

CHAPTER 11

The Repurchase Agreement (Repo) Market

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11.1 OVERVIEW

The U.S. shadow banking system played a significant role in the financial crisis that started in August 2007. The shadow banking system is a system of “financial institutions that mostly look like a bank, borrow short term in rollover debt markets, leverage themselves significantly, and lend and invest in longer-term and illiquid assets” (see Acharya, Gale, and Yorulmazer 2009). Unlike banks, however, the shadow banking system is much less regulated.

Shadow banking is a recently minted term. However, the emergence of a shadow banking system in the United States may be traced as far back as the early 1970s.¹ Its most important component is securitized debt, or simply debt secured by underlying assets (many of which are debt securities themselves), such as U.S. Treasuries, agencies, corporate bonds, commercial paper, mortgage-backed securities (MBSs), equities, and so on. By the fourth quarter of 2009, the amount of outstanding securitized debt in the United States totaled \$11.6 trillion, about one-third of the entire U.S. debt market.²

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Much of this securitized debt is in the form of what are called repurchase agreements. A *repurchase agreement* (also known as a *sale and repurchase agreement*, or more popularly as a *repo*) is a short-term transaction between two parties in which one party borrows cash from the other by pledging a financial security as collateral. A series of regulatory changes in the 1980s made the repo market an attractive source of short-term—typically overnight—financing for primary dealers to finance their positions in the debt of the U.S. government, federal agencies, corporations, and federal agency mortgage-backed securities. Later, it also became a funding source for others to lend and invest in relatively illiquid mortgage-backed securities.

The lack of official statistics precludes an accurate estimation of the size of the repo market. However, Gorton and Metrick (2009a) and also Gorton (2009) estimate that the repo market totaled about \$12 trillion as of 2009 (although this estimate likely includes some double counting). Based on the average daily amount outstanding, the Federal Reserve Bank of New York put the primary dealer repo financing of U.S. government, federal agency, corporate, and federal agency mortgage-backed securities at \$6.5 trillion in 2008. This amount fell to \$4.4 trillion in 2009. This substantial collapse has rendered the shadow banking system of the United States crippled. And notably, the collapse was also central to the financial crisis of 2007 to 2009, featuring, among others, a significant repo run on Bear Stearns in the first two weeks of March 2008. In the repo run on Bear Stearns, the money market funds that financed Bear Stearns's holdings of AAA-rated mortgage-backed securities in the overnight repo market refused to roll over the financing, forcing Bear Stearns to draw down on its liquidity pool, and ultimately ending in its Federal Reserve–assisted sale to JPMorgan Chase.

Despite its central role in the shadow banking system—and in the recent financial crisis—there was almost no mention of the repo market in the recently passed U.S. House of Representatives bill (HR 4173). Neither does there appear to be any significant mention of this market in the Senate bill or the final Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010. In this chapter, we explain why the silence about dealing with the possibility of future runs in the repo market is a significant mistake. In particular, we explain that, unlike the liquidity risk that unsecured financing may become unavailable to a firm, the liquidity risk that secured repo financing may become unavailable to a firm is inherently a systemic risk: The repo markets are likely to become illiquid precisely when a large part of the financial sector is experiencing stress. Unless this systemic liquidity risk of the repo market is resolved, the risk of a run on the repo market will remain.

In this chapter, we provide a primer on the U.S. repo market (Section 11.2), describe how it came to play such a significant role in securitized banking (Section 11.3), discuss its critical role in the form of repo runs in the crisis (Section 11.4), argue a case for reforming the repo market infrastructure based on an understanding of the fundamental source of repo runs (Section 11.5), outline our proposal for such reform (Section 11.6), and articulate implications for the future (Section 11.7).

11.2 A PRIMER ON THE U.S. REPO MARKET

Consider the following transaction between a primary securities dealer and one of its clients, say a municipality. The primary securities dealer in need of money calls the municipality and, in exchange for an MBS worth, say, \$100, borrows \$100 for a week. The understanding is that a week later, the primary securities dealer will return with \$105 to get the MBS back. The extra \$5 is the interest on the \$100 principal, whereas the MBS is the collateral securing the loan. From the municipality's perspective, the municipality lends \$100 to the primary securities dealer at \$5 interest by borrowing the MBS for a week. If the primary securities dealer fails to come back with \$105 at the end of the week, the MBS becomes the property of the municipality. If the municipality sells the borrowed MBS before the end of the week, then the municipality will need to buy the MBS back to return it to the primary securities dealer. If it is acceptable to the dealer, the municipality may instead buy a substitute (and most likely a cheaper) MBS.³ If the municipality fails to return the MBS or an acceptable substitute to the primary securities dealer, then the dealer keeps the \$100 without paying any interest.

In this transaction, the primary securities dealer enters into a sale and repurchase agreement or, in short, a repo. The municipality enters into a *purchase and resale agreement*, or a *reverse repo*. Thus, every repo is also a reverse repo and vice versa; the perspective depends on who is the seller and who is the purchaser. The day the repo is initiated is called the sale date, and the day the repo is terminated is called the purchase date. Since repos are essentially secured loans and the interest on the loan is also usually very small compared with the principal, the counterparty risk on the loan is usually not an issue. The counterparty risk can, however, be an issue on the collateral, because the value of the collateral may deviate from the principal of the loan. When there is such counterparty risk on the collateral, one of the parties is usually subject to a haircut.⁴ That is, if the MBS is worth \$100, the loan might be worth only \$90, giving rise to a 10 percent haircut to the primary securities dealer. This \$10 haircut is the margin required by the

municipality as protection against the potential value loss of the MBS in case the primary securities dealer fails to come back and the municipality has to take ownership of the MBS, sell it, and recover the loss. If the primary securities dealer does not own the MBS, then the dealer needs to find \$10 elsewhere or earn the \$10 by the sale date in order to buy the MBS. The \$10 is the dealer's equity and \$90 is the debt on the total loan of \$100. The asset of the primary securities dealer is the MBS, and therefore, the dealer's leverage is 10 times, where leverage is defined as the value of the asset divided by the value of the equity.

If, however, the MBS is worth \$90 and the loan is worth \$100, then there is a 10 percent haircut to the municipality. This \$10 haircut is the margin required by the primary securities dealer as protection against the potential value gain of the MBS in case the municipality fails to deliver the MBS on the purchase date so that the dealer has to buy a substitute MBS to replace the old one. Therefore, there can be a haircut either to the debtor (primary securities dealer) or to the creditor (municipality), although most of the time it is the debtor who is subject to the haircut, if any. If the municipality has only \$10, then the municipality needs to sell the MBS for \$90 to someone else in order to lend \$100 to the primary securities dealer; in this case, \$10 is the equity, the MBS is the debt, and the \$100 loan is the municipality's asset, making the leverage of the municipality 10 times. If the primary securities dealer does not have the MBS, the municipality does not have the money, and there is no haircut, then both the primary securities dealer and the municipality are infinitely leveraged.⁵

In the U.S. repo market, loans are mostly extended overnight; that is, they are one-day transactions. *Overnight repos* constitute about half of all repo transactions, and most of them are open; they roll over automatically until either party chooses to exit. Other repo transactions, called *term repos*, have terms longer than one day but shorter than one year, although the vast majority have maturities of three months or less. Participants in the repo market include commercial banks, investment banks, hedge funds, mutual funds, pension funds, money market funds, municipalities, corporations, and other owners of large amounts of idle cash, as well as the Federal Reserve and primary securities dealers.

The Fed participates in the repo market mainly to implement its monetary policy; primary securities dealers participate mostly to finance their market making and risk management activities. Owners of large amounts of idle cash engage in the repo market mainly for two reasons: (1) to get better interest rates in the repo market compared with deposits at commercial banks, and (2) for insurance purposes; while large deposits at commercial banks are not insured,⁶ deposits at so-called repo banks are secured by debt used as collateral.

11.3 EVOLUTION OF THE U.S. REPO MARKET

Although loans secured by some type of collateral have been traced back at least 3,000 years to ancient China, repos as we know them were introduced to the U.S. financial market by the Federal Reserve in 1917.⁷ Repos allowed the Fed to extend credit to its member banks, after a wartime tax on interest payments on commercial paper had made it difficult for banks to raise funds in the commercial paper market. Later in the 1920s, the New York Fed used repos secured with bankers' acceptances to extend credit to dealers to encourage the development of a liquid secondary market for acceptances. Repos fell from grace during the Great Depression after massive bank failures and low interest rates, only to make a comeback after the Treasury–Federal Reserve Accord of 1951 “that renewed emphasis on controlling inflation rather than keeping interest rates low” (Garbade 2006).

