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RESPONDING to the GLOBAL FINANCIAL CRISIS What We Did and Why We Did It

The Use and Effectiveness of Conventional Liquidity Tools Early in the Financial Crisis

Bill English and Trish Mosser¹

Note: The views expressed in this draft are strictly those of the author(s).

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Introduction

Strains in financial markets related to the excesses in the housing and mortgage sectors began to show in the first half of 2007, with significant deterioration in residential real estate markets, stock market volatility, hedge fund failures, and rising losses on subprime mortgage loans. Despite this turmoil, the cost of bank short-term borrowing remained fairly stable. Then on August 9, BNP Paribas, the second-biggest bank in the euro area, announced it would no longer redeem shares in three investment funds with large exposures to U.S. subprime mortgage securities.² The bank said that liquidity in the market for such securities had evaporated, making the valuation of the securities impossible.

The Paribas announcement was only one of several negative shocks to financial markets in the summer of 2007, but it was the straw that broke the camel's back and had an immediate impact on funding markets (Figure 1). Funding costs for banks jumped amid uncertainty about both the valuation of mortgage-related assets and banks' exposures to them. The market for asset-backed commercial paper, where there was considerable uncertainty about exposures to mortgage-related assets, was particularly stressed amid a pullback by money market investors. In response, the European Central Bank (ECB) injected significant reserves—the equivalent of \$130 billion—into the euro area money markets.³ When markets opened in the United States, money markets came under strain as well, with the U.S. branches of European banks reportedly bidding up money market rates. The Federal Reserve took action, conducting open market operations that added \$24 billion of reserves to the U.S. banking system that day.⁴

The financial crisis had, in effect, begun. It was left to the Fed and other central banks to provide liquidity as the lender of last resort—the traditional role for a central bank in a crisis as Walter Bagehot outlined in “Lombard Street” in 1873.⁵

This paper is about the design, use and ultimately the inadequacy of the Fed's conventional lending tools during the first part of the financial crisis. The tools we discuss—discount window lending, the Term Auction Facility, and the single-tranche repo program—were the first line of defense for the Fed in managing the largest liquidity crisis in nearly 80 years. These conventional-authority lending programs were not only implemented first, starting that August, but at the height of the panic in late 2008, they were also among the largest lending programs, used by U.S. banks and particularly by branches, agencies and subsidiaries of non-U.S. financial institutions operating in the United States.

The conventional-authority tools were innovative adaptations of longstanding lending programs used by the Fed. The innovations took several forms, but in general they were designed to address liquidity pressures in the broad financial system. In other words, they were adapted to manage a systemic financial panic rather than to provide

² See BNP Paribas (2007).

³ See ECB (2007).

⁴ Information on open market operations is available on the Federal Reserve Bank of New York website: <https://apps.newyorkfed.org/markets/autorates/tomo-results-display>.

⁵ Bagehot (1873).

liquidity to specific institutions or to manage policy interest rates. The Fed introduced the programs on a piecemeal basis, often in short time spans and based on limited information. As a result, they had to be adjusted several times over the course of the crisis.

We start with some background and history on the Fed’s conventional authorities. Then, after describing the considerations that led to the design and introduction of the programs, we consider their impact and effectiveness. While the consensus view is that the conventional programs did ease liquidity and funding strains in key lending markets, their impact was limited and ultimately proved insufficient to halt the broader financial panic. As a consequence, the Fed turned to its emergency lending authorities as well.⁶ In the last section we discuss some of the lessons from the Fed’s experience regarding the design and implementation of liquidity facilities.

I. Background, Legal Authorities, and History

Broadly speaking, the Fed has traditionally employed two types of lending. First, under Section 10 of the Federal Reserve Act (discount window authority), the Fed can lend to a restricted set of counterparties (commercial banks and other deposit-taking institutions) against a broad set of collateral.⁷ Second, under Section 14 (open market authority), the Fed can use repurchase agreements (repos) to lend to a potentially broad set of counterparties against a narrow set of collateral (government and government agency securities and foreign exchange). In practice, however, the list of counterparties for open market operations (OMOs) was restricted to a relatively small number (about 20 at the time of the crisis) of large, global securities dealers, known as primary dealers.⁸

Historically, discount window borrowing by banks was considered the Fed’s main tool in its role as lender of last resort, although large loans were relatively rare.⁹ During previous periods of financial turmoil, such as those caused by the bankruptcy of Penn Central in 1970, the failure of Continental Illinois in 1984, the 1987 stock market crash, and the September 11, 2001, attacks, the Fed made public announcements to emphasize its willingness to meet the liquidity needs of banks with discount window loans. In part, the intention behind such lending was to use the banks to allocate the funds to their customers, allowing the Fed to minimize its role in credit allocation. But as we saw during the financial crisis, banks may not effectively pass on liquidity if they are under pressure themselves. Moreover, banks accounted for only about a third of financial

⁶ See the paper on novel lender of last resort programs for a discussion.

⁷ Below, we will refer to these counterparties as “banks.” The list of eligible collateral for discount window lending and associated haircuts are determined and published by the Federal Reserve Banks. In general, most sound bank assets can be pledged.

⁸ Primary dealers are generally large securities firms that agree to participate in Treasury auctions and Federal Reserve operations. See the Federal Reserve Bank of New York web site at: <https://www.newyorkfed.org/markets/primarydealers>.

⁹ In normal times, discount window credit is divided into “primary credit,” which is available on a short-term basis to generally sound banks; “secondary credit,” which is available on a short-term basis to banks that do not qualify for primary credit; and “seasonal credit,” which is available to smaller institutions with large seasonal fluctuations in deposits or loans. See Federal Reserve (2018).

intermediation in the United States in 2007, so the majority of the financial system had no direct access to the discount window.¹⁰

In contrast, open market authority was used on an almost daily basis to implement monetary policy by the Open Market Desk at the Federal Reserve Bank of New York (“the Desk”) on behalf of the Federal Open Market Committee (FOMC).¹¹ However, open market operation tools were occasionally adapted for emergency liquidity provision as well. For example, to alleviate potential liquidity strains in the run-up to the century date change on January 1, 2000, the Desk sold options on repo operations. In times of stress, the Desk had also conducted single-tranche repo operations under which the primary dealers could deliver any type of OMO collateral—Treasury, agency debt, or agency mortgage-backed securities (MBS)—in a single repo operation to obtain (typically term) funding. Such operations were used before the century date change and after the September 11, 2001, attacks.¹²

The financial crisis, though, was different, and the Fed found new and innovative ways to put both discount window and open market tools to use. Discount window credit was provided at a lower premium to market rates and for longer terms starting in August 2007. The Fed also created a new program, the Term Auction Facility (TAF), in December 2007, under which it auctioned fixed amounts of term discount window credit to eligible borrowers. The establishment of the TAF was coordinated with central bank liquidity swap lines, which allowed foreign central banks to lend dollars to banks in their jurisdictions.¹³ Finally, starting in March 2008, the open market desk conducted large weekly single-tranche repo operations to provide primary dealers with term funding for their agency MBS.

II. The Initial Response

The Fed’s response to the growing stress in financial markets in the second half of 2007 and the first part of 2008 started in a traditional manner. The Desk used temporary OMOs to provide additional reserves and keep the federal funds rate trading near its target. In addition, the Fed emphasized the availability of discount window credit for banks with unusual funding needs. Policymakers then eased lending policies at the discount window to encourage its use.

As noted, the efforts began in earnest after the August 9 announcement by BNP Paribas, with both the Fed and the ECB adding substantial reserves on the day. However, the following day money market conditions deteriorated. As a consequence, the ECB injected another round of reserves into the banking system, and the Desk ultimately

¹⁰ See Kohn (2008) for a discussion.

