

SPEECH

## More Lessons from the Crisis

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Thank you for having me here to speak today. It is a real pleasure to have this opportunity to speak at CEPS again—this is a great forum to talk about policy issues. Tonight I want to discuss some of the challenges we face in making our financial system more robust. We have learned a great deal over the past two years about our financial system and its vulnerabilities. The task ahead is to put these lessons to good use. Our goal must be to make the financial system more resilient to shocks. If we can do that successfully, we should be able to reduce the risk of financial crises.

In assessing the causes of this crisis, one clear culprit was the failure of regulators and market participants alike to fully appreciate the strength of the amplifying mechanisms that were built into our financial system. These mechanics exacerbated the boom on the way up and the bust on the way down. Only by better understanding the sources of these damaging dynamics can we construct solutions that will strengthen our financial system and make it more robust.

Today, I am going to focus mainly on the extraordinary liquidity events that played out during this crisis. I will tackle this topic in four parts. I will begin by describing how funding dried up rapidly for firms such as Bear Stearns, Lehman Brothers, and AIG. I then will propose a conceptual framework that might prove helpful in better understanding what went wrong on the liquidity front. With this conceptual framework in hand, I will then suggest some concrete steps we might take toward making the financial system more resilient—cautioning that there are no magic bullets. Finally, I will talk about the major initiatives that are already underway to help reduce the risk of future liquidity crises.

As always, my remarks reflect my own views and opinions and not necessarily those of the Federal Reserve System.

At its most fundamental level, this crisis was caused by the rapid growth of the so-called shadow banking system over the past few decades and its remarkable collapse over the past two years. Let me give you some figures to illustrate the disparity between the growth of what I will call the “traditional” commercial banking system and the shadow banking system in recent years. At the end of 2006, the shadow banking system had grown so large that U.S. commercial banks’ share of credit market assets had fallen to only 17.7 percent, down from 27.3 percent in 1980.

With this shift in the composition of activity also came an important change in the composition of funding, particularly in the middle part of this decade. Commercial paper outstanding grew from \$1.3 trillion at the end of 2003 to a peak of about \$2.3 trillion. Repo funding by dealers to nonbank financial institutions—as measured by the reverse repos on primary dealer balance sheets—grew from less than \$1.3 trillion to a peak of nearly \$2.8 trillion over this period. In contrast, commercial bank retail deposits rose by less than 30% in the four year period from 2003 to 2007.

Though the shadow banking system was often credited with better distributing risk and improving the overall efficiency of the financial system, this system ultimately proved to be much more fragile than we had anticipated. Like the traditional banking system, the shadow banking system engaged in the maturity transformation process in which structured investment vehicles (SIVs), conduits, dealers, and hedge funds financed long-term assets with short-term funding. However, much of the maturity transformation in the shadow system occurred without the types of stabilizing backstops that are in place in the traditional banking sector.

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. Indeed, one particularly destabilizing factor in this collapse was the speed with which liquidity buffers at the large independent security dealers were exhausted. To take just one illustrative example, Bear Stearns saw a complete loss of its short-term secured funding virtually overnight. As a consequence, the firm’s liquidity pool dropped by 83 percent in a two-day span.<sup>1</sup>

These liquidity dynamics were driven by two main factors. The first factor was the underlying stress on dealer balance sheets as the prices on complex collateralized debt obligations (CDOs), private label residential mortgage-backed securities (RMBS), and commercial real estate-related assets fell sharply and uncertainty about underlying asset values rose sharply. The uncertainty stemmed, in part, from the lack of transparency about what prices these assets could be sold for, which, in turn stemmed from the difficulty of valuing these extremely complex and heterogeneous securities.

The stress on underlying asset prices and the uncertainty about the valuations of pools of illiquid assets caused investors to become concerned about the solvency of some of the weaker dealers.<sup>2</sup> These concerns contributed to liquidity pressures, which, in turn, led to forced asset sales by dealers and others. These sales both further depressed asset prices and increased asset price volatility.

The second factor contributing to the liquidity crisis was the dependence of dealers on short-term funding to finance illiquid assets. 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.