Early repos in the United States had two distinguishing features. First, accrued interest was excluded from the price of the repo securities. Second, even though the creditor could sell or deliver the repo securities to settle a prior sale at prices that included the accrued interest during the term of the repo, ownership of the repo securities rested with the debtor. These features had the following implications: (1) the repo securities were underpriced; (2) the creditor had to remit to the debtor any coupon payments on the repo securities during the term of the repo; and (3) in the event of a bankruptcy of the debtor, the repo securities were subject to automatic stay; that is, the creditor could not take ownership of the repo securities and sell them immediately.⁸ These features remained intact until the early 1980s.

During the period of high inflation in the 1970s and early 1980s, rising short-term interest rates made repos a highly attractive short-term investment to holders of large amounts of idle cash. Increasing numbers of corporations, local and state governments, and, at the encouragement of securities dealers, even school districts and other small creditors started depositing their idle cash in repo banks to earn interest rather than depositing money in commercial banks that did not pay interest on demand deposits. Furthermore, the U.S. Treasury started borrowing heavily after 1974, eventually changing the status of the United States from a creditor to a debtor nation and increasing the volume of marketable Treasury debt significantly. This led to a parallel growth in government securities dealers' positions and financing, and the repo market grew by leaps and bounds. Figure 11.1 depicts the size of the market from January 1970 to January 1986, as reported by the Federal Reserve Board.

The first important change to repo contracts was brought about after the spectacular collapse of Drysdale Government Securities Inc. in 1982. Despite

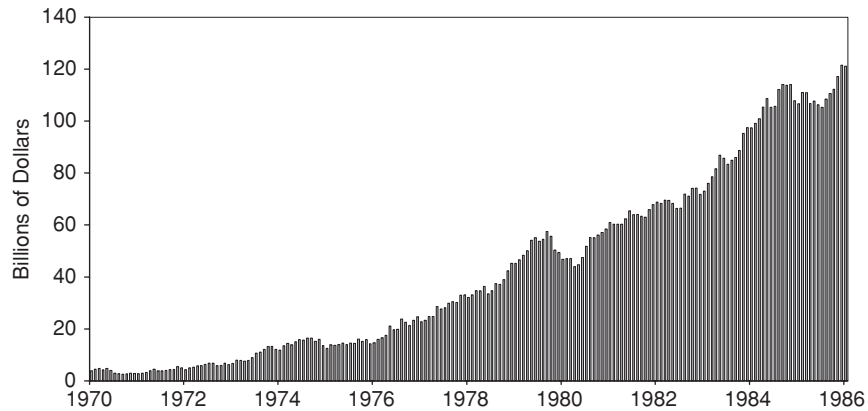


FIGURE 11.1 Monthly Averages of Daily Outstanding Overnight and Term Repos, 1970 to 1986
Source: Federal Reserve Board.

its limited equity, Drysdale had been acquiring substantial amounts of debt securities through reverse repos and at prices that excluded the accrued interest. Drysdale then sold short these debt securities to third parties at prices that included the accrued interest. Drysdale used the surplus thus generated to raise more capital and to make interest payments to its reverse repo counterparties. However, when interest rates moved against Drysdale in May 1982, the cumulative losses on its interest rate bets depleted its capital. On May 17, 1982, Drysdale failed to pay the interest on the securities it had borrowed. When that news hit the repo market, it came to a near halt, forcing the Fed to intervene as a lender of last resort to calm fears and prevent a collapse. This near collapse exposed the systemic risk associated with the exclusion of accrued interest, and therefore, largely at the encouragement of the Federal Reserve Bank of New York, inclusion of accrued interest in the invoice price of repo securities became standard market practice; for details, see Garbade (2006).

The foundation for the second important change in repo contracts was laid when another government securities dealer, Lombard-Wall, with \$2 billion in assets and comparable liabilities, collapsed three months later in August 1982. Prior to Lombard-Wall's August 12, 1982, filing with the Federal Bankruptcy Court of New York, there had been no precedent court case in which the question of whether repos were secured loans or independent sale and repurchase agreements was directly addressed. If repos were classified as independent sale and repurchase agreements, then creditors

could take immediate possession of the repo securities; if, by contrast, they were classified as secured loans, then repo securities would have been subject to automatic stay. On August 17, 1982, the Federal Bankruptcy Court of New York announced that Lombard-Wall's repos were secured loans and issued a restraining order prohibiting the sale of these repo securities. Although submissions by the Federal Reserve Bank of New York and several others argued that this decision would undermine the liquidity of the repo market, the court reaffirmed its decision a month later (Garbade 2006). This removed the vagueness associated with whether repos were secured loans or independent sale and repurchase agreements. Despite this ruling, investment banks, mutual funds, and other large financial institutions favored the exception of repo securities from the application of automatic stay, although they seemed unwilling to write contracts that clearly stated that a repo was a pair of outright sale and repurchase transactions.⁹

Debates continued until another securities dealer, Lion Capital Group, collapsed in May 1984 and a bankruptcy court placed an automatic stay on Lion's repo securities.¹⁰ Shortly thereafter, Congress ended the debates about the classification of repos by enacting the Bankruptcy Amendments and Federal Judgeship Act of 1984, exempting repos on Treasury and federal agency securities, as well as those on bank certificates of deposit and bankers' acceptances, from the application of automatic stay. Since then, repos on these securities have been exempt from automatic stay. Curiously, prior to its collapse on September 15, 2008, Lehman Brothers appears to have treated the so-called Repo 105 contracts differently. Repo 105 contracts, and the role they played in Lehman's demise, are discussed in Box 11.1.

Dealer delivery failures in the 1980s also gave rise to the emergence of *tri-party repos*, in which the counterparties used a third agent, called the tri-party agent, to manage the collateral.¹¹ The tri-party agent ensured that the collateral pledged was sufficient and met eligibility requirements, and all parties agreed to use the collateral prices supplied by the tri-party agent. Today, there are only two tri-party agents in the United States, called the *tri-party clearing banks*: Bank of New York Mellon and JPMorgan Chase. Because these two clearing banks have a huge amount of exposure on an intraday basis, regulators expressed concerns that fears regarding the financial health of a major dealer or clearing bank could quickly spread contagion throughout the market. Indeed, the Fed's decision to extend its lender-of-last-resort support to the systemically important primary dealers during the recent financial crisis through the Primary Dealer Credit Facility (PDCF) was partly a result of these concerns. (We discuss the runs on the repo market that occurred during the crisis in detail in the next section.)

On May 17, 2010, the Federal Reserve Bank of New York Task Force on Tri-Party Infrastructure published a white paper (Federal Reserve Bank of New York 2010) addressing these concerns and proposed potential solutions that may prevent a bank run on tri-party repos.¹² In Box 11.2, we present excerpts from Moody's Investors Service's May 25, 2010, assessment of the FRBNY white paper.

BOX 11.1 REPO 105 AND THE LEHMAN BANKRUPTCY

On March 13, 2010, the *Wall Street Journal* reported:

Six weeks before it went bankrupt, Lehman Brothers Holdings Inc. was effectively out of securities that could be used as collateral to back the short-term loans it needed to survive. The bank's subsequent scramble to stay alive exposed the murky but crucial role that short-term lending, done in a corner of Wall Street known as the repo market, plays in the financial world.

The report by Lehman's court-appointed bankruptcy examiner, which runs thousands of pages, recounts efforts by the bank to use sleight-of-hand accounting transactions to spiff up its financial picture and sometimes use low-quality collateral to get loans.¹³

As discussed in the main text, in the United States, repo transactions are secured loans, at least for *accounting* purposes, so that ownership of the repo securities belongs to the debtor. Despite this, prior to its bankruptcy Lehman was treating some of its repo transactions, Repo 105 transactions, as outright sales. Put differently, since it is *legally* determined that repo transactions resemble outright sales, followed by outright repurchases, Lehman was trying to make the accounting treatment follow the legal treatment.

At the root of Repo 105 is a Financial Accounting Standards Board (FASB) rule, called FAS 140, which was approved in 2000. FAS 140 allowed securitized debt to be removed from the issuer's balance sheet so that the loans backing the securities were no longer assets of the issuer and therefore the purchasers of the securities were protected in case the issuer fell into financial distress and filed for bankruptcy.

FAS 140 was passed to improve the securitization market; it was not intended for the repo market. It contained a provision that stated that the issuer could report the securities as assets on its balance sheet as long as the issuer agreed to buy the securities back for a price between 98 percent and 102 percent of the sale price. If the repurchase price was outside this band, then the securities could not be reported as assets until the repurchase date.¹⁴

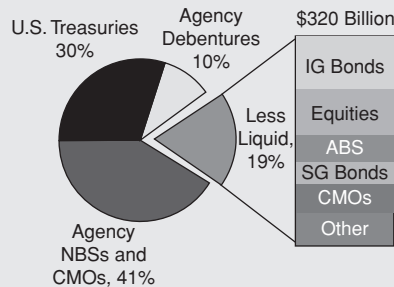
It was this provision that Lehman used as a loophole. Lehman was doing precisely what the primary securities dealer in the main text was doing: borrowing \$100 at \$5 interest by lending securities worth \$100 irrespective of the term of the repo—except that Lehman was removing the securities from the asset side of its balance sheet and using the borrowed cash to pay some of its debt temporarily. By engaging in this kind of activity toward the end of every fiscal quarter since 2001, Lehman was able to decrease its assets while keeping its equity unchanged. As a result, Lehman’s reported leverage appeared much lower than it actually was. In some quarters, Lehman’s Repo 105 transactions were as much as \$50 billion. This was the use “to spiff up its financial picture” mentioned in the quoted *Wall Street Journal* article.