¹¹ In these normal operations, the Open Market Desk at the Federal Reserve Bank of New York conducted repos with the primary dealers to adjust the supply of reserves and keep the Federal funds rate close to the target rate set by the FOMC. Since 1999, the collateral for these operations has been Treasury securities, agency debt securities, and agency MBS. See Federal Reserve Bank of New York (2000).

¹² See the discussion below for more details on single-tranche repo operations.

¹³ See the paper on the international swap lines for a discussion.

conducted three single-tranche repo operations to add liquidity.¹⁴ That morning, the FOMC met by conference call and agreed that it would be appropriate to issue a statement acknowledging the market pressures and noting the Committee’s intention to provide the reserves required to keep the federal funds rate trading near its target.¹⁵ In addition, and consistent with past practice in times of market stress, the statement noted that: “In current circumstances, depository institutions may experience unusual funding needs because of dislocations in money and credit markets. As always, the discount window is available as a source of funding.”¹⁶

Despite this announcement, virtually no primary credit was extended through the discount window in the week ending August 15,¹⁷ and strains in money markets increased as investors pulled back from providing funding, particularly term funding, in the markets for asset-backed commercial paper and other asset-backed securities.¹⁸ The Desk continued to conduct reserve-adding operations to help keep the federal funds rate trading near target.

On the evening of August 16, the FOMC met by teleconference to discuss the situation. The Committee agreed to issue a short statement the following morning saying that, while there was no change in the stance of monetary policy, the downside risks to the economy had increased. At the same time, the Board announced a temporary easing of discount window lending policy, including a 50 basis-point reduction in the discount rate and a willingness to lend for terms of up to 30 days, renewable by the borrower.¹⁹

Taken together, these announcements acknowledged the deterioration in markets and showed that the Fed was taking steps to address the strains. Those steps were intended to give financial firms the time to assess the appropriate valuations of the troubled assets and avoid fire sales. In addition, by providing a lower-cost backstop for term funding markets, policymakers expected these changes in lending policy to help limit the tendency for investors to shorten the term of funding they would provide to banks, reducing rollover risk and making banks more willing to provide term funding to their customers.

These decisions by the Board and FOMC reflected a balancing of a number of factors. First, policymakers wanted to emphasize the distinction between monetary policy and liquidity policy. The Committee considered going further and cutting the federal funds rate. Indeed, Richmond Fed President Jeffrey Lacker, who was concerned that easing the terms of discount window credit could slow needed adjustments in financial markets, said “given the choice between a rate cut and this discount window program change, I’d rather have a rate cut.” But the economic outlook was little changed, so the Committee did not want to ease monetary policy only to support financial firms and markets because doing so could lead to moral hazard.²⁰ “I’d really prefer to avoid giving any impression of a bailout, or a put, if we can,” Fed Chairman Ben Bernanke told his fellow

¹⁴ See Bill Dudley’s report in FOMC (2007d).

¹⁵ See FOMC (2007a).

¹⁶ See FOMC (2007b).

¹⁷ See Board of Governors (2007a).

¹⁸ See FOMC (2007c).

¹⁹ See FOMC (2007d) and Board of Governors (2007b).

²⁰ See FOMC (2007c).

FOMC members.²¹ Instead, the decision was to use liquidity policy—the discount window actions—to directly address the pressures in funding markets.²²

Second, while policymakers wanted to provide liquidity, they also wanted to avoid overreacting, encouraging moral hazard. In normal times, discount window lending addressed this concern by following Bagehot’s dictum, which calls for lending to solvent banks at a high rate against good collateral.²³ Specifically, the Fed provided collateralized loans for a short term, traditionally overnight, at a penalty rate of 100 basis points above the target federal funds rate. Such lending was available only to banks qualifying for primary credit—those judged to be in generally sound financial condition. Those firms not qualifying for primary credit could turn to secondary credit at a higher cost and with more administrative oversight.

Third, policymakers realized that there was significant stigma attached to discount window borrowing, making banks hesitant to borrow from the Fed even if they faced liquidity pressures.²⁴ In part this stigma reflected the long history of the discount window as an administered facility, although the changes to the discount window announced in 2002 had been intended to make the discount window a “no questions asked” facility.²⁵ In addition, this stigma reflected in part a concern that such borrowing could become known by creditors and counterparties, and so contribute to further liquidity problems at borrowing firms. While the Fed kept the identities of borrowing firms confidential, the publication of weekly balance sheet information for each Reserve Bank would allow interested observers to see if there had been significant lending in a particular district.²⁶ That published data, along with reports from market participants, could be used to identify, or at least speculate about, which institutions were borrowing.

However, policymakers judged that stigma would be reduced if the penalty rate at the window were cut. In addition, by emphasizing in their statement that the changes in discount window policy were being made temporarily in response to significant market strains, policymakers hoped to encourage banks to see borrowing at the discount window as appropriate given the unusual circumstances.

Some consideration was given to cutting the primary credit rate by 75 basis points, rather than 50 basis points, to further counter stigma. However, that possibility raised a fourth consideration: Since the extent of the stigma was not known, some policymakers were concerned that a 25 basis point spread of the discount rate over the federal funds target rate could lead to large and variable draws on discount window credit that would be difficult to manage in the federal funds market, perhaps undermining the Desk’s control over the federal funds rate.²⁷ Moreover, with primary

²¹ See FOMC (2007c).

²² See FOMC (2007c).

²³ Bagehot (1873). See also Madigan (2009) and Tucker (2014).

²⁴ For a discussion of stigma at the discount window, see Carlson and Rose (2017).

²⁵ See Madigan and Nelson (2002).

²⁶ Under provisions of the Dodd-Frank Act, the Federal Reserve is now required to publish the names of discount window borrowers with a two-year lag. As discussed below, concern about that publication will likely increase stigma in future periods of market stress.

²⁷ Note that the Federal Reserve did not have the authority to pay interest on reserves at this time, and so, to the extent that the strains reflected a misallocation of reserves rather than a shortfall in aggregate

credit available for a 30-day term, and term spreads in the federal funds market sharply higher, such a narrow spread could contribute to moral hazard, since the discount window might be an attractive funding source for some banks, particularly smaller and weaker institutions that faced higher funding costs. That being said, policymakers noted that the effectiveness of the changes in discount window lending policy was not clear, and generally agreed that the appropriate level of the primary credit spread might need to be revisited.²⁸

Unfortunately, the stigma attached to discount window credit was more substantial than policymakers had hoped, and banks were not willing to come to the window even on the new terms. In an effort to improve the effectiveness of the discount window, policymakers reached out to a few larger banks to encourage them to borrow in hopes that such borrowing would help to reduce stigma.²⁹ In the end, four large institutions did come to the window for \$500 million each, but in public statements they said that they had done so only as a demonstration, and they repaid the bulk of the loans quickly.³⁰

One reason why banks may have limited their discount window borrowing was the availability of term credit from the Federal Home Loan Banks (FHLBs).³¹ In the summer and fall of 2007, the terms on FHLB advances were attractive relative to the prevailing terms in the market for many institutions, and such advances were less costly than discount window credit and available at longer maturities. As a consequence, the total volume of advances increased sharply as conditions deteriorated in the final months of 2007.

But the willingness and ability of the FHLBs to provide liquidity was undermined by subsequent market events. Following the failure of Bear Stearns, the FHLBs increased the haircuts imposed on collateral provided for advances, reflecting tighter private funding conditions for high-risk mortgage assets. (By contrast, the Fed did not change its discount window haircuts during the crisis.) As the crisis deepened in the summer and fall of 2008, the distress and eventual conservatorship of Fannie Mae and Freddie Mac—two other large housing-related government-sponsored enterprises (GSEs)—was accompanied by pressures on the funding of the FHLBs. In response the Fed purchased discount notes issued by the GSEs, including the FHLBs, in September 2008. Lending by the FHLBs peaked in that month at roughly \$1 trillion before falling back, even as lending by the Fed increased vastly as the crisis accelerated.

reserves, the Desk would have to offset the effect on reserves of discount window lending and all other lending programs by undertaking redemptions and sales of Treasury securities and reverse repo (borrowing) operations. In practice this is what the Desk did to offset the reserves impact of all lending programs until October 2008.