Consider first tri-party repo, a market in which money market funds, securities lending operations, and other institutions finance assets mainly on an overnight basis. As asset prices fell and volatility climbed during this period, the financial condition of some dealers became more troubled. As a result, some investors in this market became worried about the risk that they might not get their cash returned in the morning, but instead might be stuck with the collateral that secured their lending. Investors responded by increasing their haircuts—that is the margin of extra collateral used to secure their funding—and reducing the range of collateral they would accept as security for their lending. Of course, these very rational reactions on the part of investors only further weakened the liquidity positions of the major securities firms.

A similar dynamic occurred in the context of prime brokerage accounts. Some institutions treated the free cash balances associated with these accounts as if they were a stable source of funding. Implicitly, they assumed that these balances would be “sticky” due to the strength of broader business relationships and the cost incurred by customers in shifting the business elsewhere. However, once markets became strained, this assumption of stable funding proved to be false. Prime brokerage customers began to withdraw their free credit balances and some moved their business elsewhere. Both of these steps reduced dealer liquidity buffers and further tightened the funding noose.

In the case of the tri-party repo market, the stress on repo borrowers was exacerbated by the design of the underlying market infrastructure. In this market, investors provide cash each afternoon to dealers in the form of an overnight loan backed by securities collateral.

Each morning, under normal circumstances, the two clearing banks that operate tri-party repo systems permit dealers to return the cash to their investors and to retake possession of their securities portfolios by overdrawing their accounts at the clearing banks. During the day, the clearing banks finance the dealers’ securities inventories.

Usually, this arrangement works well. However, when a securities dealer becomes troubled or is perceived to be troubled, the tri-party repo market can become unstable. In particular, if there is a material risk that a dealer could default during the day, the clearing bank may not want to return the cash to the tri-party investors in the morning because the bank does not want to risk being stuck with a very large collateralized exposure that could run into the hundreds of billions of dollars. Overnight investors, in turn, don’t want to be stuck with the collateral. So to avoid such an outcome, they may decide not to invest in the first place. These self-protective reactions on the part of the clearing banks and the investors can cause the tri-party funding mechanism to rapidly unravel. This dynamic explains the speed with which Bear Stearns lost funding as tri-party repo investors pulled away quickly.

Despite the strains created by the collapse of Bear Stearns, the “rivets” of the tri-party repo system held for several reasons. First, Bear Stearns did not fail; instead it was acquired by JPMorgan Chase with assistance from the Federal Reserve. Second, the Federal Reserve stepped in to support the tri-party repo system by implementing the Primary Dealer Credit Facility (PDCF). The PDCF essentially placed the Fed in the role of the tri-party repo investor of last resort thereby significantly reducing the risk to the clearing banks that they might be stuck with the collateral. As a consequence, the PDCF reassured end investors that they could safely keep investing. This, in turn, significantly reduced the risk that a dealer would not be able to obtain short-term funding through the tri-party repo system.<sup>3</sup>

Over much of this period preceding the failure of Lehman Brothers, U.S. commercial banks were relatively insulated from the liquidity run dynamics that plagued the securities dealers.<sup>4</sup> This relative stability was due, in part, to the broad access these commercial banks had to the Fed’s discount window through the traditional primary credit facility and through the Term Auction Facility (TAF), which had been introduced earlier in the crisis in response to liquidity strains in the interbank market. The fact that most commercial banks relied on insured deposits for significant portions of their funding was also important. Not only were these insured deposits stable sources of funding because they were guaranteed by the Federal Deposit Insurance Corporation (FDIC), but also because they were unsecured; these deposits freed up collateral that could be used by banks to secure borrowing from the central bank and elsewhere.

However, once Lehman Brothers failed, many commercial banks and other financial institutions encountered significant funding difficulties. News that the Reserve Fund—a large money market mutual fund—had “broken the buck” due to its holdings of Lehman Brothers paper led panicked investors to withdraw their funds from money market mutual funds. This caused the commercial paper market to virtually shut down. This hurt bank holding companies and other large financial firms that depended on the commercial paper market for short-term funding.

The result was a widespread loss of confidence throughout the money market and interbank funding market. Investors became unwilling to lend even to institutions that they perceived to be solvent because of worries that others might not share the same opinion. Rollover risk—the risk that an investor’s funds might not be repaid in a timely way—became extremely high.