BOX 11.2 MOODY’S COMMENTS ON THE FRBNY TASK FORCE ON TRI-PARTY INFRASTRUCTURE WHITE PAPER

Tri-party repo is similar to bilateral repo except for the involvement of a third party—a tri-party agent (Bank of New York Mellon or JPMorgan Chase, the two major clearing banks) provides custody, valuation, and settlement services for the exchange of cash and collateral between the borrower and the cash investor. Although nearly 40% lower than its peak size in 2008, at \$1.7 trillion the tri-party repo market remains a key source of funding for primary dealers (see figure following). The collateral funded in this market (see figure following) mostly consists of Treasuries and agencies. At \$320 billion, less liquid collateral is still a large portion, although this has decreased 65% since the start of the financial crisis.

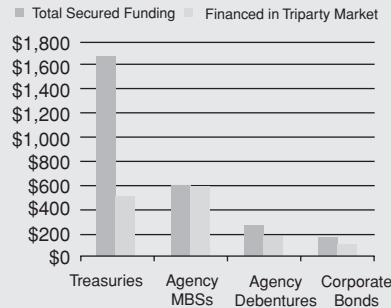
An “unwind” occurs every morning, when the tri-party agent returns the collateral to the dealer-borrower and the cash to the cash

Part A
Triparty Repo Market's Size Is \$1.7 Trillion
 The Collateral Is Mostly Liquid and High-Quality



For both exhibits, triparty data is shown as of April 7, 2010. For Part B, total secured funding is as of April 9, 2010.

Part B
A Major Funding Source for Primary Dealers
 PDs get ~50 Percent of Secured Funding * through Triparty Repo



* Applies only to collateral types shown, which represent the majority of collateral used in secured borrowing.

Source: New York Federal Reserve Bank.

investor. Until the transaction (whether a term repo or a rolling overnight repo) is “rewound” in the afternoon, it is the tri-party agent that is lending to the dealer on a secured basis. The purpose of the unwind is to allow the dealer access to the securities in its collateral pool to settle sales, which occur throughout the day. Such intraday credit extension, while normal, is not guaranteed in the clearing agreement and can be withdrawn at any point, particularly if the dealer’s creditworthiness deteriorates.

In order to reduce the gigantic amount of intraday credit extended by the clearing banks, the Task Force proposed developing an “auto-substitution” functionality. This would allow dealers to access and substitute their encumbered collateral, thus facilitating settlement without the need for the daily unwind. Any remaining intraday credit would be extended under well-defined bilateral agreements between dealers and the clearing banks.

While this is a sensible solution for both the dealers and the clearing banks, its implementation is only targeted for June of 2011. Prior to the full implementation of auto-substitution, the Task Force has recommended several tactical improvements. The first is a more robust and disciplined process for confirming repo trades between dealers and cash investors than exists today. The idea is to establish a “three-way” point-of-trade confirmation process that would ensure that clearing

banks always have an accurate, up-to-date picture of all outstanding repo trades. By knowing exactly what the dealer's position is (e.g., what collateral is already encumbered, at what haircut, and for how long), the clearing banks would have a greater degree of confidence in extending secured credit to dealers. With less uncertainty as to the level of collateralization they can count on, the odds of a rapid withdrawal of credit by the clearing banks would also be reduced.

The final implementation of a marketwide trade confirmation solution is targeted for April 2011, although incremental improvements will likely occur along the way.

The second tactical recommendation is to eliminate the unwind process from as much of the term tri-party market as possible. The logic is that collateral being funded on a term basis is not as actively traded. Therefore, not having access to it during the day poses less of a challenge for the dealers. With lower aggregate exposure, the clearing banks might be less driven to severely reduce the amount of remaining daylight credit to dealers. Still, pending the full implementation of auto-substitution and the elimination of uncertainty associated with daylight credit extension, the market is structurally vulnerable to a repo run for two reasons. First, many cash lenders (primarily money market funds) continue to make lending decisions based on the counterparty's credit risk rather than on the quality of the collateral. And second, the market as a whole has a tendency for pro-cyclical haircuts—that is, lower haircuts when liquidity is abundant, and higher haircuts when liquidity is scarce. If cash investors pulled away in a stress environment, the clearing banks would be faced with a choice—as they were in several cases in 2008—of taking on large secured credit exposure to dealers or severely constraining intraday credit to them.

Source: Moody's Investors Service.

The tri-party settlement is one of two settlement methods used in the United States. The other is the delivery versus payment (DVP) method. For example, the Federal Reserve's reverse repos are settled via the DVP method, wherein securities are moved against simultaneous payment. The Federal Reserve sends collateral to the clearing bank of its reverse repo counterparty, triggering a simultaneous movement of money against the collateral on the sale date. On the purchase date, the counterparty sends the collateral back to the Fed, which triggers the simultaneous return of the counterparty's funds. Such repo transactions are called bilateral repo transactions.

Although the repo market grew rapidly after the Bankruptcy Amendments and Federal Judgeship Act of 1984, until the mid-1990s it remained confined mostly to U.S. government debt, federal agency debt, corporate debt, and federal agency mortgage-backed securities. However, since the mid-1990s, it has grown to include a broad range of debt instruments as collateral: all types of private-label MBSs, such as residential mortgage-backed securities (RMBSs) and commercial mortgage-backed securities (CMBSs); all types of asset-backed securities (ABSs), such as automobile loans, credit cards, and student loans; and tranches¹⁵ of structured products such as collateralized mortgage obligations (CMOs), collateralized loan obligations (CLOs), collateralized debt obligations (CDOs), and the like (see Gorton 2009b).

The last significant change to the repo contracting conventions came in 2005. In April 2005, Congress enacted the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 (BAPCPA), which took effect in October 2005. BAPCPA expanded the definition of repurchase agreements to include mortgage loans, mortgage-related securities, and interest from mortgage loans or mortgage-related securities. This meant that as of October 2005, repo contracts on even MBSs, CMOs, CMBSs, and CDOs backed by mortgages and the like as collateral became exempt from automatic stay. We summarize the milestones in the evolution of the U.S. repo market in Box 11.3.

BOX 11.3 TIME LINE OF IMPORTANT U.S. REPO MARKET DEVELOPMENTS

1917	Federal Reserve introduces repos; accrued interest is excluded from the invoice price of repo securities, and repo securities are subject to automatic stay.
1929	Use of repos declines with the onset of the Great Depression.
1951	Congress enacts the Treasury–Federal Reserve Accord of 1951, bringing repos back into favor.
1982	Accrued interest is included in the invoice prices of repo securities.
1984	Congress enacts the Bankruptcy Amendments and Federal Judgeship Act of 1984 to exempt repos on Treasury and federal agency securities, as well as on bank certificates of deposit and bankers' acceptances from the application of automatic stay.
2005	Congress enacts the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 to expand the definition of repos to include mortgage loans, mortgage-related securities, and interest from mortgage loans and mortgage securities; all mortgage-related repo securities become exempt from the application of automatic stay. ¹⁶

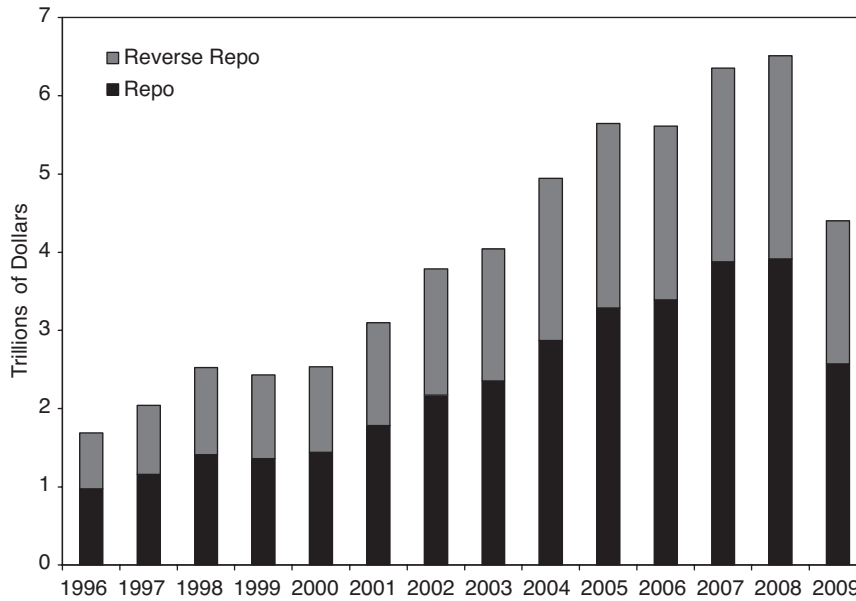


FIGURE 11.2 Annual Averages of Daily Financing by U.S. Government Securities Primary Dealers
Source: Securities Industry and Financial Markets Association.