²⁸ See FOMC (2007e).

²⁹ Bernanke (2015), pp. 150-151.

³⁰ See JP Morgan Chase (2007).

³¹ This paragraph follows the discussion in Ashcraft et al. (2010) regarding the liquidity provided by the FHLBs during the crisis.

III. Additional Steps: The Term Auction Facility and Swap Lines

As early as August 2007, staff at the Fed began to work on alternative ways to provide discount window credit to combat stigma. In 2001-2, as part of its work on how to implement monetary policy if the supply of Treasury securities proved insufficient for its repo operations, the Fed had examined the possibility of an Auction Credit Facility under which discount window credit would be auctioned to banks on a regular basis.³² Those plans were repurposed in 2007 as a lender of last resort facility, called the Term Auction Facility, or TAF.

An auction approach to providing discount window credit had three significant benefits.³³ First, by auctioning credit periodically, the amount of discount window credit would be known in advance (assuming the auctions would be fully subscribed). As a result, the Desk could plan other operations to offset the effects of the TAF credit on aggregate reserves, and so manage the federal funds rate. Second, using an auction could help diminish stigma. Since the auction would be open to many institutions and the price would be set based on the bids, there could be safety in numbers. That is, banks would not wait for others to borrow before going to the window, but all could borrow at the same time, reducing the risk that borrowers would become known. In addition, borrowing at an auction could be seen as simply borrowing at a market-determined rate, not at a penalty rate. Perhaps more important, the auction process took some time to complete, with funds from a given auction disbursed three days later—meaning that those borrowing at an auction did not need to have immediate funds, limiting concern that creditors and counterparties might have about the financial health of such banks. Indeed, banks couldn't be sure that they would win at the auction—and if they didn't win, they needed to have an alternative source of funds. Third, the Fed could gain insight into funding pressures by observing the bidding behavior of banks at the TAF.

In addition to the TAF, the Fed considered a number of other policies. These options included a reduction in the target federal funds rate, a further reduction in the spread between the primary credit rate and the funds rate target, and the introduction of a new term lending facility independent of the primary credit program and potentially with different terms and conditions. However, all of these options had significant shortcomings. The Committee continued to view monetary policy and credit policy as distinct tools with separate objectives. A reduction in the federal funds rate would be called for to manage the real economic effects of the market strains, but was not seen as an appropriate policy to address the strains directly.³⁴ And a further reduction in the discount rate spread was still seen as potentially causing higher and more volatile use of the window, making monetary policy implementation more difficult. It could also lead a large number of smaller banks to turn to the discount window because of its relatively low cost, potentially overwhelming discount window administration. A demand-driven term lending facility, under which banks could choose when to borrow term funds and in what volume, was also seen as raising complications for monetary policy implementation

³² See Federal Reserve System Study Group on Alternative Instruments for System Operations, 2002.

³³ The material discussed in this paragraph and the next is drawn from FOMC (2007e) and FOMC (2007f).

³⁴ See the paper on the monetary policy response for a discussion of the gradual changes in the Fed's economic outlook as the crisis progressed.

and, if the rate were not greatly reduced, as unlikely to overcome stigma as effectively as the auction format.

Another policy option discussed first in August 2007 was the establishment of liquidity swap lines with foreign central banks.³⁵ Much of the liquidity pressure in dollar funding markets reflected difficulties that foreign banks, in many cases in Europe, had in obtaining dollar funding for their large holdings of dollar-denominated assets, including asset-backed securities that had become relatively illiquid. While discount window credit could assist such foreign banks so long as they had U.S. operations to borrow from the Fed, such loans raised questions about the ability of the Fed to assess the solvency of the parent institution. Swap lines could address that issue by allowing the Fed to provide dollars to a foreign central bank, which would in turn on-lend the dollars to banks in its jurisdiction. (See the paper on the swap lines for additional discussion.)

By the time of the September FOMC meeting, market conditions had eased somewhat, and the Committee judged that additional liquidity policy was not required at that time. Over the course of the fall, though, investors continued to pull back from a range of term funding markets, particularly those for asset-backed commercial paper conduits and structured investment vehicles.³⁶ Term funding was increasingly shortened to overnight lending and term funding costs for banks, which had fallen slightly in the early fall, rebounded to new highs by late November, reflecting in part concerns about year-end funding conditions as well as the liquidity and financial strength of banking institutions.

Against that backdrop, the FOMC once again discussed the possibility of implementing a TAF and establishing swap lines with foreign central banks (specifically, the ECB and the Swiss National Bank) at meetings in December 2007.³⁷ As a possible alternative, the Committee considered the use of term repos with the primary dealers to support their funding and add additional reserves, at least over year-end. Such an approach would be more conventional, and so might reduce the risk that investors would become more worried about the outlook based on the highly unusual actions taken by the Fed. However, Chairman Bernanke noted, “there is a problem with dollar funding in Europe... It creates problems in other markets.” But he also indicated that, while it would be desirable for the ECB to use a swap line to lend dollars to European banks, the ECB was “...unwilling to do that except in the context of some kind of broader operation.” Thus, if Fed policymakers were inclined to employ the swap lines, then they would likely need to implement the TAF as well.

On balance, most policymakers were inclined to go forward with the two new programs, and the bulk of the discussion focused on the specific provisions to be employed. With regard to the TAF, the key decisions were the size of the program and the minimum rate to be charged. On the one hand, the extent of stigma was uncertain, and it was possible that bidding for TAF funds would be light. On the other hand, a

³⁵ Liquidity swap lines had been established the Fed and the ECB and the Bank of England (and the existing line with the Bank of Canada was increased in size) after the September 11 terrorist attacks. The lines expired after 30 days, and only the ECB drew on its line and for only three days. See Kos (2001).

³⁶ See Covitz, Liang, and Suarez (2013) for a discussion of the collapse of the ABCP market.

³⁷ The material discussed in this paragraph and the next is drawn from FOMC (2007f) and FOMC (2007g). Logistically, the swap lines were a decision by the FOMC, while the TAF was a decision by the Board of Governors.

larger auction amount would presumably lead to a lower stop-out rate and so reduce stigma and encourage participation. And given the large size of U.S. money markets, a small program might have only a limited effect on pricing. William Poole, president of the St. Louis Fed expressed the concern that, “at the margin [the TAF at the proposed size] doesn’t do anything to change banks’ funding costs.” But Chairman Bernanke responded, saying: “Well, this may not be big enough ... one of the advantages of this [is] that we can scale it up potentially quite a bit.” In the end, policymakers chose to maintain flexibility on the size of the program by leaving the size of TAF operations up to the chairman, based on a recommendation by the desk manager.

Regarding the minimum bid rate, policymakers noted that allowing lower minimum bid rates could encourage participation in the auctions, but some worried that if demand was weak the resulting low stop-out rates could contribute to moral hazard. Given these cross currents, policymakers set the minimum bid rate as the overnight index swap rate over the same period, meaning that winning bidders should not get funds at a cost below what they could expect by borrowing on a daily basis in the federal funds market. There was also considerable discussion regarding the maximum size of bids. To ensure that the number of winning firms at each auction was not too small, and so limit possible problems with stigma, policymakers decided that each firm could bid no more than 10 percent of the total size of the auction. In addition, the maximum TAF bid was limited to half the bidder’s collateral pledged to the discount window to insure sufficient collateral remained for daylight overdrafts and regular discount window borrowing. At the same time, there was concern that the program be available to smaller banks, and so the minimum bid was set at \$10 million (and subsequently reduced to \$5 million).³⁸

Policymakers also discussed whether the standards for banks to participate in TAF auctions should be tighter than the “generally sound financial condition” required for access to primary credit. A tighter standard could help limit the Fed’s risk, but it could further stigmatize traditional primary credit. Moreover, judgments about the condition of financial institutions were challenging under the circumstances, and so some institutions that would benefit from the TAF might not be able to use it. Also, it was emphasized that Reserve Banks always have the right to refuse to make loans that would not be sound, allowing them to protect themselves from riskier firms. In the end, the primary credit standard was used for TAF as well.³⁹

The first TAF operation, held on December 17, 2007, auctioned \$20 billion of 28-day discount window credit.⁴⁰ The next day, the ECB allocated \$20 billion drawn under the new swap line to euro area banks at the same rate established at the TAF auction, and the Swiss National Bank auctioned \$4 billion using proceeds from its swap line. In the United States, the first TAF auction suggested it succeeded in managing stigma. There were 93 bidders, with total bids of more than \$60 billion. Thirty-one banks

³⁸ A system for noncompetitive tenders was considered but never adopted.