The extreme market illiquidity did not abate until a number of extraordinary actions were taken by the Federal Reserve and others. For example, the Federal Reserve introduced the Commercial Paper Funding Facility (CPFF) to reduce rollover risk in the commercial paper market, the Federal Reserve and other central banks’ massively expanded the ability of banks to obtain dollar funding through the TAF and associated foreign exchange swap programs; the Treasury guaranteed money market mutual fund assets; and the FDIC increased deposit insurance limits and set up the Temporary Liquidity Guarantee Program (TLPG) to backstop bank and bank holding company debt issuance.

Having described “what” happened on the liquidity front during the crisis, I next want to examine, in a bit more detail, “why” it happened. To do this, I will lay out a simple conceptual framework that I will then use to assess what can be done to mitigate the risk of such runs occurring in the future. As a starting point, I will talk about how unsecured lenders react in a crisis, and then I will consider the behavior of secured lenders.

Unsecured liquidity providers run for two basic reasons. First, they run because there is a risk that the company they are lending funds to is insolvent. In other words, there is a risk that the assets will be worth less than the liabilities, creating the potential for loss to the creditor. The second reason that unsecured creditors run is the risk that they will not be repaid in a timely way. Even if the borrowing firm ultimately turns out to be solvent, there may be a delay in a lender getting its funds back, and this delay may prove to be unacceptably costly to the lender.

This second cause of liquidity runs—the risk of untimely repayment—is significant because it means that expectations about the behavior of others, or their “psychology”, can be important. This is a classic coordination problem. Even if a particular lender judges a firm to be solvent, it might decide not to lend to that firm for fear that others might not share the same assessment. The less certain any one lender is about the willingness of other lenders to provide liquidity to a firm, the greater the risk that too few loans will be extended to prevent liquidation. In that case, even if the lender turns out to be correct in its judgment of the firm’s solvency, there still will be a cost in terms of delay in receiving repayment.

A few pictures can help to illustrate these concepts. Figure 1 illustrates what a creditor’s assessment of the net worth of a financial firm might look like in normal times. Creditors have uncertainty about what that value is, thus, the valuation is represented by a probability distribution. The higher the degree of uncertainty, the greater is the degree of dispersion in the probability distribution. As long as the probability distribution is sufficiently far to the right—in other words—well within positive territory so that there is virtually no risk that the firm is insolvent, lenders will generally be willing to lend.

So what happens in a financial crisis? First, the probability distribution shifts to the left as the financial environment deteriorates and the financial firm takes losses that deplete its capital. Second, and even more importantly, the dispersion of the probability distribution widens—lenders become more uncertain about the value of the firm. These two phenomena are shown together in Figure 2. A lack of transparency in the underlying assets will exacerbate this increase in dispersion. As the degree of dispersion widens, a portion of the probability distribution falls into negative territory. This means that there is a real risk of loss for unsecured creditors if the firm were forced to liquidate its assets.

Finally, in a crisis, unsecured lenders become more uncertain about others’ assessment of the probability distribution. For example, if creditor A believes the probability distribution looks like Figure 1, but at the same time is concerned that creditor B views the probability distribution as looking like Figure 2, creditor A may pull back. If there is a risk creditor B and others will not lend, the firm may not receive sufficient funding. In other words, even if creditor A believes the firm is solvent, it may not lend because it does not want to risk a delay in repayment.

So what can creditors do to mitigate these risks? First, they can respond by charging a higher interest rate in compensation for the increase in the risk of default. However, there are a number of difficulties that limit how well this works in practice. Most significantly, by undermining the firm’s profitability, the higher interest rates may increase the risk of insolvency. If higher rates push insolvency risk up sharply, then higher rates may not be sufficient to make lending—even at higher rates—an attractive proposition.

In addition, some investors such as money market mutual funds may have a very low tolerance for risk. Thus, they may not be interested in trading off higher rates as compensation for a non-negligible increase in insolvency risk. Finally, paying higher rates may generate an adverse signal about the health of the borrowing institution. This may cause investors to become more worried about the risk of default.