No official statistics of the actual size of the repo market have been collected since inclusion of almost all types of securitized debt as collateral was allowed in repo agreements. Therefore, there is no official information on the evolution of the size of the repo market over the past quarter century. Figure 11.2 depicts the evolution of financing by primary dealers in the U.S. government securities market from 1996 through 2009 and offers a feel for the exponential growth of the repo market since the mid-1990s. Meanwhile, Figure 11.3 and Table 11.1, reproduced from the FRBNY Task Force on Tri-Party Infrastructure White Paper (2010), show the growth of the tri-party repo market from May 2002 through May 2010 (Figure 11.3), as well as the composition and concentration of tri-party repo collaterals (Table 11.1).

Last, Figures 11.4 and 11.5 depict the exponential growth of the U.S. debt market over the same period. It should be noted that ABS issuance surpassed corporate debt issuance in 2005 and remained higher in 2006, only to decline in 2007 after the onset of the financial crisis. In 2008 and 2009, ABS issuance returned to levels last seen in the early 1990s.

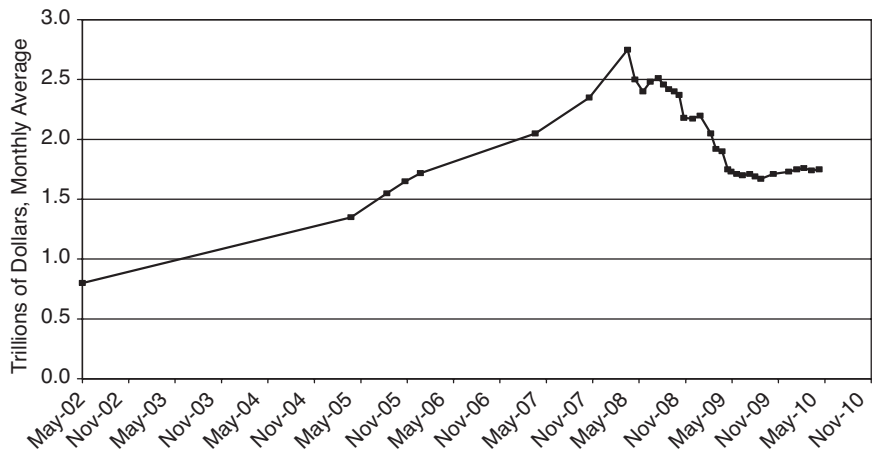


FIGURE 11.3 Growth of Tri-Party Repo Market
Source: FRBNY Task Force on Tri-Party Infrastructure White Paper (2010).

11.4 THE CRISIS

The financial crisis of 2007 to 2009 was a crisis not only of the traditional banks, but also of the shadow banks. Unlike traditional banks, shadow banks did not have access to the safety nets designed to prevent wholesale runs on banks—deposit insurance and the central bank as the lender of last resort—until 2008. Although there was no wholesale run on the traditional banking system in this period, we effectively observed a run on *shadow* banks that led to the demise of a significant part of the shadow banking system.¹⁷ Since repo financing was the basis of most of the leveraged positions of the shadow banks, a large part of the run occurred in the repo market. Other important runs that occurred in this period were on mortgage lenders, asset-backed commercial paper (ABCP) programs, structured investment vehicles (SIVs), and money market funds, to name a few (see Acharya, Gale, and Yorulmazer 2009).

When the housing market changed course in the first quarter of 2006, the subprime mortgage market began to deteriorate. While there is no secondary market for subprime mortgages and, therefore, there are no publicly observable subprime mortgage prices, the ABX index provides a publicly observable market that prices subprime risk.¹⁸ The ABX index, introduced by dealer banks in January 2006, is traded via credit default swap (CDS)

TABLE 11.1 Tri-Party Repo Statistics as of April 9, 2010

Composition and Concentration of Tri-Party Repo Collateral

Asset Group	Collateral Value (\$ Billions)	Share of Total	Concentration by Top Three Dealers
ABS (Investment and Non-Investment Grade)	\$ 41.7	2.4%	45%
Agency CMOs	112.7	6.6	46
Agency Debentures (Including STRIPS)	179.5	10.5	33
Agency MBSs	584.9	9.3	45
CMOs Private-Label (Investment Grade)	25.2	1.5	48
CMOs Private-Label (Non-Investment Grade)	18.9	1.1	47
Corporates (Investment Grade)	79.6	4.7	39
Corporates (Non-Investment Grade)	34.7	2.0	54
Equities	73.3	4.3	59
Money Markets	27.4	1.6	74
U.S. Treasuries (Excluding STRIPS)	474.4	27.7	39
U.S. Treasury STRIPS	38.7	2.3	46
Other	19.5	1.1	—
Total	\$1,710.5	100.0%	38%

Distribution of Investor Haircuts in Tri-Party Repo

Asset Group	Collateral Value (\$ Billions)	Haircuts		
		10th Percentile	Median	90th Percentile
ABSs (Investment and Non-Investment Grade)	\$ 41.7	0%	5%	8%
Agency CMOs	112.7	2	3	5
Agency Debentures (Including STRIPS)	179.5	2	2	5
Agency MBSs	584.9	2	2	4
CMOs Private-Label (Investment Grade)	25.2	2	5	7
CMOs Private-Label (Non-Investment Grade)	18.9	0	8	8
Corporates (Investment Grade)	79.6	2	5	8
Corporates (Non-Investment Grade)	34.7	5	8	15
Equities	73.3	5	8	20
Money Markets	27.4	2	3	5
U.S. Treasuries (Excluding STRIPS)	474.4	2	2	2
U.S. Treasury STRIPS	38.7	2	2	2
Other	19.5	—	—	—
Total	\$1,710.5			

Source: Reproduced from the FRBNY Task Force on Tri-Party Infrastructure White Paper (2010).

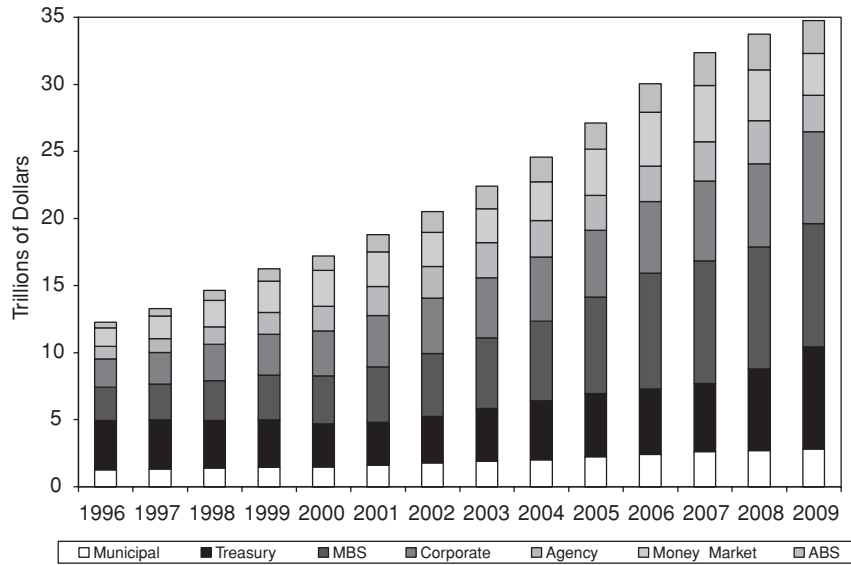


FIGURE 11.4 Size of the U.S. Debt Market, 1996 to 2009
 Source: Securities Industry and Financial Markets Association.