³⁹ To simplify the Desk’s efforts to offset the effects of TAF funding in reserves markets, the auctions were conducted every other Monday, with funds disbursed on the following Thursday, the first day of the subsequent reserve maintenance period, and with a term of 28 days—that is, two 14-day maintenance periods.

⁴⁰ Board of Governors (2007c).

obtained funds, at a stop-out rate of 4.65 percent—40 basis points over the target federal funds rate and 48 basis points over the minimum bid rate.⁴¹

Perhaps more important, the coordinated actions by multiple central banks sent a clear message that the funding pressures were global and would be jointly addressed, a practice that continued throughout the crisis.⁴² By the end of January 2008, the total amount of TAF funding outstanding was \$60 billion, reflecting two overlapping auctions of \$30 billion each.⁴³

IV. Next Steps: Early 2008

Despite the central bank actions, mortgage securities, particularly those backed by high-risk mortgages, continued to impose significant losses on banks, mortgage originators, investors, dealers, and mortgage insurers. The impairment and eventual failure of several mortgage insurers caused large declines in the credit ratings of mortgage securities backed by high-risk mortgages and great uncertainty about their future valuations. As a result, high-risk mortgage securities could not be financed in repo and other secured funding markets. The largest securities firms faced both declines in the value of important assets and the loss of a key funding source for the same assets. In turn, investors became increasingly concerned about the financial strength of major securities firms, most notably Bear Stearns, which had a particularly outsized role in high-risk mortgage markets.

By early March 2008, the withdrawal of funding in repo markets—particularly the tri-party repo market—became a run.⁴⁴ While all securities firms lost some repo funding for MBS, the run was particularly intense over the next two weeks for Bear Stearns. Even agency MBS (which had explicit or implicit U.S. government backing) were increasingly difficult to fund via repo markets. The spread between one-month repo rates using agency MBS collateral and Treasury collateral, typically about 20 basis points, rose to nearly 140 basis points by early March 2008.

⁴¹ See the TAF data published by the Federal Reserve at <https://www.federalreserve.gov/regreform/reform-taf.htm>. The one-month OIS rate was low relative to the target federal funds rate at the time because market participants expected the FOMC to cut rates at its December meeting.

⁴² For additional information on international coordination across central banks, see the papers on the swap lines and on other international issues.

⁴³ To make its provisions of credit to banks more effective, the Fed provided a number of larger institutions with temporary exemptions from Section 23A of the Federal Reserve Act, which limits the ability of banks to lend funds to affiliates. In the first half of 2007, the Fed had granted only two such exemptions. However, in the second half of the year it granted seven new exemptions and modified one, and it provided 12 more in 2008. See the paper on legal issues for additional discussion.

⁴⁴ The tri-party repo market is a market in which repo transactions between two counterparties are facilitated by a clearing bank that has both counterparties as customers. Broker-dealer firms use the tri-party repo market to fund both their own securities holdings and those of their customers. At the time of the crisis, tri-party repos totaled about \$2.8 trillion, with much of the financing at short maturities. See Brickler, Copland, and Martin (2011).

To address the strains in mortgage funding markets, the Fed expanded the size of TAF auctions and introduced a single-tranche repo program.⁴⁵ As noted earlier, single-tranche repo operations are a variation on standard open-market operations often used in times of market stress.⁴⁶ In standard OMO, repo lending is auctioned separately for each type of eligible collateral (Treasury, agency debt, and agency mortgage-backed securities). By contrast, a single-tranche repo operation is simply an auction of repo lending against all collateral types together, and so lending is overwhelming against the least liquid and riskiest collateral allowed: agency MBS.

While single-tranche repo operations are a traditional monetary policy implementation tool, the March 2008 single-tranche repo program used the tool in a new way. The operations were not needed to control the federal funds rate, instead they were conducted as a lender of last resort facility for the primary dealers, including some of the largest global financial intermediaries. The Desk auctioned \$15 billion of single-tranche repo each week in March and expanded the program to \$20 billion per week in April 2008, with the facility reaching a total size of \$80 billion.⁴⁷

Like the TAF, the large increase in Fed lending through the single tranche repo program could have significantly increased the quantity of excess reserves, making it difficult to keep the federal funds rate at the FOMC's target. To avoid that outcome, the program was expanded gradually, and the Desk redeemed and sold Treasury securities from the permanent portfolio and conducted reverse repo operations to control the size of the Fed's balance sheet, and so the fed funds rate.⁴⁸

V. Subsequent Developments

With the conventional tools already heavily engaged, the Fed turned to its emergency lending authority under Section 13(3) of the Federal Reserve Act as market conditions continued to deteriorate. To provide further support for broker-dealers, the Fed introduced newly created programs like the Term Securities Lending Facility (TSLF) and the Primary Dealer Credit Facility (PDCF) in March 2008, and a panoply of additional lending programs following the failure of Lehman Brothers in the fall. (These programs are discussed in the paper on novel lender of last resort programs.)

⁴⁵ The facility was proposed in a memo to the FOMC on the evening of March 6, 2008, and implemented the following morning, March 7, 2008. See Bernanke (2015) and Board of Governors (2008a).

⁴⁶ In a standard operation, the trading desk at the New York Fed offers at auction repo lending (typically with overnight maturity) against three types of collateral: Treasury securities, agency securities, and agency MBS. Bids from the primary dealers for a standard repo operations are sorted into three tranches based on the type of collateral: one for Treasury securities only, a second for Treasury and agency debt securities, and a third for all three types of collateral.

⁴⁷ The original memo from the open market desk to the FOMC proposed auctions of only \$10 billion per week. The program's potential size was increased to \$25 billion per week, or \$100 billion total, at the request of Chairman Bernanke, but its maximum size never exceeded \$80 billion. See Bernanke (2015).

⁴⁸ See FOMC (2008) for a discussion of impact of the single tranche repo program on the reserves market and monetary policy operations.

Use of the conventional tools continued to expand, however. As noted earlier, the spread of the primary credit rate over the funds rate target was cut to 25 basis points in March, and the term of primary credit loans was extended to 90 days.⁴⁹ The size of TAF auctions was greatly increased, and the Fed introduced 84-day TAF operations in August in addition to the previous 28-day operations. In the fall, the size of TAF auctions was increased to such a degree that bids fell short of the auction sizes, and the rate on TAF loans fell to the minimum bid rate.⁵⁰

By contrast, the size of the single-tranche repo program remained at \$80 billion through the end of 2008. There was no need to increase the size of the program, since the PDCF and TSLF both provided credit to the same counterparties against a broader range of collateral. The single-tranche program was phased out starting in December 2008, following the announcement that the Fed would undertake outright purchases of agency MBS for its permanent portfolio.⁵¹

All in all, the Fed's lending operations (including the discount window, TAF, single-tranche repo program, 13(3) facilities, and swap lines) peaked near \$2 trillion at the end of 2008. Of this total, more than \$600 billion was accounted for by the discount window, TAF, and single-tranche repos (Table 1). Thus, despite their conventional nature, these tools provided about as much liquidity as either the central bank swap lines or the 13(3) facilities.

