rigorous risk control.’ In reality banks’ internal risk management and control functions were often ineffective in the run-up to the crisis and were usually trumped by the pressure to do profitable business. 2. ‘Markets will always self-correct.’ A deference to the self-correcting property of markets inhibited supervisors from imposing prescriptive views on banks.” They wrote: “Interviewees noted the common expectation that market forces would efficiently price risks and prompt banks to control exposures in a more effective way than regulators.”

Figure 5

Average One-Year Credit Spread of Large Banks Borrowing US Dollars: LIBOR versus the OIS Swap Rate

Source: Author using data from Bloomberg.

Note: The figure shows the difference between the one-year US Dollar London Interbank Offered Rate (LIBOR) and the one-year overnight index swap (OIS) rate based on the Fed Funds rate.

Reliance on market discipline implies an assumption that excessive risk-taking by a financial intermediary will be limited by the intermediary's cost of debt financing, based in turn on creditors' perceived risk of losses at insolvency. However, before the financial crisis, there was nothing close to a realistic plan for how to resolve the insolvency of systemically important financial firms without triggering or deepening a crisis. This created a presumption among creditors that the largest banks were "too big to fail."

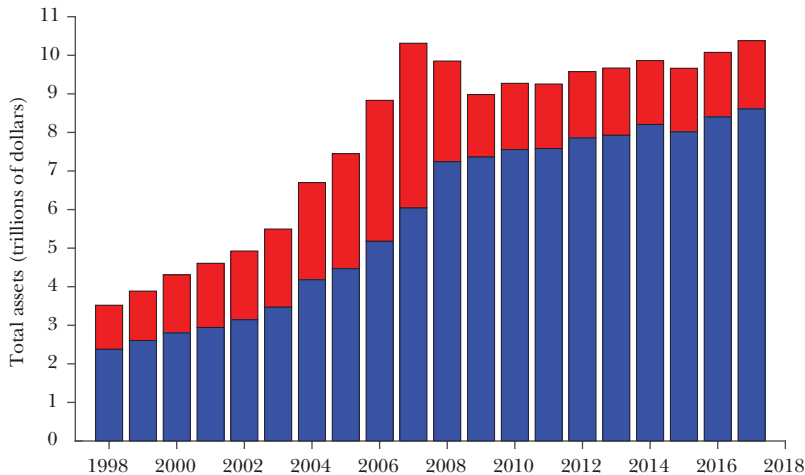
Thus, despite their thin pre-crisis solvency buffers, the big banks and investment banks experienced what is in retrospect an amazingly low cost of credit. As one example, Figure 5 shows the one-year credit spreads of large banks. Here, "LIBOR" (the London Interbank Offered Rate) is the rate at which the largest banks can borrow from each other, while the OIS (overnight indexed swaps) rate is a proxy for the rate of interest of borrowers that are nearly risk-free. The razor-thin LIBOR-OIS credit spread that large banks paid from 2002–2007 shows that their creditors had very little concern about lending to them, right up until the financial crisis hit.

With this low cost of borrowing, the pre-crisis cost to big-bank shareholders of expanding their balance sheets with debt financing was much lower than the associated social costs stemming from systemic failure risk. Their trading desks jumped at almost any opportunity to borrow that allowed them to grab a few basis points of profit, because their funding costs were so low.⁹ Indeed, Figure 6 shows a tripling of

⁹As an example, in Andersen, Duffie, and Song (forthcoming), we model how pre-crisis banks could exploit their exceptionally low credit spreads to capture shareholder profits from even small violations

Figure 6

Total Assets, by Year, of the Five Largest Investment Banks (Red) and the Four Largest Banks (Blue)



Source: Author using data from SEC 10K filings.

Note: The five largest investment banks (the red section of the bars, at the top) are Goldman Sachs, Morgan Stanley, Lehman, Bear Stearns, Merrill Lynch. The four largest banks (the blue section of the bars, at the bottom) are J.P. Morgan Chase, Bank of America, Citigroup, and Wells Fargo. J.P. Morgan Chase merged during the sample period with Bank One and Chase Manhattan. For these calculations, it was treated on a consolidated basis throughout, pro forma, as though these mergers had occurred at the beginning of the sample period.

the total assets of the five largest investment banks and the four largest banks during the decade leading up to the crisis. The incentive to borrow caused by being too big to fail and the lack of methods for safely resolving an insolvency of any of these firms, combined with the forbearance of regulators, created an increasingly toxic brew of systemic risk.

Was the dramatic expansion of borrowing in the financial sector because of moral hazard—that is, an assumption by firms that they would be bailed out? Genaioli and Shleifer (2018) argue against conventional moral-hazard explanations of the excessive pre-crisis leverage of the big banks, and I agree. Instead, the moral hazard explanation applies to creditors, who were apparently convinced that these firms would not be allowed to fail. In expanding their balance sheets with debt, financial firms did not even need to think about the moral hazard of government bailouts—they merely needed to observe the exceptionally low costs of debt financing offered to them by creditors. When Lehman ultimately did fail, the surprise of creditors exacerbated the ensuing panic (Bernanke 2018; Gennaioli and Shleifer 2018).

of covered interest parity (CIP). In the post-crisis era, however, much larger CIP violations remain unexploited because of substantially higher big-bank debt funding spreads.