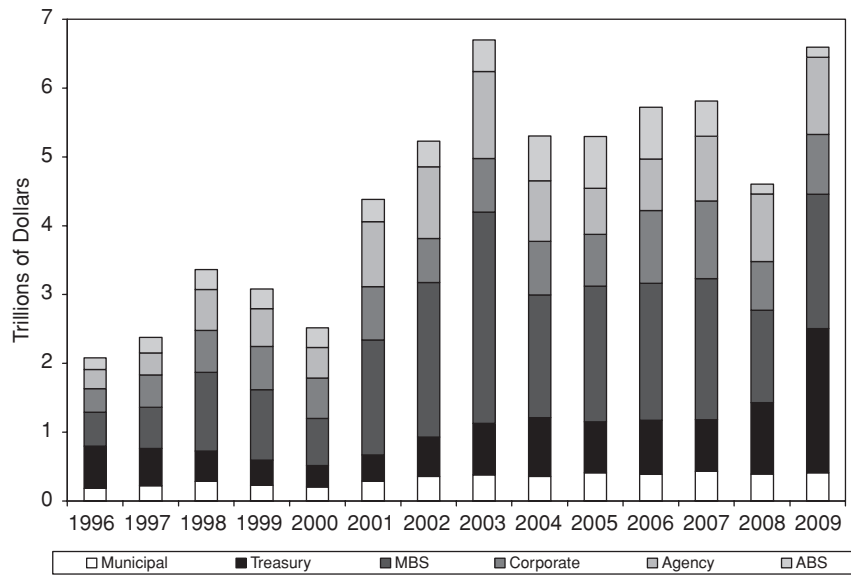


FIGURE 11.5 Issuances in the U.S. Debt Market, 1996 to 2009
 Source: Securities Industry and Financial Markets Association.

contracts and allows investors to take positions in subprime mortgage-backed securities. Figure 11.6 displays the ABX spread—that is, the CDS spread (labeled ABX) on the BBB-rated ABX tranche of the first vintage of the ABX in 2006. This vintage is representative of riskier levels of subprime securitization. Figure 11.6 also shows the London Interbank Offered Rate (LIBOR)—overnight index swap (OIS) spread (labeled LIB-OIS). The LIB-OIS is the spread between the three-month LIBOR and the three-month overnight index swap rates, and provides a proxy for the state of the repo market. Larger values of the LIB-OIS spread indicate higher perceived counterparty risk in the banking system; see Gorton and Metrick (2009a) for a detailed discussion.

Figure 11.6 depicts the steady deterioration of the subprime mortgage market from January 2007 to January 2009 and compares this with the deterioration in the interbank markets. There were two easily identifiable large jumps in the LIB-OIS: on August 9, 2007—from 13 basis points to 40 basis points, when BNP Paribas suspended redemptions on three of its SIVs—and on September 15, 2008—from 87 basis points to 105 basis points, when Lehman declared bankruptcy. The most significant move in the ABX, in contrast, appears to have occurred from 669 basis points at the end of June 2007 to 1,738 basis points at the end of July 2007, following the collapse on June 20, 2007, of two highly levered Bear Stearns hedge funds

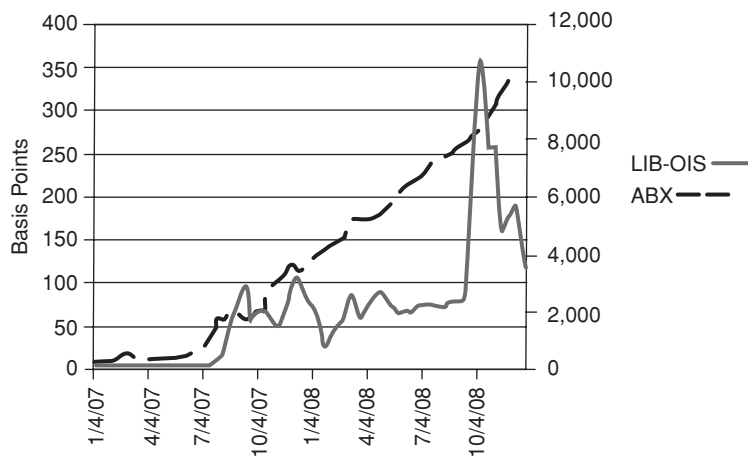


FIGURE 11.6 LIB-OIS (Left Scale) versus ABX (Right Scale; Measured in Basis Points)

Source: Reproduced from Gorton and Metrick (2009b).

that invested in subprime mortgages. The collapse of these two hedge funds was indeed a run on a shadow bank in the repo market. The two funds (one of which at its peak was levered 10 times its equity) were speculating mostly in CDOs on subprime mortgages; they borrowed funds in the repo market and pledged their CDOs as collateral.

With the deterioration of the subprime market in the first half of 2007, creditors began asking the two Bear Stearns funds to post more collateral to back the repos by mid-June 2007. When the funds failed to meet these margin calls, creditors, led by Merrill Lynch, threatened to declare the funds in default of repo agreements and to seize the investments. In fact, on June 19, 2007, Merrill seized \$850 million of the CDOs and tried to auction them. When Merrill was able to sell only about \$100 million worth of CDOs, the illiquid nature and the declining value of subprime assets became evident (see Acharya et al. 2009). Bloomberg reported that at least seven other lenders, including Lehman Brothers and Deutsche Bank, also circulated lists of CDOs and other bonds that they were planning to sell.¹⁹ The rapid increase of the ABX spread during July 2007 appears to be a response of the subprime market to this run on the shadow banks in the repo market. This shadow bank run and the systemic crisis that followed illustrate the significance of the exemption of repo securities from the application of automatic stay; had the repo securities been subject to automatic stay (or alternatives proposed later in this chapter), the Bear Stearns funds could have filed for bankruptcy and the forced fire sale of their assets could have been avoided.

Eventually, the subprime mortgage decline became systemic. In early August 2007, a run ensued on the assets of three SIVs of BNP Paribas. On August 9, BNP Paribas suspended redemptions from these SIVs. BNP Paribas's SIVs were bankruptcy-remote entities financing their subprime holdings through the issuance of ABCPs that had essentially lost their liquidity and become nontradable. The announcement of the suspension of redemptions by BNP Paribas gave rise to counterparty risk concerns and caused the ABCP market to freeze. This freeze coincided with the first major jump in the LIB-OIS spread. When fears of counterparty risk spread through markets, all short-term debt markets—including the repo market—froze, only to open after central banks injected massive amounts of liquidity into the system (see Acharya and Richardson 2009).

Based on a data set obtained from dealer banks, Gorton and Metrick (2009b) studied the repo spreads and haircuts for various types of repo securities, and their results are reproduced in Table 11.2. Of note, the spreads and the haircuts reported in this table are only for dealers; non-dealer counterparties may have been subject to other spreads and haircuts.

The repo spreads are the spreads between the three-month repo and the three-month OIS rates. Table 11.2 demonstrates clearly how a crisis that started in the subprime market spread like a wildfire to other types of comparable nontransparent securitized debt, such as automobile, credit card, and student loan asset-backed securities, as well as the high-credit-rated structured products, such as AAA- and AA-rated CLOs and CDOs.

As Gorton and Metrick claim, the increasing haircuts in the repo market may be interpreted as a run on shadow banks. Figure 11.7, reproduced from Gorton and Metrick (2009a), shows how that run evolved. The data they examine are the interbank repo haircuts for the following asset classes: (1) AA–AAA auto/credit card/student loan ABS; (2) AA–AAA RMBS/CMBS; (3) <AA RMBS/CMBS; (4) AA–AAA CLOs; (5) unpriced ABS/MBS/all subprime; (6) AA–AAA CDOs; (7) unpriced CLOs/CDOs (where *unpriced* means that the collateral does not have public pricing on either Reuters or Bloomberg). Of these, the categories (1)–(4) do not contain subprime mortgages and are labeled “Non-Subprime-Related” by Gorton and Metrick. In particular, the RMBS referred to in categories (2) and (3) are prime mortgages. The categories (5)–(7) are either directly subprime or contain subprime mortgages. CDOs, in particular, contain some subprime mortgages. Finally, using all seven categories, they also construct an equal-weighted average repo haircut index for structured bonds.

As can be seen from Figure 11.7, the run on the shadow banking system in the repo market occurred in two phases. Although Bear Stearns’s hedge funds were the first victims, it was BNP Paribas’s suspension of redemptions on its three SIVs that triggered the first phase. After Bear Stearns collapsed in March 2008, the Federal Reserve introduced its most radical change in monetary policy since the Great Depression by extending its lender-of-last-resort support to the systemically important primary dealers through the new Primary Dealer Credit Facility (PDCF). However, even this extension of the lender-of-last-resort facility did not prevent the run on Lehman Brothers, as investors realized that this support was not unconditional and unlimited (see Acharya et al. 2009). While the largest haircut jump in Figure 11.7 corresponds to the collapse of Lehman on September 15, 2008, the second-largest jump, which came in the summer of 2008, corresponds to traditional bank runs on likely insolvent banking institutions, such as IndyMac, Washington Mutual, and Wachovia.