Many of the Fed's lending programs had been priced so that they would be unattractive under normal market conditions. As market strains eased borrowing from the Fed fell back. However, given the relatively narrow 25 basis point spread of the primary credit rate over the target federal funds rate, it was subject to adverse selection over time as some smaller and weaker institutions found the window attractive even as market functioning improved. In November 2009, the Fed announced that the maturity of primary credit loans would be shortened to 28 days in early 2010, and on February 19, 2010, the Fed increased the discount rate spread to 50 basis points and returned the term of discount window loans to overnight.⁵² Following these two changes, the volume of outstanding primary credit gradually fell back close to zero. Similarly, the minimum bid rate at TAF auctions represented low-cost funding for some firms, and they also continued to borrow from the Fed despite improved market conditions. The Fed gradually reduced the size of TAF auctions, and on February 18, 2010, the minimum bid rate was increased by 25 basis points to 50 basis points. The final TAF auction, for \$25 billion of 28-day credit, was held on March 8, 2010, with take up of only \$3.4 billion.

VI. International Usage

From the beginning of the crisis, funding market strains were particularly intense for non-U.S. financial institutions. The U.S. dollar serves as the benchmark currency for pricing of financial assets globally, the dominant international reserve currency, and the

⁴⁹ Board of Governors (2008b).

⁵⁰ The minimum bid rate was the OIS rate until early 2009, when it was changed to the interest rate paid on reserve balances.

⁵¹ See the paper on the monetary policy response for a discussion of the large-scale asset purchases.

⁵² See Board of Governors (2010).

primary currency used in financing international trade. As a result, going into the crisis the largest non-U.S. global banks had large books of lending and investments denominated in U.S. dollars. They regularly funded their dollar assets through the commercial paper, repo, Eurodollar, and foreign exchange swap markets, but unlike U.S. banks, they typically did not have a U.S. dollar retail deposit base to rely on for relatively stable funding. Instead, they relied on U.S. banks and investors, particularly money market mutual funds, to obtain the dollars they needed.⁵³

As the funding stresses accelerated over the course of the crisis, non-U.S. banks were particularly hard hit and became the largest borrowers from the Fed's conventional-authority facilities. Foreign banking organizations (including branches, agencies, and subsidiaries) accounted for about 85 percent of discount window credit from the start of the crisis through the end of 2009 (Figure 5). Similarly, foreign banking organizations accounted for more than 60 percent of TAF borrowing over the life of that program, and usage of the single-tranche repo program by broker-dealer subsidiaries of foreign banking organizations accounted for about 75 percent of the total (Figures 6 and 7). Of course, foreign banks also borrowed dollars from foreign central banks that had been provided by the Fed through the central bank swap lines. By December 2008, direct borrowing by non-U.S. banks from the Fed through the discount window, the TAF, and the single-tranche repo program plus their indirect borrowing via the swap lines amounted to about \$900 billion or more than 75 percent of the funds provided by the Fed through those facilities (Table 1).

VII. Evaluating These Tools

Evaluating the effectiveness of the Fed's liquidity provision early in the crisis is difficult. Clearly, the actions taken were not sufficient to head off the much deeper financial crisis that unfolded. But given the financial system's exposures to housing-related assets, the uncertainty about those exposures, and the ultimate size of the losses incurred, better outcomes may have been difficult to achieve given the Fed's limited authorities, short of 13(3) lending. That said, the early steps did ease strains in funding markets relative to what would otherwise have happened.

Efforts by economists to evaluate the effectiveness of the TAF program have produced mixed results. As noted above, the TAF did appear to reduce the stigma associated with discount window lending.⁵⁴ But empirical tests of the effects of TAF lending on term spreads raise difficult issues of identification. The TAF was introduced in response to mounting market strains, and so any positive effects of the TAF may be hard to disentangle from the underlying deterioration in markets. For example, Taylor and Williams (2009) use simple regression tests to see if TAF auctions helped reduce term spreads, and they find no statistically significant effect of the TAF over the period from its introduction through August 2008. However, this result is fragile, depending on the details of the regression test used. McAndrews et al. (2017) employ a more flexible

⁵³ See Baba et al (2009) for a discussion.

⁵⁴ See Armentier et al. (2008) and Armentier et al. (2015) for further discussion of the TAF and its effects on stigma.

test, and they find that announcements about the size and duration of the TAF program did help to reduce LIBOR-OIS spreads.

More broadly, the purpose of the discount window and TAF was to ease strains in financial markets and so improve the flow of credit to businesses and households. Recent work by Berger et al. (2016) suggests that discount window credit and the TAF did indeed help achieve those objectives. Using data on individual banks, they find that Fed credit was associated with a reduction in funds obtained from other sources and an increase in loans by the borrowing banks. While it is hard to be confident of the identification of the effect on aggregate lending, the results suggest that the TAF had the desired economic effects.

In short, the TAF appears to have been successful in combating stigma, encouraging banks facing funding pressures to obtain financing from the Fed. And there is evidence that the Fed's lending helped ease strains in funding markets more broadly and may have supported economic activity.

The single-tranche repo program was simple to announce and implement and was well-understood by the primary dealers, with no stigma attached to its use. More important, given the speed with which market conditions deteriorated in early March 2008, the single-tranche repo program had the advantage of immediate implementation, in contrast to the time taken to design and implement new lending programs, such as the TAF and the 13(3) lending facilities.

While there are no published studies of the impact of the single-tranche repo program, it was successful in providing term funding for agency MBS, a market that was impaired because of the disruptions in mortgage markets, and increasing the supply of Treasury securities in the market, which were in high demand for the same reason. Specifically, information on operations and repo spreads suggest the program had an immediate positive impact on liquidity and funding strains in some parts of the repo markets. One-month repo spreads for agency MBS collateral, which had risen in late February and early March, fell almost immediately, although they spiked higher again in the week prior to Bear Stearns' collapse.⁵⁵ As can be seen in Figure 3, MBS repo spreads did not stabilize until late March, when the single tranche repo program, the TSLF, and the PDCF all had been put in place. Early demand for borrowing in the single-tranche repo program was high (up to five times the quantity auctioned), but it slowly diminished as the program grew, the 13(3) facilities were put in place, and funding market tensions eased in the spring and summer. Ultimately, the program's impact was likely quite limited because allowable OMO collateral was too narrow to provide a sufficient backstop to repo markets.

Taken together, the discount window, the TAF, and the single-tranche repo program provided important term funding to key financial intermediaries, and particularly the large financial firms that made up the core of the global financial system. But policymakers judged that only limited amounts of the liquidity provided by the Fed to

⁵⁵ See Federal Reserve Bank of New York (2009).

these firms was being passed on to their customers.⁵⁶ The lack of liquidity pass-through likely reflected concerns about capital adequacy given uncertainty around future losses on mortgage-related assets, which reduced the willingness of intermediaries to lend. For the same reasons, counterparty risk for individual firms rose sharply, increasing the uncertainty they faced regarding future access to funding, and leading them to conserve their liquidity and not lend to others.

VIII. Conclusions and Lessons Learned

In the end, the Fed’s conventional lender-of-last-resort authorities proved inadequate to manage a systemic event of the size seen in 2007-9 and in a market-based financial system such as that of the United States. The kaleidoscope of financial markets and institutions in the U.S. financial system is inconsistent with the lender of last resort framework that allows only depository institutions to borrow against a broad range of collateral and limits all others to borrow via repo against a very narrow set of collateral. As a result, facilities based on 13(3) lending authorities had to be used to provide funds to a range of firms and markets, and ultimately government capital was required to stem the crisis. That said, the Federal Reserve’s experience with its conventional lending authorities suggests some lessons for liquidity provision by central banks in the future.