Second, creditors can secure their lending—taking collateral valued at more than the amount they lend. However, this is not foolproof because secured funding can be just as vulnerable to a run dynamic as unsecured funding. For starters, the same types of uncertainties about the value of the firm may apply to the liquidation value of the collateral. This is especially the case if the collateral is lower quality and markets are already illiquid. Moreover, if creditors are left with the collateral instead of being repaid, fear of widespread collateral liquidation might further erode collateral values. If investors respond by seeking more collateral to

ensure they will be secured—that is, that they will be made whole in a liquidation scenario—the firm may run out of high-quality collateral that the firm can borrow against. This is a significant risk when a financial firm is highly leveraged and equity is only a very small proportion of total assets.<sup>5</sup>

The risks of liquidity crises are also exacerbated by some structural sources of instability in the financial system. Some of these sources are endemic to the nature of the financial intermediation process and banking. Others are more specific to the idiosyncratic features of our particular system. Both types deserve attention because they tend to amplify the pressures that lead to liquidity runs.

Turning first to the more inherent sources of instability, there are at least two that are worthy of mention. The first instability stems from the fact that most financial firms engage in maturity transformation—the maturity of their assets is longer than the maturity of their liabilities. The need for maturity transformation arises from the fact that the preferred habitat of borrowers tends toward longer-term maturities used to finance long-lived assets such as a house or a manufacturing plant, compared with the preferred habitat of investors, who generally have a preference to be able to access their funds quickly. Financial intermediaries act to span these preferences, earning profits by engaging in maturity transformation—borrowing shorter-term in order to finance longer-term lending.

If a firm engages in maturity transformation so that its assets mature more slowly than its liabilities, it does not have the option of simply allowing its assets to mature when funding dries up. If the liabilities cannot be rolled over, liquidity buffers will soon be weakened. Maturity transformation means that if funding is not forthcoming, the firm will have to sell assets. Although this is easy if the assets are high-quality and liquid, it is hard if the assets are lower quality. In that case, the forced asset sales are likely to lead to losses, which deplete capital and raise concerns about insolvency.<sup>6</sup>

The second inherent source of instability stems from the fact that firms are typically worth much more as going concerns than in liquidation. This loss of value in liquidation helps to explain why liquidity crises can happen so suddenly. Initially, no one is worried about liquidation. The firm is well understood to be solvent as shown in Figure 1. But once counterparties start to worry about liquidation, the probability distribution can shift very quickly toward the insolvency line, as shown in Figure 2, because the liquidation value is lower than the firm's value as a going concern.

There are also a number of idiosyncratic sources of instability worthy of mention, some of which are unique to our particular system. One source of instability is the tri-party repo system that I discussed earlier. Another is the convention of tying collateral calls to credit ratings. In this case, if a firm's credit rating is lowered, the firm may have to post additional collateral to its counterparties, eliminating this collateral as a potential source of funding. This phenomenon was a particularly important problem for AIG, which lost its access to the commercial paper market and was subject to increased collateral calls. Both factors caused the liquidity of the AIG parent company to be depleted very quickly. Finally, if asset volatility rises, haircuts can increase. This can lead to haircut spirals in which higher haircuts lead to forced asset sales, increased volatility and still higher haircuts.

These sources of instability create the risk of a cascade—of firms moving rapidly from the situation represented in Figure 1 to that shown in Figure 2. Once the firm's viability is in question and it does not have access to an insured deposit funding base, the next step is often a full-scale liquidity crisis that often cannot be stopped without massive government intervention.

Fortunately, there are ways to mitigate the risk of a cascade. First, we can require that financial intermediaries hold more capital. This would push the probability distribution to the right in Figure 2. With sufficient additional capital, the probability of insolvency could be reduced to a low enough level that liquidity providers would not run.

Higher capital requirements work to reduce the risk of liquidity runs, but potentially at the cost of making the process of financial intermediation much more expensive. In particular, a requirement that firms must hold more capital increases intermediation costs. Moreover, banks may respond to higher capital requirements by taking on greater risk. If an increase in risk-taking were to occur, the movement of the probability distribution to the right in Figure 2 might be offset by an increase in the degree of dispersion. Thus, higher capital requirements might not necessarily be sufficient to push all of the probability distribution above zero.