With the Lehman bankruptcy on September 15, 2008, the repo market on even U.S. government debt, federal agency debt, corporate debt, and federal agency mortgage-backed securities came to a near halt, and settlement fails of primary dealers skyrocketed. Table 11.3 shows a quarterly summary of the primary dealer settlement fails from the first quarter of

TABLE 11.2 Three-Month Repo Rate—OIS Spreads (Basis Points) and Haircuts (Percentage) from January 1, 2007, to December 31, 2008

Series	Period	Mean	Median	Standard Error	Maximum	Minimum	Mean Haircut
BBB+ to A Corporates	Whole period	86.50	82.14	83.15	429.43	0.50	0.50%
	First half of 2007	2.01	1.95	0.61	5.30	0.50	0.00
	Second half of 2007	61.85	65.49	36.29	126.35	1.70	0.00
	All of 2007	32.28	2.70	39.53	126.35	0.50	0.00
	All of 2008	136.19	103.63	81.61	429.43	44.33	0.90
AA to AAA Corporates	Whole period	77.59	74.78	78.42	409.43	-3.50	0.50%
	First half of 2007	-1.69	-2.05	1.90	10.44	-3.50	0.00
	Second half of 2007	55.27	58.95	34.53	116.35	-2.30	0.00
	All of 2007	27.13	-1.35	37.64	116.35	-3.50	0.00
	All of 2008	123.86	92.11	77.57	409.43	39.33	0.90
AA to AAA ABS— Auto/CC/SL	Whole period	105.22	94.76	101.00	479.43	1.70	5.20%
	First half of 2007	4.44	4.00	1.77	11.00	1.70	0.00
	Second half of 2007	68.44	71.78	40.93	141.35	3.70	0.90
	All of 2007	36.82	5.25	43.29	141.35	1.70	0.50
	All of 2008	167.92	119.81	98.07	479.43	54.33	9.50
AA to AAA ABS— RMBS/CMBS	Whole period	124.04	107.78	120.11	520.30	3.70	9.40%
	First half of 2007	6.41	6.00	1.76	13.00	3.70	0.00
	Second half of 2007	76.35	81.78	43.92	151.35	5.70	1.80
	All of 2007	41.80	7.00	46.92	151.35	3.70	0.90
	All of 2008	199.44	145.08	117.27	520.30	64.33	17.10

<AA ABS—RMBS/ CMBS	Whole period	135.90	117.78	129.02	550.30	6.70	10.60%
	First half of 2007	9.41	9.00	1.76	16.00	6.70	0.00
	Second half of 2007	84.55	88.20	48.62	166.35	8.70	3.70
	All of 2007	47.43	10.00	51.08	166.35	6.70	1.90
	All of 2008	217.01	153.95	125.56	550.30	69.33	18.60
Unpriced ABS/MBS/All Subprime	Whole period	108.94	109.69	84.64	295.38	7.70	37.30%
	First half of 2007	10.41	10.00	1.76	17.00	7.70	0.00
	Second half of 2007	95.62	97.83	58.54	196.35	9.70	7.70
	All of 2007	53.52	11.00	59.59	196.35	7.70	3.90
	All of 2008	187.28	197.88	42.23	295.38	99.33	68.00
AA to AAA CLO	Whole period	134.46	117.14	127.18	545.3	3.70	10.20%
	First half of 2007	6.41	6.00	1.76	13.00	3.70	0.00
	Second half of 2007	85.93	92.65	51.27	171.35	5.70	1.80
	All of 2007	46.64	7.00	53.98	171.35	3.70	0.90
	All of 2008	214.96	148.76	121.61	545.30	79.33	18.70
AA to AAA CDO	Whole period	130.09	124.69	107.46	380.38	4.70	30.00%
	First half of 2007	7.41	7.00	1.76	14.00	4.70	0.00
	Second half of 2007	107.77	109.35	69.56	226.35	6.70	8.30
	All of 2007	58.19	8.00	70.48	226.35	4.70	4.30
	All of 2008	231.72	241.39	56.52	380.38	129.33	53.50
Unpriced CLO/CDO	Whole period	148.32	142.60	123.54	413.75	6.70	32.40%
	First half of 2007	9.41	9.00	1.76	16.00	6.70	0.00
	Second half of 2007	122.63	124.42	80.14	256.35	8.70	10.50
	All of 2007	66.69	10.00	80.34	256.35	6.70	5.40
	All of 2008	268.39	256.58	63.03	413.75	154.33	57.30

Source: Reproduced from Gorton and Metrick (2009b).

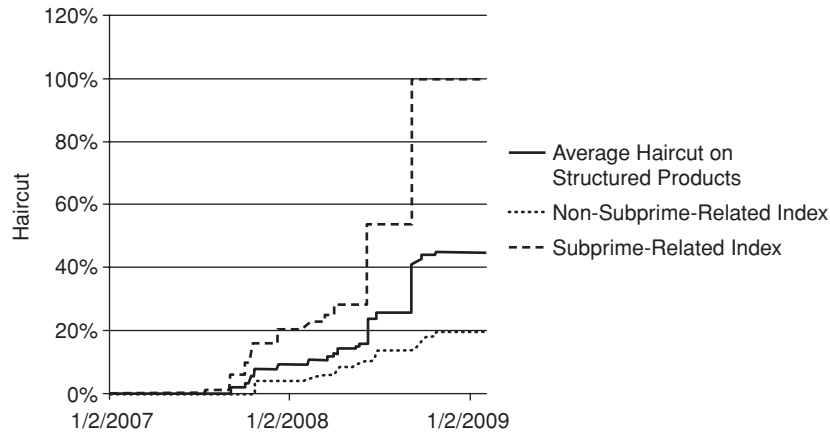


FIGURE 11.7 Repo Haircuts on Different Categories of Structured Products
Source: Reproduced from Gorton and Metrick (2009a).

2007 to the last quarter of 2009. Figure 11.8 provides a quarterly summary of the effects of the run on the repo market on the financing of primary dealers after Lehman’s collapse. As shown, it was the *borrowing* ability of the primary dealers that went down significantly, not their *lending* ability. Since this may be interpreted as large withdrawals from the broker-dealer shadow banks in the repo market, Figure 11.8 also illustrates the disappearing confidence in the shadow banking system and the severity of the run on shadow banks. When the Fed and the U.S. government let Lehman collapse, the next in line for a run, Merrill Lynch, had to merge with Bank of America. Shortly thereafter, the two remaining independent broker-dealers, Morgan Stanley and Goldman Sachs, were forced to convert to bank holding companies and were formally put under supervision and regulation of the Federal Reserve. In fact, the entire Wall Street system of independent broker-dealers collapsed in a matter of seven months (see Acharya et al. 2009).

11.5 A CASE FOR REFORMING THE REPO MARKET

As Acharya and Krishnamurthy (2010) clarify, the primary issue with financing risky securities (such as mortgage-backed securities) through repo markets is that such financing is likely to freeze or experience stress in times of aggregate (economy-wide or financial-sector-wide) stress, and on their own, financial firms do not have the incentive to internalize the costs of such

TABLE 11.3 Settlement Fails of U.S. Government Securities Primary Dealers during the Financial Crisis, 2007 to 2009
 (\$ Billions)

	Treasury		Agency		MBS		Corporate	
	Receive	Deliver	Receive	Deliver	Receive	Deliver	Receive	Deliver
2007								
Q1	\$ 738.1	\$ 586.8	\$ 91.2	\$ 76.6	\$ 474.6	\$ 473.8	\$356.1	\$404.2
Q2	726.8	528.3	117.7	118.2	595.8	617.7	498.0	572.9
Q3	834.4	549.7	239.5	231.7	805.6	819.7	822.9	884.3
Q4	1,373.0	1,085.4	202.8	192.5	757.8	686.8	488.4	547.5
2008								
Q1	\$ 3,946.2	\$ 3,835.7	\$234.7	\$221.8	\$1,023.3	\$ 952.1	\$364.8	\$413.4
Q2	3,762.9	3,726.3	202.4	192.6	596.1	566.5	361.3	407.2
Q3	3,077.4	2,784.0	238.1	228.4	463.1	425.5	199.4	214.9
Q4	16,824.6	16,266.6	586.6	600.7	971.9	863.5	271.7	337.8
2009								
Q1	\$ 1,442.9	\$ 1,286.0	\$143.1	\$167.1	\$ 867.8	\$ 950.3	\$168.0	\$225.8
Q2	806.6	764.8	95.4	100.9	1,078.9	1,319.4	151.6	215.6
Q3	617.7	536.8	62.1	76.7	1,283.9	1,553.2	145.2	192.4
Q4	245.0	184.4	141.9	163.9	3,128.6	3,945.1	156.7	192.2

Source: Federal Reserve Bank of New York.