LESSON 1: CENTRAL BANKS HAVE A UNIQUE ROLE. The U.S. experience during the crisis showed that the central bank is ultimately the only entity with the ability and the mandate to provide essentially unlimited emergency liquidity when the financial system is under extreme pressure. The experiences of the Federal Home Loan Banks, Fannie Mae, and Freddie Mac are instructive. These housing-related GSEs came under significant pressure or collapsed, and the Fed ultimately provided support by purchasing their discount notes in September 2008.

LESSON 2: PLAN IN ADVANCE. Since the central bank must stand ready to provide emergency liquidity it should plan how it would do so. Prudent risk management, good policy design and an assessment of a program’s impact take time. The Fed should design systemic liquidity facilities in advance and regularly test them. There is precedent for such testing. The FOMC authorizes the Desk to periodically conduct tests, called “small value exercises,” of policy tools that are not used currently, but may be needed in the future.⁵⁷ Lender-of-last-resort facilities for systemic liquidity provision should be designed and tested in a similar way.⁵⁸

Planning and testing should take account of a range of issues. First, they should include an assessment of the scalability of the facilities so that they can be opened to a larger group of counterparties if needed, for example to ensure that access does not favor some class of firms (e.g., larger or more complex firms). Second, planning should include

⁵⁶ See, e.g., Bernanke 2009. The results on the effects of the TAF and discount window on lending in Berger et al. (2016), while statistically significant, are not very large.

⁵⁷ See for example, Federal Reserve Bank of New York (2018).

⁵⁸ For example, the Bank of England has provided information on how it would provide liquidity in a future crisis in its Sterling Monetary Framework. See: <https://www.bankofengland.co.uk/markets/the-sterling-monetary-framework>.

interactions with monetary policy implementation to ensure that the use of the lending facilities in size would still allow the Fed to implement monetary policy effectively. As noted above, decisions about the implementation of liquidity programs were affected by the need to control the federal funds rate, sometimes constraining the crisis response.⁵⁹ But with sufficient advanced planning, management of the policy interest rate is feasible even with a large balance sheet.⁶⁰

More broadly, the Fed should design and test emergency facilities that can be adapted so that they remain effective as the structure of the financial system evolves. For example, the Fed could consider ways to expand the range of financial firms to which it could lend under open market authority in a systemic event. This would reduce the risk that liquidity is stuck inside a particular set of counterparties and improve the Fed's ability to provide liquidity across the financial system in a crisis.⁶¹ By planning in advance, the Fed could better manage the risks associated with additional counterparties and shorten its response time in a crisis. In a large systemic event, however use of 13(3) lending facilities would almost certainly be needed as well.

LESSON 3: PLAN INTERNATIONALLY. As noted above, much of the borrowing from the Fed during the crisis was by foreign firms. Moreover, the role of dollar in global finance has, if anything, become more important in recent years.⁶² Thus, in a future crisis, it is likely that the Fed will once again need to consider how to provide liquidity to banks based in other countries. In addition to existing central bank liquidity swap arrangements, advance discussions with foreign central banks are needed to clarify the responsibilities of home and host central banks when directly lending to internationally active banks during a crisis. The appropriate roles of home and host central banks most likely depend on whether the problems are at a single troubled firm, or are systemic, but it would be useful to reach at least a rough meeting of the minds on how different cases might be handled.

LESSON 4: IMPLEMENT EARLIER. Earlier implementation of lending programs could have made them more effective. Of course, the potential benefits of responding more rapidly would need to be weighed against the possible moral hazard costs of blunting private incentives to manage risks. But, the TAF and the swap facilities were implemented more than four months after the first run in the ABCP market, allowing a downward cycle of rapid deleveraging, withdrawal of short-term funding, and fire sales to build and eventually accelerate through 2008. If the TAF had been implemented earlier, it would have provided term liquidity earlier, potentially slowing the deterioration in term funding markets and allowing more time for orderly deleveraging.

Some of the delay was because of operational implementation of TAF, but a portion reflected an understandable reluctance on the part of policymakers to announce and explain an untested lending program. Moreover, the high hurdle and legal requirements

⁵⁹ These issues are discussed further in the paper on the novel lender of last resort policies.

⁶⁰ As demonstrated by the FOMC's "Normalization Principles and Plans". See FOMC (2014).

⁶¹ Using a very large group of counterparties for traditional open market operations is unwieldy and unnecessary in normal times, but the ability to expand such operations to lend to a broad set of counterparties—for example commercial banks, broker-dealers, asset managers, insurance companies, and finance companies—would improve the Fed's ability to provide liquidity broadly.

⁶² See BIS (2007) and McCauley et al (2015).

required for use of 13(3) authority by the Fed will necessarily cause delay, so earlier implementation of liquidity facilities using conventional authorities may be particularly important to help slow funding withdrawals and reduce the odds that they become a panic. This reinforces Lesson 2 above.

LESSON 5: MANAGE STIGMA. Liquidity provision during the crisis was difficult in some cases because of the stigma associated with borrowing from the Fed. Moreover, the Dodd-Frank Act has most likely increased this stigma. The Fed is required to publish the names of borrowers with a two-year lag, and to provide congressional leaders with information on recipients of emergency credit within a week. Given the widespread public criticism of borrowing from the Fed following the crisis and concerns that information provided to the Congress could leak, firms will be hesitant to come to the Fed in a future crisis. The U.S. experience with the TAF as well as cross-country comparisons of the design of central bank lending facilities suggest a few key design features that could help minimize stigma. First, use auctions or tenders. Having all firms bid for funding at the same time provides common cover for all borrowers. Standing facilities, where firms individually decide to borrow are more likely to have stigma. Second, familiarity with facility design and structure can reduce stigma. The fact that the single-tranche repo program was executed “just like an OMO” appeared to reduce the stigma associated with it. (The same observation applies to the TSLF.) This is an additional rationale for Lesson 2.

LESSON 6: MANAGE MORAL HAZARD. Government backstop facilities, including lender of last resort facilities, always have moral hazard costs. Broad liquidity provision in a crisis is no exception, and moral hazard is a particular concern if new counterparties without comprehensive regulation and prudential supervision are given access to central bank liquidity facilities. Access rules for central bank facilities can help address such concerns. In addition, the pricing of lending facilities as well as the collateral policies, such as haircuts, are also important moral hazard mitigants.

A long-standing principle to mitigate moral hazard is that central bank lending rates and collateral haircuts should be conservative. Both should be set at levels that are high relative to those in normal market conditions, but below those demanded by private lenders in a crisis. Such policies reduce moral hazard by making borrowing from the central bank unattractive in normal times. Higher haircuts also help protect the central bank from credit risk by acknowledging that loans will often be made during times of financial market stress, when asset prices are volatile and the intrinsic value of collateral is difficult to judge.

In practice, the Fed’s lending rates and haircut policies varied significantly across the facilities introduced during the crisis, which potentially allowed counterparties to benefit from the differences.⁶³ That said, it would not be appropriate for collateral rules and lending rates to be identical for all programs given their different legal authorities,

⁶³ For example, the dollars provided by the swap lines were priced at penalty rate, while the TAF auctions offered a lower rate for most of the crisis period. As a result, weaker banks borrowed greater amounts for a longer period of time (into 2010) from the TAF, while usage of swap lines naturally declined as market conditions improved.