Second, regulators could require greater liquidity buffers. These buffers would help protect the firm against having to liquidate assets under duress, and would therefore help prevent the probability distribution from sliding left toward the zero line in Figure 2. But there is a cost to the firm from holding greater liquidity buffers in terms of lower returns on capital. So, requiring greater liquidity buffers would also tend to drive up intermediation costs. And, just as in the case of higher capital requirements, banks could respond by taking greater risks.

Third, regulators could implement changes that would reduce the degree of dispersion in the potential value of a firm, pushing the right tail of the distribution in Figure 2 to the left. For example, we could require greater transparency about the composition and quality of the firm's assets and liabilities. Or, regulators could increase transparency by forcing greater disclosure of the sale price of assets and/or by pushing for greater homogeneity and price discovery for products such as OTC derivatives. We could improve the quality of regulation and supervision, which would increase confidence in regulatory measures of capital and financial firms' soundness.

Fourth, the central bank could provide a liquidity backstop to solvent firms. For example, the central bank could commit to being the lender of last resort as long as it judged the firm to be solvent and with sufficient collateral. This would reduce the coordination problem and the risk of panics sparked by uncertainty among lenders about what other creditors think. If the central bank is willing to provide backstop liquidity, then a lender that judges the financial firm to be solvent should be willing to lend. The backstop liquidity ensures timely repayment. The lender of last resort role eliminates the externality in which the expectations about the willingness of one lender to lend influences the decisions of others.

However, providing a liquidity backstop is not without its own set of problems. If firms have liquidity backstops that are viewed as credible, then this creates moral hazard. Firms do not have to worry as much about what lenders think about their capital adequacy or the size of their liquidity buffers. This creates incentives to run leaner in terms of capital and liquidity, which increases the risks to the backstop liquidity provider.

To mitigate such effects, the backstop liquidity provider could presumably charge financial firms for the value of the backstop. But what fee would be appropriate? It is difficult to assess the probability of financial panics and the value of backstop liquidity facilities.<sup>7</sup>

Fifth, regulators could take steps to reduce the difference between the value of the firm dead versus alive. For example, we could improve the resolution process so that less of a firm's value is destroyed by the liquidation process. If we could reduce the difference in value between a firm as a going concern versus the same firm in liquidation we could reduce the severity of the cascade effect when financial conditions deteriorate.

Sixth, we could make structural changes to the financial system to make it more stable in terms of liquidity provision. For example, consider the three structural issues outlined earlier that amplified the crisis—tri-party repo, collateral requirements tied to credit ratings, and haircut spirals. In the case of tri-party repo, the amplifying dynamics could be reduced by enforcing standards that limited the scope of eligible collateral or required more conservative haircuts. Formal loss-sharing arrangements among tri-party repo borrowers, investors, and clearing banks might reduce or eliminate any advantage that might stem from running early. Eliminating the market's reliance on intraday credit provided by clearing banks could eliminate the tension between the interests of clearing banks and investors when a dealer becomes troubled. In the case of collateral requirements, collateral haircuts could be required to be independent of ratings.

Many of these suggestions are already in the process of being implemented. For example, the Basel Committee is in the process of strengthening bank capital in four ways: 1) higher capital requirements; 2) higher quality capital; 3) more complete risk capture; and 4) capital conservation measures, including the use of contingent capital instruments. With greater capital buffers, the risk of liquidity runs should be reduced going forward. It should be noted, however, that use of contingent capital instruments, or any other potential changes to our current capital regime, does not obviate the need for an improved resolution process.

Second, the Basel Committee is moving forward with its work in establishing liquidity standards for large, complex financial institutions. These liquidity standards would consist of two parts. First, there would be a liquidity buffer made up of high-quality liquid assets that would be of sufficient size so that the firm could manage a stress event caused by a short-term loss of investor confidence. Second, there would be rules concerning the degree of allowable maturity transformation. Long-term illiquid assets would have to be largely funded by equity and longer-term borrowing, not by short-term borrowing, such as tri-party repo.