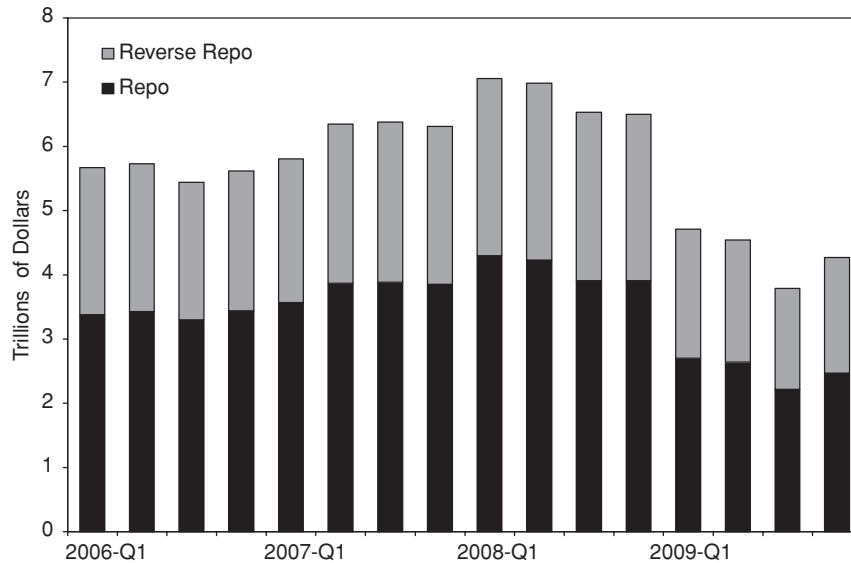


FIGURE 11.8 Quarterly Averages of Daily Financing by U.S. Government Securities Primary Dealers, 2006 to 2009
 Source: Securities Industry and Financial Markets Association.

a freeze or stress. By virtue of being secured and being typically short-term financing arrangements, repo markets, by and large, function smoothly; in other words, repos usually get rolled over. When the underlying assets, such as Treasury or agency debt, are essentially safe, the repo lender is undeterred from rolling over the financing even in stressful times. Indeed, Treasury and agency debt might even experience a flight to safety in such times.

In contrast, if the underlying collateral is a mortgage-backed security and an economic downturn ensues, the risk of an already illiquid market for MBSs gets compounded; this is because many financial institutions' portfolios are crowded with MBSs or have lost capital. In this scenario, repo lenders run the real risk of being forced to sell their collateral in illiquid markets. The repo lender may respond by raising the required haircut or simply refusing to roll over. The resulting fall in repo financing ability against the collateral is perverse, as it sets up an adverse dynamic: The future buyers of assets anticipate that they are likely to face steep haircuts, too, and thus will not offer attractive prices for assets; in turn, the collateral's ability to be financed with repo today falls even further. A complete market freeze can arise, as it did during the crisis of 2007 to 2009 and as theoretically modeled by Acharya, Gale, and Yorulmazer (2009).

To summarize, unlike the liquidity risk that *unsecured* financing may become unavailable to a firm (a risk largely specific to the credit risk of the firm), the liquidity risk that *secured* repo financing may become unavailable to a firm is inherently a systemic risk, materializing in circumstances where other financial firms are also experiencing stress and the markets for assets held predominantly by the financial sector are rendered illiquid. Federal Reserve Chairman Ben Bernanke has noted this important difference, along with the fact that current practices for bank liquidity risk management do not take into sufficient account the likely freezes in secured repo financing.²⁰

This leads to the problem that while in good times financial firms may not fully internalize the costs imposed on the system by being excessively financed through short-term repo markets, in bad times they charge excessively high haircuts on repo financing and do not internalize the pecuniary externalities imposed on other firms through the resulting fire sales of assets. Indeed, to support financial firms facing a repo freeze or to support the assets directly, the likely lender of last resort would only accentuate a problem that firms ignore in good times—namely, the systemic risk associated with repo financing. Viewed this way, in good times there is a case for subjecting repo-financed risky securities to a capital charge—effectively a *regulatory haircut*—which takes into account the security’s systemic risk and maturity mismatch relative to the repo tenor. Equally important, there is a case for a better design of the bankruptcy of a repo-financed debtor than simply granting its repo lender the full right to seize the collateral and liquidate it at will in an illiquid market.

11.6 PROPOSED REFORMS

Somewhat surprisingly, the House and the Senate bills are both quiet on how to reform the repo markets. The only concrete proposal has come from the FDIC chair, Sheila Bair, who has proposed that repo counterparties of Federal Deposit Insurance Corporation (FDIC)–regulated banks be subject to a 10 cents per dollar (originally proposed as 20 cents per dollar) haircut in case of a bank being taken over by the FDIC. The Federal Reserve Bank of New York (2010) and the Basel Committee on Banking Supervision (2010) have both taken on the issue and are in touch with industry and academia to devise a better architecture for the functioning of these markets. Later, we discuss the proposed reforms and also propose an alternative, from both an ex ante as well as an ex post perspective, that addresses these issues.

Possible reforms of the repo market can be put into three categories: a full government-guarantee scheme, a full market-discipline scheme, and a combination of the two. Our preferred alternative is the combination.

At one extreme, some (most notably, Gorton 2009) have suggested that repo financing is akin to demandable deposits in many ways and thus is similarly vulnerable to the information-sensitive panics when adverse information about underlying collateral (or counterparties) hits markets. His proposal is thus to treat repo financing in a similar way—that is, offer federal deposit insurance to the repo contracts, at least against securities that are relatively safe, such as the supersenior tranches of securitization pools. Under this proposal, it is recognized that repo financing has the inherent systemic fragility akin to demandable deposits, and in all likelihood the government would end up backing up repo counterparties were the fragility to materialize. Hence, by explicitly recognizing the guarantee up front, it becomes possible to charge repo financiers for the guarantee. As with any insurance premium, the objective is not just to collect fees for an ex post guarantee, but also to get repo financiers to internalize the systemic fragility inherent in repo contracts.

At another extreme, others (most notably, Roe 2009) have proposed that repo financiers should not be allowed unrestricted access to collateral even in case of default of the counterparty. That is, there should be some sort of automatic stay on repo financiers' claims, and they should join the bankruptcy of the defaulting counterparty as a secured creditor, as in the case of corporate bankruptcies. The rationale for this is twofold: First, it prevents the fire sales of the repo collateral by the financiers and avoids the adverse dynamic we highlighted before; and second, by exposing the repo financiers to credit risk of the counterparty (and not just that of the collateral), the financiers would subject the borrowers to much greater market discipline. In particular, financiers would opt for safer counterparties, all else being equal, or charge higher haircuts to riskier ones—either way, discriminating ex ante between safer and riskier borrowers.

The advantage of the government guarantee scheme is that it resolves virtually all ex post uncertainty by transferring the risk of repo contracts away from financiers to the government agency for an up-front fee. However, its disadvantages are more subtle and somewhat pernicious. The charging of FDIC premiums has been heavily influenced by the banking industry, and no premiums are charged to most banks when the FDIC's reserve fund is capitalized above 1.25 percent to 1.35 percent of the insured deposits. This kind of a fee structure gives rise to a highly procyclical risk-taking incentive, because, as far as the risk-return trade-off is concerned, the risks are back-loaded. There is no guarantee that repo insurance premiums would work any differently. Perhaps, and somewhat more disturbingly, such a guarantee scheme effectively amounts to transferring the credit risk of virtually most parts of the securitization market to the government's balance sheet. While conforming mortgages in the United States are already being backstopped

by Fannie Mae and Freddie Mac, the proposed guarantee scheme would extend such a backstop to subprime securitized pools, corporate loans, automobile receivables, credit card receivables, and so on. Given the inability of the government to control the urge to get Fannie and Freddie to engage in other kinds of activities, and the inclination of Fannie and Freddie, in turn, to undertake greater risks at the expense of taxpayers, the idea of extending guarantees to practically all risks of the economy should be viewed with caution. Such caution would be even more necessary for governments other than the United States, whose balance sheet is already heavily stretched.

The advantage of market discipline through the automatic stay approach is that it transfers the entire risk of the repo transaction to the repo financier—to some extent the risk of the collateral but also that of the borrower's ability to pay. This way, other than through ex post forbearance, private markets are allowed to function—bear and price risks—and thereby provide incentives to take account of relevant risk-return trade-offs. There are, however, several countervailing issues that arise. First, since the primary issue with repo contracts is their systemic externality, it is unclear that private market outcomes would be necessarily efficient from a risk-return standpoint of the economy as a whole. Second, automatic stay introduces *basis risk* in the repo contract, since its eventual payoff is linked not just to the underlying asset but to the whole pool of assets of the borrower and the rest of its capital structure. In general, this may create sufficient ex ante, as well as ex post, uncertainty to reduce the financier's willingness to lend against certain assets to all types of borrowers. The result might be a significant reduction in ex ante liquidity in some parts of repo-financed securitized markets. Third, a rationale for the bankruptcy exemption of the repos has been that when the borrower defaults, counterparty risk transmission is reduced as far as the repo contract goes, because it is protected from any spillover of the borrower's remaining risks and liabilities.

Given this relative assessment, our preferred approach is one that facilitates a ready winding down of the repo contracts and eliminates disorderly fire sales of underlying assets. In particular, the approach consists of the following four pieces:

1. In case of default of a borrower, its repo counterparties on Treasuries, and perhaps agency-backed securities (assuming the agency-backed securities are effectively government-backed), are allowed to take their collateral as under the current arrangements. However, repo counterparties on other kinds of risky collateral, such as ABSs and MBSs, are subjected to a stay.
2. Immediately upon default, repo counterparties of risky collateral are paid by a *repo resolution fund*, which could simply be within the FDIC

or the Federal Reserve, a recovery amount that is based on a conservative value assessment of the collateral.²¹ Such a value assessment could be based on market intelligence, historical estimates, projected valuations obtained from a poll of dealers, and so on. The important issue is that the assessment should be conservative.