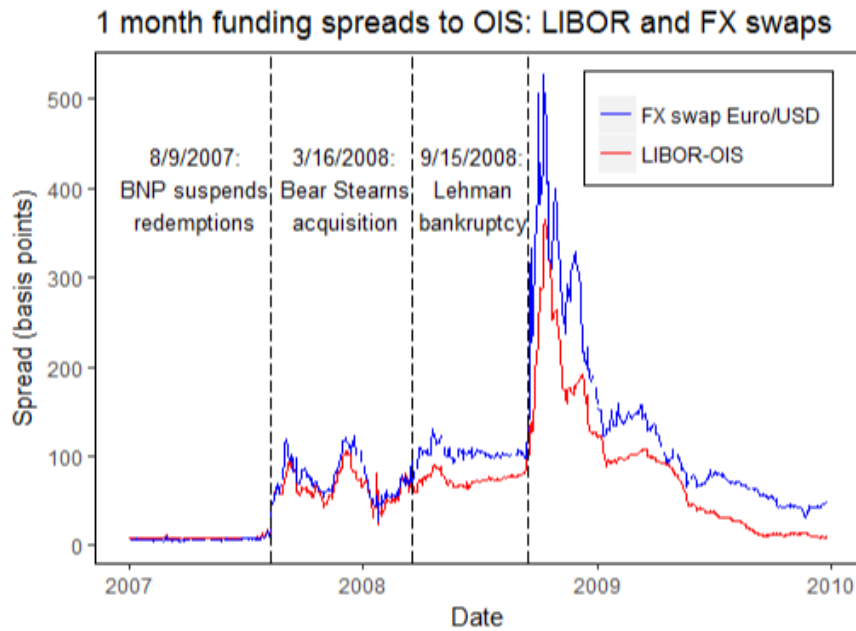
structures, counterparties, and risk profiles. But consistency on these issues should be considered as part of the planning process.⁶⁴

In short, more advanced planning for emergency liquidity provision is needed. While supervisory and regulatory changes put in place after the crisis should help to reduce the odds of another crisis emerging that would require emergency liquidity provision by the Fed, it seems unlikely that these measures will be completely effective. Thus, it is appropriate for the Fed and other central banks to plan now when markets are calm for how to best protect their economies from future periods of market turbulence and systemic crisis.

⁶⁴ For example, discount window collateral policies were different from collateral requirements in open market operations and the emergency facilities.

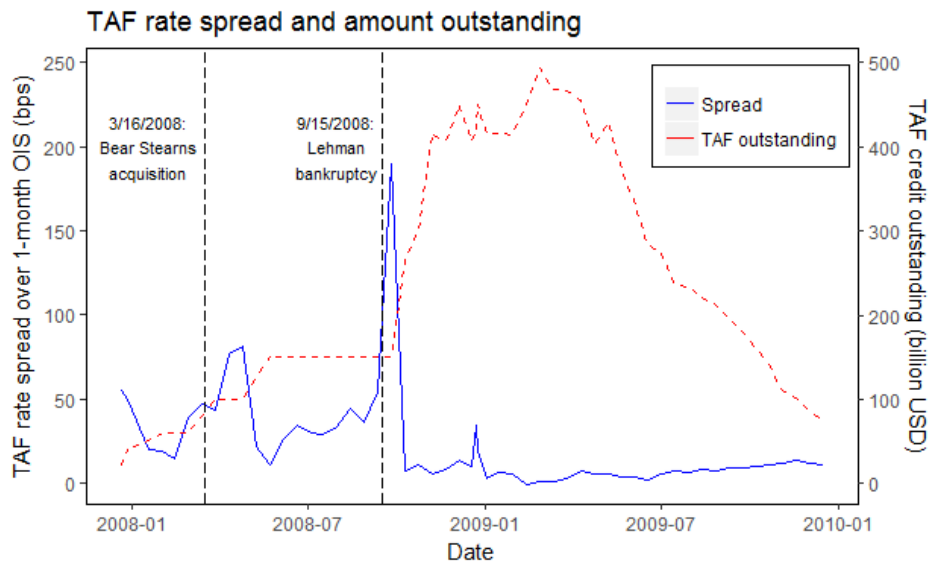
Figures and Tables

Figure 1



Source: Bloomberg and author calculations.

Figure 2



Source: Bloomberg, Federal Reserve Board, and author calculations.

Figure 3

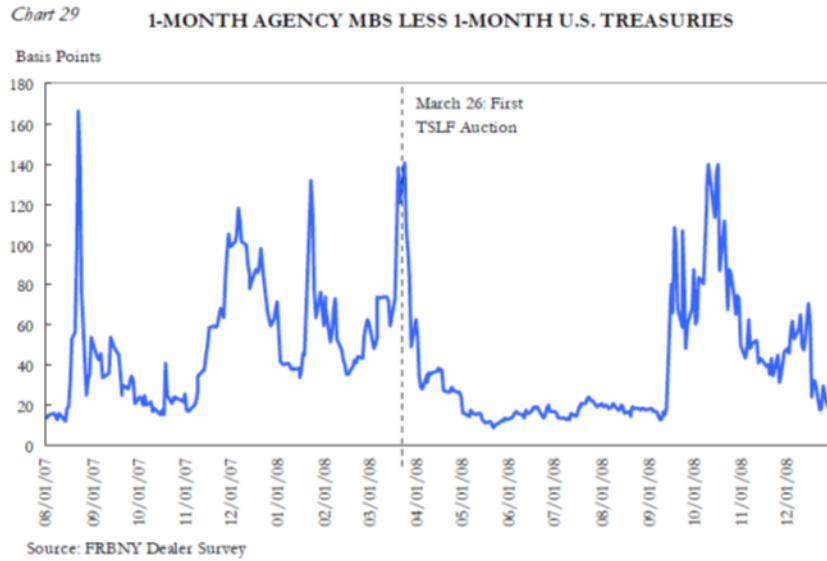
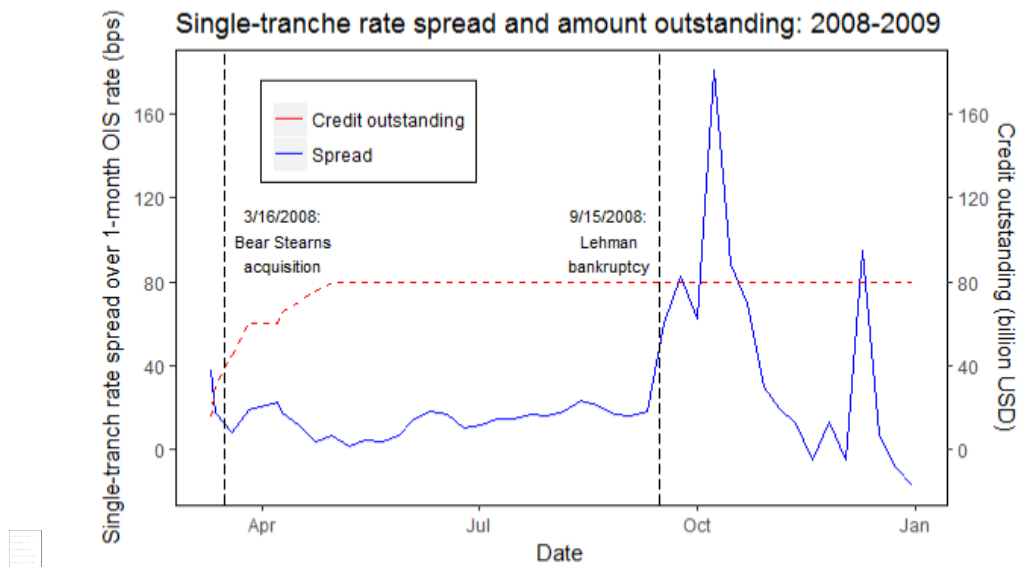
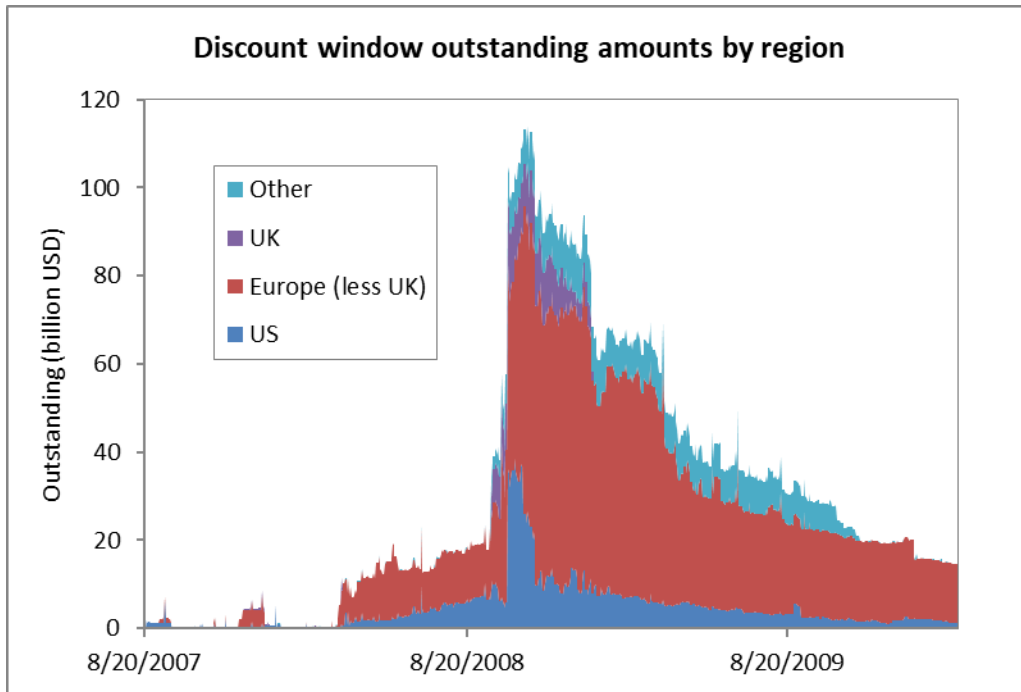