Third, the Federal Reserve is working with a broad range of private sector participants, including dealers, clearing banks, and tri-party repo investors to eliminate the structural instability of the tri-party repo system so that tri-party borrowers are less vulnerable to runs. Exactly how the mechanics of the tri-party repo system will be adjusted is still a work in process.<sup>8</sup>

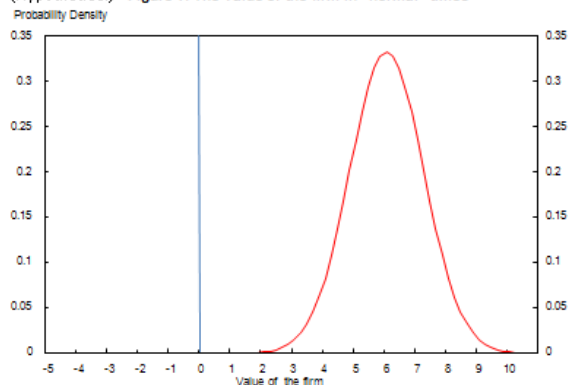
Fourth, the major U.S. securities dealers are now subject to supervision by the Federal Reserve under the Bank Holding Company Act. This means that their liquidity funding needs are subject to supervisory oversight, including stress tests, to ensure that the firms can meet large funding drains.

Liquidity risk will never be eliminated, nor should it. The preferences of borrowers to borrow long and of lenders to lend short means that the maturity transformation process generates real benefits. However, we can do better to make our system less prone to the types of liquidity runs that we have experienced. If we remain committed to implementing the reforms that are already underway, I am confident that we can dramatically reduce the risks of the type of liquidity crises that we experienced all too recently.

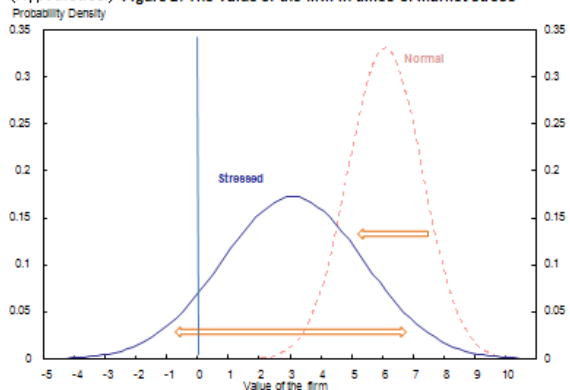
Thank you for your kind attention. I would be happy to take a few questions.



(Hypothetical) Figure 1: The value of the firm in "normal" times



(Hypothetical) Figure 2: The value of the firm in times of market stress



<sup>1</sup> The collapse of the shadow banking system, in turn, put intense pressure on commercial banks. Off-balance- sheet items came back on to bank balance sheets and the quality of bank assets fell sharply. The end result was a sharp tightening in the availability of credit that served to exacerbate the downward pressure on economic activity.

<sup>2</sup> Some dealers were further weakened by having provided significant amounts of funding to failed investment funds, which reduced the amount of funding that was available to meet other needs.

<sup>3</sup> One final factor that was important in exacerbating the funding crises was the novation of over-the-counter (OTC) derivative exposures away from a troubled dealer. In a novation, a customer asks a different dealer to stand in between the customer and the distressed dealer. This process results in the outflow of cash collateral from the distressed dealer. The novation of OTC derivatives was an important factor behind the liquidity crises at both Bear Stearns and Lehman Brothers.

<sup>4</sup> There were funding strains prior to the Lehman Brothers failure and these were most apparent in the elevated spreads evident in term LIBOR funding compared with the federal funds rate.

<sup>5</sup> Moreover, certain classes of investors such as money market mutual funds do not take much comfort in collateral. Also, the headline risk of having exposure to a troubled participant could subject investors such as money market funds to liquidity pressures of their own. Investors could withdraw funds before losses are realized.

<sup>6</sup> This problem has been largely addressed in the banking sector by deposit insurance and by providing access to lender of last resort facilities. In addition, supervisory and reporting requirements address transparency issues.

<sup>7</sup> Supervision could also be brought to bear to limit the tendency for firms to reduce their capital and liquidity when provided with a credible liquidity backstop.

<sup>8</sup> Work is also underway to shift the settlement of OTC derivative trades to central counterparties (CCPs). This is important because CCPs reduce risk exposures by netting out the offsetting exposures among the CCP participants. Also, because the counterparty risks move to the CCP rather than staying with the individual dealers, the incentive to novate—move trades away from troubled dealers—is reduced.

VIDEO