3. The underlying repo collateral is taken over by the repo resolution fund and liquidated in an orderly manner over a prespecified period, say, not more than six months (but with some flexibility to deal with unexpected circumstances). If the eventual recovery on the collateral is above the conservative estimate paid to the repo lenders (see step 2), then the time-value-adjusted difference is paid to the repo lenders. Conversely, if the eventual recovery is lower than the conservative estimate paid to the repo lenders, the time-value-adjusted difference is clawed back from the repo lenders. The claw-back feature is explicitly legislated (as with the current mechanism used by the FDIC to deal with uninsured depositors of failed FDIC-regulated banks).
4. In effect, steps 2 and 3 resemble a lender-of-last-resort operation, whereby risky collateral in times of a systemic crisis would be provided liquidity, albeit conservatively at a haircut or penalty rate. However, the claw-back feature implies that the repo resolution authority—the lender of last resort—takes on the credit risk of repo lenders, as well as of the underlying collateral (but limited to the difference between realized recovery and the conservative estimate at the time of the borrower's bankruptcy). To manage this credit risk, the repo resolution authority should do the following:
 - Include as eligible only relatively high-quality collateral.
 - Charge repo lenders an ex ante fee for the lender-of-last-resort facility, commensurate with the residual credit risk borne by the facility.
 - Require that eligible repo lenders for the lender-of-last-resort facility meet prespecified solvency criteria.
 - Impose a concentration limit at the level of individual repo lenders, as well as on the lender's overall portfolio size.

Thus, our preferred approach provides ex post liquidity to the repo market rather than a complete guarantee of underlying risks. This approach also charges ex ante for this liquidity facility and ensures that the risks undertaken by the market participants do not expose the taxpayers to losses beyond a certain size. It combines the attractive features of full insurance and full market-discipline schemes, avoiding their weaknesses. Furthermore, in contrast to Ms. Bair's proposal of a fixed haircut for resolving all repo collateral, it allows the haircut to be determined ex post based on conservative value assessments at the time of the borrower's bankruptcy.

11.7 GOING FORWARD

The current financial legislation proposals are completely silent on how to reform the repo market. We believe this is a mistake in light of the systemic nature of the repo market and its structural weaknesses. As we mentioned, unlike the liquidity risk that *unsecured* financing may become unavailable to a firm, the liquidity risk that *secured* repo financing may become unavailable to a firm is inherently a systemic risk: The markets for the repo securities may become illiquid precisely when a large part of the financial sector is experiencing undercapitalization or funding stress.

Unless this systemic liquidity risk of repo market is resolved, the risk of a run on the repo market will remain. Our proposed solution—similar to our proposed reform for money market funds (Chapter 10, “Money Market Funds”) and orderly winding down of dealers and other financial firms (Chapter 8, “Resolution Authority”)—addresses the externality of systemic risk of repo contracts on risky and potentially illiquid collaterals. Such a solution can be exercised without overly compromising market discipline, market liquidity, or taxpayer funds. Admittedly, our proposed solution is one among many possibilities; other alternatives may be possible.

Finally, although we have focused on the U.S. repo markets, our discussion and proposed reforms apply to other countries as well. Repo markets exist around the globe, from China to Japan to Hungary to Turkey, to name but a few countries, although their histories are much shorter and their sizes much smaller than that of the U.S. repo market. Many emerging countries’ repo markets date back to the early 1990s. The largest repo market outside the United States is the European repo market, which was established with the introduction of the euro in 1999 and stood at €5.6 trillion based on the amount outstanding on December 9, 2009.²² The European market is the only repo market outside the United States where potentially illiquid financial assets are used as repo collateral, and therefore our proposed reforms are also relevant to the European repo market. In other repo markets, the repo collateral generally represents government bonds issued by the sovereign states, so that in these markets, the repo lenders do not appear to run a substantial risk of being forced to sell their collateral in illiquid markets in the event of financial crises. This may change, however, if potentially illiquid collateral were to become acceptable in repo transactions in these countries. Indeed, when sovereign credit risk is an issue, even the repo markets for government bonds may be vulnerable.

At any rate, leaving the repo markets out of the discussion of financial reform is not an alternative; if these markets are not reformed and their participants not made to internalize the liquidity risk, runs on the repo market will occur in the future, potentially leading to new systemic crises.

NOTES

1. The term *shadow banking system* was coined in September 2007 by Paul McCulley, a managing director at PIMCO. It was later popularized by Bill Gross, the chief investment officer of PIMCO, and Professor Nouriel Roubini of the NYU Stern School of Business.
2. www.sifma.org/uploadedFiles/Research/Statistics/SIFMA_USBondMarketOutstanding.pdf.
3. Most often, a cheaper but equivalent substitute is acceptable to the primary securities dealer (the borrower) in the U.S. repo market. If it is not, then the interest goes up.
4. A haircut is not the only tool that is used to manage the counterparty risk in the U.S. repo market. Another tool is marking the repo securities to market. The collateral is valued at current market levels, and the trade is adjusted through a margin call (debtor sends more collateral) or repriced (funds are delivered to creditor). See www.sifma.org/services/stdforms/pdf/master_repo_agreement.pdf.
5. In other words, both the MBS and money are borrowed.
6. Since the start of the crisis, large deposits held at commercial banks are insured up to a limit of \$250,000.
7. www.roaths.com/pawnbroking.htm.
8. However, there appears to have been some deliberate vagueness about this until a government securities dealer, Lombard-Wall, collapsed in 1982, and the Federal Bankruptcy Court of New York imposed an automatic stay on the repo securities that Lombard-Wall had used as collateral. See www.nytimes.com/1982/12/17/business/lombard-wall.html. This point had always been uncertain until the 1982 and 1984 amendments to United States Code, Title 11. In a true sale, the buyer is not subject to the automatic stay. For instance, if an automobile dealer bought a car from General Motors the day before it filed for bankruptcy, it could resell the car without asking for permission of the court. However, if the deal were financed by GM, the dealer would need a court order to sell the car. The repo transactions are structured formally as a true sale, free of the automatic stay. The question was, and still is, whether courts would reclassify a repo transaction as a secured transaction. Before 1982/1984, this would inflict the stay on the collateral taker. After 1982/1984, it would only affect the rights of a secured party, which are more limited than the rights of a buyer.
9. Even if they did, a court would be free to reclassify them.
10. "Lion Capital's Collapse Raises Issue of Unresolved Legal Status of 'Repos,'" *Wall Street Journal*, May 8, 1984.
11. See Copeland, Martin, and Walker (2010) for a fuller discussion of the tri-party repo market and its various sources of vulnerability and fragility before the 2010 reforms.
12. As of April 2010, the size of the tri-party repo market was \$1.7 trillion.
13. <http://online.wsj.com/article/SB10001424052748703447104575118150651790066.html>.
14. <http://knowledge.wharton.upenn.edu/article.cfm?articleid=2464>.

15. *Tranche* means slice in French.
16. It should be mentioned that the repo banks have gone beyond BAPCPA. Parties that engage in such repos are relying on the general Section 555 of United States Code, Title 11, rather than the repo-specific Section 559 of United States Code, Title 11.
17. Isolated runs, such as the September 2008 run on the Seattle-based savings and loan Washington Mutual, did occur.
18. The index is overseen by Markit Partners. See www.markit.com/information/products/abx.html.
19. www.bloomberg.com/apps/news?pid=20601087&refer=home&sid=aYDTeHYnV3ms.
20. From Ben Bernanke's remarks to the Risk Transfer Mechanisms and Financial Stability Workshop at the Bank for International Settlements, May 29, 2008: "[U]ntil recently, short-term repos had always been regarded as virtually risk-free instruments and thus largely immune to the type of rollover or withdrawal risks associated with short-term unsecured obligations. In March, rapidly unfolding events demonstrated that even repo markets could be severely disrupted when investors believe they might need to sell the underlying collateral in illiquid markets. Such forced asset sales can set up a particularly adverse dynamic, in which further substantial price declines fan investor concerns about counterparty credit risk, which then feed back in the form of intensifying funding pressures. . . . In light of the recent experience, and following the recommendations of the President's Working Group on Financial Markets (2008), the Federal Reserve and other supervisors are reviewing their policies and guidance regarding liquidity risk management to determine what improvements can be made. In particular, future liquidity planning will have to take into account the possibility of a sudden loss of substantial amounts of secured financing."
21. The repo resolution fund should clearly be eligible for participating in the lender-of-last-resort facilities of the central bank. If such participation is not clear a priori, uncertainty concerning it could lead to a breakdown of our proposed resolution plan.
22. According to the survey conducted by the International Capital Market Association with 53 financial institutions located in 14 European countries, as well as the United States and Japan.

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