A primary factor in the judgment of creditors that the largest financial intermediaries were too big to fail was that there was no method for resolving an insolvency that didn't also crater the economy. In a standard bankruptcy procedure, contracts and claims are frozen in place during a liquidation or reorganization. However, the huge books of over-the-counter derivatives and repos of the largest banks and investment banks are legally exempt from the bankruptcy code as "qualified financial contracts" (QFCs). Because of this bankruptcy exemption for QFCs, counterparties to failing financial firms in these contracts are not required by an "automatic stay" to freeze their positions in place. Instead, counterparties can quickly terminate their contracts and keep their collateral (for details, see Duffie and Skeel 2012).

In order for market discipline to limit failure risk, creditors need to believe that they could be forced to experience a significant loss at insolvency. In the future, regulators are planning to use post-crisis legislation—Title II of the US Dodd-Frank Act and the European Union's Bank Recovery and Resolution Directive—to force wholesale "loss-absorbing" creditors to give up their debt claims when a large bank nears insolvency. In effect, these creditor claims are to be cancelled and replaced with equity claims. The threat of invoking this resolution scheme, called "bail-in," is made more credible through new legislation that includes a temporary stay on the termination of over-the-counter derivatives and repos.

Other efforts are being made to improve failure resolution methods (for an update, see US Department of the Treasury 2018). As one example, Jackson (2015) has proposed amending the US bankruptcy code with a new Chapter 14, which is designed to address the failure of systemically important financial institutions. Like Title II of the Dodd Frank Act, Chapter 14 would impose a temporary stay on over-the-counter derivatives and repos.

Whether or not bail-in actually works reasonably well in practice, what matters for big-bank borrowing costs is that *creditors believe that it would be tried*. It appears that they do now believe this. As shown earlier in Figure 5, the cost of wholesale unsecured credit for the largest banks as measured by the LIBOR-OIS credit spreads has increased dramatically and now fluctuates more notably with credit-related events.

Sarin and Summers (2016) argue that higher post-crisis big-bank credit spreads reflect a continuing failure of these firms to improve their solvency. In their view, these high post-crisis credit spreads reflect the reduced franchise values of their business operating models, rather than a reduced reliance by creditors on too-big-to-fail. However, Rosengren (2013), Carney (2014), and Tucker (2014) estimate a full order of magnitude increase in the capital buffers of the largest banks. Similarly, in Berndt, Duffie, and Zhu (2018), my coauthors and I estimate a major improvement in the "solvency ratios" of most large financial firms, defined as the ratio of tangible common equity to an estimate of the standard deviation of the annual change in the market value of the firm's assets. We find that the solvency ratios of the largest financial firms averaged only about 0.3 from 2002–2008, but have risen to around 0.8–1.0 since 2013. We argue that the general post-crisis increase in credit spreads of large financial firms does not reflect a continuing low level of solvency, but instead is a reaction by creditors to the increased probability

that the government would force wholesale creditors of a large bank approaching insolvency to take a significant loss.

A belief by creditors that the largest banks are no longer too big to fail leads to a better alignment of the risk-taking incentives of these banks with social incentives to control systemic risk. The greater is the credit spread of a financial intermediary, the greater is the impact of debt overhang in reducing the incentives of its shareholders to expand the intermediary's balance sheet using debt financing. Indeed, since the crisis, significant increases in unsecured dealer credit spreads have forced the trading desks of the largest dealers to charge their trading clients for newly designated "funding value adjustments." In Andersen, Duffie, and Song (forthcoming), we explain these funding value adjustments as debt-overhang costs to bank shareholders for enlarging their balance sheets. Thus, because of new failure resolution rules, market discipline has to some extent finally begun to work.

Although the incentives of big-bank shareholders to expand their balance sheets are now more aligned with social incentives, day-to-day market liquidity has in some cases suffered, a different form of social cost.

Final Remarks

Leading up the crisis, the core of the financial system was not prepared to withstand a significant shock. An undue reliance on market discipline had left the largest financial firms undercapitalized, and this was exacerbated by a failure of the Securities and Exchange Commission to prioritize financial stability. Core financial firms were actually encouraged, through artificially low costs of debt financing, to use leverage to grow enormous balance sheets. Creditors competed to supply these firms with funding at razor-thin credit spreads because they did not believe that these firms would be allowed by the government to fail. Their belief in "too big to fail" was based on the presumption of large spillover costs of failure on the broader economy. With hindsight, this presumption was correct. When Lehman actually did fail, it was impossible to avoid enormous bankruptcy costs and contagion because safe insolvency resolution methods for large banks had not been developed.

Since the crisis, major strides toward financial stability have been achieved. The largest US dealer banks are all now under the supervision of the Federal Reserve. Their capitalization and liquidity has been forced up with stringent new banking regulations. Some weaknesses in market infrastructure and unsafe practices in the markets for securities financing and derivatives have been corrected. New failure resolution methods now prevent derivatives and other critical financial contracts from suddenly terminating at insolvency. As a result, general creditors to these firms no longer presume that they will be bailed out. This has led to much higher costs of debt financing for these firms, which has discouraged their leverage and has knocked down the rapid pre-crisis growth of their balance sheets.

Challenges to the resilience of the core financial system remain. We do not yet know how well failure resolution methods for the largest banks will actually work in practice. There is still no known operational planning for US government failure

resolution of derivatives clearinghouses. Meanwhile, regulations have forced the majority of derivatives risk into these clearinghouses, which are the new “too big to fail” financial firms. And there will always be a threat that, with the passage of time, fading memories of the costs of the last crisis will lower the resolve and vigilance of legislatures and financial regulators to monitor changes in practice and to take steps to control socially excessive risk-taking.

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