Figure 4



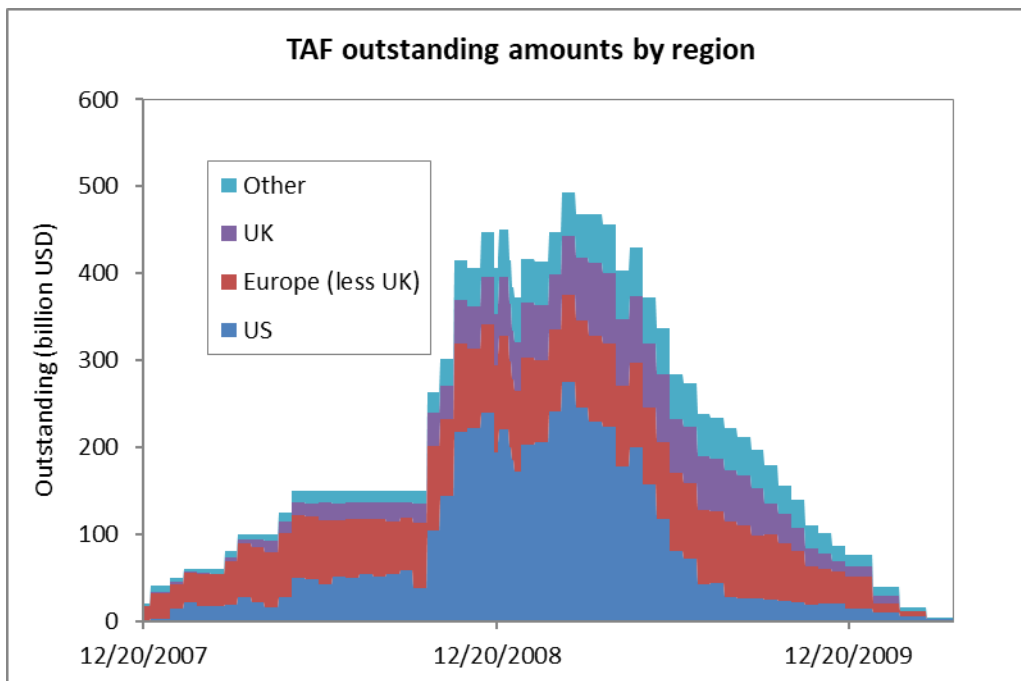
Source: Bloomberg, Federal Reserve Board, and author calculations.

Figure 5



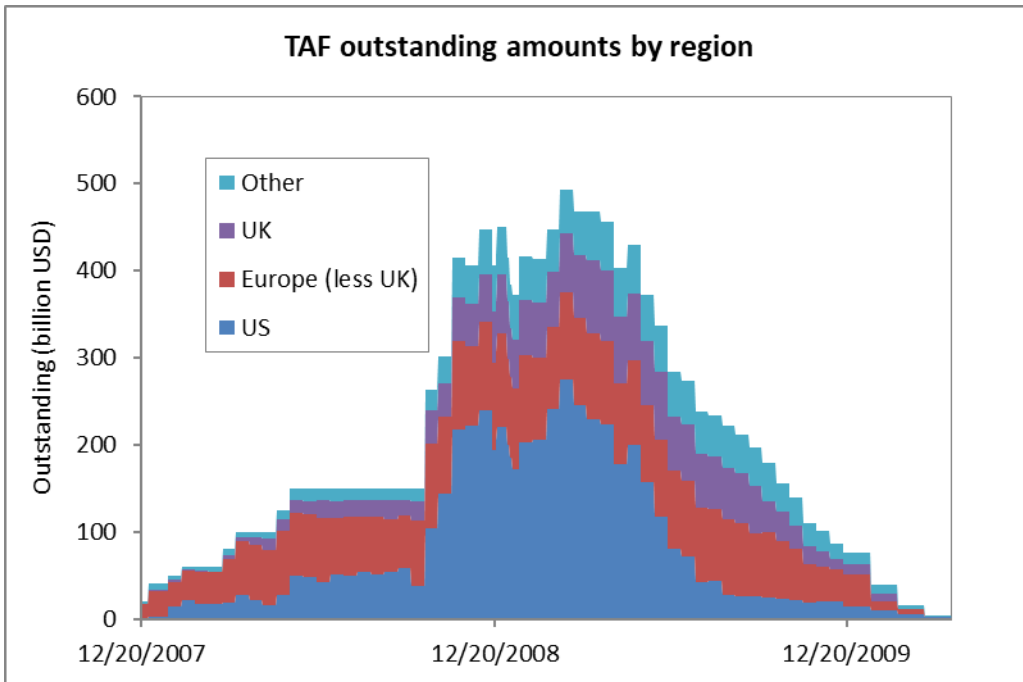
Source: Federal Reserve Board and author calculations.

Figure 6



Source: Federal Reserve Board and author calculations.

Figure 7



Source: Federal Reserve Board and author calculations.

Table 1: Federal Reserve Assets—December 2007 and 2008

	12-12-2007 (\$ Billions)	12-10-2008 (\$ Billions)	Memo: Non U.S. (Percent)
<u>Conventional authority tools:</u>			
Repo (including single tranche)	48	80	58
Discount Window	5	90	89
TAF	--	448	46
Conventional authority total	52	618	54
<u>Liquidity swap lines*</u>			
Total	--	583	100
	52	1,201	76
<u>Emergency Authority</u>			
13(3) liquidity programs**	--	589	
13(3) lending for AIG and Bear Stearns	--	104	
Total emergency authority	--	693	
<u>Securities</u>			
US Treasuries (unencumbered)	775	286	
Agencies (discount notes only)	0	16	
Other assets	58	67	
Total assets	885	2,262	

*Swap lines authorized by the FOMC under Section 14 of the FRA.

** Includes CPFF, TSLF, PDCF, AMLF.

-- Program not in place.

Note: Totals may not sum due to rounding.

Source: Board of Governors, H.4.1 Statistical Release. For swap line data, St. Louis Federal Reserve Bank, FRED database. For non-US amounts, author calculations based on data from the Board of Governors.

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